

Lecture 1 - Introduction

Lecture 2 - Stages of NLP

Lecture 3 - Stages of NLP Continue...

Lecture 4 - Two approaches to NLP

Lecture 5 - Sequence Labelling and Noisy Channel

Lecture 6 - Noisy Channel: Argmax Based Computation

Lecture 7 - Argmax Based Computation

Lecture 8 - Noisy Channel Application to NLP

Lecture 9 - Brief on Probabilistic Parsing & Start of Part of Speech Tagging

Lecture 10 - Part of Speech Tagging

Lecture 11 - Part of Speech Tagging counted ...

Lecture 12 - Part of Speech Tagging counted ... and Indian Language in Focus; Morphology Analysis

Lecture 13 - PoS Tagging contd... , Indian Language Consideration; Accuracy Measure

Lecture 14 - PoS Tagging; Fundamental Principle; Why Challenging; accuracy

Lecture 15 - PoS Tagging; Accuracy Measurement; Word categories

Lecture 16 - AI and Probability; HMM

Lecture 17 - HMM

Lecture 18 - HMM, Viterbi, Forward Backward Algorithm

Lecture 19 - HMM, Viterbi, Forward Backward Algorithm (Continued...)

Lecture 20 - HMM, Forward Backward Algorithms, Baum Welch Algorithm

Lecture 21 - HMM, Forward Backward Algorithms, Baum Welch Algorithm (Continued...)

Lecture 22 - Natural Language Processing and Informational Retrieval

Lecture 23 - CLIA; IR Basics

Lecture 24 - IR Models: Boolean Vector

Lecture 25 - IR Models: NLP and IR Relationship

Lecture 26 - NLP and IR: How NLP has used IR, Toward Latent Semantic

Lecture 27 - Least Square Method; Recap of PCA; Towards Latent Semantic Indexing (LSI)

Lecture 28 - PCA; SVD; Towards Latent Semantic Indexing (LSI)

Lecture 29 - Wordnet and Word Sense Disambiguation

Lecture 30 - Wordnet and Word Sense Disambiguation (Continued...)

Lecture 31 - Wordnet; Metonymy and Word Sense Disambiguation

[Lecture 32 - Word Sense Disambiguation](#)

[Lecture 33 - Word Sense Disambiguation; Overlap Based Method; Supervised Method](#)

[Lecture 34 - Word Sense Disambiguation: Supervised and Unsupervised methods](#)

[Lecture 35 - Word Sense Disambiguation: Semi - Supervised and Unsupervised method; resource - constrained WSD](#)

[Lecture 36 - Resource Constrained WSD; Parsing](#)

[Lecture 37 - Parsing](#)

[Lecture 38 - Parsing Algorithm](#)

[Lecture 39 - Parsing Ambiguous Sentences; Probabilistic Parsing](#)

[Lecture 40 - Probabilistic Parsing Algorithms](#)

DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

NPTEL : Design and Analysis of Algorithms (Computer Science and Engineering)

Co-ordinators : Prof. Sundar Viswanathan, Prof. Ajit A Diwan, Prof. Abhiram G Ranade

Lecture 1 - Overview of the course

Lecture 2 - Framework for Algorithms Analysis

Lecture 3 - Algorithms Analysis Framework - II

Lecture 4 - Asymptotic Notations

Lecture 5 - Algorithm Design Techniques : Basics

Lecture 6 - Divide And Conquer - I

Lecture 7 - Divide And Conquer - II Median Finding

Lecture 8 - Divide And Conquer - III Surfing Lower Bounds

Lecture 9 - Divide And Conquer - IV Closest Pair

Lecture 10 - Greedy Algorithms - I

Lecture 11 - Greedy Algorithms - II

Lecture 12 - Greedy Algorithms - III

Lecture 13 - Greedy Algorithms - IV

Lecture 14 - Pattern Matching - I

Lecture 15 - Pattern Matching - II

Lecture 16 - Combinational Search and Optimization - I

Lecture 17 - Combinational Search and Optimization - II

Lecture 18 - Dynamic Programming

Lecture 19 - Longest Common Subsequences

Lecture 20 - Matrix Chain Multiplication

Lecture 21 - Scheduling with Startup and Holding Costs

Lecture 22 - Average case Analysis of Quicksort

Lecture 23 - Bipartite Maximum Matching

Lecture 24 - Lower Bounds for Sorting

Lecture 25 - Element Distinctness Lower Bounds

Lecture 26 - NP-Completeness - I - Motivation

Lecture 27 - NP-Completeness - II

Lecture 28 - NP-Completeness - III

Lecture 29 - NP-Completeness - IV

Lecture 30 - NP-Completeness - V

Lecture 31 - NP-Completeness - VI

[Lecture 32 - Approximation Algorithms](#)

[Lecture 33 - Approximation Algorithms](#)

[Lecture 34 - Approximation Algorithms for NP](#)

- Lecture 1 - Introduction to Software Engineering - Challenges
- Lecture 2 - Introduction to Software Engineering
- Lecture 3 - Overview of Phases
- Lecture 4 - Overview of Phases
- Lecture 5 - Requirements Engineering / Specification
- Lecture 6 - Formal Specification
- Lecture 7 - Algebraic Specification Methods
- Lecture 8 - Systems Modeling Overview
- Lecture 9 - Process Modeling - DFD , Function Decomp
- Lecture 10 - Process Modeling - DFD, Function Decomp
- Lecture 11 - Data Modeling - ER Diagrams, Mapping
- Lecture 12 - Data Modeling - ER Diagrams, Mapping
- Lecture 13 - Production Quality Software - Introduction
- Lecture 14 - Software Design - Primary Consideration
- Lecture 15 - Design Patterns
- Lecture 16 - Class and Component Level Design
- Lecture 17 - Architectural Design
- Lecture 18 - Software Testing - I
- Lecture 19 - Software Testing - II
- Lecture 20 - Structural Programming and Some implementation
- Lecture 21 - Software Metrics and Quality
- Lecture 22 - Verification and Validation
- Lecture 23 - Case Study
- Lecture 24 - Case Study
- Lecture 25 - Software Evolution
- Lecture 26 - Agile Development
- Lecture 27 - Software Reuse CBSE
- Lecture 28 - Reuse Continued
- Lecture 29 - Introduction to Project Management
- Lecture 30 - Project Scope Management
- Lecture 31 - Project Time Management

[Lecture 32 - Estimation - I](#)

[Lecture 33 - Estimation - II](#)

[Lecture 34 - Project Quality Management](#)

[Lecture 35 - Quality Management Systems - I](#)

[Lecture 36 - Quality Management Systems](#)

[Lecture 37 - Project Configuration Management](#)

[Lecture 38 - Project Risk Management](#)

[Lecture 39 - Other PM Processes](#)

Lecture 1 - Motivation

Lecture 2 - Terminologies

Lecture 3 - Testing based on Models and Criteria

Lecture 4 - Automation - JUnit as an example

Lecture 5 - Basics of Graphs: As used in testing

Lecture 6 - Structural Graph Coverage Criteria

Lecture 7 - Elementary Graph Algorithms - Part 1

Lecture 8 - Elementary Graph Algorithms - Part 2

Lecture 9 - Algorithms: Structural Graph Coverage Criteria

Lecture 10 - Assignment 2: Structural Coverage Criteria

Lecture 11 - Data Flow Graphs

Lecture 12 - Algorithms: Data Flow Graph Coverage Criteria

Lecture 13 - Graph Coverage Criteria: Applied to Test Code

Lecture 14 - Testing Source Code: Classical Coverage Criteria

Lecture 15 - Data Flow Graph Coverage Criteria : Applied to Test Code

Lecture 16 - Software Design and Integration Testing

Lecture 17 - Design Integration Testing and Graph Coverage

Lecture 18 - Specification Testing and Graph Coverage

Lecture 19 - Graph Coverage and Finite state Machines

Lecture 20 - Assignment 4: Graph Coverage Criteria

Lecture 21 - Logic: Basics Needed for Software Testing

Lecture 22 - Logic: Coverage Criteria

Lecture 23 - Coverage Criteria, (Continued...)

Lecture 24 - Logic Coverage Criteria

Lecture 25 - Logic Coverage Criteria: Applied to Test Code_1

Lecture 26 - Logic Coverage Criteria: Applied to Test Code_2

Lecture 27 - Logic Coverage Criteria: Issues in Applying to Test Code

Lecture 28 - Logic Coverage Criteria: Applied to Test Specifications

Lecture 29 - Logic Coverage Criteria: Applied to Finite State Machines

Lecture 30 - Week 6 Assignment Solving

Lecture 31 - Functional Testing

- [Lecture 32 - Input Space Partitioning](#)
- [Lecture 33 - Input Space Partitioning: Coverage Criteria](#)
- [Lecture 34 - Input Space Partitioning Coverage Criteria: Example](#)
- [Lecture 35 - Syntax-Based Testing](#)
- [Lecture 36 - Mutation Testing](#)
- [Lecture 37 - Mutation Testing for Programs](#)
- [Lecture 38 - Mutation Testing: Mutation Operators for Source Code](#)
- [Lecture 39 - Mutation Testing Vs. Graphs and Logic Based Testing](#)
- [Lecture 40 - Assignment Solving for Week8](#)
- [Lecture 41 - Mutation testing](#)
- [Lecture 42 - Mutation Testing : Mutation for integration](#)
- [Lecture 43 - Mutation testing : Grammars and inputs](#)
- [Lecture 44 - Software Testing Course: Summary after Week 9](#)
- [Lecture 45 - Testing of web Applications and Web Services](#)
- [Lecture 46 - Testing of web Applications and Web Services](#)
- [Lecture 47 - Testing of web Applications and Web Services](#)
- [Lecture 48 - Testing of Object-Oriented Applications](#)
- [Lecture 49 - Testing of Object-Oriented Applications](#)
- [Lecture 50 - Symbolic Testing - 1](#)
- [Lecture 51 - Symbolic Testing - 2](#)
- [Lecture 52 - DART: Directed Automated Random Testing - 1](#)
- [Lecture 53 - DART: Directed Automated Random Testing - 2](#)
- [Lecture 54 - DART: Directed Automated Random Testing - 3](#)
- [Lecture 55 - Testing of Object-Oriented Applications](#)
- [Lecture 56 - Testing of Mobile Applications](#)
- [Lecture 57 - Non-Functional System Testing](#)
- [Lecture 58 - Regression Testing](#)
- [Lecture 59 - Assignment: Week 11 Solving](#)
- [Lecture 60 - Software Testing: Summary at the End of the Course](#)

DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

NPTEL : NOC:Design and Pedagogy of the Introductory Programming Course (Computer Science and Engineering)

Co-ordinators : Prof. Abhiram G Ranade

Lecture 1 - Course Overview

Lecture 2 - Introduction and Survey.0: The standard approach to introductory programming

Lecture 3 - Introduction and Survey.1: Experience with the standard approach

Lecture 4 - Introduction and Survey.2: Alternative approaches, Summary, and Conclusion

Lecture 5 - Basic Ideas in Our Approach.0: Introduction

Lecture 6 - Basic Ideas in Our Approach.1: Examples of translating manual algorithms to computer programs

Lecture 7 - Basic Ideas in Our Approach.2: More examples

Lecture 8 - Basic Ideas in Our Approach.3: Should we teach students (manual) problem solving strategies?

Lecture 9 - Basic Ideas in Our Approach.4: The design of the course

Lecture 10 - Basic Ideas in Our Approach.5: Remarks on individual topics - 1

Lecture 11 - Basic Ideas in Our Approach.6: Remarks on individual topics - 2, Conclusion

Lecture 12 - Pedagogy.0: Introduction and basic principles

Lecture 13 - Pedagogy.1: Scaffolding, Lesson Plan

Lecture 14 - Pedagogy.2: A quick tour of the course - 1

Lecture 15 - Pedagogy.3: Tour-2

Lecture 16 - Pedagogy.4: Tour-3, Conclusion

Lecture 17 - Advanced Programming Topics.0: Introduction, Organization of medium sized programs

Lecture 18 - Advanced Programming Topics.1: Advanced memory management, Standard Library

Lecture 19 - Advanced Programming topics.2: Object Oriented Programming, Concluding remarks

Lecture 20 - In class questions, Assignments, Examinations.0: In class questions and lab assignments

Lecture 21 - In class questions, Assignments, Examinations.1: Examinations

Lecture 22 - Summing up

Lecture 1 - Introduction - Part 1

Lecture 2 - Introduction - Part 2

Lecture 3 - Introduction - Part 3

Lecture 4 - Introduction - Part 4

Lecture 5 - Problem Solving using Computer - Part 1

Lecture 6 - Problem Solving using Computer - Part 2

Lecture 7 - Problem Solving using Computer - Part 3

Lecture 8 - Problem Solving using Computer - Part 4

Lecture 9 - Problem Solving using Computer - Part 5

Lecture 10 - Basic Elements of Program - Part 1

Lecture 11 - Basic Elements of Program - Part 2

Lecture 12 - Basic Elements of Program - Part 3

Lecture 13 - Basic Elements of Program - Part 4

Lecture 14 - Program Design - Part 1

Lecture 15 - Program Design - Part 2

Lecture 16 - Program Design - Part 3

Lecture 17 - Simple cpp Graphics

Lecture 18 - Conditional Execution - Part 1

Lecture 19 - Most general form of if - Part 2

Lecture 20 - More general form of conditions - Part 3

Lecture 21 - A somewhat large program example - Part 4

Lecture 22 - Switch statement and logical data - Part 5

Lecture 23 - Loops - Part 1

Lecture 24 - Mark averaging - Part 2

Lecture 25 - The break and continue statements - Part 3

Lecture 26 - The for statement - Part 4

Lecture 27 - Euclid's algorithm for GCD - Part 5

Lecture 28 - Correctness proof for GCD - Part 6

Lecture 29 - Computing Mathematical Functions - Part 1 : Taylor series

Lecture 30 - Computing Mathematical Functions - Part 2 : Numerical integration

Lecture 31 - Computing Mathematical Functions - Part 3 : Bisection Method

- Lecture 32 - Computing Mathematical Functions - Part 4 : Newton Raphson Method
- Lecture 33 - Loops in various applications - Part 1 : Loops in various applications brute force algorithms
- Lecture 34 - Loops in various applications - Part 2 : Finding Pythagorean Triples
- Lecture 35 - Loops in various applications - Part 3 : Modelling a system: bargaining
- Lecture 36 - Loops in various applications - Part 4 : Simulating a water tank
- Lecture 37 - Loops in various applications - Part 5 : Arithmetic on very large numbers
- Lecture 38 - Functions - Part 1 : Basics
- Lecture 39 - Functions - Part 2 : Examples
- Lecture 40 - Functions - Part 3 : Reference parameters
- Lecture 41 - Functions - Part 4 : Pointers
- Lecture 43 - Recursion - Part 1 : Introduction
- Lecture 44 - Recursion - Part 2 : Recursive objects, Tree drawing
- Lecture 45 - Recursion - Part 3 : How to think about recursion
- Lecture 46 - Virahanka Numbers - Part 1 : Introduction
- Lecture 47 - Virahanka Numbers - Part 2 : Recursive Program
- Lecture 48 - Virahanka Numbers - Part 3 : Iterative Program and Conclusion
- Lecture 49 - Program Organization and Functions - Part 1 : Introduction
- Lecture 50 - Program Organization and Functions - Part 2 : Splitting into files
- Lecture 51 - Program Organization and Functions - Part 3 : Namespaces
- Lecture 52 - Program Organization and Functions - Part 4 : How to use C++ without simplecpp
- Lecture 53 - Advanced Features of Functions - Part 1 : Introduction and passing one function to another
- Lecture 54 - Advanced Features of Functions - Part 2 : Lambda expressions
- Lecture 55 - Advanced Features of Functions - Part 3 : Default values to parameters
- Lecture 56 - Advanced Features of Functions - Part 4 : Function overloading and lecture conclusion
- Lecture 57 - Array Part-1 - Part 1 : Introduction
- Lecture 58 - Array Part-1 - Part 2 : Marks averaging problem
- Lecture 59 - Array Part-1 - Part 3 : Histogram computation
- Lecture 60 - Array Part-1 - Part 4 : Marks display variation
- Lecture 61 - Array Part-1 - Part 5 : Polynomial multiplication
- Lecture 62 - Array Part-1 - Part 6 : Queues in dispatching taxis
- Lecture 63 - Array Part-1 - Part 7 : More efficient Queues in dispatching taxis
- Lecture 64 - Array Part-1 - Part 8 : Disk intersection
- Lecture 65 - Array Part-1 - Part 9 : Arrays of graphical objects and conclusion

[Lecture 66 - Array Part-2 - Part 1 : Introduction](#)

[Lecture 67 - Array Part-2 - Part 2 : Interpretation of aname\[index\]](#)

[Lecture 68 - Array Part-2 - Part 3 : Arrays and function calls](#)

[Lecture 69 - Array Part-2 - Part 4 : A function to sort an array](#)

[Lecture 70 - More on Arrays - Part 1 : Textual data](#)

[Lecture 71 - More on Arrays - Part 2 : Functions on character strings](#)

[Lecture 72 - More on Arrays - Part 3 : Two dimensional arrays](#)

[Lecture 73 - More on Arrays - Part 4 : Command Line Arguments](#)

[Lecture 74 - Arrays and recursion - Part 1 : Binary Search Introduction](#)

[Lecture 75 - Arrays and recursion - Part 2 : Binary search analysis](#)

[Lecture 76 - Arrays and recursion - Part 3 : Mergesort overview](#)

[Lecture 77 - Arrays and recursion - Part 4 : Merge function](#)

[Lecture 78 - Arrays and recursion - Part 5 : Mergesort conclusion](#)

[Lecture 79 - Structures - Part 1 : Definition and instantiation](#)

[Lecture 80 - Structures - Part 2 : Operations on structures](#)

[Lecture 81 - Structures - Part 3 : An example program](#)

[Lecture 82 - Structures - Part 4 : Pointers and lecture conclusion](#)

[Lecture 83 - Structures Part 2 - Part 1 : Introduction to Member functions](#)

[Lecture 84 - Structures Part 2 - Part 2 : Vectors from Physics](#)

[Lecture 85 - Structures Part 2 - Part 3 : Taxi dispatch](#)

[Lecture 86 - Classes - Part 1 : Introduction](#)

[Lecture 87 - Classes - Part 2 : Constructors](#)

[Lecture 88 - Classes - Part 3 : Operator overloading](#)

[Lecture 89 - Classes - Part 4 : Access control](#)

[Lecture 90 - Classes - Part 5 : Classes for graphics and input output](#)

[Lecture 91 - Classes - Part 6 : General remarks](#)

[Lecture 92 - Representing variable length entities - Part 1 : Introduction](#)

[Lecture 93 - Representing variable length entities - Part 2 : Heap memory basics](#)

[Lecture 94 - Representing variable length entities - Part 3 : Pitfalls of using heap memory](#)

[Lecture 95 - Representing variable length entities - Part 4 : Automating memory management](#)

[Lecture 96 - Representing variable length entities - Part 5 : Implementing a class with automated memory management - 1](#)

[Lecture 97 - Representing variable length entities - Part 6 : Implementing a class with automated memory management - 2](#)

[Lecture 98 - Representing variable length entities - Part 7 : Using the implemented class and conclusion](#)

[Lecture 99 - The Standard Library - Part 1 : Class string](#)

[Lecture 100 - The Standard Library - Part 2 : Class vector](#)

[Lecture 101 - The Standard Library - Part 3 : Sorting vectors and arrays](#)

[Lecture 102 - The Standard Library - Part 4 : Classes map and unordered_map](#)

[Lecture 103 - The Standard Library - Part 5 : Iterators](#)

[Lecture 104 - Data structure based programming - Part 1 : Introduction](#)

[Lecture 105 - Data structure based programming - Part 2 : Set and pair classes](#)

[Lecture 106 - Data structure based programming - Part 3 : Implementation of standard library data structures](#)

[Lecture 107 - Data structure based programming - Part 4 : Composing data structures](#)

[Lecture 108 - Data structure based programming - Part 5 : typedef and lecture conclusion](#)

[Lecture 109 - Medium size programs - Part 1 : The new marks display program](#)

[Lecture 110 - Medium size programs - Part 2 : Manual algorithm for new marks display](#)

[Lecture 111 - Medium size programs - Part 3 : RSMTAB and rest of the program](#)

[Lecture 112 - Medium size programs - Part 4 : Sophisticated solutions to marks display](#)

[Lecture 113 - A graphical editor and solver for circuits - Part 1 : Outline](#)

[Lecture 114 - A graphical editor and solver for circuits - Part 2 : Main program and organization](#)

[Lecture 115 - A graphical editor and solver for circuits - Part 3 : Mathematical representation of the circuit](#)

[Lecture 116 - A graphical editor and solver for circuits - Part 4 : Extensions and concluding remarks](#)

[Lecture 117 - Cosmological simulation - Part 1 : Introduction and First order Euler method](#)

[Lecture 118 - Cosmological simulation - Part 2 : Second order Euler method](#)

[Lecture 119 - Cosmological simulation - Part 3 : The program](#)

[Lecture 120 - Cosmological simulation - Part 4 : Concluding remarks](#)

Lecture 1 - Introduction

Lecture 2 - Analogy for CEO's Problem

Lecture 3 - Discussing the CEO's Problem

Lecture 4 - From the CEO's Company to Layers in a Network

Lecture 5 - Layers in Detail

Lecture 6 - Layered Nature of a Network

Lecture 7 - Introduction to Internet Data Capturing using Wireshark

Lecture 8 - Network data captured while requesting a website

Lecture 9 - What is Cisco Packet Tracer

Lecture 10 - Modes of Cisco Packet Tracer

Lecture 11 - Getting Cisco Packet Tracer

Lecture 12 - Logical and Physical Typologies in Cisco Packet Tracer

Lecture 13 - Devices on Cisco Packet Tracer

Lecture 14 - Introduction to the Cisco Packet Tracer Activity for Week 1

Lecture 15 - Introduction to the campus network on Cisco Packet Tracer

Lecture 16 - Loading the page in Simulation Mode

Lecture 17 - Inspecting the packets in Simulation Mode

Lecture 18 - Editing the dummy website on Cisco Packet Tracer

Lecture 19 - Summary of the Cisco Packet Tracer Activity

Lecture 20 - Introduction to Anupam's Adventure

Lecture 21 - Anupam's adventure brings us to IP Addressing

Lecture 22 - Addressing at various layers

Lecture 23 - IP Addresses

Lecture 24 - Address Translation

Lecture 25 - Introduction to IP Addressing

Lecture 26 - Creating a network with Sub-net mask

Lecture 27 - Nomenclature of a sub-net mask

Lecture 28 - Network addresses and Private networks

Lecture 29 - Introduction to the Addressing Topology

Lecture 30 - Addressing a local network and DHCP

Lecture 31 - Addressing a local network manually

Lecture 32 - Addressing in Public and Private Networks

Lecture 33 - Verifying Connectivity using Ping

Lecture 34 - Using network address translation to communicate on internet

Lecture 35 - Using Sub nets and Summary of addressing

Lecture 36 - Summary of the week

Lecture 37 - Analogy for the week 2

Lecture 38 - Discussion on dabbawala analogy

Lecture 39 - From dabbawalas to routers and switches

Lecture 40 - What is routing ?

Lecture 41 - Static routing in a router in CPT

Lecture 42 - How does a switch forwards packets CPT

Lecture 43 - How to add static route in a router? (CPT)

Lecture 44 - Traveler's dilemma

Lecture 45 - Discussing the Traveler's dilemma

Lecture 46 - From Traveler's dilemma to Dynamic Routing

Lecture 47 - Dynamic Routing with Distance Vector

Lecture 48 - Distance Vector Routing in Detail

Lecture 49 - Dynamic Routing with Link State

Lecture 50 - Setting up dynamic routing in Packet Tracer

Lecture 51 - Summary of the week

Lecture 52 - Introduction to analogy for week 3

Lecture 53 - Analogy for week 3

Lecture 54 - Questions on analogy for week 3

Lecture 55 - Understanding the new order requirements

Lecture 56 - Introduction to Transport Layer

Lecture 57 - Introduction to TCP

Lecture 58 - Introduction to UDP

Lecture 59 - Exploring UDP on Cisco Packet Tracer

Lecture 60 - TCP Connection Establishment

Lecture 61 - TCP Connection Closure

Lecture 62 - Summary of TCP and UDP on Cisco Packet Tracer

Lecture 63 - The story of the delivery fiasco

Lecture 64 - From delivery fiasco to Port Numbers

- Lecture 65 - Application Layer in depth
- Lecture 66 - Port number in Wireshark
- Lecture 67 - Summary of port number and PAT
- Lecture 68 - Summary of the entire TCP IP stack
- Lecture 69 - Introducing the analogy for week 4
- Lecture 70 - The secret box
- Lecture 71 - Questions on analogy for week 4
- Lecture 72 - Secret of the secret box
- Lecture 73 - From secret box to encryption
- Lecture 74 - Introduction to security and CIA
- Lecture 75 - Information Security and Defence in Depth
- Lecture 76 - Information Classification and Access Control
- Lecture 77 - Process Management
- Lecture 78 - Introduction to Network Security
- Lecture 79 - Network Breach and Countermeasures
- Lecture 80 - Internet Security
- Lecture 81 - Securing the Internet Usage
- Lecture 82 - Internet Security Products
- Lecture 83 - Personal Computing Device Recommendations
- Lecture 84 - Responsible Behavior on the Internet
- Lecture 85 - Best practices for home Network and Media Devices
- Lecture 86 - Closing thoughts on security
- Lecture 87 - The story of a family trip
- Lecture 88 - The troubleshooting approach
- Lecture 89 - Troubleshooting Physical and Data Link Layers
- Lecture 90 - Troubleshooting Network Layer
- Lecture 91 - Troubleshooting Transport and Application Layers
- Lecture 92 - Troubleshooting Summary
- Lecture 93 - Troubleshooting Heuristics
- Lecture 94 - Troubleshooting Challenge - 1
- Lecture 95 - Troubleshooting challenge - 2
- Lecture 96 - Troubleshooting Challenge - 3
- Lecture 97 - Thats How we Troubleshoot

[Lecture 98 - Week Summary](#)

[Lecture 99 - Course Closure](#)

[Lecture 100 - Course Credits](#)

Lecture 1 - Intro to Data Analytics. What is Learning Analytics?

Lecture 2 - Academic Analytics, and Educational Data Mining

Lecture 3 - Four Levels of Analytics

Lecture 4 - Four Levels of Learning Analytics Overview - II

Lecture 5 - Data Collection from Different learning environment

Lecture 6 - Data collection in TELE

Lecture 7 - Data Preprocessing

Lecture 8 - Ethics in Learning Analytics, Student Privacy

Lecture 9 - Demo of Weka

Lecture 10 - Introduction to Machine Learning - Part 1

Lecture 11 - Introduction to Machine Learning - Part 2

Lecture 12 - Training and testing data

Lecture 13 - Performance Metrics - I

Lecture 14 - Performance Metrics - II

Lecture 15 - Performance Metrics - III

Lecture 16 - Demo of Orange

Lecture 17 - Descriptive Analytics - I

Lecture 18 - Descriptive Analytics - II

Lecture 19 - Charts - I

Lecture 20 - Charts - II

Lecture 21 - Charts - III

Lecture 22 - Comparing Charts

Lecture 23 - Descriptive Analytics - Example I

Lecture 24 - Descriptive Analytics - Example II

Lecture 25 - Excel tool

Lecture 26 - Diagnostics Analytics

Lecture 27 - Correlation

Lecture 28 - Correlation Matrix

Lecture 29 - Spearman's Rank Correlation

Lecture 30 - Data Mining

Lecture 31 - iSAT

[Lecture 32 - Diagnostic Analytics - SPM](#)

[Lecture 33 - Sequential pattern mining \(SPM-II\)](#)

[Lecture 34 - Differential Sequence Mining \(DSM\)](#)

[Lecture 35 - Process Mining](#)

[Lecture 36 - Diagnostic Analytics - Clustering](#)

[Lecture 37 - K-means Clustering](#)

[Lecture 38 - Hierarchical Clustering](#)

[Lecture 39 - Clustering - Examples](#)

[Lecture 40 - Predictive Analytics](#)

[Lecture 41 - Linear Regression](#)

[Lecture 42 - Multiple Regression](#)

[Lecture 43 - Logistic Regression](#)

[Lecture 44 - Linear Regression - Example](#)

[Lecture 45 - Predictive Analytics - II](#)

[Lecture 46 - Naive Bayes Classifier](#)

[Lecture 47 - Decision Tree](#)

[Lecture 48 - Decision Tree Classifier](#)

[Lecture 49 - DT, NB - Examples](#)

[Lecture 50 - Text Analytics](#)

[Lecture 51 - Introduction to NLP](#)

[Lecture 52 - NLP-II](#)

[Lecture 53 - NLP-Tools](#)

[Lecture 54 - NLP-Examples](#)

[Lecture 55 - Intro Multimodal Learning Analytics](#)

[Lecture 56 - Affective Computing - 1](#)

[Lecture 57 - Affective Computing - 2](#)

[Lecture 58 - Eye Tracking](#)

[Lecture 59 - Revision of Learning Analytics tools course](#)

[Lecture 60 - Source of Data collection and Research Community](#)

[Lecture 61 - Machine Learning tools used in industry](#)

Lecture 1 - Introduction to Computer Systems

Lecture 2 - Principles of Computer Systems Design

Lecture 3 - Overview of CPU hardware

Lecture 4 - Overview of memory and I/O hardware

Lecture 5 - Introduction to Operating Systems

Lecture 6 - Week 1: Tutorial 1

Lecture 7 - Week 1: Tutorial 2

Lecture 8 - Processes

Lecture 9 - Kernel mode execution

Lecture 10 - Threads

Lecture 11 - CPU scheduling policies

Lecture 12 - Virtual machines and containers

Lecture 13 - Week 2: Tutorial 1

Lecture 14 - Week 2: Tutorial 2

Lecture 15 - Week 2: Tutorial 3

Lecture 16 - Memory management in OS

Lecture 17 - Paging

Lecture 18 - Demand paging

Lecture 19 - File system and memory

Lecture 20 - Optimizing memory access

Lecture 21 - Week 3: Tutorial 1

Lecture 22 - Week 3: Tutorial 2

Lecture 23 - Week 3: Tutorial 3

Lecture 24 - Filesystem Datastructures

Lecture 25 - Filesystem Implementation

Lecture 26 - Network I/O via Sockets

Lecture 27 - Network I/O Implementation

Lecture 28 - Memory and I/O virtualization

Lecture 29 - Week 4: Tutorial 1

Lecture 30 - Week 4: Tutorial 2

Lecture 31 - Introduction to computer networking

- Lecture 32 - Internet Routing and Forwarding
- Lecture 33 - Transport protocols
- Lecture 34 - Application layer protocols
- Lecture 35 - Network Security
- Lecture 36 - Week 5: Tutorial 1
- Lecture 37 - Week 5: Tutorial 2
- Lecture 38 - Multithreaded application design
- Lecture 39 - Inter-process communication
- Lecture 40 - Multi-tier application design
- Lecture 41 - Examples of end-to-end systems design
- Lecture 42 - Deployment of computer systems
- Lecture 43 - Week 6: Tutorial 1
- Lecture 44 - Week 6: Tutorial 2
- Lecture 45 - Performance measurement
- Lecture 46 - Performance analysis
- Lecture 47 - Performance profiling and optimization
- Lecture 48 - Caching
- Lecture 49 - Performance scalability
- Lecture 50 - Week 7: Tutorial 1
- Lecture 51 - Fault tolerance and reliability
- Lecture 52 - Replication and consistency
- Lecture 53 - Atomicity
- Lecture 54 - Distributed transactions
- Lecture 55 - Case studies of distributed systems design

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

Lecture 1 - Introduction: Game Theory

Lecture 2 - Introduction: Mechanism Design

Lecture 3 - The game of chess

Lecture 4 - Proof of the chess theorem

Lecture 5 - Normal form games

Lecture 6 - Dominance

Lecture 7 - Nash equilibrium

Lecture 8 - Maxmin strategies

Lecture 9 - Elimination of dominated strategies

Lecture 10 - Preservation of PSNE

Lecture 11 - Matrix games

Lecture 12 - Relation between Maxmin and PSNE in matrix

Lecture 13 - Mixed strategies

Lecture 14 - Mixed strategy Nash equilibrium (MSNE)

Lecture 15 - Find MSNE

Lecture 16 - MSNE characterization theorem proof

Lecture 17 - Algorithm to find MSNE

Lecture 18 - Correlated equilibrium (CE)

Lecture 19 - Computing correlated equilibrium

Lecture 20 - Extensive form games

Lecture 21 - Subgame perfection

Lecture 22 - Limitations of SPNE

Lecture 23 - Imperfect Information Extensive Form Games (IIEFG)

Lecture 24 - Strategies in IIEFGs

Lecture 25 - Equivalence of Strategies in IIEFGs

Lecture 26 - Perfect Recall

Lecture 27 - Equilibrium in IIEFG

Lecture 28 - Game Theory in Practice: P2P file sharing

Lecture 29 - Bayesian Games

Lecture 30 - Strategy, Utility in Bayesian Games

Lecture 31 - Equilibrium in Bayesian Games

Lecture 32 - Examples of Bayesian Equilibrium

Lecture 33 - Introduction to Mechanism Design

Lecture 34 - Revelation Principle

Lecture 35 - Introduction to Arrow's Impossibility Result

Lecture 36 - Proof of Arrow's Result

Lecture 37 - Introduction to the Social Choice Setup

Lecture 38 - Introduction to Gibbard-Satterthwaite Theorem

Lecture 39 - Proof of Gibbard-Satterthwaite Theorem

Lecture 40 - Domain Restriction

Lecture 41 - Median Voting Rule

Lecture 42 - Median Voter Theorem - Part 1

Lecture 43 - Median Voter Theorem - Part 2

Lecture 44 - The Task Sharing Domain

Lecture 45 - The Uniform Rule

Lecture 46 - Mechanism Design with Transfers

Lecture 47 - Examples of Quasi-linear Preferences

Lecture 48 - Pareto Optimality and Groves Payments

Lecture 49 - Introduction to VCG Mechanism

Lecture 50 - VCG in Combinatorial Allocations

Lecture 51 - Applications to Internet Advertising

Lecture 52 - Slot Allocation and Payments in Position

Lecture 53 - Pros and Cons of VCG Mechanism

Lecture 54 - Affine Maximizers

Lecture 55 - Single Object Allocation

Lecture 56 - Myerson's Lemma

Lecture 57 - Illustration of Myerson's Lemma

Lecture 58 - Optimal Mechanism Design

Lecture 59 - Single Agent Optimal Mechanism Design

Lecture 60 - Multiple Agent Optimal Mechanism Design

Lecture 61 - Examples of Optimal Mechanisms

Lecture 62 - Endnotes and Summary

NPTEL : NOC:Introduction to Computer and Network Performance Analysis using Queuing Systems (Computer Science and Engineering)

Co-ordinators : Prof. Varsha Apte

Lecture 1 - Introduction, why do delays happen, contention for resources

Lecture 2 - Performance metrics and parameters

Lecture 3 - Introducing Queuing Systems

Lecture 4 - Memoryless Distributions

Lecture 5 - Operational Laws

Lecture 6 - Asymptotic Analysis of G/G/1, G/G/1/K queues

Lecture 7 - Asymptotic Analysis of G/G/c/K queues

Lecture 8 - Little's Law

Lecture 9 - Little's Law examples and A Case Study of Open Load test on a Web server

Lecture 10 - Some results for M/G/1 queue and Memoryless Arrivals

Lecture 11 - Continuing the Case Study of Open Load test on a web server (Response Time)

Lecture 12 - Open queuing networks - tandem queuing network

Lecture 13 - Open queuing networks - general (Jackson) queuing networks

Lecture 14 - Open queuing networks - examples

Lecture 15 - Closed Queuing Systems

Lecture 16 - Closed Queuing System (Continued...)

Lecture 17 - Case study of Closed Load Test on a Web Server

Lecture 18 - General formulation of Jacksonian Closed Queuing Networks

Lecture 19 - Mean Value Analysis for Closed Queuing Networks

Lecture 20 - Mean Value Analysis examples, Case Study of a Load test on a web server, Closing Remarks

Lecture 1 - Introduction

Lecture 2 - Visibility Problems

Lecture 3 - 2D Maxima

Lecture 4 - Line Sweep Method

Lecture 5 - Segment Intersection Problem

Lecture 6 - Line Sweep: Rectangle Union

Lecture 7 - Convex Hull

Lecture 8 - Convex Hull Contd

Lecture 9 - Quick Hull

Lecture 10 - More Convex Hull Algorithms

Lecture 11 - Intersection of Half Planes and Duality

Lecture 12 - Intersection of Half Planes and Duality Contd

Lecture 13 - Lower Bounds

Lecture 14 - Planar Point Location

Lecture 15 - Point Location and Triangulation Contd...

Lecture 16 - Triangulation of Arbitrary Polygon

Lecture 17 - Voronoi Diagram : Properties

Lecture 18 - Voronoi Diagram Construction

Lecture 19 - Delaunay Triangulation

Lecture 20 - Quick sort and Backward Analysis

Lecture 21 - Generalized RIC

Lecture 22 - RIC Continued

Lecture 23 - Arrangements

Lecture 24 - Zone Theorem and Application

Lecture 25 - Levels

Lecture 26 - Range Searching : Introduction

Lecture 27 - Orthogonal Range searching

Lecture 28 - Priority Search Trees

Lecture 29 - Non - Orthogonal Range Searching

Lecture 30 - Half - Plane Range Query

Lecture 31 - Well Separated Partitioning

[Lecture 32 - Quadrees Epsilon -WSPD](#)

[Lecture 33 - Construction of Epsilon - WSPD](#)

[Lecture 34 - Epsilon - WSPD to Geometric Spanner](#)

[Lecture 35 - Epsilon-Nets & VC Dimension](#)

[Lecture 36 - Epsilon-Nets & VC Dimension contd](#)

[Lecture 37 - Geometric Set Cover](#)

[Lecture 38 - Geometric Set Cover \(with Bounded VC Dimension\)](#)

[Lecture 39 - Shape Representation](#)

[Lecture 40 - Shape Comparison](#)

Lecture 1 - Introduction

Lecture 2 - Propositional Logic Syntax

Lecture 3 - Semantics of Propositional Logic

Lecture 4 - Logical and Algebraic Concepts

Lecture 5 - Identities and Normal forms

Lecture 6 - Tautology Checking

Lecture 7 - Propositional Unsatisfiability

Lecture 8 - Analytic Tableaux

Lecture 9 - Consistency and Completeness

Lecture 10 - The Completeness Theorem

Lecture 11 - Maximally Consistent Sets

Lecture 12 - Formal Theories

Lecture 13 - Proof Theory : Hilbert-style

Lecture 14 - Derived Rules

Lecture 15 - The Hilbert System : Soundness

Lecture 16 - The Hilbert System : Completeness

Lecture 17 - Introduction to Predicate Logic

Lecture 18 - The Semantic of Predicate Logic

Lecture 19 - Substitutions

Lecture 20 - Models

Lecture 21 - Structures and Substructures

Lecture 22 - First-Order Theories

Lecture 23 - Predicate Logic: Proof Theory (Continued...)

Lecture 24 - Existential Quantification

Lecture 25 - Normal Forms

Lecture 26 - Skolemization

Lecture 27 - Substitutions and Instantiations

Lecture 28 - Unification

Lecture 29 - Resolution in FOL

Lecture 30 - More on Resolution in FOL

Lecture 31 - Resolution : Soundness and Completeness

[Lecture 32 - Resolution and Tableaux](#)

[Lecture 33 - Completeness of Tableaux Method](#)

[Lecture 34 - Completeness of the Hilbert System](#)

[Lecture 35 - First-Order Theories](#)

[Lecture 36 - Towards Logic Programming](#)

[Lecture 37 - Verification of Imperative Programs](#)

[Lecture 38 - Verification of WHILE Programs](#)

[Lecture 39 - References](#)

- Lecture 1 - Introduction to Computer Architecture
- Lecture 2 - History of Computers
- Lecture 3 - Instruction Set Architecture - I
- Lecture 4 - Instruction Set Architecture - II
- Lecture 5 - Instruction Set Architecture - III
- Lecture 6 - Recursive Programs
- Lecture 7 - Architecture Space
- Lecture 8 - Architecture Examples
- Lecture 9 - Performance
- Lecture 10 - Performance
- Lecture 11 - Binary Arithmetic, ALU Design
- Lecture 12 - ALU Design, Overflow
- Lecture 13 - Multiplier Design
- Lecture 14 - Divider Design
- Lecture 15 - Fast Addition , Multiplication
- Lecture 16 - Floating Point Arithmetic
- Lecture 17 - Processor Design - Introduction
- Lecture 18 - Processor Design
- Lecture 19 - Processor Design - Simple Design
- Lecture 20 - Processor Design - Multi Cycle Approach
- Lecture 21 - Processor Design - Control for Multi Cycle
- Lecture 22 - Processor Design - Micro programmed Control
- Lecture 23 - Processor Design - Exception Handling
- Lecture 24 - Pipelined Processor Design Basic Idea
- Lecture 25 - Pipelined Processor Design: Data path
- Lecture 26 - Pipelined Processor Design: Handling Data
- Lecture 27 - Pipelined Processor Design
- Lecture 28 - Memory Hierarchy : Basic Idea
- Lecture 29 - Memory Hierarchy : Cache Organization
- Lecture 30 - Memory Hierarchy : Cache Organization
- Lecture 31 - Memory Hierarchy : Virtual Memory

[Lecture 32 - Memory Hierarchy : Virtual Memory](#)

[Lecture 33 - Input / Output Subsystem: Introduction](#)

[Lecture 34 - Input / Output Subsystem: Interfaces and buses](#)

[Lecture 35 - Input / Output Subsystem: Interfaces and buses](#)

[Lecture 36 - Input / Output Subsystem: I/O Operations](#)

[Lecture 37 - Input / Output Subsystem: Designing I/O Systems](#)

[Lecture 38 - Concluding Remarks](#)

Lecture 1 - Introduction to Data Structures and Algorithms

Lecture 2 - Stacks

Lecture 3 - Queues and Linked Lists

Lecture 4 - Dictionaries

Lecture 5 - Hashing

Lecture 6 - Trees

Lecture 7 - Tree Walks / Traversals

Lecture 8 - Ordered Dictionaries

Lecture 9 - Deletion

Lecture 10 - Quick Sort

Lecture 11 - AVL Trees

Lecture 12 - AVL Trees

Lecture 13 - Trees

Lecture 14 - Red Black Trees

Lecture 15 - Insertion in Red Black Trees

Lecture 16 - Disk Based Data Structures

Lecture 17 - Case Study: Searching for Patterns

Lecture 18 - Tries

Lecture 19 - Data Compression

Lecture 20 - Priority Queues

Lecture 21 - Binary Heaps

Lecture 22 - Why Sorting

Lecture 23 - More Sorting

Lecture 24 - Graphs

Lecture 25 - Data Structures for Graphs

Lecture 26 - Two Applications of Breadth First Search

Lecture 27 - Depth First Search

Lecture 28 - Applications of DFS

Lecture 29 - DFS in Directed Graphs

Lecture 30 - Applications of DFS in Directed Graphs

Lecture 31 - Minimum Spanning Trees

[Lecture 32 - The Union](#)

[Lecture 33 - Prims Algorithm for Minimum Spanning Trees](#)

[Lecture 34 - Single Source Shortest Paths](#)

[Lecture 35 - Correctness of Dijkstras Algorithm](#)

[Lecture 36 - Single Source Shortest Paths](#)

[Lecture 1 - Introduction](#)

[Lecture 2 - Raster Graphics](#)

[Lecture 3 - Raster Graphics \(Continued...\)](#)

[Lecture 4 - Clipping](#)

[Lecture 5 - Polygon Clipping and Polygon Scan Conversion](#)

[Lecture 6 - Transformations](#)

[Lecture 7 - Transformations \(Continued...\)](#)

[Lecture 8 - 3D Viewing](#)

[Lecture 9 - 3D Viewing \(Continued...\)](#)

[Lecture 10 - Curves](#)

[Lecture 11 - Assignment - I](#)

[Lecture 12 - Curves \(Continued...\)](#)

[Lecture 13 - Curves \(Continued...\)](#)

[Lecture 14 - Curves \(Continued...\)](#)

[Lecture 15 - Curves \(Continued...\)](#)

[Lecture 16 - Surfaces](#)

[Lecture 17 - Surfaces \(Continued...\)](#)

[Lecture 18 - Surfaces \(Continued...\)](#)

[Lecture 19 - Surfaces \(Continued...\)](#)

[Lecture 20 - Hierarchical Models](#)

[Lecture 21 - Rendering](#)

[Lecture 22 - Rendering \(Continued...\)](#)

[Lecture 23 - Rendering \(Continued...\)](#)

[Lecture 24 - Ray Tracing](#)

[Lecture 25 - Ray Tracing \(Continued...\)](#)

[Lecture 26 - Ray Tracing \(Continued...\)](#)

[Lecture 27 - Assignment: Ray Tracing](#)

[Lecture 28 - Hidden Surface Elimination](#)

[Lecture 29 - Hidden Surface Elimination \(Continued...\)](#)

[Lecture 30 - Hidden Surface Elimination \(Continued...\)](#)

[Lecture 31 - Fractals](#)

[Lecture 32 - Fractals \(Continued...\)](#)

[Lecture 33 - Computer Animation](#)

[Lecture 34 - Animation \(Continued...\)](#)

[Lecture 35 - Animation \(Continued...\)](#)

Lecture 1 - Introduction

Lecture 2 - Syntax

Lecture 3 - Grammars

Lecture 4 - Ambiguity

Lecture 5 - PLO:Syntax

Lecture 6 - Semantics

Lecture 7 - Syntactic Classes

Lecture 8 - Transition Systems

Lecture 9 - PL0 : Expressions

Lecture 10 - Binding

Lecture 11 - Environments

Lecture 12 - Declarations

Lecture 13 - Commands

Lecture 14 - Stores

Lecture 15 - Summary

Lecture 16 - Declarations and Commands

Lecture 17 - Blocks

Lecture 18 - Qualification

Lecture 19 - Pragmatics

Lecture 20 - Data

Lecture 21 - Structured Data

Lecture 22 - Sequences

Lecture 23 - Control

Lecture 24 - Non-Determinacy

Lecture 25 - Programming Languages

Lecture 26 - Programming Languages

Lecture 27 - Programming Languages

Lecture 28 - Data as Functions

Lecture 29 - Data and Fixpoints

Lecture 30 - Normal Forms

Lecture 31 - Programming Languages

[Lecture 32 - Monomorphism](#)

[Lecture 33 - Polymorphism](#)

[Lecture 34 - Type Checking](#)

[Lecture 35 - Contexts](#)

[Lecture 36 - Abstracts](#)

[Lecture 37 - Procedures](#)

[Lecture 38 - Meanings](#)

[Lecture 39 - Parameters](#)

[Lecture 40 - The Future](#)

Lecture 1 - Introduction

Lecture 2 - Parallel Programming Paradigms

Lecture 3 - Parallel Architecture

Lecture 4 - Parallel Architecture (case studies)

Lecture 5 - Open MP

Lecture 6 - Open MP (Continued.)

Lecture 7 - Open MP (Continued..)

Lecture 8 - Open MP & PRAM Model of Computation

Lecture 9 - PRAM

Lecture 10 - Models of Parallel Computation, Complexity

Lecture 11 - Memory Consistency

Lecture 12 - Memory Consistency & Performance Issues

Lecture 13 - Parallel Program Design

Lecture 14 - Shared Memory & Message Passing

Lecture 15 - MPI

Lecture 16 - MPI (Continued.)

Lecture 17 - MPI (Continued..)

Lecture 18 - Algorithmic Techniques

Lecture 19 - Algorithmic Techniques (Continued.)

Lecture 20 - Algorithmic Techniques (Continued..)

Lecture 21 - CUDA

Lecture 22 - CUDA (Continued.)

Lecture 23 - CUDA (Continued..)

Lecture 24 - CUDA (Continued...)

Lecture 25 - CUDA (Continued....)

Lecture 26 - CUDA (Continued.....)

Lecture 27 - CUDA (Continued.....)

Lecture 28 - Algorithms, Merging & Sorting

Lecture 29 - Algorithms, Merging & Sorting (Continued.)

Lecture 30 - Algorithms, Merging & Sorting (Continued..)

Lecture 31 - Algorithms, Merging & Sorting (Continued...)

[Lecture 32 - Algorithms, Merging & Sorting \(Continued....\)](#)

[Lecture 33 - Lower Bounds Lock Free Synchronization, Load Stealing](#)

[Lecture 34 - Lock Free Synchronization, Graph Algorithms](#)

Lecture 1 - Introduction to UNIX System Calls - Part 1

Lecture 2 - Introduction to UNIX System Calls - Part 2

Lecture 3 - Threads, Address Spaces, Filesystem Devices

Lecture 4 - PC Architecture

Lecture 5 - x86 Instruction Set, GCC Calling Conventions

Lecture 6 - Physical Memory Map, I/O, Segmentation

Lecture 7 - Segmentation, Trap Handling

Lecture 8 - Traps, Trap Handlers

Lecture 9 - Kernel Data Structures, Memory Management

Lecture 10 - Segmentation Review, Introduction to Paging

Lecture 11 - Paging

Lecture 12 - Process Address Spaces Using Paging

Lecture 13 - Translation Lookaside Buffer, Large Pages, Boot Sector

Lecture 14 - Loading the kernel, Initializing the Page table

Lecture 15 - Setting up page tables for user processes

Lecture 16 - Processes in action

Lecture 17 - Process structure, Context Switching

Lecture 18 - Process Kernel stack, Scheduler, Fork, Context-Switch, Process Control Block, Trap Entry and Return

Lecture 19 - Creating the first process

Lecture 20 - Handling User Pointers, Concurrency

Lecture 21 - Locking

Lecture 22 - Fine-grained Locking and its challenges

Lecture 23 - Locking variations

Lecture 24 - Condition variables

Lecture 25 - Multiple producer, multiple consumer queue; semaphores; monitors

Lecture 26 - Transactions and lock-free primitives read/write locks

Lecture 27 - Synchronization in xv6: acquire/release, sleep/wakeup, exit/wait

Lecture 28 - More synchronization in xv6: kill, IDE device driver; introduction to Demand Paging

Lecture 29 - Demand Paging; Introduction to Page Replacement

Lecture 30 - Page Replacement, Thrashing

Lecture 31 - Storage Devices, Filesystem Interfaces

[Lecture 32 - File System Implementation](#)

[Lecture 33 - File System Operation](#)

[Lecture 34 - Crash Recovery and Logging](#)

[Lecture 35 - Logging in Linux ext3 filesystem](#)

[Lecture 36 - Protection and Security](#)

[Lecture 37 - Scheduling Policies](#)

[Lecture 38 - Lock-free multiprocessor coordination, Read-Copy-Update](#)

[Lecture 39 - Microkernel, Exokernel, Multikernel](#)

[Lecture 40 - Virtualization, Cloud Computing, Technology Trends](#)

Lecture 1 - Introduction to Computer Architecture

Lecture 2 - The Language of Bits - Part-I

Lecture 3 - The Language of Bits - Part-II

Lecture 4 - The Language of Bits - Part-III

Lecture 5 - Assembly Language - Part-I

Lecture 6 - Assembly Language - Part-II

Lecture 7 - Assembly Language - Part-III

Lecture 8 - ARM Assembly Language - Part-I

Lecture 9 - ARM Assembly Language - Part-II

Lecture 10 - x86 Assembly Language - Part-I

Lecture 11 - x86 Assembly Language - Part-II

Lecture 12 - x86 Assembly Language - Part-III

Lecture 13 - x86 Assembly Language - Part-IV

Lecture 14 - A Primer on Digital Logic - Part-I

Lecture 15 - A Primer on Digital Logic - Part-II

Lecture 16 - A Primer on Digital Logic - Part-III

Lecture 17 - Computer Arithmetic - Part-I

Lecture 18 - Computer Arithmetic - Part-II

Lecture 19 - Computer Arithmetic - Part-III

Lecture 20 - Computer Arithmetic - Part-IV

Lecture 21 - Computer Arithmetic - Part-V

Lecture 22 - Computer Arithmetic - Part-VI

Lecture 23 - Processor Design - Part-I

Lecture 24 - Processor Design - Part-II

Lecture 25 - Processor Design - Part-III

Lecture 26 - Principles of Pipelining - Part-I

Lecture 27 - Principles of Pipelining - Part-II

Lecture 28 - Principles of Pipelining - Part-III

Lecture 29 - Principles of Pipelining - Part-IV

Lecture 30 - The Memory Systems - Part-I

Lecture 31 - The Memory Systems - Part-II

[Lecture 32 - The Memory Systems - Part-III](#)

[Lecture 33 - The Memory Systems - Part-IV](#)

Lecture 1 - Introduction to Parallel Programming

Lecture 2 - Parallel Architectures and Programming Models

Lecture 3 - Pipelining

Lecture 4 - Superpipelining and VLIW

Lecture 5 - Memory Latency

Lecture 6 - Cache and Temporal Locality

Lecture 7 - Cache, Memory bandwidth and Spatial Locality

Lecture 8 - Intuition for Shared and Distributed Memory architectures

Lecture 9 - Shared and Distributed Memory architectures

Lecture 10 - Interconnection networks in Distributed Memory architectures

Lecture 11 - OpenMP: A parallel Hello World Program

Lecture 12 - Program with Single thread

Lecture 13 - Program Memory with Multiple threads and Multi-tasking

Lecture 14 - Context Switching

Lecture 15 - OpenMP: Basic thread functions

Lecture 16 - OpenMP: About OpenMP

Lecture 17 - Shared Memory Consistency Models and the Sequential Consistency Model

Lecture 18 - Race Conditions

Lecture 19 - OpenMP: Scoping variables and some race conditions

Lecture 20 - OpenMP: thread private variables and more constructs

Lecture 21 - Computing sum: first attempt at parallelization

Lecture 22 - Manual distribution of work and critical sections

Lecture 23 - Distributing for loops and reduction

Lecture 24 - Vector-Vector operations (Dot product)

Lecture 25 - Matrix-Vector operations (Matrix-Vector Multiply)

Lecture 26 - Matrix-Matrix operations (Matrix-Matrix Multiply)

Lecture 27 - Introduction to tasks

Lecture 28 - Task queues and task execution

Lecture 29 - Accessing variables in tasks

Lecture 30 - Completion of tasks and scoping variables in tasks

Lecture 31 - Recursive task spawning and pitfalls

[Lecture 32 - Understanding LU Factorization](#)

[Lecture 33 - Parallel LU Factorization](#)

[Lecture 34 - Locks](#)

[Lecture 35 - Advanced Task handling](#)

[Lecture 36 - Matrix Multiplication using tasks](#)

[Lecture 37 - The OpenMP Shared Memory Consistency Model](#)

[Lecture 38 - Applications finite element method](#)

[Lecture 39 - Applications deep learning](#)

[Lecture 40 - Introduction to MPI and basic calls](#)

[Lecture 41 - MPI calls to send and receive data](#)

[Lecture 42 - MPI calls for broadcasting data](#)

[Lecture 43 - MPI non blocking calls](#)

[Lecture 44 - Application distributed histogram updation](#)

[Lecture 45 - MPI collectives and MPI broadcast](#)

[Lecture 46 - MPI gathering and scattering collectives](#)

[Lecture 47 - MPI reduction and alltoall collectives](#)

[Lecture 48 - Discussion on MPI collectives design](#)

[Lecture 49 - Characterization of interconnects](#)

[Lecture 50 - Linear arrays 2D mesh and torus](#)

[Lecture 51 - d dimensional torus](#)

[Lecture 52 - Hypercube](#)

[Lecture 53 - Trees and cliques](#)

[Lecture 54 - Hockney model](#)

[Lecture 55 - Broadcast and Reduce with recursive doubling](#)

[Lecture 56 - Scatter and Gather with recursive doubling](#)

[Lecture 57 - Reduce scatter and All gather with recursive doubling](#)

[Lecture 58 - Discussion of message sizes in analysis](#)

[Lecture 59 - Revisiting Reduce scatter on 2D mesh](#)

[Lecture 60 - Reduce scatter and Allreduce on the Hypercube](#)

[Lecture 61 - Alltoall on the Hypercube](#)

[Lecture 62 - Lower bounds](#)

[Lecture 63 - Pipeline based algorithm for Allreduce](#)

[Lecture 64 - An improved algorithm for Alltoall on the Hypercube using E-cube routing](#)

- Lecture 65 - Pipeline based algorithm for Broadcast
- Lecture 66 - Introduction to parallel graph algorithms
- Lecture 67 - Breadth First Search BFS using matrix algebra
- Lecture 68 - BFS Shared memory parallelization using OpenMP
- Lecture 69 - Distributed memory settings and data distribution
- Lecture 70 - Distributed BFS algorithm
- Lecture 71 - Performance considerations
- Lecture 72 - Prims Algorithm
- Lecture 73 - OpenMP based shared memory parallelization for MST
- Lecture 74 - MPI based distributed memory parallelization for MST
- Lecture 75 - Sequential Algorithm Adaptation from Prims
- Lecture 76 - Parallelization Strategy for Prims algorithm
- Lecture 77 - Dry run with the parallel strategy
- Lecture 78 - Johnsons algorithm with 1D data distribution
- Lecture 79 - Speedup analysis on a grid graph
- Lecture 80 - Floyds algorithm for all pair shortest paths
- Lecture 81 - Floyds algorithm with 2D data distribution
- Lecture 82 - Adaptation to transitive closures
- Lecture 83 - Parallelization strategy for connected components
- Lecture 84 - Analysis for parallel connected components

Lecture 1 - Outline - What is Synthesis?

Lecture 2 - Chip Design Flow and Hardware Modelling

Lecture 3 - VHDL: Introduction to Hardware Description Languages and VHDL Basics

Lecture 4 - VHDL: Modelling Timing - Events and Transactions

Lecture 5 - VHDL: Specifying Hardware Behaviour with Processes

Lecture 6 - VHDL: Specifying Structure, Test Benches, Parameterisation, and Libraries

Lecture 7 - Introduction to High-level Synthesis

Lecture 8 - Language front-end Design Representation

Lecture 9 - Compiler Transformation in High Level Synthesis: Constant Folding, Dead Code Elimination, Constant Propagation, and Strength Reduction

Lecture 10 - Memory Modelling and Compiler Transformation in High Level Synthesis: Common Sub-expression Elimination and Loop Invariant Code Motion

Lecture 11 - Compiler Transformations in High Level Synthesis: Loop Unrolling and Function Inlining

Lecture 12 - Hardware Transformations and ASAP / ALAP Scheduling

Lecture 13 - Scheduling in High Level Synthesis: List Scheduling and Time-constrained Scheduling

Lecture 14 - Force Directed Scheduling and Register Allocation

Lecture 15 - High Level Synthesis and Timing Issues

Lecture 16 - Finite State Machine Synthesis: Introduction to FSM Encoding

Lecture 17 - Finite State Machine Synthesis: Identifying Common Cubes and Graph Embedding

Lecture 18 - The Retiming Problem

Lecture 19 - Efficient Solution to Retiming and Introduction to Logic Synthesis

Lecture 20 - Binary Decision Diagrams

Lecture 21 - Introduction to Logic Synthesis

Lecture 22 - Two-level Logic Optimisation

Lecture 23 - Multi-Level Logic Optimisation

Lecture 24 - Multi-level Logic Synthesis: Technology Mapping

Lecture 25 - Introduction to Timing Analysis

Lecture 26 - Timing Analysis and Critical Paths

Lecture 1 - Introduction: What to Expect from AI

Lecture 2 - Introduction: History of AI from 40s - 90s

Lecture 3 - Introduction: History of AI in the 90s

Lecture 4 - Introduction: History of AI in NASA and DARPA (2000s)

Lecture 5 - Introduction: The Present State of AI

Lecture 6 - Introduction: Definition of AI Dictionary Meaning

Lecture 7 - Introduction: Definition of AI Thinking VS Acting and Humanly VS Rationally

Lecture 8 - Introduction: Definition of AI Rational Agent View of AI

Lecture 9 - Introduction: Examples Tasks, Phases of AI and Course Plan

Lecture 10 - Uniform Search: Notion of a State

Lecture 11 - Uniformed Search: Search Problem and Examples - Part 2

Lecture 12 - Uniformed Search: Basic Search Strategies - Part 3

Lecture 13 - Uniformed Search: Iterative Deepening DFS - Part 4

Lecture 14 - Uniformed Search: Bidirectional Search - Part 5

Lecture 15 - Informed Search: Best First Search - Part 1

Lecture 16 - Informed Search: Greedy Best First Search and A* Search - Part 2

Lecture 17 - Informed Search: Analysis of A* Algorithm - Part 3

Lecture 18 - Informed Search Proof of optimality of A* - Part 4

Lecture 19 - Informed Search: Iterative Deepening A* and Depth First Branch and Bound - Part 5

Lecture 20 - Informed Search: Admissible Heuristics and Domain Relaxation - Part 6

Lecture 21 - Informed Search: Pattern Database Heuristics - Part 7

Lecture 22 - Local Search: Satisfaction Vs Optimization - Part 1

Lecture 23 - Local Search: The Example of N-Queens - Part 2

Lecture 24 - Local Search: Hill Climbing - Part 3

Lecture 25 - Local Search: Drawbacks of Hill Climbing - Part 4

Lecture 26 - Local Search: of Hill Climbing With random Walk and Random Restart - Part 5

Lecture 27 - Local Search: Hill Climbing With Simulated Annealing - Part 6

Lecture 28 - Local Search: Local Beam Search and Genetic Algorithms - Part 7

Lecture 29 - Adversarial Search: Minimax Algorithm for two player games

Lecture 30 - Adversarial Search: An Example of Minimax Search

Lecture 31 - Adversarial Search: Alpha Beta Pruning

- Lecture 32 - Adversarial Search: Analysis of Alpha Beta Pruning
- Lecture 33 - Adversarial Search: Analysis of Alpha Beta Pruning (Continued...)
- Lecture 34 - Adversarial Search: Horizon Effect, Game Databases and Other Ideas
- Lecture 35 - Adversarial Search: Summary and Other Games
- Lecture 36 - Constraint Satisfaction Problems: Representation of the atomic state
- Lecture 37 - Constraint Satisfaction Problems: Map coloring and other examples of CSP
- Lecture 38 - Constraint Satisfaction Problems: Backtracking Search
- Lecture 39 - Constraint Satisfaction Problems: Variable and Value Ordering in Backtracking Search
- Lecture 40 - Constraint Satisfaction Problems: Inference for detecting failures early
- Lecture 41 - Constraint Satisfaction Problems: Exploiting problem structure
- Lecture 42 - Logic in AI : Different Knowledge Representation systems - Part 1
- Lecture 43 - Logic in AI : Syntax - Part 2
- Lecture 44 - Logic in AI : Semantics - Part 3
- Lecture 45 - Logic in AI : Forward Chaining - Part 4
- Lecture 46 - Logic in AI : Resolution - Part 5
- Lecture 47 - Logic in AI : Reduction to Satisfiability Problems - Part 6
- Lecture 48 - Logic in AI : SAT Solvers: DPLL Algorithm - Part 7
- Lecture 49 - Logic in AI : Sat Solvers: WalkSAT Algorithm - Part 8
- Lecture 50 - Uncertainty in AI: Motivation
- Lecture 51 - Uncertainty in AI: Basics of Probability
- Lecture 52 - Uncertainty in AI: Conditional Independence and Bayes Rule
- Lecture 53 - Bayesian Networks: Syntax
- Lecture 54 - Bayesian Networks: Factorization
- Lecture 55 - Bayesian Networks: Conditional Independences and d-Separation
- Lecture 56 - Bayesian Networks: Inference using Variable Elimination
- Lecture 57 - Bayesian Networks: Reducing 3-SAT to Bayes Net
- Lecture 58 - Bayesian Networks: Rejection Sampling
- Lecture 59 - Bayesian Networks: Likelihood Weighting
- Lecture 60 - Bayesian Networks: MCMC with Gibbs Sampling
- Lecture 61 - Bayesian Networks: Maximum Likelihood Learning
- Lecture 62 - Bayesian Networks: Maximum a-Posteriori Learning
- Lecture 63 - Bayesian Networks: Bayesian Learning
- Lecture 64 - Bayesian Networks: Structure Learning and Expectation Maximization

- Lecture 65 - Introduction, Part 10: Agents and Environments
- Lecture 66 - Decision Theory: Steps in Decision Theory
- Lecture 67 - Decision Theory: Non Deterministic Uncertainty
- Lecture 68 - Probabilistic Uncertainty and Value of perfect information
- Lecture 69 - Expected Utility vs Expected Value
- Lecture 70 - Markov Decision Processes: Definition
- Lecture 71 - Markov Decision Processes: An example of a Policy
- Lecture 72 - Markov Decision Processes: Policy Evaluation using system of linear equations
- Lecture 73 - Markov Decision Processes: Iterative Policy Evaluation
- Lecture 74 - Markov Decision Processes: Value Iteration
- Lecture 75 - Markov Decision Processes: Policy Iteration and Applications and Extensions of MDPs
- Lecture 76 - Reinforcement Learning: Background
- Lecture 77 - Reinforcement Learning: Model-based Learning for policy evaluation (Passive Learning)
- Lecture 78 - Reinforcement Learning: Model-free Learning for policy evaluation (Passive Learning)
- Lecture 79 - Reinforcement Learning: TD Learning
- Lecture 80 - Reinforcement Learning: TD Learning and Computational Neuroscience
- Lecture 81 - Reinforcement Learning: Q Learning
- Lecture 82 - Reinforcement Learning: Exploration vs Exploitation Tradeoff
- Lecture 83 - Reinforcement Learning: Generalization in RL
- Lecture 84 - Deep Learning: Perceptrons and Activation functions
- Lecture 85 - Deep Learning: Example of Handwritten digit recognition
- Lecture 86 - Deep Learning: Neural Layer as matrix operations
- Lecture 87 - Deep Learning: Differentiable loss function
- Lecture 88 - Deep Learning: Backpropagation through a computational graph
- Lecture 89 - Deep Learning: Thin Deep Vs Fat Shallow Networks
- Lecture 90 - Deep Learning: Convolutional Neural Networks
- Lecture 91 - Deep Learning: Deep Reinforcement Learning
- Lecture 92 - Ethics of AI: Humans vs Robots
- Lecture 93 - Ethics of AI: Robustness and Transparency of AI systems
- Lecture 94 - Ethics of AI: Data Bias and Fairness of AI systems
- Lecture 95 - Ethics of AI: Accountability, privacy and Human-AI interaction
- Lecture 96 - Wrapup

Lecture 1 - Introduction

Lecture 2 - Out-of-Order Pipelines - Part I

Lecture 3 - Out-of-Order Pipelines - Part II

Lecture 4 - Out-of-Order Pipelines - Part III

Lecture 5 - The Fetch and Decode Stages - Part I

Lecture 6 - The Fetch and Decode Stages - Part II

Lecture 7 - The Fetch and Decode Stages - Part III

Lecture 8 - The Issue, Execute, and Commit Stages - Part I

Lecture 9 - The Issue, Execute, and Commit Stages - Part II

Lecture 10 - The Issue, Execute, and Commit Stages - Part III

Lecture 11 - The Issue, Execute, and Commit Stages - Part IV

Lecture 12 - Alternative Approaches to Issue and Commit - Part I

Lecture 13 - Alternative Approaches to Issue and Commit - Part II

Lecture 14 - Alternative Approaches to Issue and Commit - Part III

Lecture 15 - Alternative Approaches to Issue and Commit - Part IV

Lecture 16 - Graphics Processors - Part I

Lecture 17 - Graphics Processors - Part II

Lecture 18 - Graphics Processors - Part III

Lecture 19 - Caches - Part I

Lecture 20 - Caches - Part II

Lecture 21 - Caches - Part III

Lecture 22 - Caches - Part IV

Lecture 23 - Caches - Part V

Lecture 24 - Caches - Part VI

Lecture 25 - Multicore Systems - Part I

Lecture 26 - Multicore Systems - Part II

Lecture 27 - Multicore Systems - Part III

Lecture 28 - Multicore Systems - Part IV

Lecture 29 - Multicore Systems - Part V

Lecture 30 - Multicore Systems - Part VI

Lecture 31 - Multicore Systems - Part VII

[Lecture 32 - Multicore Systems - Part VIII](#)

[Lecture 33 - Multicore Systems - Part IX](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

- Lecture 1 - Introduction to Digital VLSI Design Flow
- Lecture 2 - High Level Design Representation
- Lecture 3 - Transformations for High Level Synthesis
- Lecture 4 - Introduction to HLS: Scheduling, Allocation and Binding Problem
- Lecture 5 - Scheduling Algorithms - 1
- Lecture 6 - Scheduling Algorithms - 2
- Lecture 7 - Binding and Allocation Algorithms
- Lecture 8 - Two level Boolean Logic Synthesis - 1
- Lecture 9 - Two level Boolean Logic Synthesis - 2
- Lecture 10 - Two level Boolean Logic Synthesis - 3
- Lecture 11 - Heuristic Minimization of Two-Level Circuits
- Lecture 12 - Finite State Machine Synthesis
- Lecture 13 - Multilevel Implementation
- Lecture 14 - Introduction to formal methods for design verification
- Lecture 15 - Temporal Logic: Introduction and Basic Operators
- Lecture 16 - Syntax and Semantics of CTL
- Lecture 17 - Syntax and Semantics of CTL – Continued
- Lecture 18 - Equivalence between CTL Formulas
- Lecture 19 - Introduction to Model Checking
- Lecture 20 - Model Checking Algorithms - I
- Lecture 21 - Model Checking Algorithms - II
- Lecture 22 - Model Checking with Fairness
- Lecture 23 - Binary Decision Diagram: Introduction and construction
- Lecture 24 - Ordered Binary Decision Diagram
- Lecture 25 - Operation on Ordered Binary Decision Diagram
- Lecture 26 - Ordered Binary Decision Diagram for State Transition Systems
- Lecture 27 - Symbolic Model Checking
- Lecture 28 - Introduction to Digital VLSI Testing
- Lecture 29 - Functional and Structural Testing
- Lecture 30 - Fault Equivalence
- Lecture 31 - Fault Simulation - 1

[Lecture 32 - Fault Simulation - 2](#)

[Lecture 33 - Fault Simulation - 3](#)

[Lecture 34 - Testability Measures \(SCOAP\)](#)

[Lecture 35 - Introduction to Automatic Test Pattern Generation \(ATPG\) and ATPG Algebras](#)

[Lecture 36 - D-Algorithm - 1](#)

[Lecture 37 - D-Algorithm - 2](#)

[Lecture 38 - ATPG for Synchronous Sequential Circuits](#)

[Lecture 39 - Scan Chain based Sequential Circuit Testing - 1](#)

[Lecture 40 - Scan Chain based Sequential Circuit Testing - 2](#)

[Lecture 41 - Built in Self Test - 1](#)

[Lecture 42 - Built in Self Test - 2](#)

[Lecture 43 - Memory Testing - 1](#)

[Lecture 44 - Memory Testing - 2](#)

- Lecture 1 - Model of Computer and Working Principle
- Lecture 2 - Digital Logic Building Blocks
- Lecture 3 - Information Representation and Number Systems
- Lecture 4 - Basic Elements of a Processor
- Lecture 5 - Storage and I/O Interface
- Lecture 6 - Execution of Program and Programming Languages
- Lecture 7 - Components of Central Processing Unit (CPU) and External Interface
- Lecture 8 - Main Memory
- Lecture 9 - Instruction Execution
- Lecture 10 - Instruction Format
- Lecture 11 - Instruction Set
- Lecture 12 - Addressing Modes
- Lecture 13 - Flags and Conditional Instructions
- Lecture 14 - Instruction: Procedure CALL/RETURN
- Lecture 15 - Instruction Cycle and Micro-operations
- Lecture 16 - Control Signals and Timing Sequence
- Lecture 17 - Control Signals for Complete Instruction Execution
- Lecture 18 - Handling Different Addressing Modes
- Lecture 19 - Handling Control Transfer Instructions
- Lecture 20 - Design of Hardwired controlled Control Unit
- Lecture 21 - Microinstructions and Microprograms
- Lecture 22 - Organization and Optimization of Microprogrammed controlled Control Unit
- Lecture 23 - Different Internal CPU Bus Organization
- Lecture 24 - Basics of Memory and Cache - Part 1
- Lecture 25 - Basics of Memory and Cache - Part 2
- Lecture 26 - Direct-mapped Caches: Misses, Writes and Performance
- Lecture 27 - Associative and Multi-level Caches
- Lecture 28 - Summary - Caches
- Lecture 29 - Basics of Virtual Memory and Address Translation
- Lecture 30 - Paging and Segmentation
- Lecture 31 - TLBs and Page Fault Handling

[Lecture 32 - Cache Indexing and Tagging Variations, Demand Paging](#)

[Lecture 33 - Page Replacement Algorithms](#)

[Lecture 34 - Page Frame Allocation and Thrashing](#)

[Lecture 35 - Summary - Virtual Memory](#)

[Lecture 36 - Input-Output Primitives](#)

[Lecture 37 - Interrupt Driven I/O](#)

[Lecture 38 - DMA Transfer](#)

[Lecture 39 - Storage Devices](#)

Lecture 1 - Introduction

Lecture 2 - Modeling Techniques - 1

Lecture 3 - Modeling Techniques - 2

Lecture 4 - Hardware/Software Partitioning - 1

Lecture 5 - Hardware/Software Partitioning - 2

Lecture 6 - Introduction to Hardware Design

Lecture 7 - Hardware Architectural Synthesis - 1

Lecture 8 - Hardware Architectural Synthesis - 2

Lecture 9 - Hardware Architectural Synthesis - 3

Lecture 10 - Hardware Architectural Synthesis - 4

Lecture 11 - Hardware Architectural Synthesis - 5

Lecture 12 - Hardware Architectural Synthesis - 6

Lecture 13 - Hardware Architectural Synthesis - 7

Lecture 14 - System Level Analysis

Lecture 15 - Uniprocessor Scheduling - 1

Lecture 16 - Uniprocessor Scheduling - 2

Lecture 17 - Multiprocessor Scheduling - 1

Lecture 18 - Multiprocessor Scheduling - 2

Lecture 19 - Introduction and Basic Operators of Temporal Logic

Lecture 20 - Syntax and Semantics of CTL

Lecture 21 - Equivalence between CTL formulas

Lecture 22 - Model Checking Algorithm

Lecture 23 - Binary Decision Diagram

Lecture 24 - Use of OBDDs for State Transition System

Lecture 25 - Symbolic Model Checking

Lecture 26 - Introduction to Digital VLSI Testing

Lecture 27 - Automatic Test Pattern Generation (ATPG)

Lecture 28 - Scan Chain based Sequential Circuit Testing

Lecture 29 - Software-Hardware Co-validation Fault Models and High Level Testing for Complex Embedded Systems""

Lecture 30 - Testing for embedded cores

Lecture 31 - Bus and Memory Testing

[Lecture 32 - Testing for advanced faults in Real time Embedded Systems](#)

[Lecture 33 - BIST for Embedded Systems](#)

[Lecture 34 - Concurrent Testing for Fault tolerant Embedded Systems - 1](#)

[Lecture 35 - Concurrent Testing for Fault tolerant Embedded Systems - 2](#)

[Lecture 36 - Testing for Re-programmable hardware](#)

[Lecture 37 - Interaction Testing between Hardware and Software](#)

Lecture 1 - Introduction and Overview of the Course

Lecture 2 - Instruction Execution Principles

Lecture 3 - Introduction to Instruction Pipeline

Lecture 4 - Introduction to Superscalar Pipelines

Lecture 5 - Instruction Pipeline and Performance - I

Lecture 6 - Instruction Pipeline and Performance - II

Lecture 7 - Introduction to Cache Memory

Lecture 8 - Block Replacement Techniques and Write Strategy

Lecture 9 - gem5 Simulator - An Overview

Lecture 10 - Cache Memory

Lecture 11 - Basic Cache Optimization Techniques

Lecture 12 - gem5 Simulator - Cache Optimisation

Lecture 13 - Advanced Cache Optimization Techniques - I

Lecture 14 - Advanced Cache Optimization Techniques - II

Lecture 15 - Cache Memory Optimizations

Lecture 16 - Introduction to DRAM System

Lecture 17 - DRAM Controllers and Address Mapping

Lecture 18 - Address Translation Mechanisms

Lecture 19 - Main Memory Concepts

Lecture 20 - Introduction to Tiled Chip Multicore Processors

Lecture 21 - Routing Techniques in Network On Chip

Lecture 22 - Network On Chip Router Micro-Architecture

Lecture 23 - gem5 Simulator - NoC Optimisation

Lecture 24 - Energy Efficient Bufferless NoC Routers

Lecture 25 - Sidebuffered Deflection Routers

Lecture 26 - Concepts in Network on Chip

Lecture 27 - QoS of NoC and Caches in TCMP Systems

Lecture 28 - Emerging Trends in Network On Chips

Lecture 29 - Concepts in TCMP Systems

Lecture 1 - Review of Basic Computer Organization

Lecture 2 - Instruction Set and Addressing Modes

Lecture 3 - Instruction Encoding

Lecture 4 - Performance Evaluation Methods

Lecture 5 - Tutorial on Performance Evaluation

Lecture 6 - Introduction to RISC Instruction Pipeline

Lecture 7 - Instruction Pipeline Hazards

Lecture 8 - Tutorial on Instruction Pipeline and Hazards

Lecture 9 - Control Hazards and Branch Prediction

Lecture 10 - MIPS Pipeline for Multi-Cycle Operations

Lecture 11 - Tutorial on Longer Pipeline and Branch Prediction

Lecture 12 - Compiler Techniques to Explore ILP

Lecture 13 - Dynamic Scheduling to Explore ILP

Lecture 14 - Dynamic Scheduling with Tomasulo's Algorithm

Lecture 15 - Dynamic Scheduling with Speculative Execution

Lecture 16 - Tutorial on Static and Dynamic Scheduling

Lecture 17 - Advanced Pipelining and Superscalar Processors

Lecture 18 - Introduction to GPU architectures

Lecture 19 - Case study on GPU architectures

Lecture 20 - Tutorial on Superscalar processors and GPU

Lecture 21 - Introduction to Cache Memory

Lecture 22 - Block Replacement Techniques and Write Strategy

Lecture 23 - Design Concepts in Cache Memory

Lecture 24 - Optimization Techniques in Cache Memory

Lecture 25 - Advanced Cache Optimization Techniques

Lecture 26 - Tutorial on Advanced Concepts in Cache Memory - 1

Lecture 27 - Tutorial on Advanced Concepts in Cache Memory - 2

Lecture 28 - Cache coherence and memory consistency

Lecture 29 - Design Space for snooping protocols

Lecture 30 - Directory Based Cache coherence

Lecture 31 - Cache coherence in multiprocessor design [T]

- [Lecture 32 - Introduction to DRAM System](#)
- [Lecture 33 - DRAM Controllers and Address Mapping](#)
- [Lecture 34 - Secondary Storage Systems](#)
- [Lecture 35 - Design Concepts in Storage Systems](#)
- [Lecture 36 - Introduction to Tiled Chip Multicore Processors](#)
- [Lecture 37 - Routing Techniques in Network On Chip](#)
- [Lecture 38 - Network On Chip Router Micro-Architecture](#)
- [Lecture 39 - Concepts in Network on Chip](#)
- [Lecture 40 - Energy Efficient Bufferless NoC Routers](#)
- [Lecture 41 - Sidebuffered Deflection Routers](#)
- [Lecture 42 - Concepts in Deflection Routers \[T\]](#)
- [Lecture 43 - QoS of NoC and Caches in TCMP Systems](#)
- [Lecture 44 - Emerging Trends in Network On Chips](#)
- [Lecture 45 - Domain Specific Accelerators](#)
- [Lecture 46 - Introduction to VEGA Microprocessors \(Case Study\)](#)
- [Lecture 47 - Concepts in TCMP Systems](#)
- [Lecture 48 - How to Explore Computer Architecture?](#)

Lecture 1 - Introduction to Randomized Algorithms

Lecture 2 - Randomized Mincut Algorithm

Lecture 3 - Randomized Find

Lecture 4 - Probability Review

Lecture 5 - Expectation of Random Variables

Lecture 6 - Conditional Probability and Conditional Expectation2

Lecture 7 - Birthday Paradox

Lecture 8 - Markov and Chebychev's Inequalities

Lecture 9 - Median Algorithm

Lecture 10 - Chernoff Bound

Lecture 11 - Permutation Routing on a Hypercube

Lecture 12 - Permutation Routing on a Hypercube (Analysis)

Lecture 13 - Introduction to Probabilistic Method

Lecture 14 - More Examples on Probabilistic Method

Lecture 15 - Lovasz Local Lemma

Lecture 16 - Introduction to Markov Chains

Lecture 17 - 2-SAT and Markov Chains

Lecture 18 - 3-SAT and Markov Chains

Lecture 19 - Electrical Networks

Lecture 20 - Cover Time

Lecture 21 - Rapid Mixing

Lecture 22 - Introduction to Computational Complexity

Lecture 23 - Pratt's Certificate

Lecture 24 - Primality Testing

Lecture 25 - Miller Rabin Algorithm

Lecture 26 - All pair shortest path - I

Lecture 27 - All pair shortest path - II

Lecture 28 - Randomized MST

Lecture 29 - Introduction to approximate counting

Lecture 30 - DNF counting

Lecture 31 - Perfect Matching - I

[Lecture 32 - Perfect Matching - II](#)

[Lecture 33 - Perfect Matching - III](#)

[Lecture 34 - Treaps](#)

[Lecture 35 - Hashing](#)

[Lecture 36 - Probabilistically checkable proofs - I](#)

[Lecture 37 - Probabilistically checkable proofs - II](#)

[Lecture 38 - Probabilistically checkable proofs - III](#)

[Lecture 39 - LFKN Protocol](#)

[Lecture 40 - summary](#)

- Lecture 1 - Shared Memory Models - 1
- Lecture 2 - Shared Memory Models - 2
- Lecture 3 - Interconnection Networks
- Lecture 4 - Cost and Optimality
- Lecture 5 - Basic Techniques - 1
- Lecture 6 - Basic Techniques - 2
- Lecture 7 - Basic Techniques - 3
- Lecture 8 - Basic Techniques - 4
- Lecture 9 - Basic Techniques - 5
- Lecture 10 - Odd Even Merge Sort (OEMS)
- Lecture 11 - OEMS, Bitonic-Sort-Merge Sort (BSMS)
- Lecture 12 - BSMS, Optimal List Colouring
- Lecture 13 - Description
- Lecture 14 - Analysis
- Lecture 15 - Applications
- Lecture 16 - Applications
- Lecture 17 - Fast optimal merge algorithm
- Lecture 18 - High level Description
- Lecture 19 - Cole's Merge Sort: Details
- Lecture 20 - Analysis of Cole's Merge Sort; Lower bound for sorting
- Lecture 21 - Sorting Lower bound; Connected Components
- Lecture 22 - Connected Components (CREW)
- Lecture 23 - Connected Components, Vertex Colouring
- Lecture 24 - Sorting on a 2D mesh
- Lecture 25 - Sorting on a 2D mesh
- Lecture 26 - Sorting, Offline routing on a 2D mesh
- Lecture 27 - Sorting on a 3D mesh
- Lecture 28 - Mesh of Trees, Hypercube
- Lecture 29 - Hypercube (Continued...)
- Lecture 30 - Hypercube (Continued...), butterfly network
- Lecture 31 - Butterfly, CCC and Benes Networks

[Lecture 32 - Butterfly, CCC and Benes Networks](#)

[Lecture 33 - Shuffle Exchange Graphs, de Bruijn Graphs](#)

[Lecture 34 - Interconnection Networks Algorithms](#)

[Lecture 35 - Circuit Value Problem is P-complete for NC-reductions](#)

[Lecture 36 - Ordered DFS is P-complete for NC-reductions](#)

[Lecture 37 - Max Flow is P-complete for NC-reductions](#)

Lecture 1 - Boolean Functions

Lecture 2 - Propositional Calculus: Introduction

Lecture 3 - First Order Logic: Introduction

Lecture 4 - First Order Logic: Introduction (Continued...)

Lecture 5 - Proof System for Propcal

Lecture 6 - First Order Logic: wffs, interpretations, models

Lecture 7 - Soundness and Completeness of the First Order Proof System

Lecture 8 - Sets, Relations, Functions

Lecture 9 - Functions, Embedding of the theories of naturals numbers and integers in Set Theory

Lecture 10 - Embedding of the theories of integers and rational numbers in Set Theory; Countable Sets

Lecture 11 - Introduction to graph theory

Lecture 12 - Trees, Cycles, Graph coloring

Lecture 13 - Bipartite Graphs

Lecture 14 - Bipartite Graphs; Edge Coloring and Matching

Lecture 15 - Planar Graphs

Lecture 16 - Graph Searching; BFS and DFS

Lecture 17 - Network Flows

Lecture 18 - Counting Spanning Trees in Complete Graphs

Lecture 19 - Embedding of the theory of ral numbers in Set Theory; Paradoxes

Lecture 20 - ZF Axiomatization of Set Theory

Lecture 21 - Partially ordering relations

Lecture 22 - Natural numbers, divisors

Lecture 23 - Lattices

Lecture 24 - GCD, Euclid's Algorithm

Lecture 25 - Prime Numbers

Lecture 26 - Congruences

Lecture 27 - Pigeon Hole Principle

Lecture 28 - Stirling Numbers, Bell Numbers

Lecture 29 - Generating Functions

Lecture 30 - Product of Generating Functions

Lecture 31 - Composition of Generating Function

[Lecture 32 - Principle of Inclusion Exclusion](#)

[Lecture 33 - Rook placement problem](#)

[Lecture 34 - Solution of Congruences](#)

[Lecture 35 - Chinese Remainder Theorem](#)

[Lecture 36 - Totient; Congruences; Floor and Ceiling Functions](#)

[Lecture 37 - Introduction to Groups](#)

[Lecture 38 - Modular Arithmetic and Groups](#)

[Lecture 39 - Dihedral Groups, Isomorphisms](#)

[Lecture 40 - Cyclic groups, Direct Products, Subgroups](#)

[Lecture 41 - Cosets, Lagrange's theorem](#)

[Lecture 42 - Rings and Fields](#)

[Lecture 43 - Construction of Finite Fields](#)

- Lecture 1 - Review of Basic Computer Organization
- Lecture 2 - Performance Evaluation Methods
- Lecture 3 - Introduction to RISC Instruction Pipeline
- Lecture 4 - Instruction Pipeline and Performance
- Lecture 5 - Pipeline Hazards
- Lecture 6 - Control Hazards and Branch Prediction
- Lecture 7 - MIPS Pipeline for Multi-Cycle Operations
- Lecture 8 - Tutorial 2 : Pipeline Hazard Analysis
- Lecture 9 - Compiler Techniques to Explore ILP
- Lecture 10 - Dynamic Scheduling to Explore ILP
- Lecture 11 - Dynamic Scheduling with Tomasulo's Algorithm
- Lecture 12 - Dynamic Scheduling with Speculative Execution
- Lecture 13 - Tutorial 3 : Static and Dynamic Scheduling
- Lecture 14 - Advanced Pipelining and Superscalar Processors
- Lecture 15 - Exploiting DLP: Vector and GPU Architectures
- Lecture 16 - Tutorial 4 : Architectural Simulation using gem5
- Lecture 17 - Tutorial 5 : Core Optimization in gem5
- Lecture 18 - Introduction to Cache Memory
- Lecture 19 - Block Replacement Techniques and Write Strategy
- Lecture 20 - Tutorial 6 : Design Concepts in Cache Memory
- Lecture 21 - Optimization Techniques in Cache Memory
- Lecture 22 - Advanced Cache Optimization Techniques
- Lecture 23 - Tutorial 7 : Optimization Techniques in Cache Memory
- Lecture 24 - Tutorial 8 : Cache Optimization in gem5
- Lecture 25 - Introduction to DRAM System
- Lecture 26 - DRAM Controllers and Address Mapping
- Lecture 27 - Secondary Storage Systems
- Lecture 28 - Tutorial 9 : Design Concepts in DRAM and Harddisk
- Lecture 29 - Tiled Chip Multicore Processors
- Lecture 30 - Routing Techniques in Network on Chip
- Lecture 31 - NoC Router Microarchitecture

[Lecture 32 - How to Explore Computer Architecture?](#)

[Lecture 33 - Tutorial 10 : TCMP and NoC Design Principles](#)

- Lecture 1 - Introduction to UCC and history
- Lecture 2 - Issues and challenges
- Lecture 3 - Latest research trends
- Lecture 4 - User-Centric Design and Software Engineering
- Lecture 5 - Components of SDLC - Contextual Inquiry
- Lecture 6 - Components of SDLC - Design Guidelines
- Lecture 7 - Components of SDLC - Prototyping
- Lecture 8 - Case study (web site design)
- Lecture 9 - Introduction to User-Centric Computing
- Lecture 10 - The UCC framework with illustrative case study
- Lecture 11 - User-centric models - introduction and descriptive models
- Lecture 12 - User-centric models - predictive models and taxonomy
- Lecture 13 - Introduction to GOMS family of models
- Lecture 14 - Keystroke-Level Model (KLM)
- Lecture 15 - (CMN)GOMS Model
- Lecture 16 - The Fitts' Law
- Lecture 17 - The Hick-Hyman Law
- Lecture 18 - 2D and 3D pointing models
- Lecture 19 - The Steering Law for constrained navigation
- Lecture 20 - Model for hierarchical menu selection
- Lecture 21 - Mobile typing models (single finger and two thumb typing)
- Lecture 22 - Model for touch performance (FFitts' law)
- Lecture 23 - Introduction to formal models in UCD
- Lecture 24 - Formal modeling of user-computer dialogue
- Lecture 25 - Case studies on the use of models
- Lecture 26 - Introduction and research question formulation
- Lecture 27 - Variables determination and experiment design
- Lecture 28 - Data analysis including model building
- Lecture 29 - Introduction to user-centric design evaluation and expert evaluation technique
- Lecture 30 - User evaluation, empirical and model-based evaluation
- Lecture 31 - Concluding remarks

- Lecture 1 - Introduction to graphics
- Lecture 2 - Historical evolution, issues and challenges
- Lecture 3 - Basics of a graphics system
- Lecture 4 - Introduction to 3D graphics pipeline
- Lecture 5 - Introduction and overview on object representation techniques
- Lecture 6 - Various Boundary Representation Techniques
- Lecture 7 - Spline representation - I
- Lecture 8 - Spline representation - II
- Lecture 9 - Space representation methods
- Lecture 10 - Introduction to modeling transformations
- Lecture 11 - Matrix representation and composition of transformations
- Lecture 12 - Transformations in 3D
- Lecture 13 - Color computation - basic idea
- Lecture 14 - Simple lighting model
- Lecture 15 - Shading models
- Lecture 16 - Intensity mapping
- Lecture 17 - Color models and texture synthesis
- Lecture 18 - View transformation
- Lecture 19 - Projection transformation
- Lecture 20 - Windows-to-viewport transformation
- Lecture 21 - Clipping introduction and 2D point and line clipping
- Lecture 22 - 2D fill-area clipping and 3D clipping
- Lecture 23 - Hidden surface removal - I
- Lecture 24 - Hidden surface removal - II
- Lecture 25 - Scan conversion of basic shapes - I
- Lecture 26 - Scan conversion of basic shapes - II
- Lecture 27 - Fill area and character scan conversion
- Lecture 28 - Anti-aliasing techniques
- Lecture 29 - Graphics I/O Devices
- Lecture 30 - Introduction to GPU and Shaders
- Lecture 31 - Programming with OpenGL

Lecture 32 - Concluding remarks

- Lecture 1 - Introduction to C-Based VLSI Design
- Lecture 2 - C-based VLSI Design: An Overview
- Lecture 3 - C-based VLSI Design: Problem Formulation
- Lecture 4 - C-based VLSI Design: Course Plan
- Lecture 5 - Introduction to Scheduling
- Lecture 6 - ILP formulation of Scheduling
- Lecture 7 - ILP formulation of MRLC and MLRC Scheduling
- Lecture 8 - Multiprocessor Scheduling
- Lecture 9 - Hu's algorithm for Multiprocessor Scheduling
- Lecture 10 - List based Scheduling of MLRC
- Lecture 11 - List based Scheduling of MRLC
- Lecture 12 - Forced Directed Scheduling
- Lecture 13 - Forced Directed MLRC and MRLC Scheduling Algorithm
- Lecture 14 - Path Based Scheduling
- Lecture 15 - Path Based Scheduling
- Lecture 16 - Allocation and Binding Problem Formulation
- Lecture 17 - Left Edge Algorithm
- Lecture 18 - ILP Formulation of Allocation and Binding
- Lecture 19 - Allocation and Binding for Hierarchical Graph
- Lecture 20 - Register Allocation and Binding
- Lecture 21 - Multi-port Binding Problem
- Lecture 22 - Datapath and Controller Synthesis
- Lecture 23 - HLS for Arrays
- Lecture 24 - HLS for Loops
- Lecture 25 - HLS for Loop - pipeline
- Lecture 26 - Hardware Efficient C Coding - Part I
- Lecture 27 - Hardware Efficient C Coding - Part II
- Lecture 28 - Dataflow Optimization in HLS
- Lecture 29 - Frontend Optimizations in C
- Lecture 30 - HLS Optimizations: Case Study 1
- Lecture 31 - HLS Optimizations: Case Study 1

[Lecture 32 - Simulation based Verification](#)

[Lecture 33 - RTL to C Reverse Engineering](#)

[Lecture 34 - Phase-wise Verification of HLS](#)

[Lecture 35 - Equivalence between C and RTL](#)

[Lecture 36 - Introduction to Hardware Security](#)

[Lecture 37 - HLS for Security](#)

[Lecture 38 - Attacks on RTL Logic locking](#)

[Lecture 39 - Introduction to Logic Synthesis](#)

[Lecture 40 - FPGA Technology Mapping](#)

[Lecture 41 - Introduction to Physical Synthesis](#)

[Lecture 42 - Introduction to Circuit optimizations](#)

[Lecture 43 - Recent Advances in C-Based VLSI Design](#)

- Lecture 1 - Interactive Systems
- Lecture 2 - Introduction to Usability
- Lecture 3 - Engineering for Usability
- Lecture 4 - Interactive System Life Cycle
- Lecture 5 - Usability Requirements
- Lecture 6 - Contextual Inquiry
- Lecture 7 - Functional Requirements Specification
- Lecture 8 - Case Study on SRS
- Lecture 9 - Case Study (Usability Requirement Gathering)
- Lecture 10 - Case Study (Other Requirement Gathering)
- Lecture 11 - Case Study - Non-Functional Requirements to SRS
- Lecture 12 - Introduction to Interface Design
- Lecture 13 - Shneiderman's Golden Rules
- Lecture 14 - Norman's Principles
- Lecture 15 - Prototyping
- Lecture 16 - Prototype Evaluation - I
- Lecture 17 - Prototype Evaluation - II
- Lecture 18 - Case Study on Prototype Evaluation - I
- Lecture 19 - Case Study on Prototype Evaluation - II
- Lecture 20 - Basics of System Design
- Lecture 21 - Data Flow Diagram
- Lecture 22 - Entity Relationship Diagram
- Lecture 23 - Case Study on DFD and ER
- Lecture 24 - Introduction to Object Oriented Design
- Lecture 25 - UML
- Lecture 26 - UML Case Study
- Lecture 27 - Coding Basics
- Lecture 28 - Code Testing Basics
- Lecture 29 - Review-Based Code Testing
- Lecture 30 - Code Review Case Study
- Lecture 31 - Black-Box Testing - I

- [Lecture 32 - Black-Box Testing - II](#)
- [Lecture 33 - Black-Box Testing Case Study](#)
- [Lecture 34 - White-Box Testing](#)
- [Lecture 35 - White-Box Testing Case Study](#)
- [Lecture 36 - System Integration and Testing](#)
- [Lecture 37 - Empirical Usability Evaluation - I](#)
- [Lecture 38 - Empirical Usability Evaluation - II](#)
- [Lecture 39 - Experiment Design - I](#)
- [Lecture 40 - Experiment Design - II](#)
- [Lecture 41 - Empirical Data Analysis](#)
- [Lecture 42 - Project Management](#)
- [Lecture 43 - Note on Agile Development](#)
- [Lecture 44 - Concluding Remarks](#)

Lecture 1 - Graph_Basics

Lecture 2 - Breadth_First_Search

Lecture 3 - Dijkstra_Algo

Lecture 4 - All Pair Shortest Path

Lecture 5 - Matroids

Lecture 6 - Minimum Spanning Tree

Lecture 7 - Edmond's Matching Algo I

Lecture 8 - Edmond's Matching Algo II

Lecture 9 - Flow Networks

Lecture 10 - Ford Fulkerson Method

Lecture 11 - Edmond Karp Algo

Lecture 12 - Matrix Inversion

Lecture 13 - Matrix Decomposition

Lecture 14 - Knuth Morris Pratt Algo

Lecture 15 - Rabin Karp Algo

Lecture 16 - NFA Simulation

Lecture 17 - Integer-Polynomial Ops-I

Lecture 18 - Integer-Polynomial Ops-II

Lecture 19 - Integer-Polynomial Ops-III

Lecture 20 - Chinese Remainder-I

Lecture 21 - Chinese Remainder-II

Lecture 22 - Chinese Remainder-III

Lecture 23 - Discrete Fourier Transform-I

Lecture 24 - Discrete Fourier Transform-II

Lecture 25 - Discrete Fourier Transform-III

Lecture 26 - Schonhage Strassen Algo

Lecture 27 - Linear Programming-I

Lecture 28 - Linear Programming-II

Lecture 29 - Geometry-I

Lecture 30 - Geometry-II

Lecture 31 - Geometry-III

[Lecture 32 - Approximation Algo-I](#)

[Lecture 33 - Approximation Algo-II](#)

[Lecture 34 - Approximation Algo-III](#)

[Lecture 35 - General: Dynamic Programming](#)

Lecture 1 - What is theory of computation? Set membership problem, basic notions like alphabet, strings, formal languages

Lecture 2 - Introduction to finite automaton

Lecture 3 - Finite automata continued, deterministic finite automata (DFAs), language accepted by a DFA

Lecture 4 - Regular languages, their closure properties

Lecture 5 - DFAs solve set membership problems in linear time, pumping lemma

Lecture 6 - More examples of nonregular languages, proof of pumping lemma, pumping lemma as a game, converse of pumping lemma does not hold

Lecture 7 - A generalization of pumping lemma, nondeterministic finite automata (NFAs), computation trees for NFAs

Lecture 8 - Formal description of NFA, language accepted by NFA, such languages are also regular

Lecture 9 - 'Guess and verify' paradigm for nondeterminism

Lecture 10 - NFA's with epsilon transitions

Lecture 11 - Regular expressions, they denote regular languages

Lecture 12 - Construction of a regular expression for a language given a DFA accepting it. Algebraic closure properties of regular languages

Lecture 13 - Closure properties (Continued...)

Lecture 14 - Closure under reversal, use of closure properties

Lecture 15 - Decision problems for regular languages

Lecture 16 - About minimization of states of DFAs. Myhill-Nerode theorem

Lecture 17 - Continuation of proof of Myhill-Nerode theorem

Lecture 18 - Application of Myhill-Nerode theorem. DFA minimization

Lecture 19 - DFA minimization (Continued...)

Lecture 20 - Introduction to context free languages (cfls) and context free grammars (cfgs). Derivation of strings by cfgs

Lecture 21 - Languages generated by a cfg, leftmost derivation, more examples of cfgs and cfls

Lecture 22 - Parse trees, inductive proof that L is $L(G)$. All regular languages are context free

Lecture 23 - Towards Chomsky normal forms: elimination of useless symbols, analysis of reachable symbols, generating nonterminals, order of substeps matter

Lecture 24 - Simplification of cfgs continued, Removal of epsilon productions: algorithm and its correctness

Lecture 25 - Elimination of unit productions. Converting a cfg into Chomsky normal form. Towards pumping lemma for cfls

Lecture 26 - Pumping lemma for cfls. Adversarial paradigm

Lecture 27 - Completion of pumping lemma proof. Examples of use of pumping lemma. Converse of lemma does not hold. Closure properties of cfls

Lecture 28 - Closure properties continued. cfls not closed under complementation

Lecture 29 - Another example of a cfl whose complement is not a cfl. Decision problems for cfls

Lecture 30 - More decision problems. CYK algorithm for membership decision

Lecture 31 - Introduction to pushdown automata (pda)

Lecture 32 - pda configurations, acceptance notions for pdas. Transition diagrams for pdas

Lecture 33 - Equivalence of acceptance by empty stack and acceptance by final state

Lecture 34 - Turing machines (TM): motivation, informal definition, example, transition diagram

Lecture 35 - Execution trace, another example (unary to binary conversion)

Lecture 36 - Example continued. Finiteness of TM description, TM configuration, language acceptance, definition of recursively enumerable (r.e.) languages

Lecture 37 - Notion of non-acceptance or rejection of a string by a TM. Multitrack TM, its equivalence to standard TM. Multitape TMs

Lecture 38 - Simulation of multitape TMs by basic model. Nondeterministic TM (NDTM). Equivalence of NDTMs with deterministic TMs

Lecture 39 - Counter machines and their equivalence to basic TM model

Lecture 40 - TMs can simulate computers, diagonalization proof

Lecture 41 - Existence of non-r.e. languages, recursive languages, notion of decidability

Lecture 42 - Separation of recursive and r.e. classes, halting problem and its undecidability

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

Lecture 1 - Biometrics

Lecture 2 - Biometrics

Lecture 3 - Biometrics

Lecture 4 - Biometrics

Lecture 5 - Biometrics

Lecture 6 - Biometrics

Lecture 7 - Biometrics

Lecture 8 - Biometrics

Lecture 9 - Biometrics

Lecture 10 - Biometrics

Lecture 11 - Biometrics

Lecture 12 - Biometrics

Lecture 13 - Biometrics

Lecture 14 - Biometrics

Lecture 15 - Biometrics

Lecture 16 - Biometrics

Lecture 17 - Biometrics

Lecture 18 - Biometrics

Lecture 19 - Biometrics

Lecture 20 - Biometrics

Lecture 21 - Biometrics

Lecture 22 - Biometrics

Lecture 23 - Biometrics

Lecture 24 - Biometrics

Lecture 25 - Biometrics

Lecture 26 - Biometrics

[Lecture 1 - Parallel Algorithm](#)

[Lecture 2 - Parallel Algorithm](#)

[Lecture 3 - Parallel Algorithm](#)

[Lecture 4 - Parallel Algorithm](#)

[Lecture 5 - Parallel Algorithm](#)

[Lecture 6 - Parallel Algorithm](#)

[Lecture 7 - Parallel Algorithm](#)

[Lecture 8 - Parallel Algorithm](#)

[Lecture 9 - Parallel Algorithm](#)

[Lecture 10 - Parallel Algorithm](#)

[Lecture 11 - Parallel Algorithm](#)

[Lecture 12 - Parallel Algorithm](#)

[Lecture 13 - Parallel Algorithm](#)

[Lecture 14 - Parallel Algorithm](#)

[Lecture 15 - Parallel Algorithm](#)

[Lecture 16 - Parallel Algorithm](#)

[Lecture 17 - Parallel Algorithm](#)

[Lecture 18 - Parallel Algorithm](#)

[Lecture 19 - Parallel Algorithm](#)

[Lecture 20 - Parallel Algorithm](#)

[Lecture 21 - Parallel Algorithm](#)

[Lecture 22 - Parallel Algorithm](#)

[Lecture 23 - Parallel Algorithm](#)

[Lecture 24 - Parallel Algorithm](#)

[Lecture 25 - Parallel Algorithm](#)

Lecture 1 - Introduction, Amdahl's law, CPI equation

Lecture 2 - CPI equation, research practices, instruction set architecture

Lecture 3 - Instruction set architecture

Lecture 4 - Instruction set architecture

Lecture 5 - Instruction set architecture, case study with MIPS-I

Lecture 6 - Case study with MIPS-I

Lecture 7 - Case study with MIPS-I

Lecture 8 - Binary instrumentation for architectural studies: PIN

Lecture 9 - Binary instrumentation for architectural studies: PIN

Lecture 10 - Basic pipelining, branch prediction

Lecture 11 - Basic pipelining, branch prediction

Lecture 12 - Basic pipelining, branch prediction

Lecture 13 - Basic pipelining, branch prediction

Lecture 14 - Basic pipelining, branch prediction

Lecture 15 - Basic pipelining, branch prediction

Lecture 16 - Basic pipelining, branch prediction

Lecture 17 - Basic pipelining, branch prediction

Lecture 18 - Basic pipelining, branch prediction

Lecture 19 - Basic pipelining, branch prediction

Lecture 20 - Dynamic scheduling, speculative execution

Lecture 21 - Dynamic scheduling, speculative execution

Lecture 22 - Dynamic scheduling, speculative execution

Lecture 23 - Dynamic scheduling, speculative execution

Lecture 24 - Dynamic scheduling, speculative execution

Lecture 25 - Virtual memory and caches

Lecture 26 - Virtual memory and caches

Lecture 27 - Virtual memory and caches

Lecture 28 - Topics in memory system, DRAM and SRAM technology

Lecture 29 - Topics in memory system, DRAM and SRAM technology

Lecture 30 - Topics in memory system, DRAM and SRAM technology

Lecture 31 - Case study: MIPS R10000

[Lecture 32 - Case study: MIPS R10000](#)

[Lecture 33 - Case study: Alpha 21264](#)

[Lecture 34 - Case study: Intel Pentium 4](#)

[Lecture 35 - Input/Output](#)

[Lecture 36 - Simultaneous multithreading, multi-cores](#)

Lecture 1 - Compiler Design

Lecture 2 - Compiler Design

Lecture 3 - Compiler Design

Lecture 4 - Compiler Design

Lecture 5 - Compiler Design

Lecture 6 - Compiler Design

Lecture 7 - Compiler Design

Lecture 8 - Compiler Design

Lecture 9 - Compiler Design

Lecture 10 - Compiler Design

Lecture 11 - Compiler Design

Lecture 12 - Compiler Design

Lecture 13 - Compiler Design

Lecture 14 - Compiler Design

Lecture 15 - Compiler Design

Lecture 16 - Compiler Design

Lecture 17 - Compiler Design

Lecture 18 - Compiler Design

Lecture 19 - Compiler Design

Lecture 20 - Compiler Design

Lecture 21 - Compiler Design

Lecture 22 - Compiler Design

Lecture 23 - Compiler Design

Lecture 24 - Compiler Design

Lecture 25 - Compiler Design

Lecture 26 - Compiler Design

Lecture 27 - Compiler Design

Lecture 28 - Compiler Design

Lecture 29 - Compiler Design

Lecture 30 - Compiler Design

Lecture 1 - Intro - Process of programming

Lecture 2 - Intro - GCD

Lecture 3 - Intro - Programming cycle

Lecture 4 - Intro - Tracing a simple program

Lecture 5 - Intro - Variables

Lecture 6 - Intro - Operators

Lecture 7 - Loops - While

Lecture 8 - Loops - While example

Lecture 9 - Loops - While GCD example

Lecture 10 - Loops - Longest 1

Lecture 11 - Loops - Longest 2

Lecture 12 - Loops - Longest 3

Lecture 13 - Loops - Do-while

Lecture 14 - Loops - Matrix using nested loops

Lecture 15 - Loops - For

Lecture 16 - Loops - Matrix using nested for loops

Lecture 17 - Loops - Break statement

Lecture 18 - Loops - Continue statement

Lecture 19 - Loops - Continue statement example

Lecture 20 - Data types in C

Lecture 21 - ASCII code

Lecture 22 - Operators Expressions Associativity

Lecture 23 - Precedence of operators

Lecture 24 - Expression evaluation

Lecture 25 - Functions - Introduction

Lecture 26 - Functions - How functions are executed

Lecture 27 - Functions - Examples - 1

Lecture 28 - Functions - Examples - 2

Lecture 29 - Arrays in C

Lecture 30 - Initializing arrays

Lecture 31 - Initializing character arrays

[Lecture 32 - Pointers in C](#)

[Lecture 33 - Pointer arithmetic](#)

[Lecture 34 - Function with pointer arguments](#)

[Lecture 35 - Example - copy a subarray](#)

[Lecture 36 - Programming using arrays and pointers](#)

[Lecture 37 - Sizeof operator](#)

[Lecture 38 - Returning pointers from functions](#)

[Lecture 39 - Example - return duplicate of a string](#)

[Lecture 40 - Recursion - Linear Recursion](#)

[Lecture 41 - Recursion - Linear Recursion - 2](#)

[Lecture 42 - Recursion - Two-way Recursion](#)

[Lecture 43 - Multidimensional Arrays](#)

[Lecture 44 - Multidimensional Arrays and Pointers](#)

[Lecture 45 - Multidimensional Arrays and Pointers - continued \(2\)](#)

[Lecture 46 - Multidimensional Arrays and Pointers - continued \(3\)](#)

[Lecture 47 - File Handling](#)

[Lecture 48 - Some other file-handling functions](#)

[Lecture 49 - Structures in C - 1](#)

[Lecture 50 - Structures in C - 2](#)

[Lecture 51 - Singly Linked Lists](#)

[Lecture 52 - Doubly Linked Lists - introduction](#)

[Lecture 53 - Organizing code into multiple files - 1](#)

[Lecture 54 - Organizing code into multiple files - 2](#)

[Lecture 55 - Pre and post increment](#)

[Lecture 56 - Doubly Linked Lists - Introduction](#)

[Lecture 57 - Organizing code into multiple files - 1](#)

[Lecture 58 - Organizing code into multiple files - 2](#)

[Lecture 59 - Pre and post increment operators](#)

Lecture 1 - Introduction to Databases

Lecture 2 - Relational Data Model

Lecture 3 - Relational Algebra Basic Operators

Lecture 4 - Relational Algebra Composition of Operators

Lecture 5 - Relational Algebra Additional Operators

Lecture 6 - Relational Algebra Extended Relational Algebra

Lecture 7 - Relational Algebra: Database Modifications

Lecture 8 - SQL: Introduction and Data Definition

Lecture 9 - SQL: Basic Queries

Lecture 10 - SQL: Advanced Queries

Lecture 11 - SQL: Updates, Joins, Views and Triggers

Lecture 12 - Normalization Theory: Motivation

Lecture 13 - Normalization Theory: 1 NF and 2NF

Lecture 14 - Normalization Theory: 3NF

Lecture 15 - Normalization Theory: BCNF

Lecture 16 - Normalization Theory: MVD

Lecture 17 - Physical Design

Lecture 18 - Database Indexing: Hashing

Lecture 19 - Database Indexing: Tree-based Indexing

Lecture 20 - Query Processing: Selection

Lecture 21 - Query Processing: Sorting

Lecture 22 - Query Processing: Nested-Loop joins and Merge join

Lecture 23 - Query Processing: Hash join and other Operations

Lecture 24 - Query Optimization: Equivalent Expressions and Simple Equivalence Rules

Lecture 25 - Query Optimization: Complex Equivalence Rules

Lecture 26 - Query Optimization: Join Order

Lecture 27 - Query Optimization: Heuristics and Sizes

Lecture 28 - Database Transactions: Properties and Failures

Lecture 29 - Database Transactions: States and Systems

Lecture 30 - Recovery Systems: Deferred Database Modification

Lecture 31 - Recovery Systems: Immediate Database Modification.

[Lecture 32 - Recovery Systems: Checkpointing and Shadow Paging](#)

[Lecture 33 - Schedules: Introduction](#)

[Lecture 34 - Schedules: Conflict Serializability](#)

[Lecture 35 - Schedules: View Serializability](#)

[Lecture 36 - Schedules: Result Equivalence and Testing for Serializability](#)

[Lecture 37 - Schedules: Recoverability](#)

[Lecture 38 - Concurrency Control: Locks](#)

[Lecture 39 - Concurrency Control: Two-phase Locking Protocol](#)

[Lecture 40 - Concurrency Control: Timestamp Ordering Protocol](#)

[Lecture 41 - Concurrency Control: Validation-based Protocol](#)

[Lecture 42 - Concurrency Control: Multiple Granularity for Locks](#)

[Lecture 43 - Concurrency Control: Deadlock Prevention and Deadlock Detection](#)

[Lecture 44 - Concurrency Control: Deadlock Recovery and Update Operations](#)

[Lecture 45 - NoSQL: Introduction and Properties](#)

[Lecture 46 - NoSQL: Columnar Families](#)

[Lecture 47 - NoSQL: Different NoSQL Systems](#)

[Lecture 48 - Big Data](#)

Lecture 1 - Introduction to Finite Automata

Lecture 2 - Basic Notation and Convention, DFA Edit Lesson

Lecture 3 - Example of DFAs

Lecture 4 - Computation by DFA and Regular operation

Lecture 5 - Introduction to Nondeterminism

Lecture 6 - NFA, definition and examples

Lecture 7 - Equivalence of NFA and DFA, Closure properties

Lecture 8 - Regular expressions

Lecture 9 - Algebraic properties, RE to NFA conversion

Lecture 10 - GNFA to RE conversion

Lecture 11 - More closure properties of regular languages

Lecture 12 - Non-regular languages and pumping lemma

Lecture 13 - Examples of non-regular languages

Lecture 14 - DFA minimization

Lecture 15 - Introduction to CFGs

Lecture 16 - Examples of CFGs, Reg subset of CFL

Lecture 17 - Parse tree, derivation, ambiguity

Lecture 18 - Normal forms, Chomsky normal form

Lecture 19 - Non-CFLs, pumping lemma

Lecture 20 - Examples of non- CFLs

Lecture 21 - Pushdown Automata

Lecture 22 - Pushdown Automata - Definition and Example

Lecture 23 - Pushdown Automata - Examples and Relation with CFGs

Lecture 24 - Closure Properties of CFLs

Lecture 25 - Deterministic Context Free Languages

Lecture 26 - Turing Machine

Lecture 27 - More on Turing Machine

Lecture 28 - Non deterministic Turing Machine Edit Lesson

Lecture 29 - Configuration Graphs

Lecture 30 - Closure Properties of Decidable and Turing recognizable languages

Lecture 31 - Decidability properties of Regular and Context Free Languages

[Lecture 32 - Undecidability](#)

[Lecture 33 - More on Undecidability](#)

[Lecture 34 - Reduction](#)

[Lecture 35 - Applications of Reduction](#)

[Lecture 36 - Rice's theorem](#)

[Lecture 37 - Introduction to Computational Complexity Theory](#)

[Lecture 38 - More on the class NP](#)

[Lecture 39 - NP-Completeness](#)

[Lecture 40 - More on NP-Completeness](#)

Lecture 1 - Groups : Introduction to abstraction

Lecture 2 - Groups : Subgroups and homomorphism

Lecture 3 - Groups : Isomorphism

Lecture 4 - Groups : Quotienting

Lecture 5 - Groups : Structure Theorem

Lecture 6 - Groups : Applications

Lecture 7 - Rings : Introduction

Lecture 8 - Rings : Failure of Unique Factorization

Lecture 9 - Rings : Birth of Ideals

Lecture 10 - Rings : Ideal Arithmetic

Lecture 11 - Rings : Special Ideals

Lecture 12 - Rings : Dedekind Domains

Lecture 13 - Rings : Quotient Rings

Lecture 14 - Fields

Lecture 15 - Cauchy sequences and real numbers

Lecture 16 - Properties of Fields

Lecture 17 - Finite Fields

Lecture 18 - Application of Fields

Lecture 1 - Graph Theory: Introduction

Lecture 2 - Paths, Cycles and Trails

Lecture 3 - Eulerian Circuits, Vertex Degrees and Counting

Lecture 4 - The Chinese Postman Problem and Graphic Sequences

Lecture 5 - Trees and Distance

Lecture 6 - Spanning Trees and Enumeration

Lecture 7 - Matchings and Covers

Lecture 8 - Independent Sets, Covers and Maximum Bipartite Matching

Lecture 9 - Weighted Bipartite Matching

Lecture 10 - Stable Matchings and Faster Bipartite Matching

Lecture 11 - Factors and Perfect Matching in General Graphs

Lecture 12 - Matching in General Graphs: Edmonds's Blossom Algorithm

Lecture 13 - Connectivity and Paths: Cuts and Connectivity

Lecture 14 - k-Connected Graphs

Lecture 15 - Network Flow Problems

Lecture 16 - Vertex Coloring and Upper Bounds

Lecture 17 - Brooks's Theorem and Color-Critical Graphs

Lecture 18 - Counting Proper Colorings

Lecture 19 - Planar Graphs

Lecture 20 - Characterization of Planar Graphs

Lecture 21 - Line Graphs and Edge-coloring

Lecture 22 - Hamiltonian Graph, Traveling Salesman Problem and NP-Completeness

Lecture 23 - Connected Dominating Set and Distributed Algorithm

Lecture 1 - Introduction to Cloud Computing

Lecture 2 - Virtualization

Lecture 3 - Hotspot Mitigation for Virtual Machine Migration

Lecture 4 - Server Virtualization

Lecture 5 - Software Defined Network

Lecture 6 - Geo-distributed Cloud Data Centers

Lecture 7 - Leader Election in Rings (Classical Distributed Algorithms)

Lecture 8 - Leader Election (Ring LE and Bully LE Algorithm)

Lecture 9 - Design of Zookeeper

Lecture 10 - Time and Clock Synchronization in Cloud Data Centers

Lecture 11 - Global State and Snapshot Recording Algorithms

Lecture 12 - Distributed Mutual Exclusion

Lecture 13 - Consensus in Cloud Computing and Paxos

Lecture 14 - Byzantine Agreement

Lecture 15 - Failures and Recovery Approaches in Distributed Systems

Lecture 16 - Design of Key-Value Stores

Lecture 17 - Design of HBase

Lecture 18 - Peer to Peer Systems in Cloud Computing

Lecture 19 - MapReduce

Lecture 20 - Introduction to Spark

Lecture 21 - Introduction to Kafka

Lecture 1 - Introduction to Big Data

Lecture 2 - Big Data Enabling Technologies

Lecture 3 - Hadoop Stack for Big Data

Lecture 4 - Hadoop Distributed File System (HDFS)

Lecture 5 - Hadoop MapReduce 1.0

Lecture 6 - Hadoop MapReduce 2.0 - Part I

Lecture 7 - Hadoop MapReduce 2.0 - Part II

Lecture 8 - MapReduce Examples

Lecture 9 - Parallel Programming with Spark

Lecture 10 - Introduction to Spark

Lecture 11 - Spark Built-in Libraries

Lecture 12 - Design of Key-Value Stores

Lecture 13 - Data Placement Strategies

Lecture 14 - CAP Theorem

Lecture 15 - Consistency Solutions

Lecture 16 - Design of Zookeeper

Lecture 17 - CQL (Cassandra Query Language)

Lecture 18 - Design of HBase

Lecture 19 - Spark Streaming and Sliding Window Analytics - Part I

Lecture 20 - Spark Streaming and Sliding Window Analytics - Part II

Lecture 21 - Sliding Window Analytics

Lecture 22 - Introduction to Kafka

Lecture 23 - Big Data Machine Learning - Part I

Lecture 24 - Big Data Machine Learning - Part II

Lecture 25 - Machine Learning Algorithm K-means using Map Reduce for Big Data Analytics

Lecture 26 - Parallel K-means using Map Reduce on Big Data Cluster Analysis

Lecture 27 - Decision Trees for Big Data Analytics

Lecture 28 - Big Data Predictive Analytics - Part I

Lecture 29 - Big Data Predictive Analytics - Part II

Lecture 30 - Parameter Servers

Lecture 31 - PageRank Algorithm in Big Data

[Lecture 32 - Spark GraphX and Graph Analytics - Part I](#)

[Lecture 33 - Spark GraphX and Graph Analytics - Part II](#)

[Lecture 34 - Case Study: Flight Data Analysis using Spark GraphX](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

Lecture 1 - Turing Machines and Introduction to Arithmetic Circuits

Lecture 2 - Arithmetic complexity classes

Lecture 3 - Determinant is in VP

Lecture 4 - Determinant vs Arithmetic Branching Programs (ABP)

Lecture 5 - Determinant as signed sum of cflow sequence

Lecture 6 - Determinant has small ABP and Strassen's homogenization

Lecture 7 - Depth reduction for arithmetic formulas

Lecture 8 - Depth reduction for arithmetic circuits

Lecture 9 - Depth 4 reduction

Lecture 10 - Depth 3 reduction

Lecture 11 - Equivalence of Formulas and Width 3 ABP

Lecture 12 - Width-2 ABP Chasm

Lecture 13 - Grigoriev-Karpinski Measure

Lecture 14 - Lower Bound of Depth-3 circuit over finite fields

Lecture 15 - Lower Bound for depth 3 Multilinear Circuits

Lecture 16 - Lower Bound for Constant depth Multilinear Circuits

Lecture 17 - Structural lemma for constant depth multilinear circuits

Lecture 18 - Extending the proof for multilinear formulas

Lecture 19 - Shifted Partial Derivative Measure

Lecture 20 - Exponential Lower Bound for General depth-4 Circuits

Lecture 21 - Lower Bound on Homogeneous Depth-4 circuits

Lecture 22 - Introduction to PIT

Lecture 23 - Hitting Set and Hitting Set Generator

Lecture 24 - PIT vs Lower Bounds

Lecture 1 - Introduction

Lecture 2 - NP Completeness

Lecture 3 - SAT is NP-complete

Lecture 4 - More on NP completeness

Lecture 5 - Hierarchy Theorems

Lecture 6 - Introduction to Space Complexity

Lecture 7 - Savitch's Theorem

Lecture 8 - Immerman-Szelepcsenyi Theorem

Lecture 9 - Polynomial Hierarchy

Lecture 10 - A PSPACE Complete Problem

Lecture 11 - More on Polynomial Hierarchy

Lecture 12 - Alternating Turing Machines

Lecture 13 - Equivalence of Quantifier and Oracle Based Definitions of Polynomial Hierarchy

Lecture 14 - Boolean Circuits

Lecture 15 - Shannon's Theorem and Karp-Lipton-Sipser Theorem

Lecture 16 - Bounded Depth Circuit Classes

Lecture 17 - Kannan's Theorem

Lecture 18 - Probabilistic Complexity

Lecture 19 - StrongBPP and WeakBPP

Lecture 20 - One-sided and Zero-sided Error Probabilistic Complexity Classes

Lecture 21 - Error Reduction for BPP

Lecture 22 - BPP in PH and Logspace Randomized Classes

Lecture 23 - Valiant-Vazirani Theorem - I

Lecture 24 - Valiant-Vazirani Theorem - II

Lecture 25 - Amplified version of Valiant-Vazirani Theorem

Lecture 26 - Toda's Theorem - I

Lecture 27 - Toda's Theorem - II

Lecture 28 - Permanent and Determinant Functions

Lecture 29 - Permanent is hard for #P

Lecture 30 - Interactive Proofs

Lecture 31 - Graph Non-Isomorphism is in IP[2]

[Lecture 32 - Set Lower Bound Protocol](#)

[Lecture 33 - MA is in AM](#)

[Lecture 34 - Sumcheck Protocol - I](#)

[Lecture 35 - Sumcheck Protocol - II](#)

[Lecture 36 - Parity not in AC0 - I](#)

[Lecture 37 - Parity not in AC0 - II](#)

[Lecture 38 - Circuits with Counters](#)

[Lecture 39 - Communication Complexity - I](#)

[Lecture 40 - PCP Theorem](#)

[Lecture 41 - Communication Complexity - II](#)

Lecture 1 - Course Outline

Lecture 2 - Circuits and Polynomial Identity Testing

Lecture 3 - Derandomization and Lower Bounds

Lecture 4 - $IP=PSPACE$

Lecture 5 - ACC0 Lower Bounds

Lecture 6 - ACC0 Lower Bounds (Continued...)

Lecture 7 - Monotone Circuits

Lecture 8 - Monotone Circuit Lower Bound and Sunflower Lemma

Lecture 9 - Undirected Graph Connectivity in randomized logspace

Lecture 10 - Graph Expansion Properties

Lecture 11 - Expanders

Lecture 12 - Error Reduction using Expanders

Lecture 13 - Ajtai-Komlos-Szemerédi Theorem

Lecture 14 - Explicit construction of expanders and Zig-Zag product

Lecture 15 - Spectral analysis of Zig-Zag product

Lecture 16 - Undirected Path in logspace

Lecture 17 - Explicit Prg to derandomizing classes

Lecture 18 - Hardness vs Randomness

Lecture 19 - Hardness to NW-Generator to PRG

Lecture 20 - Partial derandomization from worst-case hardness of permanent

Lecture 21 - Error-correcting codes

Lecture 22 - Introduction to various linear explicit codes

Lecture 23 - Introduction of efficient decoding

Lecture 24 - Local decoding of WH, Reed-Muller and Concatenated codes

Lecture 25 - Introduction to List Decoding

Lecture 26 - Local List decoding of WH, RM

- Lecture 1 - Introductory examples
- Lecture 2 - Examples and Course outline
- Lecture 3 - Probability over discrete space
- Lecture 4 - Inclusion-Exclusion principle
- Lecture 5 - Probability over infinite space
- Lecture 6 - Conditional probability, Partition formula
- Lecture 7 - Independent events, Bayes theorem
- Lecture 8 - Fallacies, Random variables
- Lecture 9 - Expectation
- Lecture 10 - Conditional Expectation
- Lecture 11 - Important Random Variables
- Lecture 12 - Continuous Random Variables
- Lecture 13 - Equality Checking, Poisson Distribution
- Lecture 14 - Concentration Inequalities, Variance
- Lecture 15 - Weak Linearity of Variance, Law of Large Numbers
- Lecture 16 - Chernoff's Bound. K-wise Independence
- Lecture 17 - Union and Factorial Estimates
- Lecture 18 - Stochastic Process: Markov Chains
- Lecture 19 - Drunkard's walk, Evolution of Markov Chains
- Lecture 20 - Stationary Distribution
- Lecture 21 - Perron-Frobenius Theorem, Page Rank Algorithm
- Lecture 22 - Page Rank Algorithm: Ergodicity
- Lecture 23 - Cell Genetics
- Lecture 24 - Random Sampling
- Lecture 25 - Biased Coin Tosses, Hashing
- Lecture 26 - Hashing, Introduction to Probabilistic Methods
- Lecture 27 - Ramsey Numbers, Large Cuts in Graphs
- Lecture 28 - Sum Free Subsets, Discrepancy
- Lecture 29 - Extremal Set Families
- Lecture 30 - Super Concentrators
- Lecture 31 - Streaming Algorithms - I

Lecture 1 - Introduction

Lecture 2 - Standard Bounds

Lecture 3 - Shannon's Theorem

Lecture 4 - Riordon-Shannon Theorem

Lecture 5 - Khrapchenko's Theorem

Lecture 6 - Proof of Khrapchenko's Theorem

Lecture 7 - Application of Khrapchenko's Theorem

Lecture 8 - Nechiporuk's Theorem

Lecture 9 - Application of Nechiporuk's Theorem

Lecture 10 - Subbotovskaya's Theorem - I

Lecture 11 - Subbotovskaya's Theorem - II

Lecture 12 - Applications of Subbotovskaya's Theorem

Lecture 13 - Upper and Lower Bounds on the Andreev Function

Lecture 14 - Upper and Lower Bounds on the Andreev Function

Lecture 15 - Polynomial Size Monotone Formula for MAJORITY (Valiant's Theorem) - II

Lecture 16 - Circuits for Addition - Ripple Adder and Carry Lookahead Adder

Lecture 17 - Circuits for Addition - Parallel Prefix Sum Method

Lecture 18 - Circuits for Iterated Addition and Multiplication

Lecture 19 - Bounded Depth Circuit Classes

Lecture 20 - Basic Circuit for Division using Newton-Raphson Method

Lecture 21 - Division in NC1 (Beame, Cook, Hoover Theorem) - I

Lecture 22 - Division in NC1 (Beame, Cook, Hoover Theorem) - II

Lecture 23 - Division in NC1 (Beame, Cook, Hoover Theorem) - III

Lecture 24 - Division in NC1 (Beame, Cook, Hoover Theorem) - IV

Lecture 25 - Division in NC1 (Beame, Cook, Hoover Theorem) - V

Lecture 26 - Division in NC1 (Beame, Cook, Hoover Theorem) - VI

Lecture 27 - Relation between Bounded Depth Circuit Classes and Uniform Complexity Classes - I

Lecture 28 - Relation between Bounded Depth Circuit Classes and Uniform Complexity Classes - II

Lecture 29 - Reducing Circuit Depth

Lecture 30 - P is in P/poly

Lecture 31 - Discussion on Lower Circuit Bounds for Bounded Depth Circuit Classes

- Lecture 32 - Monotone Circuit Lower Bound for Clique (Razborov's Theorem) - I
- Lecture 33 - Monotone Circuit Lower Bound for Clique (Razborov's Theorem) - II
- Lecture 34 - Monotone Circuit Lower Bound for Clique (Razborov's Theorem) - III
- Lecture 35 - Monotone Circuit Lower Bound for Clique (Razborov's Theorem) - IV
- Lecture 36 - Monotone Circuit Lower Bound for Clique (Razborov's Theorem) - V
- Lecture 37 - Monotone Circuit Lower Bound for Clique (Razborov's Theorem) - VI
- Lecture 38 - Circuit Lower Bound for Parity by Approximating Circuits using Polynomials (Razborov-Smolensky Theorem) - I
- Lecture 39 - Circuit Lower Bound for Parity by Approximating Circuits using Polynomials (Razborov-Smolensky Theorem) - II
- Lecture 40 - Circuit Lower Bound for Parity by Approximating Circuits using Polynomials (Razborov-Smolensky Theorem) - III
- Lecture 41 - Circuit Lower Bound for Parity using Switching Lemma (Hastad's Theorem)
- Lecture 42 - Circuit Lower Bound for Parity using Switching Lemma (Hastad's Theorem)
- Lecture 43 - Circuit Lower Bound for Parity using Switching Lemma (Hastad's Theorem)
- Lecture 44 - Proof of Hastad's Switching Lemma - I
- Lecture 45 - Proof of Hastad's Switching Lemma - II
- Lecture 46 - Communication Complexity of a Function
- Lecture 47 - Relation Between Communication Complexity and Circuit Depth (Karchmer-Wigderson Theorem) - I
- Lecture 48 - Relation Between Communication Complexity and Circuit Depth (Karchmer-Wigderson Theorem) - II
- Lecture 49 - Bounded Width Branching Programs = NC1 (Barrington's Theorem) - I
- Lecture 50 - Bounded Width Branching Programs = NC1 (Barrington's Theorem) - II
- Lecture 51 - Width 3 Branching Programs = MOD3 o MOD2 Circuits (Barrington's Theorem) - I
- Lecture 52 - Width 3 Branching Programs = MOD3 o MOD2 Circuits (Barrington's Theorem) - II
- Lecture 53 - Uniform AC0 can be simulated by depth 3 Threshold circuits of quasipolynomial size (Allender-Hertramph Theorem) - I
- Lecture 54 - Uniform AC0 can be simulated by depth 3 Threshold circuits of quasipolynomial size (Allender-Hertramph Theorem) - II
- Lecture 55 - Valient-Vazirani Theorem - I
- Lecture 56 - Valient-Vazirani Theorem - II
- Lecture 57 - Natural Proof Barrier (Razborov-Rudich Theorem) - I
- Lecture 58 - Natural Proof Barrier (Razborov-Rudich Theorem) - II
- Lecture 59 - Pseudorandom Function Generator by Goldreich, Goldwasser and Micali - I
- Lecture 60 - Pseudorandom Function Generator by Goldreich, Goldwasser and Micali - II

Lecture 1 - Introduction to Edge Computing

Lecture 2 - Introduction to Cloud

Lecture 3 - Introduction to IoT Platform

Lecture 4 - Time and Clock Synchronization in IoT

Lecture 5 - Enabling Intelligence at Edge Layer for IoT

Lecture 6 - ML-based Image Classifier at IoT-Edge

Lecture 7 - Introduction to Docker Containers and Kubernetes

Lecture 8 - ML based Predictive Maintenance at IoT Edge

Lecture 9 - Deep Reinforcement Learning for Cloud Edge

Lecture 10 - Deep Reinforcement Learning for Cloud Edge Example

Lecture 11 - Public Cloud Services Case Study of AWS Services

Lecture 12 - Mathematical formulations for task offloading in Edge Cloud

Lecture 13 - Task Offloading Based on LSTM Prediction and Deep Reinforcement Learning

Lecture 14 - Vertical and Horizontal Offloading for Cloud Edge

Lecture 15 - Global State and Snapshot Recording Algorithms

Lecture 16 - Hot Data Analytics for Real Time Streaming in IoT Platform

Lecture 17 - Introduction to MQTT and Kafka in IoT Platform

Lecture 18 - Introduction to Edge Data Center for IoT Platform

Lecture 19 - Design of Key Value Stores for IoT Edge Storage

Lecture 20 - Introduction to Edge ML with AWS IoT platform

Lecture 21 - Introduction to Federated Learning at IoT Edge

Lecture 22 - ML for Autonomous Driving Car

Lecture 1 - Introduction

Lecture 2 - Overview on Modern Cryptography

Lecture 3 - Introduction to Number Theory

Lecture 4 - Probability and Information Theory

Lecture 5 - Classical Cryptosystems

Lecture 6 - Cryptanalysis of Classical Ciphers

Lecture 7 - Shannons Theory

Lecture 8 - Shannons Theory (Continued...1)

Lecture 9 - Shannons Theory (Continued...2)

Lecture 10 - Symmetric Key Ciphers

Lecture 11 - Block Cipher Standards (DES)

Lecture 12 - Block Cipher Standards (AES)

Lecture 13 - Block Cipher Standards (AES) (Continued...)

Lecture 14 - Linear Cryptanalysis

Lecture 15 - Differential Cryptanalysis

Lecture 16 - Few other Cryptanalytic Techniques

Lecture 17 - Overview on S-Box Design Principles

Lecture 18 - Modes of Operation of Block Ciphers

Lecture 19 - Stream Ciphers

Lecture 20 - Stream Ciphers (Continued...1)

Lecture 21 - Stream Ciphers (Continued...2)

Lecture 22 - Pseudorandomness

Lecture 23 - Cryptographic Hash Functions

Lecture 24 - Cryptographic Hash Functions (Continued...1)

Lecture 25 - Cryptographic Hash Functions (Continued...2)

Lecture 26 - Message Authentication Codes

Lecture 27 - More Number Theoretic Results

Lecture 28 - The RSA Cryptosystem

Lecture 29 - Primality Testing

Lecture 30 - Factoring Algorithms

Lecture 31 - Some Comments on the Security of RSA

[Lecture 32 - Discrete Logarithm Problem \(DLP\)](#)

[Lecture 33 - The Diffie-Hellman Problem and Security of ElGamal Systems](#)

[Lecture 34 - An Introduction to Elliptic Curve Cryptography](#)

[Lecture 35 - Application of Elliptic Curves to Cryptography](#)

[Lecture 36 - Implementation of Elliptic Curve Cryptography](#)

[Lecture 37 - Secret Sharing Schemes](#)

[Lecture 38 - A Tutorial on Network Protocols](#)

[Lecture 39 - System Security](#)

[Lecture 40 - Firewalls and Intrusion Detection Systems](#)

[Lecture 41 - Side Channel Analysis of Cryptographic Implementations](#)

[Lecture 1 - Introduction & Course Outline](#)

[Lecture 2 - Performance](#)

[Lecture 3 - Instruction Set Architecture](#)

[Lecture 4 - MIPS ISA and Processor](#)

[Lecture 5 - MIPS ISA and Processor \(Continued...\)](#)

[Lecture 6 - Pipelining - Introduction](#)

[Lecture 7 - Instruction Pipelining](#)

[Lecture 8 - Pipeline Hazards](#)

[Lecture 9 - Data Hazards](#)

[Lecture 10 - Software Pipelining](#)

[Lecture 11 - In Quest of Higher ILP](#)

[Lecture 12 - In Quest of Higher ILP \(Continued...\)](#)

[Lecture 13 - Dynamic Instruction Scheduling](#)

[Lecture 14 - Dynamic Instruction Scheduling \(Continued...\)](#)

[Lecture 15 - Control Hazards](#)

[Lecture 16 - Branch Prediction](#)

[Lecture 17 - Branch Prediction \(Continued...\)](#)

[Lecture 18 - Dynamic Instruction Scheduling with Branch Prediction](#)

[Lecture 19 - Hardware-based Speculation](#)

[Lecture 20 - Tutorial - I](#)

[Lecture 21 - Hierarchical Memory Organization](#)

[Lecture 22 - Hierarchical Memory Organization \(Continued...1\)](#)

[Lecture 23 - Hierarchical Memory Organization \(Continued...2\)](#)

[Lecture 24 - Hierarchical Memory Organization \(Continued...3\)](#)

[Lecture 25 - Cache Optimization Techniques \(Continued...1\)](#)

[Lecture 26 - Cache Optimization Techniques \(Continued...2\)](#)

[Lecture 27 - Main Memory Organization](#)

[Lecture 28 - Main Memory Optimizations](#)

[Lecture 29 - Virtual Memory](#)

[Lecture 30 - Virtual Memory \(Continued...\)](#)

[Lecture 31 - Virtual Machines](#)

[Lecture 32 - Storage Technology](#)

[Lecture 33 - Storage Technology \(Continued...\)](#)

[Lecture 34 - Case Studies](#)

[Lecture 35 - Case Studies \(Continued...1\)](#)

[Lecture 36 - Case Studies \(Continued...2\)](#)

[Lecture 37 - Multithreading & Multiprocessing](#)

[Lecture 38 - Simultaneous Multithreading](#)

[Lecture 39 - Symmetric Multiprocessors](#)

[Lecture 40 - Distributed Memory Multiprocessors](#)

[Lecture 41 - Cluster, Grid and Cloud Computing](#)

Lecture 1 - Introduction & Course Outline

Lecture 2 - MOS Transistors - I

Lecture 3 - MOS Transistors - II

Lecture 4 - MOS Transistors - III

Lecture 5 - MOS Transistors - IV

Lecture 6 - MOS Inverters - I

Lecture 7 - MOS Inverters - II

Lecture 8 - MOS Inverters - III

Lecture 9 - MOS Inverters - IV

Lecture 10 - Static CMOS Circuits - I

Lecture 11 - Static CMOS Circuits - II

Lecture 12 - MOS Dynamic Circuits - I

Lecture 13 - MOS Dynamic Circuits - II

Lecture 14 - Pass Transistor Logic Circuits - I

Lecture 15 - Pass Transistor Logic Circuits - II

Lecture 16 - MOS Memories

Lecture 17 - Finite State Machines

Lecture 18 - Switching Power Dissipation

Lecture 19 - Tutorial - I

Lecture 20 - Dynamic Power Dissipation

Lecture 21 - Leakage Power Dissipation

Lecture 22 - Supply Voltage Scaling - I

Lecture 23 - Supply Voltage Scaling - II

Lecture 24 - Supply Voltage Scaling - III

Lecture 25 - Supply Voltage Scaling - IV

Lecture 26 - Tutorial - II

Lecture 27 - Minimizing Switched Capacitance - I

Lecture 28 - Minimizing Switched Capacitance - II

Lecture 29 - Minimizing Switched Capacitance - III

Lecture 30 - Minimizing Switched Capacitance - IV

Lecture 31 - Minimizing Switched Capacitance - V

[Lecture 32 - Minimizing Leakage Power - I](#)

[Lecture 33 - Minimizing Leakage Power - II](#)

[Lecture 34 - Minimizing Leakage Power - III](#)

[Lecture 35 - Variation Tolerant Design](#)

[Lecture 36 - Adiabatic Logic Circuits](#)

[Lecture 37 - Battery-Driven System Design](#)

[Lecture 38 - CAD Tools for Low Power](#)

[Lecture 39 - Tutorial - III](#)

[Lecture 40 - Course Summary](#)

Lecture 1 - Introduction

Lecture 2 - Real - Time System Characteristics

Lecture 3 - Few Basic Issues

Lecture 4 - Modelling Timing Constraints

Lecture 5 - Modelling Timing Constraints (Continued.)

Lecture 6 - Basics of Real - Time Task Scheduling

Lecture 7 - Cyclic Scheduler

Lecture 8 - Event - Driven Scheduling

Lecture 9 - Rate Monotonic Scheduler

Lecture 10 - RMA Scheduling : Further Issues

Lecture 11 - Deadline Monotonic Scheduling and Other Issues

Lecture 12 - Few Issues in Use of RMA

Lecture 13 - Resource Sharing Among Real-Time Tasks

Lecture 14 - Highest Locker and Priority Ceiling Protocols

Lecture 15 - An Analysis of Priority Ceiling Protocol

Lecture 16 - Handling Task Dependencies

Lecture 17 - Real-Time Task Scheduling on Multiprocessors and Distributed Systems

Lecture 18 - Real-Time Task Scheduling on Multiprocessors and Distributed Systems (Continued.)

Lecture 19 - Clock Synchronization in Distributed Real-Time Systems

Lecture 20 - Internal Clock Synchronization in Presence of Byzantine Clocks

Lecture 21 - A Few Basic Issues in Real-Time Operating Systems

Lecture 22 - Tutorial - I

Lecture 23 - A Few Basic Issues in Real-Time Operating Systems (Continued.)

Lecture 24 - Unix and Windows as RTOS

Lecture 25 - Real - Time POSIX

Lecture 26 - Real - Time POSIX (Continued.)

Lecture 27 - Open Source and Commercial RTOS

Lecture 28 - Open Source and Commercial RTOS (Continued.)

Lecture 29 - Benchmarking Real - Time Computer & Operating Systems

Lecture 30 - Benchmarking Real - Time Computer & Operating Systems (Continued.)

Lecture 31 - Real - Time Communications

[Lecture 32 - Few Basic Issues in Real - Time Communications](#)

[Lecture 33 - Review of Computer Networking](#)

[Lecture 34 - Real - Time Communication in a LAN](#)

[Lecture 35 - Real - Time Communication in a LAN \(Continued.\)](#)

[Lecture 36 - Performance of Two Real -Time Communication Protocols](#)

[Lecture 37 - Real - Time Communication over Packet Switched Networks](#)

[Lecture 38 - Real - Time Communication over Packet Switched Networks \(Continued.\)](#)

[Lecture 39 - Real - Time Communication over Packet Switched Networks \(Continued.\)](#)

[Lecture 40 - Real - Time Databases](#)

Lecture 1 - Introduction to Artificial Intelligence

Lecture 2 - Intelligent Agents

Lecture 3 - State Space Search

Lecture 4 - Uninformed Search

Lecture 5 - Informed Search

Lecture 6 - Informed Search - 2

Lecture 7 - Two Players Games - I

Lecture 8 - Two Players Games - II

Lecture 9 - Constraint Satisfaction Problems - 1

Lecture 10 - Constraint Satisfaction Problems - 2

Lecture 11 - Knowledge Representation and Logic

Lecture 12 - Interface in Propositional Logic

Lecture 13 - First Order Logic

Lecture 14 - Reasoning Using First Order Logic

Lecture 15 - Resolution in FOPL

Lecture 16 - Rule Based System

Lecture 17 - Rule Based Systems II

Lecture 18 - Semantic Net

Lecture 19 - Reasoning in Semantic Net

Lecture 20 - Frames

Lecture 21 - Planning - 1

Lecture 22 - Planning - 2

Lecture 23 - Planning - 3

Lecture 24 - Planning - 4

Lecture 25 - Rule Based Expert System

Lecture 26 - Reasoning with Uncertainty - I

Lecture 27 - Reasoning with Uncertainty - II

Lecture 28 - Reasoning with Uncertainty - III

Lecture 29 - Reasoning with Uncertainty - IV

Lecture 30 - Fuzzy Reasoning - I

Lecture 31 - Fuzzy Reasoning - II

[Lecture 32 - Introduction to Learning - I](#)

[Lecture 33 - Introduction to Learning - II](#)

[Lecture 34 - Rule Induction and Decision Trees - I](#)

[Lecture 35 - Rule Induction and Decision Trees - II](#)

[Lecture 36 - Learning Using neural Networks - I](#)

[Lecture 37 - Learning Using Neural Networks - II](#)

[Lecture 38 - Probabilistic Learning](#)

[Lecture 39 - Natural Language Processing - I](#)

[Lecture 40 - Natural Language Processing - II](#)

- Lecture 1 - Introduction to Artificial Intelligence
- Lecture 2 - Problem Solving by Search
- Lecture 3 - Searching with Costs
- Lecture 4 - Informed State Space Search
- Lecture 5 - Heuristic Search: A* and Beyond
- Lecture 6 - Problem Reduction Search: AND/OR Graphs
- Lecture 7 - Searching Game Trees
- Lecture 8 - Knowledge Based Systems: Logic and Deduction
- Lecture 9 - First Order Logic
- Lecture 10 - Inference in First Order Logic
- Lecture 11 - Resolution - Refutation Proofs
- Lecture 12 - Resolution Refutation Proofs
- Lecture 13 - Logic Programming : Prolog
- Lecture 14 - Prolog Programming
- Lecture 15 - Prolog: Exercising Control
- Lecture 16 - Additional Topics
- Lecture 17 - Introduction to Planning
- Lecture 18 - Partial Order Planning
- Lecture 19 - GraphPLAN and SATPlan
- Lecture 20 - SATPlan
- Lecture 21 - Reasoning under uncertainty
- Lecture 22 - Bayesian Networks
- Lecture 23 - Reasoning with Bayes Networks
- Lecture 24 - Reasoning with Bayes networks (Contd.)
- Lecture 25 - Reasoning under uncertainty: Issues
- Lecture 26 - Learning : Decision Trees
- Lecture 27 - Learning : Neural Networks
- Lecture 28 - Back Propagation Learning

Lecture 1 - Emergence of Networks & Reference Models

Lecture 2 - Network Topology

Lecture 3 - Physical Medium - I

Lecture 4 - Physical Medium - II

Lecture 5 - Multiplexing (Sharing a Medium)

Lecture 6 - Telecom Networks

Lecture 7 - Switches - I

Lecture 8 - Pocket Switches

Lecture 9 - SONET/SDH

Lecture 10 - Fiber Optic Components

Lecture 11 - Routing and Wavelength Assignment

Lecture 12 - Protection and Restoration

Lecture 13 - Multiple Access

Lecture 14 - Token Based Mac

Lecture 15 - Data Link Protocols

Lecture 16 - Error Control

Lecture 17 - Stop & Wait Protocol

Lecture 18 - Satellite Communication

Lecture 19 - Ethernet - CSMA/CD

Lecture 20 - Modern Ethernet

Lecture 21 - Local Internetworking

Lecture 22 - Cellular Networks

Lecture 23 - Wireless Network

Lecture 24 - ATM : Asynchronous Transfer Mode

Lecture 25 - ATM Signaling, Routing and LAN Emulation

Lecture 26 - Introduction to Routing

Lecture 27 - RIP - Distance Vector Routing

Lecture 28 - IP version 4

Lecture 29 - IP Version 6 & Mobile IP

Lecture 30 - UDP & Client Server

Lecture 31 - TCP

[Lecture 32 - IP Multicasting](#)

[Lecture 33 - DHCP and ICMP](#)

[Lecture 34 - DNS & Directory](#)

[Lecture 35 - Congestion Control](#)

[Lecture 36 - QOS & Multimedia](#)

[Lecture 37 - Network Management](#)

[Lecture 38 - Security](#)

[Lecture 39 - FTP - SMTP](#)

[Lecture 40 - HTTP](#)

Lecture 1 - Introduction and Course Outline - Data Communication

Lecture 2 - Layered Architecture

Lecture 3 - Data and Signal

Lecture 4 - Transmission Impairments and Channel Capacity

Lecture 5 - Guided Transmission Media

Lecture 6 - Unguided Media

Lecture 7 - Transmission of Digital Signal - I

Lecture 8 - Transmission of Digital Signal - II

Lecture 9 - Transmission of Analog Signal - I

Lecture 10 - Transmission of Analog Signal - II

Lecture 11 - Multiplexing

Lecture 12 - Multiplexing

Lecture 13 - Multiplexing Applications - I

Lecture 14 - Multiplexing Applications - II

Lecture 15 - Interfacing to the Media

Lecture 16 - Error Detection and Correction

Lecture 17 - Flow and Error Control

Lecture 18 - Data Link Control

Lecture 19 - Switching Techniques Circuit Switching

Lecture 20 - Switching Techniques Packet Switching

Lecture 21 - Routing - I

Lecture 22 - Routing - II

Lecture 23 - Congestion Control

Lecture 24 - X.25 and Frame Relay

Lecture 25 - ATM

Lecture 26 - Medium Access Control - I

Lecture 27 - Medium Access Control - II

Lecture 28 - Medium Access Control - III

Lecture 29 - IEEE 802 LANs

Lecture 30 - High Speed LANs

Lecture 31 - Wireless LANs

[Lecture 32 - Cellular Telephone Systems](#)

[Lecture 33 - Satellite Communications](#)

[Lecture 34 - Internet and Internetworking](#)

[Lecture 35 - TCP/IP - I](#)

[Lecture 36 - TCP/IP - II](#)

[Lecture 37 - Multimedia Networks](#)

[Lecture 38 - Audio and Video Compression](#)

[Lecture 39 - Multimedia Services](#)

[Lecture 40 - Secured Communication - I](#)

[Lecture 41 - Secured Communication - II](#)

Lecture 1 - Introduction

Lecture 2 - Verilog : Part - I

Lecture 3 - Verilog : Part - II

Lecture 4 - Verilog : Part - III

Lecture 5 - Verilog : Part - IV

Lecture 6 - Verilog : Part - V

Lecture 7 - Verilog : Part - VI

Lecture 8 - Synthesis : Part - I

Lecture 9 - Synthesis : Part - II

Lecture 10 - Synthesis : Part - III

Lecture 11 - Synthesis : Part - IV

Lecture 12 - Synthesis : Part - V

Lecture 13 - Synthesis : Part - VI

Lecture 14 - Synthesis : Part - VII

Lecture 15 - Backend Design : Part - I

Lecture 16 - Backend Design : Part - II

Lecture 17 - Backend Design : Part - III

Lecture 18 - Backend Design : Part - IV

Lecture 19 - Backend Design : Part - V

Lecture 20 - Backend Design : Part - VI

Lecture 21 - Backend Design : Part - VII

Lecture 22 - Backend Design : Part - VIII

Lecture 23 - Backend Design : Part - IX

Lecture 24 - Backend Design : Part - X

Lecture 25 - Backend Design : Part - XI

Lecture 26 - Backend Design : Part - XII

Lecture 27 - Backend Design : Part - XIII

Lecture 28 - Backend Design : Part - XIV

Lecture 29 - Backend Design : Part - XV

Lecture 30 - Testing Part - I

Lecture 31 - Testing Part - II

[Lecture 32 - Testing Part - III](#)

[Lecture 33 - Testing Part - IV](#)

[Lecture 34 - Testing Part - V](#)

[Lecture 35 - Testing Part - VI](#)

- Lecture 1 - Introduction To Internet
- Lecture 2 - Review Of Network Technologies
- Lecture 3 - TCP/IP - Part-I
- Lecture 4 - TCP/IP - Part-II
- Lecture 5 - TCP/IP - Part-III
- Lecture 6 - IP Subnetting and Addressing
- Lecture 7 - Internet Routing Protocol - Part-I
- Lecture 8 - Internet Routing Protocol - Part-II
- Lecture 9 - Client Server Concepts DNS, Telnet, FTP
- Lecture 10 - Electronic Mail
- Lecture 11 - World Wide Web - Part-I
- Lecture 12 - World Wide Web - Part-II
- Lecture 13 - HTML : Part-I
- Lecture 14 - HTML : Part-II
- Lecture 15 - HTML : Part-III
- Lecture 16 - Extensible Markup Language (XML)
- Lecture 17 - HTML Forms
- Lecture 18 - Image Maps
- Lecture 19 - CGI Scripts
- Lecture 20 - Other Technologies
- Lecture 21 - PERL - Part-I
- Lecture 22 - PERL - Part II
- Lecture 23 - PERL - Part III
- Lecture 24 - PERL - Part IV
- Lecture 25 - Javascript : Part-I
- Lecture 26 - Javascript Examples (Continued)
- Lecture 27 - Using Cookies
- Lecture 28 - Java Applets : Part-I
- Lecture 29 - Java Applets : Part-II
- Lecture 30 - Client-Server Programming In Java
- Lecture 31 - Intranet, Extranet, Firewall

[Lecture 32 - Basic Cryptographic Concepts Part - I](#)

[Lecture 33 - Basic Cryptographic Concepts Part - II](#)

[Lecture 34 - Basic Cryptographic Concepts Part - III](#)

[Lecture 35 - Electronic Commerce](#)

[Lecture 36 - Streaming Multimedia Applications](#)

[Lecture 37 - Internet Telephony](#)

[Lecture 38 - Search Engine And Web Crawlers : Part-I](#)

[Lecture 39 - Search Engine And Web Crawlers : Part-II](#)

[Lecture 40 - Course Summary And Conclusion](#)

Lecture 1 - Introduction

Lecture 2 - C Programming - I

Lecture 3 - C Programming - II

Lecture 4 - C Programming - III

Lecture 5 - Data Structuring : Case Study - I

Lecture 6 - Data Structuring : Case Study - II

Lecture 7 - Data Structuring : Case Study - III

Lecture 8 - Problem Decomposition By Recursion - I

Lecture 9 - Problem Decomposition By Recursion - II

Lecture 10 - Problem Decomposition By Recursion - III

Lecture 11 - Merge sort And Quick sort

Lecture 12 - Characters And Strings

Lecture 13 - Arrays: Addresses And Contents

Lecture 14 - Structures - I

Lecture 15 - Structures - II

Lecture 16 - Dynamic Allocation Part - I

Lecture 17 - Linked Lists - I

Lecture 18 - Complexity (Efficiency) of Algorithms

Lecture 19 - Asymptotic Growth Functions

Lecture 20 - Asymptotic Analysis of Algorithms

Lecture 21 - Data Structuring

Lecture 22 - Search Trees

Lecture 23 - Search Trees - II

Lecture 24 - Search Trees - III

Lecture 25 - 2-3 Trees

Lecture 26 - Algorithm Design - I

Lecture 27 - Algorithm Design - II

Lecture 28 - Algorithm Design - III

Lecture 29 - Graphs - I

Lecture 30 - Graphs - II

Lecture 31 - Graphs - III

Lecture 32 - Conclusions

Lecture 1 - Introduction

Lecture 2 - Levels of Testing

Lecture 3 - Basic Concepts in Testing

Lecture 4 - Basic Concepts in Testing (Continued...)

Lecture 5 - Unit Testing

Lecture 6 - Equivalence and BV Testing

Lecture 7 - Special Value Testing

Lecture 8 - Combinatorial Testing

Lecture 9 - Pairwise Testing

Lecture 10 - White Box Testing

Lecture 11 - MC/DC Testing

Lecture 12 - MC/DC Testing (Continued...)

Lecture 13 - Path Testing

Lecture 14 - Dataflow and Mutation Testing

Lecture 15 - Mutation Testing

Lecture 16 - Integration Testing

Lecture 17 - System Testing

Lecture 18 - Regression Testing

Lecture 19 - Testing Object-Oriented Program - Part 1

Lecture 20 - Testing Object-Oriented Program - Part 2

Lecture 1 - Module 1 : Recap of C

Lecture 2 - Module 1 : Recap of C

Lecture 3 - Module 1 : Recap of C

Lecture 4 - Module 2 : Programs with IO and Loop

Lecture 5 - Module 3 : Arrays and Strings

Lecture 6 - Module 4 : Sorting and Searching

Lecture 7 - Module 5 : Stack and its Applications

Lecture 8 - Module 6 : Constants and Inline Functions

Lecture 9 - Module 6 : Constants and Inline Functions (Continued...)

Lecture 10 - Module 7 : Reference and Pointer

Lecture 11 - Module 7 : Reference and Pointer (Continued...)

Lecture 12 - Module 8 : Default Parameters and Function Overloading

Lecture 13 - Module 8 : Default Parameters and Function Overloading (Continued...)

Lecture 14 - Module 8 : Default Parameters and Function Overloading (Continued...)

Lecture 15 - Module 9 : Operator Overloading

Lecture 16 - Module 9 : Operator Overloading (Continued...)

Lecture 17 - Module 10 : Dynamic Memory Management

Lecture 18 - Module 10 : Dynamic Memory Management (Continued...)

Lecture 19 - Module 11 : Classes and Objects

Lecture 20 - Module 11 : Classes and Objects (Continued...)

Lecture 21 - Module 12 : Access Specifiers

Lecture 22 - Module 12 : Access Specifiers (Continued...)

Lecture 23 - Module 13 : Constructors, Destructors and Object Lifetime

Lecture 24 - Module 13 : Constructors, Destructors and Object Lifetime (Continued...)

Lecture 25 - Module 13 : Constructors, Destructors and Object Lifetime (Continued...)

Lecture 26 - Module 14 : Copy Constructor and Copy Assignment Operator

Lecture 27 - Module 14 : Copy Constructor and Copy Assignment Operator (Continued...)

Lecture 28 - Module 14 : Copy Constructor and Copy Assignment Operator (Continued...)

Lecture 29 - Module 15 : Const-ness

Lecture 30 - Module 15 : Const-ness (Continued...)

Lecture 31 - Module 16 : Static Members

- Lecture 32 - Module 17 : friend Function and friend Class
- Lecture 33 - Module 18 : Overloading Operator for User Defined Types - Part I
- Lecture 34 - Module 19 : Overloading Operator for User Defined Types - Part II
- Lecture 35 - Module 20 : Namespace
- Lecture 36 - Module 21 : Inheritance - Part I
- Lecture 37 - Module 22 : Inheritance - Part II
- Lecture 38 - Module 23 : Inheritance - Part III
- Lecture 39 - Module 24 : Inheritance - Part IV
- Lecture 40 - Module 25 : Inheritance - Part V
- Lecture 41 - Module 26 : Dynamic Binding - Part I
- Lecture 42 - Module 27 : Dynamic Binding (Polymorphism) - Part II
- Lecture 43 - Module 28 : Dynamic Binding (Polymorphism) - Part III
- Lecture 44 - Module 29 : Dynamic Binding (Polymorphism) - Part IV
- Lecture 45 - Module 30 : Dynamic Binding (Polymorphism) - Part V
- Lecture 46 - Module 31 : Virtual Function Table
- Lecture 47 - Module 32 : Type casting and cast operators - Part I
- Lecture 48 - Module 33 : Type casting and cast operators - Part II
- Lecture 49 - Module 34 : Type casting and cast operators - Part III
- Lecture 50 - Module 35 : Multiple Inheritance
- Lecture 51 - Module 35 : Multiple Inheritance (Continued...)
- Lecture 52 - Module 36 : Exceptions (Error Handling in C) - Part I
- Lecture 53 - Module 37 : Exceptions (Error Handling in C) - Part II
- Lecture 54 - Module 38 : Template (Function Template) - Part I
- Lecture 55 - Module 39 : Template (Function Template) - Part II
- Lecture 56 - Module 40 : Closing Comments

Lecture 1 - Introduction

Lecture 2 - Different Types of Learning

Lecture 3 - Hypothesis Space and Inductive Bias

Lecture 4 - Evaluation and Cross-Validation

Lecture 5 - Tutorial - I

Lecture 6 - Linear Regression

Lecture 7 - Introduction to Decision Trees

Lecture 8 - Learning Decision Tree

Lecture 9 - Overfitting

Lecture 10 - Python Exercise on Decision Tree and Linear Regression

Lecture 11 - Tutorial - II

Lecture 12 - k-Nearest Neighbour

Lecture 13 - Feature Selection

Lecture 14 - Feature Extraction

Lecture 15 - Collaborative Filtering

Lecture 16 - Python Exercise on kNN and PCA

Lecture 17 - Tutorial - III

Lecture 18 - Bayesian Learning

Lecture 19 - Naive Bayes

Lecture 20 - Bayesian Network

Lecture 21 - Python Exercise on Naive Bayes

Lecture 22 - Tutorial - IV

Lecture 23 - Logistic Regression

Lecture 24 - Introduction Support Vector Machine

Lecture 25 - SVM : The Dual Formulation

Lecture 26 - SVM : Maximum Margin with Noise

Lecture 27 - Nonlinear SVM and Kernel Function

Lecture 28 - SVM : Solution to the Dual Problem

Lecture 29 - Python Exercise on SVM

Lecture 30 - Introduction

Lecture 31 - Multilayer Neural Network

[Lecture 32 - Neural Network and Backpropagation Algorithm](#)

[Lecture 33 - Deep Neural Network](#)

[Lecture 34 - Python Exercise on Neural Network](#)

[Lecture 35 - Tutorial - VI](#)

[Lecture 36 - Introduction to Computational Learning Theory](#)

[Lecture 37 - Sample Complexity : Finite Hypothesis Space](#)

[Lecture 38 - VC Dimension](#)

[Lecture 39 - Introduction to Ensembles](#)

[Lecture 40 - Bagging and Boosting](#)

[Lecture 41 - Introduction to Clustering](#)

[Lecture 42 - Kmeans Clustering](#)

[Lecture 43 - Agglomerative Hierarchical Clustering](#)

[Lecture 44 - Python Exercise on kmeans clustering](#)

Lecture 1 - Challenges in Software Engineering

Lecture 2 - Complexity of Software

Lecture 3 - Complexity of Software (Continued...)

Lecture 4 - Structure and Attributes of a Complex System

Lecture 5 - Structure and Attributes of a Complex System (Continued...)

Lecture 6 - Object-Oriented Analysis and Design

Lecture 7 - Bringing Order to Chaos

Lecture 8 - Bringing Order to Chaos (Continued...)

Lecture 9 - Evolution of Object Models - Programming Languages and Paradigms

Lecture 10 - Foundations of the Object Model - OOA, OOD and OOP

Lecture 11 - Foundations of the Object Model - OOA, OOD and OOP (Continued...)

Lecture 12 - Elements of Object Model (Major) : Abstraction and Encapsulation

Lecture 13 - Elements of Object Model (Major) : Abstraction and Encapsulation (Continued...)

Lecture 14 - Elements of the Object Model (Major) : Modularity and Hierarchy

Lecture 15 - Elements of the Object Model (Major) : Modularity and Hierarchy (Continued...)

Lecture 16 - Elements of the Object Model (Minor) : Typing, Concurrency and Persistence

Lecture 17 - Elements of the Object Model (Minor) : Typing, Concurrency and Persistence (Continued...)

Lecture 18 - Nature of an object : State, Behavior and Identity

Lecture 19 - Nature of an object : State, Behavior and Identity (Continued...)

Lecture 20 - Relationships among objects

Lecture 21 - Relationships among objects (Continued...)

Lecture 22 - Nature of a class : Interface and Implementation

Lecture 23 - Nature of a class : Interface and Implementation (Continued...)

Lecture 24 - Relationships among classes

Lecture 25 - Relationships among classes (Continued...)

Lecture 26 - How to Build Quality Classes and Objects

Lecture 27 - Tutorial : LMS

Lecture 28 - How to Identify Classes and Objects ?

Lecture 29 - Identification of Classes, Objects and Relationship in LMS

Lecture 30 - Identification of Classes, Objects and Relationship in LMS (Continued...)

Lecture 31 - Identification of Classes, Objects and Relationship in LMS (Continued...)

[Lecture 32 - Identification of Classes, Objects and Relationship in LMS \(Continued...\)](#)

[Lecture 33 - Overview of UML](#)

[Lecture 34 - SDLC Phases and UML Diagrams](#)

[Lecture 35 - Use-Case Diagrams - Part I](#)

[Lecture 36 - Use-Case Diagrams - Part II](#)

[Lecture 37 - Use-Case Diagrams - Part III](#)

[Lecture 38 - Class Diagrams - Part 1 \(Class, Property and Operation\)](#)

[Lecture 39 - Class Diagrams - Part 2 \(Association, Weak and Strong Aggregation\)](#)

[Lecture 40 - Class Diagrams - Part 3 \(Generalization, Dependency and Constraints\)](#)

[Lecture 41 - Sequence Diagrams - Part 1](#)

[Lecture 42 - Sequence Diagrams - Part 2](#)

[Lecture 43 - Communication Diagram](#)

[Lecture 44 - Activity Diagrams - Part II](#)

[Lecture 45 - Activity Diagrams - Part II](#)

[Lecture 46 - Activity Diagrams - Part III](#)

[Lecture 47 - Interaction Overview Diagram](#)

[Lecture 48 - State Machine Diagrams - Part I](#)

[Lecture 49 - State Machine Diagrams - Part II](#)

[Lecture 50 - State Machine Diagrams - Part III](#)

[Lecture 51 - Various UML Diagrams](#)

[Lecture 52 - Closing Comments](#)

Lecture 1 - Introduction

Lecture 2 - Network Analysis - I

Lecture 3 - Network Analysis - II

Lecture 4 - Network Analysis - III

Lecture 5 - Network Analysis - IV

Lecture 6 - Network Analysis - V

Lecture 7 - Network Analysis - VI

Lecture 8 - Social Network Principles - I

Lecture 9 - Social Network Principles - II

Lecture 10 - Social Network Principles - III

Lecture 11 - Social Network Principles - IV

Lecture 12 - Community Analysis - I

Lecture 13 - Community Analysis - II

Lecture 14 - Community Analysis - III

Lecture 15 - Community Analysis - IV

Lecture 16 - Community Analysis - V

Lecture 17 - Community Analysis - VI

Lecture 18 - Citation Analysis - I

Lecture 19 - Citation Analysis - II

Lecture 20 - Citation Analysis - III

Lecture 21 - Citation Analysis - IV

Lecture 1 - Insertion Sort and Asymptotic Analysis

Lecture 2 - Solving Recurrences

Lecture 3 - Divide and Conquer Paradigm

Lecture 4 - Quick Sort

Lecture 5 - Heap Sort

Lecture 6 - Decision Tree

Lecture 7 - Linear Time Sorting

Lecture 8 - Order Statistics

Lecture 9 - Hashing

Lecture 10 - Universal Hashing, BST Sort

Lecture 11 - Red-Black Tree

Lecture 12 - Augmenting Data Structure

Lecture 13 - Computational Geometry

Lecture 14 - Van Emde Boas Data Structure

Lecture 15 - Dynamic Programming

Lecture 16 - Graph Algorithm

Lecture 17 - BFS and DFS

Lecture 18 - Dijkstra

Lecture 19 - Bellman Ford

Lecture 20 - Floyd Marshall

- Lecture 1 - Introduction to the Course
- Lecture 2 - What Do We Do in NLP
- Lecture 3 - Why is NLP hard
- Lecture 4 - Empirical Laws
- Lecture 5 - Text Processing: Basics
- Lecture 6 - Spelling Correction: Edit Distance
- Lecture 7 - Weighted Edit Distance, Other Variations
- Lecture 8 - Noisy Channel Model for Spelling Correction
- Lecture 9 - N-Gram Language Models
- Lecture 10 - Evaluation of Language Models, Basic Smoothing
- Lecture 11 - Tutorial I
- Lecture 12 - Language Modeling: Advanced Smoothing Models
- Lecture 13 - Computational Morphology
- Lecture 14 - Finite - State Methods for Morphology
- Lecture 15 - Introduction to POS Tagging
- Lecture 16 - Hidden Markov Models for POS Tagging
- Lecture 17 - Viterbi Decoding for HMM, Parameter Learning
- Lecture 18 - Baum Welch Algorithm
- Lecture 19 - Maximum Entropy Models - I
- Lecture 20 - Maximum Entropy Models - II
- Lecture 21 - Conditional Random Fields
- Lecture 22 - Syntax - Introduction
- Lecture 23 - Syntax - Parsing I
- Lecture 24 - Syntax - CKY, PCFGs
- Lecture 25 - PCFGs - Inside-Outside Probabilities
- Lecture 26 - Inside-Outside Probabilities
- Lecture 27 - Dependency Grammars and Parsing - Introduction
- Lecture 28 - Transition Based Parsing : Formulation
- Lecture 29 - Transition Based Parsing : Learning
- Lecture 30 - MST-Based Dependency Parsing
- Lecture 31 - MST-Based Dependency Parsing : Learning

[Lecture 32 - Distributional Semantics - Introduction](#)

[Lecture 33 - Distributional Models of Semantics](#)

[Lecture 34 - Distributional Semantics : Applications, Structured Models](#)

[Lecture 35 - Word Embeddings - Part I](#)

[Lecture 36 - Word Embeddings - Part II](#)

[Lecture 37 - Lexical Semantics](#)

[Lecture 38 - Lexical Semantics - Wordnet](#)

[Lecture 39 - Word Sense Disambiguation - I](#)

[Lecture 40 - Word Sense Disambiguation - II](#)

[Lecture 41 - Novel Word Sense detection](#)

[Lecture 42 - Topic Models : Introduction](#)

[Lecture 43 - Latent Dirichlet Allocation : Formulation](#)

[Lecture 44 - Gibbs Sampling for LDA, Applications](#)

[Lecture 45 - LDA Variants and Applications - I](#)

[Lecture 46 - LDA Variants and Applications - II](#)

[Lecture 47 - Entity Linking - I](#)

[Lecture 48 - Entity Linking - II](#)

[Lecture 49 - Information Extraction - Introduction](#)

[Lecture 50 - Relation Extraction](#)

[Lecture 51 - Distant Supervision](#)

[Lecture 52 - Text Summarization - LEXRANK](#)

[Lecture 53 - Optimization based Approaches for Summarization](#)

[Lecture 54 - Summarization Evaluation](#)

[Lecture 55 - Text Classification - I](#)

[Lecture 56 - Text Classification - II](#)

[Lecture 57 - Tutorial II](#)

[Lecture 58 - Tutorial III](#)

[Lecture 59 - Tutorial IV](#)

[Lecture 60 - Tutorial V](#)

[Lecture 61 - Sentiment Analysis - Introduction](#)

[Lecture 62 - Sentiment Analysis - Affective Lexicons](#)

[Lecture 63 - Learning Affective Lexicons](#)

[Lecture 64 - Computing with Affective Lexicons](#)

Lecture 1 - Introduction

Lecture 2 - Processors

Lecture 3 - General Purpose and ASIPs Processor

Lecture 4 - Designing a Single Purpose Processor

Lecture 5 - Optimization Issues

Lecture 6 - Introduction to FPPA

Lecture 7 - FPGA (Continued...)

Lecture 8 - Behaviour Synthesis on FPGA using VHDL

Lecture 9 - Tutorial - I

Lecture 10 - Tutorial - II

Lecture 11 - Tutorial - III

Lecture 12 - Tutorial - IV

Lecture 13 - Sensors and Signals

Lecture 14 - Discretization of Signals and A/D Converter

Lecture 15 - Quantization Noise, SNR and D/A Converter

Lecture 16 - Arduino Uno

Lecture 17 - Arduino Uno (Continued...), Serial Communication and Timer

Lecture 18 - Controller Design using Arduino

Lecture 19 - Tutorial - V

Lecture 20 - Power Aware Embedded System - I

Lecture 21 - Power Aware Embedded System - II

Lecture 22 - SD and DD Algorithm

Lecture 23 - Parallel Operations and VLIW

Lecture 24 - Code Efficiency

Lecture 25 - DSP Application and Address Generation Unit

Lecture 26 - Real Time O.S - I

Lecture 27 - Real Time O.S - II

Lecture 28 - RMS Algorithm

Lecture 29 - EDF Algorithm and Resource Constraint Issue

Lecture 30 - Priority Inversion and Priority Inheritance Protocol

Lecture 31 - Modeling and Specification - I

[Lecture 32 - Modeling and Specification - II](#)

[Lecture 33 - FSM and Statechart](#)

[Lecture 34 - Statechart and State Machine Semantics](#)

[Lecture 35 - Statecharts \(Continued...\)](#)

[Lecture 36 - Program State Machines](#)

[Lecture 37 - SDL](#)

[Lecture 38 - Data Flow Model - I](#)

[Lecture 39 - Data Flow Model - II](#)

[Lecture 40 - Hardware Synthesis - I](#)

[Lecture 41 - Hardware Synthesis - II](#)

[Lecture 42 - Scheduling](#)

[Lecture 43 - Digital Camera Design](#)

[Lecture 44 - Digital Camera - Iterative Design](#)

[Lecture 45 - HW-SW Partitioning](#)

[Lecture 46 - Optimization - I](#)

[Lecture 47 - Optimization - II](#)

[Lecture 48 - Simulation](#)

[Lecture 49 - Formal Verification](#)

[Lecture 1 - Introduction: Wireless Ad Hoc Networks - Part-I](#)

[Lecture 2 - Introduction: Wireless Ad Hoc Networks - Part-II](#)

[Lecture 3 - Self-organizing Behaviour of Wireless Ad Hoc Networks](#)

[Lecture 4 - Cooperation in Mobile Ad Hoc Networks - Part-I](#)

[Lecture 5 - Cooperation in Mobile Ad Hoc Networks - Part-II](#)

[Lecture 6 - MAC Protocols in MANETs - Part-I](#)

[Lecture 7 - MAC Protocols in MANETs - Part-II](#)

[Lecture 8 - Routing in MANETs - Part-I](#)

[Lecture 9 - Routing in MANETs - Part-II](#)

[Lecture 10 - Routing in MANETs - Part-III](#)

[Lecture 11 - Multicasting in MANETs](#)

[Lecture 12 - Mobility Models for MANETs](#)

[Lecture 13 - Transport Protocols for MANETs - Part-I](#)

[Lecture 14 - Transport Protocols for MANETs - Part-II](#)

[Lecture 15 - Opportunistic Mobile Networks - Part-I](#)

[Lecture 16 - Opportunistic Mobile Networks - Part-II](#)

[Lecture 17 - Opportunistic Mobile Networks - Part-III](#)

[Lecture 18 - UAV Networks - Part-I](#)

[Lecture 19 - UAV Networks - Part-II](#)

[Lecture 20 - UAV Networks - Part-III](#)

[Lecture 21 - Introduction: Wireless Sensor Networks - Part-I](#)

[Lecture 22 - Introduction: Wireless Sensor Networks - Part-II](#)

[Lecture 23 - WSN Coverage and Placement - Part-I](#)

[Lecture 24 - Topology Mangement in Wireless Sensor Network](#)

[Lecture 25 - Mobile Wireless Sensor Networks](#)

[Lecture 26 - Mobile Wireless Sensor Networks](#)

[Lecture 27 - Medium Access Control in Wireless Networks - Part-I](#)

[Lecture 28 - Medium Access Control in Wireless Networks - Part-II](#)

[Lecture 29 - Routing in Wireless Sensor Networks - Part-I](#)

[Lecture 30 - Routing in Wireless Sensor Networks - Part-II](#)

[Lecture 31 - Congestion and Flow Control - Part-I](#)

- [Lecture 32 - Congestion and Flow Control - Part-II](#)
- [Lecture 33 - Underwater Sensor Networks - Part-I](#)
- [Lecture 34 - Underwater Sensor Networks - Part-II](#)
- [Lecture 35 - Underwater Sensor Networks - Part-III](#)
- [Lecture 36 - Underwater Sensor Networks - Part-IV](#)
- [Lecture 37 - Security of Wireless Sensor Networks - Part-I](#)
- [Lecture 38 - Security of Wireless Sensor Networks - Part-II](#)
- [Lecture 39 - Hardware Design of Sensor Node](#)
- [Lecture 40 - Real Life Deployment of WSN](#)

Lecture 1 - Introduction

Lecture 2 - Design Representation

Lecture 3 - VLSI Design Styles - Part 1

Lecture 4 - VLSI Design Styles - Part 2

Lecture 5 - VLSI Physical Design Automation - Part 1

Lecture 6 - VLSI Physical Design Automation - Part 2

Lecture 7 - Partitioning

Lecture 8 - Floor planning

Lecture 9 - Floor planning Algorithms

Lecture 10 - Pin Assignment

Lecture 11 - Placement - Part 1

Lecture 12 - Placement - Part 2

Lecture 13 - Placement - Part 3

Lecture 14 - Placement - Part 4

Lecture 15 - Grid Routing - Part 1

Lecture 16 - Grid Routing - Part 2

Lecture 17 - Grid Routing - Part 3

Lecture 18 - Global Routing - Part 1

Lecture 19 - Global Routing - Part 2

Lecture 20 - Detailed Routing - Part 1

Lecture 21 - Detailed Routing - Part 2

Lecture 22 - Detailed Routing - Part 3

Lecture 23 - Detailed Routing - Part 4

Lecture 24 - Clock Design - Part 1

Lecture 25 - Clock Design - Part 2

Lecture 26 - Clock Design - Part 3

Lecture 27 - Clock Network Synthesis - Part 1

Lecture 28 - Clock Network Synthesis - Part 2

Lecture 29 - Clock Network Synthesis - Part 3

Lecture 30 - Clock Network Synthesis - Part 4

Lecture 31 - Power and Ground Routing

[Lecture 32 - Time Closure - Part 1](#)

[Lecture 33 - Time Closure - Part 2](#)

[Lecture 34 - Time Closure - Part 3](#)

[Lecture 35 - Time Closure - Part 4](#)

[Lecture 36 - Time Closure - Part 5](#)

[Lecture 37 - Timing Driven Placement](#)

[Lecture 38 - Timing Driven Routing](#)

[Lecture 39 - Physical Synthesis - Part 1](#)

[Lecture 40 - Physical Synthesis - Part 2](#)

[Lecture 41 - Performance-Driven Design Flow](#)

[Lecture 42 - Miscellaneous Approaches to Timing Optimization](#)

[Lecture 43 - Interconnect Modeling - Part 1](#)

[Lecture 44 - Interconnect Modeling - Part 2](#)

[Lecture 45 - Design Rule Check](#)

[Lecture 46 - Layout Compaction - Part 1](#)

[Lecture 47 - Layout Compaction - Part 2](#)

[Lecture 48](#)

[Lecture 49](#)

[Lecture 50](#)

[Lecture 51](#)

[Lecture 52](#)

[Lecture 53 - Test Pattern Generation](#)

[Lecture 54 - Design for Testability](#)

[Lecture 55 - Boundary Scan Standard](#)

[Lecture 56 - Built-in Self-Test - Part 1](#)

[Lecture 57 - Built-in Self-Test - Part 2](#)

[Lecture 58 - Low Power VLSI Design](#)

[Lecture 59 - Techniques to Reduce Power](#)

[Lecture 60 - Gate Level Design for Low Power - Part 1](#)

[Lecture 61 - Gate Level Design for Low Power - Part 2](#)

[Lecture 62 - Other Low Power Design Techniques](#)

[Lecture 63 - Algorithmic Level Techniques for Low Power Design](#)

[Lecture 64 - Summarization of the Course](#)

[Lecture 1 - Introduction to Cryptography](#)

[Lecture 2 - Classical Cryptosystem](#)

[Lecture 3 - Cryptanalysis on Substitution Cipher \(Frequency Analysis\)](#)

[Lecture 4 - Play Fair Cipher](#)

[Lecture 5 - Block Cipher](#)

[Lecture 6 - Data Encryption Standard \(DES\)](#)

[Lecture 7 - DES \(Continued...\)](#)

[Lecture 8 - Triple DES and Modes of Operation](#)

[Lecture 9 - Stream Cipher](#)

[Lecture 10 - Pseudorandom Sequence](#)

[Lecture 11 - LFSR Based StreamCipher](#)

[Lecture 12 - Mathematical Background](#)

[Lecture 13 - Abstract Algebra \(Continued...\)](#)

[Lecture 14 - Number Theory](#)

[Lecture 15 - Number Theory \(Continued...\)](#)

[Lecture 16 - Modular Inverse](#)

[Lecture 17 - Extended Euclidean Algorithm](#)

[Lecture 18 - Fermat's Little Theorem, Euler Phi-Function](#)

[Lecture 19 - Euler's theorem, Quadratic Residue](#)

[Lecture 20 - Polynomial Arithmetic](#)

[Lecture 21 - Advanced Encryption Standard \(AES\)](#)

[Lecture 22 - Advanced Encryption Standard \(AES\) \(Continued...\)](#)

[Lecture 23 - Introduction to Public Key Cryptosystem, Diffie-Hellman Key Exchange](#)

[Lecture 24 - Knapsack Cryptosystem](#)

[Lecture 25 - RSA Cryptosystem](#)

[Lecture 26 - More on RSA](#)

[Lecture 27 - Primarily Testing](#)

[Lecture 28 - ElGamal Cryptosystem](#)

[Lecture 29 - Elliptic Curve over the Reals](#)

[Lecture 30 - Elliptic curve Modulo a Prime](#)

[Lecture 31 - Generalised ElGamal Public Key Cryptosystem](#)

[Lecture 32 - Chinese Remainder Theorem](#)

[Lecture 33 - Rabin Cryptosystem](#)

[Lecture 34 - Legendre and Jacobi Symbol](#)

[Lecture 35 - Jacobi Symbol \(Continued...\)](#)

[Lecture 36 - Message Authentication](#)

[Lecture 37 - Digital Signature](#)

[Lecture 38 - Key Management](#)

[Lecture 39 - Key Exchange](#)

[Lecture 40 - Hash Function](#)

[Lecture 41 - Universal Hashing](#)

[Lecture 42 - Cryptographic Hash Function](#)

[Lecture 43 - Secure Hash Algorithm \(SHA\)](#)

[Lecture 44 - Digital Signature Standard \(DSS\)](#)

[Lecture 45 - More on Key Exchange Protocol](#)

[Lecture 46 - Cryptoanalysis](#)

[Lecture 47 - Memory Trade off Attack](#)

[Lecture 48 - Differential Cryptoanalysis](#)

[Lecture 49 - More on Differential Cryptoanalysis](#)

[Lecture 50 - Linear Cryptoanalysis](#)

[Lecture 51 - Cryptoanalysis and Stream Cipher](#)

[Lecture 52 - Modern Stream Cipher](#)

[Lecture 53 - Shamir Secret Sharing](#)

[Lecture 54 - Identity Based Encryption \(IBE\)](#)

[Lecture 55 - Attribute Based Encryption](#)

[Lecture 56 - Functional Encryption \(Introduction\)](#)

[Lecture 57 - Discrete Logarithm Problem \(DLP\)](#)

[Lecture 58 - Implementation Attacks](#)

[Lecture 59 - The Secure Sockets layer \(SSL\)](#)

[Lecture 60 - Pretty Good Privacy \(PGP\)](#)

Lecture 1 - Evolution of Computer Systems

Lecture 2 - Basic Operation of a Computer

Lecture 3 - Memory Addressing and Languages

Lecture 4 - Software and Architecture Types

Lecture 5 - Instruction Set Architecture

Lecture 6 - Number Representation

Lecture 7 - Instruction Format and Addressing Modes

Lecture 8 - CISC and RISC Architecture

Lecture 9 - MIPS32 Instruction Set

Lecture 10 - MIPS Programming Examples

Lecture 11 - Spim – A Mips32 Simulator

Lecture 12 - Measuring Cpu Performance

Lecture 13 - Choice Of Benchmarks

Lecture 14 - Summarizing Performance Results

Lecture 15 - Amadahl's Law - Part 1

Lecture 16 - Amadahl's Law - Part 2

Lecture 17 - Design Of Control Unit - Part 1

Lecture 18 - Design Of Control Unit - Part 2

Lecture 19 - Design Of Control Unit - Part 3

Lecture 20 - Design Of Control Unit - Part 4

Lecture 21 - Mips Implementation - Part 1

Lecture 22 - Mips Implementation - Part 2

Lecture 23 - Processor Memory Interaction

Lecture 24 - Static And Dynamic Ram

Lecture 25 - Asynchronous Dram

Lecture 26 - Synchronous Dram

Lecture 27 - Memory Interfacing And Addressing

Lecture 28 - Memory Hierarchy Design - Part 1

Lecture 29 - Memory Hierarchy Design - Part 2

Lecture 30 - Cache Memory - Part 1

Lecture 31 - Cache Memory - Part 2

Lecture 32 - Improving Cache Performance

Lecture 33 - Design Of Adders - Part 1

Lecture 34 - Design Of Adders - Part 2

Lecture 35 - Design Of Multipliers - Part 1

Lecture 36 - Design Of Multipliers - Part 2

Lecture 37 - Design Of Dividers

Lecture 38 - Floating-Point Numbers

Lecture 39 - Floating-Point Arithmetic

Lecture 40 - Basic Pipelining Concepts

Lecture 41 - Pipeline Scheduling

Lecture 42 - Arithmetic Pipeline

Lecture 43 - Secondary Storage Devices

Lecture 44 - Input-Output Organization

Lecture 45 - Data Transfer Techniques

Lecture 46 - Interrupt Handling - Part 1

Lecture 47 - Interrupt Handling - Part 2

Lecture 48 - Direct Memory Access

Lecture 49 - Some Example Device Interfacing

Lecture 50 - Exercises On I/O Transfer

Lecture 51 - Bus Standards

Lecture 52 - Bus Standards

Lecture 53 - Pipelining The Mips32 Data Path

Lecture 54 - Mips Pipeline (Continued...

Lecture 55 - Pipeline Hazards - Part 1

Lecture 56 - Pipeline Hazards - Part 2

Lecture 57 - Pipeline Hazards - Part 3

Lecture 58 - Pipeline Hazards - Part 4

Lecture 59 - Multicycle Operations In Mips32

Lecture 60 - Exploiting Instruction Level Parallelism

Lecture 61 - Vector Processors

Lecture 62 - Multi-Core Processors

Lecture 63 - Some Case Studies

Lecture 64 - Summarization Of The Course

Lecture 1 - Insertion sort

Lecture 2 - Analysis of Insertion Sort

Lecture 3 - Asymptotic Analysis

Lecture 4 - Recurrence of Merge Sort

Lecture 5 - Substitution Method

Lecture 6 - The Master Method

Lecture 7 - Divide-and-Conquer

Lecture 8 - Divide-and-Conquer (Continued...)

Lecture 9 - Straseen's Algorithms

Lecture 10 - QuickSort

Lecture 11 - Analysis of Quicksort

Lecture 12 - Randomized Quicksort

Lecture 13 - Heap

Lecture 14 - Heap Sort

Lecture 15 - Decision Tree

Lecture 16 - Linear time Sorting

Lecture 17 - Radix Sort and Bucket Sort

Lecture 18 - Order Statistics

Lecture 19 - Randomised Order Statistics

Lecture 20 - Worst case linear time order statistics

Lecture 21 - Hash Function

Lecture 22 - Open Addressing

Lecture 23 - Universal Hashing

Lecture 24 - Perfect Hashing

Lecture 25 - Binary Search Tree (BST) Sort

Lecture 26 - Randomly build BST

Lecture 27 - Red Black Tree

Lecture 28 - Red Black Tree (Continued...)

Lecture 29 - Augmentation of data structure

Lecture 30 - Interval trees

Lecture 31 - Fixed universe successor

[Lecture 32 - Van Emde Boas data structure](#)

[Lecture 33 - Amortized analysis](#)

[Lecture 34 - Computational Geometry](#)

[Lecture 35 - Computational Geometry \(Continued...\)](#)

[Lecture 36 - Dynamic Programming](#)

[Lecture 37 - Longest common subsequence](#)

[Lecture 38 - Graphs](#)

[Lecture 39 - Prim's Algorithms](#)

[Lecture 40 - Graph Search](#)

[Lecture 41](#)

[Lecture 42](#)

[Lecture 43](#)

[Lecture 44](#)

[Lecture 45](#)

[Lecture 46](#)

[Lecture 47](#)

[Lecture 48](#)

[Lecture 49](#)

[Lecture 50](#)

[Lecture 51](#)

[Lecture 52 - Union-Find](#)

[Lecture 53 - Augmented disjoint set data structure](#)

[Lecture 54 - Network flow](#)

[Lecture 55 - Network Flow \(Continued...\)](#)

[Lecture 56 - Network Flow \(Continued...\)](#)

[Lecture 57 - More on Dynamic Programming](#)

[Lecture 58 - More on Dynamic Programming \(Continued...\)](#)

[Lecture 59 - Computational Complexity](#)

[Lecture 60 - Computational Complexity \(Continued...\)](#)

Lecture 1

Lecture 2

Lecture 3

Lecture 4

Lecture 5

Lecture 6 - Verilog Language Features - Part 1

Lecture 7 - Verilog Language Features - Part 2

Lecture 8 - Verilog Language Features - Part 3

Lecture 9 - Verilog Operators

Lecture 10 - Verilog Modeling Examples

Lecture 11 - Verilog Modeling Examples (Continued...)

Lecture 12 - Verilog Description Styles

Lecture 13 - Procedural Assignment

Lecture 14 - Procedural Assignment (Continued...)

Lecture 15 - Procedural Assignment (Examples)

Lecture 16 - Blocking / Non-Blocking Assignments - Part 1

Lecture 17 - Blocking / Non-Blocking Assignments - Part 2

Lecture 18 - Blocking / Non-Blocking Assignments - Part 3

Lecture 19 - Blocking / Non-Blocking Assignments - Part 4

Lecture 20 - User Defined Primitives

Lecture 21 - Verilog Test Bench

Lecture 22 - Writing Verilog Test Benches

Lecture 23 - Modeling Finite State Machines

Lecture 24 - Modeling Finite State Machines (Continued...)

Lecture 25 - Datapath And Controller Design - Part 1

Lecture 26 - Datapath And Controller Design - Part 2

Lecture 27 - Datapath And Controller Design - Part 3

Lecture 28 - Synthesizable Verilog

Lecture 29 - Some Recommended Practices

Lecture 30 - Modeling Memory

Lecture 31 - Modeling Register Banks

[Lecture 32 - Basic Pipelining Concepts](#)

[Lecture 33 - Pipeline Modeling - Part 1](#)

[Lecture 34 - Pipeline Modeling - Part 2](#)

[Lecture 35 - Switch Level Modeling - Part 1](#)

[Lecture 36 - Switch Level Modeling - Part 2](#)

[Lecture 37 - Pipeline Implementation Of A Processor - Part 1](#)

[Lecture 38 - Pipeline Implementation Of A Processor - Part 2](#)

[Lecture 39 - Pipeline Implementation Of A Processor - Part 3](#)

[Lecture 40 - Verilog Modeling Of The Processor - Part 1](#)

[Lecture 41 - Verilog Modeling Of The Processor - Part 2](#)

Lecture 1 - Introduction to IoT- Part I

Lecture 2 - Introduction to IoT- Part II

Lecture 3 - Sensing

Lecture 4 - Actuation

Lecture 5 - Basics of IoT Networking - Part I

Lecture 6 - Basics of IoT Networking - Part II

Lecture 7 - Basics of IoT Networking - Part III

Lecture 8 - Basics of IoT Networking - Part IV

Lecture 9 - Connectivity Technologies - Part I

Lecture 10 - Connectivity Technologies - Part II

Lecture 11 - Connectivity Technologies - Part III

Lecture 12 - Connectivity Technologies - Part IV

Lecture 13 - Connectivity Technologies - Part V

Lecture 14 - Sensor Networks - I

Lecture 15 - Sensor Networks - II

Lecture 16 - Sensor Networks - III

Lecture 17 - Sensor Networks - IV

Lecture 18 - Sensor Networks - V

Lecture 19 - UAV Networks

Lecture 20 - Machine to Machine Communication

Lecture 21 - Interoperability in Internet of Things

Lecture 22 - Introduction to Arduino - I

Lecture 23 - Introduction to Arduino - II

Lecture 24 - Integration of Sensor and Actuators with Arduino - I

Lecture 25 - Integration of Sensor and Actuators with Arduino - II

Lecture 26 - Introduction to Python Programming - I

Lecture 27 - Introduction to Python Programming - II

Lecture 28 - Introduction to Raspberry Pi - I

Lecture 29 - Introduction to Raspberry Pi - II

Lecture 30 - Implementation of IoT with Raspberry Pi - I

Lecture 31 - Implementation of IoT with Raspberry Pi - II

- Lecture 32 - Implementation of IoT with Raspberry Pi - III
- Lecture 33 - Software Defined Networking - Part I
- Lecture 34 - Software Defined Networking - Part II
- Lecture 35 - Software Defined IoT Networking - I
- Lecture 36 - Software Defined IoT Networking - II
- Lecture 37 - Cloud Computing-Fundamental
- Lecture 38 - Cloud Computing-Service Model
- Lecture 39 - Cloud Computing-Service Management and Security
- Lecture 40 - Cloud Computing - Case Studies
- Lecture 41 - Cloud Computing - Practical
- Lecture 42 - Sensor-Cloud - I
- Lecture 43 - Sensor-Cloud - II
- Lecture 44 - Fog Computing - I
- Lecture 45 - Fog Computing - II
- Lecture 46 - Smart Cities and Smart Homes - I
- Lecture 47 - Smart Cities and Smart Homes - II
- Lecture 48 - Smart Cities and Smart Homes - III
- Lecture 49 - Connected Vehicles - I
- Lecture 50 - Connected Vehicles - II
- Lecture 51 - Smart Grid - I
- Lecture 52 - Smart Grid - II
- Lecture 53 - Industrial Internet of Things - I
- Lecture 54 - Industrial Internet of Things - II
- Lecture 55 - Data Handling and Analytics - I
- Lecture 56 - Data Handling and Analytics - II
- Lecture 57 - Case Study: Agriculture
- Lecture 58 - Case Study: Healthcare
- Lecture 59 - Case Study: Activity Monitoring - I
- Lecture 60 - Case Study: Activity Monitoring - II

Lecture 1 - Cloud Computing Overview

Lecture 2 - Cloud Computing Overview (Continued...)

Lecture 3 - Cloud Computing - Introduction

Lecture 4 - Cloud Computing Architecture

Lecture 5 - Cloud Computing Architecture (Continued...)

Lecture 6 - Cloud Computing Architecture - Deployment Models

Lecture 7 - Cloud Computing Virtualization

Lecture 8 - Cloud Computing XML Basics

Lecture 9 - Cloud Computing XML Basics - II

Lecture 10 - Cloud Computing Web Services, Service Oriented Architecture

Lecture 11 - Service Level Agreement

Lecture 12 - Cloud Economics

Lecture 13 - Managing Data

Lecture 14 - Introduction to MapReduce

Lecture 15 - Open Stack

Lecture 16 - Cloud Computing - Opensource Cloud - Openstack Demo

Lecture 17 - Cloud Computing Case Study with a commercial Cloud - Microsoft Azure

Lecture 18 - Cloud Computing Demo - Microsoft Azure

Lecture 19 - Cloud Computing Case Study - Google Cloud Platform (GCP)

Lecture 20 - Cloud Computing Demo - Google Cloud Platform (GCP)

Lecture 21 - SLA-Tutorial

Lecture 22 - Cloudeconomics-Tutorial

Lecture 23 - MapReduce-Tutorial

Lecture 24 - Resource Management - I

Lecture 25 - Resource Management - II

Lecture 26 - Cloud Computing: Security - I

Lecture 27 - Cloud Computing: Security - II

Lecture 28 - Cloud Computing: Security - III

Lecture 29 - Cloud Computing: Security Issues in Collaborative SaaS Cloud

Lecture 30 - Cloud Computing: Broker for Cloud Marketplace

Lecture 31 - Mobile Cloud Computing - I

[Lecture 32 - Mobile Cloud Computing - II](#)

[Lecture 33 - Fog Computing - I](#)

[Lecture 34 - Fog Computing - II](#)

[Lecture 35 - Use Case-Geo-spatial Cloud](#)

[Lecture 36 - Introduction to DOCKER Container](#)

[Lecture 37 - Green Cloud](#)

[Lecture 38 - Sensor Cloud Computing](#)

[Lecture 39 - IoT Cloud](#)

[Lecture 40 - Course Summary and Research Areas](#)

[Lecture 41 - Cloud-Fog Computing - Overview](#)

[Lecture 42 - Resource Management - I](#)

[Lecture 43 - Resource Management - II](#)

[Lecture 44 - Cloud Federation](#)

[Lecture 45 - VM Migration - Basics Migration strategies](#)

[Lecture 46 - VM Migration - Basics Migration strategies](#)

[Lecture 47 - Containers Container based Virtualization Kubernetes Docker Container](#)

[Lecture 48 - Docker Container - Overview Docker - Components Docker - Architecture](#)

[Lecture 49 - Docker Container - Demo](#)

[Lecture 50 - Docker Container - Demo](#)

[Lecture 51 - Dew Computing](#)

[Lecture 52 - Serverless Computing - I](#)

[Lecture 53 - Serverless Computing - II](#)

[Lecture 54 - Sustainable Cloud Computing - I](#)

[Lecture 55 - Sustainable Cloud Computing - II](#)

[Lecture 56 - Cloud Computing in 5G Era](#)

[Lecture 57 - CPS and Cloud Computing](#)

[Lecture 58 - Case Study I \(Spatial Cloud Computing\)](#)

[Lecture 59 - Case Study II \(Internet of Health Things\) - Part A](#)

[Lecture 60 - Case Study II \(Internet of Health Things\) - Part B](#)

Lecture 1 - Introduction

Lecture 2 - Idea of Algorithms

Lecture 3 - Flow Chart and Pseudocode

Lecture 4 - Introduction to Programming Language Concepts

Lecture 5 - Variables and Memory

Lecture 6 - Types of Software and Compilers

Lecture 7 - Introduction to C Programming Language

Lecture 8 - Variables and Variable Types in C

Lecture 9 - Introducing Functions

Lecture 10 - Address and Content of Variables and Types

Lecture 11 - Assignment Statement and Operators in C

Lecture 12 - Arithmetic Expressions and Relational Expressions

Lecture 13 - Logical Operators and Change in Control Flow

Lecture 14 - Use of Logical Operatoers in Branching

Lecture 15 - Branching : IF-ELSE Statement

Lecture 16 - IF-ELSE Statement (Continued...)

Lecture 17 - Switch statement

Lecture 18 - Switch Statement (Continued...) and Introduction to Loops

Lecture 19 - Implementing Repetitions (Loops)

Lecture 20 - Implementation of Loops with for Statement (Continued...)

Lecture 21 - For Statement (Continued...)

Lecture 22 - Example of If-Else

Lecture 23 - Example of Loops

Lecture 24 - Example of Loops (Continued...)

Lecture 25 - Example of Loops (Continued...), Use of FOR Loops

Lecture 26 - Introduction to Arrays

Lecture 27 - Arrays (Continued...)

Lecture 28 - Arrays (Continued...)

Lecture 29 - Program using Arrays

Lecture 30 - Array Problem

Lecture 31 - Linear Search

- [Lecture 32 - Character Array and Strings](#)
- [Lecture 33 - String Operations](#)
- [Lecture 34 - 2-D Array Operation](#)
- [Lecture 35 - Introducing Functions](#)
- [Lecture 36 - More on Functions](#)
- [Lecture 37 - Function \(Continued...\)](#)
- [Lecture 38 - Scanf and Printf Functions; Function Prototype](#)
- [Lecture 39 - Parameter Passing in Function Revision](#)
- [Lecture 40 - Parameter Passing in Function Revision \(Continued...\)](#)
- [Lecture 41 - Substitution of # include and Macro](#)
- [Lecture 42 - search as a function](#)
- [Lecture 43 - Binary Search](#)
- [Lecture 44 - Binary Search \(Continued...\)](#)
- [Lecture 45 - Sorting Methods](#)
- [Lecture 46 - Bubble Sort \(Continued...\)](#)
- [Lecture 47 - Use of Pointer in Function : Context Bubble Sort](#)
- [Lecture 48 - Arrays at Strings](#)
- [Lecture 49 - Data Representation](#)
- [Lecture 50 - Bisection Method](#)
- [Lecture 51 - Interpolation](#)
- [Lecture 52 - Trapezoidal Rule and Runge-Kutta Method](#)
- [Lecture 53 - Recursion](#)
- [Lecture 54 - Recursion \(Continued...\)](#)
- [Lecture 55 - Structure](#)
- [Lecture 56 - Structure \(Continued...\)](#)
- [Lecture 57 - Structure with typedef](#)
- [Lecture 58 - Pointer](#)
- [Lecture 59 - Pointer \(Continued...\)](#)
- [Lecture 60 - Pointer in Structures](#)
- [Lecture 61 - Dynamic Allocation and File](#)

[Lecture 1 - Introduction](#)

[Lecture 2 - Basics of Task scheduling](#)

[Lecture 3 - Cyclic executives](#)

[Lecture 4 - Cyclic Scheduler](#)

[Lecture 5 - Cyclic Scheduler](#)

[Lecture 6 - Exercises on Frame size Selection](#)

[Lecture 7 - Event-driven schedulers](#)

[Lecture 8 - Rate Monotonic Algorithm](#)

[Lecture 9 - RMA Task Schedulability](#)

[Lecture 10 - Rate Monotonic Analysis](#)

[Lecture 11 - RMA Generalizations](#)

[Lecture 12 - Further RMA Generalizations](#)

[Lecture 13 - Resource Sharing among Real-Time Tasks](#)

[Lecture 14 - Solution to Priority Inversion Problem](#)

[Lecture 15 - Highest Locker Protocol](#)

[Lecture 16 - Priority Ceiling Protocol](#)

[Lecture 17 - PCP Priority Inversions](#)

[Lecture 18 - Analysis of PCP priority inversions](#)

[Lecture 19 - Some basic issues in Real-Time Operating Systems](#)

[Lecture 20 - Unix as a Real-Time operating System](#)

Lecture 1 - Introduction to soft computing

Lecture 2 - Introduction to Fuzzy Logic

Lecture 3 - Fuzzy membership functions (Continued...) and Defining Membership functions

Lecture 4 - Fuzzy operations

Lecture 5 - Fuzzy relations

Lecture 6 - Fuzzy Relations (Continued...) and Fuzzy propositions

Lecture 7 - Fuzzy implications

Lecture 8 - Fuzzy Inferences

Lecture 9 - Defuzzification techniques (Part-I)

Lecture 10 - Defuzzification Techniques (Part-I) (Continued...)

Lecture 11 - Fuzzy logic controller

Lecture 12 - Fuzzy Logic Controller (Continued...)

Lecture 13 - Fuzzy logic controller (Continued...)

Lecture 14 - Concept of Genetic Algorithm

Lecture 15 - Concept of Genetic Algorithm (Continued...) and GA Strategies

Lecture 16 - GA Operator : Encoding schemes

Lecture 17 - GA operator : encoding scheme (Continued...)

Lecture 18 - GA Operator : Selection

Lecture 19 - GA Operator : Selection (Continued...)

Lecture 20 - GA Operator : Crossover techniques

Lecture 21 - GA Operator : Crossover (Continued...)

Lecture 22 - GA Operator : Crossover (Continued...)

Lecture 23 - GA Operator : Mutation and others

Lecture 24 - Multi-objective optimization problem solving

Lecture 25 - Multi-objective optimization problem solving (Continued...)

Lecture 26 - Concept of domination

Lecture 27 - Non-Pareto based approaches to solve MOOPs

Lecture 28 - Non-Pareto based approaches to solve MOOPs (Continued...)

Lecture 29 - Pareto-Based approaches to solve MOOPs

Lecture 30 - Pareto-based approaches to solve MOOPs (Continued...)

Lecture 31 - Pareto-based approach to solve MOOPs

[Lecture 32 - Pareto-based approach to solve MOOPs \(Continued...\)](#)

[Lecture 33 - Pareto-based approach to solve MOOPs \(Continued...\)](#)

[Lecture 34 - Introduction to Artificial Neural Network](#)

[Lecture 35 - ANN Architectures](#)

[Lecture 36 - Training ANNs](#)

[Lecture 37 - Training ANNs \(Continued....\)](#)

[Lecture 38 - Training ANNs \(Continued....\)](#)

[Lecture 39 - Training ANNs \(Continued....\)](#)

[Lecture 40 - Soft computing tools](#)

Lecture 1 - Introduction, Knowledge Discovery Process

Lecture 2 - Data Preprocessing - I

Lecture 3 - Data Preprocessing - II

Lecture 4 - Association Rules

Lecture 5 - Apriori algorithm

Lecture 6 - Rule generation

Lecture 7 - Classification

Lecture 8 - Decision Tree - I

Lecture 9 - Decision Tree - II

Lecture 10 - Decision Tree - III

Lecture 11 - Decision Tree - IV

Lecture 12 - Bayes Classifier - I

Lecture 13 - Bayes Classifier - II

Lecture 14 - Bayes Classifier - III

Lecture 15 - Bayes Classifier - IV

Lecture 16 - Bayes Classifier - V

Lecture 17 - K Nearest Neighbor - I

Lecture 18 - K Nearest Neighbor - II

Lecture 19

Lecture 20

Lecture 21

Lecture 22 - Support Vector Machine - I

Lecture 23 - Support Vector Machine - II

Lecture 24 - Support Vector Machine - III

Lecture 25 - Support Vector Machine - IV

Lecture 26 - Support Vector Machine - V

Lecture 27 - Kernel Machines

Lecture 28 - Artificial Neural Networks - I

Lecture 29 - Artificial Neural Networks - II

Lecture 30 - Artificial Neural Networks - III

Lecture 31 - Artificial Neural Networks - IV

[Lecture 32 - Clustering - I](#)

[Lecture 33 - Clustering - II](#)

[Lecture 34 - Clustering - III](#)

[Lecture 35 - Clustering - IV](#)

[Lecture 36 - Clustering - V](#)

[Lecture 37 - Regression - I](#)

[Lecture 38 - Regression - II](#)

[Lecture 39 - Regression - III](#)

[Lecture 40 - Regression - IV](#)

[Lecture 41 - Dimensionality Reduction - I](#)

[Lecture 42 - Dimensionality Reduction - II](#)

[Lecture 43 - Tutorial](#)

[Lecture 44 - Live Session](#)

Lecture 1 - Course Overview

Lecture 2 - Introduction to DBMS/1

Lecture 3 - Introduction to DBMS/2

Lecture 4 - Introduction to Relational Model/1

Lecture 5 - Introduction to Relational Model/2

Lecture 6 - Introduction to SQL/1

Lecture 7 - Introduction to SQL/2

Lecture 8 - Introduction to SQL/3

Lecture 9 - Intermediate SQL/1

Lecture 10 - Intermediate SQL/2

Lecture 11 - Advanced SQL

Lecture 12 - Formal Relational Query Languages

Lecture 13 - Entity-Relationship Model/1

Lecture 14 - Entity-Relationship Model/2

Lecture 15 - Entity-Relationship Model/3

Lecture 16 - Relational Database Design

Lecture 17 - Relational Database Design (Continued...)

Lecture 18 - Relational Database Design/3

Lecture 19 - Relational Database Design (Continued...)

Lecture 20 - Relational Database Design/5

Lecture 21 - Application Design and Development/1

Lecture 22 - Application Design and Development/2

Lecture 23 - Application Design and Development/3

Lecture 24 - Storage and File Structure/1: Storage

Lecture 25 - Storage and File Structure/2: File Structure

Lecture 26 - Indexing and Hashing/1 : Indexing/1

Lecture 27 - Indexing and Hashing/2 : Indexing/2

Lecture 28 - Indexing and Hashing/3 : Indexing/3

Lecture 29 - Indexing and Hashing/4 : Hashing

Lecture 30 - Indexing and Hashing/5 : Index Design

Lecture 31 - Transactions/1

[Lecture 32 - Transactions/2 : Serializability](#)

[Lecture 33 - Transactions/3 : Recoverability](#)

[Lecture 34 - Concurrency Control/1](#)

[Lecture 35 - Concurrency Control/2](#)

[Lecture 36 - Recovery/1](#)

[Lecture 37 - Recovery/2](#)

[Lecture 38 - Query Processing and Optimization/1 : Processing](#)

[Lecture 39 - Query Processing and Optimization/2 : Optimization](#)

[Lecture 40 - Course Summarization](#)

[Lecture 41 - Live Session](#)

[Lecture 42 - Live Session - 2](#)

Lecture 1 - Introduction - I

Lecture 2 - Introduction - II

Lecture 3 - Introduction - III

Lecture 4 - Introduction - IV

Lecture 5 - Introduction - V

Lecture 6 - Life Cycle Model

Lecture 7 - Life Cycle Model

Lecture 8 - Waterfall Model

Lecture 9 - Waterfall Derivatives

Lecture 10 - Incremental Model

Lecture 11 - Evolutionary Model

Lecture 12 - Agile Model

Lecture 13 - Extreme Programming and Scrum

Lecture 14 - Scrum

Lecture 15 - Introduction to requirement specification

Lecture 16 - Requirement gathering and analysis

Lecture 17 - Functional requirements

Lecture 18 - Representation of complex programming logic

Lecture 19 - Design Fundamentals

Lecture 20 - Modular Design

Lecture 21 - Classification of Cohesion

Lecture 22 - Classification of Coupling

Lecture 23 - Introduction to structured analysis and structured design

Lecture 24 - Basics of Data Flow Diagrams (DFD)

Lecture 25 - Developing DFD Model

Lecture 26 - Examples of DFD Model development

Lecture 27 - DFD Model - More Examples

Lecture 28 - Essentials of Structure Chart

Lecture 29 - Transform Analysis, Transaction Analysis

Lecture 30 - Structured Design Examples

Lecture 31 - Use Case Modelling

- Lecture 32 - Factoring Use Cases
- Lecture 33 - Overview of Class diagram
- Lecture 34 - Inheritance relationship
- Lecture 35 - Association relationship
- Lecture 36 - Aggregation/ Composition and dependency relations
- Lecture 37 - Interaction Modelling
- Lecture 38 - Development of Sequence diagrams
- Lecture 39 - State-Machine diagram
- Lecture 40 - An Object-Oriented design process
- Lecture 41 - Domain Analysis
- Lecture 42 - Examples of object-oriented design
- Lecture 43 - Basic concepts in Testing - I
- Lecture 44 - Basic concepts in Testing - II
- Lecture 45 - Basic concepts in Testing - III
- Lecture 46 - Unit testing strategies - I
- Lecture 47 - Unit testing strategies - II
- Lecture 48 - Equivalence Class Testing - I
- Lecture 49 - Equivalence Class Testing - II
- Lecture 50 - Special Value Testing
- Lecture 51 - Combinatorial Testing
- Lecture 52 - Decision Table Testing
- Lecture 53 - Cause effect graphing
- Lecture 54 - Pairwise Testing
- Lecture 55 - White box Testing
- Lecture 56 - Condition Testing
- Lecture 57 - MC/DC Coverage
- Lecture 58 - MC/DC Testing
- Lecture 59 - Path Testing
- Lecture 60 - Dataflow and Mutation Testing

- Lecture 1 - Introduction to Computer Networks - A brief history
- Lecture 2 - Data Networks - from Circuit Switching Network to Packet Switching Network
- Lecture 3 - Network Protocol Stack
- Lecture 4 - Services at the Different Layers of the Protocol Stack
- Lecture 5 - Application Layer I - Different Protocols at the Application Layer
- Lecture 6 - Application Layer II - Domain Name Systems
- Lecture 7 - Application Layer III - The Web
- Lecture 8 - Application Layer III - Hypertext Transfer Protocol
- Lecture 9 - Application Layer III - Internet Mail Transfer
- Lecture 10 - Application Layer IV - File Transfer (FTP)
- Lecture 11 - Transport Layer I - Services
- Lecture 12 - Transport Layer II - Connection
- Lecture 13 - Transport Layer II - Connection (Continued...)
- Lecture 14 - Transport Layer IV - Reliability
- Lecture 15 - Transport Layer V - Sliding Window Protocols
- Lecture 16 - Transport Layer Performance
- Lecture 17 - Buffer Management and Congestion Control
- Lecture 18 - Transport Layer Primitives
- Lecture 19 - Transmission Control Protocol I - Basics
- Lecture 20 - Transmission Control Protocol II - Connections
- Lecture 21 - Transmission Control Protocol III - Flow Control
- Lecture 22 - Transmission Control Protocol IV - Congestion Control
- Lecture 23 - User Datagram Protocol
- Lecture 24 - Socket Programming - I
- Lecture 25 - Socket Programming - II
- Lecture 26 - Network Layer I - Introduction
- Lecture 27 - IP Addressing (IPv4) I - Classful addressing
- Lecture 28 - IP Addressing (IPv4) II - CIDR
- Lecture 29 - IP Addressing (IPv4) III - Network Address Translation (NAT)
- Lecture 30 - IPv6 Addressing
- Lecture 31 - Internet QoS - I (What is QoS)

[Lecture 32 - Internet QoS - II \(Basic QoS Architecture\)](#)

[Lecture 33 - Internet QoS - III \(Traffic Policing and Traffic Shaping\)](#)

[Lecture 34 - Internet QoS - IV \(Traffic Scheduling\)](#)

[Lecture 35 - Internet QoS - V \(Integrated and Differentiated Service Architecture\)](#)

[Lecture 36 - IP Routing Table](#)

[Lecture 37 - Routing in the Internet I - Intra-domain routing](#)

[Lecture 38 - Routing in the Internet II - Routing protocols](#)

[Lecture 39 - Routing in the Internet III - Inter-domain Routing](#)

[Lecture 40 - Routing in the Internet IV - Border Gateway Protocol](#)

[Lecture 41 - IP Routers](#)

[Lecture 42 - IP Routers Demo](#)

[Lecture 43 - Software Defined Networking - I \(Basics\)](#)

[Lecture 44 - Software Defined Networking - II \(Open Flow\)](#)

[Lecture 45 - Software Defined Networking - III \(Demo\)](#)

[Lecture 46 - Data Link Layer - Overview](#)

[Lecture 47 - Data Link Layer - Basic Concepts](#)

[Lecture 48 - Data Link Layer - Ethernet](#)

[Lecture 49 - Data Link Layer - Ethernet \(Continued...\)](#)

[Lecture 50 - Data Link Layer - Flow and Error Control](#)

[Lecture 51 - ARP-RAPP-BOOTP-DHCP](#)

[Lecture 52 - ARP-RAPP-BOOTP-DHCP \(Continued...\)](#)

[Lecture 53](#)

[Lecture 54 - Wireless LANs](#)

[Lecture 55 - Layer 1: Physical Layer](#)

[Lecture 56 - Layer 1: Physical Layer - II](#)

[Lecture 57 - Layer 1: Physical Layer - III](#)

[Lecture 58 - Network Security - Overview](#)

[Lecture 59 - Network Security - II](#)

[Lecture 60 - Network Security - III \[TCP/IP Security\]](#)

- Lecture 1 - Introduction to Blockchain - I (Basics)
- Lecture 2 - Introduction to Blockchain - II (History)
- Lecture 3 - Introduction to Blockchain - III (Architecture)
- Lecture 4 - Introduction to Blockchain - IV (Conceptualization)
- Lecture 5 - Basic Crypto Primitives - I
- Lecture 6 - Basic Crypto Primitives - II
- Lecture 7 - Bitcoin Basics - I
- Lecture 8 - Bitcoin Basics - II
- Lecture 9 - Bitcoin Basics - III
- Lecture 10 - Distributed Consensus
- Lecture 11 - Consensus in Bitcoin - I (The Basics)
- Lecture 12 - Consensus in Bitcoin - II (PoW and Beyond)
- Lecture 13 - Consensus in Bitcoin - III (The Miners)
- Lecture 14 - Permissioned Blockchain - I (Basics)
- Lecture 15 - Permissioned Blockchain - II (Consensus)
- Lecture 16 - Permissioned Blockchain - III (RAFT Consensus)
- Lecture 17 - Permissioned Blockchain - IV (Byzantine General Problem)
- Lecture 18 - Permissioned Blockchain - V (Practical Byzantine Fault Tolerance)
- Lecture 19 - Blockchain for Enterprise - Overview
- Lecture 20 - Blockchain Components and Concepts
- Lecture 21 - Hyperledger Fabric - Transaction Flow
- Lecture 22 - Hyperledger Fabric Details
- Lecture 23 - Fabric - Membership and Identity Management
- Lecture 24 - Hyperledger Fabric Network Setup
- Lecture 25 - Fabric Demo on IBM Blockchain Cloud - I
- Lecture 26 - Fabric Demo on IBM Blockchain Cloud - II
- Lecture 27 - Fabric Demo, deploy from scratch - III
- Lecture 28 - Hyperledger Composer - Application Development
- Lecture 29 - Hyperledger Composer - Network Administration
- Lecture 30 - Blockchain Use Cases
- Lecture 31 - Blockchain in Financial Service - I (Payments and Secure Trading)

- Lecture 32 - Blockchain in Financial Service - II (Compliance and Mortgage)
- Lecture 33 - Blockchain in Financial Service - III (Financial Trade)
- Lecture 34 - Revolutionizing Global Trade
- Lecture 35 - Blockchain in Supply Chain - I
- Lecture 36 - Blockchain in Supply Chain - II
- Lecture 37 - Blockchain in Other Industries
- Lecture 38 - Blockchain in Government - I (Advantages)
- Lecture 39 - Blockchain in Government - II (Use Cases)
- Lecture 40 - Blockchain in Government - III (Digital Identity)
- Lecture 41 - Blockchain in Government - IV (Hyperledger Indy)
- Lecture 42 - Blockchain in Government - V (Tax Payments and Land Registry Records)
- Lecture 43 - Blockchain Security - I (Overview)
- Lecture 44 - Blockchain Security - II (Membership and Access control in Fabric)
- Lecture 45 - Blockchain Security - III (Privacy in Fabric)
- Lecture 46 - Blockchain Security - III (Fabric SideDB)
- Lecture 47 - Research Aspects - I (Consensus Scalability)
- Lecture 48 - Research Aspects - II (Bitcoin-NG)
- Lecture 49 - Research Aspects - III (Collective Signing)
- Lecture 50 - Research Aspects - IV (Byzcoin)
- Lecture 51 - Research Aspects - V (Algorand)
- Lecture 52 - Research Aspects - VI (Cross Fault Tolerance)
- Lecture 53 - Research Aspects - VII (Secured Multi-Party Computation)
- Lecture 54 - Blockchain for Science - I (Blockchain for Big Data)
- Lecture 55 - Blockchain for Science - II (Blockchain and AI)
- Lecture 56 - Comparing Ecosystems - Ethereum
- Lecture 57 - Comparing Ecosystems - Ethereum development tools and Quorum
- Lecture 58 - Comparing Ecosystems - Corda Part 1
- Lecture 59 - Comparing Ecosystems - Corda Part 2
- Lecture 60 - Concluding the course

Lecture 1 - Introduction

Lecture 2 - Octal and Hexadecimal Number Systems

Lecture 3 - Signed and Unsigned Binary Number Representation

Lecture 4 - Binary Addition and Subtraction

Lecture 5 - BCD and Gray Code Representations

Lecture 6 - Error Detection and Correction

Lecture 7 - Logic Gates

Lecture 8 - Logic Families to Implement Gates

Lecture 9 - Emerging Technologies - Part I

Lecture 10 - Emerging Technologies - Part II

Lecture 11 - Switching Algebra

Lecture 12 - Algebraic Manipulation

Lecture 13 - Properties of Switching Functions

Lecture 14 - Obtaining Canonical Representations of Functions

Lecture 15 - Functional Completeness

Lecture 16 - Minimization Using Karnaugh Maps - Part I

Lecture 17 - Minimization Using Karnaugh Maps - Part II

Lecture 18 - Minimization Using Karnaugh Maps - Part III

Lecture 19 - Minimization using Tabular Method - Part I

Lecture 20 - Minimization using Tabular Method - Part II

Lecture 21 - Design of Adders - Part I

Lecture 22 - Design of Adders - Part II

Lecture 23 - Design of Adders - Part III

Lecture 24 - Logic Design - Part I

Lecture 25 - Logic Design - Part II

Lecture 26 - Logic Design - Part III

Lecture 27 - Binary Decision Diagrams - Part I

Lecture 28 - Binary Decision Diagrams - Part II

Lecture 29 - Logic Design using AND-EXOR Network

Lecture 30 - Threshold Logic and Threshold Gates

Lecture 31 - Latches and Flip-Flops - Part I

- Lecture 32 - Latches and Flip-Flops - Part II
- Lecture 33 - Latches and Flip-Flops - Part III
- Lecture 34 - Clocking and Timing - Part I
- Lecture 35 - Clocking and Timing - Part II
- Lecture 36 - Synthesis of Synchronous Sequential Circuits - Part I
- Lecture 37 - Synthesis of Synchronous Sequential Circuits - Part II
- Lecture 38 - Synthesis of Synchronous Sequential Circuits - Part III
- Lecture 39 - Synthesis of Synchronous Sequential Circuits - Part IV
- Lecture 40 - Minimization of Finite State Machines - Part I
- Lecture 41 - Minimization of Finite State Machines - Part II
- Lecture 42 - Design of Registers - Part I
- Lecture 43 - Design of Registers - Part II
- Lecture 44 - Design of Registers - Part III
- Lecture 45 - Design of Counters - Part I
- Lecture 46 - Design of Counters - Part II
- Lecture 47 - Digital-to-Analog Converter - Part I
- Lecture 48 - Digital-to-Analog Converter - Part II
- Lecture 49 - Analog-to-Digital Converter - Part I
- Lecture 50 - Analog-to-Digital Converter - Part II
- Lecture 51 - Analog-to-Digital Converter - Part III
- Lecture 52 - Asynchronous Sequential Circuits - Part I
- Lecture 53 - Asynchronous Sequential Circuits - Part II
- Lecture 54 - Algorithmic State Machine (ASM Chart
- Lecture 55 - Testing of Digital Circuits
- Lecture 56 - Fault Modeling
- Lecture 57 - Test Pattern Generation
- Lecture 58 - Design for Testability
- Lecture 59 - Built-in Self-Test - Part I
- Lecture 60 - Built-in Self-Test - Part II

Lecture 1 - Background: Introduction

Lecture 2 - Probability: Concentration inequalities

Lecture 3 - Linear algebra: PCA, SVD

Lecture 4 - Optimization: Basics, Convex, GD

Lecture 5 - Machine Learning: Supervised, generalization, feature learning, clustering.

Lecture 6 - Memory-efficient data structures: Hash functions, universal / perfect hash families

Lecture 7 - Bloom filters

Lecture 8 - Sketches for distinct count

Lecture 9 - Sketches for distinct count (Continued...)

Lecture 10 - Misra-Gries sketch

Lecture 11 - Frequent Element: Space Saving and Count Min

Lecture 12 - Frequent Element: Count Sketch

Lecture 13 - Near Neighbors

Lecture 14 - Locality Sensitive Hashing

Lecture 15 - Building LSH Tables

Lecture 16 - Approximate near neighbors search: Extensions e.g. multi-probe, b-bit hashing, Data dependent variants

Lecture 17 - Approximate near neighbors search: Extensions e.g. multi-probe, b-bit hashing, Data dependent variants (Continued...)

Lecture 18 - Approximate near neighbors search: Extensions e.g. multi-probe, b-bit hashing, Data dependent variants (Continued...)

Lecture 19 - Randomized Numerical Linear Algebra: Random projection

Lecture 20 - Randomized Numerical Linear Algebra: Random projection (Continued...)

Lecture 21 - Randomized Numerical Linear Algebra: a) Matrix multiplication + QB decomposition

Lecture 22 - Randomized Numerical Linear Algebra: b) CUR+CX

Lecture 23 - Randomized Numerical Linear Algebra: a) L2 regression using RP

Lecture 24 - Randomized Numerical Linear Algebra: b) Leverage scores

Lecture 25 - Randomized Numerical Linear Algebra: c) Hash Kernels + Kitchen Sink

Lecture 26 - Map-reduce and Hadoop

Lecture 27 - Hadoop System

Lecture 28 - Hadoop System (Continued...)

Lecture 29 - Hadoop System (Continued...)

Lecture 30 - Spark

Lecture 31 - Spark (Continued...)

[Lecture 32 - Spark \(Continued...\)](#)

[Lecture 33 - Distributed Machine Learning and Optimization: Introduction](#)

[Lecture 34 - SGD+Proof](#)

[Lecture 35 - SGD+Proof \(Continued...\)](#)

[Lecture 36 - Distributed Machine Learning and Optimization:ADMM + applications](#)

[Lecture 37 - Distributed Machine Learning and Optimization:ADMM + applications \(Continued...\)](#)

[Lecture 38 - Clustering](#)

[Lecture 39 - Clustering \(Continued...\)](#)

[Lecture 40 - Conclusion](#)

[Lecture 1 - Introduction](#)

[Lecture 2 - Introduction \(Continued...\)](#)

[Lecture 3 - Introduction \(Continued...\)](#)

[Lecture 4 - Introduction \(Continued...\)](#)

[Lecture 5 - Introduction \(Continued...\)](#)

[Lecture 6 - Introduction \(Continued...\)](#)

[Lecture 7 - Lexical Analysis](#)

[Lecture 8 - Lexical Analysis \(Continued...\)](#)

[Lecture 9 - Lexical Analysis \(Continued...\)](#)

[Lecture 10 - Lexical Analysis \(Continued...\)](#)

[Lecture 11 - Lexical Analysis \(Continued...\)](#)

[Lecture 12 - Lexical Analysis \(Continued...\)](#)

[Lecture 13 - Lexical Analysis \(Continued...\)](#)

[Lecture 14 - Lexical Analysis \(Continued...\)](#)

[Lecture 15 - Lexical Analysis \(Continued...\)](#)

[Lecture 16 - Parser](#)

[Lecture 17 - Parser \(Continued...\)](#)

[Lecture 18 - Parser \(Continued...\)](#)

[Lecture 19 - Parser \(Continued...\)](#)

[Lecture 20 - Parser \(Continued...\)](#)

[Lecture 21 - Parser \(Continued...\)](#)

[Lecture 22 - Parser \(Continued...\)](#)

[Lecture 23 - Parser \(Continued...\)](#)

[Lecture 24 - Parser \(Continued...\)](#)

[Lecture 25 - Parser \(Continued...\)](#)

[Lecture 26 - Parser \(Continued...\)](#)

[Lecture 27 - Parser \(Continued...\)](#)

[Lecture 28 - Parser \(Continued...\)](#)

[Lecture 29 - Parser \(Continued...\)](#)

[Lecture 30 - Parser \(Continued...\)](#)

[Lecture 31 - Parser \(Continued...\)](#)

- Lecture 32 - SR Latch and Introduction to Clocked Flip-Flop
- Lecture 33 - Edge-Triggered Flip-Flop
- Lecture 34 - Representations of Flip-Flops
- Lecture 35 - Analysis of Sequential Logic Circuit
- Lecture 36 - Conversion of Flip-Flops and Flip-Flop Timing Parameters
- Lecture 37 - Register and Shift Register: PIPO and SISO
- Lecture 38 - Shift Register: SIPO, PISO and Universal Shift Register
- Lecture 39 - Application of Shift Register
- Lecture 40 - Linear Feedback Shift Register
- Lecture 41 - Serial Addition, Multiplication and Division
- Lecture 42 - Type Checking (Continued...)
- Lecture 43 - Symbol Table
- Lecture 44 - Symbol Table (Continued...)
- Lecture 45 - Symbol Table (Continued...)
- Lecture 46 - Symbol Table (Continued...) and Runtime Environment
- Lecture 47 - Runtime Environment
- Lecture 48 - Runtime Environment (Continued...)
- Lecture 49 - Runtime Environment (Continued...)
- Lecture 50 - Intermediate Code Generation
- Lecture 51 - Intermediate Code Generation (Continued...)
- Lecture 52 - Intermediate Code Generation (Continued...)
- Lecture 53 - Intermediate Code Generation (Continued...)
- Lecture 54 - Intermediate Code Generation (Continued...)
- Lecture 55 - Intermediate Code Generation (Continued...)
- Lecture 56 - Intermediate Code Generation (Continued...)
- Lecture 57 - Intermediate Code Generation (Continued...)
- Lecture 58 - Intermediate Code Generation (Continued...)
- Lecture 59 - Intermediate Code Generation (Continued...)
- Lecture 60 - Intermediate Code Generation (Continued...)
- Lecture 61 - Intermediate Code Generation (Continued...)

Lecture 1 - Introduction

Lecture 2 - Java Programming Steps

Lecture 3 - Java Tools and Resources

Lecture 4 - Demonstration - I

Lecture 5 - Java Applet Programming

Lecture 6 - Demonstration - II

Lecture 7 - Encapsulation

Lecture 8 - Demonstration - III

Lecture 9 - Java Programming Insights

Lecture 10 - Demonstration - IV

Lecture 11 - Java Static Scope Rule

Lecture 12 - Demonstration - V

Lecture 13 - Inheritance

Lecture 14 - Demonstration - VI

Lecture 15 - Information Hiding

Lecture 16 - Demonstration - VII

Lecture 17 - Packages - I

Lecture 18 - Packages - II

Lecture 19 - Demonstration - VIII

Lecture 20 - Interface - I

Lecture 21 - Interface - II

Lecture 22 - Demonstration - IX

Lecture 23 - Exception Handling - I

Lecture 24 - Exception Handling - II

Lecture 25 - Exception Handling - III

Lecture 26 - Demonstration - X

Lecture 27 - Multithreading - I

Lecture 28 - Multithreading - II

Lecture 29 - Demonstration - XI

Lecture 30 - I-O Stream - I

Lecture 31 - I-O Stream - II

Lecture 32 - I-O Stream - III
Lecture 33 - Demonstration - XII
Lecture 34 - Applet Programming - I
Lecture 35 - Applet Programming - II
Lecture 36 - Applet Programming - III
Lecture 37 - Demonstration - XIII
Lecture 38 - Demonstration - XIV
Lecture 39 - AWT Programming - I
Lecture 40 - AWT Programming - II
Lecture 41 - Demonstration - XV
Lecture 42 - AWT Programming - III
Lecture 43 - Swing - I
Lecture 44 - Swing - II
Lecture 45 - Demonstration - XVI
Lecture 46 - Demonstration - XVII
Lecture 47 - Demonstration - XVIII
Lecture 48 - Networking with Java
Lecture 49 - Demonstration - XIX
Lecture 50 - JDBC - I
Lecture 51 - JDBC - II
Lecture 52 - JDBC - III
Lecture 53 - Demonstration - XX
Lecture 54 - Demonstration - XXI
Lecture 55 - Demonstration - XXII
Lecture 56 - Case Studies - I
Lecture 57 - Case Studies - II
Lecture 58 - Case Studies - III
Lecture 59 - Case Studies - IV
Lecture 60 - Case Studies - V

[Lecture 1 - Introduction to Propositional Logic](#)

[Lecture 2 - Introduction to Propositional Logic \(Continued...\)](#)

[Lecture 3 - Introduction to Propositional Logic \(Continued...\)](#)

[Lecture 4 - Introduction to Propositional Logic \(Continued...\)](#)

[Lecture 5 - Introduction to Propositional Logic \(Continued...\)](#)

[Lecture 6 - Introduction to Propositional Logic \(Continued...\)](#)

[Lecture 7 - Predicate Logic](#)

[Lecture 8 - Predicate Logic \(Continued...\)](#)

[Lecture 9 - Predicate Logic \(Continued...\)](#)

[Lecture 10 - Predicate Logic \(Continued...\)](#)

[Lecture 11 - Proof Techniques](#)

[Lecture 12 - Proof Techniques \(Continued...\)](#)

[Lecture 13 - Proof Techniques \(Continued...\)](#)

[Lecture 14 - Proof Techniques \(Continued...\)](#)

[Lecture 15 - Proof Techniques \(Continued...\)](#)

[Lecture 16 - Sets and Functions](#)

[Lecture 17 - Sets and Functions \(Continued...\)](#)

[Lecture 18 - Sets and Functions \(Continued...\)](#)

[Lecture 19 - Sets and Functions \(Continued...\)](#)

[Lecture 20 - Sets and Functions \(Continued...\)](#)

[Lecture 21 - Relations and their Properties](#)

[Lecture 22 - Relations and their Properties \(Continued...\)](#)

[Lecture 23 - Relations and their Properties \(Continued...\)](#)

[Lecture 24 - Relations and their Properties \(Continued...\)](#)

[Lecture 25 - Relations and their Properties \(Continued...\)](#)

[Lecture 26 - Recursion](#)

[Lecture 27 - Recursion \(Continued...\)](#)

[Lecture 28 - Recursion \(Continued...\)](#)

[Lecture 29 - Recursion \(Continued...\)](#)

[Lecture 30 - Recursion \(Continued...\)](#)

[Lecture 31 - Recurrence relations](#)

- [Lecture 32 - Recurrence relations \(Continued...\)](#)
- [Lecture 33 - Recurrence relations \(Continued...\)](#)
- [Lecture 34 - Recurrence relations \(Continued...\)](#)
- [Lecture 35 - Recurrence relations \(Continued...\)](#)
- [Lecture 36 - Counting Techniques and Pigeonhole Principle](#)
- [Lecture 37 - Counting Techniques and Pigeonhole Principle \(Continued...\)](#)
- [Lecture 38 - Counting Techniques and Pigeonhole Principle \(Continued...\)](#)
- [Lecture 39 - Counting Techniques and Pigeonhole Principle \(Continued...\)](#)
- [Lecture 40 - Counting Techniques and Pigeonhole Principle \(Continued...\)](#)
- [Lecture 41 - Combinatorics](#)
- [Lecture 42 - Combinatorics \(Continued...\)](#)
- [Lecture 43 - Combinatorics \(Continued...\)](#)
- [Lecture 44 - Combinatorics \(Continued...\)](#)
- [Lecture 45 - Combinatorics \(Continued...\)](#)
- [Lecture 46 - Algebraic Structures](#)
- [Lecture 47 - Algebraic Structures \(Continued...\)](#)
- [Lecture 48 - Algebraic Structures \(Continued...\)](#)
- [Lecture 49 - Algebraic Structures \(Continued...\)](#)
- [Lecture 50 - Algebraic Structures \(Continued...\)](#)
- [Lecture 51 - Ring and Modular Arithmetic](#)
- [Lecture 52 - Ring and Modular Arithmetic \(Continued...\)](#)
- [Lecture 53 - Ring and Modular Arithmetic \(Continued...\)](#)
- [Lecture 54 - Ring and Modular Arithmetic \(Continued...\)](#)
- [Lecture 55 - Ring and Modular Arithmetic \(Continued...\)](#)
- [Lecture 56 - Finite Field and Applications](#)
- [Lecture 57 - Finite Field and Applications \(Continued...\)](#)
- [Lecture 58 - Finite Field and Applications \(Continued...\)](#)
- [Lecture 59 - Finite Field and Applications \(Continued...\)](#)
- [Lecture 60 - Finite Field and Applications \(Continued...\)](#)

Lecture 1 - Introduction To Embedded Systems

Lecture 2 - Design Considerations of Embedded Systems

Lecture 3 - Microprocessors and Microcontrollers

Lecture 4 - Architecture of ARM Microcontroller - Part 1

Lecture 5 - Architecture of ARM Microcontroller - Part 2

Lecture 6 - Architecture of ARM Microcontroller - Part 3

Lecture 7 - ARM Instruction Set - Part 1

Lecture 8 - ARM Instruction Set - Part 2

Lecture 9 - ARM Instruction Set - Part 3

Lecture 10 - About the STM32F401 Nucleo Board

Lecture 11 - PWM and Interrupt on STM32F401

Lecture 12 - Digital to Analog Conversion

Lecture 13 - Analog to Digital Conversion - Part 1

Lecture 14 - Analog to Digital Conversion - Part 2

Lecture 15 - Output Devices, Sensors and Actuators - Part 1

Lecture 16 - Output Devices, Sensors and Actuators - Part 2

Lecture 17 - Output Devices, Sensors and Actuators - Part 3

Lecture 18 - Microcontroller Development Boards

Lecture 19 - Mbed C Programming Environment

Lecture 20 - Interfacing With STM32F401 Board

Lecture 21 - Interfacing With Arduino Uno

Lecture 22 - Interfacing 7-Segment Led And LCD Displays - Part 1

Lecture 23 - Interfacing 7-segment LED and LCD Displays - Part 2

Lecture 24 - Serial Port Terminal Application (Coolterm)

Lecture 25 - Experiment With Temperature Sensor

Lecture 26 - Experiment With Ldr Light Sensor - Part 1

Lecture 27 - Experiment With Ldr Light Sensor - Part 2

Lecture 28 - Experiment With Speaker

Lecture 29 - Experiment With Microphone

Lecture 30 - Design Of Control System

Lecture 31 - Experiments With Relay

[Lecture 32 - Experiments On Speed Control Of Dc Motor](#)

[Lecture 33 - Experiment With Multiple Sensors And Relay](#)

[Lecture 34 - Introduction To Internet Of Things](#)

[Lecture 35 - Gsm And Bluetooth](#)

[Lecture 36 - Design Of A Home Automation System](#)

[Lecture 37 - Design Of A Simple Alarm System Using Touch Sensor](#)

[Lecture 38 - Accelerometer](#)

[Lecture 39 - Experiment Using Accelerometer](#)

[Lecture 40 - Experiment Using Bluetooth](#)

[Lecture 41 - Experiment With Gas Sensor](#)

[Lecture 42 - Summarization Of The Course](#)

Lecture 1 - Introduction to Hardware Security - Part 1

Lecture 2 - Introduction to Hardware Security - Part 2

Lecture 3 - Algorithm to Hardware

Lecture 4 - Finite Field Architectures - 1

Lecture 5 - Finite Field Architectures - 1 (Continued...)

Lecture 6 - Hardware Design for Finite Field Inverse

Lecture 7 - Hardware Architecture for Finite Field Inverse

Lecture 8 - Background on Cryptography, Cryptanalysis and Advanced Encryption Standard (AES)

Lecture 9 - Advanced Encryption Standard (AES) and Side Channel Analysis

Lecture 10 - Field Isomorphisms

Lecture 11 - Field Isomorphisms (Continued...)

Lecture 12 - Hardware Implementation of Advanced Encryption

Lecture 13 - Hardware Implementation of Advanced Encryption

Lecture 14 - Hardware Implementation of Advanced Encryption (Continued...)

Lecture 15 - Compact AES-Box

Lecture 16 - Compact AES S-Box - Part II

Lecture 17 - Compact AES S-Box in Normal Basis - Part I

Lecture 18 - Compact AES S-Box in Normal Basis - Part II

Lecture 19 - Hardware for Elliptic Curve Cryptography - Part I

Lecture 20 - Hardware for Elliptic Curve Cryptography - Part II

Lecture 21 - Hardware for Elliptic Curve Cryptography - Part III

Lecture 22 - Hardware for Elliptic Curve Cryptography - Part IV

Lecture 23 - Hardware for Elliptic Curve Cryptography - Part V

Lecture 24 - Introduction to Side Channel Analysis

Lecture 25 - Power Analysis - Part I

Lecture 26

Lecture 27

Lecture 28

Lecture 29

Lecture 30

Lecture 31 - Power Analysis - Part VII

[Lecture 32 - Power Analysis - Part VIII](#)

[Lecture 33 - Power Analysis - Part IX](#)

[Lecture 34 - Power Analysis - Part X](#)

[Lecture 35 - Power Analysis - Part XI](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

[Lecture 41 - Power Analysis - Part XVII](#)

[Lecture 42 - Power Analysis - Part XVIII](#)

[Lecture 43 - Power Analysis Countermeasures](#)

[Lecture 44 - Power Analysis Countermeasures \(Continued...\)](#)

[Lecture 45 - Power Analysis Countermeasures \(Continued...\)](#)

[Lecture 46 - Fault Analysis of Cryptosystems](#)

[Lecture 47 - Improved DFA of AES](#)

[Lecture 48 - Multi-Byte and key Scheduling Based Fault Analysis of AES](#)

[Lecture 49 - Multi-Byte and key Scheduling Based Fault Analysis of AES \(Continued...\)](#)

[Lecture 50 - Redundancy Based Fault Intensity](#)

[Lecture 51 - Redundancy Base Fault Countermeasures and Differential Fault Intensity Attacks \(Continued...\)](#)

[Lecture 52 - Infective Countermeasures for DFA](#)

[Lecture 53 - Infective Countermeasures for DFA \(Continued...\)](#)

[Lecture 54 - Infective Countermeasures for DFA \(Continued...\)](#)

[Lecture 55 - Microarchitectural attacks: Part I cache Timing attacks on Block ciphers](#)

[Lecture 56 - Microarchitectural attacks: Part I cache Timing attacks on Block ciphers \(Continued...\)](#)

[Lecture 57 - Microarchitectural attacks: Part II Branch Prediction Attacks](#)

[Lecture 58 - Microarchitectural attacks: Part II Branch Prediction Attacks \(Continued...\)](#)

[Lecture 59 - Microarchitectural attacks: Part III Row Hammer Attacks](#)

[Lecture 60 - Microarchitectural attacks: Part III Row Hammer Attacks \(Continued...\)](#)

Lecture 1 - Introduction: Sensing and Actuation

Lecture 2 - Introduction: IoT Connectivity - Part 1

Lecture 3 - Introduction: IoT Connectivity - Part 2

Lecture 4 - Introduction: IoT Networking - Part 1

Lecture 5 - Introduction: IoT Networking - Part 2

Lecture 6 - Industry 4.0: The Fourth Revolution

Lecture 7 - Industry 4.0: Sustainability Assessment of Manufacturing Industry

Lecture 8 - Industry 4.0: Lean Production System

Lecture 9 - Industry 4.0: Smart and Connected Business Perspective

Lecture 10 - Industry 4.0: Smart Factories

Lecture 11 - Industry 4.0: Cyber-Physical Systems and Next-Generation Sensors

Lecture 12 - Industry 4.0: Collaboration Platform and Product Lifecycle Management

Lecture 13 - Industry 4.0: Augmented Reality and Virtual Reality

Lecture 14 - Industry 4.0: Artificial Intelligence

Lecture 15 - Industry 4.0: Big Data and Advanced Analysis

Lecture 16 - Industry 4.0: Cybersecurity

Lecture 17 - Basics of Industrial IoT: Introduction

Lecture 18 - Basics of Industrial IoT: Industrial Internet Systems

Lecture 19 - Basics of IIoT: Industrial Sensing and Actuation

Lecture 20 - Basics of Industrial IoT: Industrial Processes - Part 1

Lecture 21 - Basics of Industrial IoT: Industrial Processes - Part 2

Lecture 22 - Business Models and Reference Architecture for IIoT: Business Models - Part 1

Lecture 23 - Business Models and Reference Architecture for IIoT: Business Models - Part 2

Lecture 24 - Business Models and Reference Architecture for IIoT: Reference Architecture - Part 1

Lecture 25 - Business Models and Reference Architecture for IIoT: Reference Architecture - Part 2

Lecture 26 - Key Enablers of Industrial IoT: Sensing - Part 1

Lecture 27 - Key Enablers of Industrial IoT: Sensing - Part 2

Lecture 28 - Key Enablers of Industrial IoT: Connectivity - Part 1

Lecture 29 - Key Enablers of Industrial IoT: Connectivity - Part 2

Lecture 30 - Key Enablers of Industrial IoT: Connectivity - Part 3

Lecture 31 - Key Enablers of Industrial IoT: Connectivity - Part 4

- Lecture 32 - Key Enablers of Industrial IoT: Connectivity - Part 5
- Lecture 33 - Key Enablers of Industrial IoT: Processing - Part 1
- Lecture 34 - Key Enablers of Industrial IoT: Processing - Part 2
- Lecture 35 - Key Enablers of Industrial IoT: Process Control
- Lecture 36 - IIoT Analytics and Data Management: Introduction
- Lecture 37 - IIoT Analytics and Data Management: Machine Learning and Data Science - Part 1
- Lecture 38 - IIoT Analytics and Data Management: Machine Learning and Data Science - Part 2
- Lecture 39 - IIoT Analytics and Data Management: Cloud Computing in IIoT - Part 1
- Lecture 40 - IIoT Analytics and Data Management: Cloud Computing in IIoT - Part 2
- Lecture 41 - Analytics and Data Management: Fog Computing in IIoT
- Lecture 42 - IIoT Analytics and Data Management: Tutorial for R and Julia Programming
- Lecture 43 - IIoT Analytics and Data Management: Data Management with Hadoop
- Lecture 44 - IIoT Analytics and Data Management: Data Center Networks
- Lecture 45 - Advanced Technologies: Software-Defined Networking (SDN) in IIoT - Part 1
- Lecture 46 - Advanced Technologies: Software-Defined Networking (SDN) in IIoT - Part 2
- Lecture 47 - Advanced Technologies: Security in IIoT - Part 1
- Lecture 48 - Advanced Technologies: Security in IIoT - Part 2
- Lecture 49 - IIoT Applications: Factories and Assembly Line
- Lecture 50 - IIoT Applications: Food Industry
- Lecture 51 - IIoT Applications: Inventory Management and Quality Control
- Lecture 52 - IIoT Applications: Plant Security and Safety
- Lecture 53 - IIoT Applications: Facility Management
- Lecture 54 - IIoT Applications: Oil, Chemical and Pharmaceutical Industry
- Lecture 55 - IIoT Applications: UAVs in Industries
- Lecture 56 - IIoT Applications: Oil, Chemical and Pharmaceutical Industry
- Lecture 57 - IIoT Applications: UAVs in Industries
- Lecture 58 - Case Studies for Industry 4.0 and IIoT
- Lecture 59 - Milk Processing and Packaging Industries
- Lecture 60 - Manufacturing Industries - Part I
- Lecture 61 - Manufacturing Industries - Part II
- Lecture 62 - Student Projects - Part I
- Lecture 63 - Student Projects - Part II
- Lecture 64 - Virtual Reality Lab

- Lecture 1 - Deterministic Finite Automata (DFA)
- Lecture 2 - Input alphabet
- Lecture 3 - Extended transition function
- Lecture 4 - Language of DFA
- Lecture 5 - Building DFA
- Lecture 6 - Building DFA (Continued...)
- Lecture 7 - NFA (Nondeterministic Finite Automata)
- Lecture 8 - Language of a NFA
- Lecture 9 - Equivalence of DFAs and NFAs
- Lecture 10 - Subset Construction
- Lecture 11 - ϵ -NFA
- Lecture 12 - Extended transition function of NFA
- Lecture 13 - Language of NFA
- Lecture 14 - NFA to DFA
- Lecture 15 - NFA to DFA
- Lecture 16 - Regular expression
- Lecture 17 - Regular expression (Continued...)
- Lecture 18 - More on regular expression
- Lecture 19 - Equivalence of NFA and regular expression
- Lecture 20 - Equivalence of NFA and regular expression (Continued...)
- Lecture 21 - DFA to Regular expression
- Lecture 22 - DFA to Regular expression (Continued...)
- Lecture 23 - Construction of regular expression from a DFA (example)
- Lecture 24 - Closure properties of Regular Set
- Lecture 25 - Closure properties of Regular Set (Continued...)
- Lecture 26 - Substitution
- Lecture 27 - Pumping Lemma
- Lecture 28 - Application of the pumping lemma
- Lecture 29 - More on Pumping lemma
- Lecture 30 - Ardens Theorem
- Lecture 31 - Minimization of FA

- Lecture 32 - Minimization of FA (Continued...)
- Lecture 33 - Two way FA
- Lecture 34 - Finite automata with output
- Lecture 35 - Equivalence of Moore and Mealy machine
- Lecture 36 - Context free grammars (CFG)
- Lecture 37 - Context free language (CFL)
- Lecture 38 - More example on CFL
- Lecture 39 - More on CFG
- Lecture 40 - Derivation Tree/Parse Tree
- Lecture 41 - Leftmost and Rightmost derivations
- Lecture 42 - Ambiguity in CFG
- Lecture 43 - Simplification of CFG
- Lecture 44 - Algorithms to construct reduced grammar
- Lecture 45 - Elimination of Null and Unit productions
- Lecture 46 - Chomsky Normal Form (CNF)
- Lecture 47 - Greibach Normal Form (GNF)
- Lecture 48 - Pushdown Automata (PDA)
- Lecture 49 - Language accepted by PDA
- Lecture 50 - Example of a language accepted by PDA
- Lecture 51 - Deterministic PDA
- Lecture 52 - Equivalence of language accepted
- Lecture 53 - Equivalence PDA
- Lecture 54 - Equivalence PDA and CFL
- Lecture 55 - Equivalence PDA and CFL (Continued...)
- Lecture 56 - Relationship between regular language and CFL
- Lecture 57 - Pumping lemma for CFLs
- Lecture 58 - Closer properties of CFLs
- Lecture 59 - Turning Machine
- Lecture 60 - Language accepted by a Turning machine

[Lecture 1 - Introduction](#)

[Lecture 2 - Introduction \(Continued...\)](#)

[Lecture 3 - Introduction \(Continued...\)](#)

[Lecture 4 - Introduction \(Continued...\)](#)

[Lecture 5 - Introduction \(Continued...\)](#)

[Lecture 6 - Introduction \(Continued...\)](#)

[Lecture 7 - Operating System Structures](#)

[Lecture 8 - Operating System Structures \(Continued...\)](#)

[Lecture 9 - Operating System Structures \(Continued...\)](#)

[Lecture 10 - Operating System Structures \(Continued...\)](#)

[Lecture 11 - Operating System Structures \(Continued...\)](#)

[Lecture 12 - Processes](#)

[Lecture 13 - Processes \(Continued...\)](#)

[Lecture 14 - Processes \(Continued...\)](#)

[Lecture 15 - Processes \(Continued...\)](#)

[Lecture 16 - Processes \(Continued...\)](#)

[Lecture 17 - Processes \(Continued...\)](#)

[Lecture 18 - Processes \(Continued...\)](#)

[Lecture 19 - Threads](#)

[Lecture 20 - Threads \(Continued...\)](#)

[Lecture 21 - Threads \(Continued...\)](#)

[Lecture 22 - Threads \(Continued...\)](#)

[Lecture 23 - Threads, Scheduling](#)

[Lecture 24 - Scheduling](#)

[Lecture 25 - Scheduling \(Continued...\)](#)

[Lecture 26 - Scheduling \(Continued...\)](#)

[Lecture 27 - Scheduling \(Continued...\)](#)

[Lecture 28 - Scheduling \(Continued...\)](#)

[Lecture 29 - Process Synchronization](#)

[Lecture 30 - Process Synchronization \(Continued...\)](#)

[Lecture 31 - Process Synchronization \(Continued...\)](#)

[Lecture 32 - Process Synchronization \(Continued...\)](#)

[Lecture 33 - Process Synchronization \(Continued...\)](#)

[Lecture 34 - Process Synchronization \(Continued...\)](#)

[Lecture 35 - Synchronization Examples](#)

[Lecture 36 - Synchronization Examples, Deadlock](#)

[Lecture 37 - Deadlock](#)

[Lecture 38 - Deadlock \(Continued...\)](#)

[Lecture 39 - Deadlock \(Continued...\)](#)

[Lecture 40 - Deadlock \(Continued...\)](#)

[Lecture 41 - Memory Management](#)

[Lecture 42 - Memory Management \(Continued...\)](#)

[Lecture 43 - Memory Management \(Continued...\)](#)

[Lecture 44 - Memory Management \(Continued...\)](#)

[Lecture 45 - Memory Management \(Continued...\)](#)

[Lecture 46 - Memory Management \(Continued...\)](#)

[Lecture 47 - Memory Management \(Continued...\)](#)

[Lecture 48 - Memory Management \(Continued...\)](#)

[Lecture 49 - Virtual Memory](#)

[Lecture 50 - Virtual Memory \(Continued...\)](#)

[Lecture 51 - Virtual Memory \(Continued...\)](#)

[Lecture 52 - Virtual Memory \(Continued...\)](#)

[Lecture 53 - Virtual Memory \(Continued...\)](#)

[Lecture 54 - Virtual Memory \(Continued...\)](#)

[Lecture 55 - Virtual Memory \(Continued...\)](#)

[Lecture 56 - Virtual Memory \(Continued...\)](#)

[Lecture 57 - File System and Secondary Storage](#)

[Lecture 58 - File System and Secondary Storage \(Continued...\)](#)

[Lecture 59 - File System and Secondary Storage \(Continued...\)](#)

[Lecture 60 - File System and Secondary Storage \(Continued...\)](#)

Lecture 1 - Introduction

Lecture 2 - Feature Descriptor - I

Lecture 3 - Feature Descriptor - II

Lecture 4 - Bayesian Learning - I

Lecture 5 - Bayesian Learning - II

Lecture 6 - Discriminant Function - I

Lecture 7 - Discriminant Function - II

Lecture 8 - Discriminant Function - III

Lecture 9 - Linear Classifier - I

Lecture 10 - Linear Classifier - II

Lecture 11 - Support Vector Machine - I

Lecture 12 - Support Vector Machine - II

Lecture 13 - Linear Machine

Lecture 14 - Multiclass Support Vector Machine - I

Lecture 15 - Multiclass Support Vector Machine - II

Lecture 16 - Optimization

Lecture 17 - Optimization Techniques in Machine Learning

Lecture 18 - Nonlinear Functions

Lecture 19 - Introduction to Neural Network

Lecture 20 - Neural Network - II

Lecture 21 - Multilayer Perceptron - I

Lecture 22 - Multilayer Perceptron - II

Lecture 23 - Backpropagation Learning

Lecture 24 - Loss Function

Lecture 25 - Backpropagation Learning- Example - I

Lecture 26 - Backpropagation Learning- Example - II

Lecture 27 - Backpropagation Learning- Example - III

Lecture 28 - Autoencoder

Lecture 29 - Autoencoder Vs PCA - I

Lecture 30 - Autoencoder Vs PCA - II

Lecture 31 - Autoencoder Training

Lecture 32 - Autoencoder Variants - I

Lecture 33 - Autoencoder Variants - II

Lecture 34 - Convolution

Lecture 35 - Cross Correlation

Lecture 36 - CNN Architecture

Lecture 37 - MLP versus CNN, Popular CNN Architecture: LeNet

Lecture 38 - Popular CNN Architecture: AlexNet

Lecture 39 - Popular CNN Architecture: VGG16, Transfer Learning

Lecture 40 - Vanishing and Exploding Gradient

Lecture 41 - GoogleNet

Lecture 42 - ResNet, Optimisers: Momentum Optimiser

Lecture 43 - Optimisers: Momentum and Nesterov Accelerated Gradient (NAG) Optimiser

Lecture 44 - Optimisers: Adagrad Optimiser

Lecture 45 - Optimisers: RMSProp, AdaDelta and Adam Optimiser

Lecture 46 - Normalization

Lecture 47 - Batch Normalization - I

Lecture 48 - Batch Normalization - II

Lecture 49 - Layer, Instance, Group Normalization

Lecture 50 - Training Trick, Regularization, Early Stopping

Lecture 51 - Face Recognition

Lecture 52 - Deconvolution Layer

Lecture 53 - Semantic Segmentation - I

Lecture 54 - Semantic Segmentation - II

Lecture 55 - Semantic Segmentation - III

Lecture 56 - Image Denoising

Lecture 57 - Variational Autoencoder - I

Lecture 58 - Variational Autoencoder - II

Lecture 59 - Variational Autoencoder - III

Lecture 60 - Generative Adversarial Network

Lecture 1 - Fundamentals of Image Processing - Part I

Lecture 2 - Fundamentals of Image Processing - Part II

Lecture 3 - Image Transform - Part I

Lecture 4 - Image Transform - Part II

Lecture 5 - Projective Geometry - Part I

Lecture 6 - Projective Geometry - Part II

Lecture 7 - Projective Transformation

Lecture 8 - Homography: Properties - Part I

Lecture 9 - Homography: Properties - Part II

Lecture 10 - Homography: Properties - Part III

Lecture 11 - Camera Geometry - Part I

Lecture 12 - Camera Geometry - Part II

Lecture 13 - Camera Geometry - Part III

Lecture 14 - Camera Geometry - Part IV

Lecture 15 - Camera Geometry - Part V

Lecture 16 - Stereo Geometry - Part I

Lecture 17 - Stereo Geometry - Part II

Lecture 18 - Stereo Geometry - Part III

Lecture 19 - Stereo Geometry - Part IV

Lecture 20 - Stereo Geometry - Part V

Lecture 21 - Stereo Geometry - Part VI

Lecture 22 - Stereo Geometry - Part VII

Lecture 23 - Stereo Geometry - Part VIII

Lecture 24 - Feature Detection And Description - Part I

Lecture 25 - Feature Detection And Description - Part II

Lecture 26 - Feature Detection And Description - Part III

Lecture 27 - Feature Detection And Description - Part IV

Lecture 28 - Feature Detection And Description - Part V

Lecture 29 - Feature Matching And Model Fitting- Part I

Lecture 30 - Feature Matching And Model Fitting- Part II

Lecture 31 - Feature Matching And Model Fitting- Part III

- Lecture 32 - Feature Matching And Model Fitting- Part IV
- Lecture 33 - Feature Matching And Model Fitting- Part V
- Lecture 34 - Color Fundamentals And Processing-Part I
- Lecture 35 - Color Fundamentals And Processing-Part II
- Lecture 36 - Color Fundamentals And Processing-Part III
- Lecture 37 - Color Fundamentals And Processing-Part IV
- Lecture 38 - Color Fundamentals And Processing-Part V
- Lecture 39 - Color Fundamentals And Processing-Part VI
- Lecture 40 - Color Fundamentals And Processing-Part VII
- Lecture 41 - Range Image Processing - Part I
- Lecture 42 - Range Image Processing - Part II
- Lecture 43 - Range Image Processing - Part III
- Lecture 44 - Range Image Processing - Part IV
- Lecture 45 - Range Image Processing - Part V
- Lecture 46 - Clustering and Classification - Part I
- Lecture 47 - Clustering and Classification - Part II
- Lecture 48 - Clustering and Classification - Part III
- Lecture 49 - Clustering and Classification - Part IV
- Lecture 50 - Clustering and Classification - Part V
- Lecture 51 - Dimensional Reduction And Sparse Representation - Part I
- Lecture 52 - Dimensional Reduction And Sparse Representation - Part II
- Lecture 53 - Dimensional Reduction And Sparse Representation - Part III
- Lecture 54 - Dimensional Reduction And Sparse Representation - Part IV
- Lecture 55 - Deep Neural Architecture And Applications - Part I
- Lecture 56 - Deep Neural Architecture And Applications - Part II
- Lecture 57 - Deep Neural Architecture And Applications - Part III
- Lecture 58 - Deep Neural Architecture And Applications - Part IV
- Lecture 59 - Deep Neural Architecture And Applications - Part V
- Lecture 60 - Deep Neural Architecture And Applications - Part VI

Lecture 1 - Introduction to Ethical Hacking

Lecture 2 - Basic Concepts of Networking - Part I

Lecture 3 - Basic Concepts of Networking - Part II

Lecture 4 - TCP/IP Protocol Stack - Part I

Lecture 5 - TCP/IP Protocol Stack - Part II

Lecture 6 - IP addressing and routing - Part I

Lecture 7 - IP addressing and routing - Part II

Lecture 8 - TCP and UDP - Part I

Lecture 9 - TCP and UDP - Part II

Lecture 10 - IP subnetting

Lecture 11 - Routing protocols - Part I

Lecture 12 - Routing protocols - Part II

Lecture 13 - Routing protocols - Part III

Lecture 14 - IP version 6

Lecture 15 - Routing examples

Lecture 16 - Demonstration - Part I

Lecture 17 - Demonstration - Part II

Lecture 18 - Demonstration - Part III

Lecture 19 - Nessus Installation

Lecture 20 - How to use nessus

Lecture 21 - Metasploit Exploiting System Software - I

Lecture 22 - Metasploit Exploiting System Software - II

Lecture 23 - Metasploit Exploiting System Software and Privilege

Lecture 24 - Metasploit Social Eng Attack

Lecture 25 - MITM (Man in The middle) Attack

Lecture 26 - Basic concepts of cryptography

Lecture 27 - Private-key cryptography - Part I

Lecture 28 - Private-key cryptography - Part II

Lecture 29 - Public-key cryptography - Part I

Lecture 30 - Public-key cryptography - Part II

Lecture 31 - Cryptographic hash functions - Part I

- Lecture 32 - Cryptographic hash functions - Part II
- Lecture 33 - Digital signature and certificate
- Lecture 34 - Applications - Part I
- Lecture 35 - Applications - Part II
- Lecture 36 - Steganography
- Lecture 37 - Biometrics
- Lecture 38 - Network Based Attacks - Part I
- Lecture 39 - Network Based Attacks - Part II
- Lecture 40 - DNS and Email Security
- Lecture 41 - Password cracking
- Lecture 42 - Phishing attack
- Lecture 43 - Maloeware
- Lecture 44 - Wifi hacking
- Lecture 45 - Dos and DDos attack
- Lecture 46 - Elements of Hardware Security
- Lecture 47 - Side Channel Attacks - Part I
- Lecture 48 - Side Channel Attacks - Part II
- Lecture 49 - Physical Unclonable Function
- Lecture 50 - Hardware Trojan
- Lecture 51 - Web Application Vulnerability Scanning
- Lecture 52 - SQL Injection Authentication Bypass - Part 1
- Lecture 53 - SQL Injection Error Based - Part 2
- Lecture 54 - SQL Injection Error Based from Web Application - Part 3
- Lecture 55 - SQLMAP
- Lecture 56 - Cross Site Scripting
- Lecture 57 - File Upload Vulnerability
- Lecture 58 - The NMAP Tool: A Relook - Part I
- Lecture 59 - The NMAP Tool: A Relook - Part II
- Lecture 60 - The NMAP Tool: A Relook - Part III
- Lecture 61 - Network Analysis using Wireshark
- Lecture 62 - Summarization of the Course

[Lecture 1 - Introduction - I](#)

[Lecture 2 - Introduction - II](#)

[Lecture 3 - Introduction - III](#)

[Lecture 4 - Project Management Standards](#)

[Lecture 5 - Life Cycle Models - I](#)

[Lecture 6 - Life Cycle Models - II](#)

[Lecture 7 - Life Cycle Models - III](#)

[Lecture 8 - Life Cycle Models - IV](#)

[Lecture 9 - Life Cycle Models - V](#)

[Lecture 10 - Life Cycle Models - VI](#)

[Lecture 11 - Project Evaluation and Programme Management](#)

[Lecture 12 - Project Evaluation and Programme Management \(Continued...\)](#)

[Lecture 13 - Project Evaluation and Programme Management \(Continued...\)](#)

[Lecture 14 - Project Evaluation and Programme Management \(Continued...\)](#)

[Lecture 15 - Project Evaluation and Programme Management \(Continued...\)](#)

[Lecture 16 - Project Estimation Techniques](#)

[Lecture 17 - Project Estimation Techniques \(Continued...\)](#)

[Lecture 18 - Project Estimation Techniques \(Continued...\)](#)

[Lecture 19 - Project Estimation Techniques \(Continued...\)](#)

[Lecture 20 - Project Estimation Techniques \(Continued...\)](#)

[Lecture 21 - Project Estimation Techniques \(Continued...\)](#)

[Lecture 22 - Project Estimation Techniques \(Continued...\)](#)

[Lecture 23 - Project Estimation Techniques \(Continued...\)](#)

[Lecture 24 - Project Estimation Techniques \(Continued...\)](#)

[Lecture 25 - Project Estimation Techniques \(Continued...\)](#)

[Lecture 26 - Project Scheduling](#)

[Lecture 27 - Project Scheduling Using PERT/CPM](#)

[Lecture 28 - Project Scheduling Using PERT/CPM \(Continued...\)](#)

[Lecture 29 - Computation of Project Characteristics Using PERT/CPM](#)

[Lecture 30 - Computation of Project Characteristics Using PERT/CPM: Illustration](#)

[Lecture 31 - PERT, Project Crashing](#)

[Lecture 32 - Team Management](#)

[Lecture 33 - Organization and Team Structure](#)

[Lecture 34 - Team Structure \(Continued...\) and Risk Management](#)

[Lecture 35 - Risk Management \(Continued...\) and Introduction to Software Quality](#)

[Lecture 36 - Resource Allocation](#)

[Lecture 37 - Resource Allocation \(Continued...\)](#)

[Lecture 38 - Resource Allocation \(Continued...\)](#)

[Lecture 39 - Project Monitoring and Control](#)

[Lecture 40 - Project Monitoring and Control \(Continued...\)](#)

[Lecture 41 - Project Monitoring and Control \(Continued...\)](#)

[Lecture 42 - Project Monitoring and Control \(Continued...\)](#)

[Lecture 43 - Project Monitoring and Control \(Continued...\)](#)

[Lecture 44 - Project Monitoring and Control \(Continued...\)](#)

[Lecture 45 - Project Monitoring and Control \(Continued...\)](#)

[Lecture 46 - Project Monitoring and Control \(Continued...\)](#)

[Lecture 47 - Project Monitoring and Control \(Continued...\)](#)

[Lecture 48 - Contract Management](#)

[Lecture 49 - Contract Management \(Continued...\)](#)

[Lecture 50 - Project Close Out](#)

[Lecture 51 - Software Quality Management](#)

[Lecture 52 - ISO 9000](#)

[Lecture 53 - ISO 9001, SEI CMM](#)

[Lecture 54 - SEI CMM \(Continued...\)](#)

[Lecture 55 - SEI CMM \(Continued...\)](#)

[Lecture 56 - Personal Software Process \(PSP\)](#)

[Lecture 57 - Software Reliability - I](#)

[Lecture 58 - Software Reliability - II](#)

[Lecture 59 - Software Reliability - III](#)

[Lecture 60 - Software Testing](#)

Lecture 1 - Introduction

Lecture 2 - Spatial Data Models - 1

Lecture 3 - Spatial Data Models - 2

Lecture 4 - Spatial Data Models - 3

Lecture 5 - Spatial Data Models - 4

Lecture 6 - Spatial Web Services - 1

Lecture 7 - Spatial Web Services - 2

Lecture 8 - Spatial Web Services - 3

Lecture 9 - Spatial Web Services - 4

Lecture 10 - Spatial Web Services - Demo

Lecture 11 - Spatial Database: An Overview

Lecture 12 - Spatial Query Processing / SQL - 1

Lecture 13 - Spatial Query Processing / SQL - 2

Lecture 14 - Spatial Query Processing / SQL - 3

Lecture 15 - Spatial Query Processing / SQL - 4

Lecture 16 - Spatial Query Demo Tutorial

Lecture 17 - Spatial Indexing - I

Lecture 18 - Spatial Indexing - II

Lecture 19 - Spatial Indexing - III

Lecture 20 - Spatial Indexing - IV

Lecture 21 - Spatial Networks - I

Lecture 22 - Spatial Networks - II

Lecture 23 - Spatial Networks - III

Lecture 24 - Spatial Networks - IV

Lecture 25 - Spatial Networks - V

Lecture 26 - Spatial Analysis - I

Lecture 27 - Spatial Analysis - II

Lecture 28 - Spatial Analysis - III

Lecture 29 - Spatial Analysis - IV

Lecture 30 - Spatial Analysis - V

Lecture 31 - Remote Sensing and GIS - I

[Lecture 32 - Remote Sensing and GIS - II](#)

[Lecture 33 - Remote Sensing and GIS - III](#)

[Lecture 34 - Remote Sensing and GIS - IIV](#)

[Lecture 35 - Remote Sensing and GIS - V](#)

[Lecture 36 - SDS / Spatial Cloud / GeoViz - I](#)

[Lecture 37 - SDS / Spatial Cloud / GeoViz - II](#)

[Lecture 38 - SDS / Spatial Cloud / GeoViz - III](#)

[Lecture 39 - SDS / Spatial Cloud / GeoViz - IV](#)

[Lecture 40 - SDS / Spatial Cloud / GeoViz - V](#)

- Lecture 1 - Review of basic COA w.r.t. performance
- Lecture 2 - Review of basic COA w.r.t. performance
- Lecture 3 - Review of basic COA w.r.t. performance
- Lecture 4 - Review of basic COA w.r.t. performance
- Lecture 5 - Intro to GPU architectures
- Lecture 6 - Intro to GPU architectures
- Lecture 7 - Intro to GPU architectures
- Lecture 8 - Intro to GPU architectures
- Lecture 9 - Intro to CUDA programming
- Lecture 10 - Intro to CUDA programming (Continued...)
- Lecture 11 - Intro to CUDA programming (Continued...)
- Lecture 12 - Intro to CUDA programming (Continued...)
- Lecture 13 - Multi-dimensional mapping of dataspace; Synchronization
- Lecture 14 - Multi-dimensional mapping of dataspace; Synchronization (Continued...)
- Lecture 15 - Multi-dimensional mapping of dataspace; Synchronization (Continued...)
- Lecture 16 - Warp Scheduling and Divergence
- Lecture 17 - Warp Scheduling and Divergence (Continued...)
- Lecture 18 - Warp Scheduling and Divergence (Continued...)
- Lecture 19 - Memory Access Coalescing
- Lecture 20 - Memory Access Coalescing (Continued...)
- Lecture 21 - Memory Access Coalescing (Continued...)
- Lecture 22 - Memory Access Coalescing (Continued...)
- Lecture 23 - Memory Access Coalescing (Continued...)
- Lecture 24 - Memory Access Coalescing (Continued...)
- Lecture 25 - Memory Access Coalescing (Continued...)
- Lecture 26 - Memory Access Coalescing (Continued...)
- Lecture 27 - Memory Access Coalescing (Continued...)
- Lecture 28 - Optimizing Reduction Kernels
- Lecture 29 - Optimizing Reduction Kernels (Continued...)
- Lecture 30 - Optimizing Reduction Kernels (Continued...)
- Lecture 31 - Optimizing Reduction Kernels (Continued...)

- [Lecture 32 - Optimizing Reduction Kernels \(Continued...\)](#)
- [Lecture 33 - Optimizing Reduction Kernels \(Continued...\)](#)
- [Lecture 34 - Optimizing Reduction Kernels \(Continued...\)](#)
- [Lecture 35 - Kernel Fusion, Thread and Block Coarsening](#)
- [Lecture 36 - Kernel Fusion, Thread and Block Coarsening \(Continued...\)](#)
- [Lecture 37 - Kernel Fusion, Thread and Block Coarsening \(Continued...\)](#)
- [Lecture 38 - Kernel Fusion, Thread and Block Coarsening \(Continued...\)](#)
- [Lecture 39 - Kernel Fusion, Thread and Block Coarsening \(Continued...\)](#)
- [Lecture 40 - Kernel Fusion, Thread and Block Coarsening \(Continued...\)](#)
- [Lecture 41 - OpenCL - Runtime System](#)
- [Lecture 42 - OpenCL - Runtime System \(Continued...\)](#)
- [Lecture 43 - OpenCL - Runtime System \(Continued...\)](#)
- [Lecture 44 - OpenCL - Runtime System \(Continued...\)](#)
- [Lecture 45 - OpenCL - Runtime System \(Continued...\)](#)
- [Lecture 46 - OpenCL - Runtime System \(Continued...\)](#)
- [Lecture 47 - OpenCL - Runtime System \(Continued...\)](#)
- [Lecture 48 - OpenCL - Heterogeneous Computing](#)
- [Lecture 49 - OpenCL - Heterogeneous Computing \(Continued...\)](#)
- [Lecture 50 - OpenCL - Heterogeneous Computing \(Continued...\)](#)
- [Lecture 51 - OpenCL - Heterogeneous Computing \(Continued...\)](#)
- [Lecture 52 - OpenCL - Heterogeneous Computing \(Continued...\)](#)
- [Lecture 53 - OpenCL - Heterogeneous Computing \(Continued...\)](#)
- [Lecture 54 - Efficient Neural Network Training/Inferencing](#)
- [Lecture 55 - Efficient Neural Network Training/Inferencing \(Continued...\)](#)
- [Lecture 56 - Efficient Neural Network Training/Inferencing \(Continued...\)](#)
- [Lecture 57 - Efficient Neural Network Training/Inferencing \(Continued...\)](#)
- [Lecture 58 - Efficient Neural Network Training/Inferencing \(Continued...\)](#)
- [Lecture 59 - Efficient Neural Network Training/Inferencing \(Continued...\)](#)
- [Lecture 60 - Efficient Neural Network Training/Inferencing \(Continued...\)](#)
- [Lecture 61 - Efficient Neural Network Training/Inferencing \(Continued...\)](#)
- [Lecture 62 - Efficient Neural Network Training/Inferencing \(Continued...\)](#)
- [Lecture 63 - Efficient Neural Network Training/Inferencing \(Continued...\)](#)

DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

NPTEL : NOC:Google Cloud Computing Foundation Course (Computer Science and Engineering)

Co-ordinators : Prof. Soumya Kanti Ghosh

Lecture 1 - Introduction to Cloud

Lecture 2 - Cloud Computing

Lecture 3 - Cloud vs Traditional Architecture

Lecture 4 - Iaas, PaaS and SaaS

Lecture 5 - Google Cloud Architecture

Lecture 6 - Cloud Computing Recap Quiz

Lecture 7 - Summary - Cloud Computing

Lecture 8 - Introduction - Start with a Solid Platform

Lecture 9 - The GCP Console

Lecture 10 - Understanding Projects

Lecture 11 - Billing in GCP

Lecture 12 - Install and Configure Cloud SDK

Lecture 13 - Use Cloud Shell

Lecture 14 - GCP APIs

Lecture 15 - Cloud Console Mobile App

Lecture 16 - Recap Quiz - Start with a Solid Foundation

Lecture 17 - Introduction

Lecture 18 - Compute Options in the Cloud

Lecture 19 - Exploring IaaS with Compute Engine

Lecture 20 - Configuring Elastic Apps with Autoscaling

Lecture 21 - Exploring PaaS with App Engine

Lecture 22 - Event Driven Programs with Cloud Functions

Lecture 23 - Containerizing and Orchestrating Apps with GKE

Lecture 24 - Summary

Lecture 25 - Introduction

Lecture 26 - Storage Options in the Cloud

Lecture 27 - Structured and Unstructured Storage in the Cloud

Lecture 28 - Unstructured Storage using Cloud Storage

Lecture 29 - SQL Managed Services

Lecture 30 - Exploring Cloud SQL

Lecture 31 - Cloud Spanner as a Managed Service

HTML Links for 108,400+ NPTEL Video Lectures, Created by Linuxpert Systems, Chennai

Lecture 32 - NoSQL Managed Services Options

Lecture 33 - Cloud Datastore a NoSQL Document Store

Lecture 34 - Cloud Bigtable as a NoSQL Option

Lecture 35 - Summary

Lecture 36 - Introduction to API

Lecture 37 - The Purpose of APIs

Lecture 38 - Cloud Endpoints

Lecture 39 - Using Apigee

Lecture 40 - Managed Message Services

Lecture 41 - Cloud Pub/Sub

Lecture 42 - Recap Quiz - There's an API for that!

Lecture 43 - Introduction - Cloud Security

Lecture 44 - Introduction to security in the cloud

Lecture 45 - Understanding the shared security model

Lecture 46 - Explore encryption options

Lecture 47 - Understand authentication and authorization

Lecture 48 - Identify best practices for authorization

Lecture 49 - Recap Quiz - Security

Lecture 50 - Summary - Security

Lecture 51 - Introduction

Lecture 52 - Intro to Networking in the Cloud

Lecture 53 - Defining a Virtual Private Cloud

Lecture 54 - Public and Private IP Address Basics

Lecture 55 - Googles Network Architecture

Lecture 56 - Routes and Firewall Rules in the Cloud

Lecture 57 - Multiple VPC Networks

Lecture 58 - Building Hybrid Clouds

Lecture 59 - Different Options for Load Balancing

Lecture 60 - Recap Quiz

Lecture 61 - Summary

Lecture 62 - Introduction - Let Google keep an eye on things

Lecture 63 - Introduction to IaC

Lecture 64 - Cloud Deployment Manager

[Lecture 65 - Monitoring and Managing Your Services, Apps, and Infra](#)

[Lecture 66 - Stackdriver](#)

[Lecture 67 - Recap Quiz - Let Google keep an eye on things](#)

[Lecture 68 - Summary - Let Google keep an eye on things](#)

[Lecture 69 - Introduction - You have the data, but what are you doing with it?](#)

[Lecture 70 - Intro to Big Data Managed Services in the Cloud](#)

[Lecture 71 - Leverage Big Data Operations with Cloud Dataproc](#)

[Lecture 72 - Build ETL Pipelines using Cloud Dataflow](#)

[Lecture 73 - BigQuery Googles Enterprise Data Warehouse](#)

[Lecture 74 - Recap Quiz - You have the data, but what are you doing with it?](#)

[Lecture 75 - Summary - You have the data, but what are you doing with it?](#)

[Lecture 76 - Introduction](#)

[Lecture 77 - Introduction to ML](#)

[Lecture 78 - ML and GCP](#)

[Lecture 79 - Building Bespoke ML models](#)

[Lecture 80 - Cloud AutoML](#)

[Lecture 81 - Googles Pre-trained ML APIs](#)

[Lecture 82 - Recap Quiz](#)

[Lecture 83 - Summary](#)

Lecture 1 - Introduction

Lecture 2 - Basic Concepts in UML

Lecture 3 - Introduction to Use case Modelling

Lecture 4 - Factoring Use Cases

Lecture 5 - Use Case Examples

Lecture 6 - Use Case Guidelines

Lecture 7 - Class Diagram

Lecture 8 - Class Relations

Lecture 9 - Binary and Unary Associations

Lecture 10 - Implementation of Association Relation in Java

Lecture 11 - Implementation of Association in General Case

Lecture 12 - Association Class and Ternary Association

Lecture 13 - Qualified Association

Lecture 14 - Aggregation and Composition

Lecture 15 - Dependency Relation

Lecture 16 - Class Diagram Exercises

Lecture 17 - Interfaces, Packages and Abstract Classes

Lecture 18 - Polymorphism

Lecture 19 - State Machine Diagrams

Lecture 20 - State Charts Overview

Lecture 21 - Features of State Machine Model

Lecture 22 - Example of State Machine Modelling

Lecture 23 - Encoding a State Machine - I

Lecture 24 - Encoding a State Machine - II

Lecture 25 - Interaction Diagrams

Lecture 26 - Sequence Diagram - I

Lecture 27 - Sequence Diagram - II

Lecture 28 - Activity Diagram

Lecture 29 - Introduction to OOAD

Lecture 30 - OOAD - I

Lecture 31 - OOAD - II

Lecture 32 - Example Application of OOAD

Lecture 33 - CRD Cards

Lecture 34 - Open/Closed Principle

Lecture 35 - LSP, ISP Principles

Lecture 36 - DIP Principle

Lecture 37 - Introduction to Design Pattern

Lecture 38 - GRASP Pattern: Introduction

Lecture 39 - Expert and Creator Pattern

Lecture 40 - Pure Fabrication, Law of Demeter

Lecture 41 - Introduction to GOF Patterns

Lecture 42 - Facade Pattern

Lecture 43 - Observer Pattern - I

Lecture 44 - Observer Pattern - II

Lecture 45 - Singleton Pattern - I

Lecture 46 - Singleton Pattern - II

Lecture 47 - State Pattern - I

Lecture 48 - State Pattern - II

Lecture 49 - Composite Pattern - I

Lecture 50 - Composite Pattern - II

Lecture 51 - Adapter Pattern - I

Lecture 52 - Adapter Pattern - II

Lecture 53 - Bridge Pattern - I

Lecture 54 - Bridge Pattern - II

Lecture 55 - Proxy Pattern - I

Lecture 56 - Proxy Pattern - II

Lecture 57 - Decorator Pattern - I

Lecture 58 - Decorator Pattern - II

Lecture 59 - Decorator Pattern - III

Lecture 60 - Iterator Pattern

Lecture 1 - Introduction and Course Plan

Lecture 2 - Generic Methods

Lecture 3 - Basics of Generic Class

Lecture 4 - Parameterized Generic Class

Lecture 5 - Bounded Argument Generic Class

Lecture 6 - Basics of the Framework

Lecture 7 - Collection in JCF

Lecture 8 - Set of JCF

Lecture 9 - Map Framework

Lecture 10 - Java Legacy Classes

Lecture 11 - Array Data Structures

Lecture 12 - Programming for Arrays

Lecture 13 - Class ArrayList for Arrays

Lecture 14 - Arrays for Arrays

Lecture 15 - Vector Class for Arrays

Lecture 16 - Linked List Data Structure - Part I

Lecture 17 - Linked List Data Structure - Part II

Lecture 18 - Programming for Linked Lists - Part I

Lecture 19 - Programming for Linked Lists - Part II

Lecture 20 - Linked Lists Using JCF

Lecture 21 - Stack Data Structures

Lecture 22 - Programming for Stack

Lecture 23 - Stack Using JCF

Lecture 24 - Queue Data Structure

Lecture 25 - Programming for Queue

Lecture 26 - Queue Using JCF

Lecture 27 - Understanding Tree Data Structures

Lecture 28 - Operations on Binary Tree Data Structures

Lecture 29 - Binary Search Tree

Lecture 30 - Programming for Binary Search Tree

Lecture 31 - Height Balanced Binary Search Tree

[Lecture 32 - Heap Tree](#)

[Lecture 33 - Programming for Heap Tree](#)

[Lecture 34 - Huffman Tree](#)

[Lecture 35 - Graph Structures](#)

[Lecture 36 - Graph Algorithms](#)

[Lecture 37 - Map Framework in Java](#)

[Lecture 38 - Applications of Map - Part I](#)

[Lecture 39 - Applications of Map - Part II](#)

[Lecture 40 - Collection Set](#)

[Lecture 41 - Operations on Set Collection](#)

[Lecture 42 - Introduction to java.io](#)

[Lecture 43 - IO with Byte Streams](#)

[Lecture 44 - IO with Character Streams](#)

[Lecture 45 - File Input-Output](#)

[Lecture 46 - Random Access File](#)

[Lecture 47 - Linear Searching Algorithms](#)

[Lecture 48 - Non-linear Searching Algorithms](#)

[Lecture 49 - Programs for Searching](#)

[Lecture 50 - Sorting Algorithms - Part I](#)

[Lecture 51 - Improved Sorting Algorithms](#)

[Lecture 52 - Advanced Sorting Algorithms](#)

[Lecture 53 - Programs for Sorting - Part I](#)

[Lecture 54 - Programs for Sorting - Part II](#)

[Lecture 55 - Sorting Using JCF](#)

[Lecture 56 - String Class](#)

[Lecture 57 - Applications of String](#)

[Lecture 58 - StringBuffer Class](#)

[Lecture 59 - Miscellaneous Utilities](#)

[Lecture 60 - Java Cursors](#)

Lecture 1 - Introduction

Lecture 2 - Introduction

Lecture 3 - Characteristics of a real-time embedded system

Lecture 4 - Characteristics of a real-time embedded system

Lecture 5 - Types of real-time tasks

Lecture 6 - Events in a Real-Time System

Lecture 7 - Types of time constraints

Lecture 8 - Basics of Real-Time Task scheduling

Lecture 9 - Clock-driven schedulers

Lecture 10 - Basics of Cyclic schedulers

Lecture 11 - Cyclic Scheduler

Lecture 12 - Frame size constraints

Lecture 13 - Frame size selection: Examples

Lecture 14 - Event-driven scheduling

Lecture 15 - EDF scheduler

Lecture 16 - Variants of EDF and Rate Monotonic Scheduling

Lecture 17 - Rate Monotonic Schedulability Analysis

Lecture 18 - Rate Monotonic Schedulability Analysis

Lecture 19 - Rate Monotonic Scheduling: Miscellaneous issues

Lecture 20 - RMS Generalizations

Lecture 21 - RMS Generalizations

Lecture 22 - Handling aperiodic and sporadic tasks in rate monotonic scheduling

Lecture 23 - Handling aperiodic and sporadic tasks in rate monotonic scheduling

Lecture 24 - Coping up with Insufficient number of priorities

Lecture 25 - Handling task jitter and precedence ordering

Lecture 26 - Resource Sharing Among Real-Time Tasks

Lecture 27 - Basic priority inheritance protocol (PIP)

Lecture 28 - Highest Locker Protocol (HLP)

Lecture 29 - Priority Ceiling Protocol (PCP)

Lecture 30 - Working of Priority Ceiling Protocol

Lecture 31 - Analysis of Priority Ceiling Protocol

- Lecture 32 - Introduction to Multiprocessor and Distributed Systems
- Lecture 33 - Static Allocation of Tasks
- Lecture 34 - Dynamic Allocation of Tasks
- Lecture 35 - Centralized Clock Synchronization in Distributed RT Systems
- Lecture 36 - Distributed Clock Synchronization in R-T Systems
- Lecture 37 - A Few Basics in Real-Time Operating Systems
- Lecture 38 - Time Services
- Lecture 39 - Unix as a Real-Time Operating System
- Lecture 40 - Unix as a Real-Time Operating System (Continued...)
- Lecture 41 - Windows as RTOS
- Lecture 42 - POSIX
- Lecture 43 - Unix-Based Real-Time Operating Systems
- Lecture 44 - A survey of some contemporary Real-Time Operating Systems
- Lecture 45 - A survey of some contemporary Real-Time Operating Systems (Continued...)
- Lecture 46 - Benchmarking Real-Time Systems
- Lecture 47 - Introduction to Real-Time Communication
- Lecture 48 - Basics of Real-Time Communication
- Lecture 49 - Basics of Networking
- Lecture 50 - Basics of Internet
- Lecture 51 - Real-Time Communication in a LAN
- Lecture 52 - Bounded Access Protocols for LANs
- Lecture 53 - Performance Comparison and QoS Framework
- Lecture 54 - Routing and Resource Reservation
- Lecture 55 - Rate Control
- Lecture 56 - QoS Models and Soft Real-Time Communication in a LAN
- Lecture 57 - Review of Basic Database Concepts
- Lecture 58 - Applications and Issues of Real-Time Database
- Lecture 59 - Characteristics of Temporal Data
- Lecture 60 - Locking-Based Concurrency Control In Real-Time Databases
- Lecture 61 - Concurrency Control In Real-Time Databases and Commercial RT Databases

- Lecture 1 - Introduction on Proteins
- Lecture 2 - Introduction on Proteins (Continued...) and Sequence Database
- Lecture 3 - Protein Data Bank
- Lecture 4 - PDB Parsing
- Lecture 5 - Molecular Visualization Tools
- Lecture 6 - Representation and Data Structure
- Lecture 7 - Digitization of a Molecule
- Lecture 8 - Application to Protein Docking, FFT
- Lecture 9 - Implementation Details
- Lecture 10 - Hashing
- Lecture 11 - Geometric Hashing
- Lecture 12 - Geometric Hashing (Continued...)
- Lecture 13 - Geometric Hashing (Continued...)
- Lecture 14 - Molecular Surface
- Lecture 15 - Genetic Algorithm (GA) for Surface Comparison
- Lecture 16 - Monte Carlo (MC) Method
- Lecture 17 - Monte Carlo Method (Continued...) and Random Number
- Lecture 18 - Monte Carlo (MC) Method (Continued...)
- Lecture 19 - Protein Folding
- Lecture 20 - Protein Folding (Continued...) and Protein Design
- Lecture 21 - Protein Energy Landscape
- Lecture 22 - Protein Energy Landscape (Continued...), Limitation of MC
- Lecture 23 - Replica Exchange Monte Carlo (REMC)
- Lecture 24 - Ab Initio Protein Folding
- Lecture 25 - Structure Alignment Measures
- Lecture 26 - Dynamic Programming
- Lecture 27 - Dynamic Programming (Continued...), Sequence Alignment
- Lecture 28 - Dynamic Programming (Continued...), Position Specific Scoring Matrix (PSSM)
- Lecture 29 - Structure Alignment
- Lecture 30 - Structure Alignment (Continued...)
- Lecture 31 - Structural Classification of Proteins (SCOP)

- Lecture 32 - SCOP (Continued...), Symmetry in Proteins
- Lecture 33 - Symmetry in Proteins
- Lecture 34 - Discriminating Biological Protein Interfaces from Crystal Artifacts
- Lecture 35 - Discriminating Biological Protein Interfaces from Crystal Artifacts (Continued...)
- Lecture 36 - Discriminating Biological Protein Interfaces from Crystal Artifacts (Continued...)
- Lecture 37 - Discriminating Biological Protein Interfaces from Crystal Artifacts (Continued...)
- Lecture 38 - Symmetry-Based Protein Complex Modeling
- Lecture 39 - Some Protein Docking Methods
- Lecture 40 - Some Protein Docking Methods (Continued...)
- Lecture 41 - Computational Protein Design (CPD)
- Lecture 42 - Computational Protein Design (CPD) (Continued...)
- Lecture 43 - Protein Design Energy Function
- Lecture 44 - Protein Design Analysis
- Lecture 45 - Application of Protein Design on Drug Design
- Lecture 46 - RECM in Protein Design
- Lecture 47 - Application of Protein Design on Drug Design
- Lecture 48 - Application of Protein Design on Drug Design (Continued...), Protein Modification
- Lecture 49 - Protein Modification (Continued...)
- Lecture 50 - Protein Modification (Continued...)
- Lecture 51 - Assigning Secondary Structure to Protein Sequence
- Lecture 52 - Assigning Secondary Structure to Protein Sequence (Continued...)
- Lecture 53 - Machine Learning to Predict the Secondary Structure from Amino Acid Sequences
- Lecture 54 - Machine Learning to Predict the Secondary Structure from Amino Acid Sequences (Continued...)
- Lecture 55 - Post Translational Modification
- Lecture 56 - Predicting Protein Phosphorylation Sites
- Lecture 57 - Predicting Protein Phosphorylation Sites (Continued...)
- Lecture 58 - Summarizing Protein Folding and Protein Docking
- Lecture 59 - Summarizing Protein Folding and Protein Docking (Continued...)
- Lecture 60 - Summarizing Protein Engineering

Lecture 1 - Course Outline

Lecture 2 - Quick Recap 01: Recap of C/1

Lecture 3 - Quick Recap 02: Recap of C/2

Lecture 4 - Course Overview

Lecture 5 - IO and Loop

Lecture 6 - Arrays and Strings

Lecture 7 - Sorting and Searching

Lecture 8 - Stack and Common Data Structures/Containers

Lecture 9 - Tutorial 1: How to build a C/C++ program?: Part 1: C Preprocessor (CPP)

Lecture 10 - Constants and Inline Functions

Lecture 11 - Reference and Pointer

Lecture 12 - Default Parameters and Function Overloading

Lecture 13 - Operator Overloading

Lecture 14 - Dynamic Memory Management

Lecture 15 - Tutorial 2: How to build a C/C++ program?: Part 2: Build Pipeline

Lecture 16 - Static Members

Lecture 17 - Classes and Objects

Lecture 18 - Access Specifiers

Lecture 19 - Constructors, Destructors and Object Lifetime

Lecture 20 - Copy Constructor and Copy Assignment Operator

Lecture 21 - Const-ness

Lecture 22 - Tutorial 3: How to build a C/C++ program?: Part 3: make Utility

Lecture 23 - Inheritance: Part 3 (Constructor and Destructor - Object Lifetime)

Lecture 24 - Friend Function and Friend Class

Lecture 25 - Overloading Operator for User-Defined Types: Part 1

Lecture 26 - Overloading Operator for User-Defined Types: Part 2

Lecture 27 - Namespace

Lecture 28 - Tutorial 4: How to build a C/C++ program?: Part 4: Static and Dynamic Library

Lecture 29 - Inheritance: Part 2 (Data Member and Member Function - Override and Overload)

Lecture 30 - Inheritance: Part 3 (Constructor and Destructor - Object Lifetime)

Lecture 31 - Inheritance: Part 4: Phone Hierarchy

- Lecture 32 - Inheritance: Part 5: private and protected Inheritance
- Lecture 33 - Tutorial 5: Mixing C and C++ Code: Part 1: Issues and Resolutions
- Lecture 34 - Polymorphism: Part 1: Type Casting
- Lecture 35 - Polymorphism: Part 2: Static and Dynamic Binding
- Lecture 36 - Polymorphism: Part 3: Abstract Base Class
- Lecture 37 - Polymorphism: Part 4: Staff Salary Processing using C
- Lecture 38 - Polymorphism: Part 5: Staff Salary Processing using C++
- Lecture 39 - Tutorial 6: Mixing C and C++ Code: Part 2: Project Example
- Lecture 40 - Virtual Function Table
- Lecture 41 - Type Casting and Cast Operators: Part 1
- Lecture 42 - Type Casting and Cast Operators: Part 2
- Lecture 43 - Type Casting and Cast Operators: Part 3
- Lecture 44 - Multiple Inheritance
- Lecture 45 - Tutorial 7: How to design a UDT like built-in types?: Part 1: Fraction UDT
- Lecture 46 - Exceptions (Error handling in C): Part 1
- Lecture 47 - Exceptions (Error handling in C++): Part 2
- Lecture 48 - Template (Function Template): Part 1
- Lecture 49 - Template (Class Template): Part 2
- Lecture 50 - Functors: Function Objects
- Lecture 51 - Tutorial 8: How to design a UDT like built-in types?: Part 2: Int and Poly UDT
- Lecture 52 - Input-Output: File Handling in C
- Lecture 53 - Input-Output: Streams in C++
- Lecture 54 - C++ Standard Library: Part 1 (Generic Programming)
- Lecture 55 - C++ Standard Library: Part 2 (STL)
- Lecture 56 - C++ Standard Library: Part 3 (STL)
- Lecture 57 - Tutorial 9: How to design a UDT like built-in types?: Part 3: Updates and Mixes of UDTs
- Lecture 58 - C++11 and beyond: General Features: Part 1
- Lecture 59 - C++11 and beyond: General Features: Part 2
- Lecture 60 - C++11 and beyond: General Features: Part 3
- Lecture 61 - C++11 and beyond: General Features: Part 4: Rvalue and Move/1
- Lecture 62 - C++11 and beyond: General Features: Part 5: Rvalue and Move/2
- Lecture 63 - Tutorial 10: How to optimize C++11 programs using Rvalue and Move Semantics?
- Lecture 64 - C++11 and beyond: General Features: Part 6: Rvalue and Perfect Forwarding

[Lecture 65 - C++11 and beyond: General Features: Part 7: Lambda in C++/1](#)

[Lecture 66 - C++11 and beyond: General Features: Part 8: Lambda in C++/2](#)

[Lecture 67 - C++11 and beyond: Class Features](#)

[Lecture 68 - C++11 and beyond: Non-class Types and Template Features](#)

[Lecture 69 - Tutorial 11: Compatibility of C and C++: Part 1: Significant Features](#)

[Lecture 70 - C++11 and beyond: Resource Management by Smart Pointers: Part 1](#)

[Lecture 71 - C++11 and beyond: Resource Management by Smart Pointers: Part 2](#)

[Lecture 72 - C++11 and beyond: Concurrency: Part 1](#)

[Lecture 73 - C++11 and beyond: Concurrency: Part 2](#)

[Lecture 74 - Closing Comments](#)

[Lecture 75 - Tutorial 12: Compatibility of C and C++: Part 2: Summary](#)

- Lecture 1 - The Model of Decentralization
- Lecture 2 - What is Blockchain
- Lecture 3 - Basic Cryptographic Primitives - I
- Lecture 4 - Basic Cryptographic Primitives - II
- Lecture 5 - Basic Cryptographic Primitives - III
- Lecture 6 - Basic Cryptographic Primitives - IV
- Lecture 7 - Basic Cryptographic Primitives - V
- Lecture 8 - Distributed Systems for Decentralization - The Beginning
- Lecture 9 - The Evolution of Cryptocurrencies
- Lecture 10 - Open Consensus and Bitcoin
- Lecture 11 - Bitcoin Mining and Beyond
- Lecture 12 - Smart Contracts and the Permissioned Models of Blockchain
- Lecture 13 - Blockchain Elements - I
- Lecture 14 - Blockchain Elements - II
- Lecture 15 - Blockchain Elements - III
- Lecture 16 - Blockchain Elements - IV
- Lecture 17 - Blockchain Elements - V
- Lecture 18 - Permissionless Model and Open Consensus
- Lecture 19 - Nakamoto Consensus (Proof of Work)
- Lecture 20 - Limitations of PoW: Forking and Security
- Lecture 21 - Beyond PoW
- Lecture 22 - Ethereum 1
- Lecture 23 - Ethereum 2
- Lecture 24 - Ethereum 3
- Lecture 25 - Ethereum 4
- Lecture 26 - Consensus for Permissioned Models
- Lecture 27 - State Machine Replication as Distributed Consensus
- Lecture 28 - Paxos
- Lecture 29 - Paxos - Safety and Liveness
- Lecture 30 - Byzantine Faults
- Lecture 31 - Byzantine Agreement Protocols

- Lecture 32 - Safety and Liveness of PBFT
- Lecture 33 - Enterprise Blockchains
- Lecture 34 - Hyperledger Fabric 1
- Lecture 35 - Hyperledger Fabric 2
- Lecture 36 - Hyperledger Fabric 3
- Lecture 37 - Hyperledger Fabric 4
- Lecture 38 - Consensus Scalability
- Lecture 39 - Bitcoin-NG
- Lecture 40 - Collective Signing (CoSi)
- Lecture 41 - ByzCoin
- Lecture 42 - Algorand
- Lecture 43 - Identity Management - I
- Lecture 44 - Identity Management - II
- Lecture 45 - Identity Management - III
- Lecture 46 - Blockchain Interoperability - I
- Lecture 47 - Blockchain Interoperability - II
- Lecture 48 - Blockchain Interoperability - III
- Lecture 49 - Hyperledger Indy - I
- Lecture 50 - Hyperledger Indy - II
- Lecture 51 - Hyperledger Aries
- Lecture 52 - Blockchain Security - I
- Lecture 53 - Blockchain Security - II
- Lecture 54 - Blockchain Security - III
- Lecture 55 - Use Cases
- Lecture 56 - A Potential Use Case From a Critics Perspective
- Lecture 57 - Blockchain in Financial Services
- Lecture 58 - Public Sector Use Cases
- Lecture 59 - Blockchain for Decentralized Marketplace - Part 1
- Lecture 60 - Blockchain for Decentralized Marketplace - Part 2

Lecture 1 - Introduction

Lecture 2 - Assumptions of Game Theory

Lecture 3 - Examples of Games

Lecture 4 - Equilibrium Concepts

Lecture 5 - Nash Equilibrium

Lecture 6 - Indifference Principle

Lecture 7 - Security of Players

Lecture 8 - Minmax Theorem

Lecture 9 - Implications of Minmax Theorem

Lecture 10 - MSNEs of Matrix Games

Lecture 11 - Iterative Eliminations of Dominated Strategies

Lecture 12 - Iterative Eliminations of Dominated Strategies (Continued...)

Lecture 13 - Braess's paradox

Lecture 14 - Yao's Lemma and its applications

Lecture 15 - Support Enumeration Algorithm

Lecture 16 - Succinct game

Lecture 17 - Potential Games

Lecture 18 - Best Response Dynamics

Lecture 19 - Fast Convergence of Best Response Dynamics

Lecture 20 - Computing ϵ -PSNE for Network Congestion Games

Lecture 21 - PSNE for Congestion Games

Lecture 22 - PSNE for Symmetric Congestion Games

Lecture 23 - Functional NP

Lecture 24 - PPAD Class

Lecture 25 - Sperner's Lemma

Lecture 26 - Approximate MSNE Computation

Lecture 27 - Correlated Equilibrium

Lecture 28 - Coarse Correlated Equilibrium

Lecture 29 - External Regret Framework

Lecture 30 - Multiplicative Weight Algorithm

Lecture 31 - Multiplicative Weight Algorithm (Continued....)

[Lecture 32 - Swap Regret and Correlated Equilibrium](#)

[Lecture 33 - Swap Regret to External Regret Reduction](#)

[Lecture 34 - Braess's paradox and Pigou's Network](#)

[Lecture 35 - PoA of Selfish Routing Game](#)

[Lecture 36 - PoA of Selfish Load Balancing Game](#)

[Lecture 37 - Bayesian Game](#)

[Lecture 38 - BNE of First Price Auction](#)

[Lecture 39 - Extensive Form Game](#)

[Lecture 40 - Mechanism Design Introduction](#)

[Lecture 41 - Implementation of Social Choice Functions](#)

[Lecture 42 - Revelation Principle](#)

[Lecture 43 - Properties of Social Choice Function](#)

[Lecture 44 - Gibbard-Satterthwaite Theorem](#)

[Lecture 45 - Quasilinear Environment](#)

[Lecture 46 - Ex-Post Efficiency](#)

[Lecture 47 - VCG Mechanism](#)

[Lecture 48 - Example of VCG Mechanism](#)

[Lecture 49 - Weighted VCG](#)

[Lecture 50 - Affine Maximizer](#)

[Lecture 51 - Recap of Topics Discussed so Far](#)

[Lecture 52 - Single Parameter Domain](#)

[Lecture 53 - DSIC in Single Parameter Domain](#)

[Lecture 54 - Myerson's Lemma](#)

[Lecture 55 - Sponsored Search Auction](#)

[Lecture 56 - Intermediate Domain](#)

[Lecture 57 - Algorithmic Mechanism Design](#)

[Lecture 58 - Stable Matching](#)

[Lecture 59 - Gale-Shapley Algorithm](#)

[Lecture 60 - Properties of Stable Matching](#)

Lecture 1 - Introduction

Lecture 2 - Basics of Spatio-Temporal Modeling

Lecture 3 - Geostatistical Equation for Spatio-Temporal Process

Lecture 4 - Gaussian Process Regression and Inverse Problems

Lecture 5 - Anomaly Event Detection

Lecture 6 - Extreme Events

Lecture 7 - Extreme Value Theory

Lecture 8 - Causality

Lecture 9 - Networks

Lecture 10 - Data Assimilation

Lecture 11 - Challenges and Opportunities for ML in ESS

Lecture 12 - Types of Machine Learning Problems in ESS

Lecture 13 - Convolutional Networks for Spatial Problems

Lecture 14 - Sequential Models for Temporal Problems

Lecture 15 - Probabilistic Models for Earth System Science

Lecture 16 - Identification of Indian Monsoon Predictors

Lecture 17 - Statistical Downscaling of Rainfall with Machine Learning

Lecture 18 - Detection of Anomaly and Extreme Events

Lecture 19 - Identifying Causal Relations from Time-Series - 1

Lecture 20 - Identifying Causal Relations from Time-Series - 2

Lecture 21 - Spatio-Temporal Modelling of Extremes

Lecture 22 - Hierarchical Bayesian Models for Spatio-Temporal Processes

Lecture 23 - Geostatistical modelling for mapping based on in-situ measurements

Lecture 24 - Nowcasting of Extreme Weather Events

Lecture 25 - Discovering Clustered Weather Patterns

Lecture 26 - Interpretable Machine Learning for Earth System Science

Lecture 27 - Object Detection in Satellite Imagery - 1

Lecture 28 - Object Detection in Satellite Imagery - 2

Lecture 29 - Image Fusion from Multiple Sources for Remote Sensing

Lecture 30 - Image Segmentation for Remote Sensing

Lecture 31 - Satellite Imagery as a Proxy for Geophysical Measurements

[Lecture 32 - Precipitation Nowcasting from Remote Sensing](#)

[Lecture 33 - Deep Domain Adaptation for Remote Sensing](#)

[Lecture 34 - Introduction to Earth System Modelling](#)

[Lecture 35 - Stochastic Weather Generator](#)

[Lecture 36 - Physics-Inspired Machine Learning for Process Models - 1](#)

[Lecture 37 - Physics-Inspired Machine Learning for Process Models - 2](#)

[Lecture 38 - Parameterizations for Sub-Grid Processes Using ML](#)

[Lecture 39 - Data Assimilation for Earth System Model Correction](#)

[Lecture 40 - ML for Climate Change Projection and Course Conclusion](#)

- Lecture 1 - Introduction to Reliability Engineering
- Lecture 2 - Introduction to Statistical Methods in Reliability
- Lecture 3 - Concept of Probability and Probability Theory
- Lecture 4 - Tutorial on Introduction to RE, SL and Probability Theory - Part I
- Lecture 5 - Conditional, Total and Reverse Probability
- Lecture 6 - Tutorial on Conditional Probability and Total Probability
- Lecture 7 - Introduction to Probability Distributions
- Lecture 8 - Introduction to Probability Distributions (Continued...)
- Lecture 9 - Discrete Probability Distribution - Part 1
- Lecture 10 - Discrete Probability Distribution - Part 2
- Lecture 11 - Tutorial on Discrete Probability Distributions
- Lecture 12 - Continuous Probability Distributions - Part 1
- Lecture 13 - Continuous Probability Distributions - Part 2
- Lecture 14 - Tutorial on Continuous Probability Distribution Functions - Part 1
- Lecture 15 - Tutorial on Continuous Probability Distribution Functions - Part 2
- Lecture 16 - Sampling Distributions - Part 1
- Lecture 17 - Sampling Distributions - Part 2
- Lecture 18 - Sampling Distributions - Part 3
- Lecture 19 - Sampling Distributions - Part 4
- Lecture 20 - Sampling Distributions - Part 5
- Lecture 21 - Tutorial on Sampling Distributions
- Lecture 22 - Statistical Inference - Part 1
- Lecture 23 - Statistical Inference - Part 2
- Lecture 24 - Statistical Inference - Part 3
- Lecture 25 - Tutorial on Statistical Inference
- Lecture 26 - Statistical Inference - Part 4
- Lecture 27 - Statistical Inference - Part 5
- Lecture 28 - Tutorial on Confidence Interval
- Lecture 29 - Statistical Inference - Part 6
- Lecture 30 - Statistical Inference - Part 7
- Lecture 31 - Statistical Inference - Part 8

[Lecture 32 - ANOVA - I](#)

[Lecture 33 - ANOVA - II](#)

[Lecture 34 - ANOVA - III](#)

[Lecture 35 - ANOVA - IV](#)

[Lecture 36 - ANOVA - V](#)

[Lecture 37 - ANOVA - VI](#)

[Lecture 38 - Correlation Analysis - Part I](#)

[Lecture 39 - Correlation Analysis - Part II](#)

[Lecture 40 - Regression Analysis - Part I](#)

[Lecture 41 - Regression Analysis - Part II](#)

[Lecture 42 - Regression Analysis - Part III](#)

[Lecture 43 - Tutorial on Relation Analysis](#)

[Lecture 44 - Auto-Regression Analysis](#)

[Lecture 45 - Logistic Regression - Part I](#)

[Lecture 46 - Logistic Regression - Part II](#)

[Lecture 47 - Logistic Regression - Part III](#)

[Lecture 48 - Tutorial on Logistic Regression](#)

[Lecture 49 - Introduction](#)

[Lecture 50 - Bayesian Classification - Part I](#)

[Lecture 51 - Bayesian Classification - Part II](#)

[Lecture 52 - k-Nearest Neighbor Classification](#)

[Lecture 53 - Tutorial on Classification Techniques](#)

[Lecture 54 - Support Vector Machine - Part I](#)

[Lecture 55 - Support Vector Machine - Part II](#)

[Lecture 56 - Support Vector Machine - Part III](#)

[Lecture 57 - Support Vector Machine - Part IV](#)

[Lecture 58 - Support Vector Machine - Part V](#)

[Lecture 59 - Support Vector Machine - Part VI](#)

[Lecture 60 - Tutorial on SVM](#)

- Lecture 1 - CPS: Motivational examples and compute platforms
- Lecture 2 - CPS: Motivational examples and compute platforms (Continued...)
- Lecture 3 - CPS: Motivational examples and compute platforms (Continued...)
- Lecture 4 - CPS: Motivational examples and compute platforms (Continued...)
- Lecture 5 - CPS: Motivational examples and compute platforms (Continued...)
- Lecture 6 - Real time sensing and communication for CPS
- Lecture 7 - Real time sensing and communication for CPS (Continued...)
- Lecture 8 - Real time sensing and communication for CPS (Continued...)
- Lecture 9 - Real time sensing and communication for CPS (Continued...)
- Lecture 10 - Real time task scheduling for CPS
- Lecture 11 - Real time task scheduling for CPS (Continued...)
- Lecture 12 - Real time task scheduling for CPS (Continued...)
- Lecture 13 - Real time task scheduling for CPS (Continued...)
- Lecture 14 - Real time task scheduling for CPS (Continued...)
- Lecture 15 - Real time task scheduling for CPS (Continued...)
- Lecture 16 - Real time task scheduling for CPS (Continued...)
- Lecture 17 - Real time task scheduling for CPS (Continued...)
- Lecture 18 - Dynamical system modeling, stability, controller design
- Lecture 19 - Dynamical system modeling, stability, controller design (Continued...)
- Lecture 20 - Dynamical system modeling, stability, controller design (Continued...)
- Lecture 21 - Dynamical system modeling, stability, controller design (Continued...)
- Lecture 22 - Dynamical system modeling, stability, controller design (Continued...)
- Lecture 23 - Dynamical system modeling, stability, controller design (Continued...)
- Lecture 24 - Delay-aware Design; Platform effect on Stability/Performance
- Lecture 25 - Delay-aware Design; Platform effect on Stability/Performance (Continued...)
- Lecture 26 - Delay-aware Design; Platform effect on Stability/Performance (Continued...)
- Lecture 27 - Delay-aware Design; Platform effect on Stability/Performance (Continued...) Corrigendum
- Lecture 28 - Hybrid Automata based modelling of CPS
- Lecture 29 - Hybrid Automata based modelling of CPS (Continued...)
- Lecture 30 - Hybrid Automata based modelling of CPS (Continued...)
- Lecture 31 - Hybrid Automata based modelling of CPS (Continued...)

[Lecture 32 - Hybrid Automata based modelling of CPS \(Continued...\)](#)

[Lecture 33 - Reachability analysis](#)

[Lecture 34 - Reachability analysis \(Continued...\)](#)

[Lecture 35 - Reachability analysis \(Continued...\)](#)

[Lecture 36 - Reachability analysis \(Continued...\)](#)

[Lecture 37 - Lyapunov Stability, Barrier Functions](#)

[Lecture 38 - Lyapunov Stability, Barrier Functions \(Continued...\)](#)

[Lecture 39 - Lyapunov Stability, Barrier Functions \(Continued...\)](#)

[Lecture 40 - Lyapunov Stability, Barrier Functions \(Continued...\)](#)

[Lecture 41 - Lyapunov Stability, Barrier Functions \(Continued...\)](#)

[Lecture 42 - Lyapunov Stability, Barrier Functions \(Continued...\)](#)

[Lecture 43 - Quadratic Program based safe Controller Design](#)

[Lecture 44 - Quadratic Program based safe Controller Design \(Continued...\)](#)

[Lecture 45 - Quadratic Program based safe Controller Design \(Continued...\)](#)

[Lecture 46 - Quadratic Program based safe Controller Design \(Continued...\)](#)

[Lecture 47 - Neural Network \(NN\) Based controllers in CPS](#)

[Lecture 48 - Neural Network \(NN\) Based controllers in CPS \(Continued...\)](#)

[Lecture 49 - Neural Network \(NN\) Based controllers in CPS \(Continued...\)](#)

[Lecture 50 - State Estimation using Kalman Filters \(KF\)](#)

[Lecture 51 - State Estimation using Kalman Filters \(KF\) \(Continued...\)](#)

[Lecture 52 - Attack Detection and Mitigation in CPS](#)

[Lecture 53 - Attack Detection and Mitigation in CPS \(Continued...\)](#)

[Lecture 54 - Attack Detection and Mitigation in CPS \(Continued...\)](#)

[Lecture 55 - Attack Detection and Mitigation in CPS \(Continued...\)](#)

[Lecture 56 - Attack Detection and Mitigation in CPS \(Continued...\)](#)

[Lecture 57 - Attack Detection and Mitigation in CPS \(Continued...\)](#)

[Lecture 58 - Attack Detection and Mitigation in CPS \(Continued...\)](#)

[Lecture 59 - Attack Detection and Mitigation in CPS \(Continued...\)](#)

- Lecture 1 - Introduction to Maximum Flow
- Lecture 2 - Ford - Fulkerson Method
- Lecture 3 - Edmond - Karp Algorithm
- Lecture 4 - Edmond - Karp Algorithm (Continued...)
- Lecture 5 - Flow Decomposition
- Lecture 6 - Maximum Bipartite Matching, Fattest Augmenting Path
- Lecture 7 - Karger's Algorithm
- Lecture 8 - Augmenting Path
- Lecture 9 - Edmonds Blossom Algorithm
- Lecture 10 - Edmond - Karp Algorithm (Continued...)
- Lecture 11 - Introduction to Randomized Algorithm
- Lecture 12 - Polynomial Identity Testing
- Lecture 13 - Perfect Bipartite Matching, Randomized Quicksort
- Lecture 14 - Concentration Inequalities: Markov, Chebyshev, Chernoff
- Lecture 15 - Proof of Chernoff Bound
- Lecture 16 - Coupon Collector Problem
- Lecture 17 - Balls and Bins
- Lecture 18 - Balls and Bins (Continued...)
- Lecture 19 - Two Point Sampling
- Lecture 20 - Randomized Algorithm for 2 SAT
- Lecture 21 - Markov Chain, Periodicity, Stationary Distribution
- Lecture 22 - Mixing Time, Reversible Markov Chain
- Lecture 23 - Metropolis Algorithm, Markov Chain on Independent Sets
- Lecture 24 - Random Walk on Cycles
- Lecture 25 - Shuffling Cards
- Lecture 26 - Monte Carlo Method, Hitting Time, Cover Time
- Lecture 27 - DNF Counting
- Lecture 28 - DNF Counting (Continued...)
- Lecture 29 - Counting Independent Sets of a Graph
- Lecture 30 - Counting Independent Sets of a Graph (Continued...)
- Lecture 31 - Introduction of NP, co-NP, and P

Lecture 32 - Turing Reduction, Karp Reduction

Lecture 33 - NP - Completeness of 3SAT

Lecture 34 - NP - Completeness of Independent Set

Lecture 35 - NP - Completeness of vertex cover and clique

Lecture 36 - NP - Completeness of 3-coloring

Lecture 37 - NP - Completeness of Subset sum and Knapsack

Lecture 38 - NP - Completeness of set cover, Weak and Strong NP - completeness

Lecture 39 - Self Reduction

Lecture 40 - Randomized Approximation Algorithm

Lecture 41 - Derandomization

Lecture 42 - Travelling Salesman Problem

Lecture 43 - 2-Factor Approximation Algorithm for Metric TSP

Lecture 44 - 1.5-Factor Approximation Algorithm for Metric TSP

Lecture 45 - Approximation Algorithm for Set Cover

Lecture 46 - FPTAS for Knapsack

Lecture 47 - Introduction to Linear Program

Lecture 48 - Introduction to Linear Program (Continued...)

Lecture 49 - Dual Fitting

Lecture 50 - Dual Fitting (Continued...)

Lecture 51 - Dual Fitting

Lecture 52 - Set Cover using LP rounding

Lecture 53 - Vertex Cover using reduction to set cover

Lecture 54 - Vertex Cover LP

Lecture 55 - Randomized Rounding

Lecture 56 - Primal Dual Scheme

Lecture 57 - Introduction to Parameterized Algorithm

Lecture 58 - Faster FPT Algorithm for Vertex Cover

Lecture 59 - Introduction to Kernelization

Lecture 60 - Linear Programming Based Kernels

Lecture 1 - AI/ML

Lecture 2 - AI/ML

Lecture 3 - Supervised and Unsupervised Learning

Lecture 4 - ML Model Algorithm

Lecture 5 - AI/ML problem

Lecture 6 - K-nearest-neighbor classification/regression

Lecture 7 - Accuracy, Precision, Recall, Confusion

Lecture 8 - Discriminative Feature Selection

Lecture 9 - Decision Tree Algorithm

Lecture 10 - Classifier Random Forests

Lecture 11 - Probability Theory

Lecture 12 - Bayesian, Naïve Bayes Classifier

Lecture 13 - Linear Algebra

Lecture 14 - Linear Classifiers, Perceptron Algorithm

Lecture 15 - Multi-class Linear Classifier, Logistic Regression

Lecture 16 - Optimization

Lecture 17 - Linear Regularized Regression

Lecture 18 - Max-margin Linear Classification

Lecture 19 - Basic Neural Networks

Lecture 20 - Neural Network Backpropagation

Lecture 21 - Overfitting and Underfitting

Lecture 22 - Boosting

Lecture 23 - Data dimensionality

Lecture 24 - Data dimensionality

Lecture 25 - Supervised Learning

Lecture 26 - Hierarchical Clustering

Lecture 27 - K-means Clustering

Lecture 28 - Evaluation of Clustering

Lecture 29 - Mean-shift, DB-Scan

Lecture 30 - Graph-based Clustering

Lecture 31 - Time-series

Lecture 32 - Image

Lecture 33 - Image

Lecture 34 - Neural Features for Images

Lecture 35 - Data

Lecture 36 - Sequential Neural Models and Natural Language Processing

Lecture 37 - Generative Models, Reinforcement Learning

Lecture 38 - Transfer Learning and Domain Adaptation

Lecture 39 - Image

Lecture 40 - Machine Learning for Climate Sciences

- Lecture 1 - Principles of Pattern Recognition I (Introduction and Uses)
- Lecture 2 - Principles of Pattern Recognition II (Mathematics)
- Lecture 3 - Principles of Pattern Recognition III (Classification and Bayes Decision Rule)
- Lecture 4 - Clustering vs. Classification
- Lecture 5 - Relevant Basics of Linear Algebra, Vector Spaces
- Lecture 6 - Eigen Value and Eigen Vectors
- Lecture 7 - Vector Spaces
- Lecture 8 - Rank of Matrix and SVD
- Lecture 9 - Types of Errors
- Lecture 10 - Examples of Bayes Decision Rule
- Lecture 11 - Normal Distribution and Parameter Estimation
- Lecture 12 - Training Set, Test Set
- Lecture 13 - Standardization, Normalization, Clustering and Metric Space
- Lecture 14 - Normal Distribution and Decision Boundaries I
- Lecture 15 - Normal Distribution and Decision Boundaries II
- Lecture 16 - Bayes Theorem
- Lecture 17 - Linear Discriminant Function and Perceptron
- Lecture 18 - Perceptron Learning and Decision Boundaries
- Lecture 19 - Linear and Non-Linear Decision Boundaries
- Lecture 20 - K-NN Classifier
- Lecture 21 - Principal Component Analysis (PCA)
- Lecture 22 - Fisher's LDA
- Lecture 23 - Gaussian Mixture Model (GMM)
- Lecture 24 - Assignments
- Lecture 25 - Basics of Clustering, Similarity/Dissimilarity Measures, Clustering Criteria.
- Lecture 26 - K-Means Algorithm and Hierarchical Clustering
- Lecture 27 - K-Medoids and DBSCAN
- Lecture 28 - Feature Selection : Problem statement and Uses
- Lecture 29 - Feature Selection : Branch and Bound Algorithm
- Lecture 30 - Feature Selection : Sequential Forward and Backward Selection
- Lecture 31 - Cauchy Schwartz Inequality

[Lecture 32 - Feature Selection Criteria Function: Probabilistic Separability Based](#)

[Lecture 33 - Feature Selection Criteria Function: Interclass Distance Based](#)

[Lecture 34 - Principal Components](#)

[Lecture 35 - Comparison Between Performance of Classifiers](#)

[Lecture 36 - Basics of Statistics, Covariance, and their Properties](#)

[Lecture 37 - Data Condensation, Feature Clustering, Data Visualization](#)

[Lecture 38 - Probability Density Estimation](#)

[Lecture 39 - Visualization and Aggregation](#)

[Lecture 40 - Support Vector Machine \(SVM\)](#)

[Lecture 41 - FCM and Soft-Computing Techniques](#)

[Lecture 42 - Examples of Uses or Application of Pattern Recognition; And When to do clustering](#)

[Lecture 43 - Examples of Real-Life Dataset](#)

Lecture 1 - Introduction to performance evaluation of computer systems

Lecture 2 - How to avoid common mistakes

Lecture 3 - Selection of techniques and metrics

Lecture 4 - Case study: Selection of techniques and metrics

Lecture 5 - Random Variables and probability distributions

Lecture 6 - Probability distributions - I

Lecture 7 - Probability distributions - II

Lecture 8 - Probability distributions - III

Lecture 9 - Stochastic process

Lecture 10 - Markov Chain

Lecture 11 - Slotted Aloha protocol model and discrete-time birth death process

Lecture 12 - Continuous time Markov chain and queuing theory - I

Lecture 13 - Queuing theory - I (Continued)

Lecture 14 - Queuing theory - II

Lecture 15 - Queuing theory - III

Lecture 16 - Queuing theory - IV

Lecture 17 - Queuing theory - V

Lecture 18 - Queuing theory - VI

Lecture 19 - Queuing networks - I

Lecture 20 - Queuing networks - II

Lecture 21 - Slotted Aloha Markov model

Lecture 22 - Simulations - I

Lecture 23 - Simulations - II

Lecture 24 - Simulations - III

Lecture 25 - Operational laws - I

Lecture 26 - Operational laws - II

Lecture 27 - Open and closed queuing networks

Lecture 28 - Approximate MVA

Lecture 29 - Convolution algorithm - I

Lecture 30 - Convolution algorithm - II

Lecture 31 - Load-dependent service centers

[Lecture 32 - Hierarchical decomposition](#)

[Lecture 33 - Balanced Job Bounds](#)

[Lecture 34 - Confidence interval for proportions and introduction to experimental design](#)

[Lecture 35 - 2k factorial design](#)

[Lecture 36 - 2k r factorial design and 2k-p fractional factorial design](#)

[Lecture 37 - Programming aspects of discrete-event simulations - I](#)

[Lecture 38 - Programming aspects of discrete-event simulations - II](#)

[Lecture 39 - Discrete-event simulations - III](#)

[Lecture 40 - PetriNets - I](#)

[Lecture 41 - PetriNets - II](#)

[Lecture 42 - PetriNets - III](#)

- Lecture 1 - Grammars and Natural Language Processing
- Lecture 2 - Grammars and Languages Generated
- Lecture 3 - Grammars and Languages Generated (Continued.)
- Lecture 4 - Ambiguity in CFG
- Lecture 5 - Simplification of CFG
- Lecture 6 - Removal of Unit Productions, Chomsky Normal Form for CFG
- Lecture 7 - Greibach Normal Form for CFG
- Lecture 8 - Final State Automata
- Lecture 9 - Non Deterministic FSA
- Lecture 10 - Non Deterministic FSA (Continued.)
- Lecture 11 - Non Deterministic FSA with E(Epsilon)- Moves
- Lecture 12 - Equivalence Between FSA and Type 3 Grammars
- Lecture 13 - Regular Expressions, Regular Expressions to NFSA
- Lecture 14 - DFSA to Regular Expressions
- Lecture 15 - Problems and Solutions - I
- Lecture 16 - Pumping Lemmas for Regular Sets and CFL
- Lecture 17 - MYHILL - Nerode Theorem
- Lecture 18 - Minimization of DFSA
- Lecture 19 - FSA with output Moore and Mealy Machines
- Lecture 20 - Pushdown Automata
- Lecture 21 - Pushdown Automata, Equivalence Between Acceptance by Empty Store and Acceptance by Final State
- Lecture 22 - Pushdown Automata CFG to PDA
- Lecture 23 - Pushdown Automata PDA to CFG
- Lecture 24 - Problems and Solutions - II
- Lecture 25 - Problems and Solutions - III
- Lecture 26 - Turing Machines
- Lecture 27 - Turing Machines (Continued.)
- Lecture 28 - Turing Machine as Acceptor, Techniques for TM Construction
- Lecture 29 - Generalized Versions of Turing Machines
- Lecture 30 - Turing Machine as a Generating Device
- Lecture 31 - Recursive Sets, Recursively Innumerable Sets, Encoding of TM, Halting Problem

[Lecture 32 - Problems and Instances, Universal TM, Decidability](#)

[Lecture 33 - RICE'S Theorem, Linear Bounded Automata, Properties of TM](#)

[Lecture 34 - POST'S Correspondence Problems](#)

[Lecture 35 - POST'S Correspondence Problems \(Continued.\), Time and Tape Complexity of TM](#)

[Lecture 36 - NP - Complete Problems, Cook's Theorem](#)

[Lecture 37 - NP - Complete Problems \(Continued.\)](#)

[Lecture 38 - Regulated Rewriting](#)

[Lecture 39 - L-Systems](#)

[Lecture 40 - Grammar Systems](#)

[Lecture 41 - DNA Computing](#)

[Lecture 42 - Membrane Computing](#)

Lecture 1 - Introduction

Lecture 2 - CRT Display Devices

Lecture 3 - CRT Display Devices (Continued...)

Lecture 4 - CRT Display Devices (Continued...)

Lecture 5 - CRT Display Devices (Continued...)

Lecture 6 - Transformations in 2D

Lecture 7 - Transformations in 2D (Continued...)

Lecture 8 - Three Dimensional Graphics

Lecture 9 - Three Dimensional Graphics (Continued...)

Lecture 10 - Three Dimensional Graphics (Continued...)

Lecture 11 - Projection Transformations And Viewing Pipeline

Lecture 12 - 3D Viewing - Projection Transformations And Viewing Pipeline

Lecture 13 - Scan Converting Lines, Circles And Ellipses

Lecture 14 - Scan Converting Lines, Circles And Ellipses (Continued...)

Lecture 15 - Scan Converting Lines, Circles And Ellipses (Continued...)

Lecture 16 - Scan Converting Lines, Circles And Ellipses (Continued...)

Lecture 17 - Scan Converting Lines, Circles And Ellipses (Continued...)

Lecture 18 - Polyfill- Scan Conversion Of A Polygon

Lecture 19 - Scan Conversion Of A Polygon (Continued...)

Lecture 20 - Clipping - Lines And Polygons

Lecture 21 - Clipping Lines And Polygons

Lecture 22 - Clipping Lines

Lecture 23 - Solid Modelling

Lecture 24 - Solid Modelling

Lecture 25 - Solid Modelling (Continued...)

Lecture 26 - Visible Surface Detection

Lecture 27 - Visible Surface Detection (Continued...)

Lecture 28 - Visible Surface Detection (Continued...)

Lecture 29 - Visible Surface Detection (Continued...)

Lecture 30 - Visible Surface Detection (Continued...)

Lecture 31 - Visible Surface Detection (Continued...)

[Lecture 32 - Visible Surface Detection \(Continued...\)](#)

[Lecture 33 - Illumination And Shading](#)

[Lecture 34 - Illumination And Shading \(Continued...\)](#)

[Lecture 35 - Illumination And Shading \(Continued...\)](#)

[Lecture 36 - Curve Representation](#)

[Lecture 37 - Curve Representation \(Continued...\)](#)

[Lecture 38 - Curves And Surface Representation](#)

[Lecture 39 - Graphics Programming Using Open GL](#)

[Lecture 40 - Graphics Programming Using Open GL \(Continued...\)](#)

[Lecture 41 - Advanced Topics: Anti Aliasing,Color,Soft Objects,Animation,Visual Effects,System Architectures](#)

[Lecture 42 - Digital Image Processing Image Compression-Jpeg-Enhancements](#)

[Lecture 43 - Digital Image Processing \(Continued...\)](#)

- Lecture 1 - Introduction To Computing
- Lecture 2 - Introduction To System : Software
- Lecture 3 - Introduction To System : Hardware
- Lecture 4 - Processor Activities
- Lecture 5 - Processor As a State Machine
- Lecture 6 - Data Path Architecture
- Lecture 7 - Data Path Controller : Micro Programmed
- Lecture 8 - State Machine Design
- Lecture 9 - Controller Design: Microprogrammed and Hardwired
- Lecture 10 - Controller Design (Contd)
- Lecture 11 - Typical Micro Instructions
- Lecture 12 - Addressing Modes
- Lecture 13 - Problem Exercise
- Lecture 14 - Problem Exercise
- Lecture 15 - Introduction to memory system
- Lecture 16 - CPU - Memory Interaction
- Lecture 17 - Cache Organization
- Lecture 18 - Cache Organization
- Lecture 19 - Virtual Memory
- Lecture 20 - Virtual Memory
- Lecture 21 - Performance Calculation
- Lecture 22 - Segmentation
- Lecture 23 - Address Translation and Protection
- Lecture 24 - Programmed I/O
- Lecture 25 - Interrupt Driven I/O
- Lecture 26 - DMA : Direct Memory Access
- Lecture 27 - Device Service Routines
- Lecture 28 - Evolution Of I/O
- Lecture 29 - I/O Devices
- Lecture 30 - I/O Devices - Contd
- Lecture 31 - Buses

[Lecture 32 - Buses Contd](#)

[Lecture 33 - Conclusion](#)

Lecture 1 - Introduction to Database Management System

Lecture 2 - Conceptual Designs

Lecture 3 - Conceptual Designs

Lecture 4 - Relational Model

Lecture 5 - Relational Model

Lecture 6 - Structured Query Language - I

Lecture 7 - Structured Query Language - II

Lecture 8 - ER Model to Relational Mapping

Lecture 9 - Functional Dependencies and Normal Form

Lecture 10 - ER Model to Relational Model Mapping

Lecture 11 - Storage Structures

Lecture 12 - Indexing Techniques Single Level

Lecture 13 - Indexing Techniques Multi Level

Lecture 14 - Constraints and Triggers

Lecture 15 - Query Processing and Optimization

Lecture 16 - Query Processing and Optimization - II

Lecture 17 - Query Processing and Optimization - III

Lecture 18 - Transaction Processing Concepts

Lecture 19 - Transaction Processing and Database Manager

Lecture 20 - Foundation for Concurrency Control

Lecture 21 - Concurrency Control Part - 1

Lecture 22 - Concurrency Control Part - 2

Lecture 23 - Concurrency Control Part - 3

Lecture 24 - Concurrency Control Part - 4

Lecture 25 - Distributed Transaction Models

Lecture 26 - Basic 2-Phase and 3-phase commit protocol

Lecture 27 - Concurrency Control for Distributed Transaction

Lecture 28 - Introduction to Transaction Recovery

Lecture 29 - Recovery Mechanisms - II

Lecture 30 - Recovery Mechanisms - III

Lecture 31 - Introduction to Data Warehousing and OLAP

[Lecture 32 - Introduction to Data Warehousing and OLAP](#)

[Lecture 33 - Case Study : MySQL](#)

[Lecture 34 - Case Study ORACLE and Microsoft Access](#)

[Lecture 35 - Data Mining and Knowledge Discovery](#)

[Lecture 36 - Data Mining and Knowledge Discovery Part - II](#)

[Lecture 37 - Object Oriented Databases](#)

[Lecture 38 - Object Oriented Databases - II](#)

[Lecture 39 - XML - Introductory Concepts](#)

[Lecture 40 - XML - Advanced Concepts](#)

[Lecture 41 - XML - Databases](#)

[Lecture 42 - Case Study - Part One - Database Design](#)

[Lecture 43 - Case Study - Part Two - Database Design](#)

Lecture 1 - Propositional Logic

Lecture 2 - Propositional Logic (Continued)

Lecture 3 - Predicates & Quantifiers

Lecture 4 - Predicates & Quantifiers (Continued)

Lecture 5 - Logical Inference

Lecture 6 - Resolution Principles & Application to PROLOG

Lecture 7 - Methods of Proof

Lecture 8 - Normal Forms

Lecture 9 - Proving Programs Correct (Continued)

Lecture 10 - Sets

Lecture 11 - Induction

Lecture 12 - Set Operations On Strings

Lecture 13 - Relations

Lecture 14 - Graphs

Lecture 15 - Graphs (Continued)

Lecture 16 - Trees

Lecture 17 - Trees And Graphs

Lecture 18 - Special Properties Of Relations

Lecture 19 - Closure Of Relations

Lecture 20 - Closure Properties Of Relations

Lecture 21 - Order Relations

Lecture 22 - Order Relations And Equivalence Relations

Lecture 23 - Equivalence Relations And Partitions

Lecture 24 - Functions

Lecture 25 - Functions (Continued)

Lecture 26 - Functions (Continued)

Lecture 27 - Pigeonhole Principle

Lecture 28 - Permutations And Combinations

Lecture 29 - Permutations And Combinations (Continued)

Lecture 30 - Generating Functions

Lecture 31 - Generating Functions (Continued)

[Lecture 32 - Recurrence Relations](#)

[Lecture 33 - Recurrence Relations \(Continued\)](#)

[Lecture 34 - Recurrence Relations \(Continued\)](#)

[Lecture 35 - Algebras](#)

[Lecture 36 - Algebras \(Continued\)](#)

[Lecture 37 - Algebras \(Continued\)](#)

[Lecture 38 - Finite State Automaton](#)

[Lecture 39 - Finite State Automaton \(Continued\)](#)

[Lecture 40 - Lattices](#)

Lecture 1 - Artificial Intelligence: Introduction

Lecture 2 - Introduction to AI

Lecture 3 - AI Introduction: Philosophy

Lecture 4 - AI Introduction

Lecture 5 - Introduction: Philosophy

Lecture 6 - State Space Search - Introduction

Lecture 7 - Search - DFS and BFS

Lecture 8 - Search DFID

Lecture 9 - Heuristic Search

Lecture 10 - Hill Climbing

Lecture 11 - Solution Space Search, Beam Search

Lecture 12 - TSP Greedy Methods

Lecture 13 - Tabu Search

Lecture 14 - Optimization - I (Simulated Annealing)

Lecture 15 - Optimization - II (Genetic Algorithms)

Lecture 16 - Population based methods for Optimization

Lecture 17 - Population Based Methods II

Lecture 18 - Branch and Bound, Dijkstra's Algorithm

Lecture 19 - A* Algorithm

Lecture 20 - Admissibility of A*

Lecture 21 - A* Monotone Property, Iterative Deeping A*

Lecture 22 - Recursive Best First Search, Sequence Allignment

Lecture 23 - Pruning the Open and Closed lists

Lecture 24 - Problem Decomposition with Goal Trees

Lecture 25 - AO* Algorithm

Lecture 26 - Game Playing

Lecture 27 - Game Playing - Minimax Search

Lecture 28 - Game Playing - AlphaBeta

Lecture 29 - Game Playing - SSS *

Lecture 30 - Rule Based Systems

Lecture 31 - Inference Engines

[Lecture 32 - Rete Algorithm](#)

[Lecture 33 - Planning](#)

[Lecture 34 - Planning FSSP, BSSP](#)

[Lecture 35 - Goal Stack Planning. Sussman's Anomaly](#)

[Lecture 36 - Non-linear planning](#)

[Lecture 37 - Plan Space Planning](#)

[Lecture 38 - GraphPlan](#)

[Lecture 39 - Constraint Satisfaction Problems](#)

[Lecture 40 - CSP continued](#)

[Lecture 41 - Knowledge-based systems](#)

[Lecture 42 - Knowledge-based Systems, PL](#)

[Lecture 43 - Propositional Logic](#)

[Lecture 44 - Resolution Refutation for PL](#)

[Lecture 45 - First-order Logic \(FOL\)](#)

[Lecture 46 - Reasoning in FOL](#)

[Lecture 47 - Backward chaining](#)

[Lecture 48 - Resolution for FOL](#)

DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

NPTEL : NOC:Programming, Data Structures and Algorithms (Computer Science and Engineering)

Co-ordinators : Prof. Hema A Murthy, Prof. Shankar Balachandran, Dr. N.S. Narayanaswamy

Lecture 1 - Introduction to Computers and Programming

Lecture 2 - Writing your first program

Lecture 3 - Variables, Operators and Expressions

Lecture 4 - Variable declarations, more operators and precedence

Lecture 5 - Input and Output Statements

Lecture 6 - Conditionals

Lecture 7 - Loops

Lecture 8 - Video Solution to Digital Root Programming Assignment

Lecture 9 - Introduction to arrays

Lecture 10 - Working with 1D arrays

Lecture 11 - Find prime numbers

Lecture 12 - Debugging demo

Lecture 13 - Multi-dimensional arrays

Lecture 14 - Pointers

Lecture 15 - More on pointers

Lecture 16 - Arrays and pointer arithmetic

Lecture 17 - Introduction to Strings

Lecture 18 - More on Strings

Lecture 19 - Video Solution to Print Elements of a Matrix in Spiral Order Programming Assignment

Lecture 20 - Introduction to functions

Lecture 21 - More details on functions

Lecture 22 - Arguments, variables and parameters

Lecture 23 - Pass parameters by reference

Lecture 24 - Recursive functions

Lecture 25 - Running time of a program

Lecture 26 - Computing time complexity

Lecture 27 - Video Solution to Palindrome Checker Programming Assignment

Lecture 28 - Algorithms and Powering

Lecture 29 - Polynomial evaluation and multiplication

Lecture 30 - Linear and Binary Search Analysis

Lecture 31 - Analysis of minimum and maximum in an array

HTML Links for 108,400+ NPTEL Video Lectures, Created by LinuXpert Systems, Chennai

[Lecture 32 - Sorting I: Insertion, Merge](#)

[Lecture 33 - Sorting II: Counting, Radix](#)

[Lecture 34 - Finding i-th smallest number](#)

[Lecture 35 - Video Solution to Sorting words Programming Assignment](#)

[Lecture 36 - Structures](#)

[Lecture 37 - More on structures](#)

[Lecture 38 - Using structures and pointers to structures](#)

[Lecture 39 - Dynamic memory allocation](#)

[Lecture 40 - Linked Lists](#)

[Lecture 41 - Brief introduction to C++: Classes and objects](#)

[Lecture 42 - Data Structures: Abstract Data Type](#)

[Lecture 43 - Lists](#)

[Lecture 44 - Supplementary Lesson](#)

[Lecture 45 - Video Solution to Implementing a Hash Table ADT Programming Assignment](#)

[Lecture 46 - Stacks: Last In First Out](#)

[Lecture 47 - Queues: First In First Out](#)

[Lecture 48 - Trees](#)

[Lecture 49 - Tree traversal](#)

[Lecture 50 - Binary Search Trees](#)

[Lecture 51 - Heaps](#)

[Lecture 52 - Graphs and Representation](#)

[Lecture 53 - Supplementary Lesson](#)

[Lecture 54 - Video Solution to the Queue in a Hospital Programming Assignment](#)

[Lecture 55 - Greedy Algorithms](#)

[Lecture 56 - Dynamic Programming](#)

[Lecture 57 - Matrix Chain Multiplication](#)

[Lecture 58 - Dijkstra's Algorithm](#)

[Lecture 59 - Boyer-Moore String Matching Algorithm](#)

[Lecture 60 - File I/O](#)

[Lecture 61 - Modular Programming](#)

- Lecture 1 - Module 1 - Part 0 - Introduction to the Course
- Lecture 2 - Module 1 - Part 1 - Definition of Information Security
- Lecture 3 - Module 1 - Part 2 - Information Security Terminologies
- Lecture 4 - Module 1 - Part 3 - Goals of Information Security
- Lecture 5 - Module 1 - Part 4 - Implementation Issues of the Goals of Information Security - I
- Lecture 6 - Module 1 - Part 5 - Implementation Issues of the Goals of Information Security - II
- Lecture 7 - Module 1 - Part 6 - Control Mechanisms for Information Security - I
- Lecture 8 - Module 1 - Part 7 - Access Control - Administrative and Technical
- Lecture 9 - Module 1 - Part 8 - Passwords - Are they secure? - I
- Lecture 10 - Module 1 - Part 9 - Access Control - Administrative and Technical
- Lecture 11 - Module 1 - Part 10 - Passwords - Are they secure? - III
- Lecture 12 - Module 1 - Part 11 - Multifactor Authentication - Challenges
- Lecture 13 - Module 1 - Part 12 - Application Level Control and Information Security Planning
- Lecture 14 - Module 1 - Part 13 - Information Security - Policy, Standard and Practice
- Lecture 15 - Module 1 - Part 14 - Policies governing Issues, Roles and Responsibilities
- Lecture 16 - Module 1 - Part 15 - Managing changes in Information Security Policies
- Lecture 17 - Module 1 - Part 16 - Spheres of Information Security
- Lecture 18 - Module 2 - Part 1 - Protecting your Personal Computer - I
- Lecture 19 - Module 2 - part 2 - Protecting your Personal Computer - II
- Lecture 20 - Module 2 - Part 3 - Protecting your Personal Computer - III
- Lecture 21 - Module 2 - Part 4 - Cloud Computing (Basic Definitions) - I
- Lecture 22 - Module 2 - Part 5 - Cloud Computing (Deployment) - II
- Lecture 23 - Module 2 - Part 6 - Cloud Computing (Security Issues) - III
- Lecture 24 - Module 2 - Part 7 - Cloud Computing (Trust and Risk) - IV
- Lecture 25 - Module 2 - Part 8 - Cloud Computing (Security and Privacy Issues) - V
- Lecture 26 - Module 2 - Part 9 - Cloud Computing (Security and Privacy Issues) - VI
- Lecture 27 - Module 2 - Part 10 - Cloud Computing (Application and Data level security) - VII
- Lecture 28 - Module 2 - Part 11 - Cloud Computing (Summary) - VIII
- Lecture 29 - Module 2 - Part 12 - Standard I
- Lecture 30 - Module 2 - Part 13 - Standard II
- Lecture 31 - Module 2 - Part 14 - Standard III

[Lecture 32 - Module 3 - Part 1](#)
[Lecture 33 - Module 3 - Part 2](#)
[Lecture 34 - Module 3 - Part 3](#)
[Lecture 35 - Module 3 - Part 4](#)
[Lecture 36 - Module 3 - Part 5](#)
[Lecture 37 - Module 3 - Part 6](#)
[Lecture 38 - Module 3 - Part 7](#)
[Lecture 39 - Module 3 - Part 8](#)
[Lecture 40 - Module 3 - Part 9](#)
[Lecture 41 - Module 4 - Part 1](#)
[Lecture 42 - module 4 - Part 2](#)
[Lecture 43 - Module 4 - Part 3](#)
[Lecture 44 - Module 4 - Part 4](#)
[Lecture 45 - Module 4 - Part 5](#)
[Lecture 46 - Module 4 - Part 6](#)
[Lecture 47 - Module 4 - Part 7](#)
[Lecture 48 - Module 4 - Part 8](#)
[Lecture 49 - Module 4 - Part 9](#)
[Lecture 50 - Module 4 - Part 10](#)
[Lecture 51 - Module 5 - Part 1](#)
[Lecture 52 - Module 5 - Part 2](#)
[Lecture 53 - Module 5 - Part 3](#)
[Lecture 54 - Module 5 - Part 4](#)
[Lecture 55 - Module 5 - Part 5](#)
[Lecture 56 - Module 5 - Part 6](#)
[Lecture 57 - Module 5 - Part 7](#)
[Lecture 58 - Module 6 - Part 1](#)
[Lecture 59 - Module 6 - Part 2](#)
[Lecture 60 - Module 6 - Part 3](#)
[Lecture 61 - Module 6 - Part 4](#)
[Lecture 62 - Module 6 - Part 5](#)
[Lecture 63 - Module 6 - Part 6](#)
[Lecture 64 - Module 6 - Part 7](#)

Lecture 1 - A Simple C Program for Sorting

Lecture 2 - Review of Structures, Pointers and Functions

Lecture 3 - Recursion

Lecture 4 - Abstract Data Types-Data + Methods

Lecture 5 - List Data Type

Lecture 6 - Access and update methods

Lecture 7 - Doubly Linked List Data Type

Lecture 8 - Doubly Linked Lists and Arrays

Lecture 9 - ADT Stacks

Lecture 10 - Checking of Balanced Parenthesis

Lecture 11 - Infix and Postfix expressions and Expression evaluation

Lecture 12 - Queue ADT Definition and Implementation

Lecture 13 - Merging using Queue ADT and Queue types

Lecture 14 - Tree ADT and Traversals

Lecture 15 - Binary Tree ADT and traversals

Lecture 16 - Tree Applications

Lecture 17 - Binary Search Trees

Lecture 18 - Heaps

Lecture 1 - Course Outline

Lecture 2 - Example: Air Travel

Lecture 3 - Example: Xerox shop

Lecture 4 - Example: Document similarity

Lecture 5 - Introduction and motivation

Lecture 6 - Input size, worst case, average case

Lecture 7 - Quantifying efficiency: $O()$, $\Omega()$, $\Theta()$

Lecture 8 - Examples: Analysis of iterative and recursive algorithms

Lecture 9 - Arrays and lists

Lecture 10 - Searching in an array

Lecture 11 - Selection Sort

Lecture 12 - Insertion sort

Lecture 13 - Merge sort

Lecture 14 - Merge sort - analysis

Lecture 15 - Quicksort

Lecture 16 - Quicksort - analysis

Lecture 17 - Sorting - Concluding remarks

Lecture 18 - Introduction to graphs

Lecture 19 - Representing graphs

Lecture 20 - Breadth first search (BFS)

Lecture 21 - Depth first search (DFS)

Lecture 22 - Applications of BFS and DFS

Lecture 23 - Directed acyclic graphs: topological sort

Lecture 24 - Directed acyclic graphs: longest paths

Lecture 25 - Single source shortest paths: Dijkstras algorithm

Lecture 26 - Dijkstras algorithm: analysis

Lecture 27 - Negative edge weights: Bellman-Ford algorithm

Lecture 28 - All pairs shortest paths

Lecture 29 - Minimum Cost Spanning Trees

Lecture 30 - Prims Algorithm

Lecture 31 - Kruskals algorithm

- Lecture 32 - Union-Find using arrays
- Lecture 33 - Union-Find using pointers
- Lecture 34 - Priority queues
- Lecture 35 - Heaps
- Lecture 36 - Heaps: Updating values, sorting
- Lecture 37 - Counting inversions
- Lecture 38 - Closest pair of points
- Lecture 39 - Binary Search Trees
- Lecture 40 - Balanced search trees
- Lecture 41 - Interval scheduling
- Lecture 42 - Scheduling with deadlines: minimizing lateness
- Lecture 43 - Huffman codes
- Lecture 44 - Introduction to dynamic programming
- Lecture 45 - Memoization
- Lecture 46 - Grid Paths
- Lecture 47 - Common subwords and subsequences
- Lecture 48 - Edit distance
- Lecture 49 - Matrix multiplication
- Lecture 50 - Linear Programming
- Lecture 51 - LP modelling: Production Planning
- Lecture 52 - LP modelling: Bandwidth allocation
- Lecture 53 - Network Flows
- Lecture 54 - Reductions
- Lecture 55 - Checking Algorithms
- Lecture 56 - P and NP

DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

NPTEL : NOC:Programming, Data Structures and Algorithms (Aricent) (Computer Science and Engineering)

Co-ordinators : Dr. N S. Narayanaswamy, Prof. Shankar Balachandran, Prof. Hema A Murthy

Lecture 1 - Introduction to Computers and Programming

Lecture 2 - Writing your first program

Lecture 3 - Variables, Operators and Expressions

Lecture 4 - Variable declarations, more operators and precedence

Lecture 5 - Input and Output Statements

Lecture 6 - Conditionals

Lecture 7 - Loops

Lecture 8 - Introduction to arrays

Lecture 9 - Working with 1D arrays

Lecture 10 - Find prime numbers

Lecture 11 - Debugging demo

Lecture 12 - Multi-dimensional arrays

Lecture 13 - Pointers

Lecture 14 - More on pointers

Lecture 15 - Arrays and pointer arithmetic

Lecture 16 - Introduction to Strings

Lecture 17 - More on Strings

Lecture 18 - Introduction to functions

Lecture 19 - More details on functions

Lecture 20 - Arguments, variables and parameters

Lecture 21 - Pass parameters by reference

Lecture 22 - Recursive Functions

Lecture 23 - C control structures, functional specification of programs

Lecture 24 - Complexity Analysis using Sum and Product Rule

Lecture 25 - Complexity Analysis of Recursive Functions

Lecture 26 - Algorithms and Powering

Lecture 27 - Polynomial evaluation and multiplication

Lecture 28 - Linear and Binary Search Analysis

Lecture 29 - Analysis of minimum and maximum in an array

Lecture 30 - Sorting I: Insertion, Merge

Lecture 31 - Sorting II: Counting, Radix

[Lecture 32 - Finding i-th smallest number](#)

[Lecture 33 - Structures](#)

[Lecture 34 - More on Structures](#)

[Lecture 35 - Using structures and pointers to structures](#)

[Lecture 36 - Dynamic memory allocation](#)

[Lecture 37 - Linked List](#)

[Lecture 38 - Brief introduction to C++: Classes and objects](#)

[Lecture 39 - Abstract Data Types](#)

[Lecture 40 - More on ADT](#)

[Lecture 41 - Stacks: Last In First Out](#)

[Lecture 42 - Queues: First In First](#)

[Lecture 43 - Trees](#)

[Lecture 44 - Tree Traversal](#)

[Lecture 45 - Binary Search](#)

[Lecture 46 - Heaps](#)

[Lecture 47 - Graphs and Representations](#)

[Lecture 48 - Greedy Algorithms](#)

[Lecture 49 - Dynamic Programming](#)

[Lecture 50 - Matrix Chain Multiplication](#)

[Lecture 51 - Hash Tables](#)

[Lecture 52 - Graph Algorithms: Dijkstras Algorithm and Prims Algorithm](#)

[Lecture 53 - Graph Traversals: BFS,DFS and Articulation Points](#)

[Lecture 54 - File I/O](#)

[Lecture 55 - Modular Programming](#)

Lecture 1 - Introduction to Computer Architecture

Lecture 2 - Quantitative Principles of Computer Design

Lecture 3 - Instruction Set Principles-Part 1

Lecture 4 - Instruction Set Principles-Part 2

Lecture 5 - Instruction Set Principles-Part 3

Lecture 6 - Cache Memory Hierarchy - Part 1

Lecture 7 - Cache Memory Hierarchy - Part 2

Lecture 8 - Cache Memory Hierarchy - Part 3

Lecture 9 - Cache Memory Hierarchy - Part 4

Lecture 10 - Main Memory Design - Part 1

Lecture 11 - Main Memory Design - Part 2

Lecture 12 - Main Memory Design - Part 3

Lecture 13 - Fundamentals of Pipelining - Part 1

Lecture 14 - Fundamentals of Pipelining - Part 2

Lecture 15 - Fundamentals of Pipelining - Part 3

Lecture 16 - Fundamentals of Pipelining - Part 4

Lecture 17 - Fundamentals of Pipelining - Part 5

Lecture 18 - Scalar to Superscalar pipeline

Lecture 19 - Instruction Dependencies

Lecture 20 - Compiler optimizations for Exposing ILP

Lecture 21 - Advanced Branch Prediction Techniques - Part 1

Lecture 22 - Advanced Branch Prediction Techniques - Part 2

Lecture 23 - Superscalar Organization

Lecture 24 - Register Renaming

Lecture 25 - Tomasulo Algorithm

Lecture 26 - Dynamic Execution Core

Lecture 27 - Multi threading

Lecture 28 - Multicore Processor Architecture

Lecture 29 - Cache Coherence

Lecture 30 - Cache Coherence Protocol Design

Lecture 31 - Synchronization

[Lecture 32 - Memory Consistency - Part 1](#)

[Lecture 33 - Memory Consistency - Part 2](#)

Lecture 1 - Course Overview

Lecture 2 - Module 1 - Modeling code behaviour

Lecture 3 - Module 2 - Modeling hardware circuits

Lecture 4 - Module 3 - Modeling data-dependent programs

Lecture 5 - Module 4 - Modeling concurrent systems

Lecture 6 - Summary

Lecture 7 - Module 1 - Model checking tools

Lecture 8 - Module 2 - Simple models in NuSMV

Lecture 9 - Module 3 - Hardware verification using NuSMV

Lecture 10 - Module 4 - Modeling concurrent systems in NuSMV

Lecture 11 - Summary.

Lecture 12 - Module 1 - A problem in concurrency

Lecture 13 - Module 2 - What is a property?

Lecture 14 - Module 3 - Invariants

Lecture 15 - Module 4 - Safety properties

Lecture 16 - Module 5 - Liveness properties

Lecture 17 - Summary..

Lecture 18 - Module 1 - Road map

Lecture 19 - Module 2 - A gentle introduction to automata

Lecture 20 - Module 3 - Simple properties of finite automata

Lecture 21 - Module 4 - Safety properties described by automata

Lecture 22 - Summary...

Lecture 23 - Module 1 - Specifying properties

Lecture 24 - Module 2 - Omega-regular expressions

Lecture 25 - Module 3 - Bchi automata

Lecture 26 - Module 4 - Simple properties of Bchi automata

Lecture 27 - Summary....

Lecture 28 - Module 1 - Overview

Lecture 29 - Module 2 - Omega-regular expressions to NBA

Lecture 30 - Module 3 - Checking emptiness of NBA

Lecture 31 - Module 4 - Generalized NBA

[Lecture 32 - Summary.....](#)

[Lecture 33 - Module 1 - Introduction to LTL](#)

[Lecture 34 - Module 2 - Semantics of LTL](#)

[Lecture 35 - Module 3 - A puzzle](#)

[Lecture 36 - Summary.](#)

[Lecture 37 - Module 1 - Automata based LTL model-checking](#)

[Lecture 38 - Module 2 - LTL to NBA](#)

[Lecture 39 - Module 3 - Automaton construction](#)

[Lecture 40 - Summary..](#)

[Lecture 41 - Module 1 - Tree view of a transition system](#)

[Lecture 42 - Module 2 - CTL*](#)

[Lecture 43 - Module 3 - CTL](#)

[Lecture 44 - summary...](#)

[Lecture 45 - Module 1 - Adequate CTL formulae](#)

[Lecture 46 - Module 2 - EX, EU, EG](#)

[Lecture 47 - Module 3 - Final algorithm](#)

[Lecture 48 - Module 4 - State-space explosion](#)

[Lecture 49 - Summary....](#)

[Lecture 50 - Module 1 - Introduction to BDDs](#)

[Lecture 51 - Module 2 - Ordered BDDs](#)

[Lecture 52 - Module 3 - Representing transition systems as OBDDs](#)

[Lecture 53 - Summary.....](#)

[Lecture 54 - Timed transition systems](#)

[Lecture 55 - Concluding remarks](#)

Lecture 1 - Functions

Lecture 2 - Types

Lecture 3 - Haskell

Lecture 4 - Running Haskell programs

Lecture 5 - Currying

Lecture 6 - Examples

Lecture 7 - Lists

Lecture 8 - Functions on lists

Lecture 9 - Characters and strings

Lecture 10 - Tuples

Lecture 11 - Computation as rewriting

Lecture 12 - Polymorphism and higher-order functions

Lecture 13 - Map and filter

Lecture 14 - List comprehension

Lecture 15 - Folding through a list

Lecture 16 - Measuring efficiency

Lecture 17 - Sorting

Lecture 18 - Using infinite lists

Lecture 19 - Conditional polymorphism

Lecture 20 - Defining functions in ghci

Lecture 21 - User-defined datatypes

Lecture 22 - Abstract datatypes

Lecture 23 - Modules

Lecture 24 - Recursive data types

Lecture 25 - Binary search trees

Lecture 26 - Balanced search trees

Lecture 27 - Arrays

Lecture 28 - Input/Output

NPTEL : Virtual Reality ()

Lecture 1 - Course mechanics

Lecture 2 - Goals and VR definitions

Lecture 3 - Historical perspective

Lecture 4 - Birds-eye view (general)

Lecture 5 - Birds-eye view (general) (Continued...)

Lecture 6 - Birds-eye view (hardware)

Lecture 7 - Birds-eye view (software)

Lecture 8 - Birds-eye view (sensation and perception)

Lecture 9 - Geometric modeling

Lecture 10 - Transforming models

Lecture 11 - Matrix algebra and 2D rotations

Lecture 12 - 3D rotations and yaw, pitch, and roll

Lecture 13 - 3D rotations and yaw, pitch, and roll (Continued...)

Lecture 14 - Axis-angle representations

Lecture 15 - Quaternions

Lecture 16 - Converting and multiplying rotations

Lecture 17 - Converting and multiplying rotations (Continued...)

Lecture 18 - Homogeneous transforms

Lecture 19 - The chain of viewing transforms

Lecture 20 - Eye transforms

Lecture 21 - Eye transforms (Continued...)

Lecture 22 - Canonical view transform

Lecture 23 - Viewport transform

Lecture 24 - Viewport transform (Continued...)

Lecture 25 - Three interpretations of light

Lecture 26 - Refraction

Lecture 27 - Simple lenses

Lecture 28 - Diopters

Lecture 29 - Imaging properties of lenses

Lecture 30 - Lens aberrations

Lecture 31 - Optical system of eyes

Lecture 32 - Photoreceptors

- Lecture 33 - Sufficient resolution for VR
- Lecture 34 - Light intensity
- Lecture 35 - Eye movements
- Lecture 36 - Eye movements (Continued...)
- Lecture 37 - Eye movement issues for VR
- Lecture 38 - Neuroscience of vision
- Lecture 39 - Depth perception
- Lecture 40 - Depth perception (Continued...)
- Lecture 41 - Motion perception
- Lecture 42 - Frame rates and displays
- Lecture 43 - Frame rates and displays (Continued...)
- Lecture 44 - Overview
- Lecture 45 - Orientation tracking
- Lecture 46 - Tilt drift correction
- Lecture 47 - Yaw drift correction
- Lecture 48 - Tracking with a camera
- Lecture 49 - Perspective n-point problem
- Lecture 50 - Filtering
- Lecture 51 - Lighthouse approach
- Lecture 52 - Visual Rendering-Overview
- Lecture 53 - Visual Rendering-overview (Continued...)
- Lecture 54 - Shading models
- Lecture 55 - Rasterization
- Lecture 56 - Pixel shading
- Lecture 57 - VR-specific problems
- Lecture 58 - Distortion shading
- Lecture 59 - Post-rendering image warp
- Lecture 60 - Physics and physiology
- Lecture 61 - Auditory perception
- Lecture 62 - Auditory localization
- Lecture 63 - Rendering
- Lecture 64 - Spatialization and display
- Lecture 65 - Combining other senses

[Lecture 66 - Interfaces -overview](#)

[Lecture 67 - Locomotion](#)

[Lecture 68 - Manipulation](#)

[Lecture 69 - System control](#)

[Lecture 70 - Social interaction](#)

[Lecture 71 - Evaluation of VR Systems](#)

Lecture 1 - A brief introduction to machine learning

Lecture 2 - Supervised Learning

Lecture 3 - Unsupervised Learning

Lecture 4 - Reinforcement Learning

Lecture 5 - Probability Basics - 1

Lecture 6 - Probability Basics - 2

Lecture 7 - Linear Algebra - 1

Lecture 8 - Linear Algebra - 2

Lecture 9 - Statistical Decision Theory - Regression

Lecture 10 - Statistical Decision Theory - Classification

Lecture 11 - Bias-Variance

Lecture 12 - Linear Regression

Lecture 13 - Multivariate Regression

Lecture 14 - Subset Selection 1

Lecture 15 - Subset Selection 2

Lecture 16 - Shrinkage Methods

Lecture 17 - Principal Components Regression

Lecture 18 - Partial Least Squares

Lecture 19 - Linear Classification

Lecture 20 - Logistic Regression

Lecture 21 - Linear Discriminant Analysis 1

Lecture 22 - Linear Discriminant Analysis 2

Lecture 23 - Linear Discriminant Analysis 3

Lecture 24 - Optimization

Lecture 25 - Perceptron Learning

Lecture 26 - SVM - Formulation

Lecture 27 - SVM - Interpretation & Analysis

Lecture 28 - SVMs for Linearly Non Separable Data

Lecture 29 - SVM Kernels

Lecture 30 - SVM - Hinge Loss Formulation

Lecture 31 - Weka Tutorial

[Lecture 32 - Early Models](#)

[Lecture 33 - Backpropagation - I](#)

[Lecture 34 - Backpropagation - II](#)

[Lecture 35 - Initialization, Training and Validation](#)

[Lecture 36 - Maximum Likelihood Estimate](#)

[Lecture 37 - Priors and MAP Estimate](#)

[Lecture 38 - Bayesian Parameter Estimation](#)

[Lecture 39 - Introduction](#)

[Lecture 40 - Regression Trees](#)

[Lecture 41 - Stopping Criteria and Pruning](#)

[Lecture 42 - Loss Functions for Classification](#)

[Lecture 43 - Categorical Attributes](#)

[Lecture 44 - Multiway Splits](#)

[Lecture 45 - Missing Values, Imputation and Surrogate Splits](#)

[Lecture 46 - Instability, Smoothness and Repeated Subtrees](#)

[Lecture 47 - Tutorial](#)

[Lecture 48 - Evaluation Measures I](#)

[Lecture 49 - Bootstrapping and Cross Validation](#)

[Lecture 50 - 2 Class Evaluation Measures](#)

[Lecture 51 - The ROC Curve](#)

[Lecture 52 - Minimum Description Length and Exploratory Analysis](#)

[Lecture 53 - Introduction to Hypothesis Testing](#)

[Lecture 54 - Basic Concepts](#)

[Lecture 55 - Sampling Distributions and the Z Test](#)

[Lecture 56 - Student's t-test](#)

[Lecture 57 - The Two Sample and Paired Sample t-tests](#)

[Lecture 58 - Confidence Intervals](#)

[Lecture 59 - Bagging, Committee Machines and Stacking](#)

[Lecture 60 - Boosting](#)

[Lecture 61 - Gradient Boosting](#)

[Lecture 62 - Random Forest](#)

[Lecture 63 - Naive Bayes](#)

[Lecture 64 - Bayesian Networks](#)

[Lecture 65 - Undirected Graphical Models - Introduction](#)

[Lecture 66 - Undirected Graphical Models - Potential Functions](#)

[Lecture 67 - Hidden Markov Models](#)

[Lecture 68 - Variable Elimination](#)

[Lecture 69 - Belief Propagation](#)

[Lecture 70 - Partitional Clustering](#)

[Lecture 71 - Hierarchical Clustering](#)

[Lecture 72 - Threshold Graphs](#)

[Lecture 73 - The BIRCH Algorithm](#)

[Lecture 74 - The CURE Algorithm](#)

[Lecture 75 - Density Based Clustering](#)

[Lecture 76 - Gaussian Mixture Models](#)

[Lecture 77 - Expectation Maximization](#)

[Lecture 78 - Expectation Maximization \(Continued...\)](#)

[Lecture 79 - Spectral Clustering](#)

[Lecture 80 - Learning Theory](#)

[Lecture 81 - Frequent Itemset Mining](#)

[Lecture 82 - The Apriori Property](#)

[Lecture 83 - Introduction to Reinforcement Learning](#)

[Lecture 84 - RL Framework and TD Learning](#)

[Lecture 85 - Solution Methods and Applications](#)

[Lecture 86 - Multi-class Classification](#)

Lecture 1 - Introduction

Lecture 2 - Abductive Inferences and Expectations

Lecture 3 - On Machine Learning

Lecture 4 - A New Test of Intelligence?

Lecture 5 - The World According to Us

Lecture 6 - From Particles to Concepts

Lecture 7 - The Domains for Reasoning

Lecture 8 - Hierarchies in Representation

Lecture 9 - Logic and Representation: A Quick Tour

Lecture 10 - Symbols and Thought

Lecture 11 - From Gears to Symbols

Lecture 12 - Truth, Logic, and Provability

Lecture 13 - A Syntactic Machine

Lecture 14 - Entailment and Proof

Lecture 15 - The Languages of Logic

Lecture 16 - Patterns in Arguments

Lecture 17 - Rules of Inference

Lecture 18 - Propositional Logic

Lecture 19 - Propositional Logic: Syntax

Lecture 20 - Propositional Logic: Semantics

Lecture 21 - Proofs: Natural Deduction

Lecture 22 - The Deduction Theorem

Lecture 23 - Models

Lecture 24 - The Tableau Method

Lecture 25 - First Order Logic

Lecture 26 - First Order Logic: Syntax

Lecture 27 - FOL: Universal Instantiation

Lecture 28 - First Order Logic: Semantics

Lecture 29 - FOL: Truth Assignments

Lecture 30 - Modified Modus Ponens

Lecture 31 - The Unification Algorithm

[Lecture 32 - Skolemization](#)

[Lecture 33 - Expert Systems](#)

[Lecture 34 - Backward Chaining Systems](#)

[Lecture 35 - Deductive Retrieval](#)

[Lecture 36 - The Resolution Refutation Method](#)

[Lecture 37 - Clause Form in FOL](#)

[Lecture 38 - Resolution Refutation in FOL](#)

[Lecture 39 - First Order Logic with Equality](#)

[Lecture 40 - Who was the surgeon?](#)

[Lecture 41 - Consistency vs. Completeness](#)

[Lecture 42 - Logic Programming](#)

[Lecture 43 - Arithmetic](#)

[Lecture 44 - Horn Clauses and Prolog](#)

[Lecture 45 - SLD Derivation = Backward Chaining](#)

[Lecture 46 - Programming in Logic](#)

[Lecture 47 - Prolog: Programming in Logic](#)

[Lecture 48 - Prolog: Procedural Interpretation](#)

[Lecture 49 - Prolog: Query Evaluation](#)

[Lecture 50 - Prolog: Unifying Terms](#)

[Lecture 51 - Prolog: Goal Order](#)

[Lecture 52 - Prolog: Tabling](#)

[Lecture 53 - Prolog: Negation by Failure](#)

[Lecture 54 - Prolog: The Cut Operator](#)

[Lecture 55 - Rule Based Expert Systems](#)

[Lecture 56 - The OPS5 Language](#)

[Lecture 57 - Match, Resolve, Execute](#)

[Lecture 58 - Conflict Resolution Strategies](#)

[Lecture 59 - The Rete Algorithm](#)

[Lecture 60 - The Rete Net](#)

[Lecture 61 - The Rete Net : Examples](#)

[Lecture 62 - Knowledge Representation](#)

[Lecture 63 - Synonyms, Antonyms, Hyponyms, Meronyms](#)

[Lecture 64 - Binary Relations](#)

[Lecture 65 - Describing Family Relations](#)

[Lecture 66 - Recursive Descriptions](#)

[Lecture 67 - Abstract Entities](#)

[Lecture 68 - Reification: Units of Measurement](#)

[Lecture 69 - Semantic Nets and Knowledge Graphs](#)

[Lecture 70 - DL: Description Logics](#)

[Lecture 71 - Defining New Concepts and Roles](#)

[Lecture 72 - The Sentences in DL](#)

[Lecture 73 - A Family of Logics](#)

[Lecture 74 - DL: Some Examples](#)

[Lecture 75 - ALC Tableau](#)

[Lecture 76 - Model Checking in ALC](#)

[Lecture 77 - ALC Tableau: Examples](#)

[Lecture 78 - Language Independent Representation](#)

[Lecture 79 - Conceptual Dependency Theory](#)

[Lecture 80 - CD States](#)

[Lecture 81 - Inferences in MARGIE](#)

[Lecture 82 - CD: Actions](#)

[Lecture 83 - English to CD](#)

[Lecture 84 - Representing Complex Verbs](#)

[Lecture 85 - Semantic Parsing of Language](#)

[Lecture 86 - Knowledge Structures](#)

[Lecture 87 - Scripts](#)

[Lecture 88 - SAM: Script Apploer Mechanism](#)

[Lecture 89 - A VIP Visit](#)

[Lecture 90 - Invoking Scripts](#)

[Lecture 91 - Goals, Plans, and Actions](#)

[Lecture 92 - Goal Interactions](#)

[Lecture 93 - Explanation Driven Understanding](#)

[Lecture 94 - Tussle Over a Bicycle](#)

[Lecture 95 - Plan Applier Mechanism \(PAM\)](#)

[Lecture 96 - Requests and Rule Instances](#)

[Lecture 97 - Managing Rule Instances](#)

[Lecture 98 - Knowledge Structures: Frames](#)

[Lecture 99 - Inheritance](#)

[Lecture 100 - A Frame System for Travel Planning](#)

[Lecture 101 - Inheritance in Taxonomies](#)

[Lecture 102 - Default Reasoning](#)

[Lecture 103 - Closed World Assumption](#)

[Lecture 104 - Circumscription](#)

[Lecture 105 - Default Logic](#)

[Lecture 106 - Autoepistemic Reasoning](#)

[Lecture 107 - The Event Calculus](#)

[Lecture 108 - The Effects of Events](#)

[Lecture 109 - Epistemic Logic](#)

[Lecture 110 - Kripke Structures: Possible Worlds Semantics](#)

[Lecture 111 - The Muddy Children Puzzle](#)

[Lecture 112 - The Effects of Epistemic Actions](#)

[Lecture 113 - Reasoning with Beliefs](#)

- Lecture 1 - Experimental Setup: Video Tutorial
- Lecture 2 - Need for Secure Systems
- Lecture 3 - Ignorance of A is Sin of B
- Lecture 4 - Function calls and Stacks
- Lecture 5 - Stack Smashing
- Lecture 6 - Virtual Machine Based Rootkits
- Lecture 7 - Security and Architecture: Introduction
- Lecture 8 - Structured Computer Organization Completed
- Lecture 9 - X86 ISA - Part1
- Lecture 10 - X86 ISA - Part 2
- Lecture 11 - X86 Protected Mode
- Lecture 12 - X86 Memory Segmentation
- Lecture 13 - Process Isolation using Segmentation
- Lecture 14 - Paging and Virtual Memory
- Lecture 15 - Task Switching and Interrupt Service
- Lecture 16 - Memory Segmentation Deep dive - Part 1
- Lecture 17 - Memory Segmentation Deep dive - Part 2
- Lecture 18 - Memory Segmentation Deep dive - Part 3
- Lecture 19 - Memory Segmentation Deep dive - Part 4
- Lecture 20 - Segmentation Recap
- Lecture 21 - Lab 1 - Part 1
- Lecture 22 - Lab 1 - Part 2
- Lecture 23 - Lab 1 - Part 3
- Lecture 24 - ISR Recap
- Lecture 25 - Lab 2 - Part 1
- Lecture 26 - Lab 2 - Part 2
- Lecture 27 - Memory Management Recap
- Lecture 28 - Lab 3 - Part 1
- Lecture 29 - Lab 3 - Part 2
- Lecture 30 - Task Switch recap
- Lecture 31 - Lab 4 - Part 1

[Lecture 32 - Lab 4 - Part 2](#)

[Lecture 33 - Lab 4 - Part 3](#)

[Lecture 34 - Lab 4 - Part 4](#)

[Lecture 35 - Introduction to Basic Cryptography](#)

[Lecture 36 - Public Key Cryptography](#)

[Lecture 37 - Freescale ARM iMX6 Processor](#)

[Lecture 38 - High Assurance Boot in iMX6](#)

[Lecture 39 - Case Study](#)

[Lecture 40 - Basics of Networking](#)

[Lecture 41 - Network Processor Vs General Purpose Processor](#)

[Lecture 42 - Network Processor Architecture](#)

Lecture 1 - Basic definitions

Lecture 2 - Conditional probability

Lecture 3 - Example problems

Lecture 4 - Karger's mincut algorithm

Lecture 5 - Analysis of Karger's mincut algorithm

Lecture 6 - Random variables

Lecture 7 - Randomized quicksort

Lecture 8 - Problem solving video - The rich get richer

Lecture 9 - Problem solving video - Monty Hall problem

Lecture 10 - Bernoulli, Binomial and Geometric distributions

Lecture 11 - Tail Bounds

Lecture 12 - Application of Chernoff bound

Lecture 13 - Application of Chebyshev's inequality

Lecture 14 - Intro to Big Data Algorithms

Lecture 15 - SAT Problem

Lecture 16 - Classification of States

Lecture 17 - Stationary Distribution of a Markov Chain

Lecture 18 - Celebrities Case Study

Lecture 19 - Random Walks on Undirected Graphs

Lecture 20 - Intro to Streaming, Morris Algorithm

Lecture 21 - Reservoir Sampling

Lecture 22 - Approximate Median

Lecture 23 - Overview

Lecture 24 - Balls, bins, hashing

Lecture 25 - Chain hashing, SUHA, Power of Two choices

Lecture 26 - Bloom filter

Lecture 27 - Pairwise independence

Lecture 28 - Estimating expectation of continuous function

Lecture 29 - Universal hash functions

Lecture 30 - Perfect hashing

Lecture 31 - Count-min filter for heavy hitters in data streams

[Lecture 32 - Problem solving video - Doubly Stochastic Transition Matrix](#)

[Lecture 33 - Problem solving video - Random Walks on Linear Structures](#)

[Lecture 34 - Problem solving video - Lollipop Graph](#)

[Lecture 35 - Problem solving video - Cat And Mouse](#)

[Lecture 36 - Estimating frequency moments](#)

[Lecture 37 - Property testing framework](#)

[Lecture 38 - Testing Connectivity](#)

[Lecture 39 - Enforce and Test Introduction](#)

[Lecture 40 - Testing if a graph is a biclique](#)

[Lecture 41 - Testing bipartiteness](#)

[Lecture 42 - Property testing and random walk algorithms](#)

[Lecture 43 - Testing if a graph is bipartite \(using random walks\)](#)

[Lecture 44 - Graph streaming algorithms: Introduction](#)

[Lecture 45 - Graph streaming algorithms: Matching](#)

[Lecture 46 - Graph streaming algorithms: Graph sparsification](#)

[Lecture 47 - MapReduce](#)

[Lecture 48 - K-Machine Model \(aka Pregel Model\)](#)

Lecture 1 - Tutorial 1 - Probability Basics 1
Lecture 2 - Tutorial 1 - Probability Basics 2
Lecture 3 - Tutorial 2 - Linear algebra - 1
Lecture 4 - Tutorial 2 - Linear algebra - 2
Lecture 5 - Introduction to RL
Lecture 6 - RL Framework and applications
Lecture 7 - Introduction to Immediate RL
Lecture 8 - Bandit Optimalities
Lecture 9 - Value function based methods
Lecture 10 - UCB 1
Lecture 11 - Concentration Bounds
Lecture 12 - UCB 1 Theorem
Lecture 13 - PAC Bounds
Lecture 14 - Median Elimination
Lecture 15 - Thompson Sampling
Lecture 16 - Policy Search
Lecture 17 - REINFORCE
Lecture 18 - Contextual Bandits
Lecture 19 - Full RL Introduction
Lecture 20 - Returns, Value Functions and MDPs
Lecture 21 - MDP Modelling
Lecture 22 - Bellman Equation
Lecture 23 - Bellman Optimality Equation
Lecture 24 - Cauchy Sequence and Green's Equation
Lecture 25 - Banach Fixed Point Theorem
Lecture 26 - Convergence Proof
Lecture 27 - L_p Convergence
Lecture 28 - Value Iteration
Lecture 29 - Policy Iteration
Lecture 30 - Dynamic Programming
Lecture 31 - Monte Carlo

Lecture 32 - Control in Monte Carlo
Lecture 33 - Off Policy MC
Lecture 34 - UCT
Lecture 35 - TD(0)
Lecture 36 - TD(0) Control
Lecture 37 - Q-Learning
Lecture 38 - Afterstate
Lecture 39 - Eligibility Traces
Lecture 40 - Backward View of Eligibility Traces
Lecture 41 - Eligibility Trace Control
Lecture 42 - Thompson Sampling Recap
Lecture 43 - Function Approximation
Lecture 44 - Linear Parameterization
Lecture 45 - State Aggregation Methods
Lecture 46 - Function Approximation and Eligibility Traces
Lecture 47 - LSTD and LSTDQ
Lecture 48 - LSPI and Fitted Q
Lecture 49 - DQN and Fitted Q-Iteration
Lecture 50 - Policy Gradient Approach
Lecture 51 - Actor Critic and REINFORCE
Lecture 52 - REINFORCE (cont'd)
Lecture 53 - Policy Gradient with Function Approximation
Lecture 54 - Hierarchical Reinforcement Learning
Lecture 55 - Types of Optimality
Lecture 56 - Semi Markov Decision Processes
Lecture 57 - Options
Lecture 58 - Learning with Options
Lecture 59 - Hierarchical Abstract Machines
Lecture 60 - MAXQ
Lecture 61 - MAXQ Value Function Decomposition
Lecture 62 - Option Discovery
Lecture 63 - POMDP Introduction
Lecture 64 - Solving POMDP

Lecture 1 - Intro to the Course

Lecture 2 - Introduction to OS

Lecture 3 - PC Hardware

Lecture 4 - From Programs to Processes

Lecture 5 - Sharing the CPU

Lecture 6 - Introduction

Lecture 7 - Virtual Memory

Lecture 8 - MMU Mapping

Lecture 9 - Segmentation

Lecture 10 - Memory Management in xv6

Lecture 11 - PC Booting

Lecture 12 - Week 3 Introduction

Lecture 13 - Create Execute and Exit from Processes

Lecture 14 - System Calls for Process Management

Lecture 15 - Interrupts

Lecture 16 - Interrupt Handling

Lecture 17 - Software Interrupts and System calls

Lecture 18 - CPU Context switching

Lecture 19 - CPU Scheduling

Lecture 20 - Priority Based Scheduling Algorithms

Lecture 21 - Multi-Processor Scheduling

Lecture 22 - Scheduling in Linux

Lecture 23 - Completely Fair Scheduling

Lecture 24 - Inter Process Communication

Lecture 25 - Synchronization

Lecture 26 - Software solutions for critical sections

Lecture 27 - Bakery Algorithm

Lecture 28 - Hardware Locks

Lecture 29 - Mutexes

Lecture 30 - Semaphores

Lecture 31 - Dining Philosophers Problem

[Lecture 32 - Deadlocks](#)

[Lecture 33 - Dealing with Deadlocks](#)

[Lecture 34 - Threads - Part 1](#)

[Lecture 35 - Threads - Part 2](#)

[Lecture 36 - Operating system security](#)

[Lecture 37 - Information Flow policies](#)

[Lecture 38 - Buffer Overflows](#)

[Lecture 39 - Preventing Buffer Overflow Attacks](#)

- Lecture 1 - Lecture 1 - Algorithms and programming: simple gcd
- Lecture 2 - Lecture 2 - Improving naive gcd
- Lecture 3 - Lecture 3 - Euclid's algorithm for gcd
- Lecture 4 - Lecture 4 - Downloading and installing Python
- Lecture 5 - Lecture 1 - Assignment statement, basic types - int, float, bool
- Lecture 6 - Lecture 2 - Strings
- Lecture 7 - Lecture 3 - Lists
- Lecture 8 - Lecture 4 - Control Flow
- Lecture 9 - Lecture 5 - Functions
- Lecture 10 - Lecture 6 - Examples
- Lecture 11 - Lecture 1 - More about range()
- Lecture 12 - Lecture 2 - Manipulating lists
- Lecture 13 - Lecture 3 - Breaking out of a loop
- Lecture 14 - Lecture 4 - Arrays vs lists, binary search
- Lecture 15 - Lecture 5 - Efficiency
- Lecture 16 - Lecture 6 - Selection Sort
- Lecture 17 - Lecture 7 - Insertion Sort
- Lecture 18 - Lecture 8 - Recursion
- Lecture 19 - Lecture 1 - Mergesort
- Lecture 20 - Lecture 2 - Mergesort, analysis
- Lecture 21 - Lecture 3 - Quicksort
- Lecture 22 - Lecture 4 - Quicksort analysis
- Lecture 23 - Lecture 5 - Tuples and dictionaries
- Lecture 24 - Lecture 6 - Function definitions
- Lecture 25 - Lecture 7 - List Comprehension
- Lecture 26 - Lecture 1 - Exception Handling
- Lecture 27 - Lecture 2 - Standard input and output
- Lecture 28 - Lecture 3 - Handling files
- Lecture 29 - Lecture 4 - String functions
- Lecture 30 - Lecture 5 - Formatting printed output
- Lecture 31 - Lecture 6 - pass, del() and None

[Lecture 32 - Lecture 1 - Backtracking, N queens](#)

[Lecture 33 - Lecture 2 - Global scope, nested functions](#)

[Lecture 34 - Lecture 3 - Generating permutations](#)

[Lecture 35 - Lecture 4 - Sets, stacks, queues](#)

[Lecture 36 - Lecture 5 - Priority queues and heaps](#)

[Lecture 37 - Lecture 1 - Abstract datatypes, classes and objects](#)

[Lecture 38 - Lecture 2 - Classes and objects in Python](#)

[Lecture 39 - Lecture 3 - User defined lists](#)

[Lecture 40 - Lecture 4 - Search trees](#)

[Lecture 41 - Lecture 1 - Memoization and dynamic programming](#)

[Lecture 42 - Lecture 2 - Grid paths](#)

[Lecture 43 - Lecture 3 - Longest common subsequence](#)

[Lecture 44 - Lecture 4 - Matrix multiplication](#)

[Lecture 45 - Lecture 5 - Wrap-up, Python vs other languages](#)

Lecture 1 - Intro to Course

Lecture 2 - Intro to Course

Lecture 3 - Incidents

Lecture 4 - Tutorial 1 - Part 1 Ubuntu

Lecture 5 - Tutorial 1 - Part 2 Python

Lecture 6 - OSM APIs and tools for data collection

Lecture 7 - Tutorial 2 - Part 1 Facebook API

Lecture 8 - Tutorial 2 - Part 2 Facebook API

Lecture 9 - Trust and Credibility on OSM

Lecture 10 - Misinformation on Social Media

Lecture 11 - Privacy and Social Media

Lecture 12 - Tutorial 3 - Part 1 Twitter API

Lecture 13 - Tutorial 3 - Part 2 MySQL

Lecture 14 - Tutorial 3 - Part 3 MongoDB

Lecture 15 - Privacy and Pictures on Online Social Media

Lecture 16 - Policing and Online Social Media

Lecture 17 - Policing and Online Social Media

Lecture 18 - Policing and Online Social Media

Lecture 19 - eCrime on Online Social Media

Lecture 20 - eCrime on Online Social Media

Lecture 21 - Tutorial 4 - Social Network Analysis

Lecture 22 - Link Farming in Online Social Media

Lecture 23 - Nudges

Lecture 24 - Semantic attacks: Spear phishing

Lecture 25 - Tutorial 5 - Analyzing text using Python NLTK

Lecture 26 - Profile Linking on Online Social Media

Lecture 27 - Anonymous Networks

Lecture 28 - Tutorial 6 - Gephi Network Visualization

Lecture 29 - Privacy in Location Based Social Networks - Part 1

Lecture 30 - Privacy in Location Based Social Networks - Part 2

Lecture 31 - Tutorial 7 - Visualization - Highcharts

[Lecture 32 - Beware of What You Share Inferring Home Location in Social Networks](#)

[Lecture 33 - On the dynamics of username change behavior on Twitter](#)

[Lecture 34 - Boston Marathon Analyzing Fake Content on Twitter](#)

Lecture 1 - Java Basics

Lecture 2 - Java : Primitive Data Types, Strings, Loops, Conditional Statements

Lecture 3 - Java : Strings, OOP principles

Lecture 4 - Java : Interfaces

Lecture 5 - Java : Classes, Exceptions, Threads

Lecture 6 - Introduction to Android Studio

Lecture 7 - Your First App

Lecture 8 - Deploying your App to a Phone

Lecture 9 - Extending app - Buttons, Toast

Lecture 10 - Android Development Environment

Lecture 11 - User Interface

Lecture 12 - Application Fundamentals

Lecture 13 - Extending the application

Lecture 14 - Activity Lifecycle - I

Lecture 15 - Activity Lifecycle - II

Lecture 16 - Activity LifeCycle - III

Lecture 17 - Adding Icon, Layouts, Handling Rotation - I

Lecture 18 - Adding Icon, Layouts, Handling Rotation - II

Lecture 19 - Debugging

Lecture 20 - Intents - I

Lecture 21 - Intents - II

Lecture 22 - Observer Pattern

Lecture 23 - Fragments - I

Lecture 24 - Fragments - II

Lecture 25 - Fragment Basic Programming Example

Lecture 26 - Fragments - Advanced Example

Lecture 27 - Implicit Intents

Lecture 28 - Saving Data - I

Lecture 29 - Saving Data - II

Lecture 30 - Security and System Permissions

Lecture 31 - Services

[Lecture 32 - Processes and threads](#)

[Lecture 33 - Working with Fragments - I](#)

[Lecture 34 - Working with Fragments - II](#)

[Lecture 35 - Working with Fragments - III](#)

[Lecture 36 - RecyclerView, Adapter](#)

[Lecture 37 - RecyclerView, Adapter, ViewHolder](#)

[Lecture 38 - ViewPager](#)

[Lecture 39 - Dialogues](#)

Lecture 1 - Introduction to the course

Lecture 2 - Introduction to a web-app

Lecture 3 - Building a web-app

Lecture 4 - Networks

Lecture 5 - Practical - Running your own web-server

Lecture 6 - Protocols

Lecture 7 - Practical - SSH + Network experiments

Lecture 8 - Practical - Building a webapp with nodejs and using git. Introduction to reverse proxies.

Lecture 9 - Practical - Introduction to server-side javascript and HTML/CSS

Lecture 10 - Introduction to client-side Javascript

Lecture 11 - Practical - APIs and mobile apps use web-servers

Lecture 12 - Introduction to databases

Lecture 13 - Data modelling and constraints

Lecture 14 - Interacting with a DBMS

Lecture 15 - Practical - Deeper exploration of a DBMS (column types and more)

Lecture 16 - Introduction to SQL

Lecture 17 - Understanding database performance

Lecture 18 - Transactions and ACID properties

Lecture 19 - Database security, backup and recovery

Lecture 20 - Analytics and Views

Lecture 21 - Scaling a database

Lecture 22 - Connecting your webapp to your database and SQL Injection

Lecture 23 - SQL and NoSQL systems

Lecture 24 - Authentication with HTTP

Lecture 25 - Understanding security, and some best practices for webapps

Lecture 26 - Introduction to authentication, hashing, curl and sessions

Lecture 27 - Introduction to mobile apps

Lecture 28 - Introduction to Mobile Application Development Part 2

Lecture 29 - Introduction to Android

Lecture 30 - Getting started with Android Application Development

Lecture 31 - Building Custom UI using XML and Logs

[Lecture 32 - Building a Blog App](#)

[Lecture 33 - Deploying an app to the Google Play Store](#)

[Lecture 34 - Introduction to iOS](#)

[Lecture 35 - The API Economy](#)

[Lecture 36 - Version Control using Git](#)

[Lecture 37 - Backend Architectures](#)

Lecture 1 - Operating System Introduction

Lecture 2 - Storage Hierarchy, Exceptions, Interrupts and traps

Lecture 3 - OS Management Services

Lecture 4 - OS Security Issues

Lecture 5 - Process and Threads

Lecture 6 - Process Scheduling

Lecture 7 - Scheduling Algorithm

Lecture 8 - Process Synchronization

Lecture 9 - Memory Management - 1

Lecture 10 - Memory Management - 2

Lecture 11 - File Systems - 1

Lecture 12 - File Systems - 2

Lecture 13 - Unix Filesystem

Lecture 14 - Unix Filesystem (Continued...)

Lecture 15 - Linux: Basic Commands

Lecture 16 - Linux: Basic Commands (Continued...)

Lecture 17 - Linux: Users and Permissions

Lecture 18 - Linux: I/O Redirection and Pipes

Lecture 19 - Linux: Task Control

Lecture 20 - Linux: Shell Environment

Lecture 21 - Linux: Text Editors

Lecture 22 - Linux: Compression / Archiving

Lecture 23 - Linux: Print and Sync Commands

Lecture 24 - Linux: File Comparison

Lecture 25 - Basic Networking Administration

Lecture 26 - Filesystems and Devices

Lecture 27 - Shell Introduction

Lecture 28 - Shell Comments and Variables

Lecture 29 - Shell Variables

Lecture 30 - Shell Arrays and Arithmetic

Lecture 31 - Shell Condition and Relation

[Lecture 32 - Shell Examples](#)

[Lecture 33 - Shell Functions](#)

[Lecture 34 - Shell File Test](#)

[Lecture 35 - Shell Loop Control](#)

[Lecture 36 - Shell Script Variations](#)

[Lecture 37 - Shell Pattern Matching](#)

[Lecture 38 - Shell Case Statements](#)

[Lecture 39 - Shell Co-routines](#)

[Lecture 40 - Shell Signals and Traps](#)

[Lecture 41 - Shell Subshell](#)

[Lecture 42 - Shell Declarations](#)

[Lecture 43 - Shell Examples 2](#)

[Lecture 44 - Shell Review](#)

[Lecture 45 - An Introduction](#)

[Lecture 46 - Structure of a Network](#)

[Lecture 47 - Network Core - Definition](#)

[Lecture 48 - Network Access and Physical Media](#)

[Lecture 49 - Structure of ISP and Packet Delays](#)

[Lecture 50 - Network Protocol Layers](#)

[Lecture 51 - Network Devices](#)

[Lecture 52 - Network Security - An Introduction](#)

[Lecture 53 - Public Key Cryptography](#)

[Lecture 54 - Digital Signatures](#)

[Lecture 55 - Security in Practise](#)

[Lecture 56 - Security in Practise \(Continued...\)](#)

[Lecture 57 - Wireshark](#)

[Lecture 58 - Snort](#)

[Lecture 59 - Review I](#)

[Lecture 60 - Review II](#)

Lecture 1 - Constraint Satisfaction Problems

Lecture 2 - CSP Examples: Map colouring, N-Queens, Classroom scheduling

Lecture 3 - CSP Examples: Huffman-Clowes Labelling, Waltz Algorithm, Crosswords

Lecture 4 - Model Based Diagnosis - An application of CSP

Lecture 5 - Constraint Networks - An Introduction

Lecture 6 - Binary Constraint Networks (BCN), Equivalent Networks

Lecture 7 - Projection Networks

Lecture 8 - Constraint Propagation

Lecture 9 - Algorithms AC1 and AC3

Lecture 10 - Can we do better than AC3?

Lecture 11 - Algorithm AC4

Lecture 12 - Generalized AC, Path-Consistency

Lecture 13 - i-Consistency, Algorithm PC1

Lecture 14 - Algorithm PC2, Strong i-Consistency

Lecture 15 - Directional Consistency and Graph Ordering

Lecture 16 - Min-Width and Min-Induced-Width Ordering

Lecture 17 - Directional Arc-Consistency and Tree CSPs

Lecture 18 - Directional Path-Consistency and Directional i-Consistency

Lecture 19 - Backtrack-Free search and Adaptive Consistency

Lecture 20 - Adaptive Consistency: Bucket Elimination

Lecture 21 - Search Methods for Solving CSPs

Lecture 22 - Algorithm Backtracking

Lecture 23 - Look-Ahead Methods in Search

Lecture 24 - Look-Ahead Search: Examples

Lecture 25 - Combining Search with Reasoning: Algorithm DPLL

Lecture 26 - Algorithm Backmarking

Lecture 27 - Dynamic Value Ordering, Dynamic Variable Ordering

Lecture 28 - Look-Back Methods - Definitions

Lecture 29 - Gaschnig's Backjumping: The Culprit Variable

Lecture 30 - Gaschnig's Backjumping, Graph-Based Backjumping

Lecture 31 - Graph-Based Backjumping: Internal and Relevant Dead-Ends

[Lecture 32 - Conflict-Directed Backjumping: Definitions](#)

[Lecture 33 - Algorithm Conflict-Directed Backjumping](#)

[Lecture 34 - Combining Look-Ahead and Look-Back: FC-CBJ](#)

[Lecture 35 - Learning During Search](#)

[Lecture 36 - Model Based Systems](#)

[Lecture 37 - Model Based Diagnosis](#)

[Lecture 38 - Truth Maintenance Systems](#)

[Lecture 39 - Planning as Constraint Satisfaction](#)

[Lecture 40 - Planning as Constraint Satisfaction \(Continued...\)](#)

[Lecture 41 - Planning as Satisfiability](#)

[Lecture 42 - Wrapping Up and Further Study](#)

Lecture 1 - Introduction High Speed Circuit - Design Recursive Doubling

Lecture 2 - High Speed Circuit Design - Fast Adder Circuits

Lecture 3 - Lab 1 : Introduction

Lecture 4 - Fast Adder Circuits (Continued...)

Lecture 5 - Fast Multiplier Circuit

Lecture 6 - Fast Multiplier Circuit (Continued...)

Lecture 7 - Programming using X86 ISA - Addressing Modes

Lecture 8 - Programming using X86 ISA - Addressing Modes

Lecture 9 - Floating point - Precision and Accuracy

Lecture 10 - Floating Point - Addition, Subtraction and Multiplication

Lecture 11 - Instruction Set Architecture

Lecture 12 - Instruction Set Architecture (Continued...)

Lecture 13 - Lab 2 : Segmentation - Part I

Lecture 14 - Lab 2 : Segmentation - Part II

Lecture 15 - Lab 2 : Segmentation - Part III

Lecture 16 - Orthogonal ISA, C Constructs Mapping, Addressing Modes

Lecture 17 - Atomic and Predicated Instructions

Lecture 18 - Atomic and Predicated Instructions (Continued...)

Lecture 19 - General Purpose Registers

Lecture 20 - Expanding opcodes

Lecture 21 - Introduction to Pipelining

Lecture 22 - Pipelining

Lecture 23 - Data Hazards

Lecture 24 - Lab 2 : Instruction Scheduling - Static and Dynamic

Lecture 25 - Dynamic Instruction Scheduling

Lecture 26 - Dynamic Instruction Scheduling (Continued...)

Lecture 27 - Control Hazard, Branch Prediction

Lecture 28 - Process Management

Lecture 29 - Branch prediction

Lecture 30 - Global Branch Prediction

Lecture 31 - Structural Hazard, Architectural Enhancements

[Lecture 32 - Lab 3 : Virtual Memory](#)

[Lecture 33 - Locality of Reference, Demand paging](#)

[Lecture 34 - Page Replacement Algorithm](#)

[Lecture 35 - Multilevel Paging, Translational Lookaside Buffer](#)

[Lecture 36 - Multilevel Paging](#)

[Lecture 37 - Multilevel Paging - Part 1](#)

[Lecture 38 - Page Frame Allocation, Beledy's Anomaly](#)

[Lecture 39 - Paging, Cache](#)

[Lecture 40 - Cache](#)

[Lecture 41 - Cache Organisation](#)

[Lecture 42 - Cache - Cache Coherency, Dual Ported Cache](#)

[Lecture 43 - Multilevel Caching, Multitasking](#)

[Lecture 44 - Cache, Degree of Multiprogramming](#)

[Lecture 45 - Shared Memory Architecture](#)

[Lecture 46 - Shared Memory Architecture - Part I](#)

[Lecture 47 - Virtually Indexed - Virtually Tagged and Physically Tagged Caches](#)

[Lecture 48 - Lab 4 : Task Switching \(Continued...\)](#)

[Lecture 49 - Shared Memory Architecture, Cache Coherence](#)

[Lecture 50 - Concurrent Programming in Hardware - Part I](#)

[Lecture 51 - Concurrent Programming in Hardware - Part II](#)

[Lecture 52 - Conclusion : Recent Trends in Computer Organization and Architecture](#)

Lecture 1 - Overview of Cellular Systems - Part 1

Lecture 2 - Overview of Cellular Systems - Part 2

Lecture 3 - Overview of Cellular Systems - Part 3

Lecture 4 - 5G and other Wireless Technologies

Lecture 5 - Basic Cellular Terminology

Lecture 6 - Introduction to Antennas and Propagation Models

Lecture 7 - Link budget, Fading margin, Outage

Lecture 8 - Cellular Concept

Lecture 9 - Cellular system design and analysis

Lecture 10 - Cellular Geometry and System Design

Lecture 11 - Cellular System Capacity, Trunking

Lecture 12 - Handoff and Mobility

Lecture 13 - Handoff Part 2, Classification of Signal Variation

Lecture 14 - Shadowing, Outage, Multipath

Lecture 15 - Rayleigh Fading and Statistical Characterization

Lecture 16 - Properties of Rayleigh Distribution

Lecture 17 - BER in Fading, Narrowband vs Wideband Channels

Lecture 18 - Characterization of Multipath Fading Channels

Lecture 19 - Choice of Modulation

Lecture 20 - Coherent versus Differential Detection

Lecture 21 - Review of Lecture 1-19

Lecture 22 - Coherent vs Differential Detection - Part II and BER in Fading

Lecture 23 - BER in Fading - Part II, Ricean Fading

Lecture 24 - Ricean and Nakagami Fading, Moment Generating Function (MGF)

Lecture 25 - MGF Part II, WSSUS Model

Lecture 26 - WSSUS Part II, Coherence Time, Doppler Spectrum

Lecture 27 - Doppler, Temporal Characteristics of Fading Channels

Lecture 28 - WSSUS-Characterization of Time Dispersive Fading Channels

Lecture 29 - WSSUS-Classification of Fading Channels

Lecture 30 - Practical Channel Models (ITU, COST), Computer generation of Rayleigh fading

Lecture 31 - Rayleigh Fading simulation - Clark and Gans Method, Jakes's™ Method

[Lecture 32 - Jakes's™ Method properties](#)

[Lecture 33 - Introduction to Diversity, Antenna selection diversity](#)

[Lecture 34 - Statistical Characterization of Antenna Diversity, Optimal Diversity Combining](#)

[Lecture 35 - BER in fading, Equal Gain Combining](#)

[Lecture 36 - Array Gain, Diversity Gain, Alamouti Scheme](#)

[Lecture 37 - Alamouti Scheme - Part II, Channel Capacity](#)

[Lecture 38 - Capacity of fading Channels, Capacity with Outage](#)

[Lecture 39 - Channel State Information, Optimum Power Allocation](#)

[Lecture 40](#)

[Lecture 41](#)

[Lecture 42](#)

[Lecture 43](#)

[Lecture 44](#)

[Lecture 45](#)

[Lecture 46](#)

[Lecture 47](#)

[Lecture 48 - Rake Receiver for multipath channels](#)

[Lecture 49 - Multiuser environment](#)

[Lecture 50 - CDMA system Capacity](#)

[Lecture 51 - CDMA Multiuser Detectors - Part 1](#)

[Lecture 52 - CDMA Multiuser Detectors - Part 2](#)

[Lecture 53](#)

[Lecture 54](#)

[Lecture 55](#)

[Lecture 56](#)

Lecture 1 - Introduction to Distributed Systems

Lecture 2 - Basic Algorithms in Message Passing System

Lecture 3 - Leader Election in Rings

Lecture 4 - Distributed Models of Computation, Causality and Logical Time

Lecture 5 - Size of Vector Clock, Matrix Clocks, Virtual Time and Physical Clock Synchronization

Lecture 6 - Global State and Snapshot Recording Algorithms

Lecture 7 - Distributed Mutual Exclusion and Non-Token based Approaches

Lecture 8 - Quorum Based Distributed Mutual Exclusion Approaches

Lecture 9 - Token Based Distributed Mutual Exclusion Approaches

Lecture 10 - Consensus and Agreement Algorithms

Lecture 11 - Checkpointing and Rollback Recovery

Lecture 12 - Deadlock Detection in Distributed Systems

Lecture 13 - Distributed Shared Memory

Lecture 14 - Distributed Minimum Spanning Tree

Lecture 15 - Termination Detection in Distributed System

Lecture 16 - Message Ordering and Group Communication

Lecture 17 - Self-Stabilization

Lecture 18 - Case Study 1 - Distributed Randomized Algorithms

Lecture 19 - Case Study 2 - Peer-to-Peer Computing and Structured Overlay Network

Lecture 20 - Case Study 3 - The Google File System (GFS)

Lecture 21 - Case Study 4 - MapReduce

Lecture 22 - Case Study 5 - HDFS

Lecture 23 - Case Study 6 - Spark

Lecture 24 - Case Study 7 - Distributed Algorithms for Sensor Networks

Lecture 25 - Case Study 8 - Authentication in Distributed Systems

Lecture 26 - Case Study 9 - Bitcoin: A Peer-to-Peer Electronic Cash System

Lecture 27 - Case Study 10 - BlockChain Technology

Lecture 1 - Introduction

Lecture 2 - Answer to the puzzle

Lecture 3 - Introduction to Python - 1

Lecture 4 - Introduction to Python - 2

Lecture 5 - Introduction to Networkx - 1

Lecture 6 - Introduction to Networkx - 2

Lecture 7 - Social Networks: The Challenge

Lecture 8 - Google Page Rank

Lecture 9 - Searching in a Network

Lecture 10 - Link Prediction

Lecture 11 - The Contagions

Lecture 12 - Importance of Acquaintances

Lecture 13 - Marketing on Social Networks

Lecture 14 - Introduction to Datasets

Lecture 15 - Ingredients Network

Lecture 16 - Synonymy Network

Lecture 17 - Web Graph

Lecture 18 - Social Network Datasets

Lecture 19 - Datasets : Different Formats

Lecture 20 - Datasets : How to Download?

Lecture 21 - Datasets : Analysing Using Networkx

Lecture 22 - Datasets : Analysing Using Gephi

Lecture 23 - Introduction : Emergence of Connectedness

Lecture 24 - Advanced Material : Emergence of Connectedness

Lecture 25 - Programming Illustration : Emergence of Connectedness

Lecture 26 - Summary to Datasets

Lecture 27 - Introduction

Lecture 28 - Granovetter's Strength of weak ties

Lecture 29 - Triads, clustering coefficient and neighborhood overlap

Lecture 30 - Structure of weak ties, bridges, and local bridges

Lecture 31 - Validation of Granovetter's experiment using cell phone data

[Lecture 32 - Embededness](#)

[Lecture 33 - Structural Holes](#)

[Lecture 34 - Social Capital](#)

[Lecture 35 - Finding Communities in a graph \(Brute Force Method\)](#)

[Lecture 36 - Community Detection Using Girvan Newman Algorithm](#)

[Lecture 37 - Visualising Communities using Gephi](#)

[Lecture 38 - Tie Strength, Social Media and Passive Engagement](#)

[Lecture 39 - Betweenness Measures and Graph Partitioning](#)

[Lecture 40 - Strong and Weak Relationship - Summary](#)

[Lecture 41 - Introduction to Homophily - Should you watch your company ?](#)

[Lecture 42 - Selection and Social Influence](#)

[Lecture 43 - Interplay between Selection and Social Influence](#)

[Lecture 44 - Homophily - Definition and measurement](#)

[Lecture 45 - Foci Closure and Membership Closure](#)

[Lecture 46 - Introduction to Fatman Evolutionary model](#)

[Lecture 47 - Fatman Evolutionary Model - The Base Code \(Adding people\)](#)

[Lecture 48 - Fatman Evolutionary Model - The Base Code \(Adding Social Foci\)](#)

[Lecture 49 - Fatman Evolutionary Model - Implementing Homophily](#)

[Lecture 50 - Quantifying the Effect of Triadic Closure](#)

[Lecture 51 - Fatman Evolutionary Model - Implementing Closures](#)

[Lecture 52 - Fatman Evolutionary Model - Implementing Social Influence](#)

[Lecture 53 - Fatman Evolutionary Model - Storing and analyzing longitudinal data](#)

[Lecture 54 - Spatial Segregation : An Introduction](#)

[Lecture 55 - Spatial Segregation : Simulation of the Schelling Model](#)

[Lecture 56 - Spatial Segregation : Conclusion](#)

[Lecture 57 - Schelling Model Implementation - 1 \(Introduction\)](#)

[Lecture 58 - Schelling Model Implementation - 2 \(Base Code\)](#)

[Lecture 59 - Schelling Model Implementation - 3 \(Visualization and Getting a list of boundary and internal nodes\)](#)

[Lecture 60 - Schelling Model Implementation - 4 \(Getting a list of unsatisfied nodes\)](#)

[Lecture 61 - Schelling Model Implementation - 5 \(Shifting the unsatisfied nodes and visualizing the final graph\)](#)

[Lecture 62 - Chapter - 5 Positive and Negative Relationships \(Introduction\)](#)

[Lecture 63 - Structural Balance](#)

[Lecture 64 - Enemy'S Enemy is a Friend](#)

- Lecture 65 - Characterizing the Structure of Balanced Networks
- Lecture 66 - Balance Theorem
- Lecture 67 - Proof of Balance Theorem
- Lecture 68 - Introduction to positive and negative edges
- Lecture 69 - Outline of implementation
- Lecture 70 - Creating graph, displaying it and counting unstable triangles
- Lecture 71 - Moving a network from an unstable to stable state
- Lecture 72 - Forming two coalitions
- Lecture 73 - Forming two coalitions (Continued...)
- Lecture 74 - Visualizing coalitions and the evolution
- Lecture 75 - The Web Graph
- Lecture 76 - Collecting the Web Graph
- Lecture 77 - Equal Coin Distribution
- Lecture 78 - Random Coin Dropping
- Lecture 79 - Google Page Ranking Using Web Graph
- Lecture 80 - Implementing PageRank Using Points Distribution Method - 1
- Lecture 81 - Implementing PageRank Using Points Distribution Method - 2
- Lecture 82 - Implementing PageRank Using Points Distribution Method - 3
- Lecture 83 - Implementing PageRank Using Points Distribution Method - 4
- Lecture 84 - Implementing PageRank Using Random Walk Method - 1
- Lecture 85 - Implementing PageRank Using Random Walk Method - 2
- Lecture 86 - DegreeRank versus PageRank
- Lecture 87 - We Follow
- Lecture 88 - Why do we Follow?
- Lecture 89 - Diffusion in Networks
- Lecture 90 - Modeling Diffusion
- Lecture 91 - Modeling Diffusion (Continued...)
- Lecture 92 - Impact of Communities on Diffusion
- Lecture 93 - Cascade and Clusters
- Lecture 94 - Knowledge, Thresholds and the Collective Action
- Lecture 95 - An Introduction to the Programming Screencast (Coding 4 major ideas)
- Lecture 96 - The Base Code
- Lecture 97 - Coding the First Big Idea - Increasing the Payoff

- Lecture 98 - Coding the Second Big Idea - Key People
- Lecture 99 - Coding the Third Big Idea - Impact of Communities on Cascades
- Lecture 100 - Coding the Fourth Big Idea - Cascades and Clusters
- Lecture 101 - Introduction to Hubs and Authorities (A Story)
- Lecture 102 - Principle of Repeated Improvement (A story)
- Lecture 103 - Principle of Repeated Improvement (An example)
- Lecture 104 - Hubs and Authorities
- Lecture 105 - PageRank Revisited - An example
- Lecture 106 - PageRank Revisited - Convergence in the Example
- Lecture 107 - PageRank Revisited - Conservation and Convergence
- Lecture 108 - PageRank, conservation and convergence - Another example
- Lecture 109 - Matrix Multiplication (Pre-requisite 1)
- Lecture 110 - Convergence in Repeated Matrix Multiplication (Pre-requisite 1)
- Lecture 111 - Addition of Two Vectors (Pre-requisite 2)
- Lecture 112 - Convergence in Repeated Matrix Multiplication- The Details
- Lecture 113 - PageRank as a Matrix Operation
- Lecture 114 - PageRank Explained
- Lecture 115 - Introduction to Powerlaw
- Lecture 116 - Why do Normal Distributions Appear?
- Lecture 117 - Power Law emerges in WWW graphs
- Lecture 118 - Detecting the Presence of Powerlaw
- Lecture 119 - Rich Get Richer Phenomenon
- Lecture 120 - Summary So Far
- Lecture 121 - Implementing Rich-getting-richer Phenomenon (Barabasi-Albert Model) - 1
- Lecture 122 - Implementing Rich-getting-richer Phenomenon (Barabasi-Albert Model) - 2
- Lecture 123 - Implementing a Random Graph (Erdos-Renyi Model) - 1
- Lecture 124 - Implementing a Random Graph (Erdos-Renyi Model) - 2
- Lecture 125 - Forced Versus Random Removal of Nodes (Attack Survivability)
- Lecture 126 - Rich Get Richer - A Possible Reason
- Lecture 127 - Rich Get Richer - The Long Tail
- Lecture 128 - Epidemics- An Introduction
- Lecture 129 - Introduction to epidemics (Continued...)
- Lecture 130 - Simple Branching Process for Modeling Epidemics

- [Lecture 131 - Simple Branching Process for Modeling Epidemics \(Continued...\)](#)
- [Lecture 132 - Basic Reproductive Number](#)
- [Lecture 133 - Modeling epidemics on complex networks](#)
- [Lecture 134 - SIR and SIS spreading models](#)
- [Lecture 135 - Comparison between SIR and SIS spreading models](#)
- [Lecture 136 - Basic Reproductive Number Revisited for Complex Networks](#)
- [Lecture 137 - Percolation model](#)
- [Lecture 138 - Analysis of basic reproductive number in branching model \(The problem statement\)](#)
- [Lecture 139 - Analyzing basic reproductive number - 2](#)
- [Lecture 140 - Analyzing basic reproductive number - 3](#)
- [Lecture 141 - Analyzing basic reproductive number - 4](#)
- [Lecture 142 - Analyzing basic reproductive number - 5](#)
- [Lecture 143 - Small World Effect - An Introduction](#)
- [Lecture 144 - Milgram's Experiment](#)
- [Lecture 145 - The Reason](#)
- [Lecture 146 - The Generative Model](#)
- [Lecture 147 - Decentralized Search - I](#)
- [Lecture 148 - Decentralized Search - II](#)
- [Lecture 149 - Decentralized Search - III](#)
- [Lecture 150 - Programming illustration- Small world networks : Introduction](#)
- [Lecture 151 - Base code](#)
- [Lecture 152 - Making homophily based edges](#)
- [Lecture 153 - Adding weak ties](#)
- [Lecture 154 - Plotting change in diameter](#)
- [Lecture 155 - Programming illustration- Myopic Search : Introduction>](#)
- [Lecture 156 - Myopic Search](#)
- [Lecture 157 - Myopic Search comparison to optimal search](#)
- [Lecture 158 - Time Taken by Myopic Search](#)
- [Lecture 159 - PseudoCores : Introduction](#)
- [Lecture 160 - How to be Viral](#)
- [Lecture 161 - Who are the right key nodes?](#)
- [Lecture 162 - finding the right key nodes \(the core\)](#)
- [Lecture 163 - Coding K-Shell Decomposition](#)

[Lecture 164 - Coding cascading Model](#)

[Lecture 165 - Coding the importance of core nodes in cascading](#)

[Lecture 166 - Pseudo core](#)

Lecture 1 - Introduction to Probability - A box of chocolates

Lecture 2 - Introduction to Probability - Axiomatic Approach to Probability Theory

Lecture 3 - Introduction to Probability - Verifying Matrix Multiplication (Statement, Algorithm and Independence)

Lecture 4 - Introduction to Probability - Verifying Matrix Multiplication (Correctness and Law of Total Probability)

Lecture 5 - Introduction to Probability - How Strong is your Network?

Lecture 6 - Introduction to Probability - How to Understand the World? Play with it!

Lecture 7 - Tutorial 1

Lecture 8 - Tutorial 2

Lecture 9 - Discrete Random Variables - Basic Definitions

Lecture 10 - Discrete Random Variables - Linearity of Expectation and Jensen's Inequality

Lecture 11 - Discrete Random Variables - Conditional Expectation I

Lecture 12 - Discrete Random Variables - Conditional Expectation II

Lecture 13 - Discrete Random Variables - Geometric Random Variables and Collecting Coupons

Lecture 14 - Discrete Random Variables - Randomized Selection

Lecture 15 - Tail Bounds I - Markov's Inequality

Lecture 16 - Tail Bounds I - The Second Moment, Variance and Chebyshev's Inequality

Lecture 17 - Tail Bounds I - Median via Sampling

Lecture 18 - Tail Bounds I - Median via Sampling - Analysis

Lecture 19 - Tail Bounds I - Moment Generating Functions and Chernoff Bounds

Lecture 20 - Tail Bounds I - Parameter Estimation

Lecture 21 - Tail Bounds I - Control Group Selection

Lecture 22 - Applications of Tail Bounds - Routing in Sparse Networks

Lecture 23 - Applications of Tail Bounds - Analysis of Valiant's Routing

Lecture 24 - Applications of Tail Bounds - Random Graphs

Lecture 25 - Live Session 2

Lecture 26 - Live Session

Lecture 1 - Introduction to Human Computer Interaction

Lecture 2 - What is HCI? Commonalities and Differences in Interfaces

Lecture 3 - Door handle, Elevators, Contextual Inquiry, Affinity Diagrams

Lecture 4 - Lab Session Contextual Inquiry

Lecture 5 - Lab Session Affinity Diagram

Lecture 6 - Tutorial on Photoshop

Lecture 7 - Tutorial on UI Designing using Photoshop

Lecture 8 - Institutional Review Board, Ethics committee, IRB documents / application, consent form

Lecture 9 - Tutorial on Proto.io

Lecture 10 - Tutorial on Lookback

Lecture 11 - How to understand user needs? Surveys, Questionnaire

Lecture 12 - How to understand user needs? Surveys, Questionnaire - Continues

Lecture 13 - Prototyping: Low fidelity and High fidelity

Lecture 14 - User-Centered Design

Lecture 15 - Lab Session: Task Analysis

Lecture 16 - Design Patterns

Lecture 17 - Lab Session: Material Design

Lecture 18 - Usable security

Lecture 19 - Lab Session: Task Analysis - 2

Lecture 20 - Continuity of Usable Security

Lecture 21 - Visual Design

Lecture 22 - Visual Design - 2

Lecture 23 - Crypto price Tracker App

Lecture 24 - Interacto

Lecture 25 - Tech Hinder

Lecture 26 - busKARO

Lecture 27 - MayMayMe

Lecture 28 - noWhinge

Lecture 1 - WISE Gen and The IT Revolution - 1

Lecture 2 - WISE Gen and The IT Revolution - 1 (Continued...)

Lecture 3 - WISE GEN - Next Step

Lecture 4 - Network Security : A Re-cap

Lecture 5 - Symmetric Key Cryptography and Digital Signatures

Lecture 6 - Basic Network Security Components

Lecture 7 - Internet Security Threats

Lecture 8 - History of Kali Linux

Lecture 9 - Penetration Testing with Kali Linux

Lecture 10 - Network Security and Forensics Introduction - I

Lecture 11 - Network Security and Forensics Introduction - II

Lecture 12 - Penetration Testing: An Introduction

Lecture 13 - Penetration testing steps in Kali Linux

Lecture 14 - Kali Linux Installation

Lecture 15 - Reconnaissance - Part I

Lecture 16 - Reconnaissance - Part II

Lecture 17 - Serverside Attacks: Tools in Kali Linux

Lecture 18 - Serverside Attacks: Tools in Kali Linux (Continued...)

Lecture 19 - Serverside Attacks: Tools in Kali Linux (Continued...)

Lecture 20 - Serverside Attacks: Tools in Kali Linux (Continued...)

Lecture 21 - Serverside Attacks: Tools in Kali Linux (Continued...)

Lecture 22 - Serverside Attacks: Tools in Kali Linux (Continued...)

Lecture 23 - Client Side Attacks - Tools in Kali Linux - 1

Lecture 24 - Client Side Attacks - Tools in Kali Linux - 2

Lecture 25 - Client Side Attacks - Tools in Kali Linux - 3

Lecture 26 - Client Side Attacks - Tools in Kali Linux - 4

Lecture 27 - Authentication Based Attacks - Tools in Kali Linux - 1

Lecture 28 - Authentication Based Attacks - Tools in Kali Linux - 2

Lecture 29 - Authentication Based Attacks - Tools in Kali Linux - 3

Lecture 30 - Authentication Based Attacks - Tools in Kali Linux - 4

Lecture 31 - Authentication Based Attacks - Tools in Kali Linux - 5

- [Lecture 32 - Web Attacks - Tools in Kali Linux - 1](#)
- [Lecture 33 - Web Attacks - Tools in Kali Linux - 2](#)
- [Lecture 34 - Penetration Testing Attacks - Defensive Countermeasures](#)
- [Lecture 35 - Technical Fundamentals for Evidence Acquisition - 1](#)
- [Lecture 36 - Technical Fundamentals for Evidence Acquisition - 2](#)
- [Lecture 37 - Packet Capture Tools and Methods](#)
- [Lecture 38 - Wireshark Introduction](#)
- [Lecture 39 - Packet Analysis](#)
- [Lecture 40 - Flow Analysis](#)
- [Lecture 41 - Case study 1](#)
- [Lecture 42 - Case study 1 \(Continued...\)](#)
- [Lecture 43 - Wireless Forensics - Technology](#)
- [Lecture 44 - Wireless Network Security Framework](#)
- [Lecture 45 - Wireless Access Points - Security issues](#)
- [Lecture 46 - Case Study 2 - Use of tools](#)
- [Lecture 47 - Network Security Devices - IDS](#)
- [Lecture 48 - IDS Evidence Acquisition and SNORT](#)
- [Lecture 49 - SNORT Rules](#)
- [Lecture 50 - SNORT Installation](#)
- [Lecture 51 - SNORT Configuration and Demonstration](#)
- [Lecture 52 - Evidence collection in Switches and Routers](#)
- [Lecture 53 - Evidence collection in Routers and Firewalls](#)
- [Lecture 54 - IPTables rules and tool usage](#)
- [Lecture 55 - Logs, Rules and Automated Tools](#)
- [Lecture 56 - Re-cap of All Topics](#)
- [Lecture 57 - Introduction to Meltdown Attack](#)
- [Lecture 58 - Introduction to Meltdown - Address Space Basics](#)
- [Lecture 59 - Meltdown Attack - Out of Order Execution](#)
- [Lecture 60 - Meltdown Attack - Recovering from Exception](#)

Lecture 1 - Data science for engineers Course philosophy and expectation

Lecture 2 - Introduction to R

Lecture 3 - Introduction to R (Continued...)

Lecture 4 - Variables and datatypes in R

Lecture 5 - Data frames

Lecture 6 - Recasting and joining of dataframes

Lecture 7 - Arithmetic,Logical and Matrix operations in R

Lecture 8 - Advanced programming in R : Functions

Lecture 9 - Advanced Programming in R : Functions (Continued...)

Lecture 10 - Control structures

Lecture 11 - Data visualization in R Basic graphics

Lecture 12 - Linear Algebra for Data science

Lecture 13 - Solving Linear Equations

Lecture 14 - Solving Linear Equations (Continued...)

Lecture 15 - Linear Algebra - Distance,Hyperplanes and Halfspaces,Eigenvalues,Eigenvectors

Lecture 16 - Linear Algebra - Distance,Hyperplanes and Halfspaces,Eigenvalues,Eigenvectors (Continued... 1)

Lecture 17 - Linear Algebra - Distance,Hyperplanes and Halfspaces,Eigenvalues,Eigenvectors (Continued... 2)

Lecture 18 - Linear Algebra - Distance,Hyperplanes and Halfspaces,Eigenvalues,Eigenvectors (Continued... 3)

Lecture 19 - Statistical Modelling

Lecture 20 - Random Variables and Probability Mass/Density Functions

Lecture 21 - Sample Statistics

Lecture 22 - Hypotheses Testing

Lecture 23 - Optimization for Data Science

Lecture 24 - Unconstrained Multivariate Optimization

Lecture 25 - Unconstrained Multivariate Optimization (Continued...)

Lecture 26 - Gradient (Steepest) Descent (OR) Learning Rule

Lecture 27 - Multivariate Optimization With Equality Constraints

Lecture 28 - Multivariate Optimization With Inequality Constraints

Lecture 29 - Introduction to Data Science

Lecture 30 - Solving Data Analysis Problems - A Guided Thought Process

Lecture 31 - Module : Predictive Modelling

[Lecture 32 - Linear Regression](#)

[Lecture 33 - Model Assessment](#)

[Lecture 34 - Diagnostics to Improve Linear Model Fit](#)

[Lecture 35 - Simple Linear Regression Model Building](#)

[Lecture 36 - Simple Linear Regression Model Assessment](#)

[Lecture 37 - Simple Linear Regression Model Assessment \(Continued...\)](#)

[Lecture 38 - Multiple Linear Regression](#)

[Lecture 39 - Cross Validation](#)

[Lecture 40 - Multiple Linear Regression Modelling Building and Selection](#)

[Lecture 41 - Classification](#)

[Lecture 42 - Logistic Regression](#)

[Lecture 43 - Logistic Regression \(Continued...\)](#)

[Lecture 44 - Performance Measures](#)

[Lecture 45 - Logistic Regression Implementation in R](#)

[Lecture 46 - K-Nearest Neighbors \(kNN\)](#)

[Lecture 47 - K-Nearest Neighbors implementation in R](#)

[Lecture 48 - K-means Clustering](#)

[Lecture 49 - K-means implementation in R](#)

[Lecture 50 - Data Science for engineers - Summary](#)

- Lecture 1 - Introduction to Programming
- Lecture 2 - Why Programming ?
- Lecture 3 - Programming for Everybody
- Lecture 4 - Any Prerequisites ?
- Lecture 5 - Where to start?
- Lecture 6 - Why do we have so many languages?
- Lecture 7 - How to go about programming?
- Lecture 8 - Why to learn programming?
- Lecture 9 - What is programming?
- Lecture 10 - How to give instructions ?
- Lecture 11 - Introduction To Scratch
- Lecture 12 - Introduction To Loops
- Lecture 13 - More About Loops
- Lecture 14 - Solution To Looping Problem
- Lecture 15 - Scratch : Animation 1
- Lecture 16 - Scratch : Animation 2
- Lecture 17 - Scratch : Animation 3
- Lecture 18 - More On Scratch
- Lecture 19 - Introduction to Anaconda
- Lecture 20 - Installation of Anaconda
- Lecture 21 - Introduction to Spyder IDE
- Lecture 22 - Printing statements in Python
- Lecture 23 - Understanding Variables in Python
- Lecture 24 - Executing a sequence of instructions in the Console
- Lecture 25 - Writing your First Program
- Lecture 26 - Taking inputs from the user
- Lecture 27 - Discount Calculation
- Lecture 28 - Motivation to if condition
- Lecture 29 - A reminder on how to deal with numbers
- Lecture 30 - Understanding if condition's working
- Lecture 31 - Realizing the importance of syntax and indentation

[Lecture 32 - Introductions to loops](#)

[Lecture 33 - Loops: Sum of numbers](#)

[Lecture 34 - Loops: Sum of numbers \(Continued...\)](#)

[Lecture 35 - Loops: Multiplication Tables](#)

[Lecture 36 - Introduction to While Loop](#)

[Lecture 37 - Lists Part 1 : Introduction](#)

[Lecture 38 - Lists Part 2 : Manipulation](#)

[Lecture 39 - Lists Part 3 : Operations](#)

[Lecture 40 - Lists Part 4 : Slicing](#)

[Lecture 41 - Loops and Conditionals : Fizzbuzz 01](#)

[Lecture 42 - Loops and Conditionals : Fizzbuzz 02](#)

[Lecture 43 - Crowd Computing - Just estimate 01](#)

[Lecture 44 - Crowd Computing - Just estimate 02](#)

[Lecture 45 - Crowd Computing - Just estimate 03](#)

[Lecture 46 - Crowd Computing - Just estimate 04](#)

[Lecture 47 - Crowd Computing - Just estimate 05](#)

[Lecture 48 - Crowd Computing - Just estimate 06](#)

[Lecture 49 - Permutations - Jumbled Words 01](#)

[Lecture 50 - Permutations - Jumbled Words 02](#)

[Lecture 51 - Permutations - Jumbled Words 03](#)

[Lecture 52 - Theory of Evolution 01](#)

[Lecture 53 - Theory of Evolution 02](#)

[Lecture 54 - Theory of Evolution 03](#)

[Lecture 55 - Theory of Evolution 04](#)

[Lecture 56 - Practice is the key](#)

[Lecture 57 - Magic Square Hit and Trial 01](#)

[Lecture 58 - Magic Square Hit and Trial 02](#)

[Lecture 59 - Magic Square Hit and Trial 03](#)

[Lecture 60 - Magic Square Hit and Trial 04](#)

[Lecture 61 - Magic Square Hit and Trial 05](#)

[Lecture 62 - Let's program and play](#)

[Lecture 63 - Dobble Game - Spot the similarity 01](#)

[Lecture 64 - Dobble Game - Spot the similarity 02](#)

- Lecture 65 - Dobble Game - Spot the similarity 03
- Lecture 66 - Dobble Game - Spot the similarity 04
- Lecture 67 - What is your date of birth?
- Lecture 68 - Birthday Paradox - Find your twin 01
- Lecture 69 - Birthday Paradox - Find your twin 02
- Lecture 70 - Birthday Paradox - Find your twin 03
- Lecture 71 - Birthday Paradox - Find your twin 04
- Lecture 72 - Birthday Paradox - Find your twin 05
- Lecture 73 - What's your favourite movie?
- Lecture 74 - Guess the Movie Name 01
- Lecture 75 - Guess the Movie Name 02
- Lecture 76 - Guess the Movie Name 03
- Lecture 77 - Guess the Movie Name 04
- Lecture 78 - Guess the Movie Name 05
- Lecture 79 - Guess the Movie Name 06
- Lecture 80 - Dictionaries
- Lecture 81 - Speech to Text : No need to write 01
- Lecture 82 - Speech to Text : No need to write 02
- Lecture 83 - Speech to Text : No need to write 03
- Lecture 84 - Monte Hall : 3 doors and a twist 01
- Lecture 85 - Monte Hall : 3 doors and a twist 02
- Lecture 86 - Rock, Paper and Scissor : Cheating not allowed !! 01
- Lecture 87 - Rock, Paper and Scissor : Cheating not allowed !! 02
- Lecture 88 - Rock, Paper and Scissor : Cheating not allowed !! 03
- Lecture 89 - Rock, Paper and Scissor : Cheating not allowed !! 04
- Lecture 90 - Sorting and Searching : 20 questions game 01
- Lecture 91 - Sorting and Searching : 20 questions game 02
- Lecture 92 - Sorting and Searching : 20 questions game 03
- Lecture 93 - Sorting and Searching : 20 questions game 04
- Lecture 94 - Sorting and Searching : 20 questions game 05
- Lecture 95 - Sorting and Searching : 20 questions game 06
- Lecture 96 - Sorting and Searching : 20 questions game 07
- Lecture 97 - Sorting and Searching : 20 questions game 08

Lecture 98 - Substitution Cipher -The science of secrecy
Lecture 99 - Substitution Cipher -The science of secrecy 01
Lecture 100 - Substitution Cipher -The science of secrecy 02
Lecture 101 - Substitution Cipher -The science of secrecy 03
Lecture 102 - Tic Tac Toe - Down the memory Lane
Lecture 103 - Tic Tac Toe - Down the memory Lane 01
Lecture 104 - Tic Tac Toe - Down the memory Lane 02
Lecture 105 - Tic Tac Toe - Down the memory Lane 03
Lecture 106 - Tic Tac Toe - Down the memory Lane 04
Lecture 107 - Tic Tac Toe - Down the memory Lane 05
Lecture 108 - Recursion
Lecture 109 - Recursion 01
Lecture 110 - Recursion 02
Lecture 111 - Recursion 03
Lecture 112 - Recursion 04
Lecture 113 - Recursion 05
Lecture 114 - Recursion 06
Lecture 115 - Snakes and Ladders - Not on the Board
Lecture 116 - Snakes and Ladders - Not on the Board - Part 01
Lecture 117 - Snakes and Ladders - Not on the Board - Part 02
Lecture 118 - Snakes and Ladders - Not on the Board - Part 03
Lecture 119 - Snakes and Ladders - Not on the Board - Part 04
Lecture 120 - Snakes and Ladders - Not on the Board - Part 05
Lecture 121 - Snakes and Ladders - Not on the Board - Part 06
Lecture 122 - Spiral Traversing - Let's Animate
Lecture 123 - Spiral Traversing - Let's Animate - Part 01
Lecture 124 - Spiral Traversing - Let's Animate - Part 02
Lecture 125 - Spiral Traversing - Let's Animate - Part 03
Lecture 126 - Spiral Traversing - Let's Animate - Part 04
Lecture 127 - Spiral Traversing - Let's Animate - Part 05
Lecture 128 - Spiral Traversing - Let's Animate - Part 06
Lecture 129 - Spiral Traversing - Let's Animate - Part 07
Lecture 130 - GPS - Track the route

Lecture 131 - GPS - Track the route - Part 01

Lecture 132 - GPS - Track the route - Part 02

Lecture 133 - GPS - Track the route - Part 03

Lecture 134 - GPS - Track the route - Part 04

Lecture 135 - Tuples- Python Data Structure

Lecture 136 - Lottery Simulation - Profit or Loss

Lecture 137 - Lottery Simulation - Profit or Loss - Part 01

Lecture 138 - Lottery Simulation - Profit or Loss - Part 02

Lecture 139 - Lottery Simulation - Profit or Loss - Part 03

Lecture 140 - Lottery Simulation - Profit or Loss - Part 04

Lecture 141 - Lottery Simulation - Profit or Loss - Part 05

Lecture 142 - Lottery Simulation - Profit or Loss - Part 06

Lecture 143 - Image Processing - Enhance your images

Lecture 144 - Image Processing - Enhance your images - Part 01

Lecture 145 - Image Processing - Enhance your images - Part 02

Lecture 146 - Image Processing - Enhance your images - Part 03

Lecture 147 - Anagrams

Lecture 148 - Anagrams - Part 01

Lecture 149 - Anagrams - Part 02

Lecture 150 - Anagrams - Part 03

Lecture 151 - Anagrams - Part 04

Lecture 152 - Facebook Sentiment Analysis

Lecture 153 - Facebook Sentiment Analysis - Part 01

Lecture 154 - Facebook Sentiment Analysis - Part 02

Lecture 155 - Facebook Sentiment Analysis - Part 03

Lecture 156 - Facebook Sentiment Analysis - Part 04

Lecture 157 - Natural Language Processing - Author Stylometry

Lecture 158 - Natural Language Processing - Author Stylometry - Part 01

Lecture 159 - Natural Language Processing - Author Stylometry - Part 02

Lecture 160 - Natural Language Processing - Author Stylometry - Part 03

Lecture 161 - Natural Language Processing - Author Stylometry - Part 04

Lecture 162 - Natural Language Processing - Author Stylometry - Part 05

Lecture 163 - Natural Language Processing - Author Stylometry - Part 06

[Lecture 164 - Natural Language Processing - Author Stylometry - Part 07](#)

[Lecture 165 - Natural Language Processing - Author Stylometry - Part 08](#)

[Lecture 166 - Natural Language Processing - Author Stylometry - Part 09](#)

[Lecture 167 - Natural Language Processing - Author Stylometry - Part 10](#)

[Lecture 168 - Introduction to Networkx - Part 01](#)

[Lecture 169 - Introduction to Networkx - Part 02](#)

[Lecture 170 - Six Degrees of Separation : Meet your favourites](#)

[Lecture 171 - Six Degrees of Separation : Meet your favourites - Part 01](#)

[Lecture 172 - Six Degrees of Separation : Meet your favourites - Part 02](#)

[Lecture 173 - Six Degrees of Separation : Meet your favourites - Part 03](#)

[Lecture 174 - Area Calculation - Don't Measure](#)

[Lecture 175 - Area Calculation - Don't Measure - Part 01](#)

[Lecture 176 - Area Calculation - Don't Measure - Part 02](#)

[Lecture 177 - Area Calculation - Don't Measure - Part 03](#)

[Lecture 178 - Area Calculation - Don't Measure - Part 04](#)

[Lecture 179 - Area Calculation - Don't Measure - Part 05](#)

[Lecture 180 - Area Calculation - Don't Measure - Part 06](#)

[Lecture 181 - FLAMES - Part 01](#)

[Lecture 182 - FLAMES - Part 02](#)

[Lecture 183 - FLAMES - Part 03](#)

[Lecture 184 - FLAMES - Part 04](#)

[Lecture 185 - FLAMES - Part 05](#)

[Lecture 186 - FLAMES - Part 06](#)

[Lecture 187 - Data Compression - Part 01](#)

[Lecture 188 - Data Compression - Part 02](#)

[Lecture 189 - Data Compression - Part 03](#)

[Lecture 190 - Data Compression - Part 04](#)

[Lecture 191 - Data Compression - Part 05](#)

[Lecture 192 - Browser Automation Whatsapp using Python - Part 01](#)

[Lecture 193 - Browser Automation Whatsapp using Python - Part 02](#)

[Lecture 194 - Browser Automation Whatsapp using Python - Part 03](#)

[Lecture 195 - Browser Automation Whatsapp using Python - Part 04](#)

[Lecture 196 - Fun with Calendar - Part 01](#)

[Lecture 197 - Fun with Calendar - Part 02](#)
[Lecture 198 - Fun with Calendar - Part 03](#)
[Lecture 199 - Fun with Calendar - Part 04](#)
[Lecture 200 - Fun with Calendar - Part 05](#)
[Lecture 201 - Fun with Calendar - Part 06](#)
[Lecture 202 - Fun with Calendar - Part 07](#)
[Lecture 203 - Fun with Calendar - Part 08](#)
[Lecture 204 - Fun with Calendar - Part 09](#)
[Lecture 205 - Fun with Calendar - Part 10](#)
[Lecture 206 - Fun with Calendar - Part 11](#)
[Lecture 207 - Fun with Calendar - Part 12](#)
[Lecture 208 - Page Rank - How does Google Work ? - Part 01](#)
[Lecture 209 - Page Rank - How does Google Work ? - Part 02](#)
[Lecture 210 - Page Rank - How does Google Work ? - Part 03](#)
[Lecture 211 - Page Rank - How does Google Work ? - Part 04](#)
[Lecture 212 - Page Rank - How does Google Work ? - Part 05](#)
[Lecture 213 - Page Rank - How does Google Work ? - Part 06](#)
[Lecture 214 - Page Rank - How does Google Work ? - Part 07](#)
[Lecture 215 - Page Rank - How does Google Work ? - Part 08](#)
[Lecture 216 - Page Rank - How does Google Work ? - Part 09](#)
[Lecture 217 - Page Rank - How does Google Work ? - Part 10](#)
[Lecture 218 - Page Rank - How does Google Work ? - Part 11](#)
[Lecture 219 - Page Rank - How does Google Work ? - Part 12](#)
[Lecture 220 - Page Rank - How does Google Work ? - Part 13](#)
[Lecture 221 - Page Rank - How does Google Work ? - Part 14](#)
[Lecture 222 - Page Rank - How does Google Work ? - Part 15](#)
[Lecture 223 - Page Rank - How does Google Work ? - Part 16](#)
[Lecture 224 - Collatz Conjecture - Part 01](#)
[Lecture 225 - Collatz Conjecture - Part 02](#)
[Lecture 226 - JOC Conclusion](#)

- Lecture 1 - Motivation for Counting
- Lecture 2 - Paper Folding Example
- Lecture 3 - Rubik's Cube Example
- Lecture 4 - Factorial Example
- Lecture 5 - Counting in Computer Science
- Lecture 6 - Motivation for Catalan numbers
- Lecture 7 - Rule of Sum and Rule of Product
- Lecture 8 - Problems on Rule of Sum and Rule of Product
- Lecture 9 - Factorial Explained
- Lecture 10 - Proof of $n!$ - Part 1
- Lecture 11 - Proof of $n!$ - Part 2
- Lecture 12 - Astronomical Numbers
- Lecture 13 - Permutations - Part 1
- Lecture 14 - Permutations - Part 2
- Lecture 15 - Permutations - Part 3
- Lecture 16 - Permutations - Part 4
- Lecture 17 - Problems on Permutations
- Lecture 18 - Combinations - Part 1
- Lecture 19 - Combinations - Part 2
- Lecture 20 - Combinations - Part 3
- Lecture 21 - Combinations - Part 4
- Lecture 22 - Problems on Combinations
- Lecture 23 - Difference between Permutations and Combinations
- Lecture 24 - Combination with Repetition - Part 1
- Lecture 25 - Combination with Repetition - Part 2
- Lecture 26 - Combination with Repetition - Problems
- Lecture 27 - Binomial theorem
- Lecture 28 - Applications of Binomial theorem
- Lecture 29 - Properties of Binomial theorem
- Lecture 30 - Multinomial theorem
- Lecture 31 - Problems on Binomial theorem

[Lecture 32 - Pascal's Triangle](#)

[Lecture 33 - Fun facts on Pascal's Triangle](#)

[Lecture 34 - Catalan Numbers - Part 1](#)

[Lecture 35 - Catalan Numbers - Part 2](#)

[Lecture 36 - Catalan Numbers - Part 3](#)

[Lecture 37 - Catalan Numbers - Part 4](#)

[Lecture 38 - Examples of Catalan numbers](#)

[Lecture 39 - Chapter Summary](#)

[Lecture 40 - Introduction to Set Theory](#)

[Lecture 41 - Example, definition and notation](#)

[Lecture 42 - Sets - Problems Part 1](#)

[Lecture 43 - Subsets - Part 1](#)

[Lecture 44 - Subsets - Part 2](#)

[Lecture 45 - Subsets - Part 3](#)

[Lecture 46 - Union and intersections of sets](#)

[Lecture 47 - Union and intersections of sets - Part 1](#)

[Lecture 48 - Union and intersections of sets - Part 2](#)

[Lecture 49 - Union and intersections of sets - Part 3](#)

[Lecture 50 - Cardinality of Union of two sets - Part 1](#)

[Lecture 51 - Cardinality of Union of two sets - Part 2](#)

[Lecture 52 - Cardinality of Union of three sets](#)

[Lecture 53 - Power Set - Part 1](#)

[Lecture 54 - Power set - Part 2](#)

[Lecture 55 - Power set - Part 3](#)

[Lecture 56 - Connection between Binomial Theorem and Power Sets](#)

[Lecture 57 - Power set - Problems](#)

[Lecture 58 - Complement of a set](#)

[Lecture 59 - De Morgan's Laws - Part 1](#)

[Lecture 60 - De Morgan's Laws - Part 2](#)

[Lecture 61 - A proof technique](#)

[Lecture 62 - De Morgan's Laws - Part 3](#)

[Lecture 63 - De Morgan's Laws - Part 4](#)

[Lecture 64 - Set difference - Part 1](#)

[Lecture 65 - Set difference - Part 2](#)

[Lecture 66 - Symmetric difference](#)

[Lecture 67 - History](#)

[Lecture 68 - Summary](#)

[Lecture 69 - Motivational example](#)

[Lecture 70 - Introduction to Statements](#)

[Lecture 71 - Examples and Non-examples of Statements](#)

[Lecture 72 - Introduction to Negation](#)

[Lecture 73 - Negation - Explanation](#)

[Lecture 74 - Negation - Truthtable](#)

[Lecture 75 - Examples for Negation](#)

[Lecture 76 - Motivation for OR operator](#)

[Lecture 77 - Introduction to OR operator](#)

[Lecture 78 - Truthtable for OR operator](#)

[Lecture 79 - OR operator for 3 Variables](#)

[Lecture 80 - Truthtable for AND operator](#)

[Lecture 81 - AND operator for 3 Variables](#)

[Lecture 82 - Primitive and Compound statements - Part 1](#)

[Lecture 83 - Primitive and Compound statements - Part 2](#)

[Lecture 84 - Problems involving NOT, OR and AND operators](#)

[Lecture 85 - Introduction to implication](#)

[Lecture 86 - Examples and Non-examples of Implication - Part 1](#)

[Lecture 87 - Examples and Non-examples of Implication - Part 2](#)

[Lecture 88 - Explanation of Implication](#)

[Lecture 89 - Introduction to Double Implication](#)

[Lecture 90 - Explanation of Double Implication](#)

[Lecture 91 - Converse, Inverse and Contrapositive](#)

[Lecture 92 - XOR operator - Part 1](#)

[Lecture 93 - XOR operator - Part 2](#)

[Lecture 94 - XOR operator - Part 3](#)

[Lecture 95 - Problems](#)

[Lecture 96 - Tautology, Contradiction - Part 1](#)

[Lecture 97 - Tautology, Contradiction - Part 2](#)

[Lecture 98 - Tautology, Contradiction - Part 3](#)

[Lecture 99 - SAT Problem - Part 1](#)

[Lecture 100 - SAT Problem - Part 2](#)

[Lecture 101 - Logical Equivalence - Part 1](#)

[Lecture 102 - Logical Equivalence - Part 2](#)

[Lecture 103 - Logical Equivalence - Part 3](#)

[Lecture 104 - Logical Equivalence - Part 4](#)

[Lecture 105 - Motivation for laws of logic](#)

[Lecture 106 - Double negation - Part 1](#)

[Lecture 107 - Double negation - Part 2](#)

[Lecture 108 - Laws of Logic](#)

[Lecture 109 - De Morgan's Law - Part 1](#)

[Lecture 110 - De Morgan's Law - Part 2](#)

[Lecture 111 - Rules of Inferences - Part 1](#)

[Lecture 112 - Rules of Inferences - Part 2](#)

[Lecture 113 - Rules of Inferences - Part 3](#)

[Lecture 114 - Rules of Inferences - Part 4](#)

[Lecture 115 - Rules of Inferences - Part 5](#)

[Lecture 116 - Rules of Inferences - Part 6](#)

[Lecture 117 - Rules of Inferences - Part 7](#)

[Lecture 118 - Conclusion](#)

[Lecture 119 - Introduction to Relation](#)

[Lecture 120 - Graphical Representation of a Relation](#)

[Lecture 121 - Various sets](#)

[Lecture 122 - Matrix Representation of a Relation](#)

[Lecture 123 - Relation - An Example](#)

[Lecture 124 - Cartesian Product](#)

[Lecture 125 - Set Representation of a Relation](#)

[Lecture 126 - Revisiting Representations of a Relation](#)

[Lecture 127 - Examples of Relations](#)

[Lecture 128 - Number of relations - Part 1](#)

[Lecture 129 - Number of relations - Part 2](#)

[Lecture 130 - Reflexive relation - Introduction](#)

[Lecture 131 - Example of a Reflexive relation](#)

[Lecture 132 - Reflexive relation - Matrix representation](#)

[Lecture 133 - Number of Reflexive relations](#)

[Lecture 134 - Symmetric Relation - Introduction](#)

[Lecture 135 - Symmetric Relation - Matrix representation](#)

[Lecture 136 - Symmetric Relation - Examples and non examples](#)

[Lecture 137 - Parallel lines revisited](#)

[Lecture 138 - Number of symmetric relations - Part 1](#)

[Lecture 139 - Number of symmetric relations - Part 2](#)

[Lecture 140 - Examples of Reflexive and Symmetric Relations](#)

[Lecture 141 - Pattern](#)

[Lecture 142 - Transitive relation - Examples and non examples](#)

[Lecture 143 - Antisymmetric relation](#)

[Lecture 144 - Examples of Transitive and Antisymmetric Relation](#)

[Lecture 145 - Antisymmetric - Graphical representation](#)

[Lecture 146 - Antisymmetric - Matrix representation](#)

[Lecture 147 - Number of Antisymmetric relations](#)

[Lecture 148 - Condition for relation to be reflexive](#)

[Lecture 149 - Few notations](#)

[Lecture 150 - Condition for relation to be reflexive](#)

[Lecture 151 - Condition for relation to be reflexive](#)

[Lecture 152 - Condition for relation to be symmetric](#)

[Lecture 153 - Condition for relation to be symmetric](#)

[Lecture 154 - Condition for relation to be antisymmetric](#)

[Lecture 155 - Equivalence relation](#)

[Lecture 156 - Equivalence relation - Example 4](#)

[Lecture 157 - Partition - Part 1](#)

[Lecture 158 - Partition - Part 2](#)

[Lecture 159 - Partition - Part 3](#)

[Lecture 160 - Partition - Part 4](#)

[Lecture 161 - Partition - Part 5](#)

[Lecture 162 - Partition - Part 6](#)

[Lecture 163 - Motivational Example - 1](#)

Lecture 164 - Motivational Example - 2

Lecture 165 - Commonality in examples

Lecture 166 - Motivational Example - 3

Lecture 167 - Example - 4 Explanation

Lecture 168 - Introduction to functions

Lecture 169 - Defintion of a function - Part 1

Lecture 170 - Defintion of a function - Part 2

Lecture 171 - Defintion of a function - Part 3

Lecture 172 - Relations vs Functions - Part 1

Lecture 173 - Relations vs Functions - Part 2

Lecture 174 - Introduction to One-One Function

Lecture 175 - One-One Function - Example 1

Lecture 176 - One-One Function - Example 2

Lecture 177 - One-One Function - Example 3

Lecture 178 - Proving a Function is One-One

Lecture 179 - Examples and Non- examples of One-One function

Lecture 180 - Cardinality condition in One-One function - Part 1

Lecture 181 - Cardinality condition in One-One function - Part 2

Lecture 182 - Introduction to Onto Function - Part 1

Lecture 183 - Introduction to Onto Function - Part 2

Lecture 184 - Definition of Onto Function

Lecture 185 - Examples of Onto Function

Lecture 186 - Cardinality condition in Onto function - Part 1

Lecture 187 - Cardinality condition in Onto function - Part 2

Lecture 188 - Introduction to Bijection

Lecture 189 - Examples of Bijection

Lecture 190 - Cardinality condition in Bijection - Part 1

Lecture 191 - Cardinality condition in Bijection - Part 2

Lecture 192 - Counting number of functions

Lecture 193 - Number of functions

Lecture 194 - Number of One-One functions - Part 1

Lecture 195 - Number of One-One functions - Part 2

Lecture 196 - Number of One-One functions - Part 3

Lecture 197 - Number of Onto functions

Lecture 198 - Number of Bijections

Lecture 199 - Counting number of functions.

Lecture 200 - Motivation for Composition of functions - Part 1

Lecture 201 - Motivation for Composition of functions - Part 2

Lecture 202 - Definition of Composition of functions

Lecture 203 - Why study Composition of functions

Lecture 204 - Example of Composition of functions - Part 1

Lecture 205 - Example of Composition of functions - Part 2

Lecture 206 - Motivation for Inverse functions

Lecture 207 - Inverse functions

Lecture 208 - Examples of Inverse functions

Lecture 209 - Application of inverse functions - Part 1

Lecture 210 - Three stories

Lecture 211 - Three stories - Connecting the dots

Lecture 212 - Mathematical induction - An illustration

Lecture 213 - Mathematical Induction - Its essence

Lecture 214 - Mathematical Induction - The formal way

Lecture 215 - MI - Sum of odd numbers

Lecture 216 - MI - Sum of powers of 2

Lecture 217 - MI - Inequality 1

Lecture 218 - MI - Inequality 1 (solution)

Lecture 219 - MI - To prove divisibility

Lecture 220 - MI - To prove divisibility (solution)

Lecture 221 - MI - Problem on satisfying inequalities

Lecture 222 - MI - Problem on satisfying inequalities (solutions)

Lecture 223 - MI - Inequality 2

Lecture 224 - MI - Inequality 2 solution

Lecture 225 - Mathematical Induction - Example 9

Lecture 226 - Mathematical Induction - Example 10 solution

Lecture 227 - Binomial Coefficients - Proof by induction

Lecture 228 - Checker board and Triominoes - A puzzle

Lecture 229 - Checker board and triominoes - Solution

[Lecture 230 - Mathematical induction - An important note](#)

[Lecture 231 - Mathematical Induction - A false proof](#)

[Lecture 232 - A false proof - Solution](#)

[Lecture 233 - Motivation for Pigeonhole Principle](#)

[Lecture 234 - Group of n people](#)

[Lecture 235 - Set of n integers](#)

[Lecture 236 - 10 points on an equilateral triangle](#)

[Lecture 237 - Pigeonhole Principle - A result](#)

[Lecture 238 - Consecutive integers](#)

[Lecture 239 - Consecutive integers solution](#)

[Lecture 240 - Matching initials](#)

[Lecture 241 - Matching initials - Solution](#)

[Lecture 242 - Numbers adding to 9](#)

[Lecture 243 - Numbers adding to 9 - Solution](#)

[Lecture 244 - Deck of cards](#)

[Lecture 245 - Deck of cards - Solution](#)

[Lecture 246 - Number of errors](#)

[Lecture 247 - Number of errors - Solution](#)

[Lecture 248 - Puzzle - Challenge for you](#)

[Lecture 249 - Friendship - an interesting property](#)

[Lecture 250 - Connectedness through Connecting people](#)

[Lecture 251 - Traversing the bridges](#)

[Lecture 252 - Three utilities problem](#)

[Lecture 253 - Coloring the India map](#)

[Lecture 254 - Definition of a Graph](#)

[Lecture 255 - Degree and degree sequence](#)

[Lecture 256 - Relation between number of edges and degrees](#)

[Lecture 257 - Relation between number of edges and degrees - Proof](#)

[Lecture 258 - Hand shaking lemma - Corollary](#)

[Lecture 259 - Problems based on Hand shaking lemma](#)

[Lecture 260 - Havel Hakimi theorem - Part 1](#)

[Lecture 261 - Havel Hakimi theorem - Part 2](#)

[Lecture 262 - Havel Hakimi theorem - Part 3](#)

- [Lecture 263 - Havel Hakimi theorem - Part 4](#)
- [Lecture 264 - Havel Hakimi theorem - Part 5](#)
- [Lecture 265 - Regular graph and irregular graph](#)
- [Lecture 266 - Walk](#)
- [Lecture 267 - Trail](#)
- [Lecture 268 - Path and closed path](#)
- [Lecture 269 - Definitions revisited](#)
- [Lecture 270 - Examples of walk, trail and path](#)
- [Lecture 271 - Cycle and circuit](#)
- [Lecture 272 - Example of cycle and circuit](#)
- [Lecture 273 - Relation between walk and path](#)
- [Lecture 274 - Relation between walk and path - An induction proof](#)
- [Lecture 275 - Subgraph](#)
- [Lecture 276 - Spanning and induced subgraph](#)
- [Lecture 277 - Spanning and induced subgraph - A result](#)
- [Lecture 278 - Introduction to Tree](#)
- [Lecture 279 - Connected and Disconnected graphs](#)
- [Lecture 280 - Property of a cycle](#)
- [Lecture 281 - Edge condition for connectivity](#)
- [Lecture 282 - Connecting connectedness and path](#)
- [Lecture 283 - Connecting connectedness and path - An illustration](#)
- [Lecture 284 - Cut vertex](#)
- [Lecture 285 - Cut edge](#)
- [Lecture 286 - Illustration of cut vertices and cut edges](#)
- [Lecture 287 - NetworkX - Need of the hour](#)
- [Lecture 288 - Introduction to Python - Installation](#)
- [Lecture 289 - Introduction to Python - Basics](#)
- [Lecture 290 - Introduction to NetworkX](#)
- [Lecture 291 - Story so far - Using NetworkX](#)
- [Lecture 292 - Directed, weighted and multi graphs](#)
- [Lecture 293 - Illustration of Directed, weighted and multi graphs](#)
- [Lecture 294 - Graph representations - Introduction](#)
- [Lecture 295 - Adjacency matrix representation](#)

Lecture 296 - Incidence matrix representation

Lecture 297 - Isomorphism - Introduction

Lecture 298 - Isomorphic graphs - An illustration

Lecture 299 - Isomorphic graphs - A challenge

Lecture 300 - Non-isomorphic graphs

Lecture 301 - Isomorphism - A question

Lecture 302 - Complement of a Graph - Introduction

Lecture 303 - Complement of a Graph - Illustration

Lecture 304 - Self complement

Lecture 305 - Complement of a disconnected graph is connected

Lecture 306 - Complement of a disconnected graph is connected - Solution

Lecture 307 - Which is more? Connected graphs or disconnected graphs?

Lecture 308 - Bipartite graphs.

Lecture 309 - Bipartite graphs

Lecture 310 - Bipartite graphs - A puzzle

Lecture 311 - Bipartite graphs - Converse part of the puzzle

Lecture 312 - Definition of Eulerian Graph

Lecture 313 - Illustration of eulerian graph

Lecture 314 - Non- example of Eulerian graph

Lecture 315 - Litmus test for an Eulerian graph

Lecture 316 - Why even degree?

Lecture 317 - Proof for even degree implies graph is eulerian

Lecture 318 - A condition for Eulerian trail

Lecture 319 - Why the name Eulerian

Lecture 320 - Can you traverse all location?

Lecture 321 - Definition of Hamiltonian graphs

Lecture 322 - Examples of Hamiltonian graphs

Lecture 323 - Hamiltonian graph - A result

Lecture 324 - A result on connectedness

Lecture 325 - A result on Path

Lecture 326 - Dirac's Theorem

Lecture 327 - Dirac's theorem - A note

Lecture 328 - Ore's Theorem

Lecture 329 - Dirac's Theorem v/s Ore's Theorem

Lecture 330 - Eulerian and Hamiltonian Are they related

Lecture 331 - Importance of Hamiltonian graphs in Computer science

Lecture 332 - Constructing non intersecting roads

Lecture 333 - Definition of a Planar graph

Lecture 334 - Examples of Planar graphs

Lecture 335 - $V - E + R = 2$

Lecture 336 - Illustration of $V - E + R = 2$

Lecture 337 - $V - E + R = 2$; Use induction

Lecture 338 - Proof of $V - E + R = 2$

Lecture 339 - Famous non-planar graphs

Lecture 340 - Litmus test for planarity

Lecture 341 - Planar graphs - Inequality 1

Lecture 342 - 3 Utilities problem - Revisited

Lecture 343 - Complete graph on 5 vertices is non-planar - Proof

Lecture 344 - Prisoners and cells

Lecture 345 - Prisoners example and Proper coloring

Lecture 346 - Chromatic number of a graph

Lecture 347 - Examples on Proper coloring

Lecture 348 - Recalling the India map problem

Lecture 349 - Recalling the India map problem - Solution

Lecture 350 - NetworkX - Digraphs

Lecture 351 - NetworkX - Adjacency matrix

Lecture 352 - NetworkX - Random graphs

Lecture 353 - NetworkX - Subgraph

Lecture 354 - NetworkX - Isomorphic graphs Part 1

Lecture 355 - NetworkX - Isomorphic graphs Part 2

Lecture 356 - NetworkX - Isomorphic graphs: A game to play

Lecture 357 - NetworkX - Graph complement

Lecture 358 - NetworkX - Eulerian graphs

Lecture 359 - NetworkX - Bipartite graphs

Lecture 360 - NetworkX - Coloring

Lecture 361 - Counting in a creative way

[Lecture 362 - Example 1 - Fun with words](#)

[Lecture 363 - Words and the polynomial](#)

[Lecture 364 - Words and the polynomial - Explained](#)

[Lecture 365 - Example 2 - Picking five balls](#)

[Lecture 366 - Picking five balls - Solution](#)

[Lecture 367 - Picking five balls - Another version](#)

[Lecture 368 - Definition of Generating function](#)

[Lecture 369 - Generating function examples - Part 1](#)

[Lecture 370 - Generating function examples - Part 2](#)

[Lecture 371 - Generating function examples - Part 3](#)

[Lecture 372 - Binomial expansion - A generating function](#)

[Lecture 373 - Binomial expansion - Explained](#)

[Lecture 374 - Picking 7 balls - The naive way](#)

[Lecture 375 - Picking 7 balls - The creative way](#)

[Lecture 376 - Generating functions - Problem 1](#)

[Lecture 377 - Generating functions - Problem 2](#)

[Lecture 378 - Generating functions - Problem 3](#)

[Lecture 379 - Why Generating function?](#)

[Lecture 380 - Introduction to Advanced Counting](#)

[Lecture 381 - Example 1 : Dogs and Cats](#)

[Lecture 382 - Inclusion-Exclusion Formula](#)

[Lecture 383 - Proof of Inclusion - Exclusion formula](#)

[Lecture 384 - Example 2 : Integer solutions of an equation](#)

[Lecture 385 - Example 3 : Words not containing some strings](#)

[Lecture 386 - Example 4 : Arranging 3 x's, 3 y's and 3 z's](#)

[Lecture 387 - Example 5 : Non-multiples of 2 or 3](#)

[Lecture 388 - Example 6 : Integers not divisible by 5, 7 or 11](#)

[Lecture 389 - A tip in solving problems](#)

[Lecture 390 - Example 7 : A dog nor a cat](#)

[Lecture 391 - Example 8 : Brownies, Muffins and Cookies](#)

[Lecture 392 - Example 10 : Integer solutions of an equation](#)

[Lecture 393 - Example 11 : Seating Arrangement - Part 1](#)

[Lecture 394 - Example 11 : Seating Arrangement - Part 2](#)

Lecture 395 - Example 12 : Integer solutions of an equation

Lecture 396 - Number of Onto Functions.

Lecture 397 - Formula for Number of Onto Functions

Lecture 398 - Example 13 : Onto Functions

Lecture 399 - Example 14 : No one in their own house

Lecture 400 - Derangements

Lecture 401 - Derangements of 4 numbers

Lecture 402 - Example 15 : Bottles and caps

Lecture 403 - Example 16 : Self grading

Lecture 404 - Example 17 : Even integers and their places

Lecture 405 - Example 18 : Finding total number of items

Lecture 406 - Example 19 : Devising a secret code

Lecture 407 - Placing rooks on the chessboard

Lecture 408 - Rook Polynomial

Lecture 409 - Rook Polynomial

Lecture 410 - Motivation for recurrence relation

Lecture 411 - Getting started with recurrence relations

Lecture 412 - What is a recurrence relation?

Lecture 413 - Compound Interest as a recurrence relation

Lecture 414 - Examples of recurrence relations

Lecture 415 - Example - Number of ways of climbing steps

Lecture 416 - Number of ways of climbing steps: Recurrence relation

Lecture 417 - Example - Rabbits on an island

Lecture 418 - Example - n-bit string

Lecture 419 - Example - n-bit string without consecutive zero

Lecture 420 - Solving Linear Recurrence Relations - A theorem

Lecture 421 - A note on the proof

Lecture 422 - Solving recurrence relation - Example 1

Lecture 423 - Solving recurrence relation - Example 2

Lecture 424 - Fibonacci Sequence

Lecture 425 - Introduction to Fibonacci sequence

Lecture 426 - Solution of Fibonacci sequence

Lecture 427 - A basic introduction to 'complexity'

- Lecture 428 - Intuition for 'complexity'
- Lecture 429 - Visualizing complexity order as a graph
- Lecture 430 - Tower of Hanoi
- Lecture 431 - Recurrence relation of Tower of Hanoi
- Lecture 432 - Solution for the recurrence relation of Tower of Hanoi
- Lecture 433 - A searching technique
- Lecture 434 - Recurrence relation for Binary search
- Lecture 435 - Solution for the recurrence relation of Binary search
- Lecture 436 - Example: Door knocks example
- Lecture 437 - Example: Door knocks example solution
- Lecture 438 - Door knock example and Merge sort
- Lecture 439 - Introduction to Merge sort - 1
- Lecture 440 - Recurrence relation for Merge sort
- Lecture 441 - Introduction to advanced topics
- Lecture 442 - Introduction to Chromatic polynomial
- Lecture 443 - Chromatic polynomial of complete graphs
- Lecture 444 - Chromatic polynomial of cycle on 4 vertices - Part 1
- Lecture 445 - Chromatic polynomial of cycle on 4 vertices - Part 2
- Lecture 446 - Correspondence between partition and generating functions
- Lecture 447 - Correspondence between partition and generating functions: In general
- Lecture 448 - Distinct partitions and odd partitions
- Lecture 449 - Distinct partitions and generating functions
- Lecture 450 - Odd partitions and generating functions
- Lecture 451 - Distinct partitions equals odd partitions: Observation
- Lecture 452 - Distinct partitions equals odd partitions: Proof
- Lecture 453 - Why 'partitions' to 'polynomial'?
- Lecture 454 - Example: Picking 4 letters from the word 'INDIAN'
- Lecture 455 - Motivation for exponential generating function
- Lecture 456 - Recurrence relation: The theorem and its proof
- Lecture 457 - Introduction to Group Theory
- Lecture 458 - Uniqueness of the identity element
- Lecture 459 - Formal definition of a Group
- Lecture 460 - Groups: Examples and non-examples

[Lecture 461 - Groups: Special Examples - Part 1](#)

[Lecture 462 - Groups: Special Examples - Part 2](#)

[Lecture 463 - Subgroup: Defintion and examples](#)

[Lecture 464 - Lagrange's theorem](#)

[Lecture 465 - Summary](#)

[Lecture 466 - Conclusion](#)

Lecture 1 - Biological Neuron

Lecture 2 - From Spring to Winter of AI

Lecture 3 - The Deep Revival

Lecture 4 - From Cats to Convolutional Neural Networks

Lecture 5 - Faster, higher, stronger

Lecture 6 - The Curious Case of Sequences

Lecture 7 - Beating humans at their own games (literally)

Lecture 8 - The Madness (2013)

Lecture 9 - (Need for) Sanity

Lecture 10 - Motivation from Biological Neurons

Lecture 11 - McCulloch Pitts Neuron, Thresholding Logic

Lecture 12 - Perceptrons

Lecture 13 - Error and Error Surfaces

Lecture 14 - Perceptron Learning Algorithm

Lecture 15 - Proof of Convergence of Perceptron Learning Algorithm

Lecture 16 - Deep Learning (CS7015): Linearly Separable Boolean Functions

Lecture 17 - Deep Learning (CS7015): Representation Power of a Network of Perceptrons

Lecture 18 - Deep Learning (CS7015): Sigmoid Neuron

Lecture 19 - Deep Learning (CS7015): A typical Supervised Machine Learning Setup

Lecture 20 - Deep Learning (CS7015): Learning Parameters: (Infeasible) guess work

Lecture 21 - Deep Learning (CS7015): Learning Parameters: Gradient Descent

Lecture 22 - Deep Learning (CS7015): Representation Power of Multilayer Network of Sigmoid Neurons

Lecture 23 - Feedforward Neural Networks (a.k.a multilayered network of neurons)

Lecture 24 - Learning Parameters of Feedforward Neural Networks (Intuition)

Lecture 25 - Output functions and Loss functions

Lecture 26 - Backpropagation (Intuition)

Lecture 27 - Backpropagation: Computing Gradients w.r.t. the Output Units

Lecture 28 - Backpropagation: Computing Gradients w.r.t. Hidden Units

Lecture 29 - Backpropagation: Computing Gradients w.r.t. Parameters

Lecture 30 - Backpropagation: Pseudo code

Lecture 31 - Derivative of the activation function

Lecture 32 - Information content, Entropy and cross entropy

Lecture 33 - Recap: Learning Parameters: Guess Work, Gradient Descent

Lecture 34 - Contours Maps

Lecture 35 - Momentum based Gradient Descent

Lecture 36 - Nesterov Accelerated Gradient Descent

Lecture 37 - Stochastic And Mini-Batch Gradient Descent

Lecture 38 - Tips for Adjusting Learning Rate and Momentum

Lecture 39 - Line Search

Lecture 40 - Gradient Descent with Adaptive Learning Rate

Lecture 41 - Bias Correction in Adam

Lecture 42 - Eigenvalues and Eigenvectors

Lecture 43 - Linear Algebra : Basic Definitions

Lecture 44 - Eigenvalue Decompositon

Lecture 45 - Principal Component Analysis and its Interpretations

Lecture 46 - PCA: Interpretation 2

Lecture 47 - PCA: Interpretation 3

Lecture 48 - PCA: Interpretation 3 (Continued...)

Lecture 49 - PCA: Practical Example

Lecture 50 - Singular Value Decomposition

Lecture 51 - Introduction to Autoncoders

Lecture 52 - Link between PCA and Autoencoders

Lecture 53 - Regularization in autoencoders (Motivation)

Lecture 54 - Denoising Autoencoders

Lecture 55 - Sparse Autoencoders

Lecture 56 - Contractive Autoencoders

Lecture 57 - Bias and Variance

Lecture 58 - Train error vs Test error

Lecture 59 - Train error vs Test error (Recap)

Lecture 60 - True error and Model complexity

Lecture 61 - L2 regularization

Lecture 62 - Dataset augmentation

Lecture 63 - Parameter sharing and tying

Lecture 64 - Adding Noise to the inputs

Lecture 65 - Adding Noise to the outputs

Lecture 66 - Early stopping

Lecture 67 - Ensemble Methods

Lecture 68 - Dropout

Lecture 69 - A quick recap of training deep neural networks

Lecture 70 - Unsupervised pre-training

Lecture 71 - Better activation functions

Lecture 72 - Better initialization strategies

Lecture 73 - Batch Normalization

Lecture 74 - One-hot representations of words

Lecture 75 - Distributed Representations of words

Lecture 76 - SVD for learning word representations

Lecture 77 - SVD for learning word representations (Continued...)

Lecture 78 - Continuous bag of words model

Lecture 79 - Skip-gram model

Lecture 80 - Skip-gram model (Continued...)

Lecture 81 - Contrastive estimation

Lecture 82 - Hierarchical softmax

Lecture 83 - GloVe representations

Lecture 84 - Evaluating word representations

Lecture 85 - Relation between SVD and Word2Vec

Lecture 86 - The convolution operation

Lecture 87 - Relation between input size, output size and filter size

Lecture 88 - Convolutional Neural Networks

Lecture 89 - Convolutional Neural Networks (Continued...)

Lecture 90 - CNNs (success stories on ImageNet)

Lecture 91 - CNNs (success stories on ImageNet) (Continued...)

Lecture 92 - Image Classification continued (GoogLeNet and ResNet)

Lecture 93 - Visualizing patches which maximally activate a neuron

Lecture 94 - Visualizing filters of a CNN

Lecture 95 - Occlusion experiments

Lecture 96 - Finding influence of input pixels using backpropagation

Lecture 97 - Guided Backpropagation

[Lecture 98 - Optimization over images](#)

[Lecture 99 - Create images from embeddings](#)

[Lecture 100 - Deep Dream](#)

[Lecture 101 - Deep Art](#)

[Lecture 102 - Fooling Deep Convolutional Neural Networks](#)

[Lecture 103 - Sequence Learning Problems](#)

[Lecture 104 - Recurrent Neural Networks](#)

[Lecture 105 - Backpropagation through time](#)

[Lecture 106 - The problem of Exploding and Vanishing Gradients](#)

[Lecture 107 - Some Gory Details](#)

[Lecture 108 - Selective Read, Selective Write, Selective Forget - The Whiteboard Analogy](#)

[Lecture 109 - Long Short Term Memory \(LSTM\) and Gated Recurrent Units \(GRUs\)](#)

[Lecture 110 - How LSTMs avoid the problem of vanishing gradients](#)

[Lecture 111 - How LSTMs avoid the problem of vanishing gradients \(Continued...\)](#)

[Lecture 112 - Introduction to Encoder Decoder Models](#)

[Lecture 113 - Applications of Encoder Decoder models](#)

[Lecture 114 - Attention Mechanism](#)

[Lecture 115 - Attention Mechanism \(Continued...\)](#)

[Lecture 116 - Attention over images](#)

[Lecture 117 - Hierarchical Attention](#)

Lecture 1 - Introduction to the Course

Lecture 2 - CMOS Transistors and Gates

Lecture 3 - Basic Gates

Lecture 4 - Building Gates Using Simulator

Lecture 5 - Hierarchical Design and Verification

Lecture 6 - Building Blocks of a Digital Computer

Lecture 7 - Binary Number Systems

Lecture 8 - Signed Number Systems

Lecture 9 - Twos Complement Number System

Lecture 10 - Binary Adder Circuits

Lecture 11 - Building the ALU of HACK

Lecture 12 - HACK ALU Functionality

Lecture 13 - Tips for Project P1

Lecture 14 - Sequential Logic Design

Lecture 15 - Latches and Flipflops

Lecture 16 - The Memory Hierarchy

Lecture 17 - Design of Program Counter

Lecture 18 - Introduction to Computer Organization: The HACK Instruction Set Architecture (ISA)

Lecture 19 - Memory Mapped I/O

Lecture 20 - Tips for Projects P2 and P3

Lecture 21 - Tips for Project 4

Lecture 22 - Tips for Project 4

Lecture 23 - Introduction to Computer Architecture

Lecture 24 - The HACK Microarchitecture

Lecture 25 - The HACK CPU - A Deep Dive - Part 1

Lecture 26 - The HACK CPU - A Deep Dive - Part 2

Lecture 27 - The Data Memory

Lecture 28 - The HACK Computer

Lecture 29 - The Assembler Construction

Lecture 30 - Understanding the Working of Assembler

Lecture 31 - Assembler : Symbol Table Construction

[Lecture 32 - Assembler : Pass 1](#)

[Lecture 33 - Assembler : Pass 2](#)

[Lecture 34 - Project 6 : Demonstration](#)

[Lecture 35 - Virtual Machines - What and Why?](#)

[Lecture 36 - The VM Instruction Set Architecture](#)

[Lecture 37 - The execution of a VM Program](#)

[Lecture 38 - How powerful is the VM?](#)

[Lecture 39 - Project 7 : VM ISA to HACK Mnemonic Translation](#)

[Lecture 40 - Project 7 : Demo](#)

[Lecture 41 - Deep Understanding of VM ISA using VM Emulator](#)

[Lecture 42 - Virtual Machine II - Program flow commands and Introduction to Function Calls](#)

[Lecture 43 - Implementation of Function Call](#)

[Lecture 44 - Working of the Virtual Machine](#)

[Lecture 45 - Project 8 : Translation of Program Flow and Function Call to HACK Mnemonic](#)

[Lecture 46 - Handling Static Variables](#)

[Lecture 47 - Project 8 : Implementation tips in a Nut Shell](#)

[Lecture 48 - Introduction to The JACK Programming Language](#)

[Lecture 49 - Project 9 : Basic Steps](#)

[Lecture 50 - Understanding Syntax of JACK using Examples](#)

[Lecture 51 - Project 9 : More Examples](#)

[Lecture 52 - The JACK Syntax - Language Specification](#)

[Lecture 53 - Application Development using JACK](#)

[Lecture 54 - JACK Compiler: Lexical Analysis - Tokenization](#)

[Lecture 55 - Project 10 : Compiler for JACK - Part-1 Demo](#)

[Lecture 56 - The JACK Grammar](#)

[Lecture 57 - Compiler for JACK: Parsing the JACK Program](#)

[Lecture 58 - The Token Analyzer](#)

[Lecture 59 - Testing the Correctness](#)

[Lecture 60 - The Jack Compiler - Back-end Introduction](#)

[Lecture 61 - The Jack Compiler - Handling Variables](#)

[Lecture 62 - The Jack Compiler - Handling Expressions](#)

[Lecture 63 - The Jack Compiler - Handling Flow of Control](#)

[Lecture 64 - The Jack Compiler - Handling Objects](#)

[Lecture 65 - The Jack Compiler - Handling Arrays](#)

[Lecture 66 - The Jack Compiler Backend: An XML guided approach](#)

[Lecture 67 - The Jack Compiler Backend: Populating the Class and Subroutine Symbol tables.](#)

[Lecture 68 - The Jack Compiler Backend: Code Generation - 1](#)

[Lecture 69 - The Jack Compiler Backend: Code Generation - 2](#)

[Lecture 70 - The Jack Compiler Backend: Code Generation - 3](#)

[Lecture 71 - The Jack Compiler Backend: Code Generation - 4](#)

[Lecture 72 - Jack Compiler: Code Generation - 5](#)

[Lecture 73 - Jack Compiler: Code Generation - 6](#)

[Lecture 74 - Jack Compiler: Code Generation - 7](#)

[Lecture 75 - Understand the Operating System - Compiler Interactions](#)

[Lecture 76 - Project 12 - One sample journey from Jack to Hack](#)

[Lecture 77 - Concluding Remarks](#)

Lecture 1 - Introduction to the Course History of Artificial Intelligence

Lecture 2 - Overview of Machine Learning

Lecture 3 - Why Linear Algebra ? Scalars, Vectors, Tensors

Lecture 4 - Basic Operations

Lecture 5 - Norms

Lecture 6 - Linear Combinations Span Linear Independence

Lecture 7 - Matrix Operations Special Matrices Matrix Decompositions

Lecture 8 - Introduction to Probability Theory Discrete and Continuous Random Variables

Lecture 9 - Conditional, Joint, Marginal Probabilities Sum Rule and Product Rule Bayes' Theorem

Lecture 10 - Bayes' Theorem - Simple Examples

Lecture 11 - Independence Conditional Independence Chain Rule Of Probability

Lecture 12 - Expectation

Lecture 13 - Variance Covariance

Lecture 14 - Some Relations for Expectation and Covariance (Slightly Advanced)

Lecture 15 - Machine Representation of Numbers, Overflow, Underflow, Condition Number

Lecture 16 - Derivatives, Gradient, Hessian, Jacobian, Taylor Series

Lecture 17 - Matrix Calculus (Slightly Advanced)

Lecture 18 - Optimization 1 Unconstrained Optimization

Lecture 19 - Introduction to Constrained Optimization

Lecture 20 - Introduction to Numerical Optimization Gradient Descent - 1

Lecture 21 - Gradient Descent 2 Proof of Steepest Descent Numerical Gradient Calculation Stopping Criteria

Lecture 22 - Introduction to Packages

Lecture 23 - The Learning Paradigm

Lecture 24 - A Linear Regression Example

Lecture 25 - Linear Regression Least Squares Gradient Descent

Lecture 26 - Coding Linear Regression

Lecture 27 - Generalized Function for Linear Regression

Lecture 28 - Goodness of Fit

Lecture 29 - Bias-Variance Trade Off

Lecture 30 - Gradient Descent Algorithms

Lecture 31 - Introduction to Week 5 (Deep Learning)

- Lecture 32 - Logistic Regression
- Lecture 33 - Binary Entropy cost function
- Lecture 34 - OR Gate Via Classification
- Lecture 35 - NOR, AND, NAND Gates
- Lecture 36 - XOR Gate
- Lecture 37 - Differentiating the sigmoid
- Lecture 38 - Gradient of logistic regression
- Lecture 39 - Code for Logistic Regression
- Lecture 40 - Multinomial Classification - Introduction
- Lecture 41 - Multinomial Classification - One Hot Vector
- Lecture 42 - Multinomial Classification - Softmax
- Lecture 43 - Schematic of multinomial logistic regression
- Lecture 44 - Biological neuron
- Lecture 45 - Structure of an Artificial Neuron
- Lecture 46 - Feedforward Neural Network
- Lecture 47 - Introduction to back prop
- Lecture 48 - Summary of Week 05
- Lecture 49 - Introduction to Convolution Neural Networks (CNN)
- Lecture 50 - Types of convolution
- Lecture 51 - CNN Architecture Part 1 (LeNet and Alex Net)
- Lecture 52 - CNN Architecture Part 2 (VGG Net)
- Lecture 53 - CNN Architecture Part 3 (GoogleNet)
- Lecture 54 - CNN Architecture Part 4 (ResNet)
- Lecture 55 - CNN Architecture Part 5 (DenseNet)
- Lecture 56 - Train Network for Image Classification
- Lecture 57 - Semantic Segmentation
- Lecture 58 - Hyperparameter optimization
- Lecture 59 - Transfer Learning
- Lecture 60 - Segmentation of Brain Tumors from MRI using Deep Learning
- Lecture 61 - Activation Functions
- Lecture 62 - Learning Rate decay, Weight initialization
- Lecture 63 - Data Normalization
- Lecture 64 - Batch Norm

[Lecture 65 - Introduction to RNNs](#)

[Lecture 66 - Example - Sequence Classification](#)

[Lecture 67 - Training RNNs - Loss and BPTT](#)

[Lecture 68 - Vanishing Gradients and TBPTT](#)

[Lecture 69 - RNN Architectures](#)

[Lecture 70 - LSTM](#)

[Lecture 71 - Why LSTM Works](#)

[Lecture 72 - Deep RNNs and Bi- RNNs](#)

[Lecture 73 - Summary of RNNs](#)

[Lecture 74 - Introduction.](#)

[Lecture 75 - Knn](#)

[Lecture 76 - Binary decision trees](#)

[Lecture 77 - Binary regression trees](#)

[Lecture 78 - Bagging](#)

[Lecture 79 - Random Forest](#)

[Lecture 80 - Boosting](#)

[Lecture 81 - Gradient boosting](#)

[Lecture 82 - Unsupervised learning and Kmeans](#)

[Lecture 83 - Agglomerative clustering](#)

[Lecture 84 - Probability Distributions- Gaussian, Bernoulli](#)

[Lecture 85 - Covariance Matrix of Gaussian Distribution](#)

[Lecture 86 - Central Limit Theorem](#)

[Lecture 87 - Naïve Bayes](#)

[Lecture 88 - MLE Intro](#)

[Lecture 89 - PCA - Part 1](#)

[Lecture 90 - PCA - Part 2](#)

[Lecture 91 - Support Vector Machines](#)

[Lecture 92 - MLE, MAP and Bayesian Regression](#)

[Lecture 93 - Introduction to Generative model](#)

[Lecture 94 - Generative Adversarial Networks \(GAN\)](#)

[Lecture 95 - Variational Auto-encoders \(VAE\)](#)

[Lecture 96 - Applications: Cardiac MRI - Segmentation and Diagnosis](#)

[Lecture 97 - Applications: Cardiac MRI Analysis - Tensorflow code walkthrough](#)

[Lecture 98 - Introduction to Week 12](#)

[Lecture 99 - Application 1 description - Fin Heat Transfer](#)

[Lecture 100 - Application 1 solution](#)

[Lecture 101 - Application 2 description - Computational Fluid Dynamics](#)

[Lecture 102 - Application 2 solution](#)

[Lecture 103 - Application 3 description - Topology Optimization](#)

[Lecture 104 - Application 3 solution](#)

[Lecture 105 - Application 4 Solution of PDE/ODE using Neural Networks](#)

[Lecture 106 - Summary and road ahead](#)

Lecture 1 - Secure Systems Engineering

Lecture 2 - Program Binaries

Lecture 3 - Buffer Overflows in the Stack

Lecture 4 - Buffer Overflows

Lecture 5 - Gdb - Demo

Lecture 6 - Skip instruction - Demo

Lecture 7 - Buffer Overflow - Demo

Lecture 8 - Buffer Overflow (create a shell) - Demo

Lecture 9 - Preventing buffer overflows with canaries and W^X

Lecture 10 - Return-to-libc attack

Lecture 11 - ROP Attacks

Lecture 12 - Demonstration of Canaries, W^X, and ASLR to prevent Buffer Overflow Attacks

Lecture 13 - Demonstration of a Return-to-Libc Attack

Lecture 14 - Demonstration of a Return Oriented Programming (ROP) Attack

Lecture 15 - ASLR - Part 1

Lecture 16 - ASLR - Part 2

Lecture 17 - Buffer overreads

Lecture 18 - Demonstration of Load Time Relocation

Lecture 19 - Demonstration of Position Independent Code

Lecture 20 - PLT Demonstration

Lecture 21 - Format string vulnerabilities

Lecture 22 - Integer Vulnerabilities

Lecture 23 - Heap

Lecture 24 - Heap exploits

Lecture 25 - Demo of Integer Vulnerabilites - I

Lecture 26 - Demo of Integer Vulnerabilites - II

Lecture 27 - Demo of Format String Vulnerabilities

Lecture 28 - Access Control

Lecture 29 - Access control in linux

Lecture 30 - Mandatory access Control

Lecture 31 - Confinement in Applications

- [Lecture 32 - Software fault isolation](#)
- [Lecture 33 - Trusted Execution Environments](#)
- [Lecture 34 - ARM Trustzone](#)
- [Lecture 35 - SGX - Part 1](#)
- [Lecture 36 - SGX - Part 2](#)
- [Lecture 37 - PUF - Part 1](#)
- [Lecture 38 - PUF - Part 2](#)
- [Lecture 39 - PUF - Part 3](#)
- [Lecture 40 - Covert Channels](#)
- [Lecture 41 - Flush+Reload Attacks](#)
- [Lecture 42 - Prime+Probe](#)
- [Lecture 43 - Meltdown](#)
- [Lecture 44 - Spectre Variant - 1](#)
- [Lecture 45 - Spectre variant - 2](#)
- [Lecture 46 - rowhammer](#)
- [Lecture 47 - Heap demo - 1](#)
- [Lecture 48 - Heap demo - 2](#)
- [Lecture 49 - Heap demo - 3](#)
- [Lecture 50 - PowerAnalysisAttacks](#)
- [Lecture 51 - Hardware Trojans](#)
- [Lecture 52 - FANCI : Identification of Stealthy Malicious Logic](#)
- [Lecture 53 - Detecting Hardware Trojans in ICs](#)
- [Lecture 54 - Protecting against Hardware Trojans](#)
- [Lecture 55 - Side Channel Analysis](#)
- [Lecture 56 - Fault Attacks on AES](#)
- [Lecture 57 - Demo: Cache timing attack on T-table implementation of AES](#)
- [Lecture 58 - Demo: Cache-timing based Covert Channel - Part 1](#)
- [Lecture 59 - Demo: Cache-timing based Covert Channel - Part 2](#)

Lecture 1 - Introduction

Lecture 2 - Medium vs. Modality

Lecture 3 - Multimedia and Multimodality

Lecture 4 - Modality Relations

Lecture 5 - Characteristics of Multimodal Systems

Lecture 6 - Introduction

Lecture 7 - Speech Production

Lecture 8 - Hearing - Ear

Lecture 9 - Hearing - Perception

Lecture 10 - Introduction

Lecture 11 - The Human Eye

Lecture 12 - Gestalt Perception

Lecture 13 - Resolution and Sensitivity

Lecture 14 - Depth Perception

Lecture 15 - Reading

Lecture 16 - Introduction

Lecture 17 - Haptics

Lecture 18 - Smell

Lecture 19 - Taste

Lecture 20 - Memory

Lecture 21 - Motorsystem

Lecture 22 - Introduction

Lecture 23 - Processing Multiple Signals

Lecture 24 - Multimodal Dual-Tasks

Lecture 25 - Effects of Discongruent Signals

Lecture 26 - Relevance

Lecture 27 - Introduction 1

Lecture 28 - Introduction 2

Lecture 29 - Gesture to Space

Lecture 30 - Turn Taking

Lecture 31 - Conclusion

[Lecture 32 - Introduction](#)

[Lecture 33 - Overview](#)

[Lecture 34 - Automatic Speech Recognition](#)

[Lecture 35 - Emotion Recognition](#)

[Lecture 36 - Text Recognition](#)

[Lecture 37 - Introduction1](#)

[Lecture 38 - Icons](#)

[Lecture 39 - Text Generation](#)

[Lecture 40 - Text to Speech](#)

[Lecture 41 - Speech Generation](#)

[Lecture 42 - Introduction .](#)

[Lecture 43 - Multimodal Interactive Systems Development](#)

[Lecture 44 - Introduction . .](#)

[Lecture 45 - Virtual Reality](#)

[Lecture 46 - Introduction to Audio for Virtual Reality](#)

[Lecture 47 - Spatial Hearing](#)

[Lecture 48 - Dummy Heads](#)

[Lecture 49 - Individuality of HRTFs](#)

[Lecture 50 - Stereophony](#)

[Lecture 51 - Crosstalk Cancelation](#)

[Lecture 52 - Ambisonics](#)

[Lecture 53 - Sound Field Synthesis](#)

[Lecture 54 - Challenges with Projection-based Systems](#)

[Lecture 55 - Capturing of Sound Scenes](#)

[Lecture 56 - Closing Remarks](#)

Lecture 1 - Recap of Probability Theory

Lecture 2 - Why are we interested in Joint Distributions

Lecture 3 - How do we represent a joint distribution

Lecture 4 - Can we represent the joint distribution more compactly

Lecture 5 - Can we use a graph to represent a joint distribution

Lecture 6 - Different types of reasoning encoded in a Bayesian Network

Lecture 7 - Independencies encoded by a Bayesian Network (Case 1: Node and it's parents)

Lecture 8 - Independencies encoded by a Bayesian Network (Case 2: Node and it's non-parents)

Lecture 9 - Independencies encoded by a Bayesian Network (Case 3: Node and it's descendants)

Lecture 10 - Bayesian Networks : Formal Semantics

Lecture 11 - I-Maps

Lecture 12 - Markov Networks: Motivation

Lecture 13 - Factors in Markov Network

Lecture 14 - Local Independencies in a Markov Network

Lecture 15 - Joint Distributions

Lecture 16 - The concept of a latent variable

Lecture 17 - Restricted Boltzmann Machines

Lecture 18 - RBMs as Stochastic Neural Networks

Lecture 19 - Unsupervised Learning with RBMs

Lecture 20 - Computing the gradient of the log likelihood

Lecture 21 - Motivation for Sampling

Lecture 22 - Motivation for Sampling - Part 2

Lecture 23 - Markov Chains

Lecture 24 - Why do we care about Markov Chains ?

Lecture 25 - Setting up a Markov Chain for RBMs

Lecture 26 - Training RBMs Using Gibbs Sampling

Lecture 27 - Training RBMs Using Contrastive Divergence

Lecture 28 - Revisiting Autoencoders

Lecture 29 - Variational Autoencoders: The Neural Network Perspective

Lecture 30 - Variational Autoencoders: The Graphical model perspective

Lecture 31 - Neural Autoregressive Density Estimator

[Lecture 32 - Masked Autoencoder Density Estimator \(MADE\)](#)

[Lecture 33 - Generative Adversarial Networks - The Intuition](#)

[Lecture 34 - Generative Adversarial Networks - Architecture](#)

[Lecture 35 - Generative Adversarial Networks - The Math Behind it](#)

[Lecture 36 - Generative Adversarial Networks - Some Cool Stuff and Applications](#)

[Lecture 37 - Bringing it all together \(the deep generative summary\)](#)

DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

NPTEL : NOC:Machine Learning (Computer Science and Engineering)

Co-ordinators : Prof. Henrik Bostrom, Prof. Fredrik Kilander, Prof. Carl Gustaf Jansson

- Lecture 1 - Introduction to the Machine Learning Course
- Lecture 2 - Foundation of Artificial Intelligence and Machine Learning
- Lecture 3 - Intelligent Autonomous Systems and Artificial Intelligence
- Lecture 4 - Applications of Machine Learning
- Lecture 5 - Tutorial for week 1
- Lecture 6 - Characterization of Learning Problems
- Lecture 7 - Objects, Categories and Features
- Lecture 8 - Feature related issues
- Lecture 9 - Scenarios for Concept Learning
- Lecture 10 - Tutorial for week 2
- Lecture 11 - Forms of Representation
- Lecture 12 - Decision Trees
- Lecture 13 - Bayes (ian) Belief Networks
- Lecture 14 - Artificial Neural Networks
- Lecture 15 - Genetic algorithm
- Lecture 16 - Logic Programming
- Lecture 17 - Tutorial for week 3
- Lecture 18 - Inductive Learning based on Symbolic Representations and Weak Theories
- Lecture 19 - Generalization as Search - Part 1
- Lecture 20 - Generalization as Search - Part 2
- Lecture 21 - Decision Tree Learning Algorithms - Part 1
- Lecture 22 - Decision Tree Learning Algorithms - Part 2
- Lecture 23 - Instance Based Learning - Part 1
- Lecture 24 - Instance Based Learning - Part 2
- Lecture 25 - Cluster Analysis
- Lecture 26 - Tutorial for week 4
- Lecture 27 - Machine Learning enabled by Prior Theories
- Lecture 28 - Explanation Based Learning
- Lecture 29 - Inductive Logic Programming
- Lecture 30 - Reinforcement Learning - Part 1 Introduction
- Lecture 31 - Reinforcement Learning - Part 2 Learning Algorithms

[Lecture 32 - Reinforcement Learning - Part 3 Q-Learning](#)

[Lecture 33 - Case - Based Reasoning](#)

[Lecture 34 - Tutorial for week 5](#)

[Lecture 35 - Fundamentals of Artificial Neural Networks - Part 1](#)

[Lecture 36 - Fundamentals of Artificial Neural Networks - Part 2](#)

[Lecture 37 - Perceptrons](#)

[Lecture 38 - Model of Neuron in an ANN](#)

[Lecture 39 - Learning in a Feed Forward Multiple Layer ANN - Backpropagation](#)

[Lecture 40 - Recurrent Neural Networks](#)

[Lecture 41 - Hebbian Learning and Associative Memory](#)

[Lecture 42 - Hopfield Networks and Boltzman Machines - Part 1](#)

[Lecture 43 - Hopfield Networks and Boltzman Machines - Part 2](#)

[Lecture 44 - Convolutional Neural Networks - Part 1](#)

[Lecture 45 - Convolutional Neural Networks - Part 2](#)

[Lecture 46 - DeepLearning](#)

[Lecture 47 - Tutorial for week 6](#)

[Lecture 48 - Tools and Resources](#)

[Lecture 49 - Interdisciplinary Inspiration](#)

[Lecture 50 - Preparation for Exam and Example of Applications](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

Lecture 1 - Introduction

Lecture 2 - Operations on a Corpus

Lecture 3 - Probability and NLP

Lecture 4 - Vector Space models

Lecture 5 - Sequence Learning

Lecture 6 - Machine Translation

Lecture 7 - Preprocessing

Lecture 8 - Statistical Properties of Words - Part 1

Lecture 9 - Statistical Properties of Words - Part 2

Lecture 10 - Statistical Properties of Words - Part 3

Lecture 11 - Vector Space Models for NLP

Lecture 12 - Document Similarity - Demo, Inverted index, Exercise

Lecture 13 - Vector Representation of words

Lecture 14 - Contextual understanding of text

Lecture 15 - Co-occurrence matrix, n-grams

Lecture 16 - Collocations, Dense word Vectors

Lecture 17 - SVD, Dimensionality reduction, Demo

Lecture 18 - Query Processing

Lecture 19 - Topic Modeling

Lecture 20 - Examples for word prediction

Lecture 21 - Introduction to Probability in the context of NLP

Lecture 22 - Joint and conditional probabilities, independence with examples

Lecture 23 - The definition of probabilistic language model

Lecture 24 - Chain rule and Markov assumption

Lecture 25 - Generative Models

Lecture 26 - Bigram and Trigram Language models - peeking inside the model building

Lecture 27 - Out of vocabulary words and curse of dimensionality

Lecture 28 - Exercise

Lecture 29 - Naive-Bayes, classification

Lecture 30 - Machine learning, perceptron, linearly separable

Lecture 31 - Linear Models for Classification

- [Lecture 32 - Biological Neural Network](#)
- [Lecture 33 - Perceptron](#)
- [Lecture 34 - Perceptron Learning](#)
- [Lecture 35 - Logical XOR](#)
- [Lecture 36 - Activation Functions](#)
- [Lecture 37 - Gradient Descent](#)
- [Lecture 38 - Feedforward and Backpropagation Neural Network](#)
- [Lecture 39 - Why Word2Vec?](#)
- [Lecture 40 - What are CBOW and Skip-Gram Models?](#)
- [Lecture 41 - One word learning architecture](#)
- [Lecture 42 - Forward pass for Word2Vec](#)
- [Lecture 43 - Matrix Operations Explained](#)
- [Lecture 44 - CBOW and Skip Gram Models](#)
- [Lecture 45 - Building Skip-gram model using Python](#)
- [Lecture 46 - Reduction of complexity - sub-sampling, negative sampling](#)
- [Lecture 47 - Binay tree, Hierarchical softmax](#)
- [Lecture 48 - Mapping the output layer to Softmax](#)
- [Lecture 49 - Updating the weights using hierarchical softmax](#)
- [Lecture 50 - Discussion on the results obtained from word2vec](#)
- [Lecture 51 - Recap and Introduction](#)
- [Lecture 52 - ANN as a LM and its limitations](#)
- [Lecture 53 - Sequence Learning and its applications](#)
- [Lecture 54 - Introudction to Recurrent Neural Network](#)
- [Lecture 55 - Unrolled RNN](#)
- [Lecture 56 - RNN - Based Language Model](#)
- [Lecture 57 - BPTT - Forward Pass](#)
- [Lecture 58 - BPTT - Derivatives for W,V and U](#)
- [Lecture 59 - BPTT - Exploding and vanishing gradient](#)
- [Lecture 60 - LSTM](#)
- [Lecture 61 - Truncated BPTT](#)
- [Lecture 62 - GRU](#)
- [Lecture 63 - Introduction and Historical Approaches to Machine Translation](#)
- [Lecture 64 - What is SMT?](#)

Lecture 65 - Noisy Channel Model, Bayes Rule, Language Model

Lecture 66 - Translation Model, Alignment Variables

Lecture 67 - Alignments again!

Lecture 68 - IBM Model 1

Lecture 69 - IBM Model 2

Lecture 70 - Introduction to Phrase-based translation

Lecture 71 - Symmetrization of alignments

Lecture 72 - Extraction of Phrases

Lecture 73 - Learning/estimating the phrase probabilities using another Symmetrization example

Lecture 74 - Introduction to evaluation of Machine Translation

Lecture 75 - BLEU - A short Discussion of the seminal paper

Lecture 76 - BLEU Demo using NLTK and other Metrics

Lecture 77 - Encoder-Decoder model for Neural Machine Translation

Lecture 78 - RNN Based Machine Translation

Lecture 79 - Recap and Connecting Bloom Taxonomy with Machine Learning

Lecture 80 - Introduction to Attention based Translation

Lecture 81 - Research Paper discussion on Neural machine translation by jointly learning to align and translate

Lecture 82 - Typical NMT architecture architecture and models for multi-language translation

Lecture 83 - Beam Search, Stochastic Gradient Descend, Mini Batch, Batch

Lecture 84 - Beam Search, Stochastic Gradient Descend, Mini Batch, Batch

Lecture 85 - Introduction to Conversation Modeling

Lecture 86 - A few examples in Conversation Modeling

Lecture 87 - Some ideas to Implement IR-based Conversation Modeling

Lecture 88 - Discussion of some ideas in Question Answering

Lecture 89 - Hyperspace Analogue to Language - HAL

Lecture 90 - Correlated Occurrence Analogue to Lexical Semantic - COALS

Lecture 91 - Global Vectors - Glove

Lecture 92 - Evaluation of Word vectors

Lecture 1 - Introduction to Python for Data Science

Lecture 2 - Introduction to Python

Lecture 3 - Introduction to Spyder - Part 1

Lecture 4 - Introduction to Spyder - Part 2

Lecture 5 - Variables and Datatypes

Lecture 6 - Operators

Lecture 7 - Jupyter setup

Lecture 8 - Sequence data - Part 1

Lecture 9 - Sequence data - Part 2

Lecture 10 - Sequence data - Part 3

Lecture 11 - Sequence data - Part 4

Lecture 12 - Numpy

Lecture 13 - Reading data

Lecture 14 - Pandas Dataframes - I

Lecture 15 - Pandas Dataframes - II

Lecture 16 - Pandas Dataframes - III

Lecture 17 - Control structures and Functions

Lecture 18 - Exploratory data analysis

Lecture 19 - Data Visualization - Part I

Lecture 20 - Data Visualization - Part II

Lecture 21 - Dealing with missing data

Lecture 22 - Introduction to Classification Case Study

Lecture 23 - Case Study on Classification - Part I

Lecture 24 - Case Study on Classification - Part II

Lecture 25 - Introduction to Regression Case Study

Lecture 26 - Case Study on Regression - Part I

Lecture 27 - Case Study on Regression - Part II

Lecture 28 - Case Study on Regression - Part III

Lecture 29 - Module : Predictive Modelling

Lecture 30 - Linear Regression

Lecture 31 - Model Assessment

[Lecture 32 - Diagnostics to Improve Linear Model Fit](#)

[Lecture 33 - Cross Validation](#)

[Lecture 34 - Classification](#)

[Lecture 35 - Logistic Regression](#)

[Lecture 36 - K-Nearest Neighbors \(kNN\)](#)

[Lecture 37 - K-means Clustering](#)

[Lecture 38 - Logistic Regression \(Continued...\)](#)

[Lecture 39 - Decision Trees](#)

[Lecture 40 - Multiple Linear Regression](#)

- Lecture 1 - Overview of Tensorflow
- Lecture 2 - Machine Learning Refresher
- Lecture 3 - Steps in Machine Learning Process
- Lecture 4 - Loss Functions in Machine Learning
- Lecture 5 - Gradient Descent
- Lecture 6 - Gradient Descent Variations
- Lecture 7 - Model Selection and Evaluation
- Lecture 8 - Machine Learning Visualization
- Lecture 9 - Deep Learning Refresher
- Lecture 10 - Introduction to Tensors
- Lecture 11 - Mathematical Foundations of Deep Learning (Continued...)
- Lecture 12 - Building Data Pipelines for Tensorflow - Part 1
- Lecture 13 - Building Data Pipelines for Tensorflow - Part 2
- Lecture 14 - Building Data Pipelines for Tensorflow - Part 3
- Lecture 15 - Text Processing with Tensorflow
- Lecture 16 - Classify Images
- Lecture 17 - Regression
- Lecture 18 - Classify Structured Data
- Lecture 19 - Text Classification
- Lecture 20 - Underfitting and Overfitting
- Lecture 21 - Save and Restore Models
- Lecture 22 - CNNs - Part 1
- Lecture 23 - CNNs - Part 2
- Lecture 24 - Transfer learning with pretrained CNNs
- Lecture 25 - Transfer learning with TF hub
- Lecture 26 - Image classification and visualization
- Lecture 27 - Estimator API
- Lecture 28 - Logistic Regression
- Lecture 29 - Boosted Trees
- Lecture 30 - Introduction to word embeddings
- Lecture 31 - Recurrent Neural Networks - Part 1

[Lecture 32 - Recurrent Neural Networks - Part 2](#)

[Lecture 33 - Time Series Forecasting with RNNs](#)

[Lecture 34 - Text Generation with RNNs](#)

[Lecture 35 - TensorFlow Customization](#)

[Lecture 36 - Customizing tf.keras - Part 1](#)

[Lecture 37 - Customizing tf.keras - Part 2](#)

[Lecture 38 - TensorFlow Distributed Training](#)

Lecture 1 - Introduction

Lecture 2 - Database Architecture

Lecture 3 - RDBMS Architecture

Lecture 4 - Introduction to ER Model

Lecture 5 - Entities and Relationships

Lecture 6 - Modelling Weak Entities and Design Choices

Lecture 7 - Relational Data Model and Notion of Keys

Lecture 8 - Introduction to Relational Algebra

Lecture 9 - Operators in Relational Model

Lecture 10 - Uses of Renaming, Join and Division in Relation Algebra

Lecture 11 - Example Queries in Relation Model and Outer Join Operation

Lecture 12 - Convert ER-Model to a Relational Model

Lecture 13 - Introduction to tuple relational calculus

Lecture 14 - Example TRC queries

Lecture 15 - Data definition using SQL

Lecture 16 - Basic SQL query block and subqueries

Lecture 17 - Correlated subqueries

Lecture 18 - Aggregate functions

Lecture 19 - Views

Lecture 20 - Programmatic access of SQL

Lecture 21 - Normal forms - Introduction

Lecture 22 - Deriving new functional dependencies

Lecture 23 - Proving soundness and completeness of Armstrong's Axioms

Lecture 24 - Normal forms - 2 NF, 3NF, BCNF

Lecture 25 - Properties of decompositions

Lecture 26 - Normal forms - 4NF, 5NF

Lecture 27 - Introduction to file organization

Lecture 28 - File organization methods

Lecture 29 - Dynamic File organization using Hashing

Lecture 30 - Index structures

Lecture 31 - B+ trees on Disks

[Lecture 32 - Performance and Reliability of Multiple Disks](#)

[Lecture 33 - Relational Query Evaluation](#)

[Lecture 34 - Join operator processing algorithms](#)

[Lecture 35 - Query optimization](#)

[Lecture 36 - ACID properties and operations in transactions](#)

[Lecture 37 - Schedules](#)

[Lecture 38 - Concurrency control using Locks](#)

[Lecture 39 - Recovery using undo logging method](#)

[Lecture 40 - Recovery using Redo and Undo-Redo logging methods](#)

[Lecture 41 - Recoverable schedules and transaction isolation levels](#)

Lecture 1 - Introduction

Lecture 2 - Symmetric-key Encryption

Lecture 3 - Historical Ciphers and their Cryptanalysis

Lecture 4 - Perfect Security

Lecture 5 - Limitations of Perfect Security

Lecture 6 - Introduction to Computational Security

Lecture 7 - Semantic Security

Lecture 8 - Pseudo-random Generators (PRGs)

Lecture 9 - Operations on Pseudorandom Generators

Lecture 10 - Stream Ciphers

Lecture 11 - Provably-secure Instantiation of PRG

Lecture 12 - Practical Instantiations of PRG

Lecture 13 - CPA-security

Lecture 14 - Pseudo-random Functions (PRFs)

Lecture 15 - CPA-secure Encryption from PRF

Lecture 16 - Modes of Operations of Block Ciphers - Part I

Lecture 17 - Modes of Operations of Block Ciphers - Part II

Lecture 18 - Theoretical Constructions of Block Ciphers

Lecture 19 - Practical Constructions of Block Ciphers - Part I

Lecture 20 - Practical Constructions of Block Ciphers - Part II

Lecture 21 - From Passive to Active Adversary

Lecture 22 - Message Integrity and Authentication

Lecture 23 - Message Authentication for Long Messages - Part I

Lecture 24 - Message Authentication for Long Messages - Part II

Lecture 25 - Information-theoretic MACs - Part I

Lecture 26 - Information-theoretic MACs - Part II

Lecture 27 - Cryptographic Hash Functions - Part I

Lecture 28 - Cryptographic Hash Functions - Part II

Lecture 29 - Message Authentication Using Hash Functions

Lecture 30 - Generic Attacks on Hash Functions and Additional Applications of Hash Functions

Lecture 31 - Random Oracle Model - Part I

[Lecture 32 - Random Oracle Model - Part II](#)

[Lecture 33 - Authenticated Encryption](#)

[Lecture 34 - Composing CPA-secure Cipher with a Secure MAC - Part I](#)

[Lecture 35 - Composing CPA-secure Cipher with a Secure MAC - Part II](#)

[Lecture 36 - Key-Exchange Protocols - Part I](#)

[Lecture 37 - Key-Exchange Protocols - Part II](#)

[Lecture 38 - Cyclic groups](#)

[Lecture 39 - Cryptographic Hardness Assumptions in the Cyclic Groups](#)

[Lecture 40 - Candidate Cyclic Groups for Cryptographic Purposes - Part I](#)

[Lecture 41 - Candidate Cyclic Groups for Cryptographic Purposes - Part II](#)

[Lecture 42 - Cryptographic Applications of the Discrete Log Assumption](#)

[Lecture 43 - Public-key Encryption](#)

[Lecture 44 - El Gamal Public-key Encryption Scheme](#)

[Lecture 45 - RSA Assumption](#)

[Lecture 46 - RSA Public-key Cryptosystem](#)

[Lecture 47 - Hybrid Public-key Cryptosystem](#)

[Lecture 48 - CCA-Secure Public-key Ciphers](#)

[Lecture 49 - CCA-Secure Public-key Ciphers Based on Diffie-Hellman Problems](#)

[Lecture 50 - CCA-Secure Public-key Ciphers Based on RSA Assumption](#)

[Lecture 51 - Digital Signatures](#)

[Lecture 52 - RSA Signatures](#)

[Lecture 53 - Identification Schemes](#)

[Lecture 54 - Schnorr Signature Scheme and TLS/SSL](#)

[Lecture 55 - Number Theory](#)

[Lecture 56 - Secret Sharing](#)

[Lecture 57 - Zero-Knowledge Protocols - Part I](#)

[Lecture 58 - Zero-Knowledge Protocols - Part II](#)

[Lecture 59 - Good Bye for Now](#)

Lecture 1 - Introduction to Modern Application Development - Part 1

Lecture 2 - Introduction to Modern Application Development - Part 2

Lecture 3 - Introduction to Modern Application Development - Part 3

Lecture 4 - Introduction to Modern Application Development - Part 4

Lecture 5 - Introduction to Modern Application Development - Part 5

Lecture 6 - Command Line - Part 1

Lecture 7 - Command Line - Part 2

Lecture 8 - Command Line - Practice Questions - Part 1

Lecture 9 - Command Line - Practice Questions - Part 2

Lecture 10 - Comparing CLI, GUI, and Web Interfaces

Lecture 11 - Producing HTML+CSS output - Part 1

Lecture 12 - Producing HTML+CSS output - Part 2

Lecture 13 - Introduction to Input in HTML

Lecture 14 - Session 2 - Part 1

Lecture 15 - Session 2 - Part 2

Lecture 16 - Session 2 - Part 3

Lecture 17 - Session 1 - Part 1 - Introduction to HTML and CSS

Lecture 18 - Session 1 - Part 2

Lecture 19 - Week6 - Session 1

Lecture 20 - Week6 - Session 2

Lecture 21 - Introduction to JDBC

Lecture 22 - Week 7 Session 1 - Part 1

Lecture 23 - Week 7 Session 1 - Part 2

Lecture 24 - Week 8 Session 1

Lecture 25 - Week 8 Session 2

Lecture 26 - Week 8 Session 3

Lecture 27 - Week 9 Session 1

Lecture 28 - Week 9 Session 3

Lecture 29 - Week 10 Part 1

Lecture 30 - Week 10 Part 2

Lecture 31 - Week 10 Part 3

[Lecture 32 - Week 11 Part 1](#)

[Lecture 33 - Week 11 Part 2](#)

[Lecture 34 - Week 12 Part 1](#)

[Lecture 35 - Week 12 Part 2](#)

[Lecture 36 - Week 12 Part 3](#)

[Lecture 37 - Week 12 Part 4](#)

Lecture 1 - Course Introduction

Lecture 2 - History

Lecture 3 - Image Formation

Lecture 4 - Image Representation

Lecture 5 - Linear Filtering

Lecture 6 - Image in Frequency Domain

Lecture 7 - Image Sampling

Lecture 8 - Edge Detection

Lecture 9 - From Edges to Blobs and Corners

Lecture 10 - Scale Space, Image Pyramids and Filter Banks

Lecture 11 - Feature Detectors: SIFT and Variants

Lecture 12 - Image Segmentation

Lecture 13 - Other Feature Spaces

Lecture 14 - Human Visual System

Lecture 15 - Feature Matching

Lecture 16 - Hough Transform

Lecture 17 - From Points to Images: Bag-of-Words and VLAD Representations

Lecture 18 - Image Descriptor Matching

Lecture 19 - Pyramid Matching

Lecture 20 - From Traditional Vision to Deep Learning

Lecture 21 - Neural Networks: A Review - Part 1

Lecture 22 - Neural Networks: A Review - Part 2

Lecture 23 - Feedforward Neural Networks and Backpropagation - Part 1

Lecture 24 - Feedforward Neural Networks and Backpropagation - Part 2

Lecture 25 - Gradient Descent and Variants - Part 1

Lecture 26 - Gradient Descent and Variants - Part 2

Lecture 27 - Regularization in Neural Networks - Part 1

Lecture 28 - Regularization in Neural Networks - Part 2

Lecture 29 - Improving Training of Neural Networks - Part 1

Lecture 30 - Improving Training of Neural Networks - Part 2

Lecture 31 - Convolutional Neural Networks: An Introduction - Part 1

[Lecture 32 - Convolutional Neural Networks: An Introduction - Part 2](#)

[Lecture 33 - Backpropagation in CNNs](#)

[Lecture 34 - Evolution of CNN Architectures for Image Classification - Part 1](#)

[Lecture 35 - Evolution of CNN Architectures for Image Classification - Part 2](#)

[Lecture 36 - Recent CNN Architectures](#)

[Lecture 37 - Finetuning in CNNs](#)

[Lecture 38 - Explaining CNNs: Visualization Methods](#)

[Lecture 39 - Explaining CNNs: Early Methods](#)

[Lecture 40 - Explaining CNNs: Class Attribution Map Methods](#)

[Lecture 41 - Explaining CNNs: Recent Methods - Part 1](#)

[Lecture 42 - Explaining CNNs: Recent Methods - Part 2](#)

[Lecture 43 - Going Beyond Explaining CNNs](#)

[Lecture 44 - CNNs for Object Detection-I - Part 1](#)

[Lecture 45 - CNNs for Object Detection-I - Part 2](#)

[Lecture 46 - CNNs for Object Detection-II](#)

[Lecture 47 - CNNs for Segmentation](#)

[Lecture 48 - CNNs for Human Understanding: Faces - Part 1](#)

[Lecture 49 - CNNs for Human Understanding: Faces - Part 2](#)

[Lecture 50 - CNNs for Human Understanding: Human Pose and Crowd](#)

[Lecture 51 - CNNs for Other Image Tasks](#)

[Lecture 52 - Recurrent Neural Networks: Introduction](#)

[Lecture 53 - Backpropagation in RNNs](#)

[Lecture 54 - LSTMs and GRUs](#)

[Lecture 55 - Video Understanding using CNNs and RNNs](#)

[Lecture 56 - Attention in Vision Models: An Introduction](#)

[Lecture 57 - Vision and Language: Image Captioning](#)

[Lecture 58 - Beyond Captioning: Visual QA, Visual Dialog](#)

[Lecture 59 - Other Attention Models](#)

[Lecture 60 - Self-Attention and Transformers](#)

[Lecture 61 - Deep Generative Models: An Introduction](#)

[Lecture 62 - Generative Adversarial Networks - Part 1](#)

[Lecture 63 - Generative Adversarial Networks - Part 2](#)

[Lecture 64 - Variational Autoencoders](#)

[Lecture 65 - Combining VAEs and GANs](#)

[Lecture 66 - Beyond VAEs and GANs: Other Deep Generative Models - Part 1](#)

[Lecture 67 - Beyond VAEs and GANs: Other Deep Generative Models - Part 2](#)

[Lecture 68 - GAN Improvements](#)

[Lecture 69 - Deep Generative Models across Multiple Domains](#)

[Lecture 70 - VAEs and Disentanglement](#)

[Lecture 71 - Deep Generative Models: Image Applications](#)

[Lecture 72 - Deep Generative Models: Video Applications](#)

[Lecture 73 - Few-shot and Zero-shot Learning - Part 1](#)

[Lecture 74 - Few-shot and Zero-shot Learning - Part 2](#)

[Lecture 75 - Self-Supervised Learning](#)

[Lecture 76 - Adversarial Robustness](#)

[Lecture 77 - Pruning and Model Compression](#)

[Lecture 78 - Neural Architecture Search](#)

[Lecture 79 - Course Conclusion](#)

- Lecture 1 - Prologue
- Lecture 2 - The Winograd Schema Challenge
- Lecture 3 - Introduction (2013 version)
- Lecture 4 - Can Machines Think?
- Lecture 5 - The Turing Test
- Lecture 6 - Language and Thought
- Lecture 7 - The Willing Suspension of Disbelief
- Lecture 8 - Machines with Wheels and Gears
- Lecture 9 - The Notion of Mind in Philosophy
- Lecture 10 - Reasoning = Computation
- Lecture 11 - Concepts and Categories
- Lecture 12 - How did AI get its name?
- Lecture 13 - The Chess Saga
- Lecture 14 - A Brief History of AI
- Lecture 15 - The Worlds in our Minds
- Lecture 16 - Epiphemona in Computers
- Lecture 17 - State Space Search
- Lecture 18 - Domain Independent Algorithms
- Lecture 19 - Deterministic Search
- Lecture 20 - DFS and BFS
- Lecture 21 - Comparing DFS and BFS
- Lecture 22 - Depth First Iterative Deepening
- Lecture 23 - Heuristic Search
- Lecture 24 - Heuristic Functions and the Search Landscape
- Lecture 25 - Solution Space Search
- Lecture 26 - The Traveling Salesman Problem
- Lecture 27 - Escaping Local Optima
- Lecture 28 - Stochastic Local Search
- Lecture 29 - Genetic Algorithms: Survival of the Fittest
- Lecture 30 - Genetic Algorithms and SAT
- Lecture 31 - Genetic Algorithms for the TSP

Lecture 32 - Emergent Systems

Lecture 33 - Ant Colony Optimization

Lecture 34 - Finding Optimal Paths

Lecture 35 - Branch and Bound

Lecture 36 - Algorithm A*

Lecture 37 - A*: An illustrated example

Lecture 38 - Is A* Admissible?

Lecture 39 - Admissibility of A*

Lecture 40 - Higher, Faster ...

Lecture 41 - B&B - A* - wA* - Best First

Lecture 42 - A*: Leaner Admissible Variations

Lecture 43 - The Monotone Condition

Lecture 44 - DNA Sequence Alignment

Lecture 45 - Divide and Conquer Frontier Search.

Lecture 46 - Smart Memory Graph Search

Lecture 47 - Variations on A*: The story so far

Lecture 48 - Breadth First Heuristic Search

Lecture 49 - Beam Stack Search

Lecture 50 - Game Theory

Lecture 51 - Popular Recreational Games

Lecture 52 - Board Games and Game Trees

Lecture 53 - The Evaluation Function in Board Games

Lecture 54 - Algorithm Minimax and Alpha-Beta Pruning

Lecture 55 - A Cluster of Strategies

Lecture 56 - SSS*: A Best First Algorithm

Lecture 57 - SSS*: A Detailed Example

Lecture 58 - Automated Domain Independent Planning

Lecture 59 - The Blocks World Domain

Lecture 60 - State Space Planning: Forward and Backward

Lecture 61 - Goal Stack Planning (GSP)

Lecture 62 - GSP: A Detailed Example

Lecture 63 - Plan Space Planning (PSP)

Lecture 64 - PSP: A Tiny Example

[Lecture 65 - Multi-Armed Robots](#)

[Lecture 66 - Means-Ends Analysis](#)

[Lecture 67 - The Planning Graph](#)

[Lecture 68 - Algorithm Graphplan](#)

[Lecture 69 - Problem Decomposition.](#)

[Lecture 70 - Algorithm AO*](#)

[Lecture 71 - AO*: An Illustration](#)

[Lecture 72 - Rule Based Expert Systems](#)

[Lecture 73 - The Inference Engine](#)

[Lecture 74 - The OPS5 Language](#)

[Lecture 75 - Conflict Resolution](#)

[Lecture 76 - Business Rule Management Systems](#)

[Lecture 77 - The Rete Net](#)

[Lecture 78 - Rete Algorithm: Optimizing the Match](#)

[Lecture 79 - Rete Algorithm: Conflict Resolution](#)

[Lecture 80 - Reasoning in Logic](#)

[Lecture 81 - Rules of Inference](#)

[Lecture 82 - Forward Reasoning](#)

[Lecture 83 - First Order Logic](#)

[Lecture 84 - Implicit Quantifier Notation](#)

[Lecture 85 - Backward Reasoning](#)

[Lecture 86 - Depth First Search on Goal Trees](#)

[Lecture 87 - Incompleteness...](#)

[Lecture 88 - Constraint Satisfaction Problems](#)

[Lecture 89 - Binary Constraint Networks](#)

[Lecture 90 - Interpreting Line Drawings](#)

[Lecture 91 - Model Based Diagnosis](#)

[Lecture 92 - Solving CSPs](#)

[Lecture 93 - Arc Consistency](#)

[Lecture 94 - Propagation = Reasoning](#)

[Lecture 95 - Lookahead Search](#)

Lecture 1 - Introduction to Computational Complexity

Lecture 2 - The Class P

Lecture 3 - The Class NP

Lecture 4 - The Class NP - Alternate Definition

Lecture 5 - Polynomial Time Reductions

Lecture 6 - NP - Completeness

Lecture 7 - Cook Levin Theorem - Part 1

Lecture 8 - Cook Levin Theorem - Part 2

Lecture 9 - More NP Complete Problems

Lecture 10 - Polynomial Hierarchy - Part 1

Lecture 11 - Polynomial Hierarchy - Part 2

Lecture 12 - Polynomial Hierarchy - Part 3

Lecture 13 - Time Hierarchy Theorem

Lecture 14 - Introduction to Space Complexity

Lecture 15 - NL-Completeness

Lecture 16 - Savitch's Theorem

Lecture 17 - NL = co-NL - Part 1

Lecture 18 - NL = co-NL - Part 2

Lecture 19 - PSPACE Completeness

Lecture 20 - Games and PSPACE Completeness

Lecture 21 - Space Hierarchy Theorem

Lecture 22 - Ladner's Theorem

Lecture 23 - Oracle Turing Machines

Lecture 24 - Polynomial Hierarchy Using Oracles

Lecture 25 - Baker-Gill-Solovay Theorem - Part 1

Lecture 26 - Baker-Gill-Solovay Theorem - Part 2

Lecture 27 - Randomized Complexity Classes - Part 1

Lecture 28 - Randomized Complexity Classes - Part 2

Lecture 29 - Randomized Complexity Classes - Part 3

Lecture 30 - Randomized Complexity Classes - Part 4

Lecture 31 - Comparison Between Randomized Complexity Classes

- Lecture 32 - BPP is in Polynomial Hierarchy
- Lecture 33 - Circuit Complexity - Part 1
- Lecture 34 - Circuit Complexity - Part 2
- Lecture 35 - Formal Definition of Circuits
- Lecture 36 - Hierarchy Theorem for Circuit Size
- Lecture 37 - Complexity Class : P/Poly
- Lecture 38 - Karp-Lipton Theorem
- Lecture 39 - Turing Machines That Take Advice
- Lecture 40 - Classes NC and AC
- Lecture 41 - Parity Not in AC0 - Part 1
- Lecture 42 - Parity Not in AC0 - Part 2
- Lecture 43 - Adleman's Theorem
- Lecture 44 - Polynomial Identity Testing and Bipartite Perfect Matching in RNC
- Lecture 45 - Search Bipartite Perfect Matching is in RNC - Part 1
- Lecture 46 - Search Bipartite Perfect Matching is in RNC - Part 2
- Lecture 47 - Promise Problems and Valiant-Vazirani Theorem
- Lecture 48 - Valiant Vazirani Theorem Continued
- Lecture 49 - #P and the Complexity of Counting
- Lecture 50 - Permanent is #P-Complete - Part 1
- Lecture 51 - Permanent is #P-Complete - Part 2
- Lecture 52 - Toda's Theorem - Part 1
- Lecture 53 - Toda's Theorem - Part 2
- Lecture 54 - Introduction to Communication Complexity - Part 1
- Lecture 55 - Introduction to Communication Complexity - Part 2
- Lecture 56 - Lower Bound Techniques
- Lecture 57 - Communication Complexity of Relations
- Lecture 58 - Monotone Depth Lower Bound for Matching
- Lecture 59 - Interactive Proofs
- Lecture 60 - #3SAT is in IP
- Lecture 61 - Public Coin Interactive Proofs and AM/MA
- Lecture 62 - Simulating Private Coins using Public Coins
- Lecture 63 - Summary and Concluding Remarks

Lecture 1 - Invitation to FPT

Lecture 2 - Formalizing FPT

Lecture 3 - Kernelization: High Degree Rule

Lecture 4 - Kernelization: d-Hitting Set

Lecture 5 - Kernelization: Crown Reduciton

Lecture 6 - Kernelization: Nemhauser-Trotter and Expansion Lemma

Lecture 7 - Introduction to Branching

Lecture 8 - Analyzing Recurrences

Lecture 9 - High-Degree Branching for FVS

Lecture 10 - Vertex Cover above LP

Lecture 11 - Applications of Vertex Cover above Matching

Lecture 12 - Iterative Compression I: Setting Up the Method

Lecture 13 - Iterative Compression II: Vertex Cover and Tournament Feedback Vertex Set

Lecture 14 - Iterative Compression III: Feedback Vertex Set and 3-Hitting Set

Lecture 15 - Iterative Compression IV: Odd Cycle Transversal

Lecture 16 - Introduction to Randomized Algorithms via a Simple Randomized FPT Algorithm for FVS

Lecture 17 - Color Coding for Longest Path

Lecture 18 - Chromatic Coding for Feedback Arc Set on Tournaments

Lecture 19 - Random Separation and Subgraph Isomorphism

Lecture 20 - Derandomization

Lecture 21 - Divide and Conquer and Separator

Lecture 22 - Towards Defining Treewidth

Lecture 23 - Treewidth and Constructing Treedecomposition of Few Graph Classes

Lecture 24 - Structural Properties of Treedecomposition and Win-Win

Lecture 25 - Nice Tree Decomposition and Algorithm for Max Weight Independent Set

Lecture 26 - Dynamic Programming Algorithm over graphs of Bounded Treewidth

Lecture 27 - FPT Approximation Algorithm for Computing Tree Decomposition - Part 1

Lecture 28 - FPT Approximation Algorithm for Computing Tree Decomposition - Part 2

Lecture 29 - FPT Approximation Algorithm for Computing Tree Decomposition and Applications - Part 1

Lecture 30 - FPT Approximation Algorithm for Computing Tree Decomposition and Applications - Part 2

Lecture 31 - Dynamic Programming Over Subsets for Set Cover

- Lecture 32 - Dynamic Programming Over Subsets for Steiner Tree
- Lecture 33 - ILP for Envy-Free Allocations and Lobbying
- Lecture 34 - ILP for Imbalance Parameterized by Vertex Cover
- Lecture 35 - Important Cuts: Basic
- Lecture 36 - Important Cuts: Enumeration and Bounds
- Lecture 37 - FPT Algorithm for Multiway Cut
- Lecture 38 - FPT Algorithm for Directed Feedback Edge Set
- Lecture 39 - Algebraic Techniques: Inclusion Exclusion (Coloring)
- Lecture 40 - Algebraic Techniques: Inclusion Exclusion (Hamiltonian Path)
- Lecture 41 - Algebraic Techniques: Matrix Multiplication
- Lecture 42 - Algebraic Techniques: Polynomial Method
- Lecture 43 - Matroids: Representative Sets
- Lecture 44 - Matroids: Representative Sets - Computation and Combinatorics
- Lecture 45 - Matroids: Representative Sets - Applications (Paths and Kernels)
- Lecture 46 - Matroids: Representative Sets - Applications (Directed Long Cycle)
- Lecture 47 - Reductions - An Introduction
- Lecture 48 - Reductions - Problems as Hard as Clique I (Clique on Regular Graphs)
- Lecture 49 - Reductions - Problems as Hard as Clique (PVC, MCC, MIS)
- Lecture 50 - Reductions - Problems as Hard as Clique (Dominating Set, Set Cover)

Lecture 0 - Welcome and Initial Setup

Lecture 1 - Reversort

Lecture 2 - Engineering Reversort

Lecture 3 - Number Game

Lecture 4 - Will It Stop?

Lecture 5 - Trouble Sort

Lecture 6 - The Meeting Place Cannot Be Changed

Lecture 7 - Magic Ship

Lecture 8 - Simple Skewness

Lecture 9 - Pancake Flipping

Lecture 10 - Islands War

Lecture 11 - Stable Marriage - I

Lecture 12 - Stable Marriage - II

Lecture 13 - When Greedy Does Not Work - Coin Change

Lecture 14 - When Greedy Does Not Work - Guarding a Museum

Lecture 15 - When Greedy Does Not Work - Traveling Salesman

Lecture 16 - DSU - Definition and Motivation

Lecture 17 - DSU via Union by Rank and Path Compression

Lecture 18 - DSU - Implementation

Lecture 19 - Destroying Array - I (Problem Statement and Solution)

Lecture 20 - Destroying Array - II (Implementation)

Lecture 21 - War-I (Problem Statement)

Lecture 22 - War-II (Solution)

Lecture 23 - War-III (Implementation)

Lecture 24 - Graph Foundations

Lecture 25 - BFS and DFS

Lecture 26 - Mahmoud and Ehab and the bipartiteness

Lecture 27 - Cover It!

Lecture 28 - Diamond Inheritance

Lecture 29 - SSSP - Overview BFS Revisited

Lecture 30 - SSSP and Dijkstra's Algorithm

[Lecture 31 - Sending Email](#)

[Lecture 32 - SSSP and Modified Dijkstra](#)

[Lecture 33 - SSSP with Negative Cycles - Bellman-Ford](#)

[Lecture 34 - Wormholes](#)

[Lecture 35 - APSP and Floyd-Warshall](#)

[Lecture 36 - Page Hopping](#)

[Lecture 37 - Introduction to MSTs](#)

[Lecture 38 - Prim's Algorithm](#)

[Lecture 39 - Kruskal's Algorithm](#)

[Lecture 40 - Cherries Mesh](#)

[Lecture 41 - Heirarchy](#)

[Lecture 42 - Island Hopping](#)

[Lecture 43 - Introduction to MaxFlow](#)

[Lecture 44 - Ford-Fulkerson for MaxFlow](#)

[Lecture 45 - Implementing Edmonds-Karp](#)

[Lecture 46 - Maximum Matching via MaxFlow](#)

[Lecture 47 - Sport Elimination via MaxFlow](#)

[Lecture 48 - Maxflow-Mincut Duality](#)

[Lecture 49 - Police Chase](#)

[Lecture 50 - Sam I AM and Vertex Covers](#)

[Lecture 51 - Top-Down Dynamic Programming with Frog 1 - Part A](#)

[Lecture 52 - Top-Down Dynamic Programming with Frog 1 - Part B](#)

[Lecture 53 - Bottom-Up Dynamic Programming with Dice Combinations](#)

Lecture 1 - Quantum Computing Roadmap

Lecture 2 - Quantum Mission in India

Lecture 3 - A Brief Introduction to Applications of Quantum

Lecture 4 - Quantum Computing Basics

Lecture 5 - Postulates of Quantum Mechanics - Part 1

Lecture 6 - Postulates of Quantum Mechanics - Part 2

Lecture 7 - Quantum Measurements

Lecture 8 - Quantum Gates and Circuits - Part 1

Lecture 9 - Quantum Gates and Circuits - Part 2

Lecture 10 - Programming using IBM Quantum Experience and Circuit Composer

Lecture 11 - Quantum Computing Concepts: Entanglement and Interference - Part 1

Lecture 12 - Quantum Computing Concepts: Entanglement and Interference - Part 2

Lecture 13 - Programming using Qiskit - Part 1

Lecture 14 - Programming using Qiskit - Part 2

Lecture 15 - Quantum Algorithms: Deutsch Jozsa Algorithm

Lecture 16 - Quantum Algorithms: Bernstein Vazirani Algorithm

Lecture 17 - Quantum Algorithms: Grover's Search

Lecture 18 - Grover's algorithm Programming

Lecture 19 - NISQ-era quantum algorithms

Lecture 20 - Variational Quantum Algorithms

Lecture 21 - Variational Quantum Eigensolver

Lecture 22 - Quantum Generative Adversarial Networks (QGANs)

Lecture 23 - Fixing quantum errors with quantum tricks: A brief introduction to QEC - Part 1

Lecture 24 - Fixing quantum errors with quantum tricks: A brief introduction to QEC - Part 2

Lecture 25 - Fixing quantum errors with quantum tricks: A brief introduction to QEC - Part 3

Lecture 1 - Introduction to Computer Security - Part 1

Lecture 2 - Introduction to Computer Security - Part 2

Lecture 3 - Malicious Software - Part 1

Lecture 4 - Malicious Software - Part 2

Lecture 5 - Social Engineering and Phishing Attacks - Part 1

Lecture 6 - Social Engineering and Phishing Attacks - Part 2

Lecture 7 - Operating System Security - Part 1

Lecture 8 - Operating System Security - Part 2

Lecture 9 - Operating System Security - Part 3

Lecture 10 - Operating System Security - Part 4

Lecture 11 - Email Security - Part 1

Lecture 12 - Email Security - Part 2

Lecture 13 - Transport Layer Security - Part 1

Lecture 14 - Transport Layer Security - Part 2

Lecture 15 - IP Security - Part 1

Lecture 16 - IP Security - Part 2

Lecture 17 - Security and Usability Overview

Lecture 18 - User Privacy and Usability

- Lecture 1 - Online Privacy
- Lecture 2 - Privacy concepts and studies
- Lecture 3 - Fair Information Practices
- Lecture 4 - Right to Privacy Contextual Integrity
- Lecture 5 - Privacy Policy - Part I
- Lecture 6 - Privacy Policy - Part II
- Lecture 7 - Privacy-based technologies and decision making
- Lecture 8 - Social Media Privacy
- Lecture 9 - Identity resolution
- Lecture 10 - Privacy Nudges
- Lecture 11 - Cookies
- Lecture 12 - Ethics about studying Online Privacy
- Lecture 13 - Anonymization techniques and Differential Privacy
- Lecture 14 - Conducting (user, lab, online) studies
- Lecture 15 - Research paper reading
- Lecture 16 - Voter and Browser Privacy Leaks, Profiling form PII - Part I
- Lecture 17 - Voter and Browser Privacy Leaks, Profiling form PII - Part II
- Lecture 18 - Online Privacy Tools (Hands-on) - Part I
- Lecture 19 - Online Privacy Tools (Hands-on) - Part II
- Lecture 20 - Mobile numbers, home location, Location-based social networks
- Lecture 21 - Location-based social networks
- Lecture 22 - Privacy laws and regulations - Part I
- Lecture 23 - Privacy laws and regulations - Part II
- Lecture 24 - Privacy standards
- Lecture 25 - Look back

Lecture 1 - Paradigms of Machine Learning

Lecture 2 - Few more examples

Lecture 3 - Types of Learning

Lecture 4 - Types of supervised learning

Lecture 5 - Mathematical tools

Lecture 6 - Three Fundamental spaces

Lecture 7 - Conditional Probability

Lecture 8 - Bayes Theorem

Lecture 9 - Continuous Probability

Lecture 10 - Introduction to vectors

Lecture 11 - Span of vectors

Lecture 12 - Linear Independence

Lecture 13 - Basis of vector space

Lecture 14 - Orthogonality and Projection

Lecture 15 - Introduction to Regression

Lecture 16 - Linear regression

Lecture 17 - Geometrical Interpretation

Lecture 18 - Visual Guide to Orthogonal Projection

Lecture 19 - Iterative solution: Gradient descent

Lecture 20 - Gradient Descent

Lecture 21 - Choosing Step size

Lecture 22 - Taylor Series

Lecture 23 - Stochastic Gradient Descent and basis functions

Lecture 24 - Regularization Techniques

Lecture 25 - Binary Classification

Lecture 26 - K-Nearest Neighbour Classification

Lecture 27 - Distance metric and Cross-Validation

Lecture 28 - Computational efficiency of KNN

Lecture 29 - Introduction to Decision Trees

Lecture 30 - Level splitting

Lecture 31 - Measure of Impurity

[Lecture 32 - Entropy and Information Gain](#)

[Lecture 33 - Generative vs Discriminative models](#)

[Lecture 34 - Naive Bayes classifier](#)

[Lecture 35 - Conditional Independence](#)

[Lecture 36 - Classifying the test point and summary](#)

[Lecture 37 - Discriminative models](#)

[Lecture 38 - Logistic Regression](#)

[Lecture 39 - Summary and big picture](#)

[Lecture 40 - Maximum likelihood estimation](#)

[Lecture 41 - Linear separability](#)

[Lecture 42 - Perceptron and its learning algorithm](#)

[Lecture 43 - Perceptron : A thing of past](#)

[Lecture 44 - Support Vector Machine](#)

[Lecture 45 - Optimizing weights](#)

[Lecture 46 - Handling Outliers](#)

[Lecture 47 - Dual Formulation](#)

[Lecture 48 - Kernel formulation](#)

[Lecture 49 - Introduction to Ensemble methods](#)

[Lecture 50 - Bagging](#)

[Lecture 51 - Bootstrapping](#)

[Lecture 52 - Limitations of bagging](#)

[Lecture 53 - Introduction to boosting](#)

[Lecture 54 - Ada boost](#)

[Lecture 55 - Unsupervised learning](#)

[Lecture 56 - K-means Clustering](#)

[Lecture 57 - Lloyd's Algorithms](#)

[Lecture 58 - Convergence and Initialization](#)

[Lecture 59 - Representation Learning](#)

[Lecture 60 - Orthogonal Projection](#)

[Lecture 61 - Covariance Matrix and Eigen direction](#)

[Lecture 62 - PCA and mean centering](#)

Lecture 1 - Introduction - Part 1, Programming languages and compilers

Lecture 2 - Introduction - Part 2, Language translators

Lecture 3 - Introduction - Part 3, Phases of a compiler

Lecture 4 - Introduction - Part 4, Static vs Dynamic contexts,Parameter passing

Lecture 5 - Lexing - Part 1, Terminology, Regex, flex tool- Part 1

Lecture 6 - Lexing - Part 2, Lexical errors, Input buffering

Lecture 7 - flex tool- Part 2

Lecture 8 - Lexing - Part 3, Lookahead, KMP string matching

Lecture 9 - Lexing - Part 4, Regex to DFA conversion - Part 1

Lecture 10 - Lexing - Part 5, Regex to DFA conversion - Part 2, Prasing - Part 1

Lecture 11 - Parsing - Part 2, CFG, Parse tree, Precedence, Ambiguity

Lecture 12 - flex tool - Part 3

Lecture 13 - Parsing - Part 3, Sentinel forms, Error recovery, if-else ambiguity

Lecture 14 - Parsing - Part 4, Left recursion, Recursive descent parsing

Lecture 15 - Parsing - Part 5, First and Follow, Predictive parsing table

Lecture 16 - Parsing - Part 6, Predictive parsing table, LL(1) grammars

Lecture 17 - Discussions and doubts clarification - Part 1

Lecture 18 - Parsing - Part 6, Bottom-up, Shift-reduce parsing, SLR parsing

Lecture 19 - Parsing - Part 6, LR(0) automaton, SLR parsing using automaton

Lecture 20 - Parsing - Part 7, SLR(1) parsing table, SLR(1) parsing algorithm

Lecture 21 - Parsing - Part 8, Viable prefixes, LR(1) parsing, LR(1) automaton

Lecture 22 - Parsing - Part 9, LALR parsing, SDT- Part 1, attributes

Lecture 23 - Syntax Directed Translation - Part 2, S- and L-attributed SDD

Lecture 24 - Syntax Directed Translation - Part 3, L-attributed SDD, Applications

Lecture 25 - Syntax Directed Translation - Part 4, Actions within productions

Lecture 26 - Discussions and doubts clarification - Part 2

Lecture 27 - Quiz-1 discussion, SDT - Part 5, Code generation for while loop

Lecture 28 - Intermediate Code Generation - Part 1, Syntax trees and DAGs

Lecture 29 - Intermediate Code Generation - Part 2, Three-address code

Lecture 30 - Discussions and doubts clarification Part 3

Lecture 31 - Intermediate Code Generation - Part 3, Static single assignment

- Lecture 32 - Intermediate Code Generation - Part 4, IR for type expressions
- Lecture 33 - Intermediate Code Generation - Part 4, IR for array expressions
- Lecture 34 - Intermediate Code Generation - Part 4, IR for boolean expressions
- Lecture 35 - Intermediate Code Generation - Part 4, IR for break, continue, switch
- Lecture 36 - Code Generator - Part 1, Introduction, IR and target code
- Lecture 37 - Code Generator - Part 2, Instruction selection, ordering
- Lecture 38 - Code Generator - Part 2, Basic blocks and CFG
- Lecture 39 - x86 assembly code
- Lecture 40 - Code optimizer - Part 1, Local optimizations within a basic block
- Lecture 41 - Code optimizer - Part 2, Array references, Peephole optimization
- Lecture 42 - Discussions and doubts clarification - Part 4
- Lecture 43 - Code optimizer - Part 3, Register allocation, Liveness
- Lecture 44 - Code optimizer - Part 4, Register allocation as graph coloring
- Lecture 45 - Discussions and doubts clarification - Part 5
- Lecture 46 - Code optimizer - Part 5, Data flow analysis, Reaching definitions
- Lecture 47 - Discussions and doubts clarification - Part 6
- Lecture 48 - Code optimizer - Part 6, DFA for reaching definitions, Live variables

DIGIMAT - The No.1 Autonomous Learning Platform for Creative Learning

NPTEL : NOC:Applied Accelerated Artificial Intelligence (Computer Science and Engineering)

Co-ordinators : Prof. Satyadhyan Chickerur, Prof. Bharatkumar Sharma, Prof. Adesuyi Tosin, Prof. Satyajit Das

Lecture 1 - Introduction to AI Systems Hardware - Part 1

Lecture 2 - Introduction to AI Systems Hardware - Part 2

Lecture 3 - Introduction to AI Accelerators, GPUs

Lecture 4 - Introduction to Operating Systems, Virtualization, Cloud - Part 1

Lecture 5 - Introduction to Operating Systems, Virtualization, Cloud - Part 2

Lecture 6 - Introduction to Containers and IDE Dockers - Part 1

Lecture 7 - Introduction to Containers and IDE Dockers - Part 2

Lecture 8 - Scheduling and Resource Management - Part 1

Lecture 9 - Scheduling and Resource Management - Part 2

Lecture 10 - DeepOps: Deep Dive into Kubernetes with deployment of various AI based Services - Part 1

Lecture 11 - DeepOps: Deep Dive into Kubernetes with deployment of various AI based Services - Part 2

Lecture 12 - DeepOps: Deep Dive into Kubernetes with deployment of various AI based Services Session II - Part 1

Lecture 13 - DeepOps: Deep Dive into Kubernetes with deployment of various AI based Services Session II - Part 2

Lecture 14 - Design principles for Building High Performance Clusters - Part 1

Lecture 15 - Design principles for Building High Performance Clusters - Part 2

Lecture 16 - Design principles for Building High Performance Clusters - Part 3

Lecture 17 - Design principles for Building High Performance Clusters - Part 4

Lecture 18 - Introduction to Pytorch - Part 1

Lecture 19 - Introduction to Pytorch - Part 2

Lecture 20 - Introduction to Pytorch - Part 3

Lecture 21 - Introduction to Pytorch - Part 4

Lecture 22 - Profiling with DLProf Pytorch Catalyst - Part 1

Lecture 23 - Profiling with DLProf Pytorch Catalyst - Part 2

Lecture 24 - Introduction to TensorFlow - Part 1

Lecture 25 - Introduction to TensorFlow - Part 2

Lecture 26 - Accelerated TensorFlow - Part 1

Lecture 27 - Accelerated TensorFlow - Part 2

Lecture 28 - Accelerated TensorFlow - XLA Approach - Part 1

Lecture 29 - Accelerated TensorFlow - XLA Approach - Part 2

Lecture 30 - Optimizing Deep learning Training: Automatic Mixed Precision - Part 1

Lecture 31 - Optimizing Deep learning Training: Automatic Mixed Precision - Part 2

HTML Links for 108,400+ NPTEL Video Lectures, Created by LinuXpert Systems, Chennai

- Lecture 32 - Optimizing Deep learning Training: Transfer Learning - Part 1
- Lecture 33 - Optimizing Deep learning Training: Transfer Learning - Part 2
- Lecture 34 - Fundamentals of Distributed AI Computing Session 1 - Part 1
- Lecture 35 - Fundamentals of Distributed AI Computing Session 1 - Part 2
- Lecture 36 - Fundamentals of Distributed AI Computing Session 2 - Part 1
- Lecture 37 - Fundamentals of Distributed AI Computing Session 2 - Part 2
- Lecture 38 - Distributed Deep Learning using Tensorflow and Horovod
- Lecture 39 - Challenges with Distributed Deep Learning Training Convergence
- Lecture 40 - Fundamentals of Accelerating Deployment - Part 1
- Lecture 41 - Fundamentals of Accelerating Deployment - Part 2
- Lecture 42 - Accelerating neural network inference in PyTorch and TensorFlow - Part 1
- Lecture 43 - Accelerating neural network inference in PyTorch and TensorFlow - Part 2
- Lecture 44 - Accelerated Data Analytics - Part 1
- Lecture 45 - Accelerated Data Analytics - Part 2
- Lecture 46 - Accelerated Data Analytics - Part 3
- Lecture 47 - Accelerated Data Analytics - Part 4
- Lecture 48 - Accelerated Machine Learning
- Lecture 49 - Scale Out with DASK
- Lecture 50 - Web visualizations to GPU accelerated crossfiltering - Part 1
- Lecture 51 - Web visualizations to GPU accelerated crossfiltering - Part 2
- Lecture 52 - Accelerated ETL Pipeline with SPARK - Part 1
- Lecture 53 - Accelerated ETL Pipeline with SPARK - Part 2
- Lecture 54 - Applied AI: Smart City (Intelligent Video Analytics) Session 1 - Part 1
- Lecture 55 - Applied AI: Smart City (Intelligent Video Analytics) Session 1 - Part 2
- Lecture 56 - Applied AI: Smart City (Intelligent Video Analytics) Session 2 Deepstream - Part 1
- Lecture 57 - Applied AI: Smart City (Intelligent Video Analytics) Session 2 Deepstream - Part 2
- Lecture 58 - Applied AI: Health care Session I - Part 1
- Lecture 59 - Applied AI: Health care Session I - Part 2
- Lecture 60 - Applied AI: Health care Session II - Part 1
- Lecture 61 - Applied AI: Health care Session II - Part 2

Lecture 1 - Chapter 1 Lectuer 1

Lecture 2 - Chapter 1 Lectuer 2

Lecture 3 - Chapter 1 Lectuer 3

Lecture 4 - Tutorial 1: Introduction to Python/Colab

Lecture 5 - Tutorial 2: Introduction to NetworkX - Part I

Lecture 6 - Chapter 2 Lectuer 1

Lecture 7 - Chapter 2 Lectuer 2

Lecture 8 - Chapter 2 Lectuer 3

Lecture 9 - Chapter 2 Lectuer 4

Lecture 10 - Chapter 2 Lectuer 5

Lecture 11 - Chapter 2 Lectuer 6

Lecture 12 - Tutorial 3: Introduction to NetworkX - Part II

Lecture 13 - Chapter 3 Lectuer 1

Lecture 14 - Chapter 3 Lectuer 2

Lecture 15 - Chapter 3 Lectuer 3

Lecture 16 - Chapter 3 Lectuer 4

Lecture 17 - Chapter 3 Lectuer 5

Lecture 18 - Chapter 3 Lectuer 6

Lecture 19 - Chapter 3 Lectuer 7

Lecture 20 - Chapter 4 Lectuer 1

Lecture 21 - Chapter 4 Lectuer 2

Lecture 22 - Chapter 4 Lectuer 3

Lecture 23 - Chapter 4 Lectuer 4

Lecture 24 - Chapter 4 Lectuer 5

Lecture 25 - Chapter 4 Lectuer 6

Lecture 26 - Tutorial 4

Lecture 27 - Chapter 5 Lectuer 1

Lecture 28 - Chapter 5 Lectuer 2

Lecture 29 - Chapter 5 Lectuer 3

Lecture 30 - Chapter 5 Lectuer 4

Lecture 31 - Chapter 5 Lectuer 5

Lecture 32 - Chapter 5 Lectuer 6
Lecture 33 - Chapter 5 Lectuer 7
Lecture 34 - Chapter 5 Lectuer 8
Lecture 35 - Chapter 5 Lectuer 9
Lecture 36 - Chapter 5 Lectuer 10
Lecture 37 - Chapter 6 Lectuer 1
Lecture 38 - Chapter 6 Lectuer 2
Lecture 39 - Chapter 6 Lectuer 3
Lecture 40 - Chapter 6 Lectuer 4
Lecture 41 - Chapter 6 Lectuer 5
Lecture 42 - Chapter 7 Lectuer 1
Lecture 43 - Chapter 7 Lectuer 2
Lecture 44 - Chapter 7 Lectuer 3
Lecture 45 - Chapter 7 Lectuer 4
Lecture 46 - Chapter 7 Lectuer 5
Lecture 47 - Chapter 7 Lectuer 6
Lecture 48 - Chapter 7 Lectuer 7
Lecture 49 - Chapter 7 Lectuer 8
Lecture 50 - chapter 8 Lectuer 1
Lecture 51 - chapter 8 Lectuer 2
Lecture 52 - Chapter 8 Lectuer 3
Lecture 53 - Chapter 8 Lectuer 4
Lecture 54 - Chapter 8 Lectuer 5
Lecture 55 - Chapter 8 Lectuer 6
Lecture 56 - Chapter 9 Lectuer 1
Lecture 57 - Chapter 9 Lectuer 2
Lecture 58 - Chapter 9 Lectuer 3
Lecture 59 - Chapter 9 Lectuer 4
Lecture 60 - Chapter 9 Lectuer 5
Lecture 61 - Chapter 9 Lectuer 6
Lecture 62 - Chapter 9 Lectuer 7
Lecture 63 - Chapter 9 Lectuer 8
Lecture 64 - Chapter 9 Lectuer 9

[Lecture 65 - Chapter 9 Lectuer 10](#)

[Lecture 66 - Chapter 9 Lectuer 11](#)

[Lecture 67 - Tutorial 5](#)

[Lecture 68 - Chapter 10 Lectuer 1](#)

[Lecture 69 - Chapter 10 Lectuer 2](#)

[Lecture 70 - Chapter 10 Lectuer 3](#)

[Lecture 71 - Chapter 10 Lectuer 4](#)

[Lecture 72 - Chapter 10 Lectuer 5](#)

[Lecture 73 - Conclusion - Panel discussion](#)

[Lecture 74 - Conclusion](#)

- Lecture 1 - Quantum Algorithms and Cryptography
- Lecture 2 - Basics of Quantum Information - Part 1
- Lecture 3 - Basics of Quantum Information - Part 2
- Lecture 4 - Computation and No-Cloning - Part 1
- Lecture 5 - Computation and No-Cloning - Part 2
- Lecture 6 - Computation and No-Cloning - Part 3
- Lecture 7 - Going beyond classical - Part 1
- Lecture 8 - Going beyond classical - Part 2
- Lecture 9 - Going beyond classical - Part 3
- Lecture 10 - Going beyond classical- Deutsch and Deutsch-Jozsa - Part 1
- Lecture 11 - Going beyond classical- Deutsch and Deutsch-Jozsa - Part 2
- Lecture 12 - Simon's and Bernstein's Vazirani Algorithm - Part 1
- Lecture 13 - Simon's and Bernstein's Vazirani Algorithm - Part 2
- Lecture 14 - Introduction to Cryptography - Part 1
- Lecture 15 - Introduction to Cryptography - Part 2
- Lecture 16 - Introduction to Cryptography - Part 3
- Lecture 17 - Building Cryptography - Part 1
- Lecture 18 - Building Cryptography - Part 2
- Lecture 19 - Building Cryptography - Part 3
- Lecture 20 - Building Cryptography - Part 4
- Lecture 21 - Building Cryptography - Part 5
- Lecture 22 - Building Public Key Encryption - Part 1
- Lecture 23 - Building Public Key Encryption - Part 2
- Lecture 24 - RSA Encryption - Part 1
- Lecture 25 - RSA Encryption - Part 2
- Lecture 26 - Finishing RSA, Fourier Transform - Part 1
- Lecture 27 - Finishing RSA, Fourier Transform - Part 2
- Lecture 28 - Finishing RSA, Fourier Transform - Part 3
- Lecture 29 - Grover's Algorithm - Part 1
- Lecture 30 - Grover's Algorithm - Part 2
- Lecture 31 - Grover's Algorithm - Part 3

- Lecture 32 - Simon's Algorithm over Z_n - Part 1
- Lecture 33 - Simon's Algorithm over Z_n - Part 2
- Lecture 34 - Simon's Algorithm over Z_n - Part 3
- Lecture 35 - Simon's Algorithm over Z_n - Part 4
- Lecture 36 - Simon's Algorithm over Z_n - Part 5
- Lecture 37 - Simon's Algorithm over Z_n - Part 6
- Lecture 38 - Shor's Algorithm - Part 1
- Lecture 39 - Shor's Algorithm - Part 2
- Lecture 40 - Hidden Subgroup Problem - Part 1
- Lecture 41 - Hidden Subgroup Problem - Part 2
- Lecture 42 - Introduction to Lattices - Part 1
- Lecture 43 - Introduction to Lattices - Part 2
- Lecture 44 - Public Key Encryption from LWE - Part 1
- Lecture 45 - Public Key Encryption from LWE - Part 2
- Lecture 46 - Public Key Encryption from LWE - Part 3
- Lecture 47 - Fully Homomorphic Encryption - Part 1
- Lecture 48 - Fully Homomorphic Encryption - Part 2
- Lecture 49 - Fully Homomorphic Encryption - Part 3
- Lecture 50 - Quantum Cryptography - Part 1
- Lecture 51 - Quantum Cryptography - Part 2
- Lecture 52 - Quantum Cryptography - Part 3
- Lecture 53 - Quantum Cryptography - Part 4
- Lecture 54 - Quantum Cryptography - Part 5
- Lecture 55 - Quantum PKE and FHE - Part 1
- Lecture 56 - Quantum PKE and FHE - Part 2
- Lecture 57 - Quantum PKE and FHE - Part 3
- Lecture 58 - Quantum PKE and FHE - Part 4
- Lecture 59 - Quantum PKE and FHE - Part 5

Lecture 1 - An Introduction to The Theory of Computation

Lecture 2 - Notations and Terminology in Theory of Computation

Lecture 3 - An Introduction to Finite Automata and Regular Languages - Part 1

Lecture 4 - An Introduction to Finite Automata and Regular Languages - Part 2

Lecture 5 - Significance of Regular Languages and Regular Operations

Lecture 6 - Closure Properties of Regular Languages Under Union, Concatenation and Kleene Star Operation - Part 1

Lecture 7 - Closure Properties of Regular Languages Under Union, Concatenation and Kleene Star Operation - Part 2

Lecture 8 - An Introduction to Non-Deterministic Finite Automata (NFA)

Lecture 9 - Formal Definitions and Examples of Non-Deterministic Finite Automata (NFA)

Lecture 10 - Equivalence of NFA and DFA

Lecture 11 - Closure of Regular Languages Under Regular Operations (Using NFA)

Lecture 12 - Regular Expressions - Part 1

Lecture 13 - Regular Expressions - Part 2

Lecture 14 - Proving Equivalence of Regular Expression and DFA Through a GNFA

Lecture 15 - Pumping Lemma for Regular Languages - Part 1

Lecture 16 - Pumping Lemma for Regular Languages - Part 2

Lecture 17 - Distinguishability of Strings and Myhill-Nerode Theorem

Lecture 18 - Proving the Myhill-Nerode Theorem

Lecture 19 - An Introduction to Context-Free Languages - Part 1

Lecture 20 - An Introduction to Context-Free Languages - Part 2

Lecture 21 - Chomsky Normal Form

Lecture 22 - CYK Algorithm - Part 1

Lecture 23 - CYK Algorithm - Part 2 (Example)

Lecture 24 - Closure Properties of Context Free Languages

Lecture 25 - An Introduction to Push Down Automata

Lecture 26 - Normalizations in PDA and Intersection of Regular Language and CFL

Lecture 27 - Equivalence of Context Free Grammars and Push Down Automata - Part 1

Lecture 28 - Equivalence of Context Free Grammars and Push Down Automata - Part 2

Lecture 29 - Equivalence of Context Free Grammars and Push Down Automata - Part 3

Lecture 30 - Pumping Lemma for Context Free Languages

Lecture 31 - Examples of Pumping Lemma Usage for Context Free Languages

- Lecture 32 - Formal Definition of a Turing Machine
- Lecture 33 - Turing Recognizable and Decidable Languages and TM Examples
- Lecture 34 - Multitape Turing Machine
- Lecture 35 - Non-Deterministic Turing Machines
- Lecture 36 - Equivalence of Deterministic and Nondeterministic TM
- Lecture 37 - Church-Turing Thesis
- Lecture 38 - Decidable Problems Concerning Regular Languages
- Lecture 39 - Decidable Problems Concerning Context Free Languages
- Lecture 40 - Countability of Sets
- Lecture 41 - Proof of Existence of Undecidable Languages
- Lecture 42 - Halting Problem
- Lecture 43 - Co-Turing Recognizability
- Lecture 44 - An Introduction to Mapping Reducibility
- Lecture 45 - Examples of Proving Undecidability Using Reductions
- Lecture 46 - Rice Theorem
- Lecture 47 - Computation Histories
- Lecture 48 - The Post Correspondence Problem
- Lecture 49 - Checking Ambiguity in CFG is Undecidable
- Lecture 50 - Time Complexity - Part 1
- Lecture 51 - Time Complexity - Part 2
- Lecture 52 - Non-Deterministic Polynomial Time - Part 1
- Lecture 53 - Non-Deterministic Polynomial Time - Part 2
- Lecture 54 - Verifiability and NP
- Lecture 55 - Polynomial Time Reductions - Part 1
- Lecture 56 - Polynomial Time Reductions - Part 2
- Lecture 57 - NP-Completeness
- Lecture 58 - Cook-Levin Theorem
- Lecture 59 - Cook-Levin Theorem - Proof and Implications
- Lecture 60 - CLIQUE and VERTEX-COVER is NP-Complete
- Lecture 61 - HAM-PATH is NP-Complete
- Lecture 62 - SUBSET-SUM is NP-Complete
- Lecture 63 - Knapsack Problem
- Lecture 64 - Integer Linear Program is NP-Complete

[Lecture 65 - Space Complexity and its Complexity Classes](#)

[Lecture 66 - Logspace Reductions and NL-Completeness](#)

[Lecture 67 - Savitch's theorem](#)

[Lecture 68 - Results in Space Complexity](#)

[Lecture 69 - Summary and Concluding Remarks](#)

Lecture 1 - An Introduction to High Performance Switching and Routing - Part 1

Lecture 2 - An Introduction to High Performance Switching and Routing - Part 2

Lecture 3 - IP Table Lookup - Part 1

Lecture 4 - IP Table Lookup - Part 2

Lecture 5 - IP Table Lookup: Trie Based Data Structures - Part 1

Lecture 6 - IP Table Lookup: Trie Based Data Structures - Part 2

Lecture 7 - IP Table Lookup: Optimized Trie based Data Structures - Part 1

Lecture 8 - IP Table Lookup: Optimized Trie based Data Structures - Part 2

Lecture 9 - Packet Classification - Part 1

Lecture 10 - Packet Classification - Part 2

Lecture 11 - Packet Classification - Part 3

Lecture 12 - Packet Classification Implementation - Part 1

Lecture 13 - Packet Classification Implementation - Part 2

Lecture 14 - Traffic Management - Part 1

Lecture 15 - Traffic Management - Part 2

Lecture 16 - Traffic Management - Part 3

Lecture 17 - Traffic Management - Part 4

Lecture 18 - Traffic Management - Part 5

Lecture 19 - Traffic Management - Part 6

Lecture 20 - Traffic Management - Part 7

Lecture 21 - Packet Switching Fabric Design - Part 1

Lecture 22 - Packet Switching Fabric Design - Part 2

Lecture 23 - Introduction to Network Softwarization

Lecture 24 - Internet Impasse and Network Ossification

Lecture 25 - Network Ossification

Lecture 26 - Network Virtualization - Part 1

Lecture 27 - Network Virtualization - Part 2

Lecture 28 - Road to SDN

Lecture 29 - Active Networks

Lecture 30 - Data and Control Plane Separation

Lecture 31 - Control Plane Abstractions

- Lecture 32 - Software Defined Networking - I
- Lecture 33 - Software Defined Networking - II
- Lecture 34 - Software Defined Networking - III
- Lecture 35 - OpenFlow
- Lecture 36 - SND Prospects and Challenges
- Lecture 37 - Introduction to Network Function Virtualization - I
- Lecture 38 - Introduction to Network Function Virtualization - II
- Lecture 39 - Network Function Virtualization - Concepts, Framework and Architecture - I
- Lecture 40 - Network Function Virtualization - Concepts, Framework and Architecture - II
- Lecture 41 - Network Function Virtualization - Road ahead and Key challenges
- Lecture 42 - High Performance Network Packet Processing
- Lecture 43 - Summary and Comparison of NFV and SDN
- Lecture 44 - Programmable Networks - Data Plane Programmability - Overview I
- Lecture 45 - Programmable Networks - Data Plane Programmability - Overview II
- Lecture 46 - Reconfigurable Match Action Tables
- Lecture 47 - P4 Programming
- Lecture 48 - Data Center Networking - Introduction - Part 1
- Lecture 49 - Data Center Networking - Introduction - Part 2
- Lecture 50 - Data Center Networking - Characteristics and Challenges
- Lecture 51 - Data Center Networking - Topologies and Architecture - Part 1
- Lecture 52 - Data Center Networking - Topologies and Architecture - Part 2
- Lecture 53 - Data Center Networking - Protocol Innovations - Part 1
- Lecture 54 - Data Center Networking - Protocol Innovations - Part 2
- Lecture 55 - Network Telemetry
- Lecture 56 - Serverless Computing - Part 1
- Lecture 57 - Serverless Computing - Part 2
- Lecture 58 - SmartNICs and In-band Network Telemetry, Future of Network Softwarization, SDN 3.0
- Lecture 59 - QUIC
- Lecture 60 - Green and Sustainable Data Centers
- Lecture 61 - Content Distribution in IP Networks - Part 1
- Lecture 62 - Content Distribution in IP Networks - Part 2
- Lecture 63 - Information Centric Networking - Part 1
- Lecture 64 - Information Centric Networking - Part 2

[Lecture 65 - Information Centric Networking - Part 3](#)

[Lecture 66 - Named Data Networking - Part 1](#)

[Lecture 67 - Named Data Networking - Part 2](#)

- Lecture 1 - Fundamentals of Affective computing
- Lecture 2 - Fundamentals of Affective computing Applications
- Lecture 3 - Emotion Psychology
- Lecture 4 - Emotion Theory
- Lecture 5 - Brain and Asymmetry
- Lecture 6 - Emotional Design
- Lecture 7 - Affect Elicitation
- Lecture 8 - Experimental Methodology
- Lecture 9 - Tutorial
- Lecture 10 - Introduction to Facial Expression Recognition
- Lecture 11 - Facial Feature Extraction
- Lecture 12 - Group Level Emotion
- Lecture 13 - Applications of Facial Expression Recognition
- Lecture 14 - Tutorial
- Lecture 15 - Tutorial
- Lecture 16
- Lecture 17
- Lecture 18
- Lecture 19
- Lecture 20 - Tutorial
- Lecture 21 - Emotions in Physiological Signals
- Lecture 22 - Tutorial
- Lecture 23 - Emotions via Skin Conductance
- Lecture 24 - Emotions Via EEG
- Lecture 25 - Multimodal Affect Recognition
- Lecture 26 - Multimodal Analysis
- Lecture 27 - MM Tutorial
- Lecture 28 - Tutorial
- Lecture 29
- Lecture 30
- Lecture 31

[Lecture 32 - Emotionally Intelligent Machines - Part 1](#)

[Lecture 33 - Emotionally Intelligent Machines - Part 2](#)

[Lecture 34 - Case Study](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37 - Ethics in Affective Computing - 1](#)

[Lecture 38 - Ethics in Affective Computing - 2](#)

[Lecture 39 - Course Finale](#)

Lecture 1 - Basics of Linear Algebra: Linear Independence

Lecture 2 - Linear Algebra: Rank of a matrix

Lecture 3 - Linear Algebra - Subspaces of a matrix - 1

Lecture 4 - Linear Algebra - Subspaces of a matrix - 2

Lecture 5 - Linear Algebra - Null space

Lecture 6 - Linear Algebra - Eigen Vectors/Values of a matrix - 1

Lecture 7 - Linear Algebra - Eigen Vectors/Values of a matrix - 2

Lecture 8 - Programming Eigen Decomposition using Python

Lecture 9 - Singular Value Decomposition - 1

Lecture 10 - Singular Value Decomposition - 2

Lecture 11 - Principal Component Analysis - 1

Lecture 12 - Principal Component Analysis - 2

Lecture 13 - Principal Component Analysis - 3

Lecture 14 - Principal Component Analysis - Coding

Lecture 15 - Machine Learning - Overview

Lecture 16 - Optimisation Problems

Lecture 17 - Gradient of a Vector Valued Function - 1

Lecture 18 - Gradient of a Vector Valued Function - 2

Lecture 19 - Neural Netowrks - Overview

Lecture 20 - Neural Netowrks - Backpropagation

Lecture 21 - Optimisation - Introduction to optimisation problems

Lecture 22 - Optimisation - Relaxation and approximate convergence

Lecture 23 - Optimisation - First Order Optimality Condition

Lecture 24 - Optimisation - Second Order Optimality Condition

Lecture 25 - Proof of Second Order Optimality Condition, Gradient Methods

Lecture 26 - Gradient Descent - 2

Lecture 27 - Variants of Gradient Descent - 1

Lecture 28 - Variants of Gradient Descent - 2

Lecture 29 - Variants of Gradient Descent - 3

Lecture 30 - Convex Sets

Lecture 31 - Convex Functions

[Lecture 32 - Duality and Lagrangian - Part 1](#)

[Lecture 33 - Duality and Lagrangian - Part 2](#)

[Lecture 34 - Duality and Lagrangian - Part 3](#)

[Lecture 35 - Coding: Introduction to Pytorch](#)

[Lecture 36 - Guest Lectuer: Support Vector Machine](#)

Lecture 1 - Introduction to AI/ML/DS

Lecture 2 - Introduction to Probability; Introduction to machine learning - Part 1

Lecture 3 - Introduction to Probability; Introduction to machine learning - Part 2

Lecture 4 - Introduction to Probability; Introduction to machine learning - Part 3

Lecture 5 - Introduction to Probability; Introduction to machine learning - Part 4

Lecture 6 - Python for AI/ML/DS - Part 1

Lecture 7 - Python for AI/ML/DS - Part 2

Lecture 8 - Descriptive statistics and Inferential statistics - Part 1

Lecture 9 - Descriptive statistics and Inferential statistics - Part 2

Lecture 10 - Descriptive statistics and Inferential statistics - Part 3

Lecture 11 - Descriptive statistics and Inferential statistics - Part 4

Lecture 12 - Descriptive statistics and Inferential statistics - Part 5

Lecture 13 - Distribution, Data visualization, Plotting libraries - Part 1

Lecture 14 - Distribution, Data visualization, Plotting libraries - Part 2

Lecture 15 - Distribution, Data visualization, Plotting libraries - Part 3

Lecture 16 - Linear Algebra for Data science

Lecture 17 - Identification of linear relationship among attributes

Lecture 18 - Solving Linear Equations - 1

Lecture 19 - Solving Linear Equations - 2

Lecture 20 - Linear Algebra - Distance, Hyperplanes and Halfspaces, Eigenvalues, Eigenvectors - Part 1

Lecture 21 - Linear Algebra - Distance, Hyperplanes and Halfspaces, Eigenvalues, Eigenvectors - Part 2

Lecture 22 - Linear Algebra - Part 1

Lecture 23 - Linear Algebra - Part 2

Lecture 24 - Linear Algebra - Part 3

Lecture 25 - Regression Models, Models Selection and Evaluation - Part 1

Lecture 26 - Regression Models, Models Selection and Evaluation - Part 2

Lecture 27 - Regression Models, Models Selection and Evaluation - Part 3

Lecture 28 - Regression Models, Models Selection and Evaluation - Part 4

Lecture 29 - Regression - Part 1

Lecture 30 - Regression - Part 2

Lecture 31 - Regression - Part 3

[Lecture 32 - Classification Naive Bayes, Logistic Regression, K-NN - Part 1](#)

[Lecture 33 - Classification Naive Bayes, Logistic Regression, K-NN - Part 2](#)

[Lecture 34 - Classification Naive Bayes, Logistic Regression, K-NN - Part 3](#)

[Lecture 35 - Classification Naive Bayes, Logistic Regression, K-NN - Part 4](#)

[Lecture 36 - Classification - Part 1](#)

[Lecture 37 - Classification - Part 2](#)

[Lecture 38 - Classification - Part 3](#)

[Lecture 39 - Linear Models for Classification - Part 1](#)

[Lecture 40 - Linear Models for Classification - Part 2](#)

[Lecture 41 - Kernel Machines](#)

[Lecture 42 - Solving Langrange Dual in SVM](#)

[Lecture 43 - Classification and SVM - Part 1](#)

[Lecture 44 - Classification and SVM - Part 2](#)

[Lecture 45 - Tree - Based methods, Boosting bagging - Part 1](#)

[Lecture 46 - Tree - Based methods, Boosting bagging - Part 2](#)

[Lecture 47 - Tree - Based methods, Boosting bagging - Part 3](#)

[Lecture 48 - Tree - Based methods, Boosting bagging - Part 4](#)

[Lecture 49 - Tree-based approaches for regression and classification - Part 1](#)

[Lecture 50 - Tree-based approaches for regression and classification - Part 2](#)

[Lecture 51 - Supervised Learning Using K Nearest Neighbors - Part 1](#)

[Lecture 52 - Supervised Learning Using K Nearest Neighbors - Part 2](#)

[Lecture 53 - Supervised Learning Using K Nearest Neighbors - Part 3](#)

[Lecture 54 - Supervised Learning Using K Nearest Neighbors - Part 4](#)

[Lecture 55 - Clustering methods - Part 1](#)

[Lecture 56 - Clustering methods - Part 2](#)

[Lecture 57 - Induction to Neural Networks, Perceptrons, Multilayer Perceptrons, Feedforward Neural Networks - Part 1](#)

[Lecture 58 - Induction to Neural Networks, Perceptrons, Multilayer Perceptrons, Feedforward Neural Networks - Part 2](#)

[Lecture 59 - Induction to Neural Networks, Perceptrons, Multilayer Perceptrons, Feedforward Neural Networks - Part 3](#)

[Lecture 60 - Induction to Neural Networks, Perceptrons, Multilayer Perceptrons, Feedforward Neural Networks - Part 4](#)

[Lecture 61 - Neural Networks and Feedforward NN - Part 1](#)

[Lecture 62 - Neural Networks and Feedforward NN - Part 2](#)

[Lecture 63 - Neural Networks and Feedforward NN - Part 3](#)

[Lecture 64 - Backpropagation \(Intuition\)](#)

[Lecture 65 - Backpropagation: Computing Gradients w.r.t the Output Units](#)

[Lecture 66 - Learning Parameters: Gradient Descent](#)

[Lecture 67 - Contours](#)

[Lecture 68 - Nesterov Accelerated Gradient Descent](#)

[Lecture 69 - Stochastic and Mini-Batch Gradient Descent](#)

[Lecture 70 - Tips for Adjusting learning Rate and Momentum](#)

[Lecture 71 - Line Search](#)

[Lecture 72 - The convolution operation](#)

[Lecture 73 - Convolutional Neural Networks](#)

[Lecture 74 - CNN and DL models - Part 1](#)

[Lecture 75 - CNN and DL models - Part 2](#)

[Lecture 76 - CNN and DL models - Part 3](#)

[Lecture 77 - CNN and DL models - Part 4](#)

[Lecture 78 - AI/ML/DS Industry Use Cases - Part 1](#)

[Lecture 79 - AI/ML/DS Industry Use Cases - Part 2](#)

[Lecture 80 - AI/ML - Case Studies in Industry - Part 1](#)

[Lecture 81 - AI/ML - Case Studies in Industry - Part 2](#)

[Lecture 82 - Q and A on career in research a woman faculty representative from PSGTech and RBCDSAI](#)

Lecture 1 - Introduction to Machine Learning

Lecture 2 - Linear Algebra: Review (Vector Spaces)

Lecture 3 - Linear Algebra: Review (Matrices)

Lecture 4 - Probability Theory: Review (Basics of Probability)

Lecture 5 - Probability Theory: Review (Random Variables)

Lecture 6 - Linear Regression

Lecture 7 - Linear Regression

Lecture 8 - Tutorial: Linear Regression

Lecture 9 - Linear Regression

Lecture 10 - Linear Kernel Regression

Lecture 11 - k-Nearest Neighbour (k-NN) Regression

Lecture 12 - Tutorial: k-NN Regression

Lecture 13 - Tutorial: Kernel Regression

Lecture 14 - Logistic Regression: Classification Evaluation Metrics

Lecture 15 - Logistic Regression

Lecture 16 - Logistic Regression: Examples

Lecture 17 - Tutorial: Logistic Regression

Lecture 18 - Neural Networks

Lecture 19 - Neural Networks

Lecture 20 - Neural Networks: Examples

Lecture 21 - Tutorial: Neural Networks

Lecture 22 - Practical Machine Learning - Part 1

Lecture 23 - Practical Machine Learning - Part 2

Lecture 24 - Practical Machine Learning - Part 3

Lecture 25 - Practical Machine Learning - Part 4

Lecture 26 - Support Vector Machines (SVM)

Lecture 27 - Tutorial: Support Vector Machines (SVM)

Lecture 28 - Kernel Support Vector Machines (k-SVM)

Lecture 29 - Naïve Bayes Classification

Lecture 30 - Decision Trees - Part 1

Lecture 31 - Decision Trees - Part 2

[Lecture 32 - Tutorial: Naive Bayes Classification](#)

[Lecture 33 - Tutorial: Decision Trees](#)

[Lecture 34 - k-NN Classifier](#)

[Lecture 35 - Ensemble Learning](#)

[Lecture 36 - Random Forests](#)

[Lecture 37 - Bagging \(Bootstrap AGGregatING\)](#)

[Lecture 38 - Tutorial: Random Forests](#)

[Lecture 39 - Tutorial: k-NN Classifier and Bootstrap AGGregatING \(Bagging\)](#)

[Lecture 40 - Boosting](#)

[Lecture 41 - Clustering](#)

[Lecture 42 - k-means Clustering](#)

[Lecture 43 - Tutorial: Boosting](#)

[Lecture 44 - Spectral Clustering](#)

[Lecture 45 - Mixture of Models \(Gaussian Mixture Models-GMM\)](#)

[Lecture 46 - Dimensionality Reduction: Principal Component Analysis \(PCA\) and kernel PCA](#)

[Lecture 47 - Tutorial: k-means and Spectral Clustering](#)

[Lecture 48 - Tutorial: Principal Component Analysis \(PCA\) and Gaussian Mixture Models \(GMM\)](#)

[Lecture 49 - Introduction to Deep Learning \(DL\)](#)

[Lecture 50 - Convolutional Neural Networks \(CNN\) - Part A](#)

[Lecture 51 - Convolutional Neural Networks \(CNN\) - Part B](#)

[Lecture 52 - Autoencoders](#)

[Lecture 53 - Applications of ML in Healthcare Problems - Part 1](#)

[Lecture 54 - Applications of ML in Healthcare Problems - Part 2](#)

[Lecture 55 - Tutorial: CNN and Autoencoder](#)

Lecture 1 - Introduction - Part 1

Lecture 2 - Introduction - Part 2

Lecture 3 - Introduction - Part 3

Lecture 4 - Foundations - Part 1

Lecture 5 - Foundations - Part 2

Lecture 6 - Foundations - Part 3

Lecture 7 - Security management, GRC - Part 1

Lecture 8 - Security management, GRC - Part 2

Lecture 9 - Security management, GRC - Part 3

Lecture 10 - Contingency planning - Part 1

Lecture 11 - Contingency Planning - Part 2

Lecture 12 - Contingency Planning - Part 3

Lecture 13 - Cybersecurity policy - Part 1

Lecture 14 - Cybersecurity policy - Part 2

Lecture 15 - Cybersecurity policy - Part 3

Lecture 16 - Risk Management - Part 1

Lecture 17 - Risk Management - Part 2

Lecture 18 - Risk Management - Part 3

Lecture 19 - Cybersecurity: Industry perspective - Part 1

Lecture 20 - Cybersecurity: Industry perspective - Part 2

Lecture 21 - Cybersecurity: Industry perspective - Part 3

Lecture 22 - Cyber security technologies - Part 1

Lecture 23 - Cyber security technologies - Part 2

Lecture 24 - Cyber security technologies - Part 3

Lecture 25 - Foundations of privacy - Part 1

Lecture 26 - Foundations of privacy - Part 2

Lecture 27 - Foundations of privacy - Part 3

Lecture 28 - Privacy regulation - Part 1

Lecture 29 - Privacy regulation - Part 2

Lecture 30 - Privacy regulation - Part 3

Lecture 31 - Privacy regulation in Europe - Part 1

[Lecture 32 - Privacy regulation in Europe - Part 2](#)

[Lecture 33 - Privacy regulation in Europe - Part 3](#)

[Lecture 34 - Privacy: The Indian Way - Part 1](#)

[Lecture 35 - Privacy: The Indian Way - Part 2](#)

[Lecture 36 - Privacy: The Indian Way - Part 3](#)

[Lecture 37 - Information privacy: Economics and strategy - Part 1](#)

[Lecture 38 - Information privacy: Economics and strategy - Part 2](#)

[Lecture 39 - Information privacy: Economics and strategy - Part 3](#)

[Lecture 40 - Privacy: Strategy and safety - Part 1](#)

[Lecture 41 - Privacy: Strategy and safety - Part 2](#)

[Lecture 42 - Privacy: Strategy and safety - Part 3](#)

Lecture 1 - Introduction Caesar cipher

Lecture 2 - Modular arithmetic, shift cipher

Lecture 3 - Affine Cipher, Vigenere Cipher

Lecture 4 - Perfect secrecy, Application of Shift Cipher

Lecture 5 - Problem Discussion on Affine cipher and Perfect Secrecy

Lecture 6 - Product Cipher, Block Cipher, Modes of Operation for Block Cipher

Lecture 7 - Substitution Permutation network, Feistel Cipher

Lecture 8 - S-Box Theory

Lecture 9 - Cryptanalysis and its Variants, Linear Attack

Lecture 10 - Problem Discussion

Lecture 11 - Public Key Cryptology Introduction RSA Cryptosystem

Lecture 12 - Complexity analysis of Euclidian Algorithm and RSA Cryptosystem square and multiply algorithm

Lecture 13 - Primality testing: Miller-Rabin Algorithm, Legendre Symbol and Jacobi Symbol

Lecture 14 - Efficient Computation of Jacobi Symbol Primality Testing: Solovay-Strassen Algorithm

Lecture 15 - Problem Discussion on Jacobi Symbol Calculation and RSA Cryptosystem

Lecture 16 - Cryptographic hash function: Introduction

Lecture 17 - Random Oracle model, Security of hash functions

Lecture 18 - Randomized Algorithm and its application on Preimage resistance and collision resistance

Lecture 19 - Iterated Hash Functions

Lecture 20 - Problem Discussion

- Lecture 1 - Introduction to data analytics
- Lecture 2 - Python Fundamentals - I
- Lecture 3 - Python Fundamentals - II
- Lecture 4 - Central Tendency and Dispersion - I
- Lecture 5 - Central Tendency and Dispersion - II
- Lecture 6 - Introduction to Probability - I
- Lecture 7 - Introduction to Probability - II
- Lecture 8 - Probability Distributions - I
- Lecture 9 - Probability Distributions - II
- Lecture 10 - Probability Distributions - III
- Lecture 11 - Python Demo for Distributions
- Lecture 12 - Sampling and Sampling Distribution
- Lecture 13 - Distribution of Sample Means, population, and variance
- Lecture 14 - Confidence interval estimation: Single population - I
- Lecture 15 - Confidence interval estimation: Single population - II
- Lecture 16 - Hypothesis Testing - I
- Lecture 17 - Hypothesis Testing - II
- Lecture 18 - Hypothesis Testing - III
- Lecture 19 - Errors in Hypothesis Testing
- Lecture 20 - Hypothesis Testing: Two sample test - I
- Lecture 21 - Hypothesis Testing: Two sample test - II
- Lecture 22 - Hypothesis Testing: Two sample test - III
- Lecture 23 - ANOVA - I
- Lecture 24 - ANOVA - II
- Lecture 25 - Post Hoc Analysis (Tukey's test)
- Lecture 26 - Randomize block design (RBD)
- Lecture 27 - Two Way ANOVA
- Lecture 28 - Linear Regression - I
- Lecture 29 - Linear Regression - II
- Lecture 30 - Linear Regression - III
- Lecture 31 - Estimation, Prediction of Regression Model Residual Analysis - I

[Lecture 32 - Estimation, Prediction of Regression Model Residual Analysis - II](#)

[Lecture 33 - Multiple Regression Model - I](#)

[Lecture 34 - Multiple Regression Model - II](#)

[Lecture 35 - Categorical variable regression](#)

[Lecture 36 - Maximum Likelihood Estimation - I](#)

[Lecture 37 - Maximum Likelihood Estimation - II](#)

[Lecture 38 - Logistic Regression - I](#)

[Lecture 39 - Logistic Regression - II](#)

[Lecture 40 - Linear Regression Model Vs Logistic Regression Model](#)

[Lecture 41 - Confusion matrix and ROC - I](#)

[Lecture 42 - Confusion Matrix and ROC - II](#)

[Lecture 43 - Performance of Logistic Model - III](#)

[Lecture 44 - Regression Analysis Model Building - I](#)

[Lecture 45 - Regression Analysis Model Building \(Interaction\) - II](#)

[Lecture 46 - Chi - Square Test of Independence - I](#)

[Lecture 47 - Chi-Square Test of Independence - II](#)

[Lecture 48 - Chi-Square Goodness of Fit Test](#)

[Lecture 49 - Cluster analysis: Introduction - Part I](#)

[Lecture 50 - Clustering analysis - Part II](#)

[Lecture 51 - Clustering analysis - Part III](#)

[Lecture 52 - Cluster analysis - Part IV](#)

[Lecture 53 - Cluster analysis - Part V](#)

[Lecture 54 - K- Means Clustering](#)

[Lecture 55 - Hierarchical method of clustering - I](#)

[Lecture 56 - Hierarchical method of clustering - II](#)

[Lecture 57 - Classification and Regression Trees \(CART\) - I](#)

[Lecture 58 - Measures of attribute selection](#)

[Lecture 59 - Attribute selection Measures in \(CART\) - II](#)

[Lecture 60 - Classification and Regression Trees \(CART\) - III](#)

Lecture 1 - Pigeon hole principle - (Part 1)

Lecture 2 - Pigeon hole principle - (Part 2)

Lecture 3 - Pigeon hole principle - (Part 3)

Lecture 4 - Pigeon hole principle - (Part 4)

Lecture 5 - Elementary concepts and basic counting principles

Lecture 6 - Elementary concepts; Binomial theorem; Bijective proofs - Part (1)

Lecture 7 - Bijective proofs - Part (2)

Lecture 8 - Bijective proofs - Part (3); Properties of binomial coefficients; Combinatorial identities - Part (1)

Lecture 9 - Combinatorial identities - Part (2); Permutations of multisets - Part (1)

Lecture 10 - Permutations of multisets - Part (2)

Lecture 11 - Multinomial Theorem, Combinations of Multisets - Part (1)

Lecture 12 - Combinations of Multisets - Part (2)

Lecture 13 - Combinations of Multisets - Part (3), Bounds for binomial coefficients

Lecture 14 - Stirling's Formula, Generalization of Binomial coefficients - Part (1)

Lecture 15 - Generalization of Binomial coefficients - Part (2)

Lecture 16 - Generalization of Binomial coefficients - Part (3); Double counting - Part (1)

Lecture 17 - Double counting - Part (2)

Lecture 18 - Hall's Theorem for regular bipartite graphs; Inclusion exclusion principle - Part (1)

Lecture 19 - Inclusion exclusion principle - Part (2)

Lecture 20 - Inclusion exclusion principle - Part (3)

Lecture 21 - Inclusion exclusion principle - Part (4)

Lecture 22 - Inclusion exclusion principle - Part (5)

Lecture 23 - Recurrence Relations - Part (1)

Lecture 24 - Recurrence Relations - Part (2)

Lecture 25 - Recurrence Relations - Part (3)

Lecture 26 - Recurrence Relations - Part (4)

Lecture 27 - Recurrence Relations - Part (5)

Lecture 28 - Generating functions - Part (1)

Lecture 29 - Generating functions - Part (2)

Lecture 30 - Solving recurrence relations using generating functions - Part (1)

Lecture 31 - Solving recurrence relations using generating functions - Part (2)

[Lecture 32 - Exponential generating functions - Part \(1\)](#)

[Lecture 33 - Exponential generating functions - Part \(2\), Partition Number - Part \(1\)](#)

[Lecture 34 - Partition Number - Part \(2\)](#)

[Lecture 35 - Partition Number - Part \(3\)](#)

[Lecture 36 - Partition Number - Part \(4\); Catalan Numbers - Part \(1\)](#)

[Lecture 37 - Catalans Numbers - Part \(2\)](#)

[Lecture 38 - Catalan Numbers - Part \(3\), Sterling numbers of the 2nd kind](#)

[Lecture 39 - Difference Sequences](#)

[Lecture 40 - Sterling Numbers](#)

[Lecture 41 - Summary](#)

Lecture 1 - An Overview of a Compiler - Part 1

Lecture 2 - An Overview of a Compiler - Part 2 and Run-Time Environments - Part 1

Lecture 3 - An Overview of a Compiler - Part 2 and Run-Time Environments - Part 1

Lecture 4 - Run-Time Environments - Part 2

Lecture 5 - Run-Time Environments - Part 3 and Local Optimizations - Part 1

Lecture 6 - Run-Time Environments - Part 3 and Local Optimizations - Part 1

Lecture 7 - Local Optimizations - Part 2 and Code Generation - Part 1

Lecture 8 - Local Optimizations - Part 2 and Code Generation - Part 1

Lecture 9 - Code Generation - Part 1

Lecture 10 - Code Generation - Part 2

Lecture 11 - Code Generation - Part 3 and Global Register Allocation - Part 1

Lecture 12 - Code Generation - Part 3 and Global Register Allocation - Part 1

Lecture 13 - Global Register Allocation - Part 2

Lecture 14 - Global Register Allocation - Part 3 and Implementing Object-Oriented Languages - Part 1

Lecture 15 - Global Register Allocation - Part 3 and Implementing Object-Oriented Languages - Part 1

Lecture 16 - Implementing Object-Oriented Languages - Part 2 and Introduction to Machine-Independent Optimizations - Part 1

Lecture 17 - Implementing Object-Oriented Languages - Part 2 and Introduction to Machine-Independent Optimizations - Part 1

Lecture 18 - Introduction to Machine-Independent Optimizations - Part 2 and Data-Flow Analysis - Part 1

Lecture 19 - Introduction to Machine-Independent Optimizations - Part 2 and Data-Flow Analysis - Part 1

Lecture 20 - Data-Flow Analysis - Part 2

Lecture 21 - Data-Flow Analysis - Part 3 and Control-Flow Analysis - Part 1

Lecture 22 - Data-Flow Analysis - Part 3 and Control-Flow Analysis - Part 1

Lecture 23 - Control-Flow Analysis - Part 2

Lecture 24 - Machine-Independent Optimizations - Part 1

Lecture 25 - Machine-Independent Optimizations - Part 2

Lecture 26 - Machine-Independent Optimizations - Part 3 and Data-Flow Analysis: Theoretical Foundation - Part 1

Lecture 27 - Machine-Independent Optimizations - Part 3 and Data-Flow Analysis: Theoretical Foundation - Part 1

Lecture 28 - Data-Flow Analysis: Theoretical Foundation - Part 2 and Partial Redundancy Elimination - Part 1

Lecture 29 - Data-Flow Analysis: Theoretical Foundation - Part 2 and Partial Redundancy Elimination - Part 1

Lecture 30 - Partial Redundancy Elimination - Part 2

Lecture 31 - The Static Single Assignment Form: Construction and Application to Program Optimizations - Part 1

[Lecture 32 - The Static Single Assignment Form: Construction and Application to Program Optimizations - Part 2](#)

[Lecture 33 - The Static Single Assignment Form: Construction and Application to Program Optimizations - Part 3](#)

[Lecture 34 - Automatic Parallelization - Part 1](#)

[Lecture 35 - Automatic Parallelization - Part 2](#)

[Lecture 36 - Automatic Parallelization - Part 3](#)

[Lecture 37 - Automatic Parallelization - Part 4](#)

[Lecture 38 - Instruction Scheduling - Part 1](#)

[Lecture 39 - Instruction Scheduling - Part 2](#)

[Lecture 40 - Instruction Scheduling - Part 3](#)

[Lecture 41 - Software Pipelining](#)

[Lecture 42 - Energy-Aware Software Systems - Part 1](#)

[Lecture 43 - Energy-Aware Software Systems - Part 2](#)

[Lecture 44 - Energy-Aware Software Systems - Part 3](#)

[Lecture 45 - Energy-Aware Software Systems - Part 4](#)

[Lecture 46 - Just-In-Time Compilation and Optimizations for .NET CLR](#)

[Lecture 47 - Garbage Collection](#)

[Lecture 48 - Interprocedural Data-Flow Analysis](#)

[Lecture 49 - Worst Case Execution Time - Part 1](#)

[Lecture 50 - Worst Case Execution Time - Part 2](#)

- Lecture 1 - Introduction: Vertex cover and independent set
- Lecture 2 - Matchings: Konig's theorem and Hall's theorem
- Lecture 3 - More on Hall's theorem and some applications
- Lecture 4 - Tutte's theorem on existence of a perfect matching
- Lecture 5 - More on Tutte's theorem
- Lecture 6 - More on Matchings
- Lecture 7 - Dominating set, path cover
- Lecture 8 - Gallai's " Millgram theorem, Dilworth's theorem
- Lecture 9 - Connectivity: 2-connected and 3-connected graphs
- Lecture 10 - Menger's theorem
- Lecture 11 - More on connectivity: k- linkedness
- Lecture 12 - Minors, topological minors and more on k- linkedness
- Lecture 13 - Vertex coloring: Brooks theorem
- Lecture 14 - More on vertex coloring
- Lecture 15 - Edge coloring: Vizing's theorem
- Lecture 16 - Proof of Vizing's theorem, Introduction to planarity
- Lecture 17 - 5- coloring planar graphs, Kuratowski's theorem
- Lecture 18 - Proof of Kuratowski's theorem, List coloring
- Lecture 19 - List chromatic index
- Lecture 20 - Adjacency polynomial of a graph and combinatorial Nullstellensatz
- Lecture 21 - Chromatic polynomial, k - critical graphs
- Lecture 22 - Gallai-Roy theorem, Acyclic coloring, Hadwiger's conjecture
- Lecture 23 - Perfect graphs: Examples
- Lecture 24 - Interval graphs, chordal graphs
- Lecture 25 - Proof of weak perfect graph theorem (WPGT)
- Lecture 26 - Second proof of WPGT, Some non-perfect graph classes
- Lecture 27 - More special classes of graphs
- Lecture 28 - Boxicity, Sphericity, Hamiltonian circuits
- Lecture 29 - More on Hamiltonicity: Chvatal's theorem
- Lecture 30 - Chvatal's theorem, toughness, Hamiltonicity and 4-color conjecture
- Lecture 31 - Network flows: Max flow mincut theorem

[Lecture 32 - More on network flows: Circulations](#)

[Lecture 33 - Circulations and tensions](#)

[Lecture 34 - More on circulations and tensions, flow number and Tutte's flow conjectures](#)

[Lecture 35 - Random graphs and probabilistic method: Preliminaries](#)

[Lecture 36 - Probabilistic method: Markov's inequality, Ramsey number](#)

[Lecture 37 - Probabilistic method: Graphs of high girth and high chromatic number](#)

[Lecture 38 - Probabilistic method: Second moment method, Lovasz local lemma](#)

[Lecture 39 - Graph minors and Hadwiger's conjecture](#)

[Lecture 40 - More on graph minors, tree decompositions](#)

Lecture 1 - Programs and Data

Lecture 2 - Data Representation

Lecture 3 - Registers and Memory

Lecture 4 - Instructions, Addressing Modes

Lecture 5 - A RISC Instruction Set

Lecture 6 - A RISC Instruction Set (Continued...)

Lecture 7 - Function Call and Return

Lecture 8 - Function Call and Return (Continued...)

Lecture 9 - Instruction Execution

Lecture 10 - Instruction Execution (Continued...)

Lecture 11 - Software organization

Lecture 12 - System Calls

Lecture 13 - Virtual memory

Lecture 14 - Virtual memory (Continued...)

Lecture 15 - Virtual Memory (Continued...)

Lecture 16 - Process

Lecture 17 - Process scheduling

Lecture 18 - Process lifetime

Lecture 19 - Interprocess communication

Lecture 20 - Concurrent programming

Lecture 21 - Pipelining

Lecture 22 - Pipeline hazards

Lecture 23 - Pipeline hazards (Continued...)

Lecture 24 - Pipeline hazards (Continued...)

Lecture 25 - Cache memory

Lecture 26 - Memory hierarchy

Lecture 27 - Cache operation

Lecture 28 - Cache operation (Continued)

Lecture 29 - Cache aware programming

Lecture 30 - Cache aware programming (Continued...)

Lecture 31 - More on cache

[Lecture 32 - Measuring time](#)

[Lecture 33 - Program Profiling](#)

[Lecture 34 - Secondary storage](#)

[Lecture 35 - Files and disks](#)

[Lecture 36 - Directories](#)

[Lecture 37 - Protection and Performance](#)

[Lecture 38 - Parallel architecture](#)

[Lecture 39 - Cache coherence](#)

[Lecture 40 - MPI programming](#)

[Lecture 41 - MPI programming \(Continued...\)](#)

Lecture 1 - Introduction

Lecture 2 - Mathematical Background

Lecture 3 - Mathematical Background (Continued...)

Lecture 4 - One Dimensional Optimization - Optimality Conditions

Lecture 5 - One Dimensional Optimization (Continued...)

Lecture 6 - Convex Sets

Lecture 7 - Convex Sets (Continued...)

Lecture 8 - Convex Functions

Lecture 9 - Convex Functions (Continued...)

Lecture 10 - Multi Dimensional Optimization - Optimality Conditions, Conceptual Algorithm

Lecture 11 - Line Search Techniques

Lecture 12 - Global Convergence Theorem

Lecture 13 - Steepest Descent Method

Lecture 14 - Classical Newton Method

Lecture 15 - Trust Region and Quasi-Newton Methods

Lecture 16 - Quasi-Newton Methods - Rank One Correction, DFP Method

Lecture 17 - i) Quasi-Newton Methods - Broyden Family ii) Coordinate Descent Method

Lecture 18 - Conjugate Directions

Lecture 19 - Conjugate Gradient Method

Lecture 20 - Constrained Optimization - Local and Global Solutions, Conceptual Algorithm

Lecture 21 - Feasible and Descent Directions

Lecture 22 - First Order KKT Conditions

Lecture 23 - Constraint Qualifications

Lecture 24 - Convex Programming Problem

Lecture 25 - Second Order KKT Conditions

Lecture 26 - Second Order KKT Conditions (Continued...)

Lecture 27 - Weak and Strong Duality

Lecture 28 - Geometric Interpretation

Lecture 29 - Lagrangian Saddle Point and Wolfe Dual

Lecture 30 - Linear Programming Problem

Lecture 31 - Geometric Solution

[Lecture 32 - Basic Feasible Solution](#)

[Lecture 33 - Optimality Conditions and Simplex Tableau](#)

[Lecture 34 - Simplex Algorithm and Two-Phase Method](#)

[Lecture 35 - Duality in Linear Programming](#)

[Lecture 36 - Interior Point Methods - Affine Scaling Method](#)

[Lecture 37 - Karmarkar's Method](#)

[Lecture 38 - Lagrange Methods, Active Set Method](#)

[Lecture 39 - Active Set Method \(Continued...\)](#)

[Lecture 40 - Barrier and Penalty Methods, Augmented Lagrangian Method and Cutting Plane Method](#)

[Lecture 41 - Summary](#)

Lecture 1 - Overview

Lecture 2 - Storage, Processing, Networking

Lecture 3 - Naming and Storing

Lecture 4 - Storage Filesystems

Lecture 5 - Access Architecture, Hard Disks

Lecture 6 - SCSI

Lecture 7 - Fibre Channel Protocol (FCP)

Lecture 8 - FCP, 10Gb Ethernet, iSCSI, TCP

Lecture 9 - NFS, NFSv2

Lecture 10 - NFSv2, NFSv3, NFSv4, CIFS

Lecture 11 - USB Storage

Lecture 12 - Tiering

Lecture 13 - Mobile/Personal/Organizational - type Storage

Lecture 14 - Parallel/Cloud/Web-scale Storage

Lecture 15 - Long-term Storage

Lecture 16 - Storage interfaces

Lecture 17 - User-Memory-CPU interactions

Lecture 18 - Spinlock, Concurrency

Lecture 19 - Block Layer design

Lecture 20 - FAT, TFAT, F2FS, LFS, FTL

Lecture 21 - Data Structures

Lecture 22 - Abstractions

Lecture 23 - Link & Write Operations

Lecture 24 - ZFS

Lecture 25 - RAID in Filesystems

Lecture 26 - RAID-Z, NetApp RAID4, Flash Filesystems

Lecture 27 - Reliability

Lecture 28 - Performance

Lecture 29 - Security

Lecture 30 - CAP Theorem

Lecture 31 - POSIX/NFS/S3/Zookeeper, ACID Vs. BASE

[Lecture 32 - Consistency & Commit problems](#)

[Lecture 33 - Paxos](#)

[Lecture 34 - Group Communication problem](#)

[Lecture 35 - Message Ordering](#)

[Lecture 36 - Ordering Models](#)

[Lecture 37 - Orderings in Filesystems](#)

[Lecture 38 - Semantics of highly scalable filesystems](#)

[Lecture 39 - GFS](#)

[Lecture 40 - GFS Model](#)

[Lecture 41 - GFS functions and operations](#)

[Lecture 42 - GFS problems, BigTable](#)

[Lecture 43 - Lessons to learn](#)

[Lecture 1](#)

[Lecture 2](#)

[Lecture 3](#)

[Lecture 4](#)

[Lecture 5](#)

[Lecture 6](#)

[Lecture 7](#)

[Lecture 8](#)

[Lecture 9](#)

[Lecture 10](#)

[Lecture 11](#)

[Lecture 12](#)

[Lecture 13](#)

[Lecture 14](#)

[Lecture 15](#)

[Lecture 16](#)

[Lecture 17](#)

[Lecture 18](#)

[Lecture 19](#)

[Lecture 20](#)

[Lecture 21](#)

[Lecture 22](#)

[Lecture 23](#)

[Lecture 24](#)

[Lecture 25](#)

[Lecture 26](#)

[Lecture 27](#)

[Lecture 28](#)

[Lecture 29](#)

[Lecture 30](#)

[Lecture 31](#)

[Lecture 32](#)

[Lecture 33](#)

[Lecture 34](#)

[Lecture 35](#)

[Lecture 36](#)

[Lecture 37](#)

[Lecture 38](#)

[Lecture 39](#)

[Lecture 40](#)

Lecture 1 - An Overview of a Compiler

Lecture 2 - Lexical Analysis - Part 1

Lecture 3 - Lexical Analysis - Part 2

Lecture 4 - Lexical Analysis - Part 3

Lecture 5 - Syntax Analysis: Context-free Grammars, Pushdown Automata and Parsing Part - 1

Lecture 6 - Syntax Analysis: Context-free Grammars, Pushdown Automata and Parsing Part - 2

Lecture 7 - Syntax Analysis: Context-free Grammars, Pushdown Automata and Parsing Part - 3

Lecture 8 - Syntax Analysis: Context-free Grammars, Pushdown Automata and Parsing Part - 4

Lecture 9 - Syntax Analysis: Context-free Grammars, Pushdown Automata and Parsing Part - 5

Lecture 10 - Syntax Analysis: Context-free Grammars, Pushdown Automata and Parsing Part - 6

Lecture 11 - Syntax Analysis: Context-free Grammars, Pushdown Automata and Parsing Part - 7

Lecture 12 - Semantic Analysis with Attribute Grammars Part - 1

Lecture 13 - Semantic Analysis with Attribute Grammars Part - 2

Lecture 14 - Semantic Analysis with Attribute Grammars Part - 3

Lecture 15 - Semantic Analysis with Attribute Grammars Part - 4

Lecture 16 - Semantic Analysis with Attribute Grammars Part - 5

Lecture 17 - Intermediate code generation Part - 1

Lecture 18 - Intermediate code generation Part - 2

Lecture 19 - Intermediate code generation Part - 3

Lecture 20 - Intermediate code generation Part - 4 (first half of lecture)

Lecture 21 - Run-time environments - 1 (second half of lecture)

Lecture 22 - Run-time environments - 2

Lecture 23 - Run-time environments - 3

Lecture 24 - Run-time environments - 4 (first half of lecture)

Lecture 25 - Control-Flow Graph and Local Optimizations - Part 1 (second half of lecture)

Lecture 26 - Control-Flow Graph and Local Optimizations - Part 2 (first half of lecture)

Lecture 27 - Machine code generation - 1 (second half of lecture)

Lecture 28 - Machine code generation - 2

Lecture 29 - Machine code generation - 3

Lecture 30 - Machine code generation - 4 (first half of lecture), Implementing object-oriented languages 1 (second half of lecture)

Lecture 31 - Implementing object-oriented languages 2 (first half of lecture)

- Lecture 32 - Global register allocation - 1 (second half of lecture)
- Lecture 33 - Global register allocation - 2
- Lecture 34 - Global register allocation - 3
- Lecture 35 - Introduction to Machine-Independent Optimizations - 1
- Lecture 36 - Introduction to Machine-Independent Optimizations - 2
- Lecture 37 - Introduction to Machine-Independent Optimizations - 3
- Lecture 38 - Introduction to Machine-Independent Optimizations - 4
- Lecture 39 - Introduction to Machine-Independent Optimizations - 5
- Lecture 40 - Introduction to Machine-Independent Optimizations - 6
- Lecture 41 - Introduction to Machine-Independent Optimizations - 7 (first half of lecture)
- Lecture 42 - Instruction Scheduling and Software Pipelining - 1 (second half of lecture)
- Lecture 43 - Instruction Scheduling and Software Pipelining - 2
- Lecture 44 - Instruction Scheduling and Software Pipelining - 3 (first part of lecture)
- Lecture 45 - Automatic parallelization - 1 (second half of lecture)
- Lecture 46 - Automatic parallelization - 2

Lecture 1 - Introduction to Mathematical Logic

Lecture 2 - Logical Equivalence

Lecture 3 - SAT Problem

Lecture 4 - Rules of Inference

Lecture 5 - Resolution

Lecture 6 - Tutorial 1 - Part I

Lecture 7 - Tutorial 1 - Part II

Lecture 8 - Predicate Logic

Lecture 9 - Rules of Inferences in Predicate Logic

Lecture 10 - Proof Strategies - I

Lecture 11 - Proof Strategies - II

Lecture 12 - Induction

Lecture 13 - Tutorial 2 - Part I

Lecture 14 - Tutorial 2 - Part II

Lecture 15 - Sets

Lecture 16 - Relations

Lecture 17 - Operations on Relations

Lecture 18 - Transitive Closure of Relations

Lecture 19 - Warshall's Algorithm for Computing Transitive Closure

Lecture 20 - Tutorial - 3

Lecture 21 - Equivalence Relation

Lecture 22 - Equivalence Relations and Partitions

Lecture 23 - Partial Ordering

Lecture 24 - Functions

Lecture 25 - Tutorial 4 - Part I

Lecture 26 - Tutorial 4 - Part II

Lecture 27 - Countable and Uncountable Sets

Lecture 28 - Examples of Countably Infinite Sets

Lecture 29 - Cantor's Diagonalization Argument

Lecture 30 - Uncomputable Functions

Lecture 31 - Tutorial - 5

[Lecture 32 - Basic Rules of Counting](#)

[Lecture 33 - Permutation and Combination](#)

[Lecture 34 - Counting Using Recurrence Equations](#)

[Lecture 35 - Solving Linear Homogeneous Recurrence Equations - Part I](#)

[Lecture 36 - Solving Linear Homogeneous Recurrence Equations - Part II](#)

[Lecture 37 - Tutorial 6 - Part I](#)

[Lecture 38 - Tutorial 6 - Part II](#)

[Lecture 39 - Solving Linear Non-Homogeneous Recurrence Equations](#)

[Lecture 40 - Catalan Numbers](#)

[Lecture 41 - Catalan Numbers - Derivation of Closed Form Formula](#)

[Lecture 42 - Counting Using Principle of Inclusion-Exclusion](#)

[Lecture 43 - Tutorial - 7](#)

[Lecture 44 - Graph Theory Basics](#)

[Lecture 45 - Matching](#)

[Lecture 46 - Proof of Hall's Marriage Theorem](#)

[Lecture 47 - Various Operations on Graphs](#)

[Lecture 48 - Vertex and Edge Connectivity](#)

[Lecture 49 - Tutorial - 8](#)

[Lecture 50 - Euler Path and Euler Circuit](#)

[Lecture 51 - Hamiltonian Circuit](#)

[Lecture 52 - Vertex and Edge Coloring](#)

[Lecture 53 - Tutorial 9 - Part I](#)

[Lecture 54 - Tutorial 9 - Part II](#)

[Lecture 55 - Modular Arithmetic](#)

[Lecture 56 - Prime Numbers and GCD](#)

[Lecture 57 - Properties of GCD and Bezout's Theorem](#)

[Lecture 58 - Linear Congruence Equations and Chinese Remainder Theorem](#)

[Lecture 59 - Uniqueness Proof of the CRT](#)

[Lecture 60 - Fermat's Little Theorem, Primality Testing and Carmichael Numbers](#)

[Lecture 61 - Group Theory](#)

[Lecture 62 - Cyclic Groups](#)

[Lecture 63 - Subgroups](#)

[Lecture 64 - Discrete Logarithm and Cryptographic Applications](#)

[Lecture 65 - More Applications of Groups](#)

[Lecture 66 - Rings, Fields and Polynomials](#)

[Lecture 67 - Polynomials Over Fields and Properties](#)

[Lecture 68 - Finite Fields and Properties - I](#)

[Lecture 69 - Finite Fields and Properties - II](#)

[Lecture 70 - Primitive Element of a Finite Field](#)

[Lecture 71 - Applications of Finite Fields](#)

[Lecture 72 - Goodbye and Farewell](#)

Lecture 1 - What is Secure MPC

Lecture 2 - Real-World Examples of Secure MPC

Lecture 3 - Various Dimensions to Study Secure MPC

Lecture 4 - Recap of Basic Concepts from Abstract Algebra

Lecture 5 - Recap of Basic Concepts from Abstract Algebra (Continued...)

Lecture 6 - Recap of Basic Concepts from Cryptography

Lecture 7 - Secret sharing

Lecture 8 - Additive Secret Sharing

Lecture 9 - Inefficient Threshold Secret Sharing

Lecture 10 - Polynomials Over Fields

Lecture 11 - Shamir Secret-Sharing

Lecture 12 - Linear secret-sharing

Lecture 13 - Linear Secret Sharing (Continued...)

Lecture 14 - General Secret Sharing

Lecture 15 - Perfectly-Secure Message Transmission

Lecture 16 - A Toy MPC Protocol

Lecture 17 - A Toy MPC Protocol (Continued...)

Lecture 18 - A Toy MPC Protocol (Continued...)

Lecture 19 - The BGW MPC Protocol

Lecture 20 - The BGW MPC Protocol for Linear Functions

Lecture 21 - The BGW MPC Protocol for Linear Functions: Security Analysis

Lecture 22 - The BGW MPC Protocol: The Case of Non-Linear Gates

Lecture 23 - The Degree-Reduction Problem

Lecture 24 - The Gennaro-Rabin-Rabin (GRR) Degree-Reduction Method

Lecture 25 - Analysis of the GRR, Degree-Reduction Method

Lecture 26 - Shared Circuit-Evaluation via GRR Degree-Reduction Method

Lecture 27 - Shared Circuit-Evaluation in the Pre-processing Model

Lecture 28 - Optimality of Corruption Bound for Perfectly-Secure MPC

Lecture 29 - Perfectly-Secure MPC Tolerating General (Non-Threshold) Adversaries

Lecture 30 - Perfectly-Secure MPC Tolerating General (Non-Threshold) Adversaries with $Q^{(2)}$ Condition

Lecture 31 - Perfectly-Secure MPC for Small Number of Parties

- [Lecture 32 - Perfectly-Secure 3PC \(Continued...\)](#)
- [Lecture 33 - More Efficient Perfectly-Secure 3PC](#)
- [Lecture 34 - More Efficient Perfectly-Secure 3PC \(Continued...\)](#)
- [Lecture 35 - Towards Cryptographically-Secure MPC](#)
- [Lecture 36 - GMW MPC protocol](#)
- [Lecture 37 - Oblivious Transfer \(OT\)](#)
- [Lecture 38 - RSA Assumption and RSA Hard-Core Predicate](#)
- [Lecture 39 - Bit OT Based on RSA Assumption and Hard-Core Predicate](#)
- [Lecture 40 - Discrete Logarithm and DDH Assumption](#)
- [Lecture 41 - OT Based on the DDH Assumption](#)
- [Lecture 42 - Pre-Processing Phase for the GMW Protocol](#)
- [Lecture 43 - Pre-Processing Phase for the GMW Protocol: The n-Party Case](#)
- [Lecture 44 - Pre-Processing Phase for the GMW Protocol \(Continued...\)](#)
- [Lecture 45 - Pre-Processing of OT](#)
- [Lecture 46 - OT Extension](#)
- [Lecture 47 - Analysis of IKNP OT Extension](#)
- [Lecture 48 - Yao's Protocol for Secure 2PC](#)
- [Lecture 49 - Yao's Garbling Scheme](#)
- [Lecture 50 - Yao's Protocol for Secure 2PC](#)
- [Lecture 51 - Optimizations for Yao's Garbling](#)
- [Lecture 52 - Interpreting Yao's Secure 2PC Protocol as a Secret-Sharing Based Protocol](#)
- [Lecture 53 - Mixed Protocols for Secure 2PC](#)
- [Lecture 54 - The Arithmetic, Boolean and Yao Sharing for Secure 2PC](#)
- [Lecture 55 - The ABY Conversions](#)
- [Lecture 56 - The ABY Conversions \(Continued...\)](#)
- [Lecture 57 - The ABY Conversions \(Continued...\)](#)
- [Lecture 58 - ABY Computations : Example](#)
- [Lecture 59 - Goodbye and Farewell](#)

Lecture 1 - What is Secure Multi-Party Computation (MPC)?

Lecture 2 - Reliable Broadcast and Byzantine Agreement

Lecture 3 - EIG Protocol for Perfectly-Secure Byzantine Agreement

Lecture 4 - EIG Protocol for Perfectly-Secure Byzantine Agreement: Illustration

Lecture 5 - EIG Protocol for Perfectly-Secure Byzantine Agreement: Analysis - Part I

Lecture 6 - EIG Protocol for Perfectly-Secure Byzantine Agreement: Analysis - Part II

Lecture 7 - Efficient Protocols for Perfectly-Secure Byzantine Agreement - Part I

Lecture 8 - Efficient Protocols for Perfectly-Secure Byzantine Agreement - Part II

Lecture 9 - Domain Extension for Perfectly-Secure Byzantine Agreement

Lecture 10 - Cryptographically/Statistically-Secure Reliable Broadcast

Lecture 11 - Dolev-Strong Reliable Broadcast Protocol: Analysis

Lecture 12 - Randomized Protocol for Byzantine Agreement - Part I

Lecture 13 - Randomized Protocol for Byzantine Agreement - Part II

Lecture 14 - Randomized Protocol for Byzantine Agreement - Part III

Lecture 15 - Lower Bound for Number of Parties for Byzantine Agreement - Part I

Lecture 16 - Lower Bound for Number of Parties for Byzantine Agreement - Part II

Lecture 17 - Lower Bound for Number of Parties for Byzantine Agreement - Part III

Lecture 18 - Recap of Basic Concepts from Abstract Algebra

Lecture 19 - Reed-Solomon Error-Correcting Codes

Lecture 20 - Perfectly-Secure Message Transmission

Lecture 21 - Properties of Polynomials Over a Field - I

Lecture 22 - Properties of Polynomials Over a Field - II

Lecture 23 - One Round PSMT Protocol

Lecture 24 - Multi-Round PSMT Protocol - I

Lecture 25 - Multi-Round PSMT Protocol - II

Lecture 26 - Domain Extension for Perfectly-Secure Broadcast Based on RS Error-Correcting Codes - I

Lecture 27 - Domain Extension for Perfectly-Secure Broadcast Based on RS Error-Correcting Codes - II

Lecture 28 - Domain Extension for Perfectly-Secure Broadcast Based on RS Error-Correcting Codes - III

Lecture 29 - (n,t) - Star Structure

Lecture 30 - Domain Extension for Perfectly-Secure Broadcast Based on RS Error-Correcting Codes - IV

Lecture 31 - The BGW MPC Protocol for Passive Corruptions: Recap

- Lecture 32 - The BGW MPC Protocol for Byzantine Corruptions: Challenges
- Lecture 33 - Perfectly-Secure VSS: Necessary Condition
- Lecture 34 - Bivariate Polynomials Over Finite Fields - I
- Lecture 35 - Bivariate Polynomials Over Finite Fields - II
- Lecture 36 - Bivariate Polynomials Over Finite Fields - III
- Lecture 37 - Bivariate Polynomials Over Finite Fields - IV
- Lecture 38 - Perfectly-Secure VSS with n greater than $3t$ - Part I
- Lecture 39 - Perfectly-Secure VSS with n greater than $3t$ - Part II
- Lecture 40 - Perfectly-Secure VSS with n greater than $3t$ - Part III
- Lecture 41 - Perfectly-Secure VSS with n greater than $3t$ - A Round-Reducing Technique
- Lecture 42 - Perfectly-Secure VSS with n greater than $4t$ - Part I
- Lecture 43 - Perfectly-Secure VSS with n greater than $4t$ - Part II
- Lecture 44 - The BGW MPC Protocol for Linear Functions
- Lecture 45 - The BGW MPC Protocol for Linear Functions: Security Analysis
- Lecture 46 - The BGW MPC Protocol: The Case of Non-Linear Gates
- Lecture 47 - The Degree-Reduction Problem
- Lecture 48 - Generating Random Multiplication-Triples - I
- Lecture 49 - Generating Random Multiplication-Triples - II
- Lecture 50 - Generating Random Multiplication-Triples - III
- Lecture 51 - Perfectly-Secure Protocol for Verifying Multiplicative Relationship
- Lecture 52 - Perfectly-Secure Verifiable Triple-Sharing Protocol
- Lecture 53 - Perfectly-Secure Triple-Extraction Protocol
- Lecture 54 - Towards Secure MPC with an Honest Majority
- Lecture 55 - ICP from Information-Theoretic MAC - I
- Lecture 56 - ICP from Information-Theoretic MAC - II
- Lecture 57 - Ingredients for Statistically-Secure MPC
- Lecture 58 - Statistically-Secure VSS
- Lecture 59 - Cyclic Groups and Discrete Logarithm
- Lecture 60 - Pedersen Commitment Scheme
- Lecture 61 - Cryptographically-secure VSS and MPC
- Lecture 62 - Goodbye and Farewell