Savitribai Phule Pune University Second Year of Engineering (2019 Course) 210253: Data Structures & Algorithms		
Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 03 Hours/Week	03	Mid_Semester(TH): 30 Marks End_Semester(TH): 70 Marks

Prerequisite Courses, if any:
- Fundamentals of Data Structure
- Basic Mathematics, Geometry, linear algebra, vectors and matrices

Companion Course, if any:

Course Objectives:
- To develop a logic for graphical modeling of the real life problems.
- To suggest appropriate data structure and algorithm for graphical solutions of the problems.
- To understand advanced data structures to solve complex problems in various domains.
- To operate on the various structured data
- To build the logic to use appropriate data structure in logical and computational solutions.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:
On completion of the course, learner will be able to—
CO1: To identify & articulate the complexity goals and benefits of a good hashing scheme for real-world applications.
CO2: To apply non-linear data structures for solving problems of various domain.
CO3: To design and specify the operations of a nonlinear-based abstract data type and implement them in a high-level programming language.
CO4: To analyze the algorithmic solutions for resource requirements and optimization
CO5: To use efficient indexing methods and multiway search techniques to store and maintain data.
CO6: To use appropriate modern tools to understand and analyze the functionalities confined to the secondary storage.

Course Contents

Unit I	Hashing	(07 Hours)

Hash Table- Concepts-hash table, hash function, basic operations, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing, closed addressing and separate chaining.
Skip List- representation, searching and operations- insertion, removal

#Exemplar/Case Studies	Book Call Number, Dictionary,
Mapping of Course Outcomes for Unit I	CO1

Unit II	Graphs	(08 Hours)

Basic Concepts, Storage representation, Adjacency matrix, adjacency list, adjacency multi list, inverse adjacency list. Traversals-depth first and breadth first, Minimum spanning Tree, Greedy algorithms for computing minimum spanning tree- Prims and Kruskal Algorithms, Dikjtra's Single source shortest path, All pairs shortest paths- Flyod-Warshall Algorithm Topological ordering.

#Exemplar/Case Studies	Data structure used in Webgraph and Google map
Mapping of Course Outcomes for Unit II	CO2, CO3

Unit III	Trees	(07 Hours)

Tree- basic terminology, General tree and its representation, representation using sequential and linked organization, Binary tree- properties, converting tree to binary tree, binary tree traversals(recursive and non-recursive)- inorder, preorder, post order, depth first and breadth first, Operations on binary tree. Huffman Tree (Concept and Use), Binary Search Tree (BST), BST operations, Threaded binary search tree- concepts, threading, insertion and deletion of nodes in in-order threaded binary search tree, in order traversal of in-order threaded binary search tree.

#Exemplar/Case Studies	Use of binary tree in expression tree-evaluation and Huffman's coding
Mapping of Course Outcomes for Unit III	CO2,CO3

Unit IV	Search Trees	(08 Hours)

Symbol Table-Representation of Symbol Tables- Static tree table and Dynamic tree table, Weight balanced tree - Optimal Binary Search Tree (OBST), OBST as an example of Dynamic Programming, Height Balanced Tree- AVL tree. Red-Black Tree, AA tree, K-dimensional tree, Splay Tree

#Exemplar/Case Studies	Keyword search in a document using OBST.
Mapping of Course Outcomes for Unit IV	CO3, CO4

Unit V	Indexing and Multiway Trees	(06 Hours)

Indexing and Multiway Trees- Indexing, indexing techniques-primary, secondary, dense, sparse, Multiway search trees, B-Tree- insertion, deletion , B+Tree - insertion, deletion, use of B+ tree in Indexing, Trie Tree.

#Exemplar/Case Studies	Heap as a priority queue
Mapping of Course Outcomes for Unit V	CO3, CO5

Unit VI	File Organization	(06 Hours)

Files: concept, need, primitive operations. **Sequential file organization-** concept and primitive operations, **Direct Access File-** Concepts and Primitive operations, **Indexed sequential file organization-**concept, types of indices, structure of index sequential file, **Linked Organization-** multi list files, coral rings, inverted files and cellular partitions.

#Exemplar/Case Studies	**External Sort-** Consequential processing and merging two lists, multiway merging- a k way merge algorithm
Mapping of Course Outcomes for Unit VI	CO6

Learning Resources

Text Books:

1. Horowitz, Sahani, Dinesh Mehata, ―Fundamentals of Data Structures in C++ , Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2. M Folk, B Zoellick, G. Riccardi, ―File Structures , Pearson Education, ISBN:81-7758-37-5
3. Peter Brass, ―Advanced Data Structures , Cambridge University Press, ISBN: 978-1-107-43982-5
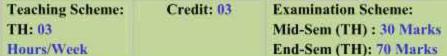
Reference Books:

1. A. Aho, J. Hopcroft, J. Ulman, ―Data Structures and Algorithms , Pearson Education, 1998, ISBN-0-201-43578-0.
2. Michael J Folk, ―File Structures an Object Oriented Approach with C++ , Pearson Education, ISBN: 81-7758-373-5.
3. Sartaj Sahani, ―Data Structures, Algorithms and Applications in C++ , Second Edition, University Press, ISBN:81-7371522 X.
4. G A V Pai, ―Data Structures and Algorithms , The McGraw-Hill Companies, ISBN - 9780070667266.
5. Goodrich, Tamassia, Goldwasser, ―Data Structures and Algorithms in Java , Wiley Publication, ISBN: 9788126551903

@The CO-PO mapping table

PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	3	1	-	-	-	-	1	-	-	1
CO2	3	2	3	1	-	-	-	-	1	-	-	-
CO3	3	2	3	1	-	-	-	-	1	-	-	-
CO4	3	2	3	1	1	-	-	-	1	-	-	-
CO5	3	2	3	1	1	-	-	-	1	-	-	1
CO6	3	2	3	1	1	-	-	-	1	-	-	1

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310253: Artificial Intelligence

Home

Teaching Scheme:	Credit: 03	Examination Scheme:
TH: 03 Hours/Week		Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: Programming and Problem solving (110005),
Data Structures and Algorithms (210252)

Companion Course: Laboratory Practice II (310258)

Course Objectives:

- To understand the concept of Artificial Intelligence (AI) in the form of various Intellectual tasks
- To understand Problem Solving using various peculiar search strategies for AI
- To understand multi-agent environment in competitive environment
- To acquaint with the fundamentals of knowledge and reasoning
- To devise plan of action to achieve goals as a critical part of AI
- To develop a mind to solve real world problems unconventionally with optimality

Course Outcomes:

After completion of the course, students should be able to

CO1: Identify and apply suitable Intelligent agents for various AI applications

CO2: Build smart system using different informed search / uninformed search or heuristic approaches

CO3: Identify knowledge associated and represent it by ontological engineering to plan a strategy to solve given problem

CO4: Apply the suitable algorithms to solve AI problems

CO5: Implement ideas underlying modern logical inference systems

CO6: Represent complex problems with expressive yet carefully constrained language of representation

Course Contents		
Unit I	**Introduction**	**07 Hours**

Introduction to Artificial Intelligence, Foundations of Artificial Intelligence, History of Artificial Intelligence, State of the Art, Risks and Benefits of AI, Intelligent Agents, Agents and Environments, Good Behavior: Concept of Rationality, Nature of Environments, Structure of Agents.

#Exemplar/Case Studies	Kroger: How This U.S. Retail Giant Is Using AI And Robots To Prepare For The 4th Industrial Revolution
*Mapping of Course Outcomes for Unit I	CO1, CO4

Unit II	**Problem-solving**	**07 Hours**

Solving Problems by Searching, Problem-Solving Agents, Example Problems, Search Algorithms, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Search in Complex Environments, Local Search and Optimization Problems.

#Exemplar/Case Studies	4th Industrial Revolution Using AI, Big Data And Robotics
*Mapping of Course Outcomes for Unit II	CO2, CO4

Unit III	Adversarial Search and Games	07 Hours
Game Theory, Optimal Decisions in Games, Heuristic Alpha–Beta Tree Search, Monte Carlo Tree Search, Stochastic Games, Partially Observable Games, Limitations of Game Search Algorithms, Constraint Satisfaction Problems (CSP), Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs.		
#Exemplar/Case Studies	Machine Learning At Google: The Amazing Use Case Of Becoming A Fully Sustainable Business	
*Mapping of Course Outcomes for Unit III	CO3, CO4	

Unit IV	Knowledge	07 Hours
Logical Agents, Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic, First-Order Logic, Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-Order Logic, Knowledge Engineering in First-Order Logic.		
#Exemplar/Case Studies	BBC To Launch AI - Enabled Interactive Radio Show For Amazon Echo And Google Home Chatbots	
*Mapping of Course Outcomes for Unit IV	CO3, CO4	

Unit V	Reasoning	07 Hours
Inference in First-Order Logic, Propositional vs. First-Order Inference, Unification and First-Order Inference, Forward Chaining, Backward Chaining, Resolution, Knowledge Representation, Ontological Engineering, Categories and Objects, Events, Mental Objects and Modal Logic, Reasoning Systems for Categories, Reasoning with Default Information		
#Exemplar/Case Studies	The Amazing Ways How Wikipedia Uses Artificial Intelligence	
*Mapping of Course Outcomes for Unit V	CO4, CO5	

Unit VI	Planning	07 Hours
Automated Planning, Classical Planning, Algorithms for Classical Planning, Heuristics for Planning, Hierarchical Planning, Planning and Acting in Nondeterministic Domains, Time, Schedules, and Resources, Analysis of Planning Approaches, Limits of AI, Ethics of AI, Future of AI, AI Components, AI Architectures.		
#Exemplar/Case Studies	The Amazing Ways Samsung Is Using Big Data, Artificial Intelligence And Robots To Drive Performance	
*Mapping of Course Outcomes for Unit VI	CO4, CO6	

Learning Resources

Text Books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third edition, Pearson, 2003, ISBN :10: 0136042597
2. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education(India), 2013, ISBN : 978-1-25-902998-1
3. Elaine Rich, Kevin Knight and Nair, "Artificial Intelligence", TMH, ISBN-978-0-07-008770-5

Reference Books:

1. Nilsson Nils J , "Artificial Intelligence: A new Synthesis", Morgan Kaufmann Publishers Inc. San Francisco, CA, ISBN: 978-1-55-860467-4
2. Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley Publishing Company, ISBN: 0-201-53377-4
3. Andries P. Engelbrecht-Computational Intelligence: An Introduction, 2nd Edition-Wiley India- ISBN: 978-0-470-51250-0

e-Books :

- https://cs.calvin.edu/courses/cs/344/kvlinden/resources/AIMA-3rd-edition.pdf
- https://www.cin.ufpe.br/~tfl2/artificial-intelligence-modern-approach.9780131038059.25368.pdf
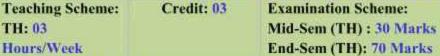- http://aima.cs.berkeley.edu/

NPTEL video lecture link

- https://nptel.ac.in/courses/106/102/106102220/
- https://nptel.ac.in/courses/106/105/106105077/
- https://nptel.ac.in/courses/106/105/106105078/
- https://nptel.ac.in/courses/106/105/106105079/

@The CO-PO Mapping Matrix

CO/ PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	2	1	-	-	1	3	-	2	-	-
CO2	1	3	3	2	3	1	-	3	1	2	-	-
CO3	3	2	2	2	1	1	1	-	-	2	-	-
CO4	1	2	2	1	-	-	1	3	1	2	-	-
CO5	1	2	2	1	-	-	1	3	1	2	-	-
CO6	1	2	2	1	-	-	1	3	1	2	-	-

Savitribai Phule Pune University
Third Year of Computer Engineering (2019 Course)
310244: Computer Networks and Security

Home

Teaching Scheme: TH: 03 Hours/Week	Credit: 03	Examination Scheme: Mid-Sem (TH) : 30 Marks End-Sem (TH): 70 Marks

Prerequisites Courses: --

Companion Course: Computer Networks and Security Laboratory (310247)

Course Objectives:
- To understand the fundamental concepts of networking standards, protocols and technologies
- To learn different techniques for framing, error control, flow control and routing
- To learn different layer protocols in the protocol stacks
- To understand modern network architectures with respect to design and performance
- To learn the fundamental concepts of Information Security

Course Outcomes:

On completion of the course, learners should be able to

CO1: Summarize fundamental concepts of Computer Networks, architectures, protocols and technologies

CO2: Illustrate the working and functions of data link layer

CO3: Analyze the working of different routing protocols and mechanisms

CO4: Implement client-server applications using sockets

CO5: Illustrate role of application layer with its protocols, client-server architectures

CO6: Comprehend the basics of Network Security

Course Contents		
Unit I	**Introduction To Computer Networks**	**06 Hours**

Definition, **Types of Networks**: Local area networks (LAN), Metropolitan area networks (MAN), Wide area networks (WAN), Wireless networks, Networks Software, Protocol, Design issues for the Network layers. **Network Models**: The OSI Reference Model, TCP/IP Model, Network Topologies, Types of Transmission Medium. **Network Architectures**: Client-Server, Peer To Peer, Hybrid. **Network Devices**: Bridge, Switch, Router, Gateway, Access Point. **Line Coding Schemes**: Manchester and Differential Manchester Encodings, Frequency Hopping (FHSS) and Direct Sequence Spread Spectrum (DSSS).

#Exemplar/Case Studies	Study of Campus wide networking.
*Mapping of Course Outcomes for Unit I	CO1

Unit II	**Data Link Layer**	**08 Hours**

Introduction, functions. **Design Issues**: Services to Network Layer, Framing. **ARQ strategies**: Error Detection and correction, Parity Bits, Hamming Codes (11/12-bits) and CRC. **Flow Control Protocols**: Unrestricted Simplex, Stop and Wait, Sliding Window Protocol. **WAN Connectivity**: PPP and HDLC. **MAC Sub layer**: Multiple Access Protocols: Pure and Slotted ALOHA, CSMA, WDMA, CSMA/CD, CSMA/CA, Binary Exponential Back-off algorithm, Introduction to Ethernet IEEE 802.3, IEEE 802.11 a/b/g/n, IEEE 802.15 and IEEE 802.16 Standards.

#Exemplar/Case Studies	Demonstration of DLL protocols on Simulator

*Mapping of Course Outcomes for Unit II	CO2	

Unit III	Network Layer	08 Hours

Introduction: Functions of Network layer. **Switching Techniques**: Circuit switching, Message Switching, Packet Switching. **IP Protocol**: Classes of IP (Network addressing), IPv4 , IPv6, Network Address Translation, Sub-netting , CIDR. **Network layer Protocols**: ARP, RARP, ICMP, IGMP. **Network Routing and Algorithms**: Static Routing, Dynamic Routing, Distance Vector Routing, Link State Routing, Path Vector. **Routing Protocols**: RIP, OSPF, BGP, MPLS. **Routing in MANET**: AODV, DSR, Mobile IP.

#Exemplar/Case Studies	Demonstration of Routing Protocols on simulator.
*Mapping of Course Outcomes for Unit III	CO3

Unit IV	Transport Layer	07 Hours

Process to Process Delivery, Services, Socket Programming. **Elements of Transport Layer Protocols**: Addressing, Connection establishment, Connection release, Flow control and buffering, Multiplexing, Congestion Control. **Transport Layer Protocols**: TCP and UDP, SCTP, RTP, Congestion control and Quality of Service (QoS), Differentiated services, TCP and UDP for Wireless networks.

#Exemplar/Case Studies	Demonstration of Transport layer protocols on Simulator.
*Mapping of Course Outcomes for Unit IV	CO4

Unit V	Application Layer	06 Hours

Introduction, Web and HTTP, Web Caching, DNS, Email: SMTP, MIME, POP3, Webmail, FTP, TELNET, DHCP, SNMP.

#Exemplar/Case Studies	Study of Application Layer protocols using network protocol analyzer. e.g. Wireshark
*Mapping of Course Outcomes for Unit V	CO5

Unit VI	Security	07 Hours

Introduction, Security services, Need of Security, Key Principles of Security, Threats and Vulnerabilities, Types of Attacks, ITU-T X.800 Security Architecture for OSI, Security Policy and mechanisms, Operational Model of Network Security, Symmetric and Asymmetric Key Cryptography.

Security in Network, Transport and Application: Introduction of IPSec, SSL, HTTPS, S/MIME, Overview of IDS and Firewalls.

#Exemplar/Case Studies	Study of security protocols in Network, Transport and Application Layer using network protocol analyzer. e.g. Wireshark
*Mapping of Course Outcomes for Unit VI	CO6

Learning Resources

Text Books :

1. Fourauzan B.,"Data Communications and Networking", 5th Edition, Tata McGraw-Hill, Publications, ISBN:0–07 – 058408 – 7
2. Andrew S. Tanenbaum, Computer Networks, 5th Edition, Pearson India, 2012.

Reference Books :

1. Kurose, Ross, "Computer Networking a Top Down Approach Featuring the Internet", Pearson, ISBN-10: 0132856204
2. L. Peterson and B. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan-Kaufmann, 2012.
3. Douglas E. Comer & M.S Narayanan,"Computer Network & Internet", Pearson Education
4. William Stallings, "Cryptography and Network Security: Principles and Practice", 4th Edition
5. Pachghare V. K., "Cryptography and Information Security", 3rd Edition, PHI,

e-Books :

- https://people.cs.clemson.edu/~jmarty/courses/kurose/KuroseCh1-2.pdf
- http://eti2506.elimu.net/Introduction/Books/Data_Communications_and_Networking_By_Behrouz_A.Forouzan.pdf
- http://intronetworks.cs.luc.edu/current/ComputerNetworks.pdf
- https://www.tutorialspoint.com/data_communication_computer_network/data_communication_computer_network_tutorial.pdf

Case Study:

- https://slideplayer.com/slide/6106945
- http://www.worldcolleges.info/sites/default/files/Cisco_-_Ccie_Fundamental_-_Network_Design_And_Case_Studies.PDF
- http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/explist.php

MOOCs Courses link:

- nptel.ac.in/courses/106/105/106105183
- nptel.ac.in/courses/106/105/106105080
- nptel.ac.in/courses/106/105/106105081
- nptel.ac.in/courses/106/106/106106091
- nptel.ac.in/courses/106/105/106105031
- https://www.mooc-list.com/tags/computer-networking
- https://www.coursera.org/courses?query=computer%20network

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CO3	3	1	2	1	2	-	-	-	-	-	-	1
CO4	1	2	1	2	2	-	-	-	1	-	1	1
CO5	1	3	-	-	1	-	1	1	-	-	-	-
CO6	1	-	2	1	-	1	-	-	-	-	-	1