Amrita School of Computing, Amritapuri Campus,
AmritaVishwaVidyapeetham
Department of Computer Science and Engineering
Course Plan November2023-March 2024

22AIE203 DATA STRUCTURES & ALGORITHMS 2 (L-T-P-C:2-0-3-3)
S3 B.Tech CSE(AIE)

Faculty Information

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Course Description:

Data Structures & Algorithms 2 is a course offered for 3rd-semester B. Tech- CSE(AI) students. This course provides a comprehensive exploration of advanced data structures and algorithms, emphasizing their practical applications. Unit 1 covers graph representations, including matrices and lists, while highlighting scalability and data-driven parallelism. Unit 2 introduces functional data structures and sorting techniques, along with map and reduce operations. In Unit 3, students learn about retroactive structures, geometric algorithms, higher-level data structures, and distributed representations, equipping them with the knowledge to address complex computational challenges in diverse fields like computer science, cryptography, bioinformatics, and distributed systems.

Course Objectives:

- This course helps students to implement and understand space and time optimizing structures and learn their behaviours
- This course helps students to comprehend multidimensionality in memory structures
- This course helps students to understand the geometric organization of data
- This course provides an overview of space-building and immutability in functional data structure
- This course gives an introduction to graphical structures and use them in solving problems

Course Learning Outcomes (CO):

After completing this course, the students will be able to

CO1: Design suitable data structures for problem-solving.
CO2: Use appropriate data structures for problem-solving scenarios.
CO3: Apply the interoperability of data structures to solve problems.
CO4: Visualize multidimensional geometry of data structure and concurrency.

CO-PO Affinity Map

PO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	2	3	1	-	-	-	3	3	-	3	3	3	-

CO2	2	1	2	3	1	-	-	-	3	3	-	3	3	2	-
CO3	2	1	2	3	1	-	-	-	3	3	-	3	3	3	-
CO4	1	-	-	1	3	-	-	-	3	3	-	3	-	1	-

Course Syllabus:

Unit 1
Graphs- Representations of graphs, Adjacency and Incidence matrices, Adjacency List, Dynamic Graphs and persistence - Sparse Matrices- Key Value and Structural implementations, Scalability and data driven parallelism, Block and band matrices. Generalized Matrix and Vector interface. Standard implementations in Numpy (Python) and NDArray (Java) - Temporal manipulation and persistence

Unit 2
Functional data structures, ConsList, immutable Set, Immutable Maps, Sorting immutable linear structures (functional sort). Map and Reduce Operations on Sequences

Unit 3
Retroactive structures and operations – Geometric structures- Point location and sweeping, Orthogonal Range searches and fractional cascading in 2D and 3D. -Higher data structures - Tries and inverted Tries- Radix Sort, Higher Hash functions, SHA256, Chaining of Hash Lists (Blockchain) and change detection, Merkel trees- Distributed bitwise representations and Fusion trees - large string structures (Google and DNA problems)

Textbooks/References

1. Mehlhorn, Kurt, Peter Sanders, and Peter Sanders. Algorithms and data structures: The basic toolbox. Vol. 55. Berlin: Springer, 2008.
2. Bhim P Upadhyaya, Data Structures and Algorithms with Scala. Springer International Publishing, 2019.
3. Aho, Alfred V. "Data Structures and Algorithms, Addison-Wesley." Reading, Mass. (1983).
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. 2009. Introduction to Algorithms, Third Edition (3rd ed.). The MIT Press

Program Outcomes (PO): (Given by NBA, no need for any modifications)

Program Outcomes	Objective
PO1 Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2 Problem analysis	Identify, formulate, review research literature, and analyze complex engineering problems, reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3 Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety and the cultural, societal, and environmental considerations.
PO4 Numerical and Data Analysis	Use research-based knowledge and research design of experiments, analysis and interpretation of data, and synthesis of the valid conclusion.

PO5 Modern tool usage	Create, select and apply appropriate techniques, resources and modern including prediction and modeling to complex engineering activities with an understanding of the limitation
PO6 The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice
PO7 Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of and need for sustainable development.
PO8 Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9 Individual and team work	Function effectively as an individual and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10 Communication	Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instruction.
PO11 Project management and finance	Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.
PO12 Life-long learning	Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO): (Specific for Department of CSE, Amritapuri, no need for modifications here)

Program Specific Outcomes	Objectives
PSO1 Adopt Standard Practices	Ability to design and engineer, innovative, optimal and elegant computing solutions to interdisciplinary problems using standard practices, tools and technologies.
PSO2 Research and Innovation	Ability to learn emerging computing paradigms for research and innovation

Lecture Plan

Week #	Lecture No(s)	Topics	CO	PO/PSO*
Week#1 Non20-24, 2023	1-2	Graphs- Representations of graphs, Adjacency and Incidence matrices, Adjacency List, Graph Traversals-BFS,DFS	CO1 CO3	PO1, PO3, PO5, PO8, PO10, PSO1, PSO2
Week#2 Nov27-30, 2023	3-4	Shortest Path Algorithm-Dijkshtra, Floyd Varshall, Bellman ford	CO1 CO2	PO1, PO3, PO5, PO8, PO10, PSO1, PSO2
Week #3 Dec4-8,2023	5-6	Spanning Tree-Prims, Kruskal	CO1 CO2	PO1, PO3, PO5, PO8, PO10, PSO1, PSO2
Week #4 Dec11-15,2023	7-8	Dynamic Graphs-Link Cut Tree, Splay Tree and persistence - Sparse Matrices- Key Value and Structural implementations	CO1, CO3, CO4	PO1-PO8, PO10, PSO1, PSO2
Week #5 Dec18-22,2023	9-10	Block and band matrices. Generalized Matrix and Vector interface	CO1, CO3, CO4	PO1-PO8, PO10, PSO1, PSO2
Week #6 Dec26-30,2023	11-12	Standard implementations in Numpy (Python) and NDArray (Java) - Temporal manipulation and persistence	CO2, CO3	PO1-PO4, PO6-PO8, PO10, PSO1,PSO2
Week #7 Jan1-6,2024	13-14	Functional data structures, ConsList, immutable Set, Immutable Maps, Sorting immutable linear structures (functional sort).	CO1, CO3	PO1-PO8, PO10, PSO1, PSO2
Week #8 Jan8-12	15-16	Mid Term Examination		
Week #9 Jan15-20	17-18	Map and Reduce Operations on Sequences	CO1 CO2 CO3	PO1-PO8, PO10, PSO1, PSO2
Week #10 Jan22-25	19-20	Retroactive structures and operations – Geometric structures- Point location and sweeping, Orthogonal Range searches and fractional cascading in 2D and 3D.	CO1 CO2 CO3	PO1-PO8, PO10, PSO1, PSO2
Week #11 JJan29-Feb2	21-22	Higher data structures - Tries and inverted Tries-Radix Sort	CO2, CO3	PO1-PO4, PO6-PO8, PO10, PSO1,PSO2
Week #12 Feb 5-9	23-24	Higher Hash functions, SHA256, Chaining of Hash Lists (Blockchain) and change detection	CO1, CO3, CO4	PO1-PO8, PO10, PSO1, PSO2

Week #13 Feb12-17	25-26	Merkel trees- Distributed bitwise representations and Fusion trees	CO1, CO3, CO4	PO1-PO8, PO10, PSO1, PSO2
Week #14 Feb19-23	27-28	Large string structures (Google and DNA problems)	CO2, CO4	PO1-PO4, PO6-PO8, PO10, PSO1,PSO2
Week #15 Feb26-29	29-30	Revisions		

Evaluation Policy: 70 (Internal Assessment) + 30 (End Semester)

Evaluation Policy	Components	Remarks-Submissions	Split up	**Weightage**
Continuous Evaluation (Lab +Theory)	Quiz-total 2	Quiz #1-week 3 Quiz #2-Week 6	Quizzes with equal weightage (2*10M=20 Marks)	50 %
	Assignments#1 (Week 4)	Numerical Problems	1*5M=5 Marks	
	Lab sheet Assignment #2	Lab Sheet Evaluation (Completeness & timely submission	5 Marks	
	Lab Component	Lab Viva (#1)	10 Marks	
		Lab Exam	10Marks	
Mid Term				20 %
End Semester				30 %

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