Department Elective – I

(CT(DE) - 21001) Advanced Data Structures

Teaching Scheme:

Lectures: 3 Hrs/week

Examination Scheme:

Assignment/Quizzes – 40 Marks

End Sem Exam – 60 Marks

Course Outcomes

Students will be able to:

1. Design new operations by using advanced data structures such as search trees, dictionary structures, and multi-dimensional data structures
2. Analyze the time and space complexity of the operations associated with the advanced data structures and there by appreciate the use of these structures
3. Analyze performance of new data structures
4. Propose new customized structures for efficient dictionary.
5. Apply advanced data structures to solve real life problems.

Course Contents

Unit 1: Review of Basic Concepts: Abstract data types, Data Structures, Algorithms, Asymptotic notations, Time Analysis of recursive programs, Amortized analysis. **[4 Hrs]**

Unit 2: Search Trees: Binary Search Tree, Balanced Binary Search Trees – (AVL Trees, Red-Black Trees, Splay Trees), Multi-way Search Trees – (B Trees, 2-3 Trees), Specialized Search Trees – (Treaps, Skip lists), Multidimensional Search Trees – (K-D Trees, Segment Trees). **[8 Hrs]**

Unit 3: Heaps: Overview, Leftist Heaps, Skew Heaps, Binomial Heaps, Fibonacci Heaps, Applications – (Priority Queue, Graph Algorithms, Huffman Coding). **[7 Hrs]**

Unit 4: Data Structures for Strings: Introduction to String Data Structures, Tries, Compressed Tries, Suffix Trees, Suffix Arrays, Applications – (Search Engines, Bioinformatics, Pattern Matching). **[7 Hrs]**

Unit 5: Hash Tables: Introduction, Internal Working of Hashing, Collision resolution techniques, Hash Functions, Load Factor and Resizing, Applications. **[7 Hrs]**

Unit 6: Advanced Graph and Problems: Disjoint set union problem, Maximal flow problem, Shortest Path Problem, Hamiltonian Path and Circuit Problem, Introduction to Hypergraphs, Applications – (Social Network Analysis, A* for AI Pathfinding) **[7 Hrs]**

Text Books

- Introduction to Algorithms; 3rd Edition; by by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein; PHI Learning Pvt. Ltd.; ISBN-10: 0262033844; ISBN-13: 978-0262033848
- Advanced Data Structures; by Prof Peter Brass; Cambridge University Press; ISBN-10: 1107439825; ISBN-13: 978-1107439825

Reference Books

- Handbook of Data Structures and Applications; by Dinesh P. Mehta (Editor) , Sartaj Sahni (Editor) ; Chapman and Hall/CRC; ISBN-10: 1584884355;ISBN-13: 978-1584884354

Internet Resources:

- MIT OpenCourseWare
- https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-851-advanced-data-structures-spring-2012/index.htm
- COP 5536: Advanced Data Structures: Prof. Sartaj Sahni, University of Florida
- https://www.cise.ufl.edu/~sahni/cop5536/