Birla Institute of Technology & Science, Pilani
Hyderabad Campus

**SECOND SEMESTER 2020-2021**

Course Handout Part II

Date: 16-01-2021

In addition to Part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

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|---|---|---|
| *Course No.* | : | *CS F211* |
| *Course Title* | : | Data Structures & Algorithms |
| *Instructor-in-Charge* | : | Venkatakrishnan Ramaswamy (venkat@hyderabad.bits-pilani.ac.in) |
| *Instructors* | : | K Sai Anirudh,<br>Manjanna B,<br>NL Bhanumurthy,<br>Apurba Das,<br>S Vishwanath Reddy,<br>T Sahithi |

**Scope and Objective of the Course:**

Data Structures & Algorithms is a foundational course in Computer Science. It pertains to the design of efficient logical structures to store, access & manipulate data and the design of efficient algorithms to solve computational problems. The course starts with defining precise notions of measuring efficiency of algorithms. The course covers design, implementation and analysis of data structures such as linked lists, stacks, queues, heaps, binary search trees and graphs. It discusses sorting and search techniques, with detailed performance analysis. Additionally, the course covers algorithm design techniques such as Divide-and Conquer, Greedy Algorithms and Dynamic Programming, with applications to computational problems.

The objectives of the course are for the student to be able to

- Understand asymptotic time complexity and analyze algorithms using this formalism.
- Understand basic data structures with performance analysis and obtain the ability to write correct and efficient implementations.
- Understand basic searching and sorting techniques.
- Understand basic algorithmic design techniques and acquire the ability to apply these techniques to design correct and efficient algorithms to pertinent problems.
- Understand rudimentary notions of time complexity lower bounds, especially in relation to search and sorting problems.

**Textbook:**

**T1.** T.H. Cormen, C.E. Leiserson, R.L. Rivest, and C. Stein. ***Introduction to Algorithms,*** *MIT Press (Indian reprint: Prentice Hall of India),* 3rd Edition, 2009.

**Reference books**

**R1.** M.T. Goodrich and R. Tamassia, ***Algorithm Design: Foundations, Analysis and Internet examples,*** John Wiley & Sons, 2006.

**R2.** J. Kleinberg and E. Tardos, ***Algorithm Design***. Pearson Education, 2013.

**R3.** S. Dasgupta, C. Papadimitriou, U. Vazirani, ***Algorithms***, McGraw-Hill (Indian edition), 2017.

**Course Plan:**

| Lecture No. | Learning objectives | Topics to be covered | Chapter in the Text Book |
|---|---|---|---|
| 1-2 | Introducing the importance of data structures & algorithms | Course introduction. | 1 |
| 3-4 | Introduce asymptotic notation formalism for analyzing performance of algorithms | Growth of functions | 3 |
| 5-12 | Understand standard sorting techniques with performance analysis | Sorting algorithms: Insertion sort, Bubble sort, Quick sort, Merge sort, Radix sort and Bucket sort.<br>Lower bounds on complexity of comparison-based sorting algorithms. | 2, 7, 8 |
| 13-15 | Understand standard selection techniques with performance analysis | Selection algorithms. Linear-time selection algorithm via median of medians | 9 |
| 16-25 | Understand elementary data structures | Elementary Data Structures: Stacks, Queues, Linked lists, Priority queues, Heaps, Heapsort | 10, 6 |
| 26-27 | Understand hash tables | Hash tables | 11 |
| 28-30 | Understand binary search techniques and techniques to balance them | Binary search trees, balancing binary search trees, Red-Black Trees, Skip lists | 12, 13 |
| 31-37 | To understand standard algorithm design techniques and acquire the ability to correctly apply them to problems. | Algorithm design techniques: Divide and conquer, Greedy algorithms, Dynamic Programming, Backtracking, Branch & Bound | 4, 15, 16 |
| 38 | To understand basics of amortized analysis | Amortized analysis | 17 |
| 39-42 | To understand basic graph algorithms and their performance analysis | Graph algorithms: Traversals, Shortest Path Algorithms | 22, 24, 25 |

**Evaluation Scheme:**

| Component | Duration | Weightage | Date & Time | Nature of Component |
|---|---|---|---|---|
| Midsemester Test | 90 minutes | 30% | 01/03 9.00 - 10.30AM | Open book |
| Laboratory -- Continuous evaluation & Final Test | Weekly lab assignments will be evaluated. Final lab test will be of 2 hours | 35% in total: 24% -- Continuous evaluation (approximately half will be done pre-midsem) 11% -- Final lab test | TBA | Open book |
| Comprehensive Examination | 120 minutes | 35% | 01/05 FN | Open book |

**Chamber Consultation Hour:** At https://whereby.com/vramaswamy at a time that will be announced in class.

**Notices:** Will be posted online on the CMS course management system. Students are expected to subscribe for email notifications from CMS that they would need to check several times a day. Students are responsible for keeping up with announcements.

**Make-up Policy:**
No make-ups will be offered, except in case of medical or family emergencies of a severe nature or other unavoidable extenuating circumstances, as judged by the Instructor-in-Charge, for which prior permission must be sought, where feasible. Documented evidence (e.g. a Doctor's note) will be necessary before consideration of such a request.

**Academic Honesty and Integrity Policy**: Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**INSTRUCTOR-IN-CHARGE**
**CS F211**