Design & Analysis of Algorithms

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| Instructor *Asim Rehan* Contact Detail +923465317740  arehan@numl.edu.pk Office Location *Ghazali Block,*  *Basement, Room 20* Office Hours *8:00 to 10:00*  *Wednesday*  *8:00 to 10:00*  *Thursday* | Course Overview  |  |  | | --- | --- | | Classes | BSCS | | Session | Fall 2020 | | Course Time | Monday, 8:00 AM– 09:15 AM  Tuesday, 12:15 PM – 1:30PM | | Credit Hours | 03 (3,0) | | Total Weeks | 16 | | Prerequisite | *DSA* |  Course Description This course is an introductory graduate level and advanced undergraduate course on design and analysis of algorithms. Topics such as Linear Algorithms, Iterative algorithms, divide-and-conquer, dynamic programming, String Matching algorithms, Randomized algorithms, Greedy algorithms and most of the searching and sorting algorithms will be covered. |

# Course Learning Outcomes

At the end of this course, Students should be able to

* Given a problem, students would be able to design and analyze efficient algorithms for it
* Determine informally the time and space complexity of simple algorithms
* Use of the strategies (brute-force, greedy, divide-and conquer, and dynamic programming) to solve an appropriate problem.
* Students would have an understanding of the fundamental algorithms in computer science and engineering and be able to use this knowledge to help solve problems in computer science and engineering more efficiently.

# Course Schedule

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| Week | Topic | Material | Assignment/Quiz |
| Week 1 | **Basics:**  Introduction to Course, Analyzing algorithms  RAM (Computational Model, Computational Complexity | Slides |  |
| Week 2 | Proof techniques, Induction Summations  Asymptotic analysis (Big-O, Big Ω, Big Θ) | Slides |  |
| Week 3 | **Amortized Analysis:**  Charging schemes, potential method,  binary incrementing/decrementing counter, loop invariants | Slides |  |
| Week 4 | **Linear Programming:**  Sorting Algorithms Analysis (Bubble Sort, Selection Sort) | Slides | Quiz |
| Week 5 | Insertion Sort, Custom Sorting Algorithms ) | Slides | Assignment |
| Week 6 | Searching Algorithms  Recursion | Slides |  |
| Week 7 | Recurrence Relations  Method to Solve Recurrence Relation (Iteration Method)  Exercise | Slides | Quiz  Assignment |
| Week 8 | Algorithm Design Techniques.  Divide-and-conquer: Merge-Sort + Complexity Analysis | Slides |  |
| Week 9 | Quicksort, Randomized Quicksort + Complexity Analysis | Slides | Quiz  Assignment |
| Week 10 | Recursion Tree Method | Slides |  |
| Week 11 | Master’s Theorem | Slides |  |
| Week 12 | Bucket Sort, String Matching Algorithms | Slides | Quiz  Assignment |
| Week 13 | Heaps | Slides |  |
| Week 14 | Hashing | Slides | Project |
| Week 15 | Greedy algorithms | Slides |  |
| Week 16 | Dynamic programming | Slides |  |

# Course Report/Degree Project

Students are required to write a report on a ----------- topic of your choosing, subject to professor approval. The timeline for the reports is as follows

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| --- | --- | --- |
| Deliverables | | Due Date |
| Assignments | Accordingly | |
| In-class oral presentations of reports: | 21st December 2020 | |
| Final report due | 28th  December 2020 | |

# Recommended Textbook

1. Introduction to Algorithms (3rd edition) by Thomas H. Corman, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein
2. Algorithm Design (1st edition, 2013/2014) Jon Kleinberg, Eva Tardos

**Reference Material**

Online Material: *Journal and Conferences:*

* IEEE Access

**Teaching Methodology**

* Lecturing, case studies, recent articles review,
* Analyzing upcoming conferences content review, special issues of journals

**Grading Policy**

Your final grade will depend on the following:

* Attendance and participation in class discussions
* Scores in assignment and quiz.
* The quality of your oral presentation and final report.

However, following calculations are necessary for the final evaluation:

* + - Mid Term Exam: 30%
    - End Term Exam: 50%
    - Assignment and Quiz: 10%
    - Research Article Report and Presentation: 10%
    - (You may add more to define your internal evaluation policy)

# Academic Honesty and Cheating

The University, the Faculty, and the teaching staff take cheating, plagiarism and other forms of academic fraud very seriously.

* Note 1: No late academic deliverables will be accepted.
* Note 2: There are no "make up" tests. Tests missed for no reason are deemed to have been written and failed and are marked “F”.