



UNIVERSITY OF ZAKHO
DIRECTORATE OF QUALITY ASSURANCE



Design & Analysis of Algorithms

Course Book

Faculty/ College: Faculty of Science

Department of: Computer Science

Year: 3

Module Name: Design & Analysis of Algorithm

Academic Year: 2019-2020

1. Introductory information:

| | |
|-----------------------|---|
| Module Name | Design & Analysis of Algorithm |
| Module Code | Click or tap here to enter text. |
| Module Type | Requisite |
| Hours per week | Theory (2 hours) |
| No. of ECTS | 4 |
| Semester | 3 |
| Lecturer(s) in charge | Abdulhakeem Othman Mohammed |
| Academic Title | Lecturer |
| Department | Computer Science |
| Faculty /College | Science |
| Contact details | E-mail address: a.mohammed@uoz.edu.krd |
| | Mobile Number: Click or tap here to enter text. |

2. Module Overview:

This course will cover basic concepts in the design and analysis of algorithms, and fundamental data structures. The goal is to introduce a number of important algorithm design techniques as well as basic algorithms that are interesting both from a theoretical and also practical point of view. First, we will introduce some methods for analysing algorithms. We will cover techniques for proof of the correctness of algorithms and also asymptotic analysis of algorithm time bounds by the solution of recurrence equations. Then, we will introduce basic data structures including priority queues, heaps, dictionaries and hash tables. We will cover basic algorithm design techniques such as divide-and-conquer, dynamic programming, and greedy techniques for optimization. We will apply these design and analysis techniques to derive algorithms for a variety of tasks such as sorting, searching, and graph problems. Some specific topics include: Worst and average case analysis. Elementary data structures. Recurrences and asymptotics. Efficient algorithms for sorting, searching, and selection. Data structures: binary search trees, heaps, hash tables. Algorithm design techniques: divide-and-conquer, dynamic programming, greedy algorithms, amortized analysis. Algorithms for fundamental graph problems: minimum spanning tree, depth-first and breadth-first algorithms for finding paths and matchings, topological sort, and shortest paths. Possible additional topics: network flow.

3. Module Objective:

Students will learn:

- i. Advanced data structures and their analysis;
- ii. Different techniques and methods for designing efficient algorithms for solving computational problems.
- iii. Evaluate and analyse the efficiency of algorithms.

4. Assessment Strategy:

| Task(s) | Marks |
|----------------------|--|
| Assignments | 10% |
| Quizzes | 10% |
| Mid-term examination | Two midterms: each will be 20%, total: 40% |
| Final examination | 40% |

5. Learning OUTCOMES:

Algorithms are the soul of computing; they provide the theoretical backbone of computer science. Students will be able to:

1. To analyze the running time of algorithms.
2. To think algorithmically like a "real" computer scientist;
3. Prove the correctness of algorithms.
4. Ability to choose appropriate algorithm design techniques for solving problems.
5. Ability to understand how the choice of data structures and the algorithm design methods impact the performance of algorithms.
6. Develop the ability to design efficient algorithms;

6. Teaching and Learning Methods:

2 hours lecture. We will have a lot of assignments and quizzes which will be a good preparation for the exam.

7. Module Reading List and References:

Textbooks:

- 1) *Algorithm Design: Foundations, Analysis, and Internet Examples*, Wiley, 2002, ISBN 0-471-38365-1 (by Michael T. Goodrich and Roberto Tamassia)

2) *Introduction to Algorithms*, by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein, 3rd edition, MIT Press, 2009

8. Syllabus:

This schedule is not final. It may change.

| Weeks | Topic(s)/ Theoretical | Date |
|-------|--|------------|
| 1 | Syllabus and Introduction | 12/9/2019 |
| 2 | Analysis of algorithms | 19/9/2019 |
| 3 | Elementary Data Structures + Quiz1 | 26/9/2019 |
| 4 | Priority Queues and Heaps+ Assignment1 | 3/10/2019 |
| 5 | Binary Search Trees + Assignment2 | 10/10/2019 |
| 6 | Red-Black TreesQuiz2 | 17/10/2019 |
| 7 | Merge Sort, Quick Sort | 24/10/2019 |
| 8 | Sorting Lower Bound, Radix Sort | 31/10/2019 |
| 9 | Sets, Selection | 7/11/2019 |
| 10 | Greedy Method | 14/11/2019 |
| 11 | Divide and Conquer | 21/11/2019 |
| 12 | Dynamic Programming | 28/11/2019 |
| 13 | Graphs, Breadth-First Search | 5/12/2019 |
| 14 | Graphs, Depth-First Search | 12/12/2019 |
| 15 | Shortest Paths, Minimum Spanning Trees | 19/12/2019 |

9. Examinations:

- 1. Compositional:** In this type of exam the questions usually start with Explain how what are the reasons for...? Why...? How....? With their typical answers, Examples should be provided

Question: You are given two integer arrays A and B. Design an algorithm in $O(n \log n)$ time to check if there is an integer i which is in both arrays.

- 2. True or false type of exams:** In this type of exam, a short sentence about a specific subject will be provided, and then students will comment on the trueness or falseness of this particular sentence. Examples should be provided

Question: The greedy method will always produce an optimal solution to any optimization problem.

10. Peer Review:

| | |
|----------------|----------------------------------|
| Name | Click or tap here to enter text. |
| Academic Title | Choose an item. |
| E-mail | Click or tap here to enter text. |
| Signature | Click or tap here to enter text. |

Does the course book meet the requirements of the module? Choose an item.

If (NO), please specify what needs to be changed in the table below

Click or tap here to enter text.