King Fahd University of Petroleum & Minerals
College of Computer Sciences and Engineering

Course Name: ICS 353: Design and Analysis of Algorithms (3-0-3)
Semester: Summer Term 2014 (2013-3)
Course URL: http://faculty.kfupm.edu.sa/ICS/darwish/ics353-summer2014/
Class Time & Location: UMTW 12:45-2:00 pm, 24-158
Designation: Required
Instructor: Dr. Nasir Al-Darwish
Contact Info: **phone:** 860-2942, **e-mail:** darwish@kfupm.edu.sa
Office Location & Hours: 22-309, UMT: 2:00-2:50 pm

Catalog Description

Algorithms and problem solving. Basic algorithmic analysis. Advanced algorithmic analysis. Advanced data structures. Algorithmic strategies & analysis of fundamental computing algorithms. Basic computability. The complexity classes P and NP.

Prerequisite: ICS 202, ICS 253

Required Material

Textbook: M. Alsuwaiyel. Introduction to Algorithms: Design Techniques and Analysis.

Recommended References

1. Instructor's Lecture Notes and Slides (available at the course web-site).

2. Nasir Al-Darwish. Algorithms: Development and Programming. http://www.amazon.com/Algorithms-Development-Dr-Nasir-Al-Darwish/dp/1475057105.

Course Objectives

1. To convey the importance of studying the complexity of a given algorithm.

2. To introduce various algorithmic design techniques.

3. To utilize data structures and/or algorithmic design techniques in solving new problems.

4. To know basic computability concepts and the complexity classes P, NP, and NP-Complete.

5. To learn some techniques to deal with hard problems.

Learning Outcomes

After completion of this course, the student shall be able to:

- Analyze the complexity of a given algorithm. *[Program Outcome a]*
- Apply classical sorting, searching, optimization and graph algorithms. *[Program Outcome j]*.
- Compare, contrast, and choose appropriate algorithmic design techniques to present an algorithm that solves a given problem. *[Program Outcome j]*
- Able to explain NP-Completeness and deal with NP-complete problems. *[Program Outcome j]*

Assessment Plan

Assignments and Quizzes	20%
Major Exam # 1	25%
Major Exam # 2	25%
Semi-Comprehensive Final Exam	30%

Schedule of Topics

Allotted Time*	Topics	Readings**
Part1: (7 lectures)	Overview of algorithm design and analysis. Basic problem solving techniques: brute-force search and problem reduction. O-notation. Sequential and binary search. Selection and Insertion Sort. Top-Down and Bottom-Up MergeSort. Quicksort.	Ch. 1
Part2: (4 lectures)	Heaps. HeapSort. Disjoint Set Data Structure. Union-Find algorithms and sample applications.	Ch. 4
Part3: (8 lectures)	Techniques based on Induction and Recursion. Recursive selection/ and insertion Sort. Converting recursion to iteration. Constructing a Latin square. Strong induction. Strengthening the induction hypothesis. Partitioning. Set Union. Polynomial evaluation. Integer exponentiation. Counting Sort. Radix Sort.	Ch. 5
Part4: (5 lectures)	Divide-and-Conquer. Finding Min and Max. Master Theorem. Constructing a tournament schedule. Multiplication of polynomials.	Ch. 6
Part5: (5 lectures)	Dynamic Programming. Computing binomial coefficients. The Knapsack problem. Memoization. Finding the majority element. The all-pairs shortest path problem. Floyd's Algorithm.	Ch. 7
Part6: (6 lectures)	Greedy approach. Dijkstra's single source shortest path algorithm. Prim's and Kruskal's minimum spanning tree algorithms. Graph traversal (depth-first search and breadth-first search). Topological sorting.	Ch. 8:1-4
Part7: (4 lectures)	Backtracking. Graph Coloring.	Ch. 13: 1-3
Part8: (5 lectures)	Introduction to NP-Completeness. Reducibility. The Halting problem. Techniques for dealing with hard problems.	Ch. 10: 1-4

 * Based on 45-minute lectures.
 ** From the course Textbook. Some topics are found in the Instructor's Lecture Notes.

Course Policies

- *Student collaboration* and class participation is encouraged; According to several studies, the more the student engagement in the learning process, the better they learn.
- Attendance
  - Attendance will be checked at the beginning of each class.
  - Each 2 late attendances will be considered as one absence.
  - 1% will be deducted for every two unexcused absences.
  - More than 9 absences will result in a DN grade.
- No make-up of Quizzes or Exams.
- Cheating will be reported to the Department Chairman and will be severely penalized.
- Students are responsible for all announcements made by the instructor
- Taking notes during the class is highly recommended