KAU CPCS 223 • 2022–23

Analysis and Design of Algorithms

Dr. Muhammad Al-Hashimi

Credits 3

Prerequisite CPCS 204 (Data Structures)

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Office Hours Visit homepage for current times

We learn in this course how to develop efficient computer-based solutions. We examine fundamental algorithms from various application areas. We explore how to construct solutions using classic methods, such as divide and conquer or trading time for space, then study how well a solution performs. The course includes a programming component to help develop an experience-based understanding of core issues. Students are encouraged to compare the characteristics of different algorithms that solve the same problems. Check the FCIT syllabus for the official catalog description.

Topics Current teaching schedule in homepage.

- ✎ **Background** Summations, recurrence relations, Master theorem, Fibonacci numbers, formal definition and characterization of algorithms.
- ✎ **Algorithm Efficiency** Measuring eficiency, run time growth and asymptotic notation, efficiency classes, using sums and recurrences to determine efficiency, empirical methods.
- ✎ **Algorithm Design** Brute force, divide-and-conquer, decrease-and-conquer, problem transformation, trading space for time.
- ✎ **Fundamental Algorithms** Efficient sorting and searching, greatest common divisor, string matching, geometric (closest pair, convex hull), graph (traversals and related properties, topological sorting), numerical (multiplying large integers, matrix multiplication, Gaussian elimination, LU decomposition, solution of systems of linear equations, matrix inversion, exponentiation and polynomial evaluation), statistical (mode, selection and efficient computation of median), combinatorial (generating set permutations and subsets, travelling salesman, knapsack, and assignment problems), operations on binary and select balanced search trees and related properties, fake coin problem and more.
- ✎ **Data structures** Binary search trees, heaps, AVL and 2-3 trees.

Textbook Anany Levitin, *Introduction to The Design and Analysis of Algorithms*, Addison-Wesley (Pearson International Edition), 3rd Edition, 2011. ISBN: 027376411X

Assessment Empirical analysis of algorithm performance is explored in a term project. Details on the homepage.

20%	Midterm exam
20%	Project
20%	Homework exercises
40%	Final exam

Learning Resources Check homepage for the latest lecture schedule, course material, discussion group, and software tools.

Outcomes Detailed learning outcomes are articulated in the course file. Broadly, students will:

1. Study solutions to fundamental programming problems
2. Examine how computer-based solutions are designed
3. Determine performance of solution
4. Compare different computer-based solutions to the same programming problem

References

1. Robert Sedgwick and Kevin Wayne, *Algorithms*, fourth edition, Addison-Wesley, 2011. ISBN: 9780321573513
2. Robert Sedgwick, *Algorithms in C*, Addison-Wesley, 1990. ISBN: 0201514257
3. Steven Skiena, *The Algorithm Design Manual*, Springer, 2nd edition, 2008. ISBN: 9781848000698

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