ECE406   **Algorithm Design and Analysis**   **Winter 2013**

Course Motivation: Algorithms provide methods for solving problems, and are at the foundation of computing. It is important that practitioners in electrical and computer engineering understand how algorithms are designed, and how to analyze them for correctness and efficiency. It is important also to be able to distinguish intractable problems from ones that are tractable so one does not naively seek efficient solutions when none may exist. For cases that are intractable, it is important to know how to design approximate solutions that satisfy bounds on correctness and efficiency. Industry has long recognized the critical importance of algorithms that are correct and efficient.

Instructor: Prof. Stephen L. Smith   (stephen.smith@uwaterloo.ca; Office: EIT 3108).

- Office Hours: Wed 5:00-6:00 (EIT 3108), or as arranged otherwise.
- Please put "ECE406" at the front of your subject line for all course related email.

TAs: Elaheh Fata (efata@uwaterloo.ca); Haotian Zhang (h223zhan@uwaterloo.ca)

Lectures: Mon/Wed/Fri: 3:30-4:20 (QNC 1502)

- Lectures will not be held during reading week (Feb 18 - 22).
- Mar 29 is a holiday, and thus our last class is held on Monday, Apr 08.

Tutorials: Fri 5:30-6:20 (QNC 1502 with Elaheh Fata)

Course Outline: Design and analysis of efficient, correct algorithms. Advanced data structures, divide and conquer algorithms, recurrences, greedy algorithms, dynamic programming, graph algorithms, search and backtrack, inherently hard and unsolvable problems, approximation and randomized algorithms, and amortized analysis.

Topic	Text	Duration
Introduction to algorithms	Chapter 0	1.5 hours
Factoring, primality, cryptography, hashing	Chapter 1	5 hours
Divide and conquer algorithms	Chapter 2	5 hours
Graphs, decompositions and depth-first search	Chapter 3	3 hours
Paths in graphs: Dijkstra's alg, priority queues	Chapter 4	3 hours
Greedy algorithms: MST, MP3 encoding, set cover	Sec 5.1, 5.2, 5.4	4 hours
Dynamic Programming: Shortest paths, knapsack	Chapter 6	4 hours
Inherently hard problems: NP-completeness, reductions	Chapter 8	6 hours
Intelligent exhaustive search and approximation algorithms	Chapter 9	4.5 hours

Textbook: The main (and required) text for the course is

1. S. Dasgupta, C. Papadimitriou, and U. Vazirani, *Algorithms*, McGraw-Hill, 2008. Freely available online at `http://www.cs.berkeley.edu/~vazirani/algorithms.html`.

The following textbooks may also be useful for additional information on subjects:

1. J. Kleinberg and E. Tardos, *Algorithm Design*, Addison Wesley, 2005.
2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, *Introduction to Algorithms*, MIT Press, 2009

Grading: The course will consist of homeworks, a midterm, and a final exam. The homeworks will assigned roughly once every two weeks. The grading scheme is

- Homeworks: 20%
- Midterm: 30%
- Final Exam: 50%

There will be no extensions or late homeworks accepted. As compensation, the homework with least score will be dropped in calculating the homework average.

General University of Waterloo Guidelines:

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. Check `http://www.uwaterloo.ca/academicintegrity/` for more information.

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70, Student Petitions and Grievances, Section 4, `http://www.adm.uwaterloo.ca/infosec/Policies/policy70.htm`.

When in doubt please be certain to contact the departments administrative assistant who will provide further assistance.

Discipline: A student is expected to know what constitutes academic integrity—check `http://www.uwaterloo.ca/academicintegrity/` to avoid committing an academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offence, or who needs help in learning how to avoid offences (e.g., plagiarism, cheating) or about rules for group work/collaboration should seek guidance from the course instructor, academic advisor, or the undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, `http://www.adm.uwaterloo.ca/infosec/Policies/policy71.htm`.

For typical penalties check Guidelines for the Assessment of Penalties, `http://www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm`.

Appeals: A decision made or penalty imposed under Policy 70 (Student Petitions and Grievances) (other than a petition) or Policy 71 (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals) `http://www.adm.uwaterloo.ca/infosec/Policies/policy72.htm`.

Note for Students with Disabilities: The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.