

# COMPSCI 530: Design and Analysis of Algorithms

## Handout #1: Course Information

Fall 2013

**Summary:** Algorithms are a cornerstone of computational sciences and the need for efficient algorithms is ubiquitous in modern technology. However, the primary goals of algorithm design, the resources that need to be optimized, and even the model of computation varies widely between application areas. In this course, we will study some of the fundamental principles of algorithm design that appear in multiple areas and have had broad impact. In addition, we will focus on the mathematical tools that are frequently used in the theoretical analysis of algorithms, and study how such analysis, in turn, influences algorithm design. The course will be at a graduate level and will aim to serve the following two objectives:

- provide necessary training for the future algorithms researcher, and
- provide a sufficient set of algorithmic tools for application to other areas in computational sciences for the non-algorithms researcher.

### Course Staff

Instructor: Debmalya Panigrahi; D203, LSRC; debmalya@cs.duke.edu; <http://www.cs.duke.edu/~debmalya/>  
Teaching Assistant: Jiangwei Pan; N05, North Building; jwpan@cs.duke.edu; <http://www.cs.duke.edu/~jwpan/>  
Email for Course Staff: compsci530-staff@cs.duke.edu

**Course Webpage:** <http://www.cs.duke.edu/courses/fall13/compsci530/>

**Course Mailing List:** compsci530@cs.duke.edu

This mailing list includes *all* participants in the course. You should add yourself to the mailing list by signing up in the first lecture. Before the second lecture, we will send an email to this mailing list. If you receive no emails before the second lecture, send an email to Jiangwei asking him to add you to the mailing list. It is *your* responsibility to make sure that you are receiving emails sent to the course mailing list before the beginning of the second week of classes.

*All email communication about the course (including emails to one or both the course staff) must have COMPSCI 530 in the subject line.*

### Office Hours

Debmalya Panigrahi: Wednesdays 3-4 pm and Fridays 2-3 pm (in LSRC D203)  
Jiangwei Pan: Mondays 12:30-1:30 pm and Wednesdays 4:40-5:40 pm (in LSRC D301)

**Lectures:** Tuesdays and Thursdays 4:40-5:55 pm in LSRC D106

**Topics:** This is a *tentative* list of topics to be covered in this course:

- **Data structures:** Fibonacci heaps; splay trees
- **Network flows:** Augmenting paths; blocking flows; push-relabel; scaling
- **Linear programming:** Duality; separation oracles; applications
- **Randomized algorithms:** Tail bounds; counting via sampling; Monte Carlo and Las Vegas algorithms; power of two choices

- **NP-hardness and approximation algorithms:** Polynomial-time reductions; examples of approximation algorithms; strong NP-hardness and polynomial-time approximation schemes; LP relaxations and rounding; primal-dual algorithms
- **Online algorithms:** Competitive analysis; paging and k-server; online LP rounding

**Prerequisites:** COMPSCI 330 (or an equivalent undergraduate course in algorithms) is a hard prerequisite. In addition, students must demonstrate maturity in mathematical reasoning. If you are looking for a graduate algorithms course with more of an applications focus, you should consider taking COMPSCI 590.02.

**Course Requirements:** The course grades will be determined based on:

- Problem Sets (PSETs) [**weightage: 40%**]
- MIDTERM examination [**weightage: 30%**]
- FINAL examination [**weightage: 30%**]

**Problem Sets.** There will be a total of 6 PSETs, one roughly every two weeks, and due before class on the day that the next PSET is released (see the course website for the PSET release schedule). Solutions to PSETs have to be submitted via **Sakai**.

Collaboration is allowed on PSETs. However, every student **MUST** write his/her own answer after understanding the solution and clearly state the names of all collaborators for each problem. Students will be heavily penalized if they are unable to explain their answers on being asked to do so. Collaboration should be limited to groups of 2-3 students.

PSETs submitted within one week of the deadline will be awarded 50% credit. PSETs submitted more than one week late will receive no credit. In exceptional circumstances, students can submit PSETs late without any loss in credit if prior permission is obtained from the instructor.

**Scribing.** You are also **required** to scribe one lecture. The quality of your scribe notes may be used to determine your grade in borderline cases. A scribing template will be provided and you will have to adhere to it. Scribe notes are due by midnight the day after lecture (i.e. Wednesday midnight or Friday midnight for a Tuesday lecture and a Thursday lecture respectively). The naming convention to be followed is *compsci530-fall2013-lecture-#.file-extension* (e.g. the source file for Lecture 1 should be called *compsci530-fall2013-lecture-1.tex*). Scribe notes should be submitted by email to the course staff.

*All submissions (assignments and scribe notes) must be pdf files produced by compiling LaTeX code. The LaTeX source files are also required for scribe notes.*

**Discussions:** We will use **Piazza** for discussions. It is your responsibility to ensure that you are on the course list in the Piazza website. If you have any questions, post them on Piazza.

**References:** The instructor will give a list of book chapters and/or research papers that will serve as reference for the material covered in each lecture. The following books may be useful in general as reference books:

- T. Cormen, C. Leiserson, R. Rivest, and C. Stein. Introduction to Algorithms. MIT Press, 2009
- J. Kleinberg and E. Tardos, Algorithm Design, Addison Wesley, 2005
- S. Dasgupta, C. Papadimitriou, and U. Vazirani, Algorithms, McGraw Hill, 2006
- R. Motwani and P. Raghavan, Randomized Algorithms, Cambridge University Press, 1995.
- D. Williamson and D. B. Shmoys, The Design of Approximation Algorithms, Cambridge University Press, 2011.
- V. V. Vazirani, Approximation Algorithms, Springer-Verlag, Berlin, 2001.