

CS 5114: Theory of Algorithms

Syllabus

Spring, 2007

1 General Course Information

CRN	17086
MEETING TIME	11:00 AM–12:15 AM; Tuesdays and Thursdays
CLASSROOM	Whittemore 281, Blacksburg, VA
	Also offered at AAST Cairo and Alexandria
TAKE-HOME MIDTERM EXAM	Due at 5:00 PM EST, March 16, 2007
TAKE-HOME FINAL EXAM	Due at 5:00 PM EST, May 9, 2007

Instructor: Lenwood S. Heath

- **Office:** 2160J Torgersen Hall
- **Office Hours:** 9:00–10:00 and 1:30–2:30 Tuesdays and Thursdays
- **Email:** heath@vt.edu

Web Site: <http://courses.cs.vt.edu/cs5114/spring2007/index.php>

Blackboard (Course Grades Only): <https://learn.vt.edu/>

Class Listserv: CS5114_17086@listserv.vt.edu

Prerequisites:

- CS 2604, Data Structures and File Management
- An undergraduate course in algorithms is not required, but is highly desirable.

Required Textbook: Algorithm Design. Jon Kleinberg and Éva Tardos. Addison-Wesley, 2006. ISBN: 0-321-29535-8.

2 Course Description

This course is a traditional introduction to the theory of algorithms for computer science graduate students. It covers methods to construct efficient algorithms and to analyze algorithms mathematically for correctness and complexity. The course proceeds from efficiency to the theory of NP-completeness and on to modern approaches of coping with intractability, including approximation and randomized algorithms. The course provides a foundation for research in the theory of algorithms itself or on problems with significant algorithmic content.

3 Grading Policy

Grading for the course is on a 1000-point scale, with the points distributed as follows:

Homework assignments: 10 at 60 points each	600
Take-home midterm exam: March 16, 2007	150
Take-home final exam: May 9, 2007	250

A typical homework assignment consists of two or three problems, posted on the course web site approximately one week before the due date. During the first week of class, students will be organized into **discussion groups** of two (or perhaps three) students each. These discussion groups are meant to help students learn the subject by providing **partners** to discuss material with. Also, with his or her partner(s), each student may discuss the homework problems and devise solution strategies. However, each student must write up his or her solutions individually. It is acceptable for a student to proofread and offer feedback on a partner's solutions before they are submitted.

All homework must be prepared with L^AT_EX¹ or other word processing system and uploaded as a PDF file to the course web site by 5:00 EST on the due date². Use of L^AT_EX is **strongly** recommended, though not absolutely required. **No late homework will be accepted.**

4 Readings

For most classes, there is a reading assignment (see Section 7) to be completed by class time. Each assignment consists of sections in the textbook.

5 Ethics

The Honor Code applies. All work submitted must be the student's own work. A student may solicit help with homework assignments only from the instructor and his or her partner(s). A student must complete the take-home midterm and final exams without any outside help of any kind.

¹See L^AT_EX resources on the course web site.

²See due dates on the Calendar on the course web site.

6 Announcement

If any student needs special accommodations because of a disability, please contact the instructor during the first week of classes.

7 Course Schedule

DATES	READING ASSIGNMENT	TOPICS
JANUARY		
1/16–1/18	Sections 4.5 and 4.6	Introduction; MSTs; Prim’s and Kruskal’s algorithms; Union-Find data structure
1/23–1/25	Sections 4.7 and 4.8	Clustering for maximum spacing; Huffman codes
FEBRUARY		
1/30–2/1	Sections 6.2, 6.5, and 6.6	Dynamic programming; RNA secondary structure; sequence alignment
2/6–2/8	Sections 6.8 and 6.9	Sequential and distributed shortest paths
2/13–2/15	Section 7.1	Max-flow problem; Ford-Fulkerson algorithm
2/20–2/22	Sections 7.2 and 7.3	Max-flow, min-cut; scaling max-flow algorithm
MARCH		
2/27–3/1	Sections 7.5 and 7.6	Bipartite matching; disjoint paths
3/5–3/9	SPRING BREAK	
3/13–3/15	Sections 8.1 and 8.2	Polynomial-time reduction; gadgets
3/16	Take-home midterm	Due at 5:00 PM EST: Topics through the scaling max-flow algorithm
3/20–3/22	Sections 8.3 and 8.4	Complexity class NP; NP-completeness
3/27–3/29	Sections 8.5–8.7	Specific reductions
APRIL		
4/3–4/5	Sections 10.1 and 10.2	Small vertex covers; NP-hard problems on trees
4/10–4/12	Sections 11.1 and 11.3	Approximate load balancing; approximate set cover
4/17–4/19	Sections 11.4 and 13.1	Approximate vertex cover; randomized contention resolution
4/24–4/26	Sections 13.2–13.4	Global max cut; random variables; randomized approximate Max 3-SAT
MAY		
5/1	Last Day of Class	Review for take-home final
5/9	Take-home final	Due at 5:00 PM EST: Comprehensive exam

END OF SYLLABUS