Syllabus: CS 5114
Theory of Algorithms
Spring, 2000
http://courses.cs.vt.edu/~cs5114

Instructor: Lenwood Heath

- **Office:** 638 McBryde Hall
- **Office Hours:** Wednesdays, 10–12; Fridays, 9–11
- **EMAIL:** heath@cs.vt.edu

Graduate Teaching Assistants:

<table>
<thead>
<tr>
<th>MIR FAROOQ ALI</th>
<th>PATRICK VAN METRE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office Hours:</td>
<td>Consult web pages</td>
</tr>
<tr>
<td></td>
<td>128 McBryde</td>
</tr>
<tr>
<td>EMAIL:</td>
<td><a href="mailto:mfali@csgrad.cs.vt.edu">mfali@csgrad.cs.vt.edu</a></td>
</tr>
<tr>
<td></td>
<td><a href="mailto:vanmetre@csgrad.cs.vt.edu">vanmetre@csgrad.cs.vt.edu</a></td>
</tr>
</tbody>
</table>

Class Meets: McBryde 210, TTh 12:30–1:45

Exams: Saturday, May 6, 1:05-3:05

<table>
<thead>
<tr>
<th>Midterm Exam</th>
<th>Thursday, March 2, 12:30–1:45 PM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final Exam</td>
<td>Saturday, May 6, 1:05-3:05</td>
</tr>
</tbody>
</table>

Index Number: 1400

Prerequisite:

- CS 4104, Data and Algorithm Analysis, or equivalent is preferred, but not required

Textbook:

- *Introduction to Algorithms*, Cormen, Leiserson, and Rivest (CLR)

On Reserve:

For current list, see class web site.

- *(QA76.6 A36) The Design and Analysis of Computer Algorithms*, Aho, Hopcroft, and Ullman

• (QA76.6 C662 1990) *Introduction to Algorithms*, Cormen, Leiserson, and Rivest


• (QA76.9 D35 M36 1989) *Introduction to Algorithms: A Creative Approach*, Manber

• (QA164 R6 1984) *Applied Combinatorics*, Roberts

**Description**

This course emphasizes the computational complexity of a problem, the efficiency of an algorithm for solving a problem, techniques for designing algorithms, and the inherent intractability of certain problems. Skills that the student will take away from this course include: (1) determining whether a problem is NP-complete, (2) analyzing the time complexity of an algorithm, and (3) applying techniques for designing efficient algorithms.

**Ethics**

The Honor Code applies. All work submitted must be the student’s own work. Students may solicit help only from the instructor or the teaching assistant.

**Announcement**

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

<table>
<thead>
<tr>
<th>DATE</th>
<th>SIGNIFICANT EVENT</th>
<th>TOPIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/18</td>
<td>Read Chapters 1 through 6</td>
<td>Problems, Algorithms, Computational Complexity, Analysis, Asymptotic Notation, Master Theorem on Recurrences, Merge Sort</td>
</tr>
<tr>
<td>1/20</td>
<td><strong>\LaTeX Workshop</strong></td>
<td>Review of \LaTeX basics, with emphasis on use of \LaTeX in CS 5114</td>
</tr>
<tr>
<td>1/25</td>
<td>Read Chapters 8 and 10</td>
<td>Divide and Conquer, Quicksort, Expected Time Complexity; Order Statistics, Getting Linear Time out of Divide and Conquer</td>
</tr>
<tr>
<td>2/1</td>
<td>Read Chapter 16 and 23</td>
<td>Dynamic Programming: An Extension of Divide and Conquer</td>
</tr>
<tr>
<td>2/8</td>
<td>Read Chapters 17 and 24</td>
<td>Greedy Algorithms: Cheap and Effective; Matroids; Minimum Spanning Trees</td>
</tr>
<tr>
<td>2/15</td>
<td>Read Chapter 25</td>
<td>Single-Source Shortest Paths</td>
</tr>
<tr>
<td>2/22</td>
<td>Read Chapter 26</td>
<td>All-Pairs Shortest Paths</td>
</tr>
<tr>
<td>2/29</td>
<td>Read Chapter 27</td>
<td>Maximum Flow</td>
</tr>
<tr>
<td>3/2</td>
<td><strong>Midterm Exam</strong></td>
<td></td>
</tr>
<tr>
<td>3/7</td>
<td>Read Chapter 34</td>
<td>String Matching</td>
</tr>
<tr>
<td>3/10</td>
<td><strong>Spring Break</strong></td>
<td></td>
</tr>
<tr>
<td>3/21</td>
<td>Read Chapter 35</td>
<td>Computational Geometry</td>
</tr>
<tr>
<td>3/28</td>
<td>Read Chapter 31</td>
<td>Matrix Operations, Strassen’s Algorithm, LUP Decomposition, Matrix Inversion</td>
</tr>
<tr>
<td>4/4</td>
<td>Read Chapter 32</td>
<td>Polynomials and the FFT</td>
</tr>
<tr>
<td>4/11</td>
<td>Read Chapter 33</td>
<td>Number-theoretic algorithms</td>
</tr>
<tr>
<td>4/18</td>
<td>Read Chapter 36</td>
<td>P, NP, NP-completeness, NP-hardness; Polynomial-time Reductions; Satisfiability, Cook’s Theorem; Paradigm for Proving NP-completeness</td>
</tr>
<tr>
<td>4/25</td>
<td>Read Chapter 37</td>
<td>Approximation algorithms</td>
</tr>
<tr>
<td>5/2</td>
<td></td>
<td>Last Day of Class</td>
</tr>
<tr>
<td>5/6</td>
<td><strong>Final exam—1:05-3:05</strong></td>
<td></td>
</tr>
</tbody>
</table>
Announcements

Email and ListServe. There is a CS 5114 listserve named CS5114_1400@listserv.vt.edu. Every student is expected to be a member of that list-serve to receive announcements and class discussion.

WWW Access. The course will have a WWW home page at:

http://courses.cs.vt.edu/~cs5114

This is primarily a repository for handouts, which may be found in \LaTeX, postscript, and PDF forms.

Homework and Project Submission. Preparation of your homework assignments and project components must be done in \LaTeX. Work is typically submitted in printed form by noon on the date due. The submission procedure will be included in each assignment.

Readings. For most weeks, there is a reading assignment to be completed by class time Tuesday. Each reading assignment consists of chapters in one of the texts.

Grading Policy

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

Homework assignments—8 at about 50 points each 400
Project 300
  Proposal 50
  Literature review 50
  First draft of project paper 50
  Second draft of project paper 50
  Final draft of project paper — May 3, Noon 100
Midterm exam—March 2, 12:30-1:45 100
Final exam—May 6, 1:05-3:05 200

A typical homework assignment consists of 2 or 3 problems, some from the text and some not. Homework is due at noon on the due date (see course calendar). **No late homework will be accepted.**