CS 5310 - Algorithms
Spring 2014

<u>Instructors and their lecture sections:</u>
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and by appointment.	

Catalog Description of CS 5310

This course is a continuation of the study of data structures and algorithms, emphasizing methods useful in practice. It provides a theoretical foundation in designing algorithms as well as their efficient implementations. The focus is on the advanced analysis of algorithms and on how the selections of different data structures affect the performance of algorithms. Topics covered include: sorting; search trees, heaps, and hashing; divide-and-conquer; dynamic programming; backtracking; branch-and-bound; amortized analysis; graph algorithms; shortest paths; network flow; computational geometry; number-theoretic algorithms; polynomial and matrix calculations; and parallel computing.

Prerequisites

By Courses: (MATH 1450 or CS1310) and CS3310 or equivalent with a grade of C or better; or permission of the instructor.

By Topic: Advance understanding of high-level language programming - conditional structures; looping structures; arrays; program logic - to solve problems; object oriented programming - be able to create and use objects; software life cycle; validating quality of software produced; introductory sorting and searching algorithms; elementary data structures (linked lists, queues, stacks, hash maps); documenting programs effectively and efficiently; team work.

General Information

This is an exciting but challenging advanced undergraduate and beginning graduate course fundamental, basic and foundational to computer science. A continuation of the study of data structures and algorithms. It provides a theoretical foundation in designing algorithms. The focus is on the advanced analysis of algorithms and on how the selections of different data structures affect the performance of algorithms. Algorithmic paradigms such as divide and conquer, greedy method, dynamic programming, backtracking and branch, and bound are covered. B-trees, 2-3 search trees and their variations and a variety of graph structures are discussed along with their applications to algorithm implementation. Algorithms will be analyzed for their complexity. NP-completeness will be introduced.

The course is appropriate for seniors and beginning graduate students. Like most college courses, this course

As is typical of many college courses, this course will require two midterm examinations during the course and a number of quizzes.

Classroom activities, unlike the readings and quizzes, are somewhat less structured. This allows for tangents in discussions, the use of occasional visiting guests, unforeseen instructor absences, holidays, etc. The flexibility of the classroom does not tie students or instructor to the textbook readings, but does complement and enhance those readings. *Students are responsible for material in the textbook, whether or not the material is addressed in the classroom.* Students are also responsible for material and skills presented or discussed in class.

Objectives

Develop *algorithmic thinking* to serve us well in computational challenges to come.

Course Outcomes

- Reinforce analytic development and problem solving abilities, and develop a foundation in computer science.
- Show progress with regard to understanding the analysis and performance of algorithms (for further use, e.g., in graduate level courses), including knowledge and use of terminology and how the theory connects with real-world applications, possibly in different and new areas.
- Apply the concepts covered in the course to written and practical problems, e.g., by combining problem solving with computer programming and the use of software tools as part of assignments.
- **Students who earn a "C" or better in this course should have knowledge of**
    - o Sequential algorithms pertaining to the greedy, divide-and-conquer, dynamic programming, backtracking and branch-and-bound paradigms;
    - o Parallel algorithms pertaining to SIMD, MIMD, shared memory and message passing systems;
    - o Introductory databases and data management applications;
    - o Analyzing iterative and recursive sequential and parallel algorithms;
    - o Efficient data structures such as AVL trees, 2-3 trees, min-max heaps, B-trees.

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Text

Required

Algorithm Design: Foundations, Analysis and Internet Examples by Michael Goodrich and Roberto Tammassia, Wiley, ISBN: 978-0-471-38365-9.

Notes - Summation and Recurrence Relations.

Optional:

A number of textbooks (in addition to SW's book) on algorithm design appropriate for this course have been published. You may refer to any of those. The course may also cover material from these books as well as material from research papers.

The book "Algorithms (4th Edition) by Robert Sedgewick and Kevin Wayne, Addison-Wesley Professional, ISBN-10: 032157351X, ISBN-13: 978-0321573513" used last semester may suffice for you, if you can copy problems sets needed in homeworks from one of your colleagues who has purchased the required texbook.

During the term there will be two mid-term exams and a number of quizzes (see tentative schedule below). Pop-quizzes may be given at anytime in the lecture without prior notification. Your grade will be computed from your performance on these components using the following weights:

Midterm Exam 1:	**20%**
(Thursday, February 20, 2014 in class)	
Midterm Exam 2:	**20%**
(Thursday, March 20, 2014 in class)	
Final Exam:	**20%**
(Tuesday, April 22, 2014, 5:00pm-7:00pm in class)	
Homeworks and Programming Assignments:	**30%**
Participation and lecture quizzes:	**10%**

The following grading scale will be used.
   A - 90; BA - 85; B - 80; CB - 75; C - 70; DC - 65; D - 60.

Missed Exams

If you miss an exam (Midterm Exams or Final Exam), the decision as to whether or not it is made up and how it is made up will be made on an individual basis. To be excused there must be significant circumstances beyond the student's control. Generally this will require documentation, such as a doctor's note in the case of an illness. Normally, if your absence from an exam is excused, you will have to take a make up exam. Contact the instructor asking for a make up exam as soon as it is possible (if possible inform the instructor even before the exam that you will miss).

Programming and Homework Assignments

Programming & homework assignments to reinforce algorithm design concepts will be given on a regularly scheduled basis.

Each assignment will have a due date/time. For each day an assignment is late, 5% of the total possible points for the assignment will be deducted. (If an assignment is more than 20 days late, it is no longer worth any points.) Weekends and holidays are all counted when calculating lateness. No assignments may be submitted after 11:59 PM on the day preceding the last day of the classes. By this time all work should be complete and submitted.

Quizzes

There will be regular quizzes given in the lectures. Additionally, pop-quizzes may be given at anytime in the lectures without prior notification. If you miss a quiz for any reason, you will receive a 0 on it.

Use of Electronic Devices

To fully benefit from lectures and recitations, you are expected to stay alert and pay attention to the directions/announcements in the class. Cellphones, PDAs, and other electronic devices should NOT be used during the lecture and should be turned-off. If available, please do bring your laptop to the class. Email checking or web-surfing of non-course related material is NOT permitted during the class. You may surf the web only when specifically told to do so. In order to maintain the integrity of the classroom and if I feel it is distracting you or others, I may ask you to turn-off your laptop/desktop or leave the room.

Incomplete Grades

Please note that the incomplete grade - *I* - is intended for the student who has missed a relatively small portion of work due to circumstances beyond his/her control. In general, performance on work done must be at a level of C or better in order to qualify for an incomplete. An *I* grade will not be given to replace an otherwise low or failing grade in the class.

Academic Honesty

The following statement has been approved and distributed by the Western Michigan University Faculty Senate:
   "You are responsible for making yourself aware of and understanding the policies and procedures in the

Unless otherwise told, you may not bring aids to exams. Submission of another person's work in part or whole is not permitted. Learning can certainly occur with discussion of class material and assignments with other students, and we will be doing considerable collaborative activity, but at all times take care that you don't represent the work of another as your own.

> If you are copying another's work in part or whole, either by hand or electronically, you are going too far.
>
> If two or more people are working so closely together that the outcomes, particularly on significant portions of computer programs, are essentially line-by-line the same in logical structure, they are going too far.
>
> You should not give your completed work to someone else or accept another's completed work to "review or look at" in either hardcopy or electronic form. This too easily facilitates copying.

Easy availability of information, material, source codes, lecture notes etc. on the Internet may make it possible to find solutions to your assignments on the Internet or elsewhere. It is okay to refer to those, understand them and use them to enhance your solutions, generate your own ideas etc. However, you must give proper and full credit to original authors of the work, if you include their ideas and/or solutions. Failing to do so is part of academic and professional dishonesty. It will not be tolerated in this class. Do not give in to temptations.

A student found responsible for violation of academic honesty in the course, will receive a course penalty up to and including an E grade for the class. (Note that the Office of Student Conduct can impose additional penalties.)

Course Topics

To be added.

College Success Seminars

> Academic resource center at WMU offers a number of seminars to enhance your learning experiences. Check out the current offering and schedule at
> http://www.wmich.edu/tutoring/services/college-success-seminars.html

Dates of Interest

Source: Academic Calendar 2014 at:

http://www.wmich.edu/registrar/calendars/academic/calendar2014.pdf

Details of Academic Year 2013-2014 ("University Calendar") at:
http://www.wmich.edu/registrar/calendars/UC2013-2014.pdf

Final Exam Schedule at:
http://www.wmich.edu/registrar/finalexam-spring.html

January 6, Monday, Classes begin at 8 a.m.

January 20, Monday, Dr. Martin Luther King Jr. Day recess convocation & activities

February 28, Friday, Spirit day

March 3 , Monday, Spring break

March 10, Monday, Classes resume

April 21-25, Monday-Friday, Final examination week

April 26   Saturday   Semester ends-Commencement

April 29   Tuesday   Spring session grades due at noon

Refunds

January 10 - Last day to receive 100% refund

January 16 - Last day to receive 90% refund for a complete withdrawal

January 17 - Last day to receive 50% refund for a partial withdrawal

February 3 - Last day to receive a 50% refund for a complete withdrawal

February 28 - Last day to receive a 25% refund for a complete withdrawal

Note: Calendars are subject to change. Dates and events are added or changed as information becomes available.