CS 374 (ECE 374) - Algorithms and Models of Computation

Instructors:

The class was taught first in Spring 2014 as a pilot course by Professor Erickson and Professor Pitt. It was taught at full capacity in Spring 2015 by Professor Pitt and Professor Chekuri. This course has also been taught by Mahesh Viswanathan and Manoj Prabhakaran.

Prerequisites:

You must understand the material from CS 173 and CS 225. While the course is being offered as a pilot it might not even be possible to take the course without credit for those classes. The content from these courses serve as the foundation for the course. If you took the proficiency exam for the prerequisites or took them a while ago, it might be necessary to refresh yourself with the material during the first couple of weeks.

This course is basically a continuation of CS 173 and has a very similar "feel" to it (get ready for more induction!).

When to Take It:

This course can be taken is probably best taken sometime between sophomore and junior year when it fits best in your schedule. Signing up for the course immediately after CS 225 will make moving into the material of the course much easier. As it is a theoretical course, it is about solving problems from the highest level of abstraction by using psuedocode and proofs. This course is fairly challenging so take caution taking this course with too many other technical courses.

Class Content:

The class begins with an overview of the prerequisite material, especially induction which serves as a critical way of writing proofs. It then follows with some basics of graphs, Definite finite automatas, Nondefinite finite automatas, and regular languages. Some recursive and divide-and-conquer algorithms are taught before the first midterm. More advanced material such as dynamic programming and various greedy algorithms are taught afterwards. Much of the content is available in Jeff Erickson's book: http://jeffe.cs.illinois.edu/teaching/algorithms/. A full list of topics is below:

- Regular and context-free languages
- Finite-state automata
- Recursive algorithms
  - Divide and conquer
  - Backtracking
  - Dynamic programming
  - Greedy algorithms
- Fundamental graph algorithms
  - Depth-first search
  - Breadth-first search
  - Topological sorting
  - Minimum spanning trees
  - Shortest paths
- Undecidability
- NP-completeness

Work:

Students can expect to put in roughly 6-10 hours of work outside of class completing an online quiz individually and a homework assignment in a group. These assignments are challenging, but they serve as good practice for the two midterms and final for the course.

Each homework assignment is typically 3-4 problems long and can be turned in in groups of up to three. 3-4 problems may not seem like much, but many of the problems are very difficult or require lengthy answers/proofs. It is highly recommended that students meet regularly to work on homework together (be sure to note who you worked with), as well as attend office hours and discussion sections. Students will learn a lot by taking this course, but they will also work to earn their 4 credits.

Lectures are typically 75 minutes, 2 days a week, and discussion sections usually meet twice a week. Discussion sections usually review lecture material and work through sample problems.

Grade Breakdown (Spring 2015):

- Quizzes: 5%
- Homework: 25%
- Midterm I: 21%
• Midterm II: 21%
• Final Exam: 28%

Life After:

For those interested in hardware, this course can help understand algorithms that are used in hardware design courses such as ECE 425.

For those interested in software, this course is rather important in pursuing other courses and after taking ECE 391/CS 241 allows a student to take most CS 400 level courses. This course really helps conceptualize, break down, and solve problems which is an important skill for engineers to have and the reason this course is required for Computer Engineering majors.

As far as continuing forward in theoretical computer science, this course will follow up with CS 473 which is follows up with more algorithms and grad-level topics and other special topics courses.