1 Catalog Description

Provide mathematical foundations from discrete mathematics for analyzing computer algorithms, for both correctness and performance; introduction to models of computation, including finite state machines and Turing machines. Prerequisite: MATH 151. Cross-listed with ECEN 222.

2 Learning outcomes and Course objectives

At the end of the course, students will understand the basic principles of logic, proofs and sets. They will be able to apply results from discrete mathematics to analysis of algorithms. They will be able to produce proofs by induction and apply counting techniques. They will have a basic understanding of models of computation.

3 Course Overview

Discrete Mathematics is to computer science as words and grammar are to English. Solving a problem in computer science without discrete math is like writing a novel with garbled grammar or a confusing plot. It just won’t work. Your thinking will be muddled, and your code just won’t work. Worse yet, your code will likely have hidden bugs that won’t be found until an end-user complains (or explodes ...). At that point, fixing the bug is costly, or even impossible.

This course teaches you the fundamentals of logic, proof techniques, induction/recursion, counting, advanced counting (not as easy as it sounds!), relations, and graph theory. These mathematical tools are essential to doing and understanding computer science / computer engineering.

The primary emphasis of the course is mathematical reasoning and problem solving. Equipping you with specific skills (such as tools for solving recurrence relations) is important, but only a secondary goal of this course. You won’t find many plug-and-chug type of problems to solve. Many of the problems will require original thought, instead. This is true for the homeworks, quizzes, and exams.
4 Class times:

- Lecture: MWF 10:20am to 11:10am in HRBB 124.
- There are two other sections of the course, taught by other instructors (Hyunyoung Lee and J. Michael Moore). However, you must attend the section you are assigned to.

5 About the instructor:

- Office: 425E HRBB
- Phone: (979) 845 4094 (office). My cell phone is (352) 359 2812. This may change to a new number soon, in the (979) area code.
- Email: davis@tamu.edu
- Web sites are listed below. I just arrived at A&M from the University of Florida, and much of my background and research pages are still there.
  - http://engineering.tamu.edu/cse/people/davis-tim
  - https://parasol.tamu.edu/people/davis/
  - http://faculty.cse.tamu.edu/davis/
- Office hours: MWF after class, until 12:30pm (or later as needed). I’m often available at other times as well. Feel free to stop by.

6 About the TAs and graders:

- There are 2 TAs and 4 graders assigned to all 3 sections of CSCE 222. Our section has Jason Lin as our TA. email: senyalin@tamu.edu. Office hours Tuesday and Thursday, 1:30pm-4:00pm. Location: HRBB 503.
- Graders: to be announced.

7 Book:


8 Grading:

- Quizzes: These will given during lecture the day after homeworks are due. They will be based on the homework due the day before, and will typically be just 5 or 10 minutes each. Each quiz will count for 1.5% of your grade. I expect to have about one per week.
- Weekly homework: These will typically be due Wednesdays, via eCampus or csnet.cse.tamu.edu. Solutions will be posted after class so that you will have plenty of time to review them before the quiz on the same topic on the following Friday. Each homework accounts for 1% of your grade. You are explicitly permitted and even encouraged to work together on homeworks. If you do that, you may even turn in a single homework with each of your names on it. If you work together on part of
the homework but not all, then include a statement on the first page ("problems 1, 3, and 5 were done in collaboration with ... (name here) ...”). To do this, you must actually collaborate on each problem. You cannot just split the work and pool your solutions. If you would like help connecting with other students, the TAs and I can help. Groups can be of size up to 3, no larger.

- All homework will be submitted in \LaTeX, a mark-up typesetting language that works wonderfully for mathematics. You will submit both the \LaTeX source (a plain text file in the \LaTeX mark-up language) and the PDF. This syllabus and all my books and papers are written in \LaTeX. Nothing else comes close to its ease of use for generating great documents, once you understand the basics.

- This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com.

Find our class page at: https://piazza.com/tamu/fall2014/csce222davissection500/home

- Class resources for \LaTeX can also be found at https://sites.google.com/site/changjoonam/t/csce-222—fall-2014 and at http://faculty.cs.tamu.edu/hlee/csce222/.

- Two in-class exams: dates to be determined, in the regular classroom (watch this space). Exams may be curved, as needed. Each exam accounts for \((100-X)/4\)% of your grade, where \(X\) is the total quiz and homework grade.

- Final exam: Tuesday, Dec 16th, from 8am to 10am in the regular classroom (HRBB 124). The final exam accounts for \((100-X)/2\)% of your grade.

- Grading scale (after curving of individual quizzes and exams, as needed):
  - 90 or higher: A
  - 80: B
  - 70: C
  - 60: D
  - less than 60: F

- No rescheduling permitted for exams, unless you have a medical reason, or you get a letter from a doctor or from the Dean’s office. No rescheduling for quizzes unless you get my permission first.

9 Topics

From the sections of the book. Struck-out sections are skipped. We will do the chapters in order, except for chapter 4.

- 1 The Foundations: Logic and Proofs
  - 1.1 Propositional Logic
  - 1.2 Applications of Propositional Logic
  - 1.3 Propositional Equivalences
  - 1.4 Predicates and Quantifiers
  - 1.5 Nested Quantifiers
1.6 Rules of Inference
1.7 Introduction to Proofs
1.8 Proof Methods and Strategy

2 Basic Structures: Sets, Functions, Sequences, Sums, and Matrices. We will cover this chapter very quickly, since most of it should be a review (except 2.5).

2.1 Sets
2.2 Set Operations
2.3 Functions
2.4 Sequences and Summations
2.5 Cardinality of Sets
2.6 Matrices

3 Algorithms

3.1 Algorithms
3.2 The Growth of Functions
3.3 Complexity of Algorithms

4 Number theory and cryptography. This chapter will be done last, and covered as time permits.

4.1 Divisibility and Modular Arithmetic
4.2 Integer Representation and Algorithms
4.3 Primes and Greatest Common Divisor
4.4 Solving Congruences
4.5 Applications of Congruences
4.6 Cryptography

5 Induction and Recursion

5.1 Mathematical Induction
5.2 Strong Induction and Well-Ordering
5.3 Recursive Definitions and Structural Induction
5.4 Recursive Algorithms
5.5 Program Correctness

6 Counting

6.1 The Basics of Counting
6.2 The Pigeonhole Principle
6.3 Permutations and Combinations
6.4 Binomial Coefficients and Identities
6.5 Generalized Permutations and Combinations
6.6 Generating Permutations and Combinations

7 Discrete Probability will be skipped with probability 100%.

8 Advanced Counting Techniques

8.1 Applications of Recurrence Relations
8.2 Solving Linear Recurrence Relations
8.3 Divide-and-Conquer Algorithms and Recurrence Relations
8.4 Generating Functions
8.5 Inclusion-Exclusion
8.6 Applications of Inclusion-Exclusion

9 Relations
9.1 Relations and Their Properties
9.2 n-ary Relations and Their Applications
9.3 Representing Relations
9.4 Closures of Relations
9.5 Equivalence Relations
9.6 Partial Orderings

10 Graphs
11 Trees
12 Boolean Algebra
13 Modeling Computation
   Languages and Grammar
   Finite-State Machines with Output
   Finite-State Machines with No Output
   Language Recognition
   Turing Machines

10 Policies:

- Peer-Teachers are available to help you with this class. See [http://engineering.tamu.edu/cse/academics/peer-teachers/] for more details.
- I will be collecting or taking photos of each student in the class, so I can more easily learn your names. To speed things up, I will also ask you to upload a photo of yourself on eCampus. The photos will only be available to the instructor and the TAs.
- The use of laptops is prohibited in class, unless I approve otherwise (for example, if you have horrible handwriting and require a laptop to take notes). Laptops are a distraction to your fellow students. Please see me if you need an exception.
- You must attend the section you are registered for. Taking the wrong quiz is worth zero points.
- The use of bootleg copies of the textbooks is strictly prohibited.
- No International Edition of the book may be used. It is not the same as the US Edition. If you use it, you will find yourself doing the wrong problems.
- The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services, in Cain Hall, Room B118, or call 845-1637. For additional information visit [http://disability.tamu.edu].
- You must observe the Aggie Code of Honor: [http://student-rules.tamu.edu/aggiecode]