

## Syllabus for Math 55: Discrete Mathematics

Summer 2011, MTuWThF 2:10–4 PM, 004 Evans

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### Course Description

Goldbach's conjecture states that every even number above 2 can be written as a sum of two primes. This conjecture, which can be explained to a high school student, has remained both famous and unproven for over 250 years. "Simple on the outside, subtle on the inside" is the hallmark of a discrete mathematics problem. Of course, the problems addressed in this course will be much easier than Goldbach's conjecture.

For most students, math 55 is a first step away from computational mathematics, in the direction of "pure," *rigorous mathematics*. This course surveys such diverse topics as the *logical foundations* of mathematics, *number theory*, *combinatorics* and *graph theory*. This survey advances three goals. First, by introducing students to a range of concepts, we begin the gradual, subconscious process of *developing intuition* about these concepts. Second, these areas provide a setting in which students can learn to give *rigorous proofs*. And third, these particular areas naturally lend themselves to the *aesthetic* qualities of mathematics, and to the *creative* aspects of the mathematical process.

Lectures will be centered around number theoretic and combinatorial problems. These problems will motivate our exploration of the techniques used in the class – techniques such as modular arithmetic, mathematical induction and combinatorial proofs. In addition to attending lectures, students will have the opportunity to work in groups to solve problems in class.

### Grading

**Homework** (20%): Homework will be due at the start of class on almost every Tuesday and Friday. Homework must be submitted in the form of a stapled hard copy. Homework will be graded in part on completeness, and in part on the correctness of two of the problems. Late homework will not be accepted, but to accommodate unavoidable absences and time conflicts, your lowest homework score will not be counted.

**Quizzes** (30%): 30 to 40-minute quizzes will be held most Thursdays (see the course schedule). There will be no make-up quizzes, but as with homework, students may drop their lowest quiz score.

**Midterm** (20%): There will be one midterm exam on Friday, July 15<sup>th</sup>. The exam will be two hours, in-class.

**Final exam** (30%): The final exam will be two hours, in-class, and will be cumulative.

Weighted averages of 90+ will receive at least an A-, 80+ at least a B-, and 70+ at least a C-, although grades will likely be curved higher than that.

### Resources

**Textbook:** The required textbook is *Discrete Mathematics and Its Applications*, 6<sup>th</sup> ed., by Kenneth Rosen.

**Office hours:** My office number and hours are listed at the top of this sheet.

**Discussion board:** There is a class Q & A board online at [www.piazza.com](http://www.piazza.com). This is an ideal place to seek answers to challenging worksheet questions. You will receive an invitation to join via e-mail. I will monitor the board regularly, and may jump in with answers when your classmates are unable to provide them.

### Course Policies

**Enrollment:** You *must* be registered for both the lecture and the corresponding discussion section. If you are waitlisted or need to switch sections, contact Barbara Peavy in 967 Evans.

**Special arrangements:** If you have arrangements with DSP for any special accommodations, please let me know via e-mail, as soon as possible.

**Collaboration and academic honesty:** You are strongly encouraged to form study groups and to collaborate on homework. However, you must each write *your own solutions in your own words*. As a rule of thumb, if you can't solve a homework problem without consulting notes

from a discussion with a peer, then you haven't fully understood the solution, and should not claim credit for it. This policy is intended to prepare you for exams and quizzes, where no collaboration of any kind will be permitted.

**Calculators and cheat sheets:** Calculators are allowed, but will not typically be required on homework. Neither calculators nor cheat sheets will be available during tests.

**Make-ups:** To accommodate unavoidable conflicts, your lowest quiz score and your lowest homework score will not be counted. In the case of repeated illness (confirmed by doctor's note) or confirmed family emergencies, contact me as soon as possible via e-mail.

**Regrades:** Students may request a regrade on an exam or quiz question, but the problem will only be rescored if it deserves full or nearly-full credit. Regrade requests must be submitted in class, on the day the exam or quiz is returned.

**Homework revisions:** Homework will not be "regraded," however, students are invited to submit corrected versions of proofs that were marked down on homework. If the corrected proof is deserving of full credit, then the student will be awarded half the difference in credit between their original score and a perfect score – e.g. if a student scored  $\frac{8}{20}$  on a proof and submitted a corrected version, then their score would be replaced with  $\frac{14}{20}$ .

Revisions must be submitted within a week of the homework being returned, and non-proof problems may not be revised.

### Some advice

**Work problems.** Math is *not* a spectator sport; solving problems is the only way to learn. The more problems you've done, the more comfortable you'll be when you see new ones on tests.

**Speak up!** If I write something on the board or say something that doesn't quite make sense, please yell at me. I'm always happy to try explaining something another way; besides, I guarantee there's at least one other person in class who's stuck on the same point.

**Attend every lecture.** Because of the summer session schedule, this class moves fast! Falling behind for even a day can be dangerous. And while most of the material is in the book, lectures will also cover other material; so be sure you understand both the book and the lectures.

**Use class resources.** That means piazza.com, as well as office hours.

**Write clearly.** Math isn't just about figuring out whether or why something is true; it's also about explaining your arguments clearly. Even if all the necessary components are in there (somewhere...), if your proof is presented in an unclear or confusing way, then it will not receive full credit. In fact, it may receive very little credit. And as a corollary to this principle...

**Write in complete sentences.** Partial sentences merit partial (or no) credit.

**Master definitions.** Finally, on a more technical note, pay close attention to *formal definitions*. The exact wording matters! These definitions are the most basic building blocks of proofs.

## Course Schedule

This lecture and reading schedule may be subject to change over the course of the semester. However, all changes will be announced in class. For an up-to-date schedule, consult the course website. However, the dates of exams will not be changed.

Day	Date	Reading	Lecture	Assignments due
Unit 1 – Foundations				
M	6/20	1.1, 1.2	If, and, or, not	
Tu	6/21	1.3, 1.4	Predicates and quantifiers	HW0: Join piazza
W	6/22	1.5, 1.6	Rules of inference, proof	
Th	6/23	1.7	Proof techniques	Quiz 1
F	6/24	2.1, 2.2	Sets	HW1
M	6/27	8.1, 8.3	Relations	
Tu	6/28	2.3	Functions	HW2
W	6/29	2.4	Infinity and diagonalization, review	
Unit 2 – Number Theory				
Th	6/30	3.4	Divisibility, modular arithmetic	Quiz 2
F	7/01	3.5	Primes, FTA, sqrt(2), infinite primes	HW3
M	7/04		FIREWOKS!	
Tu	7/05	8.6	Posets, lattices	HW4
W	7/06	3.6	GCD, Euclidean algorithm, different bases	
Th	7/07	3.6, 3.7	Modular exponentiation, Chinese Remainder Theorem	Quiz 3
F	7/08	3.7	RSA, review	HW5
Unit 3 – Induction and recursion				
M	7/11	4.1	Induction	
Tu	7/12	notes	Flex / games and winning strategies	HW6
W	7/13	4.2, 4.3	Recursion, structural induction	Quiz 4 (W, not Th!)
Th	7/14	7.1, 7.4	Recurrence relations, solutions	
F	7/15		Gen fctn example, midterm review	HW7
M	7/18			Midterm
Unit 4 – Counting				
Tu	7/19	5.1, 5.2	Counting strings, pigeonhole	(no HW)
W	7/20	5.3, 5.4	Permutations, combinations, binomial coefficients	
Th	7/21	8.5	Equivalence relations	(no quiz)
F	7/22	5.5	Indistinguishable objects	HW8
M	7/25	7.5, 7.6	Inclusion-exclusion, derrangements	
Tu	7/26	7.4	Generating functions	HW9
W	7/27	7.6	Sterling numbers, review	
Unit 5 – Probability				
Th	7/28	6.1	Sample spaces and events	Quiz 5
F	7/29	6.2	Conditioning, random variables	HW10
M	8/01	6.3, 6.4	Bayes' theorem, expectation	
Tu	8/02	6.4	Linearity of expectation, review	HW11
Unit 6 – Graph Theory				
W	8/03	9.1, 9.2	Graphs and the Erdos-Bacon number	
Th	8/04	9.3, 9.4	Connectivity, isomorphisms	Quiz 6
F	8/05	10.1, 10.2	Trees and their applications	HW12
M	8/08	10.4, 10.5	Spanning trees	
Tu	8/09	notes	Flex / Graph algorithms	HW13
W	8/10	notes	Flex / Graph algorithms	
Th	8/11		Review	(no quiz)
F	8/12			Final Exam