

Math 15 — Discrete Mathematics

Time and place: 2:00–3:05pm, MWF, PH 3

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Office: New Mathematics Building (next to Post Office)

Office Hours: TTh 11–noon, or by appointment.

Catalog Description: “(Four credit hours) The study of ideas of discrete mathematics including sets, permutations, relations, graphs, trees, and finite-state machines. Using these concepts, students will learn mathematical skills such as: methods of proof; problem solving via advanced counting techniques; problem solving through the creation of algorithms.”

Course Objectives

Core Knowledge: The above catalog description lists the broad topics that we will cover in this course, but the most important thing you will get from this course is the ability to think mathematically. You will learn how to find mathematical structures in almost everything. You will develop a lens for viewing the world that interprets data, tasks, and questions in an organized, logical, and systematic way. This viewpoint is powerful. It will enable you to diagnose and solve problems that you have not faced before.

This course will give the beginning computer science student a strong background in the types of mathematical thinking used in upper division courses. But I designed the course with a larger group of students in mind. Students in any technical discipline will benefit from learning how to think mathematically. My hope is that this course will make a fundamental contribution to a general liberal arts education. Since mathematical ideas undergird so much of modern scholarship, it is good for students to take this course early, even in the first semester of their first year.

Communication: I intend this course as a serious invitation to the discipline of mathematics. Although a course or two in calculus is the generally accepted place to begin the study of college-level mathematics, I believe that the material in this course is a better introduction to what mathematics is all about. Mathematicians prove theorems. So, throughout the course, students will learn how to read and write proofs. Any student wishing to go on to more theoretical upper-division mathematics courses will find this preparation valuable.

Creativity: Any course in discrete mathematics will provide you with an excellent set of tools. These tools are essential for the computer scientist, and they are becoming increasingly more applicable to other fields, including sociology, biology, physics, chemistry, economics, and psychology. However, mathematical thinking is less about having the right tool in hand, and more about knowing how to find the right tool for the job. You might even find yourself building a new tool for a new problem. After all, mathematics is more than a bag of tricks; at its core, mathematics is a creative enterprise, where good answers spawn better questions.

Christian Perspective: Finally, my hope for you is that as you grow in your ability to think mathematically, you will also grow as a disciple of Christ. How? There are many ways, and I pray that God will make your particular path straight. On a basic level, a broad education across many disciplines glorifies God, because it enables us to see God’s work in the world. It also helps us impact the world to further the Kingdom: as you grow intellectually and become more technically competent, you are preparing yourself to bring the gospel to a technologically complex world. Your witness for Christ will be more credible in many circles (especially those He is calling you to) if others can see that you have a sophisticated perspective on the world. I hope that you see your work in this course, and in all your courses, as part of the good work that God is bringing to completion in you.

General Education Components: This course satisfies two components of Westmont's general education requirements: the Common Inquiry of Reasoning Abstractly, and the Common Skill of Quantitative and Analytical Reasoning.

Reasoning Abstractly. One of the main themes of this course is abstract reasoning. We will study logical arguments using the formal methods of propositional and predicate logic, and we will also explore direct proofs, proofs by contradiction and contraposition, and proofs by induction. We will learn how to evaluate valid arguments by studying abstractions of structures that occur in computer science and other areas of study. The problems we do in this class are not just about getting the correct answer—the point of working problems is to understand the reasoning that leads to the solution.

Quantitative and Analytical Reasoning. This course is not just about abstraction; many of the methods we will study provide quantitative and analytical models for problems in computer science, physics, biology, and the social sciences. When we study combinatorics, we will learn advanced counting techniques, and we will see how to analyze problems using discrete probability. The study of graph theory leads to a range of applications in industrial optimization, data analysis, coding theory, and a variety of other contexts. Many of these applications involve manipulating structures using algorithms; the analysis of algorithms is another main theme of the course.

Textbook: We will cover Chapters 1–5 of a draft of *Essentials of Discrete Mathematics*, by David J. Hunter. This book is scheduled to be on the market by August 2008, published Jones and Bartlett Inc. The text is more or less complete, but I'm relying on your feedback to improve the final draft. Please let me know about typographical or (gasp!) mathematical errors.

Grading: Your grade will be calculated as follows:

Homework:	30%
Hour Exams (4):	50%
Final Exam:	20%

I grade on the standard 90/80/70/60 scale, although I reserve the right to decide borderline cases by taking into account attendance and participation.

Homework: You will master the concepts in this course best by writing up solutions to problems and receiving regular feedback on your written work. Therefore, there will be a homework assignment due almost every other class day, usually at 5pm. Leave your papers at my office. You must show all of your work to get full credit. Late homework will not be accepted, but I will drop the lowest homework score. In addition to the graded homework, it is your responsibility to complete additional problems and check them for correctness; this is especially important in preparation for the exams.

I encourage you to form study groups and collaborate on the homework. However, you should never copy your homework from somebody else. The work you hand in should represent your own understanding. Copying a solution from a classmate is dishonest, and it is a waste of your time. If you collaborate on homework, please cite the collaboration on your paper: for example, "I got help for problem 8 from Tommy Trout," or, "I worked in collaboration with Susie Salmon on this assignment." Failure to do so constitutes plagiarism.

You may find the homework difficult. You will learn best by persevering. When you get stuck, please come to office hours for help, but only after you have spent some time trying to figure out the problem yourself. Our time in office hours will be much more profitable if you have invested some time in advance trying to understand the material.

Other Policies: I expect you to attend class every day. If you are unable to hand in your homework by 5pm, have someone bring your homework to my office for you. Please inform me in advance of any classes you plan to miss. Work missed (including tests) without a valid excuse will receive a zero.

I will post the assignments and other course materials on the **eureka** page for this course. Go to <http://eureka.westmont.edu>

and make sure you are subscribed to MA-015-1; a link to the course should appear after you have logged in. I expect you to check this page, along with your email, on a regular basis. If you use a non-Westmont email account, please forward your Westmont email to your preferred account. Instructions for doing so are at

<http://acweb.westmont.edu>

Learning communities function best when students have academic integrity. Cheating is primarily an offense against your classmates because it undermines our learning community. Therefore, **dishonesty or plagiarism will result in a zero for the work in question, and repeated or major infractions will result in expulsion from the course with a grade of F.**

If you miss more than six classes without a valid excuse, I reserve the right to terminate you from the course with a grade of F.

Tentative Schedule: We will try to conform to the following schedule, although it is subject to revision at the instructor's discretion. We will cover approximately one section per day, not counting review and test days. The **eureka** page will tell you when the assignments are due and when the tests will be.

1.1–1.6: Logical Thinking

Hour Exam #1: Chapter 1

2.1–2.6: Relational Thinking

Hour Exam #2: Chapter 2

3.1–3.5: Recursive Thinking

Hour Exam #3: Chapter 3

4.1–4.5: Quantitative Thinking

Hour Exam #4: Chapter 4

5.1–5.6 Analytical Thinking

Final Exam: Wednesday, 12/12, 8–10am. 60% Chapter 5, 40% cumulative review