SYLLABUS

Mathematics 050 will meet Mondays, Wednesdays, and Fridays, 9:00 a.m. to 9:50 a.m., in King 237.

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OFFICE HOURS: Tuesday, 2:00–3:00 p.m.,
Wednesday, 10:00–11:30 a.m.,
Wednesday, 2:00-3:00 p.m.,
Thursday, 3:00–4:00 p.m.

GOALS OF THE COURSE: A friendly introduction, complete with examples, applications, discussion, and digression, to the mathematics of networks. Two sets of tools are key: *Graph theory* describes and classifies networks by their patterns of interconnection. *Probability* is the mathematics of chance. We will discuss, model, and analyze many examples of networks, including social networks and the World Wide Web.

TEXTS: Required: *Networks, Crowds, and Markets: Reasoning about a Highly Connected World*, by David Easley and Jon Kleinberg, Cambridge, 2010, ISBN 978-0-521-19533-1. Available at the Oberlin Bookstore. Also available at: http://www.cs.cornell.edu/home/kleinber/networks-book/ We will be covering Chapters 1, 2, and parts of 3, 4, 13, 14, and 18—21.

We will often work from handouts. I will also be posting to Blackboard chapters from *The Pleasures of Probability (*Richard Isaac, Springer, 1995, ISBN 978-0387944159) and *Graphs and Their Uses* (Oystein Ore, Mathematical Association of America, 1996, ISBN 978-0883856352).

MATHEMATICA: We will be using the symbolic and numeric computation system *Mathematica* in several ways this semester. You can

- Use in the Mathematics Department computer lab (King 218, door combination 1452), or other computer labs on campus.
- Install it on your own computer by downloading from the CIT software downloads page: http://new.oberlin.edu/office/cit/downloads/ and then requesting a license key from cit@oberlin.edu.

CALCULATORS: You may find a scientific calculator useful for your homework and for in-class activities. You may already own a suitable calculator—e.g., any graphing calculator should work. Necessary functions include exponentials, logarithms, factorials, binomial coefficients ("nCr"), and random numbers. The iPhone app Scientific Graphing Calculator (William Jockusch, $0.99) is appropriate. *Mathematica* can also handle all necessary computations.

COURSE MECHANICS

EVALUATION: The midterm will be worth 100 points. The final will be worth 200 points. The homework will be worth 140 points. The geography project will be worth 40 points. The networks project will be worth 100 points. Blackboard participation will be worth 20 points.

EXAMS: There will one in-class exam, on **Wednesday, March 19**.

The final exam will be on **Thursday, May 15, from 9:00 to 11:00 a.m.**

ASSIGNMENTS: There will generally be one assignment per week, due at the beginning of lecture on Friday.

Late assignments will not be accepted (documented emergencies excepted).

I will, however, drop your lowest two homework scores from consideration in your final grade.
The homework will be graded on a check-plus/check/check-minus scale.

The assignments will vary considerably in form. Each week, you can expect some hybrid between:

- a typical "math homework", with computation (possibly using Mathematica), explanation, and/or logical argument.
- a 2-page paper based on recent reading or a bit of library/web research (you might need to look up a reference or find an article with relevant data).
- a technical diagram—perhaps somewhere between a map and a wiring diagram.

You should explain your thought processes in words. When answering mathematical questions or solving word problems, describe your reasoning and explain why you are carrying out computations.

I will provide samples in advance of what I expect for some assignments. When appropriate, a solution set will be posted to the course web site after the assignment has been collected.

GEOGRAPHY PROJECT: Early in the semester, you will collect data on and explore a small (on the Oberlin campus) geographic network. You will work in pairs; the first part will be due on **Friday, February 14** and the second on **Friday, February 21**.

NETWORK PROJECT: Near the end of the semester, you will complete a final project, working together with a group of students (3 to 5 people). I anticipate that the form of these projects will vary considerably: some groups may do experiments to probe social networks on campus, while others may construct simulations, or explore some properties of on-line networks or network data. All groups will collect data on the connections of some network of interest, and then analyze its properties. Your final project will include a presentation and analysis of network data that you have collected. Your proposal will be due **Friday, April 11**; initial data report **Friday, April 25**; and final report **Friday, May 9**.

BLACKBOARD DISCUSSION: There will be a Discussion Board set up in Blackboard. I expect each of you to post at least 3 times (and there is a tiny fraction of your final grade based on having done so). Please post pointers to interesting networks news, or other relevant links. This will also be a useful place for getting Mathematica help and sharing useful code; I will post example code you can cut and paste.

IF YOU HAVE QUESTIONS: Ask! Stop by at office hours (or make an appointment for a time that's better for you). Send e-mail (although I am unlikely to answer between 9:00 p.m. and 8:30 a.m.). Post to our Blackboard discussion board.

STUDENTS WITH DISABILITIES

Any student eligible for and needing academic accommodations because of a disability should consult with the Office of Disability Services and Prof. Wilmer at least one week before the accommodations will be needed.

THE HONOR CODE

UNDERSTANDING NETWORKS AND THE HONOR CODE: As your grade for Mathematics 050 will depend on the results of your exams, your homework assignments, and your projects, you must uphold the Honor Code while completing all three types of work. You are expected to write and sign the Honor Pledge,

"I affirm that I have adhered to the Honor Code in this assignment,"

at the end of each assignment and each exam; at the end of your final project, every member of the group should write and sign the Honor Pledge. The meaning of adhering to the Honor Code differs, however, for the three types of assignments.

THE HONOR CODE AND HOMEWORK: Talking about mathematics is one of the best ways to improve your understanding of the subject, both because other points of view can be illuminating and because conversation requires you to articulate your own ideas.

I encourage you to discuss any of your assignments with other students. Unless otherwise specified, however, *you must write up your work on your own*. Some quick examples:

> **OKAY:** "I wonder if we can figure out this probability by counting how many ways there are to win the game. Pat, do you think that two cases will cover everything?"
>
> **NOT OKAY:** "Pat, I hate it when you write so small! Is that a *2* or a *7*? I'm never going to get this copied by the time class starts!"
>
> **OKAY:** "I'm not sure I understand what's going on. Maybe we should try to find another example like this, except where you can't get from vertex x to vertex y."
>
> **NOT OKAY:** "Huh. You have this letter m in your write-up. Maybe I can call it k instead, to make it look different. "

THE HONOR CODE AND PROJECTS: You should be careful to follow the same standards for citation of sources and for originality of your own work when working on the 050 final project as you would for a paper in any other Oberlin class. Be particularly careful when citing electronic sources.

THE HONOR CODE AND EXAMS: You will be expected to work *entirely on your own* during the exams. You will be allowed to use a scientific calculator during exams, but no books or notes

SCHEDULE (APPROXIMATE)

Week	Dates	
1	February 3–5	Why graphs? What can graphs model? Vertices, edges, neighbors, degree, isomorphism.
2	February 10–14	Planarity. Distances in graphs. **Geography Project Part 1 due.**
3	February 17–21	Connectivity. Traveling on graphs. Eulerian circuits, Hamiltonian cycles. **Geography Project Part 2 due.**
4	February 24–28	Polyhedra and Euler's Formula
5	March 3–5	Structure of the World Wide Web
6	March 10–14	Link Analysis and Web Search
7	March 17–21	Link analysis, continued. **MIDTERM Wednesday 3/19.**
	March 25–27	SPRING BREAK
8	March 31–April 4	Probability: sample spaces, expected value.
9	April 7–11	Probability: Conditional probability. Bayes' Theorem. **Networks Project Part 1 due.**
10	April 14–18	Probability: limit theorems.
11	**April 21–25**	Models for large networks. Small-world phenomena. **Networks Project Part 2 due.**
12	April 28 –May 2	Epidemics on networks.
13	**May 5–9**	What do we know about large networks? What don't we know? **Networks Project final report due.**
	May 15	**FINAL EXAM**