# Syllabus for MATH 313:
# Graph Theory
## Spring Semester 2016

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Class: held TTh 1:30-2:55pm in Lansing 301
Textbook: *A First Course in Graph Theory*, by Gary Chartrand and Ping Zhang
Website: http://math.hws.edu/eking/GraphTheory/math313.html

## Course Content and Organization

Graph theory is one of the youngest areas of mathematics in terms of its formal development; the first article believed to be graph theoretical was published in 1736 by the Swiss mathematician and physicist Leonhard Euler, the term "graph" as we mean it was coined in 1878 by the English mathematician James Joseph Sylvester, and the first graph theory textbook was written only about eighty years ago by a Hungarian mathematician, Denés König. Many of the early records of graph theory are related to studies of strategies for games such as chess. Mathematicians realized, however, that graph theory is powerful well beyond the realm of recreational activity – that many problems both in pure mathematics and in other fields, such as chemistry, traffic management and telecommunications, could be solved more easily by expressing the problems in terms of graphs. A question in graph theory can usually be explained to (and understood by) a layperson because of graph theory's pictorial nature, though the answer and conjectures in general are often very difficult to prove. Graph theory is a discipline of beauty and complexity, and I find it the most rewarding branch of mathematics to study. In this class, we will cover roughly eight chapters of the text, exploring the basic structures of graphs as well as some of the major results in areas of graph theory such as traversability, coloring and planarity.

The class will be a mixture of group work, discussion, student presentation, and lecture. Active and regular participation is expected from each student. This will be an exciting and time-consuming class. In addition to your active involvement in the classroom, you should expect to spend a minimum of ten hours per week working on graph theory outside of class (and expect to want to spend more!).

## Prerequisites and Goals

First Steps into Advanced Mathematics and Linear Algebra are prerequisites for this class. You are expected to understand the basic proof techniques covered in First Steps and to be able to apply them. Although you may not need many of the individual facts from Linear Algebra, it is expected that you will have refined your proof-writing skills and mathematical ability in that course.

There are two main goals for this course. The first is to introduce (or reintroduce) you to an area of mathematics you may not have studied before, and hopefully excite you about its beauty and power. Graph theory falls into the category of discrete mathematics, a different track from the continuous mathematics (which includes subjects such as calculus) most schools have focused on. The second goal is to guide you on your path to becoming a more sophisticated mathematician. We will work to hone your proof-writing skills and mathematical-speaking skills, and to build your mathematical creativity. You will also gain experience reading research articles.

## Assessment

*Readings and uncollected homework:* After each class I will assign reading and practice problems. These assignments (as well as collected assignments and announcements) will be listed on our website. You should read the text with a pencil and paper in hand, drawing example graphs to strengthen your understanding of definitions and proofs, filling in gaps to proofs, and taking notes as you go. Although it is not required, it is recommended that you keep a notebook with notes from the readings, a vocabulary list, and your work on the practice problems. It is also recommended that you form a small study group of two to four people to discuss the readings and work on the problems together **after** you have spent some time studying these on your own.

*Collected Homework:* Roughly once a week you will turn in a written assignment (due Fridays by 3pm). These assignments should be done neatly; you should complete rough drafts first. Neat work will be easier for me to follow and easier for you to follow when you are reviewing for the exams. Although you may discuss the main ideas of the **general** collected homework problems together (not notebook problems as described below), details and your write-up must be entirely your own. The point value for each assignment will vary. Assignments will be considered late if they are not turned in by the time and date they are due. You may turn in up to two late assignments (any time before Monday at 9am, 66 hours after they are due) without penalty.

In additional to general homework problems, one or two of the collected homework problems each week will be designated as "notebook problems". **Treat these like take-home exams.** Notebook problems will generally be proofs or more complex computations. Each proof will be assigned two grades – one for content and one for form. The content grade will reflect the extent to which the appropriate ideas are expressed in your write-up; that is, whether you understood the mathematical ideas required for the proof, and justified and explained this understanding well through appropriate proof methods. The grade for form will take into consideration clarity of expression, completeness, proper usage of both English and mathematical grammar, and whether you really said what you meant to say. Notebook problems may be resubmitted up to two times within one month of the original due date, but not after Tuesday, May 3rd at 5pm. The goal is for the final draft of these proofs to be the caliber of those written in a good textbook. When resubmitting, be sure to include the previous versions of your work. Please turn in notebook problems on a **separate sheet** of paper than the general problems, and do not staple them to your other work. Note that the expectations for the quality of your write-up will rise with each resubmission, though you will not be penalized for resubmitting your work and grades of previous versions will be erased. Resubmitting your work does not automatically mean your grade will increase. In fact, if your resubmission introduces errors, your grade may go down. However, this is uncommon and should **NOT** deter you from resubmitting your work. **Notebook problems must be entirely your own work. You may consult me, but may not talk with anyone else. Again – treat them like take-home exams.**

*Quizzes:* I will give a quiz roughly every Tuesday. These will be short and ask you to be able to explain definitions, give examples, or know the statements of theorems. Thus it will be very valuable for you to take notes and keep a vocabulary list from your readings. These quizzes will be worth fifteen points. **Under no circumstances may a quiz be made up**, however, I will drop your lowest quiz score.

*Presentations:* We will discuss some of the practice problems in class, some problems in response to a student question and some because I think the problem illustrates an important concept. Each student will be expected to present at least twice (this number may increase quite a bit depending on how we move through the material). Presentations will often be from these practice problems, but also may be assigned proofs from the text. Start volunteering early. Each presentation will be worth twenty points. The presentation will be graded on correctness, ability to answer questions and presentation style.

*Seminars:* In addition to regular class time, you will be required to attend two mathematics or computer science seminar talks during the semester, at least one of which must be mathematics. There will likely be a graph theory talk (or two), and you should make every effort to attend it. Seminars usually begin between 3pm and 5pm and last an hour (the days vary). Attendance at each talk is worth ten points (you must be present and attentive for the whole talk to receive credit). Try to ask a question during the talk or one-on-one with the presenter after the talk (this is a good way of showing me that you were alert!). Full credit is not automatic.

*Bonus:* You may earn five bonus points for each additional mathematics or computer science seminar talk you attend (up to fifteen points). You may also earn ten bonus points for turning in at least two-thirds of your homeworks typed in LaTeX. I would be happy to give you a short tutorial to introduce you to this process. In addition, up to ten points can be earned for each additional presentation.

Your collected assignments, quizzes, presentations and seminar attendance will make up 40% of your grade.

*Projects:* In pairs, you will complete a project that will involve working through reading a research article on graph theory. This will include learning (if you do not already know it!) about the mathematical database, MathSciNet, writing a (roughly) ten page paper, and presenting your work to the class. The presentations will occur the week of April 25th. Details about this project will be discussed at the beginning of March. The project will be worth 20% of your grade.

*Exams:* There will be a midterm exam in class on Thursday, March 10th and a final exam on Tuesday, May 10th from 8:30am until 11:30am. The midterm will be worth 18% of your course grade and the final 23% of your course grade. It is impossible to construct fair makeup exams in mathematics; thus, for your protection, my policy is that there are **no** makeup exams. Write the above dates in your calendar. **You must be present for all exams.** Make your travel plans accordingly.

*Attendance:* As this is a three hundred level course, you should be here because you are interested in and dedicated to learning about mathematics. The full nuances of the subject will only be understood if you give the class your complete attention. In addition, this course is about participating in the discovery of mathematics (class discussion, group work, presentations, etc.), not just learning the facts. Thus, *attendance in class is required.* **Four or more unexcused absences will result in an automatic failure in the course**, and any unexcused absences fewer than four may also adversely affect your grade. Talk to me in advance if you must miss class for some reason beyond your control. Also, common courtesy dictates that you be on time for class and not leave the room during class (unless you are ill). Phones should be turned off and stowed during the entire class period. This will help you, your classmates and me focus on what we all came here to learn.

## Disclaimer

The above exam dates, quantity of graded work, policies, and course layout are subject to change in the event of extenuating circumstances.

## The Center for Teaching and Learning

At Hobart and William Smith Colleges, we encourage you to learn collaboratively and to seek the resources that will enable you to succeed. The Center for Teaching and Learning (CTL) is one of those resources: CTL programs and staff help you engage with your learning, accomplish the tasks before you, enhance your thinking and skills, and empower you to do your best. Resources at CTL

are many: Study Mentors help you find your time and manage your responsibilities, Writing Fellows help you think well on paper, and professional staff help you assess academic needs. I encourage you to explore these and other CTL resources designed to inspire your very best work. You can talk with me about these resources, visit the CTL office on the 2nd floor of the library to discuss options with the staff, or visit the CTL website at http://www.hws.edu/academics/ctl/index.aspx.

If you are a student with a "disability" (or what I like to call a "nontraditional approach to learning") for which you may need accommodations, you should self-identify and register for services with the Coordinator of Disability Services at the CTL, and provide documentation of your disability. Disability-related accommodations and services will not be provided until the registration and documentation process is complete. The guidelines for documenting disabilities can be found at the following website: http://www.hws.edu/academics/ctl/disability_services.aspx. Please direct questions about this process, or Disability Services at HWS, to David Silver, Coordinator of Disability Services, at silver@hws.edu or x3351.

## Academic Integrity

I highly encourage you to form a small group with whom you can discuss the readings and collaborative assignments. Verbalizing your questions, explaining your mathematical ideas and listening to others will increase your understanding. However, you should **not** feel free to copy someone else's work or make your work available to someone else. **Copying constitutes plagiarism, a violation of academic integrity which could result in failure in the course. There is, of course, no collaboration or use of outside resources (including other textbooks or the internet) allowed on notebook problems, quizzes, or exams (unless specifically noted).** Violation of the Colleges' Principle of Academic Integrity will likely result in a report sent to your file in the dean's office and/or appearance before the Committee on Standards.

## How to Succeed

- Attend all classes on time.
- Remain seated and attentive during all lectures, presentations and whole class discussions.
- Participate in class discussions and take good notes.
- Be prepared and volunteer to present!
- Review your notes before each class.
- Draw lots of graphs to help you understand the reading.
- Keep a list of vocabulary words and learn them.
- Come to see me for help whenever you have questions.
- Begin working on assignments as soon as they are assigned. (Early start = less time spent!)
- Find one to three classmates with whom you can discuss the material outside of class.
- Ask your classmates and me lots of questions.
- Have fun!

## Essay Assignment

This assignment will contribute toward your active participation grade. Write a full one-page typed (usual font size and margin widths) autobiography. Discuss the following in your essay:

- what your major(s) and minor(s) are
- why you chose to take this course
- a mathematical course project you found particularly interesting and why it did (if you have not had the opportunity to do a mathematical course project yet, describe a mathematical topic you have encountered that particularly intrigued you and why)
- any exposure you have had to graph theory in the past
- what you expect from this course
- your favorite hobbies, and anything else interesting (for example, interesting plans you have for the summer).

The paper is due at 4:00pm tomorrow (Wednesday, January 20th) or before. You may hand it in personally to me or just slip it under my office door. This assignment also includes a short one-on-one meeting with me in my office after I have read your essay. Sign up for this appointment when you drop off your paper. Please bring a photo of yourself, with which you are willing to part, to the meeting (you do not need to have the photo when you turn in your essay). This meeting and the photo help me get to know each of you I do not, and catch up with those of you I do. Your grade on this assignment will be based on whether you address all the topics requested, as well as the quality of your writing (including good grammar and typography) and your prompt attendance of our meeting, photo in hand. It is critical that you are on time for your appointment! This assignment is worth 15 points. **Note:** if you had me for a course in a previous semester you do not need to bring a photo, **but** you should make sure this essay is different from the essay(s) you gave me then. It should update any of the topics listed above that have changed or discuss further topics you think are especially important to who you are.