Syllabus - MA 433 Spring 2024

Graph Theory

Professor: Juanita Duque-Rosero (she/her) - juanita@bu.edu.
Course hours: TR 11:00 AM - 12:15 PM (PSY B47).
Office hours: TR 9:15 - 10:15 AM and W 4:00 - 5:00 PM, or by appointment (at CDS 311).
Text: Introduction to Graph Theory, by Douglas B. West, 2nd edition, Prentice Hall 2001.
Course website: Blackboard via `learn.bu.edu`.

Material

Graph Theory can be used to generalize the concept of what it means for geometric objects to be connected and describe complex systems. Using vertices to represent objects and edges to represent which objects are adjacent to each other, students will be able to analyze the system as a whole. Students can study which geometrical objects can be placed on a plane, sphere, torus, etc. as well as generalize the concept of connected to more abstract settings. Students will explore these geometric aspects as well as analyze various algorithms and open problems in Graph Theory.

Teaching methods and philosophy

I firmly believe in Federico Ardila's axioms and I encourage you to think about them at every step of your learning process:

Axiom 1 Mathematical potential is equally present in different groups, irrespective of geographic, demographic, and economic boundaries.
Axiom 2 Everyone can have joyful, meaningful, and empowering mathematical experiences.
Axiom 3 Mathematics is a powerful, malleable tool that can be shaped and used differently by various communities to serve their needs.
Axiom 4 Every student deserves to be treated with dignity and respect.

Expectations. These are my expectations for you: treat me, your classmates, and yourself with respect; come to class on time and prepared to learn; actively work and participate in class; and follow BU's academic conduct code. This is what you can expect from me: treat everyone with respect; come to class on time and prepared; do my best to support your class interactions and to help you succeed; and have open channels of communication during class, office hours, or by email.
Class format. Classes will usually consist on a combination of lectures and small group class work. We will try to build an active learning environment, so please come to class willing to participate!

Course objectives

The two main goals of this class are to develop your ability to read and write proofs, and to cover the basic topics in Graph Theory. This course is intended for Mathematics majors in the pure math track but anyone with an interest in higher level mathematics and a working knowledge of Linear Algebra is welcome. Depending on interest, topics may become more focused on computer science.

Academic honesty

Boston University's policies on cheating are spelled out in the BU Academic Conduct Code, available at `http://www.bu.edu/academics/resources/academic-conduct-code/`. These policies will be followed in this class.

Grading

The course grade will be based upon the scores on class participation (10%), written homework (40%), one midterm (20%), and a final project (30%). This grading policy is subject to change, but grades will not decrease as a result of changes.

Homework. Homework will be due one week after it is assigned. You are welcome to work with others, but the assignment **must be written up on your own** and you must acknowledge your collaborators on the first page of your write-up. Your lowest homework score will be dropped.

Final project. You will write a final report on a Graph Theory topic of your choice. I will give you several ideas, but you are free to pick any relevant topic. The guidelines and rubric for the final project will be posted on BlackBoard as it gets closer to the date the project will be assigned.

Extension policy

Every student is granted an automatic extension for one homework set; you however need to tell me before the submission deadline. This policy does not apply to the final project or midterm. I might grant extensions after the automatic one based on special circumstances, but students will need to ask for it.

Attendance policy

You are expected to attend each class session unless you have a valid reason for being absent.

Absence due to religious observance

If you must miss class due to religious observance, you will not be penalized for that absence and you will receive a reasonable opportunity to make up any work or examinations that you may miss. Please notify me of absences for religious observance as soon as possible and **before the absence**.

Mental health and wellness

The academic environment is challenging, and classes are not the only demanding part of your life. There are a number of resources available to you on campus to support your wellness, including: mental health services at SHS (https://www.bu.edu/shs/behavioral-medicine), which allows you to book initial evaluation appointments online (http://patientconnect.bu.edu/); and Student Wellbeing (https://www.bu.edu/studentwellbeing/). Please make me aware of anything that will hinder your success in this course.

Accommodations

Students with documented disabilities, including learning disabilities, may be entitled to accommodations intended to ensure that they have integrated and equal access to the academic, social, cultural, and recreational programs the university offers. Accommodations may include, but are not limited to, additional time on tests, staggered homework assignments, note-taking assistance. If you believe you should receive accommodations, please contact the Office of Disability & Access Services to discuss your situation. This office can give you a letter that you can share with me outlining the accommodations you should receive. The letter will not contain any information about the reason for the accommodations.

Tentative course outline

The following is a tentative outline for the course. **This page will be updated irregularly**. Please refer to the Blackboard page for updated assignments.

Week	Lecture	Section in Text	Brief Description
1	1/18	1.1	Preliminaries, what is a graph?
2	1/23	1.1, 1.2	Isomorphisms, Paths, cycles, and trails
	1/25	1.2	Induction
3	1/30	1.2	Strong induction, Eulerian graphs
	2/1	1.2	Bipartite graphs
4	2/6	1.3	Vertex degree and counting
	2/8	2.1	Trees: basic properties
5	2/13	2.2	Spanning trees and enumeration
	2/15	2.3	Optimization and trees
6	2/20	5.1	Graph coloring
	2/22	5.1	Graph coloring
7	2/27	6.1	Planar graphs
	2/29	6.1	Euler's formula
8	3/5	6.3	Coloring of planar graphs
	3/7	6.3	Five Color Theorem
9	3/12 - 3/14		**Spring break**
10	3/19	2.3	Optimization
	3/21	2.3	Trees in computer science
11	3/26		**Midterm**: chapters 1, 2, 5, and 6
	3/28	3.1	Matchings and covers
12	4/2	3.1	Hall's Theorem
	4/4	3.1	Min-max theorems
13	4/9		**Canceled**: first meeting about your project
	4/11	4.1	Cuts and connectivity
14	4/16	4.2	k-connected graphs
	4/18	8.1	Perfect graphs
15	4/23	8.2	Matroids
	4/25		**Canceled**: second meeting about your project
16	4/30	8.3	Ramsey Theory