

# Graph Theory (Math/CPT 453/553)

## Syllabus

### Fall 2020

Logistics: MWF 14:10 – 15:00 on Zoom via Blackboard

Text: M. Hudelson, *Introductory Graph Theory*  
(Open Educational Resource in development; available in Blackboard)

Optional: Bondy and Murty, *Graph Theory with Applications*  
Brouwer and Haemers, *Spectra of Graphs*  
(Links to both are also in Blackboard)

Instructor: Matt Hudelson

Office Hours: TBA via Zoom

Office: Neill 330, Phone 335-3125

E-mail: [mhudelson@wsu.edu](mailto:mhudelson@wsu.edu) as well as through Blackboard

#### Anticipated Coverage:

Weeks	Section	Topic
1-3	I	Introduction
4-6	II	Connectivity
7-8	III	Trees
9-10	IV	Graph Topology
11-12	V	Digraphs
13	VI.A, VI.B	Linear Algebra Review and Graph Matrices
14-15	VI (remainder)	Eigenvalues and Graph Spectra

This course is intended as an intensive introduction to graphs. Intuitively, a **graph** is a collection of “vertices” (visualized as dots) joined by “edges” (visualized as line segments or curve segments.) With this intuition, we try to develop abstract pictures of relationships among discrete objects.

The “official” text for this course is my own O.E.R. (this means it’s free of charge among other things. Fair warning: It’s still in development; I’ll be working on the latter sections as the course goes on) which is inspired by several sources, including the Bondy and Murty classical treatment of graph theory, along with the Brouwer and Haemers treatment of spectral graph theory (how graph theory and linear algebra interact.) To start, we will develop standard terminology, defining and using terms such as “vertex, edge, adjacent, path, cycle, connected, acyclic, ....” We will examine many families of graphs (trees, bipartite graphs, complete graphs, cycles,  $n$ -cubes,...), developing many results that are considered part of the graph theory “canon.” Along the way, we’ll look at many standard proof techniques—variants of mathematical induction play a central role, so some review of mathematical induction will be helpful early on—that are commonly used in graph theory. As the audience for this course is widely varied, I

will lean toward showing fully the shorter proofs of well-used results, while offering sketches of longer proofs.

After Thanksgiving break, we'll switch gears and concentrate on the interplay between linear algebra and graph theory, specifically, how to draw information from the eigenstructure of various matrices associated with a graph. While there will be a brief review of background material during the course, it is recommended that students who feel "rusty" about linear algebra invest some time in advance of Thanksgiving revisiting the foundational material of linear algebra, especially concerning eigenvalues and eigenvectors.

### **Course Management**

We will use Blackboard as the main learning management system. All assignments will be assigned by, submitted to, and graded on the course Blackboard site. Since all WSU students have access to Office 360 (which includes MSWord equipped with equation editor), one of the learning goals of this course is to be able to communicate mathematical ideas in a professional manner. This includes gaining the ability to navigate in some sort of mathematical typesetting environment. I will use MSWord's equation editor in class as an ongoing demonstration of the capabilities of even rudimentary software. Assignments are to be electronically completed and then submitted to Blackboard as PDFs. I will encourage you to use software to draw diagrams, but this will not be required; hand-drawn images that are scanned in as part of your final PDF will be accepted.

### **Grading**

Your opportunities to demonstrate mastery of course concepts will take the form of periodic homework sets (due at 5:00 p.m. on dates as specified on Blackboard – a deduction of 0.5 points will be assessed for late submissions) along with a final course project consisting of a 7-13 page narrative paper to be written by all students and a 10-20 slide Power Point style presentation to be crafted by all 553 students. This project is due at 5:00 p.m. on Monday, December 9, the date that the final exam for this course is scheduled; a 5 point deduction on the overall project score will be assessed for late submissions unless compelling circumstances arise. "Compelling circumstances" include family emergencies, military obligations, medical circumstances beyond routine illnesses, extensive travel obligations, or other unforeseen circumstances that cause one to lose access to Blackboard for extended periods of time. Other course commitments do not fall under the banner of "compelling circumstances," so budget your time wisely (especially toward the end of the semester.) An "I" grade will be granted only if compelling circumstances make it impossible to complete the project.

There will be no in-class midterm or final exams.

The periodic homework sets (553 students should expect additional challenging questions) will count for 60% of the final grade and the project (plus Power Point style presentation for 553 students which counts for part of the project grade) will count for 40%. I will award points for each problem set and take the average of these when computing final grades.

Homework sets are graded out of 10 points. If a score below 8.5 is awarded, then the homework set may be re-attempted with a maximum possible score of 8.5.

The written paper is worth 100 points for 453 students. The written paper is worth 75 points and the Power Point style presentation is worth 25 points for 553 students.

Final course grades will be awarded on the following scale:

Interval	Grade	Interval	Grade
[92,100]	A	[76,79)	C+
[89,92)	A-	[72,76)	C
[86,89)	B+	[69,72)	C-
[82,86)	B	[66,69)	D+
[79,82)	B-	[60,66)	D
		[0,60)	F

### Reasonable Accommodations

Reasonable accommodations are available for students with documented disabilities or chronic medical conditions. If you have a disability and need accommodations to fully participate in this class, please visit the Access Center website to follow published procedures to request accommodations:

<http://www.accesscenter.wsu.edu>. Students may also either call or visit the Access Center in person to schedule an appointment with an Access Advisor. Location: Washington Building 217; Phone: 509-335-3417. All disability related accommodations MUST be approved through the Access Center. Students with approved accommodations are strongly encouraged to visit with instructors early in the semester during office hours to discuss logistics.

### Academic Integrity

Academic integrity is the cornerstone of higher education. As such, all members of the university community share responsibility for maintaining and promoting the principles of integrity in all activities, including academic integrity and honest scholarship. Academic integrity will be strongly enforced in this course. Students who violate WSU's Academic Integrity Policy (identified in Washington Administrative Code (WAC) 504- 26-010(3) and -404) will receive a 0 score on the assignment, will not have the option to withdraw from the course pending an appeal, and will be reported to the Office of Student Conduct.

Cheating includes, but is not limited to, plagiarism and unauthorized collaboration as defined in the Standards of Conduct for Students, WAC 504-26-010(3). You need to read and understand all of the definitions of cheating. If you have any questions about what is and is not allowed in this course, you should ask course instructors before proceeding.

If you wish to appeal a faculty member's decision relating to academic integrity, please use the form available at [communitystandards.wsu.edu](http://communitystandards.wsu.edu). Make sure you submit your appeal within 21 calendar days of the faculty member's decision.

## **Classroom and Campus Safety**

Classroom and campus safety are of paramount importance at Washington State University, and are the shared responsibility of the entire campus population. WSU urges students to follow the “Alert, Assess, Act,” protocol for all types of emergencies and the “Run, Hide, Fight” response for an active shooter incident. Remain ALERT (through direct observation or emergency notification), ASSESS your specific situation, and ACT in the most appropriate way to assure your own safety (and the safety of others if you are able).

Please sign up for emergency alerts on your account at MyWSU. For more information on this subject, campus safety, and related topics, please view the FBI’s Run, Hide, Fight video and visit the classroom safety page [ <https://provost.wsu.edu/classroom-safety/> ].

## **Severe Weather**

For severe weather alerts, see <http://alert.wsu.edu/> and <https://oem.wsu.edu/emergency-procedures/severe-weather/>. In the event of severe weather affecting university operations, guidance will be issued through the alert system.

## **Religious Accommodation**

Washington State University reasonably accommodates absences allowing for students to take holidays for reasons of faith or conscience or for organized activities conducted under the auspices of a religious denomination, church, or religious organization. Reasonable accommodation requires the student to coordinate with instructor on scheduling examinations or other activities necessary for course completion. Students requesting accommodation must provide written notification within the first two weeks of the beginning of the course and include specific dates for absences. Approved accommodations for absences will not adversely impact student grades. Absence from classes or examinations for religious reasons does not relieve students from responsibility for any part of the course work required during the period of absence.

## **WSU Discrimination and Harrassment Policy**

Discrimination, including discriminatory harassment, sexual harassment, and sexual misconduct (including stalking, intimate partner violence, and sexual violence) is prohibited at WSU (See WSU Policy Prohibiting Discrimination, Sexual Harassment, and Sexual Misconduct (Executive Policy 15) and WSU Standards of Conduct for Students).

If you feel you have experienced or have witnessed discriminatory conduct, you can contact the WSU Office of Civil Rights Compliance & Investigation (CRCI) and/or the WSU Title IX Coordinator at 509-335-8288 to discuss resources, including confidential resources, and reporting options. (Visit [crcl.wsu.edu](http://crcl.wsu.edu) for more information). Most WSU employees, including faculty, who have information regarding sexual harassment or sexual misconduct are required to report the information to CRCI or a designated Title IX Coordinator or Liaison. (Visit [crcl.wsu.edu/reportingrequirements](http://crcl.wsu.edu/reportingrequirements) for more info).

## Students in Crisis – Pullman Resources

This information will also be available through myWSU. Similar lists of resources will be compiled for the other campus locations.

- If you or someone you know is in immediate danger, DIAL 911 FIRST!
- AWARE Network: [aware.wsu.edu](http://aware.wsu.edu)
- Cougar Transit: 978 267-7233
- WSU Counseling and Psychological Services (CAPS): 509 335-2159
- Suicide Prevention Hotline: 800 273-8255
- Crisis Text Line: Text HOME to 741741
- WSU Police: 509 335-8548
- Pullman Police (Non-Emergency): 509 332-2521
- WSU Office of Civil Rights Compliance & Investigation: 509 335-8288
- Alternatives to Violence on the Palouse: 877 334-2887
- Pullman 24-Hour Crisis Line: 509 334-1133