Math 2100 – Fall 2024
Discrete Mathematics

My Contact Information

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Lectures:	Section 101: MWF, 10:00am - 10:50am, Wehr Chemistry 113
	Section 102: MWF, 11:00am - 11:50am, Wehr Chemistry 107
Office Hours:	Monday, 2:00pm - 3:00pm
	Wednesday, 3:00pm - 4:00pm
	Friday, 8:30am - 9:30am
	and by appointment (just email me!)

Course Description

This course is an introduction to abstract mathematics through the lens of discrete mathematics, a field centered on the study of mathematical objects such as sets, functions, and graphs. We will learn many techniques that allow one to rigorously prove mathematical facts, and we will apply those techniques to the study of discrete mathematics. Emphasis is placed on logical, abstract thinking and clear and precise mathematical writing.

Common Learning Objectives

1. Determine the truth values of logical statements, and construct truth tables and use them to determine logical equivalence.
2. Perform elementary set operations, and prove results related to sets.
3. Prove results related to relations, including functions and equivalence relations.
4. Prove results using the methods of the Principle of Mathematical Induction, direct proof, proof by contrapositive, and proof by contradiction.
5. Use basic graph theory results.
6. Write logically sound proofs in English sentences, justifying all steps appropriately.
7. Glimpse some of the beauty of mathematics by working with mathematical theory.

Textbook

Discrete Mathematics: Mathematical Reasoning and Proof with Puzzles, Patterns, and Games, by Douglas E. Ensley and J. Winston Crawley. There is only one edition of this book.

Course Websites

Some course materials will be posted on D2L, and may be accessed through https://d2l.mu.edu. Other course material will be posted on our course page (see the link at the top of this page). Please email me directly, not through the D2L system. Important information will be emailed to you, so please check your email often.

Specifications-Based Grading

Assessment in this course will be based on the model of *Specifications-Based Grading*, or *Spec Grading*. The primary goals of spec grading are:

- ≻ Emphasize understanding over memorization
- ≻ Reduce student stress
- ≻ Provide students with more concrete feedback about their progress in this course, and allow students to have more control of their grade
- ≻ Create clear expectations

Quick Overview

Course grades will be based on your level of performance in five categories of work, each of which will be explained in more detail below.

1. Homework
2. Quizzes
3. Exams
4. Class Participation
5. Demonstration of Productive Failure

Questions on homework, quizzes, and exams will be graded on the **EMPI** scale (explained below), and students will have the opportunity to submit revisions to homework, quiz, and exam questions (except the final exam) for rescoring. If the revised score is lower than the original score, the better score will always be kept.

EMPI Scale

Your solution to each question on a homework assignment, quiz, or exam will be given a grade of **E**, **M**, **P**, or **I** based on the criteria below (adapted from http://eric.ed.gov/?id=EJ717675).

Excellent	Contains no mathematical errors Demonstrates complete understanding Written clearly and concisely, and in logical order Contains very few spelling or grammatical errors
Meets Expectations	Contains few mathematical errors Contains no significant mathematical errors Understanding is evident Writing is mostly clear and concise, possible issues with logical order Contains few spelling or grammatical errors
(Still) **P**rogressing	Demonstrates partial understanding, but significant gaps remain — Further teaching is necessary Contains significant mathematical errors Writing is unclear, unnecessarily verbose, or out of logical order Contains significant spelling or grammatical errors
Incomplete	Solution not attempted or only partially completed Writing is completely unclear or illegible

Homework

Homework will be assigned approximately every other Wednesday, except in the case of breaks, holidays, or exams. Altogether, there will be six homework assignments. Each homework assignment will consists of 6-10 questions. Late homework will only be accepted up to 24 hours after the deadline, and there will be a 2 token penalty (see the section below about tokens). Homework can be handwritten, or typed.

Four questions will be chosen from each assignment to be graded on the **EMPI** scale.

Each day I will suggest several *recommended exercises* from the textbook. These will not be collected or graded, but completing them will be valuable for your understanding of the material and preparing for quizzes and exams. All quiz questions will come verbatim from the recommended exercises, and you should consider using them to form your own practice tests.

Quizzes

A very short quiz consisting of two questions will given most Fridays except on exam days, for a total of eight quizzes. Each quiz will be on material covered since the previous quiz. The exact topics of each quiz will be announced in class.

The purpose of these quizzes is to check that material is being retained as the course progresses. Each of the two questions will be graded on the **EMPI** scale.

Exams

There will be three in-class midterm exams and a final exam. Each midterm will have 6 questions, and the final exam will have 10 questions, for a total of 28 exam questions during the term.

Homework/Quiz/Exam Revision

One of the most important features of spec grading is that students are given the opportunity to reassess and revise their work so that they can demonstrate complete understanding of the material.

All revisions are due within one week of the day that the graded assignment is returned. If you miss class when I return the assignment and pick it up later, your revision is still due one week from when I passed the assignment back to the rest of the class. Deadlines may be extended at my discretion in the case of class holidays.

Any homework question that does not receive the score **E** can be revised and resubmitted. If the resubmission still does not receive the score **E**, then it can be rerevised and reresubmitted within a week of the graded resubmissions being distributed to the class. Solutions can be revised and resubmitted an unlimited number of times, subject to the one-week deadlines. If the revised score is lower than the original score, the better score will always be kept.

Any homework solution that has been left blank, or that only contains gibberish or irrelevant information, will be marked as Not Revisable, and such questions cannot be revised and resubmitted. This is just to prevent people from turning in blank assignments to receive automatic one-week extensions. As long as you make a good faith effort on a question, you will have the opportunity to revise and resubmit.

Any quiz question or exam question that does not receive the score of **E** can be revised and resubmitted subject to the same one-week deadline conditions as homework. However, resubmitting a quiz question costs *1 Token* and resubmitting an exam question costs *2 Tokens*. (See below for information about tokens.) If you need to resubmit the same question more than once, you must spend the tokens each time.

Class Participation

We will spend a significant part of class time working on exercises together, and discussing solutions as a class. To satisfy the *class participation* category, I expect you to be (1) in class, (2) awake!, (3) active, and (4) working cooperatively with your group during any group work.

I understand that occasional absences happen. If you need to miss class, send me an email to let me know. Chronic absences may lead to not satisfying the class participation requirement.

Final decisions about class participation are completely up to my discretion.

Demonstrating Productive Failure

One of the most profound benefits of a spec grading system is that students have the opportunity to evaluate and revise their own work by analyzing their thought process, figuring out where they went wrong, and determining how to avoid similar mistakes in the future. By going through this process, each of you will discover more about your own learning styles. By the end of the course, the revise/resubmit process will teach you to be more efficient, effective, and productive learners.

When you resubmit assignments, I will ask you to write a quick sentence or two about what went wrong the first time, and how you can prevent similar mistakes in the future. Please take time to reflect honestly on these critical questions.

At the end of the course, I will ask you to write a brief note about how you've learned from this process. You will be considered to have *Demonstrated Productive Failure* if you've written this note and can demonstrate that you've thought carefully during the semester about your learning process and your study methods.

Grade Assignments

Your final grade in the course will be based on your performance in each of the 5 categories of assessment. **To achieve a particular letter grade, you must meet or exceed *all* benchmarks for that grade.**

	To earn an **A**	To earn a **B**	To earn a **C**	To earn a **D**
Homework: (24 scores)	$\geq$ 22 **M/E** $\geq$ 14 **E**	$\geq$ 20 **M/E** $\geq$ 12 **E**	$\geq$ 18 **M/E** $\geq$ 10 **E**	$\geq$ 16 **M/E**
Quizzes: (16 scores)	$\geq$ 14 **M/E** $\geq$ 9 **E**	$\geq$ 12 **M/E** $\geq$ 7 **E**	$\geq$ 10 **M/E** $\geq$ 4 **E**	$\geq$ 8 **M/E**
Exams: (28 scores)	$\geq$ 24 **M/E** $\geq$ 15 **E**	$\geq$ 22 **M/E** $\geq$ 13 **E**	$\geq$ 18 **M/E** $\geq$ 10 **E**	$\geq$ 14 **M/E** $\geq$ 6 **E**
Class Participation:	Participate actively in class	Participate actively in class	*no requirement*	*no requirement*
Demonstrate Productive Failure:	Demonstrate productive failure	Demonstrate productive failure	*no requirement*	*no requirement*

If you meet at least two of the requirements for a higher letter grade, your final grade moves from X to $X+$. If you meet at least four of the requirements for a higher letter grade, your final grade moves from X to $(X+1)-$ (for example, from B to $A-$).

Marquette does not offer the letter grades $D-$ or $F+$. As such, students who do not meet all of the criteria for a D will earn an F.

Tokens

Tokens may be earned by completing extra activities and spent on quiz/exam revisions and other advantages. Each student starts the course with 8 tokens.

Ways to earn tokens:

- $+1$: Come to office hours. *(Can be earned at most six times per term.)*
- $+1$: Study for a quiz or exam in a group of at least three students. *(Can be earned at most four times per term. To get credit for this, all students present should email me to tell me where and when they met, how they studied together, and whether they thought it was effective.)*

- ≻ $+1$: Write your homework in LaTeX; see our course website for information about LaTeX. *(Can be earned at most three times per term.)*
- ≻ $+2$: Bring a mathematical news story to class and tell us about it in at most two minutes. *(Can be earned at most once per term. Email me first for approval. No duplicate news stories.)*
- ≻ **I am open to other suggestions!**

Ways to spend tokens:

- ≻ -0: Revise and resubmit a homework question
- ≻ -1: Revise and resubmit a quiz question
- ≻ -2: Revise and resubmit a midterm exam question *(Note: final exam questions cannot be revised/resubmitted!)*
- ≻ -2: 24 hour extension on a homework assignment
- ≻ **I am open to other suggestions!**

Other Classroom Policies

Office Hours

Office hours are scheduled times that I will be available to help you with course material, including topics from lecture, homework questions, revisions, etc. You are *strongly encouraged* to come to office hours frequently! You don't need an appointment, you can come in and out at any time, and often office hours are empty so they are essentially free one-on-one help. Please watch this instructional and informative video about office hours: https://vimeo.com/270014784.

Writing in Latex

Latex is a text editor that enables you to create good-looking mathematical documents. It is very commonly used in mathematics, computer science, physics, engineering, and other STEM fields. It is not required to use Latex for your homework, but you can earn tokens for doing so, and it makes revisions easier. The course website has some tutorial information and templates to help you get started, and I'm always more than happy to help out in office hours.

Grading Disputes

If you believe that I have made an error in scoring an assignment, you must bring it to my attention within one week of the graded paper being returned. I will carefully reread, and if necessary rescore, the assignment. Note that the one-week revise/resubmit deadline is still in effect, so if you think you may want to revise/resubmit, then you should bring the score to my attention before one full week.

Classroom Conduct

The classroom is an interactive learning environment in which everyone should feel valued and comfortable. I strongly encourage you to ask questions and give answers throughout the term, even if (particularly if!) you're not sure that your answers are correct. This is an important part of the learning process.

Students in past courses have often told me that they might peek at their phone, or get otherwise distracted, when they see something in the lecture that they already know. Then, they look up a few minutes later and realize that they're already lost and because math lectures build on themselves, they tend to stay lost for the rest of the class period. To prevent this, and in order to not distract your classmates, I ask that you keep your phones away.

Returned Papers

You must retain all returned papers in case of any discrepancy with the recorded grades on D2L. I cannot correct any mistakes in grading or recording of scores without the original document. All concerns regarding grades on assignments must be brought to me within one week of the return of the paper.

Homework Collaboration Policy

It can be very helpful to study and work with a group. This type of cooperative learning is encouraged; however, be sure that you have a thorough understanding of the concepts as well as the mathematical steps used to solve an exercise. You must be able to work through the exercises on your own. Each student must write up her or his assignment individually and independently and must turn in her or his own work. **All revisions of homework, quiz, and exam questions should be done independently, with no discussion between classmates.**

Accommodations and Special Needs

If you have a disability and require accommodations, please contact your instructor during the first week of class so that your learning needs may be appropriately met. You will need to provide documentation of your disability to the Office of Disability Services. If you are unsure of what you need to qualify for services, visit the Office of Disability Services' website at http://www.marquette.edu/disability-services or contact their office by phone at (414) 288-1645.

Excused Absences

Students with absences due to legal obligations, religious observances, or participation in Division 1 athletics and other university sanctioned events will be given an opportunity to make up examinations or other graded assignments, if a request is made to the instructor prior to the absence. After all absences, excused or unexcused, you are responsible for contacting your classmates to obtain lecture note and any other missed materials.

Advice from Prior Students

- *"Do the suggested homework, they help a lot and generally the questions are taken from the suggested homework. Unfortunately I never did the suggested homework and regret not doing it because I believe that it would have helped me greatly throughout the year."*
- *"If I had to do it again, I would take full advantage of the revision system and be sure to get off to an early start and fulfill as many requirements on the grading sheet as soon as possible, instead of trying to pick up slack at the end.*
- *"Expectations were very clear and the grading system definitely reduced stress. Sometimes it was difficult to figure out how I was doing in the class, but I loved having the opportunity to do revisions."*
- *"If I could give any advice to future students, it would be to take full advantage of the revision system. It's there to help you and can only help improve your grade. Additionally, I'd tell them to be sure to gain as many tokens as possible in the beginning of the semester and be sure to begin revising problems very early on if you need to. The coursework only gets harder, and its much easier to revise a problem about something you already know than something you're struggling with."*
- *"I think the revision process in general favors students who try and put effort to learn the material because they soon realize this method actually works to help you retain material. However, I do feel as though for some students it can be a deceiving trap to be lazy and rely on revision for the first half of the semester until they realize there are only a finite amount of tokens."*
- *"For future students my advice is to DO THE EXTRA PRACTICE PROBLEMS. This is for obvious reasons, but I did not take full advantage of this like I should have."*
- *"My first piece of advice to a student who will take this class in the future will be to do the corrections whenever possible. I do feel that taking a second chance at an assignment, particularly homework and quizzes, helped me to relearn what I may have misunderstood, as well as getting an overall clearer understanding of the material."*