Discrete Structures

Course Information

- **Institution**: Dordt University
- **Course**: Math 212-01 (3 cr.)
- **Term**: Spring 2021
- **Instructor**: Dr. Mike Janssen, Associate Professor of Mathematics
- **Classroom**: CL 1143
- **Class time**: 2:00-2:50pm MWF
- **Office**: SB 1612
- **Student Hours**: Make an appointment or drop by
- **Course notes**: https://prof.mkjanssen.org/ds/notes/ | PreTeXt source
- **Course website**: https://prof.mkjanssen.org/ds/
- **Catalog Course Description**: A study of topics in discrete mathematics that are relevant to computer science and mathematics, including logic and proof, induction and recursion, elementary set theory, combinatorics, relations and functions, Boolean algebra, and introductory graph theory. Prerequisite: a grade of C- or better in Math 152.

Required Resources

- Regular access to:
    - the course notes
    - the textbook
    - Canvas
    - Edfinity for homework
    - Overleaf for producing your portfolio/problems
- A copy of *Mathematics for Human Flourishing*, by Francis Su

Learning Objectives

In this course, students will:

- be *communicators* through regular presentations to the Math 212 learning community and growing fluency in the writing of mathematical proofs. (CD)
- be *explorers* by engaging with in-class activities and regular work outside the classroom. (CD)
- be *connectors* by building relationships between real-world questions and discrete mathematical tools for answering them. (CS)
- be *learners* by leveraging knowledge of logic, functions, and sets to explore foundational questions in discrete mathematics. (CS)

- be *ambassadors* by reflecting on the ways the practice of mathematics can promote human flourishing. (RO, CD, CR)

Course Liturgies

The best way to learn mathematics is to *do* mathematics. To that end, we'll regularly engage in the following.

In-Class Explorations

Each class period will start with a short introduction to the topics for the day, and will be followed by examples and explorations for you work in groups in order to gain fluency and practice with new mathematical ideas. Near the end of class, solutions will be solicited from the class. You should be ready to share your thinking, even if it's incomplete or you're unsure of your correctness. This exchange of ideas will be crucial for our learning!

This also means that attendance is a must. We'll learn best from one another and by explaining our thinking to one another. Engaged attendance at one class meeting will earn you one engagement point. Engagement points will be monitored and factored into the final grade.

Quizzes

Most Fridays will conclude with a short 2-engagement point quiz over the week's big ideas.

Homework

The online homework (done on Edfinity and accessed via Canvas) consists of regular problems due by 11:59pm Central on the listed due dates, typically the class day after we finish covering the relevant section. Your average on all of the homework sets will affect your final grade. You have an unlimited number of attempts on each problem, so your overall homework average should reflect not only your knowledge of the material but also your perseverance and commitment to finishing the work.

Reading Reflections

As we mature in our mathematical studies, we'll consider the formative nature of mathematical practice. (Former Dordt First Mondays Speaker) Francis Su argues that mathematics can help inculcate certain virtues. We'll read Su's book in chunks, complete reflection essays, and discuss them in class. See the schedule and the reflection assignments' Canvas pages for more details.

Portfolio

One of the ways in which we will grow as mathematical communicators is through careful study of/practice with writing mathematical proofs. We'll look at techniques, writing style, and, the LaTeX document preparation system (accessed via Overleaf). Periodically you will be assigned **Portfolio Problems** (see due dates in the schedule below). These must be typed in LaTeX and submitted in PDF form on Canvas. Each problem/proof will be assessed according to Dr. Janssen's standard proof rubric. You will have the freedom to revise and resubmit your work throughout the semester. New feedback will be given approximately once every two weeks (after the next batch of

problems are due; see the schedule). At the end of the semester, your work will be compiled into a single portfolio, along with a short reflection assignment. **This is the major summative work of the semester**; your final grade will be directly impacted by the cumulative final assessments of each portfolio problem.

Exams

There will be two exams, the first on March 5, and the second on April 30. The first will be cumulative up to that point, while the second will be cumulative from the point at which the first exam ended. The format for the exams will be announced at least three weeks ahead of time. Your exam average will be a major factor in your final grade.

Grading

In general, your final grade will be the highest fully completed row in the following table.

Grade	Engagement Points	Homework Average	Exams	Reflections	Portfolio M's	Portfolio E's
A	60	90%	87%	5	15	10
A-	57	88%	85%	5	15	9
B+	54	85%	81%	5	15	9
B	51	82%	77%	5	15	8
B-	47	78%	75%	5	14	7
C+	44	75%	70%	5	13	6
C	40	72%	65%	4	12	5
C-	35	65%	60%	4	11	4
D	30	50%	50%	3	10	2

Other Polices and Advice

- I am generally fairly accepting of late work, with a built-in 24-hour grace period for any non-classroom activities (e.g., mid-semester portfolio problems, homework assignments, reflections). Additional time beyond the 24-hour grace period must be approved ahead of time.
- Student hours are your time to ask questions about all aspects of the class and college life. If you can't find an appointment, send me an email! I will do my very best to accommodate your schedule.
- **Email Policy**: I check my email twice per school day: once in the morning, where I'll deal with any emergencies, and once in the afternoon, when I'll respond to other emails (including any that have come in since the morning). If you require a more immediate response, you're welcome to come find me in my office.

Additional Information

Dordt University Student's Right to Accommodations Policy   Any student who needs access to accommodations based on the impact of a documented disability should contact the Coordinator of Services for Students with Disabilities (CSSD): Marliss Van Der Zwaag, Academic Enrichment Center, (712) 722-6490, marliss.vanderzwaag@dordt.edu.

Dordt University Academic Dishonesty Policy Dordt University is committed to developing a community of Christian scholars where all members accept the responsibility of practicing personal and academic integrity in obedience to biblical teaching. For students, this means not lying, cheating, or stealing others' work to gain academic advantage; it also means opposing academic dishonesty. Students found to be academically dishonest will receive academic sanctions from their professor (from a failing grade on the particular academic task to a failing grade in the course) and will be reported to the Student Life Committee for possible institutional sanctions (from a warning to dismissal from the university). Appeals in such matters will be handled by the student disciplinary process. For more information, see the Student Handbook.

COVID-19 Classroom Protocols As we begin the semester, Dordt is a mask-required environment. While on Dordt's campus, you will need to wear a mask in all public places or common indoor spaces, which include: classrooms, hallways, laboratories, restrooms, the Hulst Library and all building lobbies. Should you forget your mask, there may be a disposable paper mask available in the classroom/lab for your use. If not, your instructor will ask you to return to your room to retrieve your mask. Physical distancing practices will also be in effect. Your instructor may also ask for student volunteers to who are willing to take a few minutes to spray cleaning solution on classroom surfaces when class concludes.

If you are approved by Student Services for accommodations for virtual learning due to COVID-19, your instructor will be notified by Student Services and you will receive information from your instructor about virtual learning during your isolation period.

Tentative Schedule

I aim to build a dynamic classroom; as such, the schedule below may be changed as the semester progresses. Any changes will be reflected here and in the course notes.

Week	Day	Topic	Work Due
1	15-Jan	Course intro	
2	18-Jan	0.2 Statements and Implications	
2	20-Jan	0.2: Predicates and Quantifiers	Edfinity Demo assignment
2	22-Jan	0.3: Sets and Relationships	Quiz; Edfinity 0.2
3	25-Jan	0.3: Operations on Sets	
3	27-Jan	Relations and Equivalence Relations	Portfolio Problem 0; Edfinity 0.3
3	29-Jan	Relations and Equivalence Relations	Quiz
4	1-Feb	0.4: Functions	M4HF Reflection: Chs. 1-5
4	3-Feb	**Reading discussion**; 0.4: Functions	Portfolio Problem I
4	5-Feb	0.4: Functions	Quiz
5	8-Feb	1.1: Additive and Multiplicative Principles	Edfinity 0.4
5	10-Feb	1.1: Counting with Sets; PIE	
5	12-Feb	1.2: Binomial Coefficients I	Quiz; Edfinity 1.1
6	15-Feb	**No class**	
6	17-Feb	1.2: Binomial Coefficients II	Portfolio Problem II

Week	Day	Topic	Work Due
6	19-Feb	1.3: Combinations and Permutations	M4HF Reflection: Chs. 6-7; Quiz; Edfinity 1.2
7	22-Feb	1.4: Combinatorial Proofs	Edfinity 1.3
7	24-Feb	1.4: Combinatorial Proofs	
7	26-Feb	1.5: Stars and Bars	Quiz
8	1-Mar	1.6: Advanced Counting with PIE	Edfinity 1.5
8	3-Mar	Catchup and Review	Portfolio Problem III; Edfinity 1.6
8	5-Mar	**Midterm I**	
9	8-Mar	2.1: Sequences	
9	10-Mar	2.2: Arithmetic and Geometric Sequences	Edfinity 2.1
9	12-Mar	2.3: Polynomial Fitting	Quiz; Edfinity 2.2
10	15-Mar	2.4: Recurrence relations	Edfinity 2.3
10	17-Mar	2.5: Induction I	Portfolio Problem IV; Edfinity 2.4
10	19-Mar	2.5: Induction II	Quiz
11	22-Mar	3.1: Propositional Logic I	M4HF Reflection: Chs. 8-11; 2.5 Homework
11	24-Mar	**Reading discussion**; 3.1: Propositional Logic	
11	26-Mar	3.2: Direct Proofs	Quiz; Edfinity 3.1
12	29-Mar	3.2: Proofs by Contrapositive/Proofs by Contradiction	
12	31-Mar	3.2: Other Proof Techniques	Portfolio Problems V-IX
12	2-Apr	4.1: Intro to Graph Theory	Quiz; Edfinity 3.2
13	5-Apr	4.1: Intro to Graph Theory	
13	7-Apr	**No class**	
13	9-Apr	Portfolio work	Quiz; Edfinity 4.1
14	12-Apr	4.2: Trees I	
14	14-Apr	4.2: Trees II	Portfolio Problems X-XIII
14	16-Apr	4.3: Planar graphs	Quiz; Edfinity 4.2
15	19-Apr	4.4: Coloring	Edfinity 4.3
15	21-Apr	4.5: Euler Paths and Circuits	M4HF Reflection: Chs. 12-13, Epilogue; Edfinity 4.4
15	23-Apr	4.6: Matching in Bipartite Graphs	Quiz; Edfinity 4.5
16	26-Apr	**Reading discussion**; 5.1: Generating Functions	
16	28-Apr	5.1: Generating Functions	Portfolio Problems XIV-XV
16	30-Apr	**Midterm II**	
Finals		Portfolio	