DISCRETE MATHEMATICS - Fall 2020

If you prefer, I have made a video syllabus: https://youtu.be/7O3hL9JJreI

Class and Instructor Details

MATH 228-008 (3 credits)

Virgil U. Pierce
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Office: Ross Hall 2239

Class Meetings: Monday, Wednesday, Friday 2:30p - 3:20p Via Zoom.

Zoom Class Link:
https://unco.zoom.us/j/94404738407?pwd=YVJxSi90RENSWnBMZVJ6d1BQUFlnQT09
The password will be sent in an email. The direct link and dial in options will be in Canvas.

We will discuss the specifics of our schedule on Monday 8/24 in our first meeting; but the plan is to begin with 2-3 days per week of synchronous meetings, transition to 1 synchronous meeting per week and then asynchronous collaborations by the end of the semester. In plain language: keep the class meeting time free in your schedule for now, but anticipate that as the semester goes on you will have more flexibility and freedom.

Youtube Playlist: Videos for class, including recordings of class will be put into a youtube playlist available here.
https://www.youtube.com/playlist?list=PLtO14BSFfYs4pECLRv89oXxvIDo-btrL1

Student Hours: TBD. You can always email me and we can schedule a meeting. Emails will have a response within 24 hours. *See the note below about this democratic syllabus.*

No Textbook Purchase Required.

Course Description and Prerequisites

From the catalog: A survey course of non-calculus based mathematics used extensively in computer science and other disciplines. Study sets, types of proofs, logic, recursion and related topics.

A more complete description: You will most likely find this course very different from previous math courses. Instead of memorizing formulas and procedures, we will spend our time investigating patterns and solving problems. Further getting an answer will

rarely be enough for us; we will need to give good reasons that the answers are correct or even multiple reasons the answers are correct. To give these "proofs" of our answers, there will be a fair amount of writing in this course.

Outline of Course Content:
1. Graph Theory: colorings, trees, planar graphs, Euler trails, and Hamilton paths.
2. Logic: truth-tables, valid arguments, converse and contrapositive, quantifiers, sets, proofs.
3. Combinatorics: binomial coefficients, binomial expansions, principle of includsion / exclusion, permutations, sum and product rule, derangements.
4. Sequences and Recursions: finite differences, polynomial fitting, characteristic roots, generating functions.
5. Mathematical induction and recursive reasoning.

Some comments about the organization of the course.
1. We will start with Graph Theory because this has a high probability of being new for all of us. We will then come back to this topic throughout the course as we explore new ideas in the other content.
2. We will do some quick lessons on logic to set up the structures we need, and then we will also return to this topic throughout the course as we need more of it.
3. Combinatorics (what you should think of as counting things) is the meat of the course.
4. Throughout the entire course I will be introducing you to some of the applications of this content. Discrete Mathematics can be seen as both a very pure mathematical topic (pure in the sense of done only for the purposes of the doing) and as a very applied mathematical topic (applied in the sense of being used to solve problems from other fields, improving the human condition, and adding value). Both motivations are worthy and noble!

Learning Objectives/Outcomes for the Course
Students will:
1. Identify connections between a wide variety of combinatorial problems, including counting patterns, graph theory, and games.
2. Support their arguments for solutions of problems in graph theory, combinatorics, and sequences.
3. Create and evaluate proofs about graph theory, combinatorics, and sequences.
4. Use results from Calculus to solve problems in combinatorics and recursions.
5. Identify graph theory and combinatorial ideas in applications, and apply techniques from class to their solution.

Textbook.

We will be using the FREE and OPEN online textbook *Discrete Mathematics: An Open Introduction, 3rd edition* by Oscar Levin. The books is available at the website: http://discrete.openmathbooks.org/dmoi3.html

You read it on an online device: http://math.oscarlevin.com/dmegt/dmegt.html and in particular it is formatted to display well even if you are using a phone. Note in fact that this online version is slightly different from the print version on Amazon. It is reordered with the graph theory section first.

You can also download the PDF of the book for your e-reader or tablet, and finally you can purchase a paper copy from Amazon's print-on-demand service for $24 (last I checked). Note that the Amazon purchase is likely cheaper than printing the PDF book unless you use one of the complimentary printing services like the High Plains Library Districts membership.

Other resources used during class will be *The Online Encyclopedia of Integer Sequences: https://oeis.org/*

And Python. You can install Python on your own computer, and I suggest doing it using the Anaconda Package Manager: https://www.anaconda.com/products/individual

However, the university has a server that is running a Jupyter Notebook with Python that will be available for you. I will put instructions here for accessing it once I have them. This will let you use Python without having to install it, and you could also access it using a tablet or phone.

You can access the Jupyter Hub by going to this website: https://jupyter.unco.edu/hub/login click sign on with Azure ID (you may be asked to login with your UNC credentials at this step) and then choose the minimalist Python notebook (this keeps our resources usage lower). That's it. Your account should be persistent, unfortunately sharing files is not easy - you will need to download them to your own machine. I will distribute instructions for getting the files we will use during class.

Communication

We will be using Canvas to communicate for this class. Particularly the discussion boards are a useful place to post questions and collaborate with other students. Unless your question for me is about your grades, I would love to have you post it in the discussions page in Canvas. I can guarantee if you have a question, someone else has the same question.

Democracy

My classroom functions a little bit like a democracy. One example is that in the first week we will decide when the best hours during the week for student hours are (my partner has veto authority here).

At any time you can bring up a proposal for the class, and it can be discussed and voted on. Not all proposals will be things I can act on for one reason or another, but I am open to discussion about any decision related to your class. Proposals that are accepted become acts and will be added to this syllabus.

Some examples:
1. I have had classes change the due dates on assignments;
2. Change the weights for assignments;
3. Adjust the content for an exam.

Edfinity

We will be using Edfinity practice exercises. The advantage of this software over doing everything with paper/pencil/google docs is that it gives you immediate feedback on your work. Due dates and assignments will be posted in Canvas. These assignments will prepare you for the teamwork assignments we will do during class.

You will have to pay for a license for the software. The cost is $20 for the semester. One of the things we get for that $20 is customer support if we have any technical problems.

You are encouraged to work with others and seek help on the Edfinity problems. But you will need to submit your own solutions.

Homework

More involved homework will be assigned weekly and will involve writing and explaining your solutions. This will be collected in Canvas. Homework is meant for us to develop our understanding beyond what we did during class. Some of the things we will be thinking about during the semester will take time to process and see in better light. If you participate in the teamwork assignments, either during class or in the discussion board, the homework will be easier for you.

You will be able to submit updates to your homework.You are encouraged to work with others and seek help on the homework problems. But what you submit should be written in your own words and you need to be ready to explain your ideas.

A few homework assignments will be video assignments where your submission will be a video explaining your solution to the problem.

Quizzes

We will have quizzes in Canvas to check our understanding and progress. They will be based on the homework assigned. There will be enough of them that any individual one will not make a big difference in your grade. Again, participating in the teamwork assignments will improve how you do on the quizzes.

The intent is for you to do the quizzes as an individual and to only use the online resources you are directed to. In some cases collaboration will be required, but it will be built into the design of the quiz.

Attendance / Class Participation / Teamwork Problems

You do not need to seek my permission for missing a class meeting. Class meetings will be useful to help you complete the course successfully and will also I hope help you complete the assignments more efficiently. However, there are other things more important than school or an individual class day.

I hope you will be able to make all of our synchronous classes. However I also know that life happens (and a lot of it is happening in Fall 2020). What will count is that you have participated in the community of our class. That participation can take many forms:

1. You can of course attend our class meetings and participate in our discussions and teamwork.
2. You can participate in the discussion of a teamwork problem in Canvas.
3. You can make a video about a teamwork or homework problem with another student from class.

As has been mentioned above, the course will be a series of teamwork problems that form the actual bulk of how we explore the topics. You should be contributing to our exploration of these either in class or through contributions to Canvas.

Exam / Projects

Let me start this section by saying that I understand the pressure and workload you have. While what I am describing here sound like long projects, they will be designed as something you can complete with two hours of effort, and will be built upon assignments you have already done and received feedback about. I do not believe in surprises.

There will be two mid-semester, let us call them *projects*, and then a *final project.* The format for these will be a short collection of mathematical problems from our course that will be closely related to the other work you have done in class either in Edfinity, as Homework, as a Quiz, or as Teamwork. Then there will be some questions asking you to reflect on what you have learned and done.

The project will be distributed and collected in Canvas. The dates are in the course outline, and you will have five days to finish your submission. There will be no other assignments to work on during that period.

There will also be an oral component to these projects. You will have a short 10 minute meeting with me where I will ask you to explain your solution to some of the problems you submitted.

You can use online resources provided that you give citations for what you use, but you should not work with anyone else in class. You will need to be prepared to explain anything you submit during the meeting with me.

Grading Scheme

The components of your grade will be based on the weighted distributions:

- Edfinity 10%
- Homework 10%
- Participation / Teamwork 10%
- Quizzes 5%
- Projects 20 % each
- Final Project 25%

Your letter grade will be assigned based on a scale no more difficult than the table below:

93-100% A	90-92% A-	87-89% B+	83-86% B	80-82% B-	77-79% C+
73-76% C	70-72% C-	67-69% D+	63-66% D	60-62% D-	0 - 59% F

UNCO Policy Statements

Disability Support Services

It is the policy and practice of the University of Northern Colorado to create inclusive learning environments. If there are aspects of the instruction or design of this course that present barriers to your inclusion or to an accurate assessment of your achievement such as time-limited exams, inaccessible web content, or use of videos without caption, please communicate this with your professor and contact Disability Support Services (DSS) at (970) 351-2289, Michener Library L-80 to request accommodations. Students can learn more about the accommodation process at
http://www.unco.edu/disability-support-services/accommodations/

Honor Code

All members of the University of Northern Colorado community are entrusted with the responsibility to uphold and promote five fundamental values: Honesty, Trust, Respect, Fairness, and Responsibility. These core elements foster an atmosphere, inside and outside of the classroom, which serves as a foundation and guides the UNC community's academic, professional, and personal growth. Endorsement of these core elements by students, faculty, staff, administration, and trustees strengthens the integrity and value of our academic climate.

UNC's Policies

UNC's policies and recommendations for academic misconduct will be followed. For additional information, please see the Student Code of Conduct at the Dean of Student's website http://www.unco.edu/dos/Conduct/codeofconduct.html. *In the case of academic appeals, university procedures will be followed. For information on academic appeals, see* http://www.unco.edu/regrec/Current%20Students/AcademicAppeals.html.