As professionals in technology, you will need to be able to explain technical topics at various levels. How you explain a topic or idea to a coworker will be vastly different from an explanation to stakeholders. The goal of this project is for you to learn how to explain a complex topic in a way most professionals can understand.

1 Math Explainers

"Math Explainers," a term likely coined by Grant Sanderson, are videos that explain a topic or problem in mathematics. These are usually around 10-30 minutes long, and delve deep into one specific focus, potentially drawing connections to other problems, fields, or disciplines.

Grant Sanderson has a channel on YouTube titled 3Blue1Brown. You should recognize the name, as a few of his videos are in the Anchor pages for this course! These videos, along with many others on the channel are examples of "math explainers."

Grant also hosted a few contests, trying to encourage people to post math explainers themselves. The results of this competition are summed up in this blog post, showcasing a few winners, and all the runner-up videos. It would be a good idea to review a few of these videos before starting on the project, to get an idea of what you'll be creating. To help understand why some of these videos were winners, try watching Grant's Ted Talk on making math engaging.

For this project, you'll be expected to create your own math explainer, on a topic related to some material we covered in Discrete Math. You can create a video, but you may also create a blog post, as some people did in the contest mentioned above.

2 Instructions

There will be two rubrics: one for a video math explainer, and one for a blog-post style math explainer. Both will have many items in common, with a few key differences.

The first task to complete for this project is Module Selection, and is due by the start of week 5. Do not be alarmed! It is a simple task: simply select the module from which you would like to select a topic.

The second task is a proposal. The due date for this depends on the topic selected in the previous stage, but will be due either in week 6 or week 7.

The last task is the project itself: completing a video or blog post on a mathematical topic, related to ideas we covered in class. This is due at the end of the 10th week, but **it's recommended that you start early**.

2.1 Module Selection

By the start of week 5 (by 2/4/2024, 11:59 PM GMT), you need to decide roughly the topic you would like to work on for an explainer. You will only

need to submit the module number (week) that is most related to your topic.

For example, if you wanted to do a math explainer on generating random points in a circle, this are most related to probability, which would be week 6. You should submit the number 6. If you have a good idea of your project topic, you can submit this as well for feedback at this time.

It is okay at this point to not be sure of the exact topic you would like to cover, and you're allowed to change what you submit between this deadline and the next. Pick a module you think will be most interesting to you, or feel free to ask questions in the Discord/my office hours if you need help selecting a topic.

2.2 Proposal

After deciding on a topic, you must submit a project proposal. For selections from weeks 1-6, the due date is the Saturday of week 6 (2/17/2024). For selections from weeks 7 and 8, the due date is the Saturday of week 7 (2/24/2024). This is to ensure enough time to revise the project topic if it is not deemed acceptable. Your proposal must be typeset in LaTeX.

This should include the topic you will be explaining, materials you will be using as references, and an outline of your explainer.

You may use references from math stack exchange or from wikipedia, however, you cannot only use references from these sources. At least two of your references should be from research papers or textbooks.

It might be a good idea to look at what people do say about your problem on math stack exchange. How many different answers are there? Which ones are better? Can you explain the good and bad parts to each solution method in your own words?

In doing this, be careful you do not plagiarize material. You should not simply use the comments on math stack exchange for your project. Draw from multiple sources, cite any sources you do use, and curate the best methods.

Continuing the points in a circle example, a submission could say:

For my project, I intend to explore a few different ways to select random points from a circle, and some common mistakes people make when selecting random points from a circle.

My main points will be:

- Acceptance/Rejection method
- Different coordinate systems
- Inverse Transform
- Infinite triangle Sampling
- Irwin-Hall Distribution
- The maximum of two random points

2.3 Project

Based on feedback from your proposal, create a math explainer! This could be a video form, or a blog-post style explainer.

Video projects must be at least 10 minutes long, and no longer than 20 minutes.

Blog posts must be at least 1,500 words, and no longer than 3,000 words.

These numbers have been chosen as they are roughly equivalent. A 10 minute video should have about 1,500 words spoken in it. For reference, this document outlining the project specifications meets the criteria! It is your choice as to which medium you would prefer.

In both cases, you must include at least 2 mathematical visualizations/diagrams to explain your points. This could be a drawing on paper, an image generated using the TikZ package, or you could use 3Blue1Brown's code for beautiful math visualizations.

These will be graded on a few key components:

- Topic Choice: Is the topic related to topics we have covered in the class? Is it distinct from topics that are already covered in the class. Covering a topic already discussed on Anchor, or a topic that is not mathematical will result in a low score in Topic Choice.
- Quality: Is the topic explained well for an audience of Discrete Math students? Could any student with a computer science degree understand the material covered, as it is portrayed in the project?
- Length: Did the explainer meet the length requirements? In particular, did it do so without long pauses or filler sentences?
- Visualizations: Does the explainer contain at least 2 mathematical visualizations or diagrams? Are the diagrams appropriate for the topic, that is, do they show something within the topic that *should* be created as a diagram?

It is required that you cite any sources you use in your project. If you do not cite your sources, it is considered plagiarism, and you will earn a zero.

For blog posts, use any of the citation styles mentioned here. Be sure to properly use in-text citations.

For videos, include a citation method from the link above in the descriptions, and the time stamps where this information was used instead of in-text citation.

2.4 Project Rubric

Name	Score	Feedback
Topic Choice	/20	
Quality	/20	
Length	/15	
Visualization	/15	
Total	/70	

Continuing the example from previous parts, this video is the one I was referencing!

This video is at the top end of what I would expect from a student in this Discrete Math course. In fact, it is likely many of the math explainers in the playlist are above the level expected here. However, the top videos in that playlist are quality math explainers, and the ideas, flow, and images used in them should provide good examples. I've listed some examples below of topics that are mostly related to topics from the course, or topics you are likely familiar with. Feel free to look at them to get a sense of what is expected here, though keep in mind that your specific guidelines are 1,500-3,000 words, or 10-20 minutes.

- Extending the Harmonic Numbers
- Two Envelope Problem
- 12 Musical Notes
- The Case of the Impossible Triangles

As a special mention, there is an interactable game as one of the blog post entries, and it's pretty neat!

3 Grading

The grade will be split as follows:

- 10% Topic Selection
- 20% Proposal
- 70% Project

4 Submission

Videos should be uploaded to YouTube (unlisted or public), and the link should be submitted to Gradescope and Anchor. Make sure you do not use any music

in your video, nor any clips of copyrighted media, as they may get removed for violating terms of service.

Blog posts should be created as a PDF or as a post on a blog. The PDF or blog link should be submitted to Gradescope and Anchor. Blog posts which are not posted on a website must be typeset in LaTeX.

5 Project Topics

Below are some concepts or topics which might make a good math explainer for this class. Some are very big categories, and some are smaller. I've included a link to the Wikipedia page, since these pages often have references at the bottom, and are disambiguated from other, similar terms. There is also a week number associated with each, though some topics may involve multiple weeks, and the way you explore the topic may fit another week better.

You are not restricted to choosing one of these topics! Feel free to make your own topic that interests you. However, you must ensure that there is a heavy mathematical component for you to discuss in your video/blog post, and that your project does not cover too much of what we've already covered on Anchor/in class.

Mathematical Fields:

- Stochastic Processes, Week 6
- Data Science, Week 6
- Simulation Modeling, Week 6
- Psuedo-random number generation, Week 6
- Cryptography, Week 7

Mathematical Structures:

- Pascal's Triangle, Week 5
- Rings, Week 7
- Different Types of Graphs, Week 8

Mathematical Dilemmas (contentious topics):

- Computer-Assisted Proofs, Week 4
- Incomplete Proofs, Week 4
- Benford's Law, Week 6
- Monty Hall Problem / Birthday Problem (humans are bad at estimating probabilities), Week 6
- Bootstrapping, Week 6

- Conjectures (unproved statements), Various Weeks

Mathematical Problems/Theorems:

- Akra-Bazzi Method, Week 3
- Approximations of Pi, Week 6
- Chebyshev's Inequality, Week 6
- Diophantine Equations, Week 7
- Graph Coloring, Week 8

The following list contains more "fun" topics. The majority of your video should discuss some mathematical background or relationship to these topics.

- Combination Puzzles, Week 5
- Self-Working Magic (Card Tricks), Week 5
- Magic Squares, Week 5
- Mathematical Puzzles, Various Weeks