Week 1 assignment

For this first week I present you with three options. I imagine that doing one of these well is the right amount of work, but I feel free to do multiple.

1. **Math puzzles** In class we discussed five puzzles. For this activity I would like you to focus on two or more of them. For each puzzle

   (a) try to solve the puzzle (or you can skip this step if you already solved it),

   (b) with attention to clarity and sound reasoning, write up a solution to the puzzle,

   (c) write a short reflection about strategies you used to solve the puzzle.

   Some example strategies are:

   - using experimentation and play to uncover patterns or structure;
   - abstracting ideas and observations;
   - exploring all possible cases/scenarios;
   - generalizing patterns;
   - breaking a difficult problem into one or more smaller, easier ones;
   - Look at extreme examples (the largest number, the smallest number, etc).
   - Work backwards.
   - Draw a picture or figure.
   - the power of a mathematical proof; In other words being very, very careful with your logic.
   - Add an auxiliary element and/or find an invariant.

   If you would like to think about different puzzles than the ones we did in class, the first chapter of *The Heart of Mathematics* has several puzzles.

   In my feedback I will be looking for clarity and logic in your explanation, and for what kinds of strategies I observe in your work.

2. **Game theory** For this problem I would like you to listen to the following entertaining episode (20 min) of radiolab.

   `https://www.wnycstudios.org/podcasts/radiolab/segments/golden-rule`

   Let's compare this game with "the evolution of trust" game and see what mathematical conclusions we can come to.

   (a) The games played in *the evolution of trust* and *golden balls* are similar but subtly different. Explain why both games could be described as a prisoners dilemma, where the incentive is to betray the other person.

   (b) The payoffs in the evolution of trust are:

	Co-op	Cheat
Co-op	+2,+2	-1,+3
Cheat	+3,-1	0,0

   Make a payoff diagram for golden balls. In what ways are they similar? In what ways are they different?

(c) In the evolution of trust it is very important that the game can be repeated. What do you think would happen if you repeated golden balls? You can actually use the sandbox mode in the evolution of trust to simulate this!

(d) Do you think the clever strategy used in the radio lab episode would work in the evolution of trust? Maybe there is a clever strategy if you know the game will be repeated?

(e) Can you think of a mathematical model of what happens in this episode of golden balls? You might draw inspiration from one of the ending quotes in the evolution of trust:

"What the game is, defines what the players do...In the short run, the game defines the players. But in the long run, it's us players who define the game"

(f) Lastly, are there any other takeaways you got from looking at the evolution of trust and this game of golden balls?

When giving feedback on this I will be looking for clarity in exposition, sound reasoning with supporting evidence, and creativity of ideas.

3. **What is mathematical thinking?** Write a short (I imagine 1-2 pages but go wild) response to Francis Su's essay *Mathematics for Human Flourishing*. Your response should have a thesis. If you had a strong reaction and know what you want to say already write that. If you want a more direct prompt you could try one of these:

(a) In some sense this essay is a description of what mathematical thinking is. In what ways do you think this essay accurately describes mathematical thinking and what is missing?

(b) At the heart of this essay is the question "why do mathematics?" Answer this question in your own words, and if you completely agree with the answer of "for human flourishing" give your own (shorter) explanation of what that means.

(c) This essay is also a deeply personal reflection on Su's part. In what ways have you experienced some of the themes he brings up in your own life? How has mathematics helped you flourish or not?