This assignment is due at the beginning of class on Wednesday, February 5. Please bring a neat, legible hard copy of your work with you to class. If your homework is multiple pages long, please staple the pages in the correct order.

Homework guidelines: While you are welcome to discuss the homework problems with your classmates and you are strongly encouraged to seek help from me, after discussing the problems with others, your must write your own solutions. On work you turn in, you should acknowledge your collaborators by writing their names next to any problems you discussed with them. Write clearly and neatly (or type), giving thorough solutions that could be understood well by your classmates. Note that carefully communicating a solution is one of the most important parts of mathematics: if we can't convince others that our solution is correct, then our solution will not be accepted by the mathematical community.

After each solution, write a few sentences about your solution process: what was clear to you from the beginning, what did you have to think about more, what approaches did you take, what virtues of the ones we've discussed in *Math for Human Flourishing* did you feel were cultivated as you thought the problem and wrote your solution, etc. You do not need to answer all of these questions, but you should give a thoughtful explanation. **Solutions without a sufficient reflection will earn an R.**

1. In class on Wednesday, we agreed that in the game of "infinite" tic-tac-toe, all options for X's first move are equivalent to each other, so X has no real choice for the first move. We also classified the options O has for a first move into 5 different categories based on symmetry, so effectively, O only has 5 different options for a first move. Choose two of those options and analyze the game from there: does X have a winning strategy in response to O's first move? If so, describe X's winning strategy. If not, does O have a winning strategy? If so, describe O's winning strategy. If neither player has a winning strategy, explain how they will each proceed in order to ensure the game ends in a tie.

   Remember that when you're describing a winning strategy, you need to say what the winning player should do at each turn and explain why that ensures a win for that player.

2. Choose one of the following variations of tic-tac-toe or create your own and analyze it as far as you can (if you create your own, include a detailed description of it). See if you can determine if one player can always win (if so, describe the strategy to use). If you get stuck on that, create several scenarios like the questions in Problem Set 2 about regular tic-tac-toe and explain what you've figured out about them. Describe any "definitely do not do this" moves that you find for either player. This is an open-ended question; the intention is for you to explore and play with these ideas.

   - Choose-your-own-adventure tic-tac-toe: played on a regular tic-tac-toe board, but neither player is restricted to playing only X or playing only O. Instead, you can play either X or O on your turn. You still win by creating three in a row, but in this case, it's three in a row of either Xs or Os.
   - Pay-To-Play Tic-Tac-Toe: Click on the name to go to a blog post describing the rules and showing a sample game. It's regular tic-tac-toe with a twist.