The Game of Nim

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1 Introduction

The number of piles, i.e., the rows in the image, of the game is finite, and each pile contains a finite number of matchsticks. These numbers can vary for different instances of Nim. Each player, during her turn, chooses exactly one pile, and removes any number of matchsticks from the pile she has selected (she must remove at least one matchstick). The player who removes the last matchstick wins the game.

Figure 1: Diagram of a Nim game with three heaps

Check this website out to play a game of Nim against the computer. It would be recommended that you do not look into how the computer beats you, so that subsequently you figure it out yourself.

2 Questions to ponder about

1. Does there always exist a sequence of moves such that the player making the first move wins?

2. Given a Nim position, is there a way to determine whether it is possible to win for any player with perfect play? If not, why? If yes, how?

3. If a sequence of move which guarantees a win does exist for a Nim position, how will you determine the sequence of moves? That is to say, how is the computer coded to play the most optimum way?

3 To do

Try to answer all of the questions above. Then try it out against the computer. Remember, there can be any number of rows and number of matchsticks in each row. So you need to come up with a general solution. We will discuss this in the next meet. Nevertheless, you will find the solutions online, but you won't like that, would you? If there's any difficulty, there are tons of hints which would build you upto the solution, so ask for those if you need before looking up the solution. Document the answers or any insights that you come up with in short.

4 Optional Exercise

1. Code the interface for playing the game of Nim in any language that you are comfortable with. I would recommend python for ease. That is, two players need to be able to play against each other a game of Nim on the computer.

2. If the above activity is complete, write a program to play using the strategy that you find to be the most optimal. That is, create a bot to play against humans.