Math 167: Game Theory
UCLA

Darsh Verma

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Hello and welcome! As the title suggests, these are my lecture notes on Game Theory. Our professor is **Sylvester Zhang**. The textbook that we are using is **Game Theory, Alive by Anna R. Karlin and Yuval Peres**.

The goal of these lecture notes is to write **understandable** math. Some dude said, "If you can't explain it to a six year old, then you don't understand it yourself". The hope is that anyone coming across these notes (like you!) will be able to at least take away the gist of these concepts. Email me at darsh [at] ucla [dot] edu if you find any errors!

Huge shoutout to https://zitong.me/notes/rings-notes.pdf who inspired me to attend class and lock in.

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1 Lecture 1: Jan 5

1.1 Introduction

Today, the professor arrived 20 minutes late so we just did a brief intro on things we're gonna do in the class like combinatorial games, two-person zero sum games, general sum games, Nash equilibria, fixed-point theorem, and evolutionary models.

Apparently, the fixed point theorem is used to prove something related to the Nash equilibria. Interestingly enough, Zitong sent me this reel a few days ago where I first learned about the fixed point theorem.

We ended lecture by playing the classic 4×5 version of Chomp! It seems to me that the first player always has a winning strategy but I need to formalize why this is true.

2 Jan 7 : Lecture 2

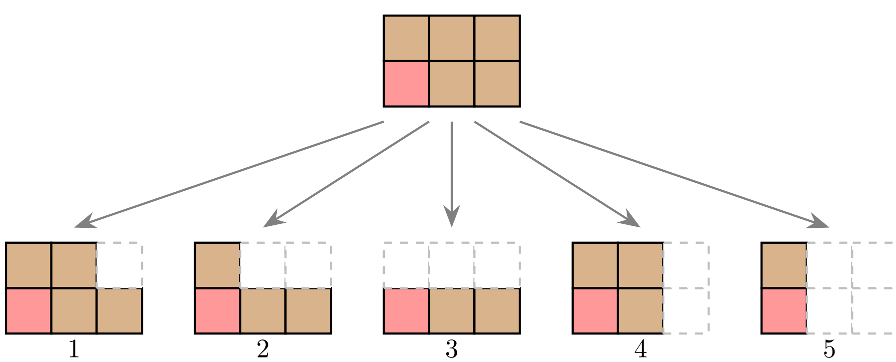
2.1 Impartial Combinatorial games

- two-player games, alternate turns
- perfect information
- no randomess
- both players have the same set of moves
- player who takes the last move wins
- win or loss outcome

Example 2.1. There are n chips on a table. There are two players, Larry and Rick. A valid move is to take 1, 2, or 3 chips from the pile. Assume that Larry goes first and the player who takes the last chip wins.
We proceed with backward induction. Let's define the following states:
N : the next player to take a move wins.
P : the previous player that took a move won.
These are conventions because you can have multiple players instead of just two. We could have also just called them you and your opponent.

Backward induction just means that we start analyzing states by having 0 chips on the table. That falls under state P. This implies that if there are 1, 2, or 3 chips on the table, those fall under state N because the next player who moves can just take 1, 2, or 3 chips and win the game. Similarly, we can extend this logic that 4 chips falls under state P, and so on.
It turns out that the Larry has a 75% chance of winning, and Rick has a 25% chance of winning simply because of who went first.

Example 2.2 (Chomp)**.** Given a 2×3 chocolate bar, here are the possible states it can go to



We ended class with a quiz on induction.