

Game Theory



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Combinatorial Games

- 2 Player Games
- An outcome of a Win, Loss, or a Draw

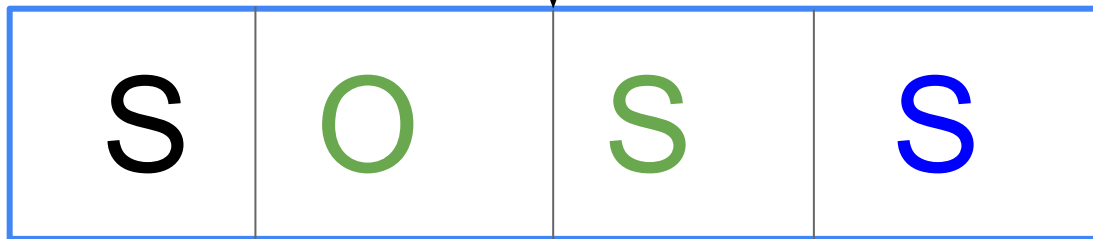
SOS Game:

Rules:

- Each player can place an S or an O in any of the blank boxes.
- The winner is the person that is able to spell out SOS

S			
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Winning Strategy for SOS:



Game Trees & Tic

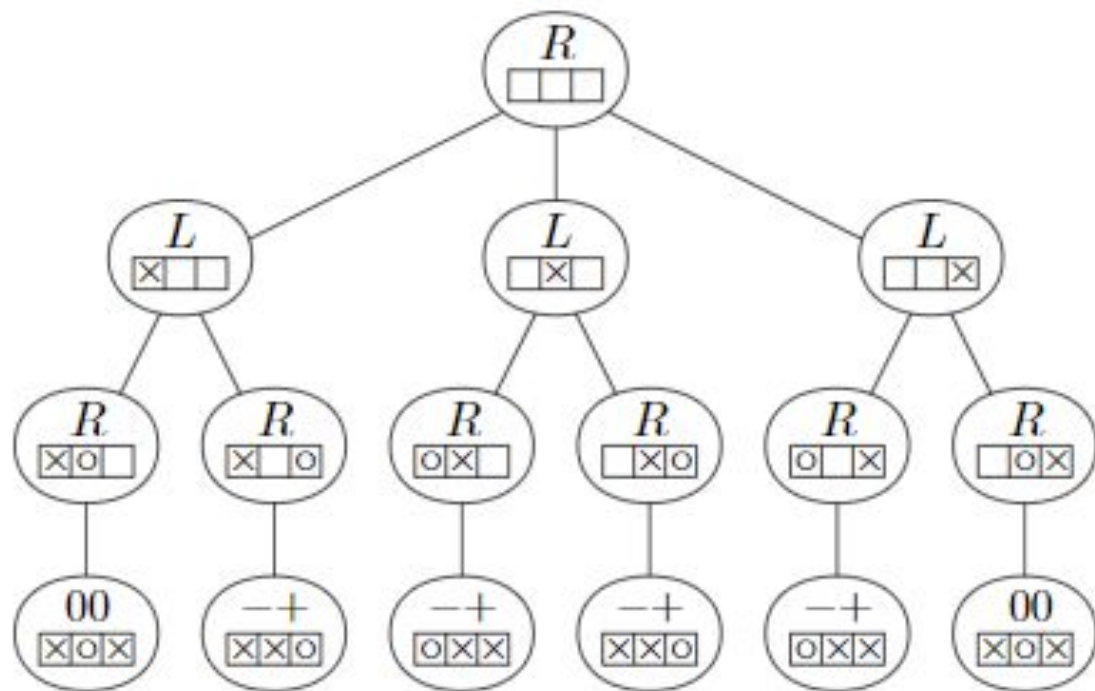
Game Tic:

- First player uses X
- Second player uses O
- Winner is whoever places two of their marks in adjacent squares (otherwise it's a tie.)

Game Trees:

- Shows all the possible outcomes in a game.
- It shows what strategy a player will want to use.

Game Tree for Tic



Normal Play Games

- The last player to move wins.

Types:

Type N: First Player Wins.

Type P: Second Player Wins.

Type R: Richard will win playing optimally.

Type L: Louise will win playing optimally

Impartial Games

- Both players have the same moves available.
- The possible moves depends on the board.

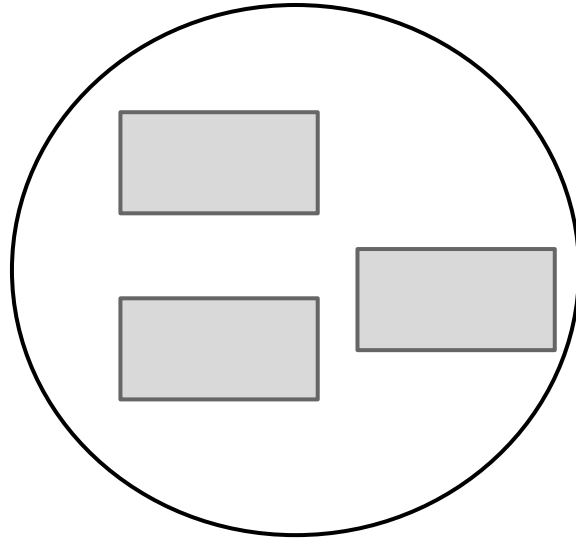
There are only two types:

- Type N: First Player Wins
- Type P: Second Player Wins

Pick Up Bricks

Rules:

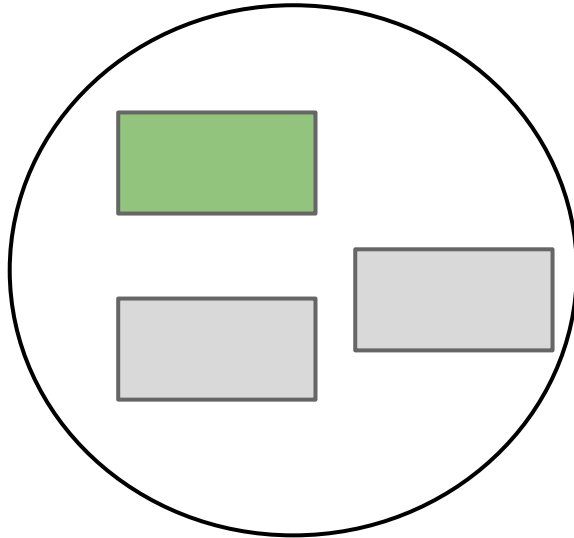
- Each player can take 1 or 2 bricks from the pile.
- The player to take the last bricks wins!



Pick Up Bricks

Rules:

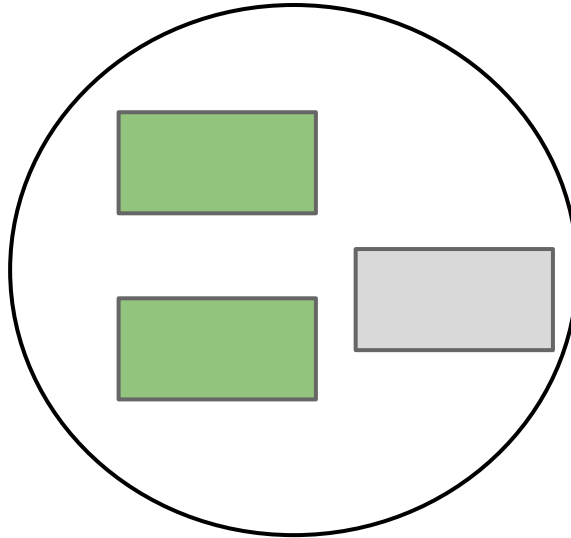
- Each player can take 1 or 2 bricks from the pile.
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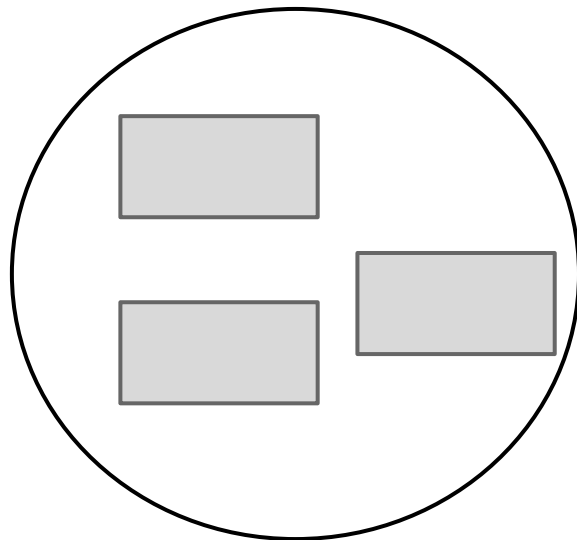
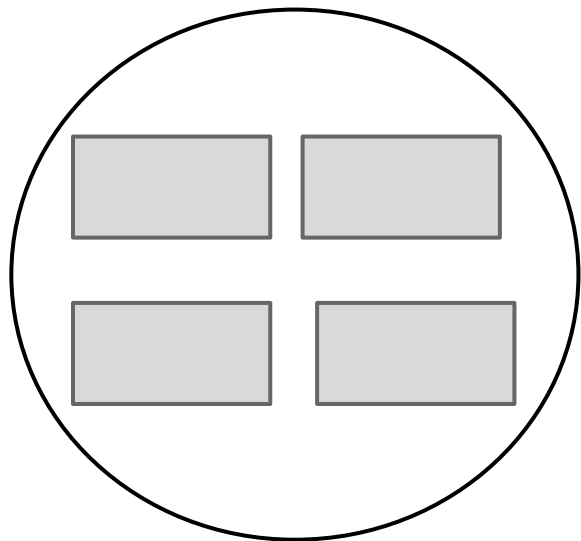
Pick Up Bricks

Rules:

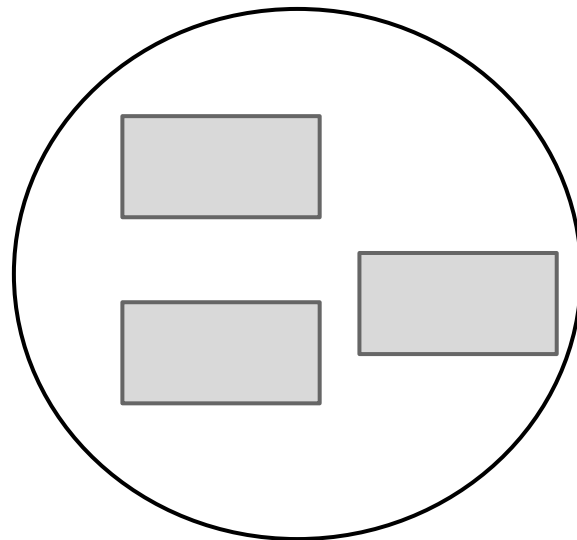
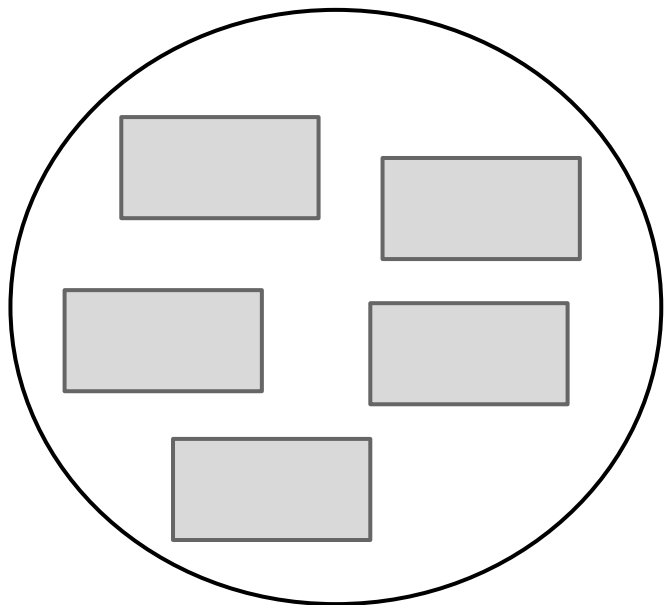
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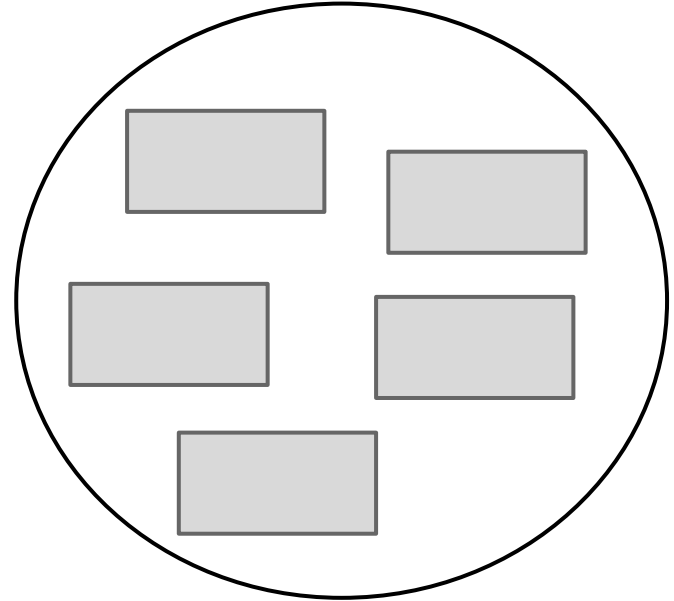
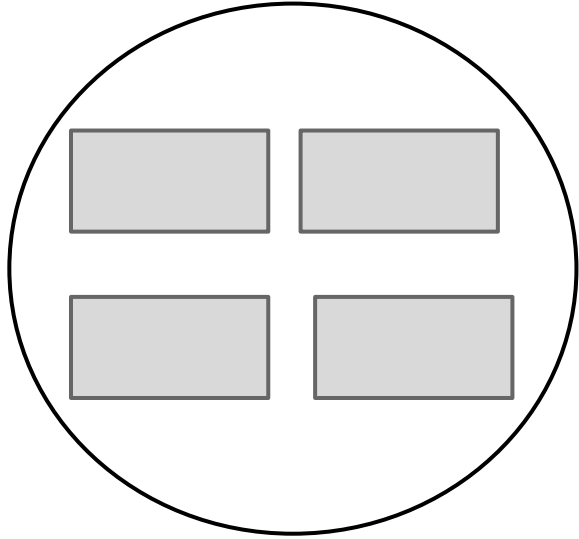
Pick Up Bricks



Pick Up Bricks



Pick Up Bricks



If the number of bricks is divisible by 3 the second player will win. If it is not then the first player will win.

Nim

Rules:

- Each player can take as many sticks from a column that they want.
- Last player to take the sticks wins!

Explaining Binary Expansion:

Binary Expansion is when you break down numbers using only “power of 2’s”,

- 2 would be broken down as just 2
 - 18 as $16 \oplus 2$
 - 25 as $16 \oplus 8 \oplus 1$
- With those numbers for the game nim you’ll cross out any number of pairs (same numbers) Then the remaining numbers would be add together to get a nim which is 11.

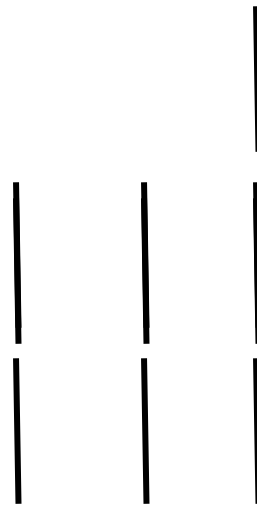
Nim



$$1 \oplus 2 \oplus 3$$

$$\textcircled{1} \oplus \textcircled{2} \oplus (\textcircled{2} + \textcircled{1}) \oplus \textcircled{0}$$

*0



$$2 \oplus 2 \oplus 3$$

$$\textcircled{2} \oplus \textcircled{2} \oplus (2+1)$$

*3

Explanation of Nim

Balanced:

- The game is a type P
- The game will go from balanced to unbalanced and back depending on the players move.

Unbalanced:

- The game is type N
- The game will go from unbalanced to balanced and back again.

Thank you all for listening!!!

Any Questions???