

# *Dots And Boxes Game*

*Using  
Adversarial Search*

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# Problem Statement and Description:

*This project is the implementation of Dots and Boxes Game in python with AI. You can play the game against the artificial intelligence with the option to choose the board size and the difficulty level for the game. AI uses the method of Min-Max with alpha-beta pruning to defeat you.*

- ★ Agent : Human and AI player.
- ★ Sensors : To Detect the Move of AI player and plan the next move.
- ★ Actions : To make a square box by connecting the Dots.
- ★ Environment Type : Fully Observable .
- ★ Functions : Min-Max algorithm with Alpha-Beta Pruning.
- ★ Expected Outcomes : The AI will play against Human and will try to win.

# Min-Max with Alpha-Beta Pruning:

- ❑ *Minimax is a kind of backtracking algorithm that is used in game theory to find the optimal move for a player assuming that the opponent also plays optimally. It involves two players called maximizer (tries to get highest score possible) and minimizer (tries to get the lowest score possible).*
- ❑ *Alpha-Beta pruning is an optimization technique for the minimax algo. This allows us to search much faster and even go into deeper levels in the game tree. It cuts off branches in the game tree which need not be searched because there already exists a better move available.*
- ❑ *Alpha is the best value that the maximizer currently can guarantee at that level or above.*
- ❑ *Beta is the best value that the minimizer currently can guarantee at that level or above.*

# Game Board Designing and Game Playing :

- ❖ *No. of Possible moves will be according to the size of Board:  $2 \times \text{size} \times (\text{size}-1)$ .*
- ❖ *Each Row will be represented by a list.*
- ❖ *Even tuples correspond to vertices (Using "\*" as Dots) and Odd tuples correspond to spaces.*
- ❖ *We are assigning random values to spaces (using randint module )which will be used for scoring.*
- ❖ *We are Displaying indices for vertices which will help in joining edges(For Both Rows And Columns).*
- ❖ *We need to Complete the Square(Box) for points , Horizontal line( "---") can complete top or bottom part of squares and Vertical line(" |") can complete left or right part of squares.*
- ❖ *We are using Copy(module) method to avoid unintentional mutation.*

# OUTPUT(Possible Scenarios):

## ★ Case 1:

```
0 1 2 3 4
0 *---*---*
1 | 1 | 4 |
2 *---*---*
3 | 4 | 8 |
4 *---*---*
```

7

Human wins! ... Wait what?

## ★ Case 2:

```
0 1 2 3 4
0 *---*---*
1 | 6 | 8 |
2 *---*---*
3 | 2 | 3 |
4 *---*---*
```

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AI wins! Better luck net time...

## ★ Case 3:

```
0 1 2 3 4
0 *---*---*
1 | 2 | 5 |
2 *---*---*
3 | 3 | 6 |
4 *---*---*
```

0

It's a draw!