SCHOOL OF COMPUTER AND INFORMATION SCIENCES

PROJECT REPORT ON:

"DOTS AND BOXES GAME"

COURSE: Introduction to Artificial Intelligence

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SUBMITTED TO: Assistant Professor Dr. PSVS Sai Prasad

PROJECT DESCRIPTION: Dots and Boxes is a game for two players. The game starts with an empty grid of dots. Usually two players take turns adding a single horizontal or vertical line between two unjoined adjacent dots. A player who completes the fourth side of a 1×1 box earns one point and takes another turn. (A point is typically recorded by the color of the last line that completes the box and adds a point to score card).

RULES:

1. The game board has 4x4 rows and columns boxes.
2. The player has two join a line between two unjoined adjacent dots.
3. First player starts with red color and the second player will be automatically assigned blue color.
4. The turn goes simultaneously followed by red then blue.
5. If any player is able to complete the 1x1 box by joining the forth side of box point is added to its scorecard and again its turn came to join a line.

6. One cannot undo its last move and select the line which is already taken.
7. The game ends when no more lines can be placed.
8. A player or AI wins if he manages to get more points by joining the lines and make box.
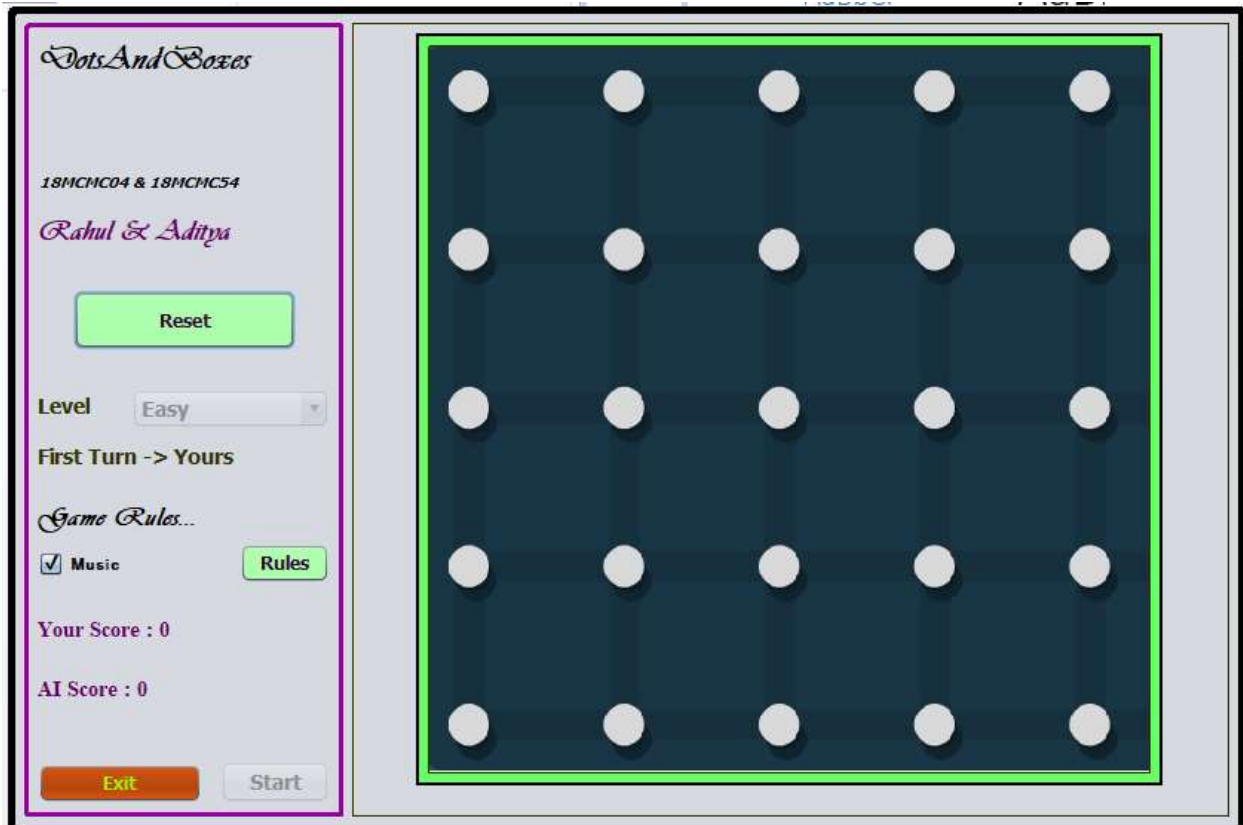9. The winner will be decided by most points gained on score card.

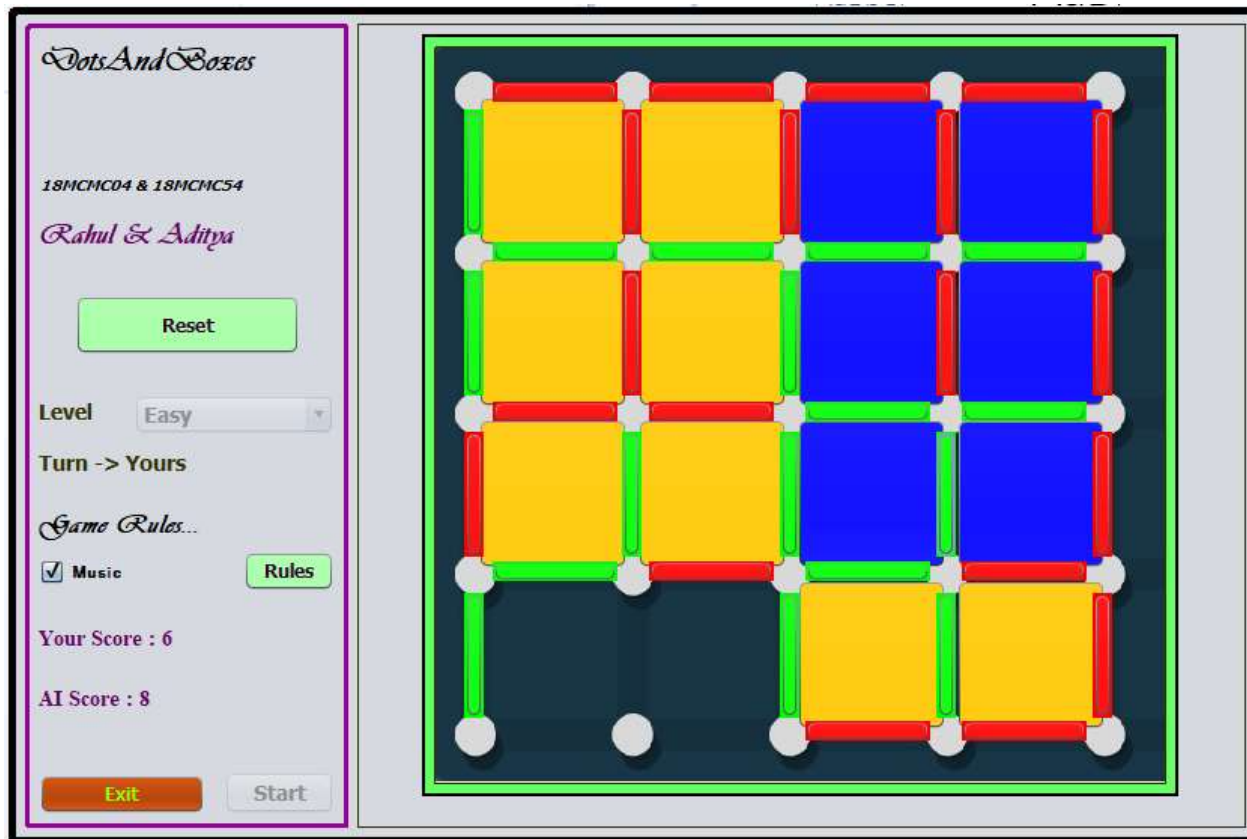**Fig: Above figure shows game board of dots and boxes**

Fig: Above figure shows game and joining line between two points

ENVIRONMENT SETUP:

Since game is developed in Java programming language so there should be some setup done before running this game.

1. Java run time environment must be installed.

2. It can be run in 32 bit as well as 64 bit system.
3. Minimum version of java is 1.7.0
4. It can be only install on windows platform

DIVISION OF MODULES:

In starting of this project we first developed a player vs player **Dots and Boxes** game. Then we applied the minimax algorithm and designed the game human vs AI in command line. And also start to designing the graphics part simultaneously.

Rahul Thakur (18MCMC04)

- The development of the graphics play game part is done by me .
I take the doted picture of grid 4x4 and set it into the background with all labels. And after that we took 40 buttons which indicate the on which position you can draw a line, and set there alignment accordingly, then take the button to made the box and fill the color according to the player type.

    Here we take the difficulty level from the left panel combo box and after clicking on start button the game play is start. And the score will display on left panel. You can also restart the game in middle by simply clicking on Reset button. And to play and stop game music click on checkbox .

Aditya Kumar (18MCMC54)

- The development of the backend that is human vs AI game in command line is made by me.

How algorithms work

First it set the height and width of the box that I set here 4x4 after that player or AI make the first move, so each time player or ai makes move it's calculate his score and if he is able to complete a square then his score will increase and he takes again the chance of drawing a line. Input is taken in the row, col format. If the term is of AI then it's find the best moving row, col value by applying minimax algorithm in the algorithm first we make the copy of the current state in grid array(2D). Then we get the current minimum and maximum score value and all the attribute and make a call to the minimax function then each time minimax is calling itself recursively and explore it's all possible moves according to the levl(easy, medium, hard) if you select the hard one then after 21 moves it increase the detpth for better searching result. When it's reach to the leaf node or max_depth after that it's

return the utility value(maxscore-minscore) and after that we do alpha beta pruning and calculate the best score. And finally return the best row,col to the playai(){DotsAndBoxes.java) which makes a move according to best move draws the line.

Note :-

Player line is of green color

Player box is of blue color

AI line is of red color.

AI box is of orange color.

REFERENCES:

- https://en.wikipedia.org/wiki/Dots_and_Boxes
- http://dotsgame.co/
- https://www.geeksforgeeks.org/minimax-algorithm-in-game-theory-set-1-introduction/
- https://en.wikipedia.org/wiki/Alpha%E2%80%93beta_pruning