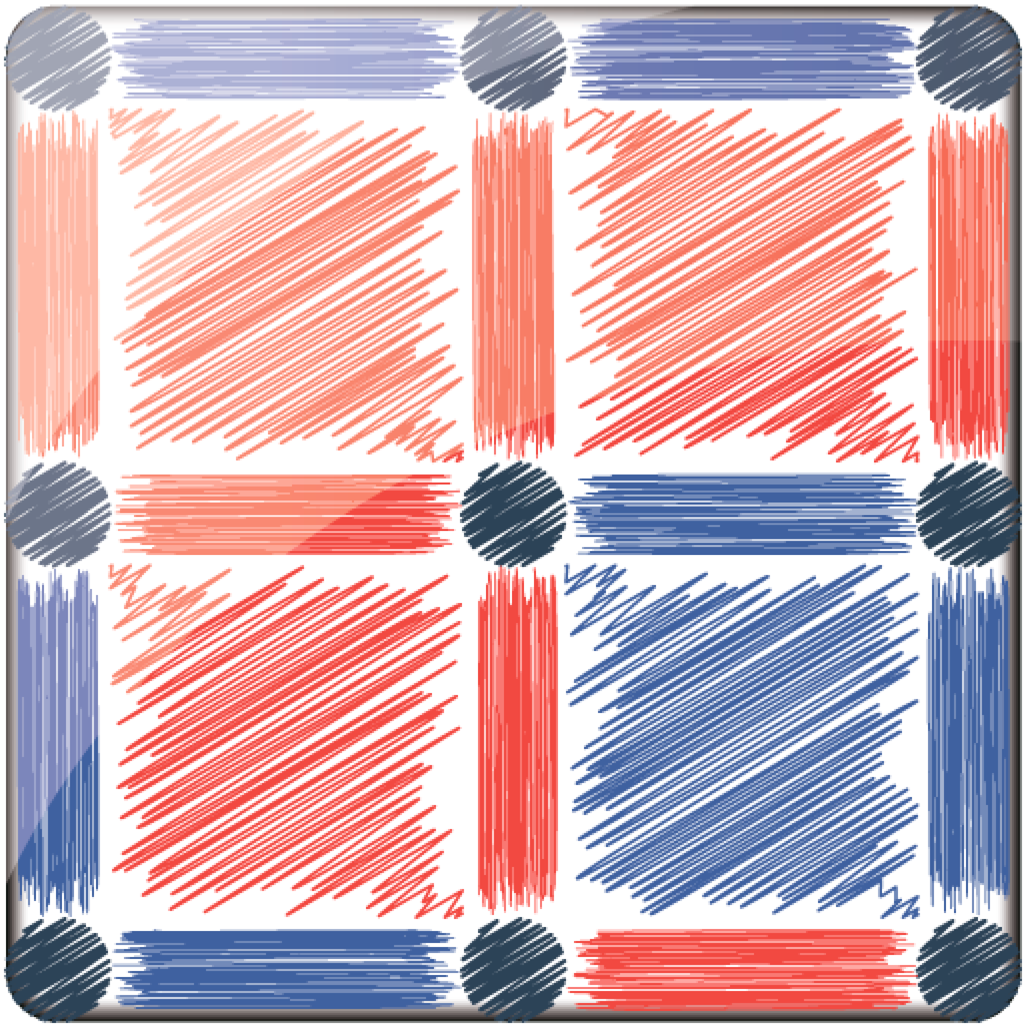


Dots & Boxes

REPORT OF PROJECT

By / Abdelrahman alsayed ahmed abdelrizk elwakel (23) && Gamal Eldeen ahmed khalaf alsayed(15)

Contents

GAME DESCRICTION :-

Dots and Boxes is a pencil-and-paper game for two players (sometimes more). It was first published in the 19th century by Édouard Lucas, who called it **la pipopipette**. It has gone by many other names, including the **game of dots**, **boxes**, **dot to dot grid**, and **pigs in a pen**.

Starting with an empty grid of dots, two players take turns adding a single horizontal or vertical line between two *unjoined* adjacent dots. The player who completes the fourth side of a 1×1 box earns one point and takes another turn. (A point is typically recorded by placing a mark that identifies the player in the box, such as an initial). The game ends when no more lines can be placed. The winner is the player with the most points. The board may be of any size. When short on time, a 2×2 board (a square of 9 dots) is good for beginners. A 5×5 is good for experts.

GAME FEATURES :-

- It contains an easy main menu with smooth movement between modes
- It supports using UP,DOWN,RIGHT,LEFT to move in whole game
- It contains PC mode (with good AI)
- It contains two modes (2*2)&&(5*5) , they are also available in PC mode
- There is a leader board to know your rank between all players
- You can do Undo & Redo during the game but with some restrictions
- You have a dynamic time to know how much time did you spend in the game
- There are three slots to save your game with an easy access
- In the game you can only play with arrow buttons
- You have the option to abort during the game and returning to main menu

DESIGN OVERVIEW :-

In the beginning of the game there is a main menu it contains all options you will need in the game , it has option of start new game or load a game or to show leader board or to exit the game , you have an easy method to select those options only use UP,DOWN,ENTER buttons to select any option. In the game the board of game is made of asterisks when you connecting between two available asterisks they turn to hashtag , the line between asterisks colored with player's color .Closed squares have the color of the player who close this square .There are fields to score ,remaining lines, moves for each player, dynamic timer . There is a frame around the board tell you which player will play (colored with player's color). When game is finished you are asked if you want to go back to the menu or play again.

-**<u>OVERALL STRUCTURE</u>** :-

Every mode has his own function, this function contains how to switch between two players (1P VS PC) , contains some functions as colors function , Undo & Redo function , arrows function , detect and check function (draw the movement in game's array and check if this movement available or not) , function of save & load (algorithm save & load has doubled our code lines[as we copy and paste many times]).

<u>ASSUMPTIONS</u> :-

- we used an arrow to choose which two asterisks the player want to connect to avoid butting string or anything may crush our game and to easy control for our game
- we use backspace button to give the player chance to return if he has chosen something wrong and gives our game stable movement between different menus
- we made three slots to save games if our players need to save their games and continue at any time
- there is a handling if any player choose two asterisks which is impossible to connect line between them
- we use a frame that colors with player's color in his turn as it an obvious method to declare who player will play
- there is a handling if any player choose to load game and there is not any saved game
- there is a handling if any player do redo before doing any undo
- if the player want to exit during the game so there is a handling for this
- there is a handling to have the right turn of players after load a saved game
- there a handling when any player load a saved game players can not do undo till they played any available movement
- after finishing the game and player want to player again we give him this option to choose if he want to play again or go to main menu
- when player want to save a game he will need to choose the slot that he want to save on it so there is a handling if he pressed any button else the available buttons to choose the slot he want
- in our game there is a lot of yes or no questions so there is a handling if the players have pressed incorrect button
- undo in PC mode undo PC movements and player's movements (with a restriction)
- there is a handling if player has chosen a movement that had played before

**Note :- any handling declared above you can try it to know what is happening ☺

DATA STRUCTURE :-

- structs
- arrays (char & integers)
- integers
- time_t

DESCRIBTION OF IMPORTANT FUNCTIONS :-

- **Colors function** :- we used this to print everything in our game when we clear screen , it prints lines with suitable colors also squares , print our interface
- **Arrows function** :- this to detect the position of the arrow and print the new position of arrow
- **Detect_check function** :- this to take coordinates of dots and test them (if this line has played before or not , the possibility of playing this movement)
- **Drawing function** :- this draw the movement in the array of the game and store the movement in the array of movements
- **S1 & S2 functions** :- they are used to calculate score for each player also PC , they store the coordinates of closed square in order to calculate score accurately and not to increase score every time you check this closed square
- **Undo function** :- in this function we control the counter of array of movements in order to remove drawing line , returning hashtag to asterisks , removing colored lines (as we used this counter in the printing colored lines' algorithm) , check if and square has opened or not and remove coordinates for the array of coordinates but we have 1D array holds a flag to know the closed square belongs to which player (helping us in printing colored squares and helping in redo logic), it is obvious that when player does undo remaining lines decrease , moves of players.
  ** Undo in mode P1 VS P2 when any player does undo the turn goes directly to another player
  **Undo in PC mode when the player does undo computer and player movements will removed till the game's turn goes to player not PC
- **Redo function** :- reflecting all what we do in undo ☺
- **Save & Load functions** :- they are obvious but to make slots' system we have to copy and paste many lines this leads to have those many lines of code (Unfortunately , there is no time to optimize this system but it is efficient)
- **Gotoxy function** :- the greatest function ☺☺ it helps us a lot in printing and to make our interface as it gives us the ability to change position of the cursor

- **Kbhit() function** **:-** this function exists in c libraries it helped us in making time dynamic with interrupt way as it checks if you pressed and key or not without pausing the code this lead to update time every second

- **Clock() function** **:-** it helped us to calculate time

- **AI functions** **:-** in this function we have three parts . The first part check if there is any square can be close (there are three lines) and set the PC to play this movement which will close the square . The second part we check every square if there is one line or there is not any line we set the PC to play in any position in this square (In the code the loop that check this part I have varied its limits in 2*2 I have made the limits random to play in the empty square or the square which has one line randomly but in 5*5 after two game you will understand how the PC will play in his first movements as the limits without random [it is obvious in code] . The third part is to play randomly if all above checks does not exist

- **Mode function (as a example [p1Vsp2])** **:-** these functions contains all above functions , they contain the loop that control game's switch and finishing the game

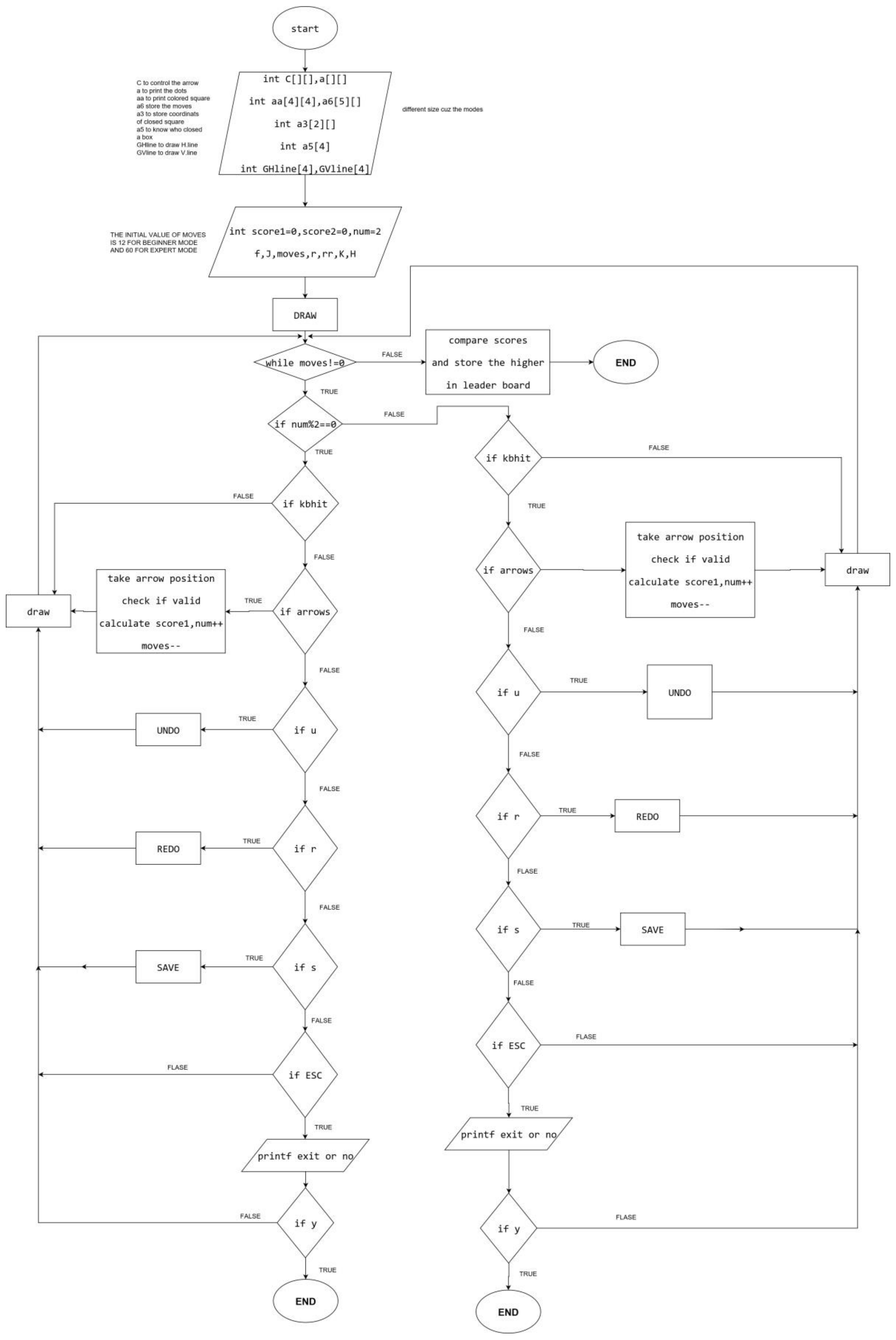
**<u>Header files that we used</u>

- **Header files that we made** **:-**
  - function.h >> it is used to use the functions of 1P VS 1P (2*2 mode)
  - functionspc.h >> it is used to use the functions of 1P VS PC (2*2 mode)
  - function5.h >> it is used to use the functions of 1P VS 1P (5*5 mode)
  - functionpc_5.h >> it is used to use the functions of 1P VS PC (5*5 mode)
- **Header files in C** :-
  - **stdio.h**
  - **stdlib.h**
  - **math.h**
  - **string.h**
  - **ctype.h**
  - **windows.h**
  - **conio.h**
  - **time.h**

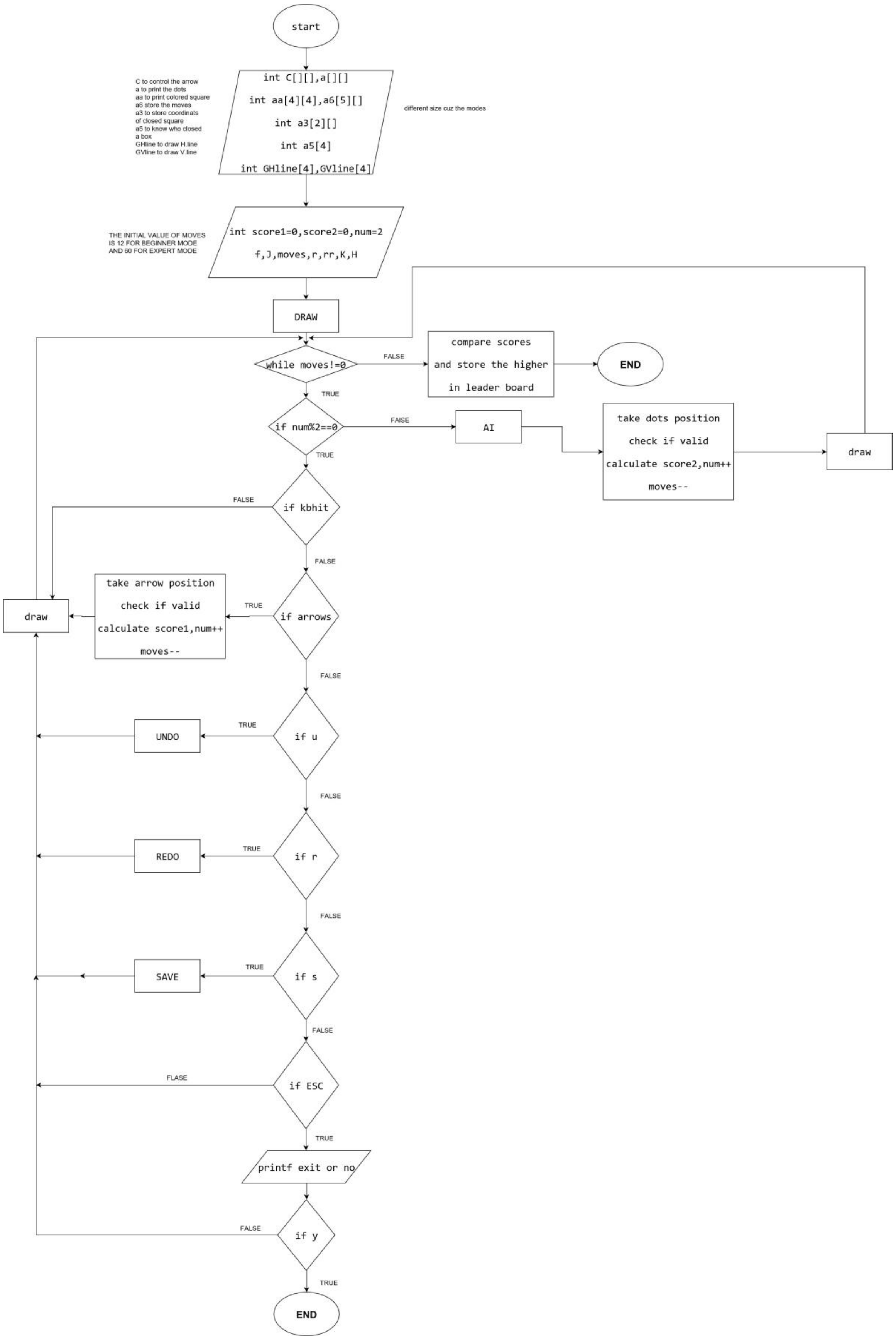
FLOWCHARTS AND PSEUDO CODE :-

- flowcharts :-

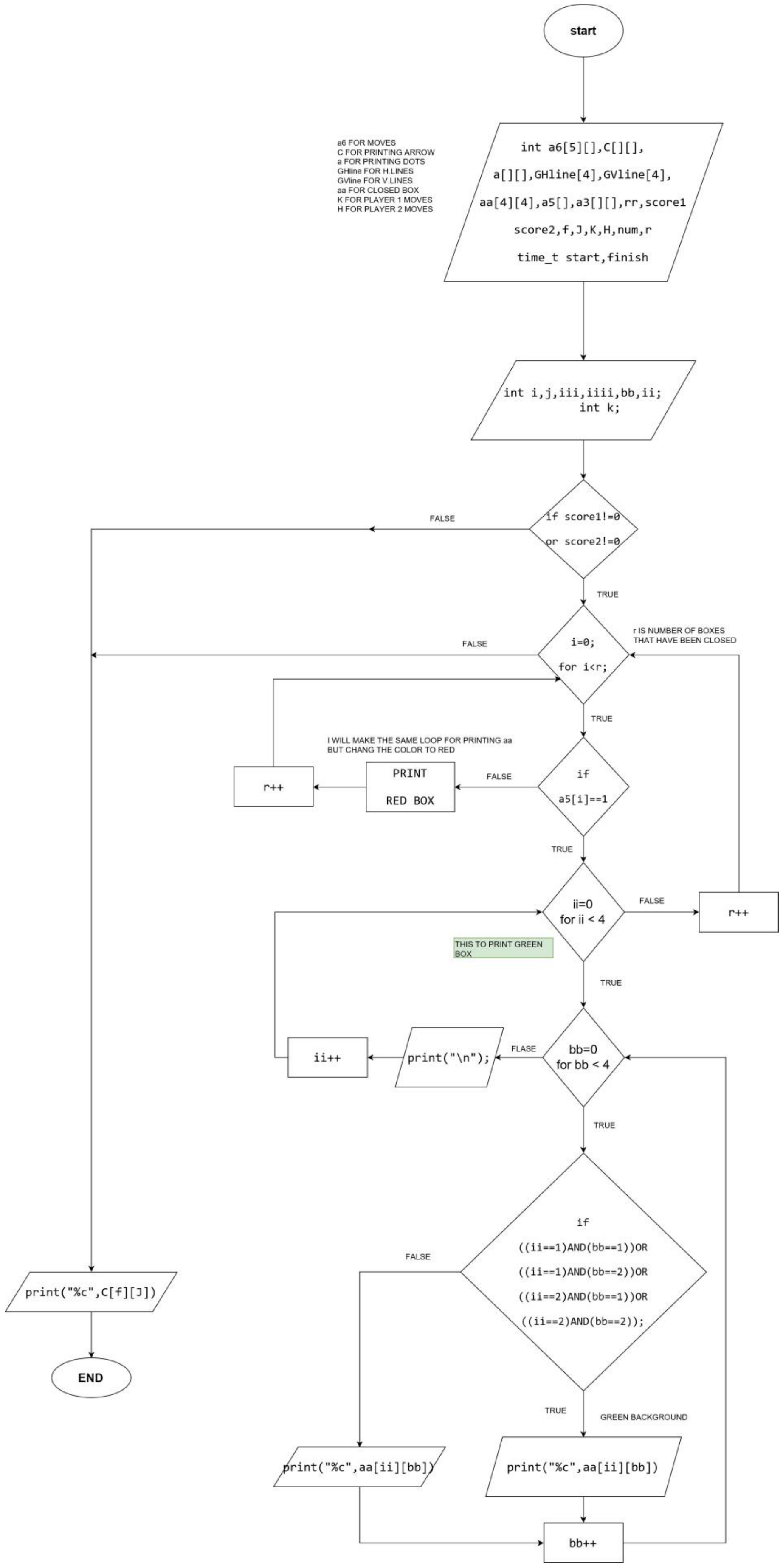
1P VS 2P



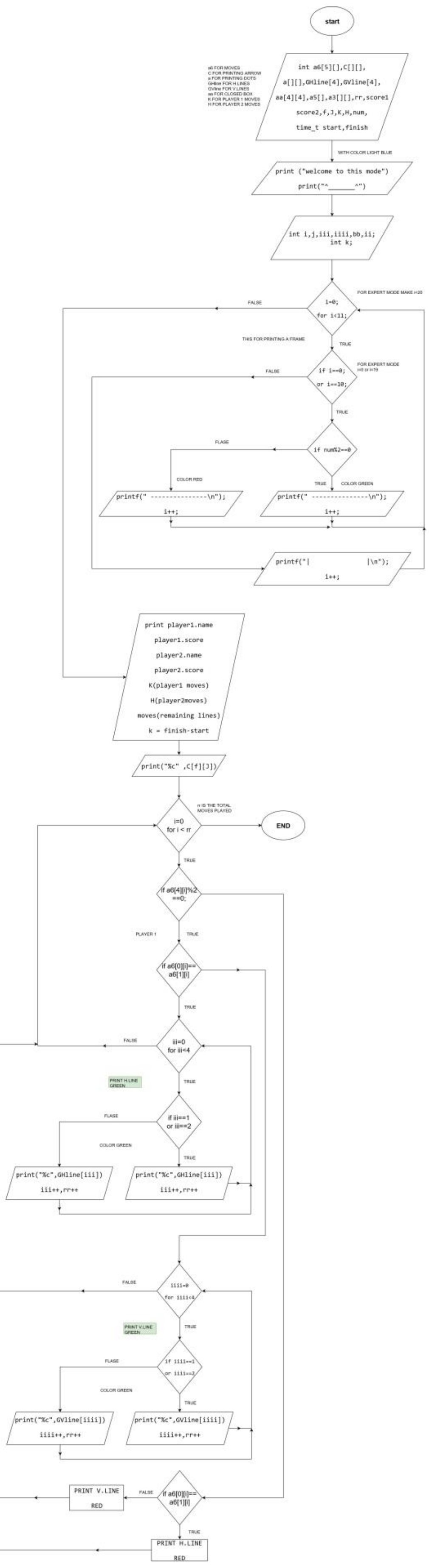
1P VS PC


start
C to control the arrow
a to print the dots
aa to print colored square
a6 store the moves
a3 to store coordinats
of closed square
a5 to know who closed
a box
GHline to draw H.line
GVline to draw V.line
int C[][],a[][]
int aa[4][4],a6[5][]
int a3[2][]
int a5[4]
int GHline[4],GVline[4]
different size cuz the modes
THE INITIAL VALUE OF MOVES
IS 12 FOR BEGINNER MODE
AND 60 FOR EXPERT MODE
int score1=0,score2=0,num=2
f,J,moves,r,rr,K,H
DRAW
while moves!=0
FALSE
compare scores
and store the higher
in leader board
END
TRUE
if num%2==0
FAlSE
AI
take dots position
check if valid
calculate score2,num++
moves--
draw
TRUE
FALSE
if kbhit
FALSE
take arrow position
check if valid
calculate score1,num++
moves--
TRUE
if arrows
draw
FALSE
TRUE
UNDO
if u
FALSE
TRUE
REDO
if r
FALSE
TRUE
SAVE
if s
FALSE
FLASE
if ESC
TRUE
printf exit or no
FALSE
if y
TRUE
END

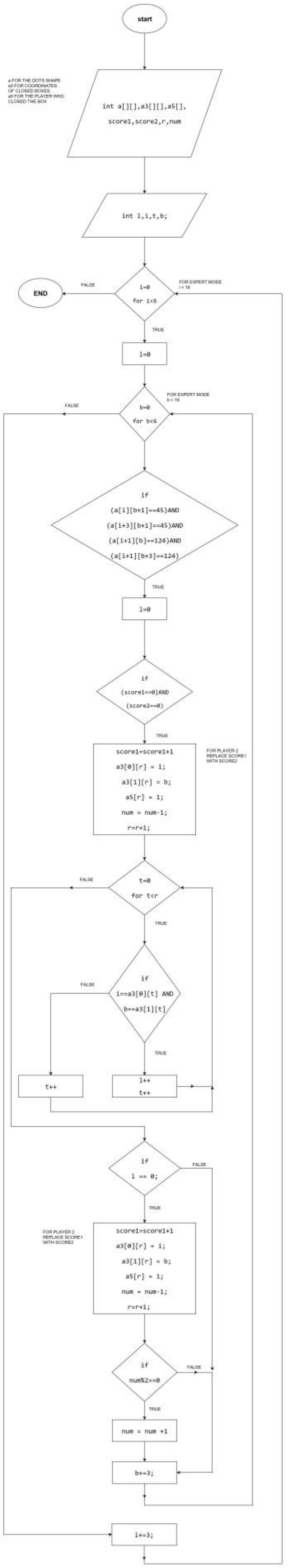
- Print colored squares



- Printing colored lines



- Calculating score



- Pseudo code

- <u>For undo</u> :-

```
set a6[][],int a[][],int a3[][],a5[],r,score1,score2,flag,f2,moves, K,
H,rr,undo,k,v,m,u;
set i,b,l=0,P=0;
if (rr!=0){ //to check if there is movements or not
      if (a6[4][rr-1]%2==0){
         K=K-1; //to decrease movement
      }else{
      H=H-1;    //to decrease movement
      }end else

      k=a6[0][rr-1];  //Start removing drew lines
      v=a6[1][rr-1];
      u=a6[2][rr-1];
      m=a6[3][rr-1];
      flag=2;
      rr=rr-1;    //In order not to print that removed line with color
      BUMP undo;  //to know how many times can i do redo
       if(k==v){  //if rows were equal
      BUMP moves;
      a[k][m]=a[v][u]=42; //ascii for asteriks
      for(i=k;i<(k+1);i++){
         for(b=u+1;b<(u+3);b++){
            a[i][b]=32;  //ascii for space
         }end for
      }end for
  }else if(u==m){  //if columns were equal
     BUMP moves;
      a[k][m]=a[v][u]=42;
      for(b=u;b<(u+1);b++){
         for(i=k+1;i<(k+3);i++){
            a[i][b]=32;
         }end for

      }end for
  }end else if
  for(i=0;i<6;i+=3){  //these loops to check if there is a square opened or
not
         l=0;
      for(b=0;b<6;b+=3){
```

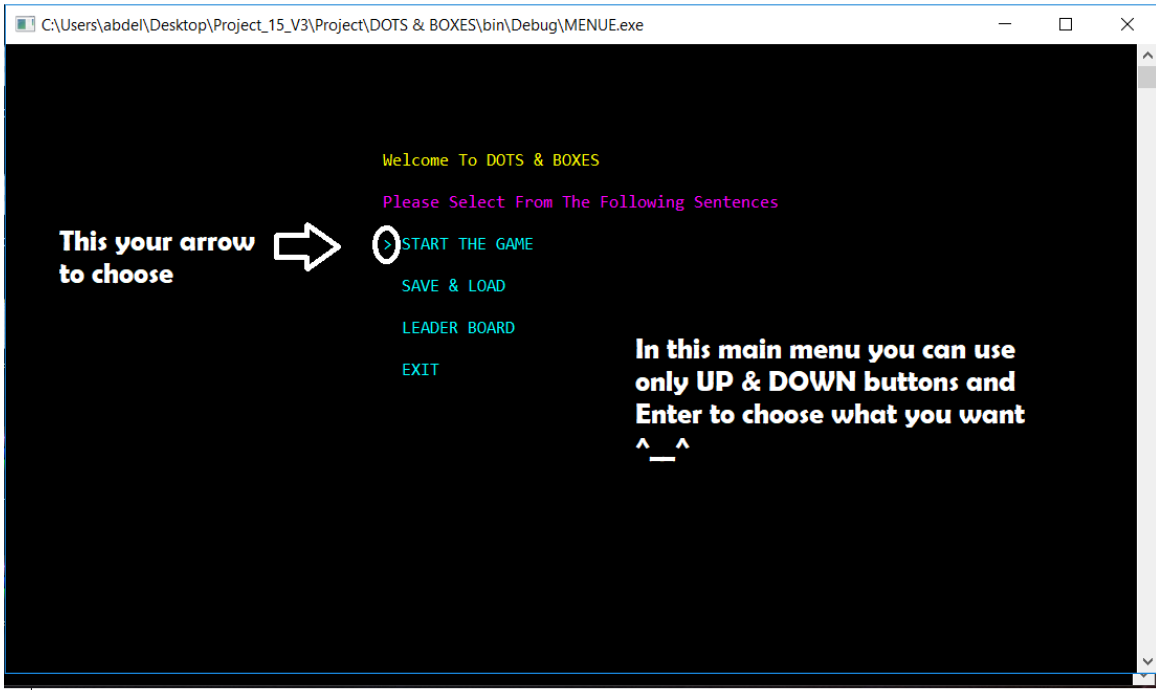
```
if((a[i][b+1]==45)&&(a[i+3][b+1]==45)&&(a[i+1][b]==124)&&(a[i+1][b+3]=
=124)){
            l=0;
             }else {
             for (P=0; P<4; P++){
                 if((a3[0][P]==i)&&(a3[1][P]==b)){ //removing coordinates
                     a3[0][P]=2;
                     a3[1][P]=2;
                     BUMP f2; //we use it if there are two squares had opened at
the same time to give the turn correctly
                     r=r-1;
                     if (a5[P]==1){
                     score1=score1-1;
                     }else {
                     score2=score2-1;
                     }end else


                 }end for
             }end else

             }end if
          }end for
         }end for
}else {

             OUTPUT Invalid;
             delay(500);
             cls;
}
}
```

- **<u>for redo</u>**

```
set
a6[][],rr,undo,k,v,m,u,a[][],a3[][],a5[],r,score1,score2,flag,f2,moves,K,H

set i,b,t,l=0;
flag=2;
if (undo==0){ //to check if there is an undo or not
 gotoxy(0,13);
 OUTPU "You can't do Redo without Undo";
}else {  //returning the value of moves of two players
if (a6[4][rr]%2==0){
 BUMP K;
}else{
 BUMP H;
}end else
 k=a6[0][rr]; //starting returning removed line
 v=a6[1][rr];
 u=a6[2][rr];
 m=a6[3][rr];
 BUMP rr;
 undo=undo-1; //in order not to make any more redo
if(k==v){
 moves=moves-1;
 a[k][m]=a[v][u]=35; //ascii for asteriks
 for(i=k;i<(k+1);i++){
  for(b=u+1;b<(u+3);b++){
   a[i][b]=45; //ascii for line
           }end for
 }end for
}else if(u==m){
 moves=moves-1;
 a[k][m]=a[v][u]=35;
 for(b=u;b<(u+1);b++){
  for(i=k+1;i<(k+3);i++){
   a[i][b]=124; //ascii for line
   }end for

 }
}
 for(i=0;i<6;i+=3){ //this loop for checking if there is any square had
closed again
  l=0;
   for(b=0;b<6;b+=3){

if((a[i][b+1]==45)&&(a[i+3][b+1]==45)&&(a[i+1][b]==124)&&(a[i+1][b+3]=
=124)){
     l=0;
     if ((score1==0)&&(score2==0)){
      a3[0][r]=i;
      a3[1][r]=b;
      BUMP f2
      if (a5[r]==1){
      BUMP score1;
      }else {
      BUMP score2;
      }end else
      BUMP r;
     }else {
      for (t=0; t<4; t++){ //checking if closed square has calculating before
or not
       if ((i==a3[0][t])&&(b==a3[1][t])){
        l++;
       }end if
      }end for
      if (l==0){ //it is did not calculating before
       a3[0][r]=i;
       a3[1][r]=b;
       BUMP f2;
      if (a5[r]==1){
       BUMP score1;
      }else {
       BUMP score2;
      }end else
      BUMP r;
      }end if
      }end if
      }end for
   }end for
```

USER MANUAL :-

- **How to enter a new game** :-



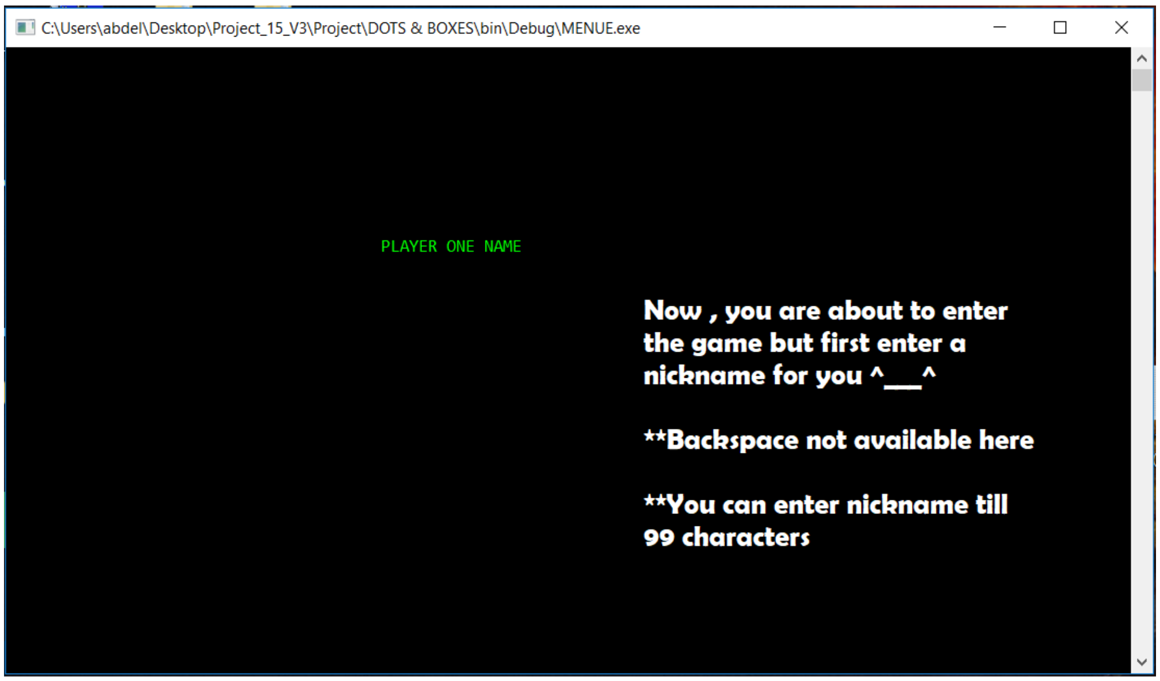
C:\Users\abdel\Desktop\Project_15_V3\Project\DOTS & BOXES\bin\Debug\MENUE.exe

```
Welcome To DOTS & BOXES

Please Select From The Following Sentences

>START THE GAME

 SAVE & LOAD

 LEADER BOARD

 EXIT
```

This your arrow to choose

In this main menu you can use only UP & DOWN buttons and Enter to choose what you want ^_^

Figure(1)



C:\Users\abdel\Desktop\Project_15_V3\Project\DOTS & BOXES\bin\Debug\MENUE.exe

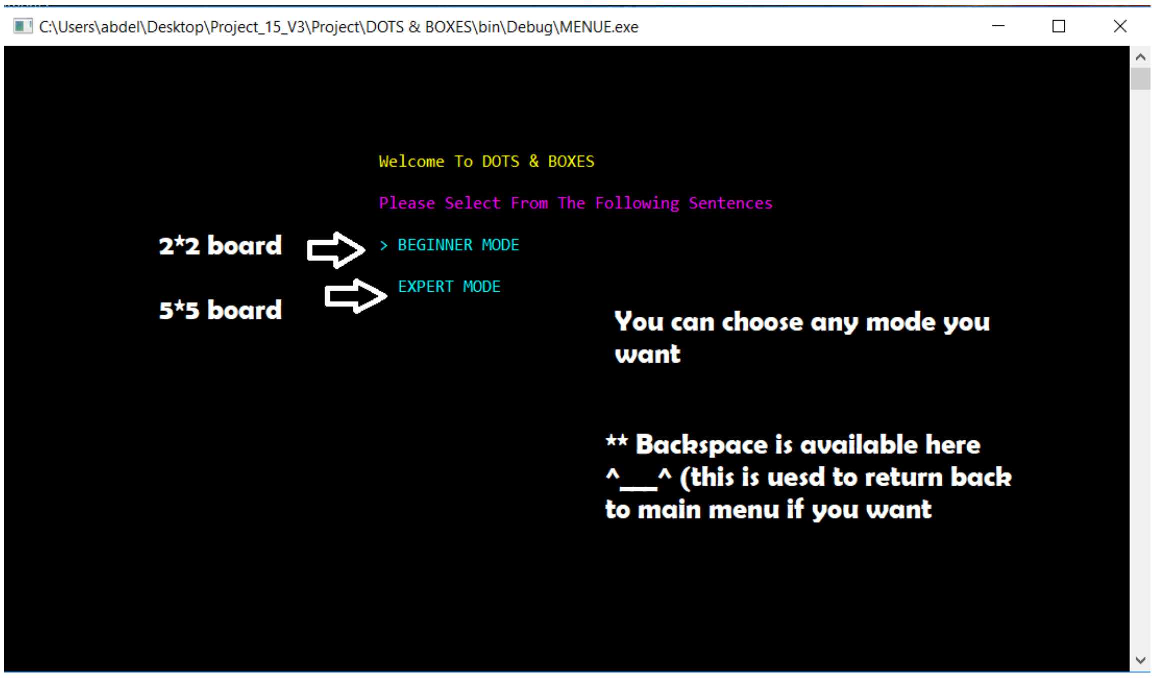
```
PLAYER ONE NAME
```

Now , you are about to enter the game but first enter a nickname for you ^___^

**Backspace not available here

**You can enter nickname till 99 characters

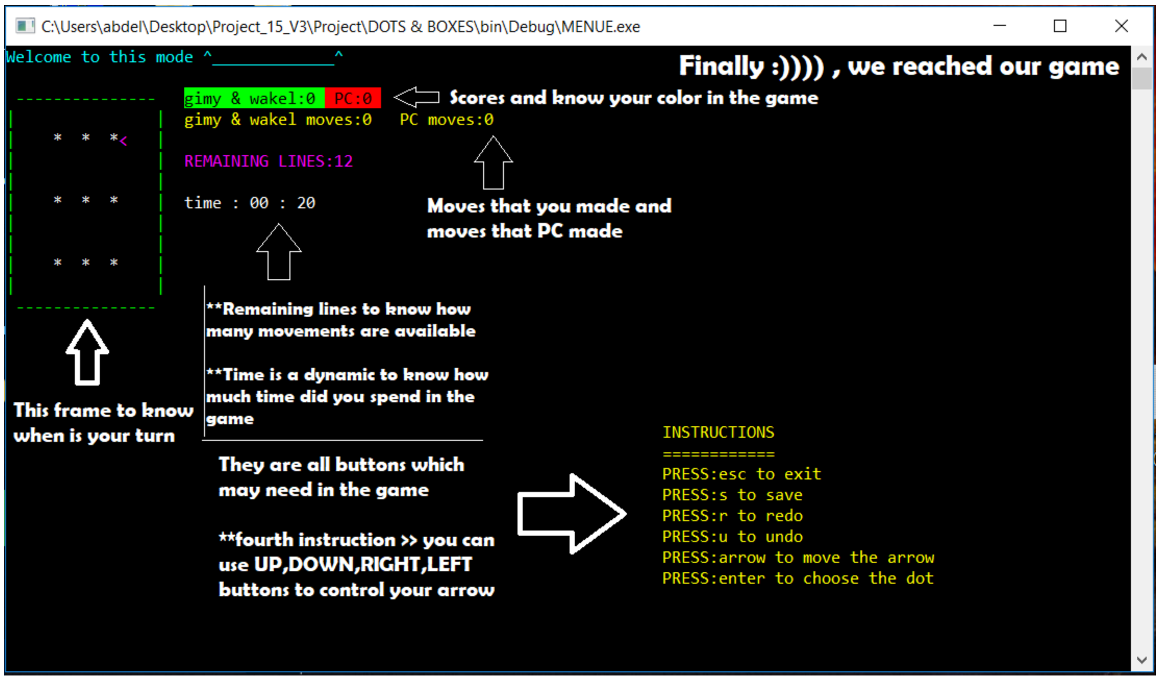
Figure(2)



```
C:\Users\abdel\Desktop\Project_15_V3\Project\DOTS & BOXES\bin\Debug\MENUE.exe

                    Welcome To DOTS & BOXES

                    Please Select From The Following Sentences

                    > BEGINNER MODE

                      EXPERT MODE
```

2*2 board
5*5 board
You can choose any mode you want
** Backspace is available here ^__^ (this is uesd to return back to main menu if you want

Figure(3)



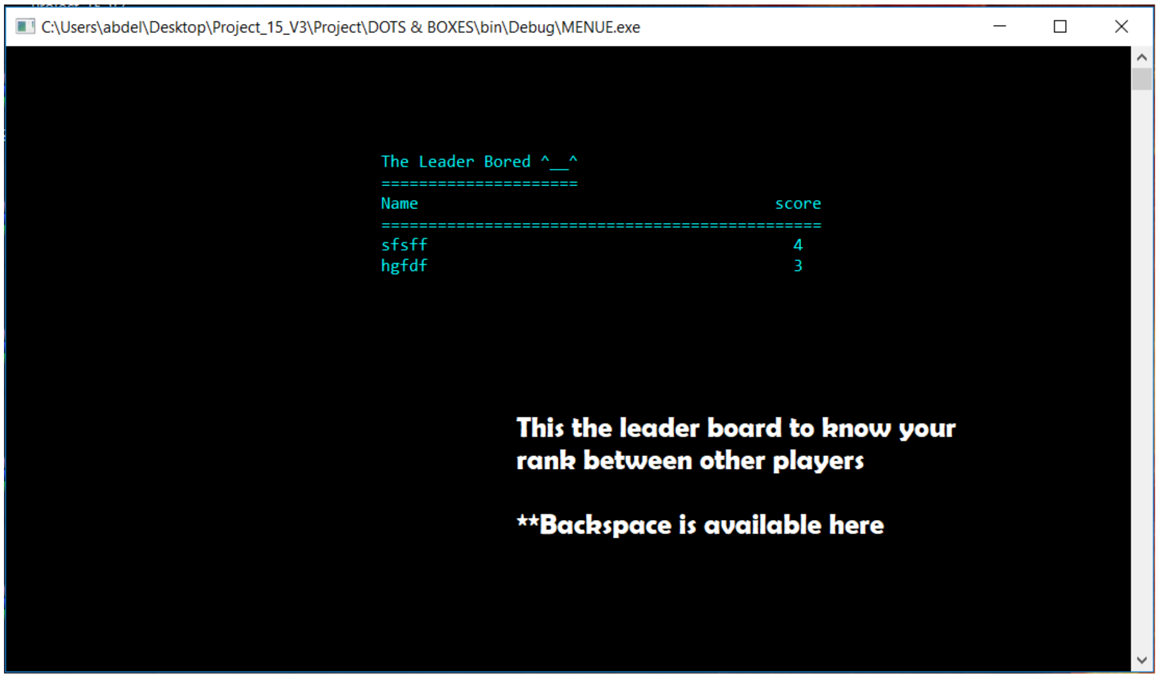
```
C:\Users\abdel\Desktop\Project_15_V3\Project\DOTS & BOXES\bin\Debug\MENUE.exe
Welcome to this mode ^___________^

 --------------   gimy & wakel:0  PC:0
|              |  gimy & wakel moves:0   PC moves:0
|   *  *  *<   |
|              |  REMAINING LINES:12
|   *  *  *    |
|              |  time : 00 : 20
|   *  *  *    |
|              |
 --------------

                                                 INSTRUCTIONS
                                                 ============
                                                 PRESS:esc to exit
                                                 PRESS:s to save
                                                 PRESS:r to redo
                                                 PRESS:u to undo
                                                 PRESS:arrow to move the arrow
                                                 PRESS:enter to choose the dot
```

Finally :)))) , we reached our game
Scores and know your color in the game
Moves that you made and moves that PC made
**Remaining lines to know how many movements are available
**Time is a dynamic to know how much time did you spend in the game
This frame to know when is your turn
They are all buttons which may need in the game
**fourth instruction >> you can use UP,DOWN,RIGHT,LEFT buttons to control your arrow

Figure(4)

**<u>Note</u> :- this is tutorial is for one mode but you can do the same things to enter Other modes

- **<u>How to open the leader board</u>** :-
  From the main menu in fig.(1) , choose Leader board option then you will have the fig(5)


C:\Users\abdel\Desktop\Project_15_V3\Project\DOTS & BOXES\bin\Debug\MENUE.exe

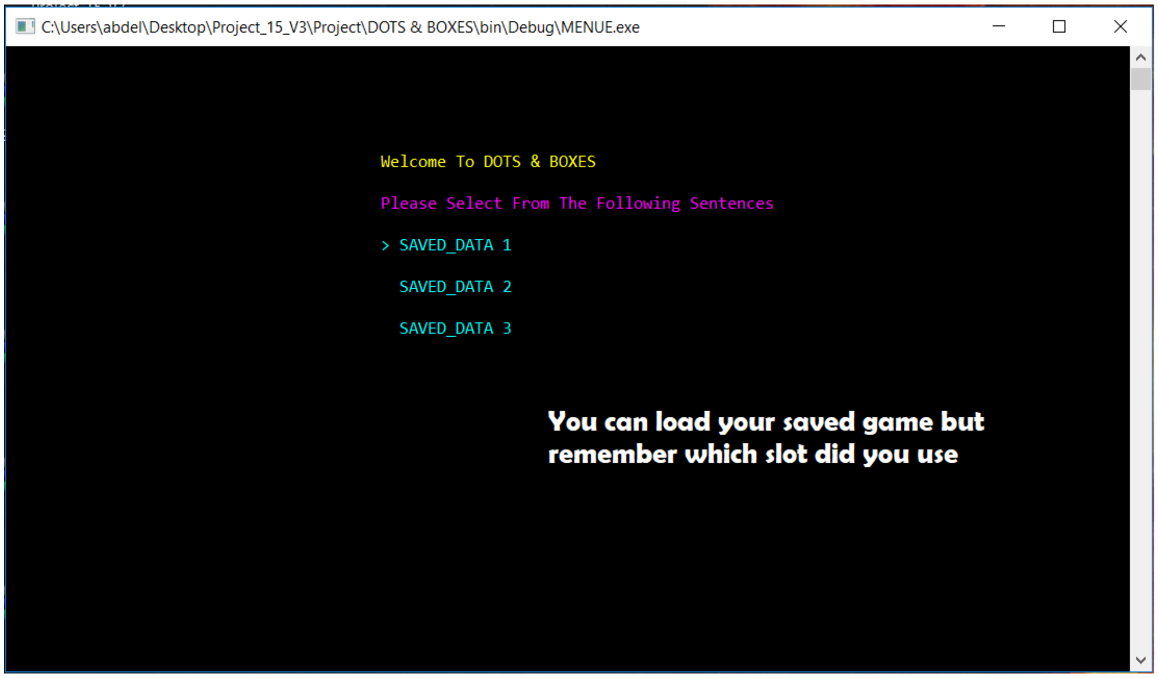
```
The Leader Bored ^__^
====================
Name                                        score
==============================================
sfsff                                         4
hgfdf                                         3
```

This the leader board to know your rank between other players

**Backspace is available here

Figure(5)

- **<u>How to load a saved game</u>** :-
  From fig(1) choose SAVE & LOAD option then you have the fig (6)


C:\Users\abdel\Desktop\Project_15_V3\Project\DOTS & BOXES\bin\Debug\MENUE.exe

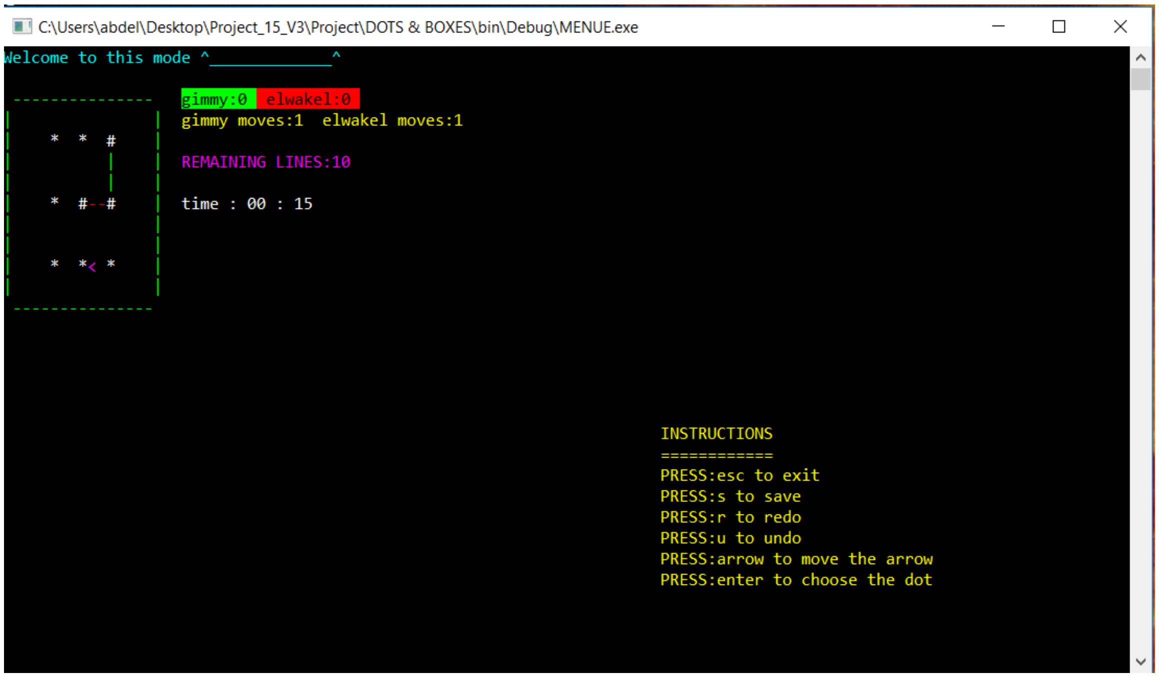
```
Welcome To DOTS & BOXES

Please Select From The Following Sentences

> SAVED_DATA 1

  SAVED_DATA 2

  SAVED_DATA 3
```

You can load your saved game but remember which slot did you use

Figure(6)

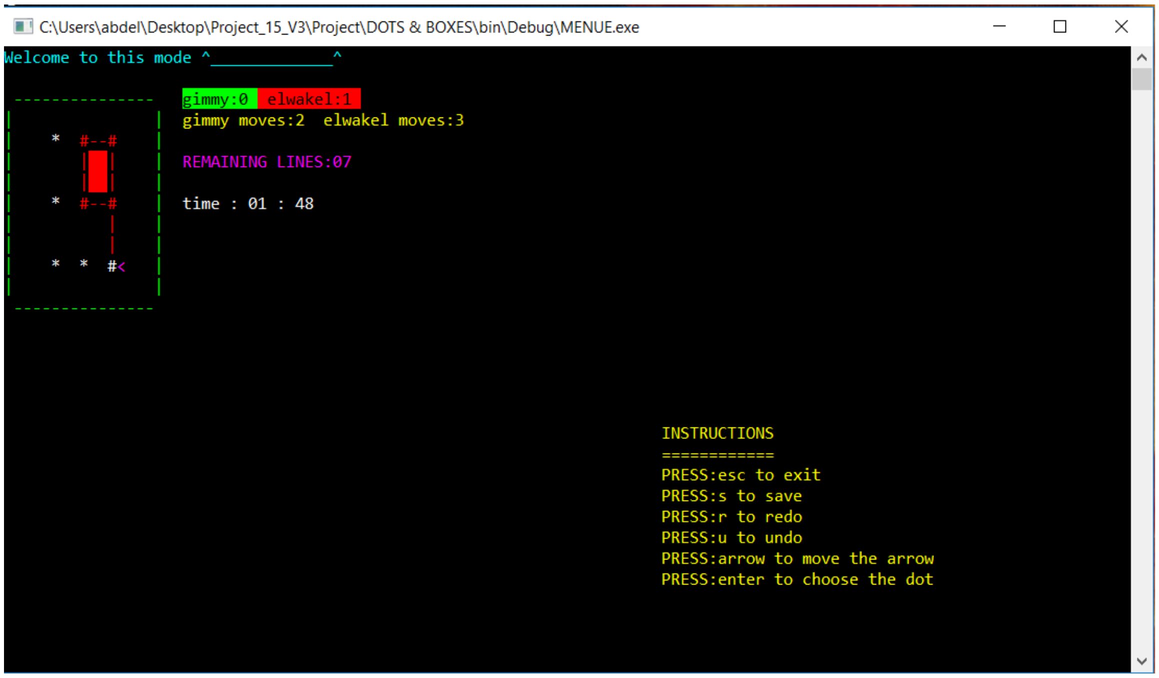
<u>SAMPLE RUNS</u> :-

- Playing two lines in 2*2 mode P1 VS P2



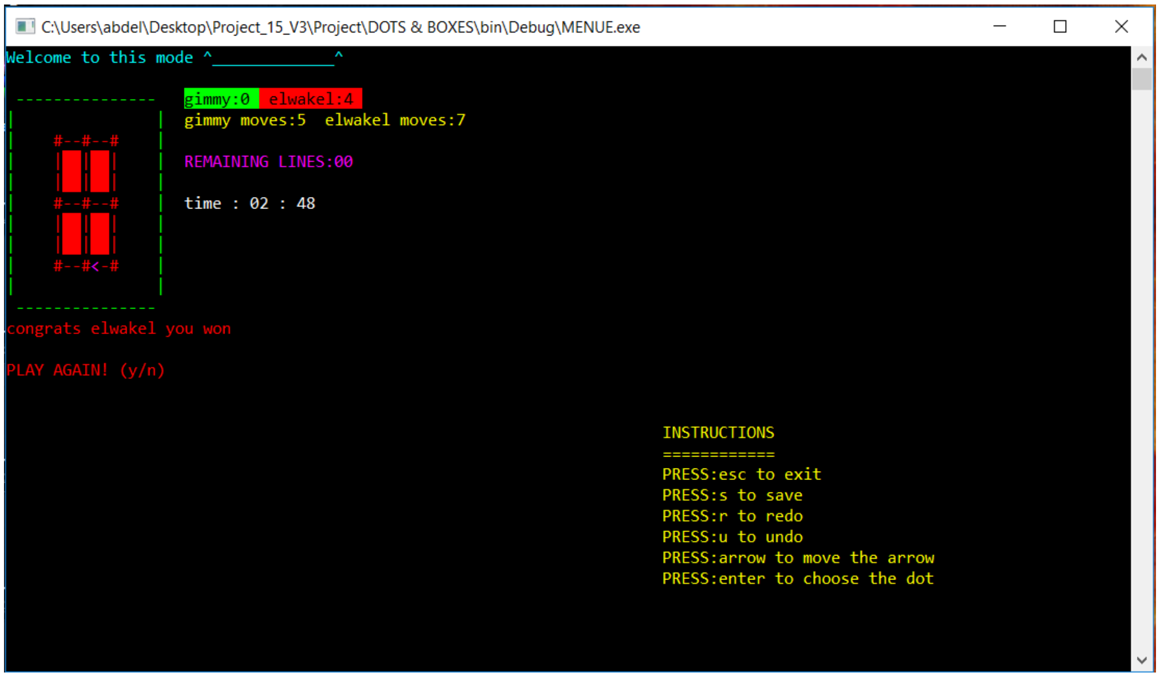
```
C:\Users\abdel\Desktop\Project_15_V3\Project\DOTS & BOXES\bin\Debug\MENUE.exe
Welcome to this mode ^_____________^

 ---------------      gimmy:0  elwakel:0
|               |     gimmy moves:1  elwakel moves:1
|    *  *  #    |
|          |    |     REMAINING LINES:10
|          |    |
|    *  #--#    |     time : 00 : 15
|               |
|               |
|    *  *< *    |
|               |
 ---------------

                                                   INSTRUCTIONS
                                                   ============
                                                   PRESS:esc to exit
                                                   PRESS:s to save
                                                   PRESS:r to redo
                                                   PRESS:u to undo
                                                   PRESS:arrow to move the arrow
                                                   PRESS:enter to choose the dot
```

- One player closed a square



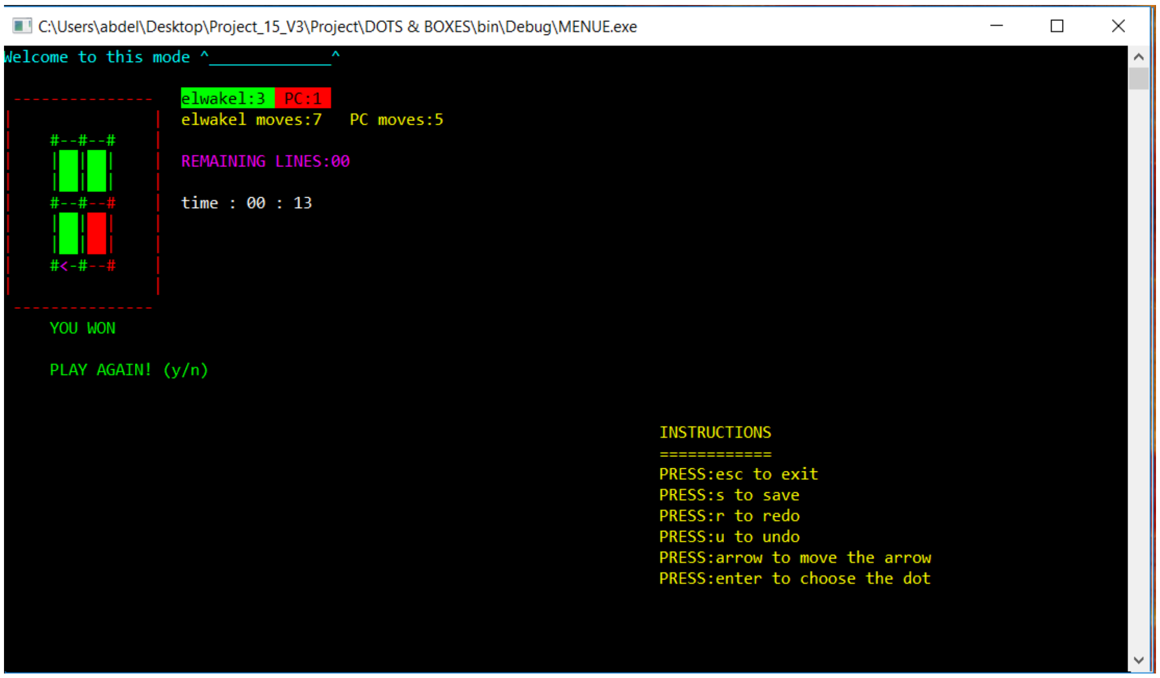
```
C:\Users\abdel\Desktop\Project_15_V3\Project\DOTS & BOXES\bin\Debug\MENUE.exe
Welcome to this mode ^_____________^

 ---------------      gimmy:0  elwakel:1
|               |     gimmy moves:2  elwakel moves:3
|    *  #--#    |
|       |  |    |     REMAINING LINES:07
|       |  |    |
|    *  #--#    |     time : 01 : 48
|          |    |
|          |    |
|    *  *  #<   |
|               |
 ---------------

                                                   INSTRUCTIONS
                                                   ============
                                                   PRESS:esc to exit
                                                   PRESS:s to save
                                                   PRESS:r to redo
                                                   PRESS:u to undo
                                                   PRESS:arrow to move the arrow
                                                   PRESS:enter to choose the dot
```

- One of the players has won



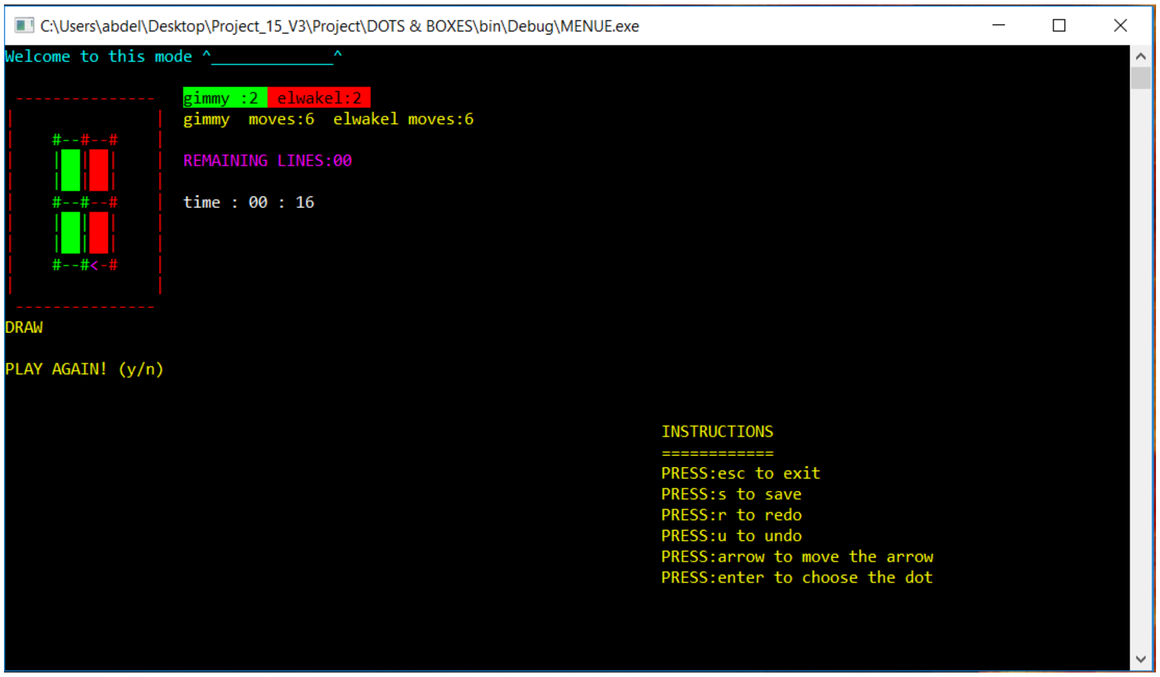
```
C:\Users\abdel\Desktop\Project_15_V3\Project\DOTS & BOXES\bin\Debug\MENUE.exe
Welcome to this mode ^___________^

 ---------------     gimmy:0  elwakel:4
|               |    gimmy moves:5  elwakel moves:7
|    #--#--#    |
|    |  |  |    |    REMAINING LINES:00
|    #--#--#    |
|    |  |  |    |    time : 02 : 48
|    #--#<-#    |
|               |
 ---------------
congrats elwakel you won

PLAY AGAIN! (y/n)

                                                                INSTRUCTIONS
                                                                ============
                                                                PRESS:esc to exit
                                                                PRESS:s to save
                                                                PRESS:r to redo
                                                                PRESS:u to undo
                                                                PRESS:arrow to move the arrow
                                                                PRESS:enter to choose the dot
```

- Beating PC



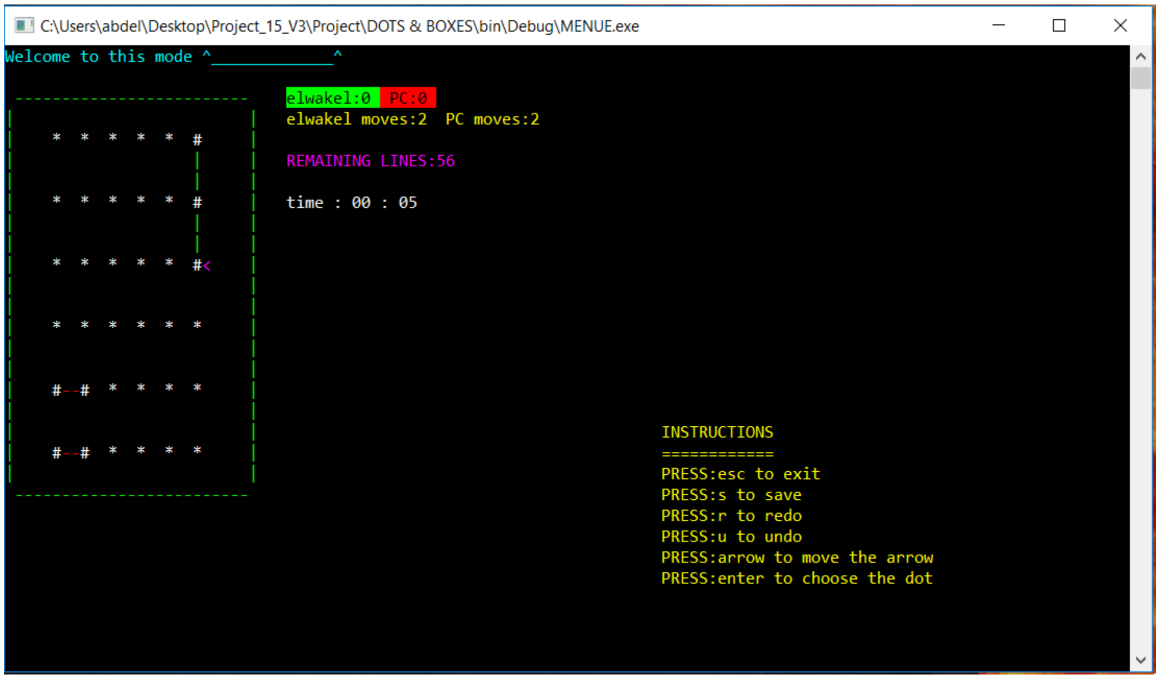
```
C:\Users\abdel\Desktop\Project_15_V3\Project\DOTS & BOXES\bin\Debug\MENUE.exe
Welcome to this mode ^___________^

 ---------------     elwakel:3  PC:1
|               |    elwakel moves:7   PC moves:5
|    #--#--#    |
|    |  |  |    |    REMAINING LINES:00
|    #--#--#    |
|    |  |  |    |    time : 00 : 13
|    #<-#--#    |
|               |
 ---------------
    YOU WON

    PLAY AGAIN! (y/n)

                                                                INSTRUCTIONS
                                                                ============
                                                                PRESS:esc to exit
                                                                PRESS:s to save
                                                                PRESS:r to redo
                                                                PRESS:u to undo
                                                                PRESS:arrow to move the arrow
                                                                PRESS:enter to choose the dot
```

- Draw between two players



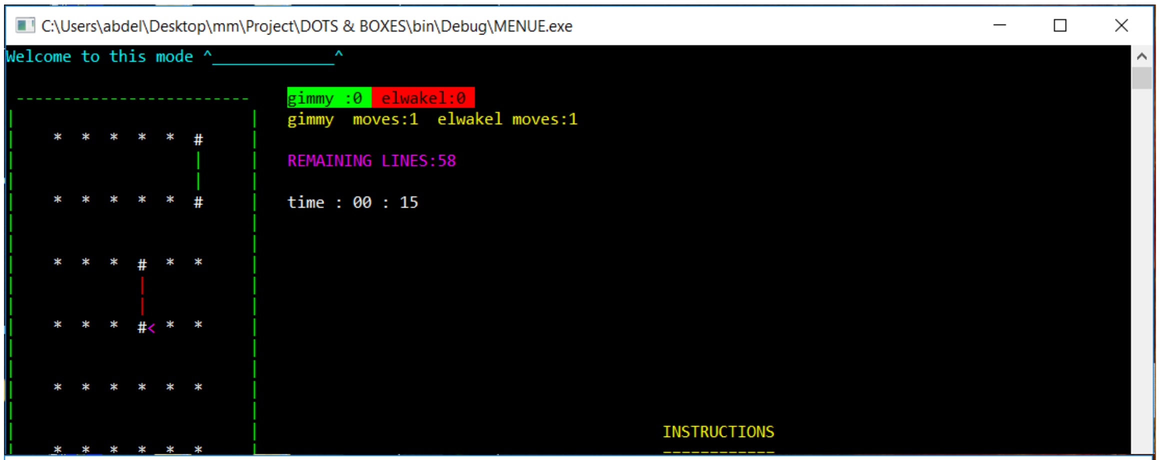
```
C:\Users\abdel\Desktop\Project_15_V3\Project\DOTS & BOXES\bin\Debug\MENUE.exe
Welcome to this mode ^____________^

 --------------    gimmy :2 elwakel:2
|              |   gimmy  moves:6  elwakel moves:6
|    #--#--#   |
|    |  |  |   |   REMAINING LINES:00
|    |  |  |   |
|    #--#--#   |   time : 00 : 16
|    |  |  |   |
|    |  |  |   |
|    #--#<-#   |
|              |
 --------------
DRAW

PLAY AGAIN! (y/n)

                                                               INSTRUCTIONS
                                                               ============
                                                               PRESS:esc to exit
                                                               PRESS:s to save
                                                               PRESS:r to redo
                                                               PRESS:u to undo
                                                               PRESS:arrow to move the arrow
                                                               PRESS:enter to choose the dot
```

- Playing with PC in 5*5 board

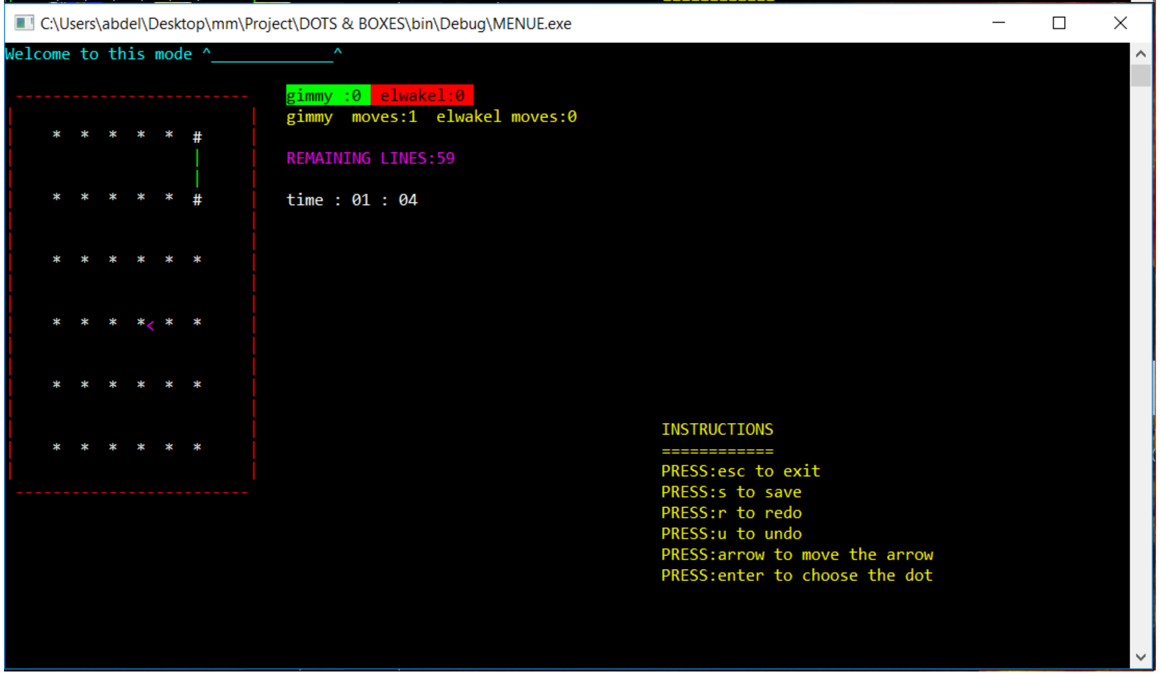


```
C:\Users\abdel\Desktop\Project_15_V3\Project\DOTS & BOXES\bin\Debug\MENUE.exe
Welcome to this mode ^____________^

 -------------------------    elwakel:0 PC:0
|                         |   elwakel moves:2  PC moves:2
|    *  *  *  *  *  #     |
|                   |     |   REMAINING LINES:56
|                   |     |
|    *  *  *  *  *  #     |   time : 00 : 05
|                   |     |
|                   |     |
|    *  *  *  *  *  #<    |
|                         |
|                         |
|    *  *  *  *  *  *     |
|                         |
|                         |
|    #--#  *  *  *  *     |
|                         |
|                         |
|    #--#  *  *  *  *     |
|                         |
 -------------------------
                                                               INSTRUCTIONS
                                                               ============
                                                               PRESS:esc to exit
                                                               PRESS:s to save
                                                               PRESS:r to redo
                                                               PRESS:u to undo
                                                               PRESS:arrow to move the arrow
                                                               PRESS:enter to choose the dot
```

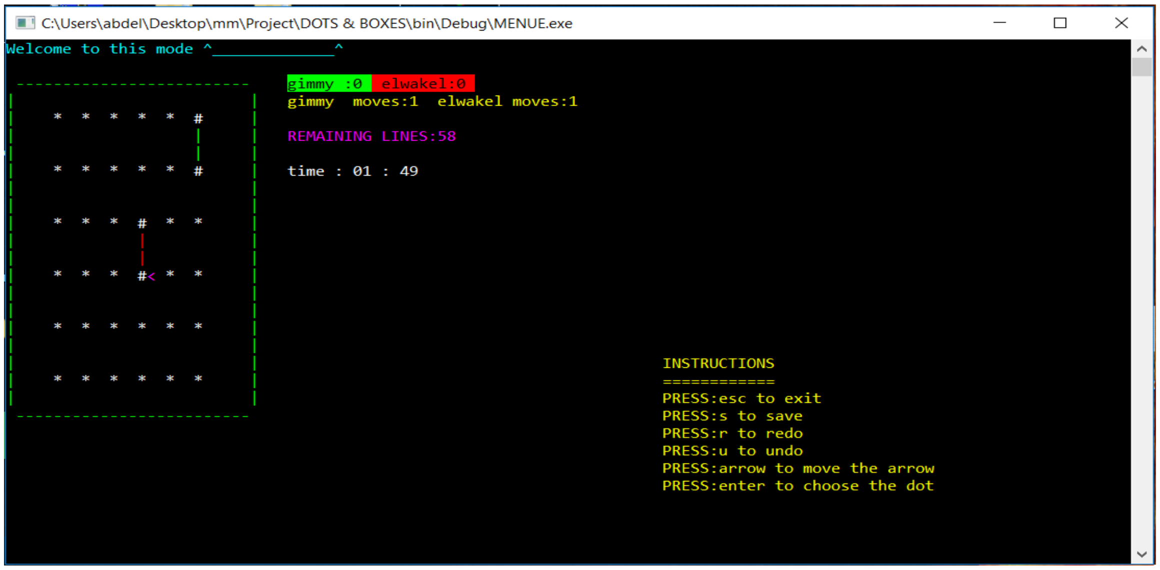
- Playing two players mode and doing UNDO & REDO



```
C:\Users\abdel\Desktop\mm\Project\DOTS & BOXES\bin\Debug\MENUE.exe
Welcome to this mode ^____________^

                              gimmy :0  elwakel:0
                              gimmy  moves:1  elwakel moves:1

                              REMAINING LINES:58

                              time : 00 : 15

                                                                  INSTRUCTIONS
```



```
C:\Users\abdel\Desktop\mm\Project\DOTS & BOXES\bin\Debug\MENUE.exe
Welcome to this mode ^____________^

                              gimmy :0  elwakel:0
                              gimmy  moves:1  elwakel moves:0

                              REMAINING LINES:59

                              time : 01 : 04

                                                                  INSTRUCTIONS
                                                                  ============
                                                                  PRESS:esc to exit
                                                                  PRESS:s to save
                                                                  PRESS:r to redo
                                                                  PRESS:u to undo
                                                                  PRESS:arrow to move the arrow
                                                                  PRESS:enter to choose the dot
```



```
C:\Users\abdel\Desktop\mm\Project\DOTS & BOXES\bin\Debug\MENUE.exe
Welcome to this mode ^____________^

                              gimmy :0  elwakel:0
                              gimmy  moves:1  elwakel moves:1

                              REMAINING LINES:58

                              time : 01 : 49

                                                                  INSTRUCTIONS
                                                                  ============
                                                                  PRESS:esc to exit
                                                                  PRESS:s to save
                                                                  PRESS:r to redo
                                                                  PRESS:u to undo
                                                                  PRESS:arrow to move the arrow
                                                                  PRESS:enter to choose the dot
```

References :-

- C programming : A modern Approach (as most of our algorithm depended on which had studied this semester)
- Stack Overflow’s answers (they helped us in making our time dynamic , helped us in printing things in colors) [link : https://stackoverflow.com/questions]
- https://www.tutorialspoint.com/cprogramming/
- https://www.cprogramming.com/
- http://www.codeincodeblock.com/