```c
/* C program by Dave Russillo. Made for CS1310. TicTacToe.
 *          _                       _
 *         | |                     | |
 *        / /                      \ \
 *       /  \____                ____/  \
 *  ____/   (|____)             (____|)  \____
 * |    |   (|_____)            (_____|) |    |
 * |    |    (|____)             (____|)  |    |
 * |___|_____(|___)              (___|)___|____|
 *
 */

#include <stdio.h>

char ttt[3][3];  // array represents board
char player;  // current player: either X or O
int row;  // variable used for loops and more
int col;  // variable used for loops and more
int moves;  // tracks number of moves



void draw_board_options(void) {  // draws equivalency of numbers [1-9] to places on board
  printf("\n"
         "_1_|_2_|_3_\n"
         "_4_|_5_|_6_\n"
         " 7 | 8 | 9 \n\n");
}



void draw_board(int winstate) {  // draws board and current status. adds lines based on winstate
  int i;
  int wintype = winstate / 10;  // relies on truncating
  int wincoord = winstate - winstate / 10 * 10;  // relies on truncating

  for(row = 0; row < 3; row++) {  // iterate through rows
    for(i = 0; i < 5; i++) {  // iterate through character lines within the row
      for(col = 0; col < 3; col++) {  // iterate through each column
        if(ttt[row][col] == ' ') {  // based on which line it's on, draw different parts of the ascii for X
          if(i == 4 && row != 2) printf("_________");  // separator between rows: dont add if last row
          else printf("         ");
          if(col != 2) printf("|");  // dont add column separator if last column
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    } else {
      switch(i) {
        case 0:  // first line in row
          if(wintype == 2 && wincoord == col) printf("    |    ");  // if win on column, add pipe
          else if(wintype == 3 && row == col) printf("\\\\       ");  // if backward win, add backslashes
          else if(wintype == 4 && row + col == 2) printf("       /");  // if backward win, add slash
          else printf("         ");  // if no win yet
          break;
        case 1:  // second line in row
          if(ttt[row][col] == 'X') {
            if(wintype == 2 && wincoord == col) printf("   X|X   ");  // if win on column, add pipe
            else if(wintype == 3 && row == col) printf("  \\X X   ");  // if backward win, add backslash
            else if(wintype == 4 && row + col == 2) printf("   X X// ");  // if forward win, add slashes
            else printf("   X X   ");  // if no win yet
          } else {
            if(wintype == 2 && wincoord == col) printf("   O|O   ");  // if win on column, add pipe
            else if(wintype == 3 && row == col) printf("  \\OOO   ");  // if backward win, add backslash
            else if(wintype == 4 && row + col == 2) printf("   OOO// ");  // if forward win, add slashes
            else printf("   OOO   ");  // if no win yet
          }
          break;
        case 2:  // third line in row
          if(ttt[row][col] == 'X') {
            if(wintype == 1 && wincoord == row) printf("=========="); // if win on row, add equal signs
            else if(wintype == 2 && wincoord == col) printf("    |    ");
            else if(wintype == 3 && row == col) printf("    \\\\   ");  // if backward win, add backslashes
            else if(wintype == 4 && row + col == 2) printf("    //   ");  // if forward win, add slashes
            else printf("    X    ");  // if no win yet
          } else {
            if(wintype == 1 && wincoord == row) printf("==O===O=="); // if win on row, add equal signs
            else if(wintype == 2 && wincoord == col) printf("  O | O  ");
            else if(wintype == 3 && row == col) printf("  O \\\\\O  ");  // if backward win, add backslashes
            else if(wintype == 4 && row + col == 2) printf("  O //O  ");  // if forward win, add slashes
            else printf("  O   O  ");  // if no win yet
          }
          break;
        case 3:  // fourth line in row
          if(ttt[row][col] == 'X') {
            if(wintype == 2 && wincoord == col) printf("   X|X   ");  // if win on column, add pipe
            else if(wintype == 3 && row == col) printf("   X X\\\\ ");  // if backward win, add backslashes
            else if(wintype == 4 && row + col == 2) printf("  /X X   ");  // if forward win, add slash
            else printf("   X X   ");  // if not win yet
          } else {
```

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87                  if(wintype == 2 && wincoord == col) printf("   0|0   ");  // if win on column, add pipe
88                  else if(wintype == 3 && row == col) printf("   000\\\\ ");  // if backward win, add backslashes
89                  else if(wintype == 4 && row + col == 2) printf("  /000   ");  // if forward win, add slash
90                  else printf("   000   ");  // if not win yet
91                }
92                break;
93              case 4:  // last line in row
94                if(row != 2) {  // if not on last row, add separator between rows
95                  if(wintype == 2 && wincoord == col) printf("____|____");  // if win on column, add pipe
96                  else if(wintype == 3 && row == col) printf("________\\\");  // if backward win, add backslash
97                  else if(wintype == 4 && row + col == 2) printf("//_______");  // if forward win, add slash
98                  else printf("_________");  // if no win yet
99                } else {
100                 if(wintype == 2 && wincoord == col) printf("    |    ");  // if win on column, add pipe
101                 else if(wintype == 3 && row == col) printf("       \\\");  // if backward win, add backslash
102                 else if(wintype == 4 && row + col == 2) printf("//      ");  // if forward win, add slash
103                 else printf("         ");  // if no win yet
104               }
105             }
106             // separator between columns
107             if(col != 2 && wintype == 1 && wincoord == row && i == 2) printf("=");  // if win is on row, add equal sign
108             else if(wintype == 3 && row == col && i == 4) printf("\\");  // add backslash instead of pipe if it's a backward win
109             else if(wintype == 4 && row + col == 2 && i == 0) printf("/");  // add slash instead of pipe if it's a backward win
110             else if(col != 2) printf("|");  // dont add pipe if last column
111
112           }
113         }
114         printf("\n");  // newline between each line in row
115       }
116     }
117     if(wintype == 5) {  // if it's a tie
118       printf("\nTie! \n\n");
119     } else if(wintype != 0) {
120       printf("\n%c won! \n\n", player);
121     }
122   }
123
124
125
126   void clear_board(void) {  // clears board
127     for(row = 0; row < 3; row++) {  // iterate through rows
128       for(col = 0; col < 3; col++) {  // iterate through columns
129         ttt[row][col] = ' ';
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    }
  }
  moves = 0;  // reset moves
}



void take_turn(void) {  // lets current player take turn and checks for valid move
  int position;
  int position_valid = 0;
  int x = 0;
  int y = 0;

  while(position_valid == 0) {  // check for valid move
    printf("\nIt's %c's turn. Choose an empty field (1-9):  ", player);  // prints instructions
    scanf("%d", &position);
    position_valid = 1;  // assumes valid
    switch(position) {  // sets coords based on position number
      case 1:
        x = 0;
        y = 0;
        break;
      case 2:
        x = 0;
        y = 1;
        break;
      case 3:
        x = 0;
        y = 2;
        break;
      case 4:
        x = 1;
        y = 0;
        break;
      case 5:
        x = 1;
        y = 1;
        break;
      case 6:
        x = 1;
        y = 2;
        break;
      case 7:
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        x = 2;
        y = 0;
        break;
      case 8:
        x = 2;
        y = 1;
        break;
      case 9:
        x = 2;
        y = 2;
        break;
      default:  // means position is invalid because not in [1-9]
        position_valid = 0;
        break;
    }
    if(ttt[x][y] == ' ' && position_valid == 1) {  // check if spot is free
      ttt[x][y] = player;
    } else {
      position_valid = 0;
      printf("\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n");
      draw_board_options();
      draw_board(0);
      printf("Invalid input! Try again.");
    }
  }
  moves++;  // increment moves to keep track of them
}


void reassign_player(void) {  // switches player between X and O
  if(player == 'X')
    player = 'O';
  else
    player = 'X';
}


int check_for_end(void) {  // returns wintype in tenths and coord number in units
  // stores two single digit ints in double digit int: 2, 4 -> 24
  int i;

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  for(i = 0; i < 3; i++) {  // i is which row or column the win is on
    if(ttt[i][0] != ' ' && ttt[i][0] == ttt[i][1] && ttt[i][1] == ttt[i][2]) {
      return 10 + i;  // wintype 1 is horizontal win
    } else if(ttt[0][i] != ' ' && ttt[0][i] == ttt[1][i] && ttt[1][i] == ttt[2][i]) {
      return 20 + i;  // wintype 2 is vertical win
    }
  }
  if(ttt[0][0] != ' ' && ttt[0][0] == ttt[1][1] && ttt[1][1] == ttt[2][2]) {
    return 30;  // wintype 3 is backward diagonal (needs no coord)
  } else if(ttt[0][2] != ' ' && ttt[0][2] == ttt[1][1] && ttt[1][1] == ttt[2][0]) {
    return 40;  // wintype 4 is forward diagonal (needs no coord)
  } else if(moves == 9) {
    return 50;  // wintype 5 is for ties
  }
  return 0;
}



int check_for_two_in_row(int coords) {
  int r = coords / 10;  // extract row out of coords. relies on truncating.
  int c = coords % 10;  // extract column out of coords
  char current = ttt[r][c];  // current sign in cell
  char opposite;
  int i;  // to iterate (row and col already in use)
  int has_current;  // keeps track if there's the current sign on the row/column/diagonal
  int has_opposite;  // keeps track if there's an opposite to the current sign on the row/column/diagonal

  if(current == 'X') {  // find opposite
    opposite = 'O';
  } else {
    opposite = 'X';
  }

  if(ttt[r][c] == ' ') {  // don't check if given cell is empty
    return 0;
  } else {
    ttt[r][c] = ' ';
  }

  // assume coords are not (1, 1) because middle will be occupied either way
  if(coords == 11) {
    return 0;
```

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259   }
260
261   // check each column on row
262   has_current = 0;
263   has_opposite = 0;
264   for(i = 0; i < 3; i++) {
265     if(ttt[r][i] == current) {
266       has_current = 1;
267     } else if(ttt[r][i] == opposite) {
268       has_opposite = 1; }
269   }
270   if(has_current == 1 && has_opposite == 0) {
271     ttt[r][c] = current;
272     return 1;
273   }
274
275   // check each row on column
276   has_current = 0;
277   has_opposite = 0;
278   for(i = 0; i < 3; i++) {
279     if(ttt[i][c] == current) {
280       has_current = 1;
281     } else if(ttt[i][c] == opposite) {
282       has_opposite = 1;
283     }
284   }
285   if(has_current == 1 && has_opposite == 0) {
286     ttt[r][c] = current;
287     return 1;
288   }
289
290   // check each cell on diagonal
291   has_current = 0;
292   has_opposite = 0;
293   for(i = 0; i < 3; i++) {
294     if(ttt[i][i] == current) {
295       has_current = 1;
296     } else if(ttt[i][i] == opposite) {
297       has_opposite = 1;
298     }
299   }
300   if(has_current == 1 && has_opposite == 0) {
301     ttt[r][c] = current;
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      return 1;
    }

    // check each cell on backward diagonal
    has_current = 0;
    has_opposite = 0;
    for(i = 0; i < 3; i++) {
      if(ttt[i][2 - i] == current) {
        has_current = 1;
      } else if(ttt[i][2 - i] == opposite) {
        has_opposite = 1;
      }
    }
    if(has_current == 1 && has_opposite == 0) {
      ttt[r][c] = current;
      return 1;
    }

    ttt[r][c] = current;
    return 0;
  }



  // can make 3 in a row
  // block an opponents 3 in a row
  // make 2 in a row
  // place in middle if available
  // place in corner
  // place in available spot

  void take_turn_cpu(void) {
    int coords;

    // 3 in a rows
    for(row = 0; row < 3; row++) {
      for(col = 0; col < 3; col++) {
        if(ttt[row][col] == ' ') {
          ttt[row][col] = 'O';  // test with O for three in a rows
          if(check_for_end() == 0) {  // if it's not the end
            ttt[row][col] = 'X';  // test with X for three in a rows
            if(check_for_end() == 0) {  // if it's not the end
              ttt[row][col] = ' ';  // clear because no 3 in a rows
              } else {
                ttt[row][col] = 'O';
                moves++;
                return;
              }
            } else {
              ttt[row][col] = 'O';
              moves++;
              return;
            }
          }
        }
      }

      // 2 in a rows
      for(row = 0; row < 3; row++) {
        for(col = 0; col < 3; col++) {
          if(ttt[row][col] == ' ') {
            ttt[row][col] = 'O';  // test with O for two in a rows
            coords = row * 10 + col;  // store current single digit coords in double digit int
            if(check_for_two_in_row(coords) == 0) {  // if it's not two O in a row
                ttt[row][col] = ' '; // clear because no 2 in a rows
            } else {
              ttt[row][col] = 'O';  // set to O to two in a row
              moves++;  // keep track of moves
              return;
            }
          }
        }
      }

      if(ttt[1][1] == ' ') {  // if middle is available
        ttt[1][1] = 'O';  // set middle to 'O'
      } else if(ttt[0][0] == ' ') {  // if top left is available
        ttt[0][0] = 'O';
      } else if(ttt[0][2] == ' ') {  // if top right is available
        ttt[0][2] = 'O';
      } else if(ttt[2][0] == ' ') {  // if bottom left is available
        ttt[2][0] = 'O';
      } else if(ttt[2][2] == ' ') {  // if bottom right is available
        ttt[2][2] = 'O';
      } else {
        printf("How did you get here?");  // impossible outcome
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  }
  moves++;
}



int main(void) {
  char input;  // user input. used for capturing newlines
  char restart;
  int gamemode;

  do {
    printf("\nWelcome to TicTacToe! First to get three in a row, column, or diagonal wins! X goes first. \n");
    player = 'X';
    gamemode = 0;
    while(gamemode != 1 && gamemode != 2) {
      printf(" _________________________ \n"
             "|                         | \n"
             "| 1 : Player vs Player    | \n"
             "|                         | \n"
             "| 2 : Player vs CPU       | \n"
             "|_________________________| \n\n");
      printf("Select a gamemode... ");
      scanf("%d", &gamemode);
      if(gamemode != 1 && gamemode != 2) {
        printf("Invalid gamemode selection. Try again. \n\n");
      }
    }
    clear_board();
    while(check_for_end() == 0) {
      printf("\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n");
      draw_board_options();
      draw_board(0);

      if(gamemode == 1 || player == 'X') {
        take_turn();
      } else {
        take_turn_cpu();
      }
      reassign_player();
    }
    reassign_player();
    printf("\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n\n");
    draw_board_options();
    draw_board(check_for_end());
    scanf("%c", &input);
    printf("Would you like to restart?  (Y/N)");
    scanf("%c", &restart);
    scanf("%c", &input);
  } while(restart == 'y' || restart == 'Y');
  printf("Thank you for playing! \n\n");

  return 0;
}
```
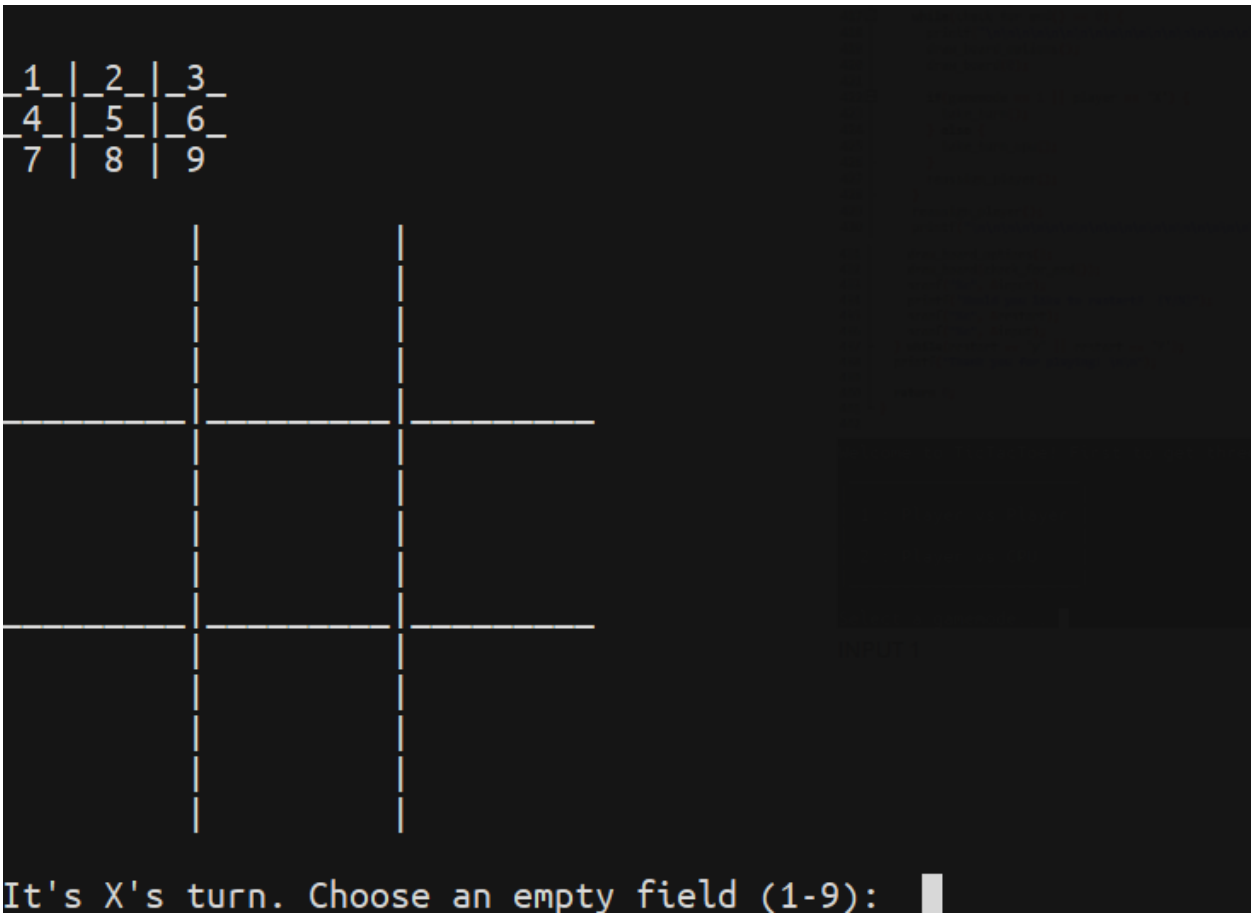
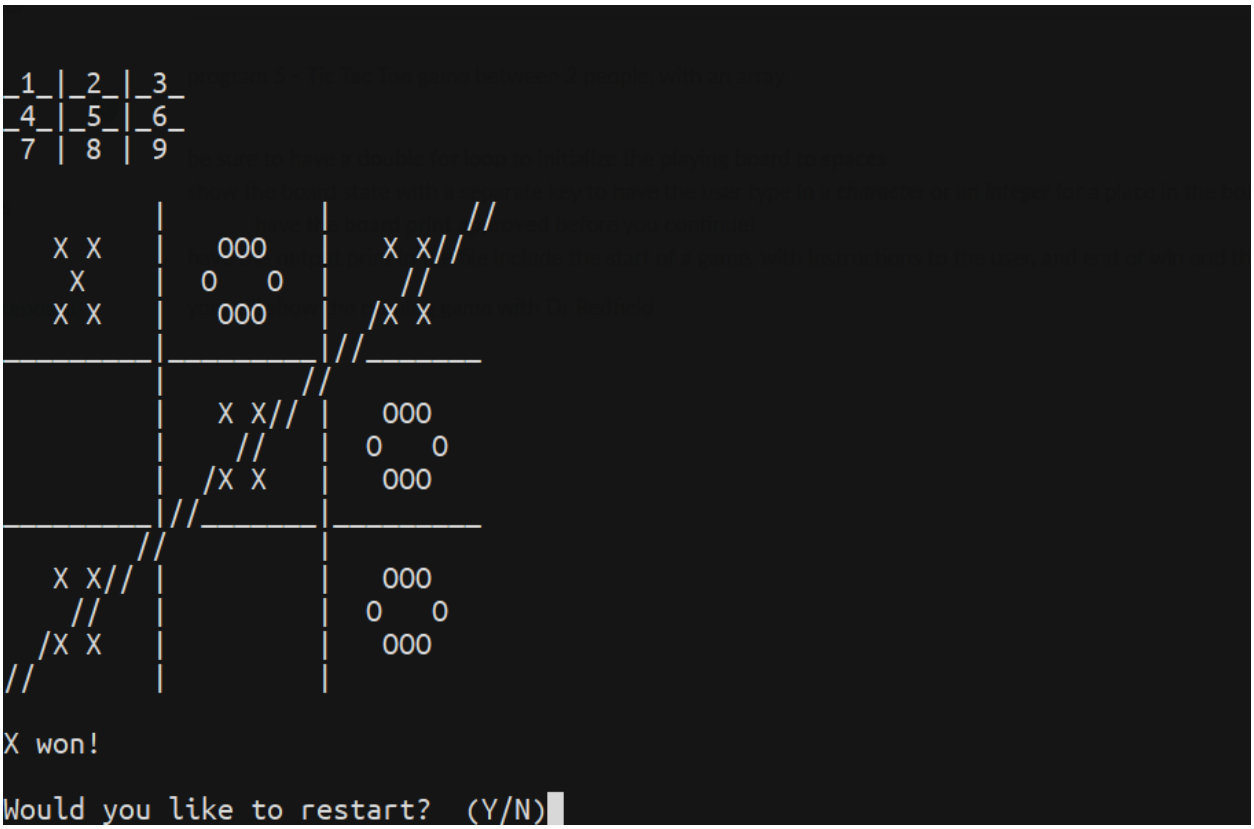
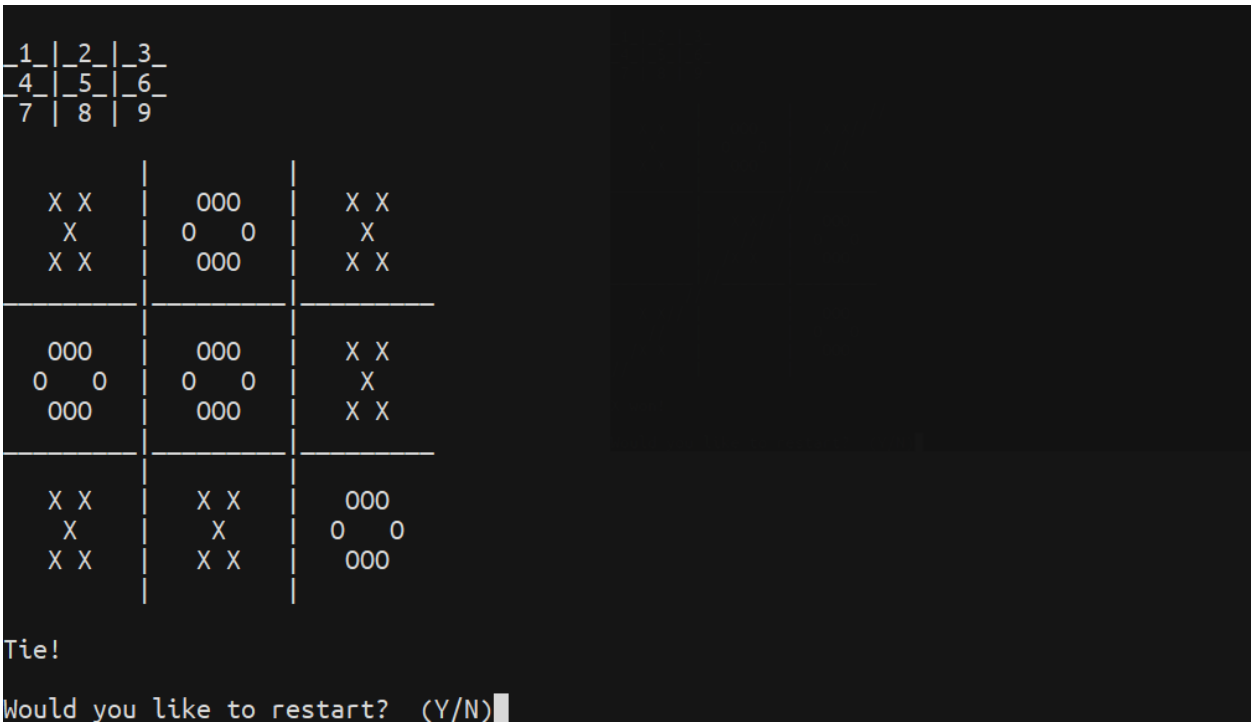
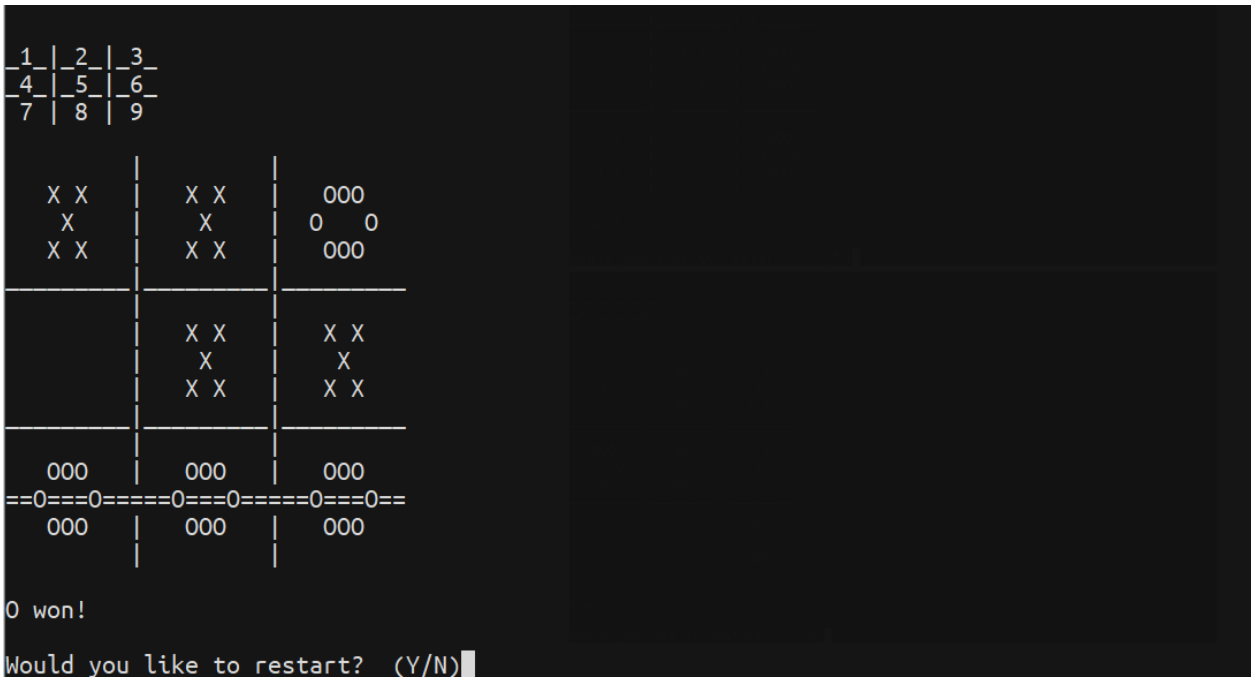

```
Welcome to TicTacToe! First to get three in a row, column, or diagonal wins! X goes first.
 _________________________
|                         |
| 1 : Player vs Player    |
|                         |
| 2 : Player vs CPU       |
|_________________________|

Select a gamemode...
```

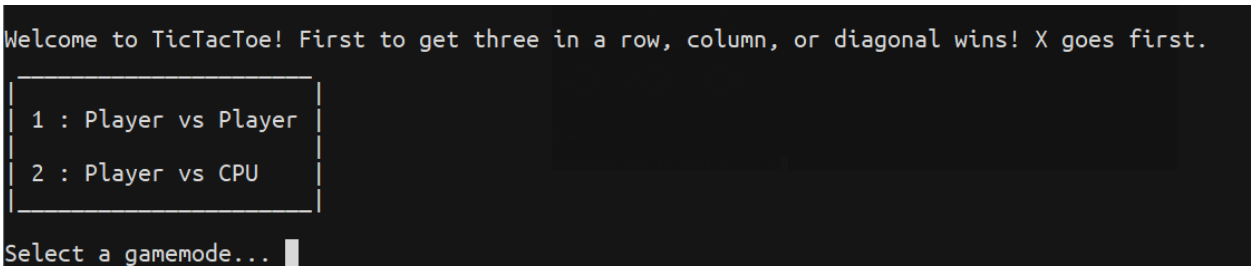
INPUT 1


_1_|_2_|_3_
_4_|_5_|_6_
 7 | 8 | 9
It's X's turn. Choose an empty field (1-9):

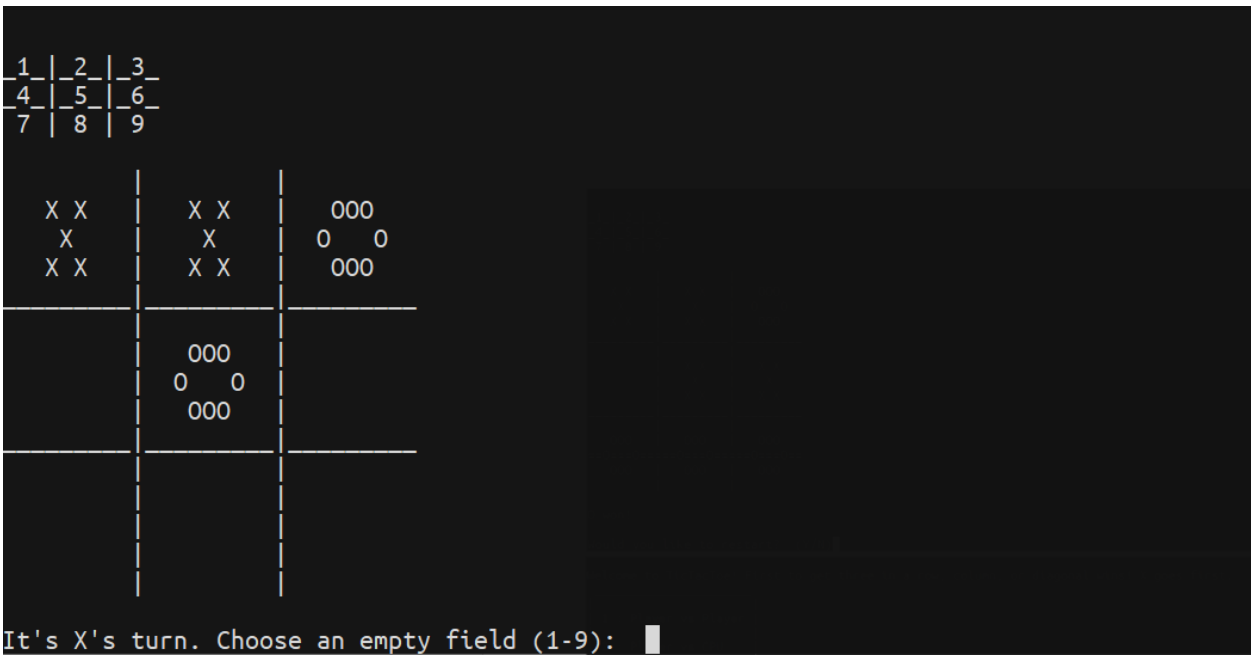

_1_|_2_|_3_
_4_|_5_|_6_
 7 | 8 | 9
X won!
Would you like to restart? (Y/N)


_1_|_2_|_3_
_4_|_5_|_6_
 7 | 8 | 9
Tie!
Would you like to restart? (Y/N)





INPUT 2



Player is X and CPU plays O (smart)