Assignment 2: iWin

Weight: 9% Topics: 1 and 2D arrays and Strings, functions using call-by-value and call-by-reference parameters

1.0 Your task (90%)

Tic-Tac-Toe is a board game that is very popular with kids. Typically, this game is played using a 3 X 3 board. Each player chooses a symbol – usually an 'X' or an 'O' and tries to be the first one to place 3 of his / her symbol in a straight line. This straight line could be horizontal (straight across a row), vertical (straight across a column), diagonal from left corner to the right corner or diagonal from right corner to the left. You may refer to Wikipedia to learn more about the game.

In this assignment, given the main and one function definition (see givenA2.c), you are asked to write several other functions that make up this game. Prototypes and description of these functions is given in the following pages. **/!** Note that an empty cell is represented by a '?' on the board. The game is played between a player and the computer. **/!\ Note that in this game (1) the player always goes first and (2) Player's symbol is 'X' and the computer's symbol is 'O'.** It is important to understand the details of each function - this will guide you in coding the others.

Important tips:

1. You may want to start by writing code for functions createInitialBoard and printCurrentBoard. These are easiest to implement. Function printCurrentBoard will help to troubleshoot the rest of the assignment.
2. Read and understand the code (main and one function definition) given in givenA2.c – they will help you get started on the assignment. All function prototypes and other required global constants are defined in givenA2.h (make sure you include it in your code).
3. Start the assignment early.

Function names, their prototypes and description:

1	int isInputValid (int entered, int minimum, int maximum) Returns 1 if entered is between minimum and maximum; 0 otherwise
2	int isBoardFull (char board [n][n]); Returns 1 if there is no empty cell in the board; 0 otherwise
3	void createInitialBoard (char board [n][n]); Creates an empty board, which is a 2D array of size n X n – each cell on the board is assigned a '?'. It also prints the board.

	? | ? | ? ---------- ? | ? | ? ---------- ? | ? | ?
4	void readUserMove (int * userRow, int * userCol, int * stepsWon); Prompts the user to input row and column values to place symbol X on the board. **/!\ Note** that your program must validate row and column values entered by the user – they must be a number between 1 and 3 (both inclusive). You may use the helper function isInputValid to validate.
5	void printCurrentBoard (char board [n][n]); Prints the current board. **/!** Note that you must use a nested loop to print the board.
6	int getComputerMove (char [n][n], int *, int *, int, int); generate a move for the computer - **Function definition given in givenA2.c**
7	int gameWon (char board [n][n], char symbol); Returns 1 if there is a winner. This function is explained further on page on pages 3 and 4.
8	int computerPlaysToWin (char board [n][n], int * cRow, int * cCol); Returns 1 if the computer wins in this step. This function is explained further on pages 3 and 4.
9	void computerPlaysRandom (int * cRow, int * cCol); Sets the computer's move (position on the board for symbol 'O' in terms of row and column number).
10	void sumAllDimensions (char board [n][n], int sumR[n], int sumC[n], int * sumLD, int * sumRD); This is a utility function that can be used by other functions. It computes the sum of scores across all rows, columns, left diagonal and right diagonal.
11	int memberOf (int aNum, int someArray [n]); Returns 1 if a value exists in the given array. For example, if someArray has the following values [10,20,30], then memberOf (30, someArray) returns 1 but memberOf (3, someArray) returns 0.

/!\ Note that you may or may not use some of these functions in your code. But we will have test cases for them. So you must include their function definitions even if you plan to not use it in your code.

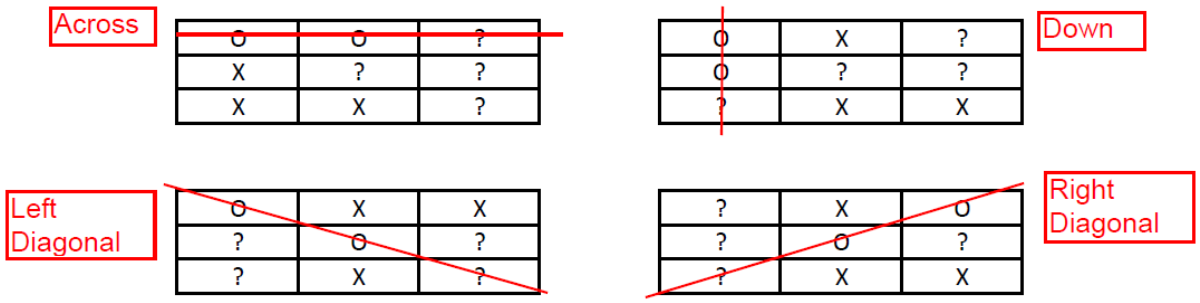
Details on some functions

/!\ Note that in this game, when it is the computer's turn to play, it first plays to win (Function computerPlaysToWin). If the computer cannot win, then it plays a random move (Function computerPlaysRandom). These two functions are explained below. Details on function gameWon is also given.

1. **Details on Function computerPlaysToWin**

   int computerPlaysToWin (char board[N][N], int * cRow, int * cCol);

In order to win, it checks whether the board has 2 'O' in any of the rows, columns or the diagonals. Some example scenarios below leads the computer to win:



One possible way of accomplishing this is discussed next:

a. assign a score of 4 to symbol 'O' on the board and 1 to symbol 'X'

b. If the total score for symbol 'O' in any of the rows or columns or diagonals is 8 (implying that 2 cells in that row / column / diagonal have symbol 'O'), then
   If the third cell in that row /column / diagonal is unoccupied (i.e. it has a '?'), then

   - the third unoccupied cell is assigned 'O'
   - computer wins and game ends

2. **Details on computerPlaysRandom**

   If the computer cannot win, then it plays a random move (Function computerPlaysRandom)

   void computerPlaysRandom (int * , int *);

   - It randomly picks a row and column for a cell. If the cell it picks is occupied (by 'O' or 'X'), then it must repeat the process until it finds an empty cell (indicated by a '?').

3. **Details on Function gameWon:**

int gameWon(char board[n][n], char symbol);

This function is called every time a user or a computer makes a move to check if there is a winner. The winning rule is similar to the one described in function computerPlaysToWin. Computer wins if the total score in any row / column / diagonal of the board is 12 (implying a count of 3 'O's in any single row or column or diagonal). Similarly, player wins if the total score in any row / column / diagonal of the board is 3 (implying a count of 3 'X's in any single row or column or diagonal).

2.0 Additional Functionality (10%)

For this part, you have to write the function for a situation where computer plays to block the player's next winning move.

int computerPlaysToBlock (char board[N][N], int * cRow, int * cCol); Returns 1 if the computer successfully blocks the players next winning move. Returns a 0 if it doesn't block.

In order to block the user's move, it checks whether the board has 2 'X' in any of the rows, columns or the diagonals. Use a strategy similar to computerPlaysToWin. The function returns a 0 if it doesn't block.

So, If the total score for symbol 'X' in any of the rows or columns or diagonals is 2 (implying that 2 cells in that row / column / diagonal have symbol 'X'), then

If the third cell in that row /column / diagonal is unoccupied (i.e. it has a '?'), then the third unoccupied cell is assigned 'O'.

Function getComputerMove given to you has a commented part that you may use to test this function. You must uncomment that section if you wish to attempt this function.

3.0 Sample Scenario:

/!\ Note that

- line numbers are given only for convenience – you DO NOT have to display them.
- this sample does not include the additional functionality.

```
Player's symbol: X
Computer's symbol: O

Here is the initial board - spaces are indicated by a ?
? | ? | ?
----------
? | ? | ?
----------
? | ? | ?

Your move - enter numbers between 1 and 3

Enter row number: 2
Enter column number: 2

You chose row 2 and column 2

Computer chose row 1 and column 3

Current board now is:

? | ? | O
----------
? | X | ?
----------
? | ? | ?
```

Continued on next page

```
27
28  Your move - enter numbers between 1 and 3
29
30  Enter row number: 1
31  Enter column number: 2
32
33  You chose row 1 and column 2
34
35  Computer chose row 1 and column 1
36
37  Current board now is:
38
39  O | X | O
40  ----------
41  ? | X | ?
42  ----------
43  ? | ? | ?
44
45  Your move - enter numbers between 1 and 3
46
47  Enter row number: 3
48  Enter column number: 2
49
50  You chose row 3 and column 2
51
52  Congrats - you won against the computer :)
53
54  Current board now is:
55
56  O | X | O
57  ----------
58  ? | X | ?
59  ----------
60  ? | X | ?
```

4.0 Submission Instructions

- Submit a single C file containing your function definitions only. Make sure that you include "givenA2.h" in your code. DO NOT submit main. To submit, upload your C file to the submission box for A2 on moodle. Name your file as lastnameFirstnameA2.c (For example, if Ritu is the first name and Chaturvedi is the last name, the file would be called chaturvediRituA2.c). Incorrect file name will result in 10% penalty.
- Incorrect format of submitted files will result in automatic zero. (Must be a valid .c file)
- The program you submit must compile with no warnings and run successfully for full marks. You get a zero if your program doesn't compile. There is also a penalty for warnings (5% for each unique warning).
- Penalties will occur for missing style, comments, header comments etc.

- DO NOT use global variables. Use of any global variables will result in automatic zero.
- DO NOT use goto statements. Use of any goto statements will result in automatic zero.
- Use the template given below for header comment.
  /!\ Note: The file name, student name and email ID must be changed per student.

```
/************************lastnameFirstnameA2.c**************

   Student Name: Ritu Chaturvedi     Email Id: ritu
   Due Date: November 11th           Course Name: CIS 1300
   I have exclusive control over this submission via my password.
   By including this statement in this header comment, I certify that:

   1) I have read and understood the University policy on academic
   integrity;

   2) I have completed the Computing with Integrity Tutorial on Moodle; and

   3) I have achieved at least 80% in the Computing with Integrity Self
   Test.

   I assert that this work is my own. I have appropriately acknowledged any
   and all material that I have used, whether directly quoted or
   paraphrased. Furthermore, I certify that this assignment was prepared by
   me specifically for this course.

 ************************************************************/
```

- The program file must contain instructions for the TA on how to compile and run your program in a header comment.

  /!\ Note: The file name must be changed per student.

```
/*********************************************************
   Compiling the program
   The program should be compiled using the following flags: -std=c99 -Wall

   compiling:
   gcc givenA2.c lastnameFirstnameA2.c -std=c99 -Wall

   OR
   gcc lgivenA2.c astnameFirstnameA2.c -std=c99 -Wall -o assn2

   Running the Program
   Running: ./a.out

    OR
    Running: ./assn2
 *********************************************************/
```