

Programming Assignment #4: Class TicTacToe

Background:

Tic Tac Toe is a simple game where two players take turns putting Xs and Os on a 3x3 grid. The first person to form 3 of their symbols in a row (horizontally, vertically, or diagonally) wins the game. If all 9 squares have been filled and there is no winner, the game is a draw and is designated CAT (a cat's game or the cat wins).

For a more detailed explanation, many sources are available online, including Wikipedia:

<http://en.wikipedia.org/wiki/Tic-tac-toe>

Example: Consider the following sequence of moves for three games of Tic Tac Toe shown below:

Game 1	<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td> </td><td> </td></tr><tr><td> </td><td>O</td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr></table>					O					<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td> </td><td> </td></tr><tr><td>X</td><td>O</td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr></table>				X	O					<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td> </td><td> </td></tr><tr><td>X</td><td>O</td><td> </td></tr><tr><td>O</td><td> </td><td> </td></tr></table>				X	O		O			<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td> </td><td>X</td></tr><tr><td>X</td><td>O</td><td> </td></tr><tr><td>O</td><td> </td><td> </td></tr></table>			X	X	O		O			<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td> </td><td>X</td></tr><tr><td>X</td><td>O</td><td> </td></tr><tr><td>O</td><td>O</td><td> </td></tr></table>			X	X	O		O	O		<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td> </td><td>X</td></tr><tr><td>X</td><td>O</td><td> </td></tr><tr><td>O</td><td>O</td><td>X</td></tr></table>			X	X	O		O	O	X	<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td style="background-color: yellow;">O</td><td>X</td></tr><tr><td>X</td><td style="background-color: yellow;">O</td><td> </td></tr><tr><td>O</td><td style="background-color: yellow;">O</td><td>X</td></tr></table>		O	X	X	O		O	O	X	O Wins!																				
	O																																																																																										
X	O																																																																																										
X	O																																																																																										
O																																																																																											
		X																																																																																									
X	O																																																																																										
O																																																																																											
		X																																																																																									
X	O																																																																																										
O	O																																																																																										
		X																																																																																									
X	O																																																																																										
O	O	X																																																																																									
	O	X																																																																																									
X	O																																																																																										
O	O	X																																																																																									
Game 2	<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td> </td><td> </td></tr><tr><td> </td><td>X</td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr></table>					X					<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td>O</td><td> </td></tr><tr><td> </td><td>X</td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr></table>		O			X					<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td>O</td><td> </td></tr><tr><td> </td><td>X</td><td> </td></tr><tr><td>X</td><td> </td><td> </td></tr></table>		O			X		X			<table border="1" style="width: 30px; height: 30px;"><tr><td>O</td><td>O</td><td> </td></tr><tr><td> </td><td>X</td><td> </td></tr><tr><td>X</td><td> </td><td> </td></tr></table>	O	O			X		X			<table border="1" style="width: 30px; height: 30px;"><tr><td style="background-color: yellow;">O</td><td style="background-color: yellow;">O</td><td style="background-color: yellow;">X</td></tr><tr><td> </td><td style="background-color: yellow;">X</td><td> </td></tr><tr><td style="background-color: yellow;">X</td><td> </td><td> </td></tr></table>	O	O	X		X		X			X Wins!																																								
	X																																																																																										
	O																																																																																										
	X																																																																																										
	O																																																																																										
	X																																																																																										
X																																																																																											
O	O																																																																																										
	X																																																																																										
X																																																																																											
O	O	X																																																																																									
	X																																																																																										
X																																																																																											
Game 3	<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td>X</td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr></table>		X								<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td>X</td><td> </td></tr><tr><td> </td><td>O</td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr></table>		X			O					<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td>X</td><td> </td></tr><tr><td>X</td><td>O</td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr></table>		X		X	O					<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td>X</td><td>O</td></tr><tr><td>X</td><td>O</td><td> </td></tr><tr><td> </td><td> </td><td> </td></tr></table>		X	O	X	O					<table border="1" style="width: 30px; height: 30px;"><tr><td> </td><td>X</td><td>O</td></tr><tr><td>X</td><td>O</td><td> </td></tr><tr><td>X</td><td> </td><td> </td></tr></table>		X	O	X	O		X			<table border="1" style="width: 30px; height: 30px;"><tr><td>O</td><td>X</td><td>O</td></tr><tr><td>X</td><td>O</td><td> </td></tr><tr><td>X</td><td> </td><td> </td></tr></table>	O	X	O	X	O		X			<table border="1" style="width: 30px; height: 30px;"><tr><td>O</td><td>X</td><td>O</td></tr><tr><td>X</td><td>O</td><td> </td></tr><tr><td>X</td><td> </td><td>X</td></tr></table>	O	X	O	X	O		X		X	<table border="1" style="width: 30px; height: 30px;"><tr><td>O</td><td>X</td><td>O</td></tr><tr><td>X</td><td>O</td><td> </td></tr><tr><td>X</td><td>O</td><td>X</td></tr></table>	O	X	O	X	O		X	O	X	<table border="1" style="width: 30px; height: 30px;"><tr><td>O</td><td>X</td><td>O</td></tr><tr><td>X</td><td>O</td><td>X</td></tr><tr><td>X</td><td>O</td><td>X</td></tr></table>	O	X	O	X	O	X	X	O	X	CAT (draw)
	X																																																																																										
	X																																																																																										
	O																																																																																										
	X																																																																																										
X	O																																																																																										
	X	O																																																																																									
X	O																																																																																										
	X	O																																																																																									
X	O																																																																																										
X																																																																																											
O	X	O																																																																																									
X	O																																																																																										
X																																																																																											
O	X	O																																																																																									
X	O																																																																																										
X		X																																																																																									
O	X	O																																																																																									
X	O																																																																																										
X	O	X																																																																																									
O	X	O																																																																																									
X	O	X																																																																																									
X	O	X																																																																																									

Background and online resources

This assignment is a modification of problem 8.20 in Introduction to Programming with C++, 3E, by Liang. Problem 8.20 uses an array to solve a Tic Tac Toe game. This assignment extends this idea to creating a class for the game.

Online resources for C++ are extensive and you can probably find examples that use a class to solve a Tic Tac Toe game. However, programming assignments must be your own work. Just as you cannot give help to another student or receive help from another person, you cannot copy code that you find online. Copying code found online is cheating and will result in a grade of 0 on the assignment. The instructor will do an extensive search for online examples and will be looking for similarities.

Most programming assignments offer opportunities for creativity. This assignment will limit creativity to some extent by specifying that a particular *class diagram* be used. This will also have the benefit of guiding you through the assignment to some extent.

Program Description

Write a C++ program that will allow two players (sharing the same keyboard) to play Tic Tac Toe.

The program must satisfy the following requirements:

- 1) Creating a class: The program should define **class TicTacToe** according to the following class diagram. Use the data members indicated and member functions indicated. Additional data members and member functions can be added if you wish, but may not be necessary.

Class TicTacToe	
<u>Member Data:</u> - Size = 3: static const int - Board: char [Size][Size] - Player: string [2] - rowMove: int - colMove: int	Size of the matrix Matrix for the game board Array of player names Row position for current move Column position for current move
<u>Member Functions:</u> + TicTacToe(); + First_Player(): int + Enter_Player_Name(N: int): void + Display_Player_Name(N: int): void + Make_Move(N int): void + Valid_Move(): int + Display_Board(N: int): void + Set_Value(N: int): void + Game_Over(N: int): int	Constructor – Create object and initialize Board with all null char Indicates which player goes first Enter player N Display name of player N Prompt player N to enter desired row and column Test to see if move is valid Display board after N turns Add X or O to the board for player N Test to see if game is over

- 2) Main program: The main program should make one game object and make use of member functions to complete the game.
- 3) Program specifications:
 - Prompt each user to enter their name
 - Prompt the user to indicate which player goes first
 - Display the game board after every move along with the number of moves that have been made. Indicate which player uses X and which player uses O.
 - Add Xs and Os to the board as players make their moves.
 - Prompt each user to enter the row & column number for their move. If the space is already occupied or if the row or column number is out of range, display an error message and allow the user to re-enter the values.
 - Test to see if the game has been completed. When it has been completed either display a message indicating who has won the game or display CAT to indicate that the game was a draw.
 - Use separate implementation and header files for the class.
 - Correct for errors in all inputs.
 - Give the user the option of playing another game.
 - The program should be user-friendly.
- 4) Test Cases: Run test cases as follows:
 - Player 0 wins with a horizontal tic tac toe.
 - Player 1 wins with a vertical tic tac toe.
 - Player 0 wins with a diagonal tic tac toe.
 - The game is a draw and CAT is displayed.
- 5) Output Format: The output might look somewhat like the example shown on the following page.

Example: Sample output for a game of Tic Tac Toe (formatting may vary). This example matches Game1 shown earlier.

```
Enter name for Player #0: John
Enter name for Player #1: Jane
Which player goes first?
Enter 0 for John or 1 for Jane: 0
OK. John goes first.
John will use O and Jane will use X

Board status after 0 turn(s):
John uses O and Jane uses X
-----
|   |   |   |
-----
|   |   |   |
-----
|   |   |   |
-----

John make your selection.
Enter the row (0-2) and column number (0-2): 1 1

Board status after 1 turn(s):
John uses O and Jane uses X
-----
|   |   |   |
-----
|   | O |   |
-----
|   |   |   |
-----

Jane make your selection.
Enter the row (0-2) and column number (0-2): 1 0
.
.
.

John make your selection.
Enter the row (0-2) and column number (0-2): 0 1

Board status after 7 turn(s):
John uses O and Jane uses X
-----
|   | O | X |
-----
| X | O |   |
-----
| O | O | X |
-----

Game over. John wins!
```

Extra credit:

A maximum of 10 points of extra credit may be earned by adding extra features to your assignment as follows:

- 1) (10 points) Give the user the choice of:
 - A) Two-player game as described above.
 - B) One-player game where the player plays against the computer. In this option let the computer be an unintelligent player that makes moves at random. Use random number functions in C++ to make the computer's moves.
- 2) (10 points) Give the user the choice of:
 - A) Playing on a 3x3 board as described above.
 - B) Playing on a 4x4 board. You can either modify the class used for the 3x3 board or use a separate class for the 4x4 board.
- 3) (Number of points varies) Use your imagination!

For any of the extra credit options, include suitable test runs.

Report Format

Use the same format for the report and the same rules for submission as with previous programming projects.