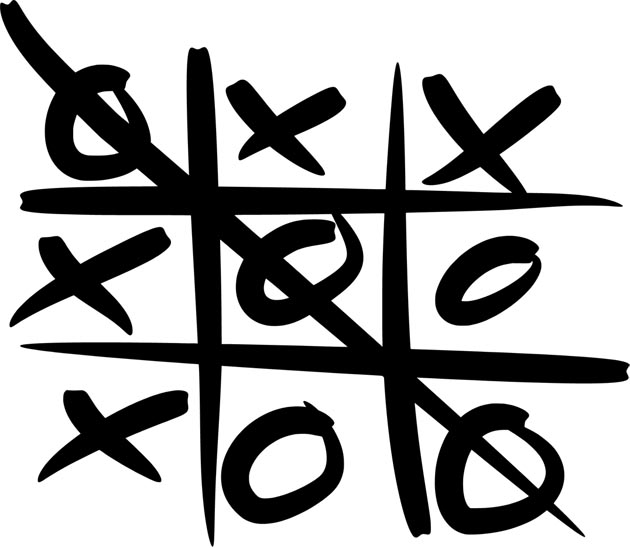
**PROJECT 2**

TIC TAC TOE



1See References

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CSC 5 – 46023

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**INTRODUCTION**

Tic-Tac-Toe is a game in which two players, represented as either X or O, mark a 3 x 3 grid until one player wins. The objective of the game is to mark 3 spaces that are horizontally, vertically, or diagonally adjacent to one another before the other player does.

**Rules –**

* Each player will take turns marking the grid. No player will mark the grid more than once at a time.
* You must only mark the empty spaces in the grid.
* Many times you will find that neither player wins. This game is considered a draw, or a cat’s game.

**Instructions –**

* The program will randomly decide which player (‘X’ or ‘O’) will play first
* Each space in the 3 x 3 grid will be represented by a number. Please select the numbered space in which you would like to place your mark. Your mark will be placed on the grid after each time you input.
* The game will continue to run until 1) one person wins, or 2) all spaces are occupied and no one wins.
* If you wish to see your total scores, see the text file names "scores"
* Enjoy the game!

**DESIGN DETAILS**

**Approach -**

In order to successfully code Tic-Tac-Toe, I first played a game and broke the game down in small steps in order to fully understand the sub components of the game and to ultimately implement them in a code. Below are the steps I initially drafted:

1. Draw and output a 3x3 board.
2. Designate each player as either 'X' or 'O'
3. Allow users to take turns and to mark the board with their respective marks.
4. Conditions for the game to end
5. Ways which players can win
6. Keeping scores and outputting them so user can see

**Overview -**

At the end of my project, I had developed a game that had encompassed all of the steps that I had originally thought of. (Step 1) My program outputs a board each time a player makes a move. The board I created consists of a set of variables that represents each space. An example of my board is below:

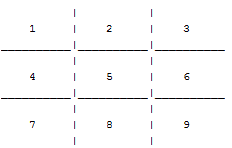


Figure 1. My tic-tac-toe board. In order to make a move, each player is required to input the number where he or she wants to place his or her mark.

If the space is already taken up, the program prompts the user to input another number. (Step 2) My program also designates Player 1 as 'X' and Player 2 as 'O' and randomly chooses which player will be able to play first. Then, the program switches between each player from one move to the next. (Step 3) When the player chooses a number to place his mark, the number in the grid will be substituted with the mark. An example is shown below:

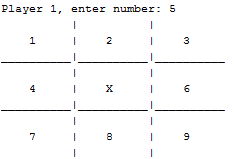


Figure 2. When player 1 (X) chooses number 5, that specific space is then replaced with player 1's mark.

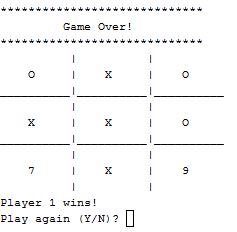
(Step 4) Of course, when playing any game there are conditions to signal the end of the game. The game can end in nine different ways. Three ways the game can is if there are the same marks adjacent to one another in each of the three horizontal rows of the board (e.g. spaces 1, 2, and 3). Another three ways the game can end is the same as the aforementioned condition, but it applies to each of the three vertical columns. Two ways that will end the game is if the same marks are adjacent to one another diagonally. The last way the game can end is if all the spaces are taken up. In this case, neither player wins and the game is considered a draw. Below shows an example of an output to signal the end of the game. Also note that I prompt the user to decide whether he or she wants to play again.

Figure 3. Player 1 wins because he/she placed 3 marks adjacent to one another vertically before the other player could. The program also asks the user if he or she wants to play again.

C:\Users\user\Desktop\Capture.PNG(Step 5) As you can see in *figure 3*, the program is able to determine who wins. The condition that determines who wins is which player is able to end the game first. (Step 6) When each game ends, the scores for each player are subsequently added depending on which player wins. Scores are tallied and output on a text file titled "scores." Below is a sample of a the text file:

Figure 4. Player 1 has one win while Player 2 has none.

The details of my program will be further discussed throughout my report.

**RESEARCH**

In order to code my game, I had to research and study the following topics that I found difficult to understand:

1. **Arrays -**

I used arrays so I could hold the variables that would represent each space on the board. When the user inputs where they want their mark, that variable in the array would be replaced with the user's respective mark. I mostly used arrays in order to hold a lot of variables on my tic-tac-toe board; this made it very easy for me to reassign each space with a mark throughout the game. Initially, I had used a one dimensional array to hold my variables. In order to encompass my understanding of 2D arrays into the project, I converted my array from a 1D to a 2D array, with 3 columns and 3 rows.

1. **Functions** -

Without functions, my code would have been unnecessarily long. I would have to repeat my code to output a grid every time a player makes a move. The same applies for determining the winner or whether the game is over. Instead of repeating the same lines of code over and over again, declaring a function and defining them would be much easier. Instead of repeating lines of code, I could call functions that would perform these codes. It greatly simplified the layout of my code and made it much easier to read and understand. I have separate functions for printing out the grid, determining whether the game is over, determining the winner, and outputting the right marks on each space.

**3. Bubble Sort -**

I had a really hard time thinking of a way to incorporate sorting into my project. Finally, I decided to sort all the elements in my board array after the game was over. When sorted, the grid should do a little dance and sort itself out. When done sorting, it should display the remaining numbers in ascending order, then the O's and then the X's, since the ASCII code for capital O is less in value than X.

**FLOWCHART**

My flowchart was too large to place in my report, so please refer either to the JPEG files in my GitHub account, or the JPEG files titled "Project 2 Part 1" and "Project 2 Part 2" located in my Project 2 folder.

**VARIABLE LIST**

|  |  |
| --- | --- |
| **Variables & System Libraries** | **Purpose** |
| #include <iostream> | Used for cout and cin |
| #include <ctime> | Necessary for setting random seed |
| #include <cstdlib> | Generating random number |
| #include <fstream> | File output |
| const int ROW=3 | Number of rows in grid |
| const int COL=3 | Number of columns in grid |
| char grid[ROW][COL] | 2D array used to hold variables for spaces on the tic tac toe board.  Has 3 columns and 3 rows |
| bool p1 | Decides who's turn it is and which player is which mark |
| unsigned short score1=0 | Used to count score for player 1 |
| unsigned short score2=0 | Count score for player 2 |
| char again | Option that allows user to play game again. |
| bool over | Determine whether the game is over |
| Unsigned short choice | Where user wants to place his or her mark. Also used to allows user to choose from menu |
| Short win | Determine which player wins. |
| Int i, j | These variables were used to loop through the 2d array various times throughout my code |
| Int num | I used this number to print out numbers when I reset my board after each game |
| Char x, y, temp | Used to swap values during bubble sort |
| Char ch, row, column | Used to take user's choice, then converts to coordinates on the board |

**FUNCTION LIST**

|  |  |
| --- | --- |
| **Function** | **Purpose** |
| void **welcome**() | Displays welcome message and randomly chooses who plays first |
| void **displayGrid**(char[][COL],const int) | Prints out Tic-Tac-Toe board |
| void **takeTurn**(char[][COL],const int,bool) | Places mark on board, determines who's turn it is |
| bool **gameOver**(char[][COL],const int) | Checks conditions to determine if game is over |
| short **winner**(char[][COL],const int) | Determines winner |
| void **menu**() | Displays menu before game starts |
| void **reset** (char[][COL],const int) | Resets board after game |
| void **file** (int,const int) | Outputs scores to file |
| void **sort**(char[][COL],const int) | Sorts board after each game |
| void **swap**(char&,char&) | Swaps values for sort |
| void **stall**() | Stalls program so we can see board sorting itself out |
| void **conversion**(char,int&,int&) | Converts user's number choice to coordinate to place mark |

**TOPICS COVERED**

|  |  |
| --- | --- |
| **Topic** | **Examples** |
| Primitive Data Types | ***Boolean*** (Line 40)  ***Char*** (Line 44)  ***Int*** (Line 60)  ***Short*** (Line 41)  \*I did not use floats, I couldn't think of a way to incorporate a necessary float into my program. |
| System Level Libraries | ***Iostream***  ***Cstdlib***  ***Ctime***  ***Fstream*** |
| Operators | Lines 207-232  105  (&&, ||, ==, ++,etc) |
| Conditionals | ***Do While*** (Line 69-82)  ***If else*** (Line 77)  ***Switch*** (Line 395)  ***For*** (Line 245) |
| Menu | Line 289 |
| 2D Arrays | Line 39 |
| Functions | Line 21 |
| Bubble Sorting | 363 |
| Reading and Writing to a file | Reading from file (Line 57)  Writing to file (Line 339) |
| Generating Random Number | Lines 155, 158 |

**PSUEDOCODE**

/\*

2 \* File: main.cpp

3 \* Author: Anh Vu

4 \*

5 \* Created on July 29, 2014, 3:36 PM

6 \*/

7

8 //System Level Libraries

9

10 //User Libraries

11

12 //Global Constants

13

14 //Function Prototypes

15

16 //Execution Begins Here:

17 //Declare and Initialize Variables

18

19 //Display Menu

20

21 //Welcome Message

22

23 //Initialize board

24 //open file

25 //Input data from file to board while i is less than 3

26 //Close file

27

28 //Do this while user decides to play again

29 //While game is not over

30 //Display Grid

31 //User takes turn

32 //Switches between players 1 & 2

33

34

35 //If game is over, output message

36 //Display final board that ends game

37 //Displays winner

38 //Keep track of scores

39 //Add scores for player 1 if player 1 wins

40 //Add scores for player 2 if player 2 wins

41 //Don't add any scores for either players if game is a draw

42 //Output scores to file

43 //Ask if player wants to play again

44 //Sorts grid and prints out dance before board resets

45 //Reset board so user can play again

46

47 //End of main

48

49 //Function to display grid

50 //display board and variables

51

52 //Displays welcome message as well as randomly chooses who plays first

53 //Welcome player and output which player is what mark

54 //Set random seed

55 //Determine who will go first - generate random number from 1 to 2

56 //Set this value to a bool

57

58 //If bool is true

59 //Player 1 gets to play first

60 //It not true, player 2 gets to play first

61

62 //Places mark on board

63 //While number is from 1-9

64 //Get number from user

65 //Convert this number to coordinates on board

66

67 //Player 1

68 //Output an X

69 //Player 2

70 //Output an O

71

72 //Switch between player 1 and 2

73

74 //Determines whether game is over

75 //As long as integer i is less than 3, keep repeating

76 //If there are the same marks adjacent to each other horizontally,

77 //diagonally, or vertically, then the game is over

78 //Game will also end if all spots are taken up

79

80

81 //Determines winner

82 //If there are X's vertically, horizontally, or diagonally adjacent, then

83 //player 1 wins

84 //If there are X's vertically, horizontally, or diagonally adjacent, then

85 //player 2 wins

86 //If spots are all taken up and there are no marks next to one another,

87 //then no one wins

88

89 //Menu

90 //Show user options

91 //If they choose 1, play game

92 //If they choose 2, display rules then play game

93

94 //Resets board

95 //Set each coordinate equal to a number in increasing order from 1 to 9

96

97

98 //Reads scores to file

99 //Open file

100 //Output scores to file

101 //Compares scores between player 1 and player 2

102 //If player 1's scores is less than player 2's scores, then

103 //tell player 1 to step up their game

104 //If player 2's scores is less than player 1's scores, then

105 //tell player 2 to step up their game

106 //If scores are equal, tell them they are tied

107 //Close file

108

109 //Sorts grid out after game is over

110 //Go through each element of array, compare each value to each other

111 //If value 1 is greater than value 2, then swap values

112 //Display grid after sorting

113 //Stall printing of grid

114

115 //Used to swap values in bubble sort

116 //switch one value with another using a temporary variable

117

118 //Stalls printing of the graph each time it sorts itself

119 //count numbers from 0 to 100000000 times

120

121

122

123 //Converts user's choice to coordinates on grid

124 //if the user chooses 1

125 //set coordinates

126 //if the user chooses 2

127 //set coordinates

128 //if the user chooses 3

129 //set coordinates

130 //if the user chooses 4

131 //set coordinates

132 //if the user chooses 5

133 //set coordinates

134 //if the user chooses 6

135 //set coordinates

136 //if the user chooses 7

137 //set coordinates

138 //if the user chooses 8

139 //set coordinates

140 //if the user chooses 9

141 //set coordinates

142

**CODE**

1 /\*

2 \* File: main.cpp

3 \* Author: Anh Vu

4 \* Project 2

5 \* Created on July 25, 2014, 10:17 PM

6 \*/

7

8 //System Level Libraries

9 #include <iostream>

10 #include <ctime>

11 #include <cstdlib>

12 #include <fstream>

13 using namespace std;

14

15 //User Libraries

16

17 //Global Constants

18 const int COL=3; //Size of columns of grid

19

20 //Function Prototypes

21 void **welcome**();

22 void **displayGrid**(char[][COL],const int); //Displays Tic-Tac-Toe board

23 void **takeTurn**(char[][COL],const int,bool); //Places appropriate mark on board

24 bool **gameOver**(char[][COL],const int); //Determines whether or not game is over

25 short **winner**(char[][COL],const int); //Determines winner

26 void **menu**(); //Displays menu

27 void **reset** (char[][COL],const int); //Resets board

28 void **file** (int,const int); //Outputs scores to file

29 void **sort**(char[][COL],const int); //Sorts board

30 void **swap**(char&,char&); //Swap values used for sort

31 void **stall**(); //Stalls program so it can print out sorts slower

32 void **conversion**(char,int&,int&); //Converts user's choice to coordinates

33

34

35 //Execution Begins Here:

36 int **main**(int argc, char\*\* argv) {

37 //Declare and Initialize Variables

38 const int ROW=3; //Size of rows

39 char grid[ROW][COL]; //Array used to print grid

40 bool p1; //Used to determine who's turn it is

41 short win; //Used to determining winner

42 unsigned short score1=0; //Calculate score for player 1

43 unsigned short score2=0; //Calculate score for player 2

44 char again; //Whether players want to play again

45 bool over; //Determines if game is over

46 bool first; //Used to switch between players

47

48 //Display Menu

49 menu();

50

51 //Welcome Message

52 welcome();

53

54 //Initialize board

55 //Open and input data from file

56 ifstream board;

57 board.open(**"**board.txt**"**);

58

59 //Read Data into array

60 for (int i=0; i<ROW; i++){

61 for (int j=0; j<COL; j++)

62 board>>grid[i][j];

63 }

64

65 //Close file

66 board.close();

67

68 //Reiterates game until players decide to stop

69 do{

70 //Game continues until it is over

71 do{

72 //Display Grid

73 displayGrid(grid,ROW);

74 //User takes turn

75 takeTurn(grid,ROW,first);

76 //Switches between players 1 & 2

77 if(first){

78 first=false;

79 }else{

80 first=true;

81 }

82 }while(!gameOver(grid, ROW));

83

84 //Determines if game is over & outputs game over message

85 gameOver(grid, ROW);

86 if (over=true){

87 cout<<**"\n**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***\n"**;

88 cout<<**"** Game Over! **\n"**;

89 cout<<**"**\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\***\n"**;

90 }

91

92 //Display final board that ends game

93 displayGrid(grid, ROW);

94

95 //Displays winner

96 win = winner(grid,ROW);

97

98 //Keep track of scores

99 //win=1, player 1 wins

100 //win=0, player 2 wins

101 //win=-1; no one wins

102 if (win==1){

103 score1++;

104 }else if (win==0){

105 score2++;

106 }else if (win==-1){

107 score1+=0;

108 score2+=0;

109 }

110

111 //Output scores to file

112 file (score1,score2);

113

114 //Ask if player wants to play again

115 cout<<**"**Play again (Y/N)? **"**;

116 cin>>again;

117

118 //Sorts grid and prints out dance before board resets

119 sort(grid,ROW);

120

121 //Reset board so user can play again

122 reset(grid, ROW);

123 }while((again=='Y')||(again=='y'));

124

125 //Exit Stage Right!

126 return 0;

127 }

128

129 //Function displays grid

130 void **displayGrid**(char grid[][COL], const int ROW){

131 //Board with variables at designated positions

132 cout<<**"** | | **"**<<endl;

133 cout<<**"** **"**<<grid[0][0]<<**"** | **"**<<grid[0][1]<<**"** | **"**;

134 cout<<grid[0][2]<<endl;

135 cout<<**"** \_\_\_\_\_\_\_\_\_\_|\_\_\_\_\_\_\_\_\_\_|\_\_\_\_\_\_\_\_\_\_**"**<<endl;

136 cout<<**"** | | **"**<<endl;

137 cout<<**"** **"**<<grid[1][0]<<**"** | **"**<<grid[1][1]<<**"** | **"**;

138 cout<<grid[1][2]<<endl;

139 cout<<**"** \_\_\_\_\_\_\_\_\_\_|\_\_\_\_\_\_\_\_\_\_|\_\_\_\_\_\_\_\_\_\_**"**<<endl;

140 cout<<**"** | | **"**<<endl;

141 cout<<**"** **"**<<grid[2][0]<<**"** | **"**<<grid[2][1]<<**"** | **"**;

142 cout<<grid[2][2]<<endl;

143 cout<<**"** | | **"**<<endl;

144 }

145

146 //Displays welcome message as well as randomly chooses who plays first

147 void **welcome**(){

148 //Welcome player and output which player is what mark

149 cout<<**"**Welcome to Tic-Tac-Toe! First player will be randomly chosen.**"**;

150 cout<<**"** May the best man win!**"**<<endl;

151 cout<<**"**Player 1= X**"**<<endl;

152 cout<<**"**Player 2= O**"**<<endl<<endl;

153

154 //Set random seed

155 srand(static\_cast<unsigned int>(time(0)));

156

157 //Determine who will go first

158 bool first=rand()%2;

159

160 //Output who will go first

161 if(first){

162 cout<<**"**Congratulations Player 1, you get to play first!**"**;

163 cout<<endl<<endl;

164 }else{

165 cout<<**"**Congratulations Player 2, you get to play first!**"**;

166 cout<<endl<<endl;

167 }

168 }

169

170 //Places mark on board

171 void **takeTurn**(char grid[][COL], const int ROW, bool p1){

172 //Declare Variables

173 char ch; //User's choice

174 int row; //Row coordinate

175 int column; //Column coordinate

176

177 //Gather Data Input

178 //Takes user's choices as long as it's valid

179 do{

180 if(p1){

181 cout<<**"**PLAYER 1'S TURN**"**<<endl;

182 }else{

183 cout<<**"**PLAYER 2'S TURN**"**<<endl;

184 }

185 cout<<**"**Enter number: **"**;

186 cin>>ch;

187 //Converts user's choice to coordinate on game board

188 conversion(ch,row,column);

189 }while(row==3||column==3);

190

191 //If player one makes mark, place an X. If player 2, place O.

192 if(p1){

193 grid[row][column] = 'X';

194 }else{

195 grid[row][column] = 'O';

196 }

197 }

198

199 //Determines whether game is over

200 bool **gameOver**(char grid[][COL], const int ROW){

201 //Declare Variables

202 bool over=false;

203

204 //Game over conditions

205 //Checks for rows

206 for(int i=0; i<ROW; i++){

207 if((grid[i][0]==grid[i][1])&&(grid[i][0]==grid[i][2]))

208 over=true;

209 }

210

211 //Checks for columns

212 for (int j=0; j<COL; j++){

213 if ((grid[0][j]==grid[1][j])&&(grid[0][j]==grid[2][j]))

214 over=true;

215 }

216

217 //Checks for diagonals

218 if ((grid[0][0]==grid[1][1])&&(grid[0][0]==grid[2][2]))

219 over=true;

220 else if ((grid[0][2]==grid[1][1])&&(grid[0][2]==grid[2][0]))

221 over=true;

222

223 //Checks for a draw

224 else if (((grid[0][0]=='X')||(grid[0][0]=='O'))&&

225 ((grid[0][1]=='X')||(grid[0][1]=='O'))&&

226 ((grid[0][2]=='X')||(grid[0][2]=='O'))&&

227 ((grid[1][0]=='X')||(grid[1][0]=='O'))&&

228 ((grid[1][1]=='X')||(grid[1][1]=='O'))&&

229 ((grid[1][2]=='X')||(grid[1][2]=='O'))&&

230 ((grid[2][0]=='X')||(grid[2][0]=='O'))&&

231 ((grid[2][1]=='X')||(grid[2][1]=='O'))&&

232 ((grid[2][2]=='X')||(grid[2][2]=='O')))

233 over=true;

234

235 //Over=true, Game over

236 //Over=false, game not over

237 return over;

238 }

239 //Determines winner

240 short **winner**(char grid[][COL], const int ROW){

241 //Will be used to determine who wins

242 short win=-1;

243

244 //Loop through rows and columns to see who wins

245 for(int i=0; i<ROW; i++){

246 if ((grid[i][0]=='X')&&(grid[i][1]=='X')&&(grid[i][2]=='X')){

247 cout<<**"**Player 1 wins!**"**<<endl;

248 win=1;

249 }else if ((grid[i][0]=='O')&&(grid[i][1]=='O')&&(grid[i][2]=='O')){

250 cout<<**"**Player 2 wins!**"**<<endl;

251 win=0;

252 }else if ((grid[0][i]=='X')&&(grid[1][i]=='X')&&(grid[2][i]=='X')){

253 cout<<**"**Player 1 wins!**"**<<endl;

254 win=1;

255 }else if ((grid[1][i]=='O')&&(grid[1][i]=='O')&&(grid[2][i]=='O')){

256 cout<<**"**Player 2 wins!**"**<<endl;

257 win=0;

258 }

259 }

260

261 //Used to find wins in diagonals. Will only execute if statements above

262 //aren't true

263 if(!(win==1||win==0)){

264 if ((grid[0][0]=='X')&&(grid[1][1]=='X')&&(grid[2][2]=='X')){

265 cout<<**"**Player 1 wins!**"**<<endl;

266 win=1;

267 }else if ((grid[0][0]=='O')&&(grid[1][1]=='O')&&(grid[2][2]=='O')){

268 cout<<**"**Player 2 wins!**"**<<endl;

269 win=0;

270 }else if ((grid[0][2]=='X')&&(grid[1][1]=='X')&&(grid[2][0]=='X')){

271 cout<<**"**Player 1 wins!**"**<<endl;

272 win=1;

273 }else if ((grid[0][2]=='O')&&(grid[1][1]=='O')&&(grid[2][0]=='O')){

274 cout<<**"**Player 2 wins!**"**<<endl;

275 win=0;

276 }else{

277 cout<<**"**No one wins.**"**<<endl;

278 win=-1;

279 }

280 }

281

282 //win=1, player 1 wins

283 //win=0, player 2 wins

284 //win=-1, draw

285 return win;

286 }

287

288 //Menu

289 void **menu**(){

290 //Declare Variables

291 char choice;

292

293 //Prompt user to input choice

294 do{

295 cout<<**"**Main Menu: **"**<<endl;

296 cout<<**"**[1] Play Game**"**<<endl;

297 cout<<**"**[2] Rules**"**<<endl;

298 cin>>choice;

299 }while(choice<'1'||choice>'2');

300

301 //Output options

302 switch(choice){

303 case '1':

304 cout<<endl;

305 break;

306 case '2':

307 cout<<**"**Rules: **"**<<endl;

308 cout<<**"**1. Decide who will be Player 1 or Player 1**"**<<endl;

309 cout<<**"**2. When making your move, choose a number (1-9) to place **"**;

310 cout<<**"**your mark. **"**<<endl;

311 cout<<**"**4. If you attempt to choose a number lower than 1 or **"**;

312 cout<<**"**higher than 9 or if the space is already taken, you will**"**;

313 cout<<**"** be asked to choose another spot.**"**<<endl;

314 cout<<**"**5. Try to get all three of your marks in a row, **"**;

315 cout<<**"** column, or diagonal row before the other player does.**\n"**;

316 cout<<**"**6. After each game, choose 'Y' if you want to play again**"**;

317 cout<<**"** or 'N' if you don't. **"**<<endl;

318 cout<<**"**7. If you want to see a tally of your scores, see the **"**;

319 cout<<**"**text file entitled scores.**"**<<endl;

320 cout<<**"**8. Have fun!**"**<<endl<<endl;

321 break;

322 }

323 }

324

325 //Resets board

326 void **reset** (char grid[][COL], const int ROW){

327 int num=1;

328 for (int i=0; i<ROW; i++){

329 for (int j=0; j<COL; j++ ){

330 grid[i][j]=(num+'0');

331 num++;

332 }

333 }

334 }

335

336 //Reads scores to file

337 void **file** (int score1, int score2){

338 //Output scores to file

339 ofstream output;

340 output.open (**"**scores.txt**"**);

341 output<<**"**Player 1: **"**<<score1<<**"** wins & **"**

342 <<**"**Player 2: **"**<<score2<<**"** wins...........**"**;

343

344 //Compares scores between player 1 and player 2

345 if(score1<score2)

346 output<<**"**Player 1, you need to step up your game!**\n"**;

347 else if (score2<score1)

348 output<<**"**Player 2, you need to step up your game!**\n"**;

349 else

350 output<<**"**Player 1 and Player 2, you are tied.**\n"**;

351

352 //Close File

353 output.close ();

354

355 }

356

357 //Sorts grid out after game is over

358 void **sort**(char grid[][COL], const int ROW){

359 //Declare Variables

360 const int TOTAL = 9; //Number of elements in the board

361

362 //Loops through enter array to bubble sort elements

363 for(int i=0; i<TOTAL; i++){

364 for(int j=i+1;j<TOTAL;j++){

365 if(grid[0][i]>grid[0][j]){

366 //Swap function

367 swap(grid[0][i],grid[0][j]);

368 //Displays new grid after each sort

369 displayGrid(grid,ROW);

370 //Stalls program in between each sort

371 stall();

372 cout<<endl;

373 }

374 }

375 }

376 }

377

378 //Used to swap values in bubble sort

379 void **swap**(char& x, char& y){

380 //Declare Variables

381 char temp; //Temporary Variable

382 temp=x;

383 x=y;

384 y=temp;

385 }

386

387 //Stalls printing of the graph each time it sorts itself

388 void **stall**(){

389 for(int i=0;i<100000000;i++);

390 }

391

392 //Converts user's choice to coordinates on grid

393 void **conversion**(char ch, int &r,int &c){

394 switch(ch){

395 case '1': r=0;c=0;break;

396 case '2': r=0;c=1;break;

397 case '3': r=0;c=2;break;

398 case '4': r=1;c=0;break;

399 case '5': r=1;c=1;break;

400 case '6': r=1;c=2;break;

401 case '7': r=2;c=0;break;

402 case '8': r=2;c=1;break;

403 case '9': r=2;c=2;break;

404 default: r=3;c=3;

405 }

406 }

407

408

**REFERENCES**

1"Tic Tac Toe." [Http://kidavalanche.wordpress.com/2010/02/03/tic-tac-toe-magic-trick prediction/](Http://kidavalanche.wordpress.com/2010/02/03/tic-tac-toe-magic-trick-prediction/). N.p., n.d. Web.