Battleship
Board Game

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CIS 5 - 43518

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Project 2

http://github.com/koa2019/cis5/tree/main/project_2

Introduction

Battleship is a guessing game that dates back to the 1930s around World War I and started as a pencil and paper game. It wasn't until 1967 that Milton Bradley started to produce it as a plastic board game with pegs. It was one of the earliest board games to be turned into a computer game. It's even found its way to gaming consoles like Playstation 2, Nintendo Wii, and Xbox. The time-honored classic is still being produced and can be found as a plastic game unit, a card game, or an outer space version.

How the Board Game Works

Object of the Game

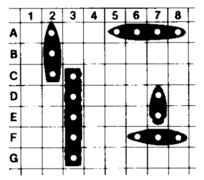
Be the first to sink all 5 of your opponent's ships.

Prepare for Battle

Battleship is a 2 player game that uses 2 game units. You and your opponent sit facing each other, with the lids of your game units raised so neither of you can see the other's grid. Secretly place your fleet of 5 ships on your ocean grid. Your opponent does the same.

Rules for placing ships:

1. Place each ship in any horizontal or vertical position, but not diagonally.
2. Do not place a ship so that any part of it overlaps letters, numbers, the edge of the grid, or another ship.
3. Do not change the position of any ship once the game has begun.

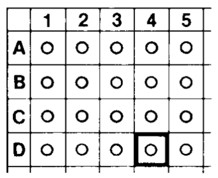


ere's an example of how t
osition your fleet correctly.

How to Battle

Decide who will go first. You and your opponent alternate turns, calling out one shot per turn to try and hit each other's ships.

On your turn, pick a target hole on your grid and call out its location by letter and number. Each target holds has a letter-number coordinate that corresponds with the same coordinate on your opponent's ocean grid, To determine each coordinate, find its corresponding letter on the left side of the grid and its number on the top of the grid.



Call "D-4" as your shot.

When you call your shot, your opponent must tell whether your shot is a hit or miss.

Winning the Game

If you're the first player to sink your opponent's entire fleet of 5 ships, you win the game!

My Approach to the Game

Translating Game Play to Rules to Programming Language

Initial questions I faced when trying to figure out how to convert this game from single data types to arrays and/or 2D arrays:

- "How do I convert the board from single variables to 2D arrays?"
- "Should I also convert the player's guesses from single randomly generated values to user input?"
- "Should players' guesses be generated with a random value each time or should I a 2D array using a single array coupled with a random function?"
- "Is there a way to mimic the different number of peg holes each ship has?"

Problems and Solutions I incurred while coding:

- Problem: mixing up which of the four 2D arrays I was comparing or displaying.
- Solution: created a print array function & called it in strategic locations

- Problem: requiring both players to have at least 3 ships in each of their randomly generated 2D arrays
- Solution: Required at least 1 player to have a minimum of 3 ships

- Problem: How and when to end the game. Max games and total games controlled version 1, and I wanted the game to play through the entire 2D arrays.
- Solution: Set max games to equal whichever player had the most hits which meant I had to compare the four 2D arrays at the beginning of the game

- Problem: Resetting the game to allow a player to play again
- Solution: Removed "Play again" feature

Similarities to the Board Game

My version of the game and the actual game are similar in a few ways. Both games require 2 players. They both utilize a grid layout with letters and numbers for the game board. Players alternate taking guesses. The winner is determined by the first player to sink all of their opponent's ships.

Differences from the Board Game

The games differ in that my version doesn't give each player a fleet of 5 vessels. My game requires at least one player to have at least 3 ships in their fleet. My board is an 8x2 grid whereas the original uses an 8x7 grid. I automatically generate each player's guess.

The Logic of it All

Pseudo
I've included the pseudo for my game. My program had over fifteen functions, so I decided to only pseudo functions that illustrated the main ideas we covered in the second half of the semester: passing single arrays and 2D arrays through functions, bubble sort, and selection sort using vectors. I've also included a zip folder of project 1 in this project's folder, so you could reference my progression.

```
Include system libraries

Declare function prototypes

Start main function

Declare constants and variables

Open file1 that contains player 1's ship locations

Open file2 that contains player 2's ship locations

Create a new file to write to

Initialize 4 different counter variables to zero.
numShp1=numShp2=count1=count2=0;

Start double for loop to run from 1 < 9.
        Read in file1 and save to character 2D array board1[row][col]
        If conditional that checks  if it equals 'S', then increase numShp1 by 1;

        Increase count1 by 1;

        Read in file2 and save to character 2D array board2[row][col]
        If conditional that checks  if it equals 'S', then increase numShp2 by 1;

        Increase count2 by 1;

Call function with a reference variable to ask for player 1's name

Call function to randonly fill p1Guess[] []  and p2Guess[][] with choices[ ]

Call function to show switch menu ( )

Call function with a pass-by-value to display the game's introduction message.

Call string function to return player 2's name that is picked randomly from an array
```

```
Display player 1 and player 2 names

Call function to pause game to let the user see who they're playing

Set flags for if p1 guessed correctly and p2 guessed correctly

Set row and col indices that control the flow of  p1Guess[][], board2[][], p2Guess[][], board1[]
[] to 1

while loop. Runs until a player correctly guesses their opponent's ship location

Call function to display round number banner


//  PLAYER 1'S TURN BEGINS HERE

Call function to  display instructions and player 1's name

Set player1Guess to first indices guessP1[row][col]

Set player2Ship to first indices board2[row][col]

Call function to show player 1's guess as a letter and number

// Compare two 2D arrays to check if player 1's guess is correct
if p1Guess equals 'S' & p2Ship equals 'S', then
        decrease player2 number of ships by 1
        Increase player 1's number of wins by 1
        Set isHit to true
        Call function to display HIT message, p1Guess and p2Ship values
        Call function to ask if they want to verify it was a hit
        Call function to validate user's answer. Function returns bool value.
        if(true), then
                Call function to display opposing 2D arrays to confirm it was a hit
                Call pause function to allow user time to view the arrays
        if (player 1's number of wins equals max games), then
                Set player 1 correct flag variable to true;

else condition for when player 1 is wrong
        Set isHit to false
        Call function to display MISS message, p1Guess, p2Ship values

//  PLAYER 2'S TURN BEGINS HERE

if conditional only runs if player 1 was wrong, then
```

```
        Call function to  display instructions and player 2's name
        Set player2Guess to first indices guessP2[row][col]
        Set player1Ship to first indices board1[row][col]
        Call function to show player 2's guess as a letter and number

        // Compare two 2D arrays to check if player 1's guess is correct
        if p2Guess equals 'S' & p1ship equals 'S', then

            decrease player1 number of ships by 1
            Increase player 2's number of wins by 1
            Set isHit to true
            Call function to display HIT message, p2Guess and p1Ship values
            Call function to ask if they want to verify it was a hit
            Call function to validate user's answer. Function returns bool value

            if(true), then
                Call function to display opposing 2D arrays to confirm it was a hit
                Call pause function to allow user time to view the arrays

            if (player 2's number of wins equals max games), then
                Set player 2 correct flag to true;

        else condition for when player 2 is wrong
            Set isHit to false
            Call function to display MISS message, p2Guess, p1Ship values

    // player 2's turn ends here

    if col index is less than or equal to 8, then
        Increment col index by 1

    if p1Correct is false & p2Correct is false, then

        if col Index is greater than 8 & row Index is than or equal to 2, then
            Increment row Index by 1.
            Reassign col Index to 1

        // make sure game ends if neither player has guessed their opponent's ship's location
          correctly
        if round is equal to or greater than 16, then
            Set p1Correct and p2Correct flags to true
        else display try again message when both players guesses are wrong

     // end of while( )

    Sum total number of games won & total number rounds played
```

Calculate average number of rounds it took to win

Call function to display both player's scores

Call pause function to allow user time to view the scores

// START SORT & SEARCH SECTION

Call main sort & search function

Write each player’s wins and number of games played to outFile

Close all files being read in and written to

return 0

// FUNCTION DEFINTIONS PSEUDO

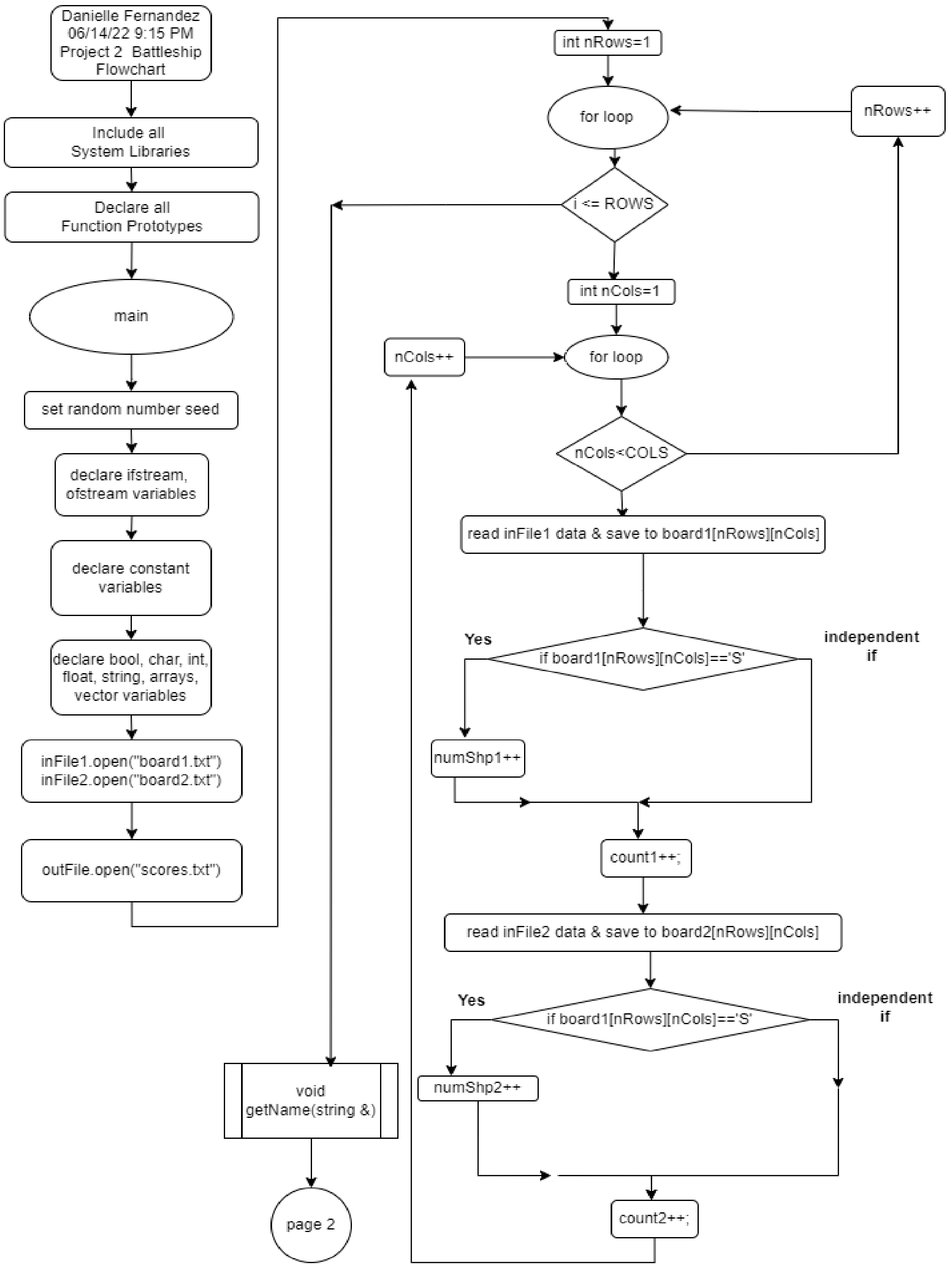
```
void fllGArr(char guessP1[ ][9],char guessP2[ ][9],char choices[ ],int ROWS,int COLS,int
&p1GShps, int &p2GShps){
     Set size for array
     Set number of ships p1 & p2 have to zero
    Declare bool.
    do
        Set bool to false
        for loop from 1 < 3
            for loop from 1 < 9
                Initialize p1Guess[ ][ ] to a random char from choices[ ]
                if p1Guess==’S’, then increment p1 ships
                    if they have 3 ships, then set bool to true
                Repeat to initialie p2Guess[ ][ ]
    while(bool is false)

int binarySrch(string [ ], string &,int){
    Set bool to false
        Declare & initialize various index values to their starting positions in array
    Call function to change string to uppercase letters
    While bool is false & searching between first and last indices
        If array[middle] equals string, then
            Set bool to true
            Set position to middle index
    else if array[middle] is bigger than string, then
            last equals middle index minus 1
    Else first equals middle index plus 1
```

```
        Return position

bool isReady(char ans){
        if..if else…else to check ans equals a 'y' or 'Y'

void sortBub(string names[ ], int size){
        Declare bool
        Declare & initialize int to last index in an array
        do
                Set bool to false
                Loop through array
                        Compare neighboring indices against each other
                        if index on left is greater than its neighbor, then
                                swap their positions in array
                                Reassign bool to true
                Drecrement int by 1
        while(bool is true)
        Sort names in alphabetically order

void sortSel(vector<string> &){
        lor range loop through vector and print each name
        Loop through vector 0 through size-1
                Set min to zero
                Set smallest value to first index in vector
                Loop trough vector starting at 1 to vector.size()
                        If vector[index] is less than smallest value, then
                                Smallest value equals that vector[index]
                                Reassign min to current index value
        Swap their positions in vector
        Print vector of names in alphabetical order
```

Flowchart

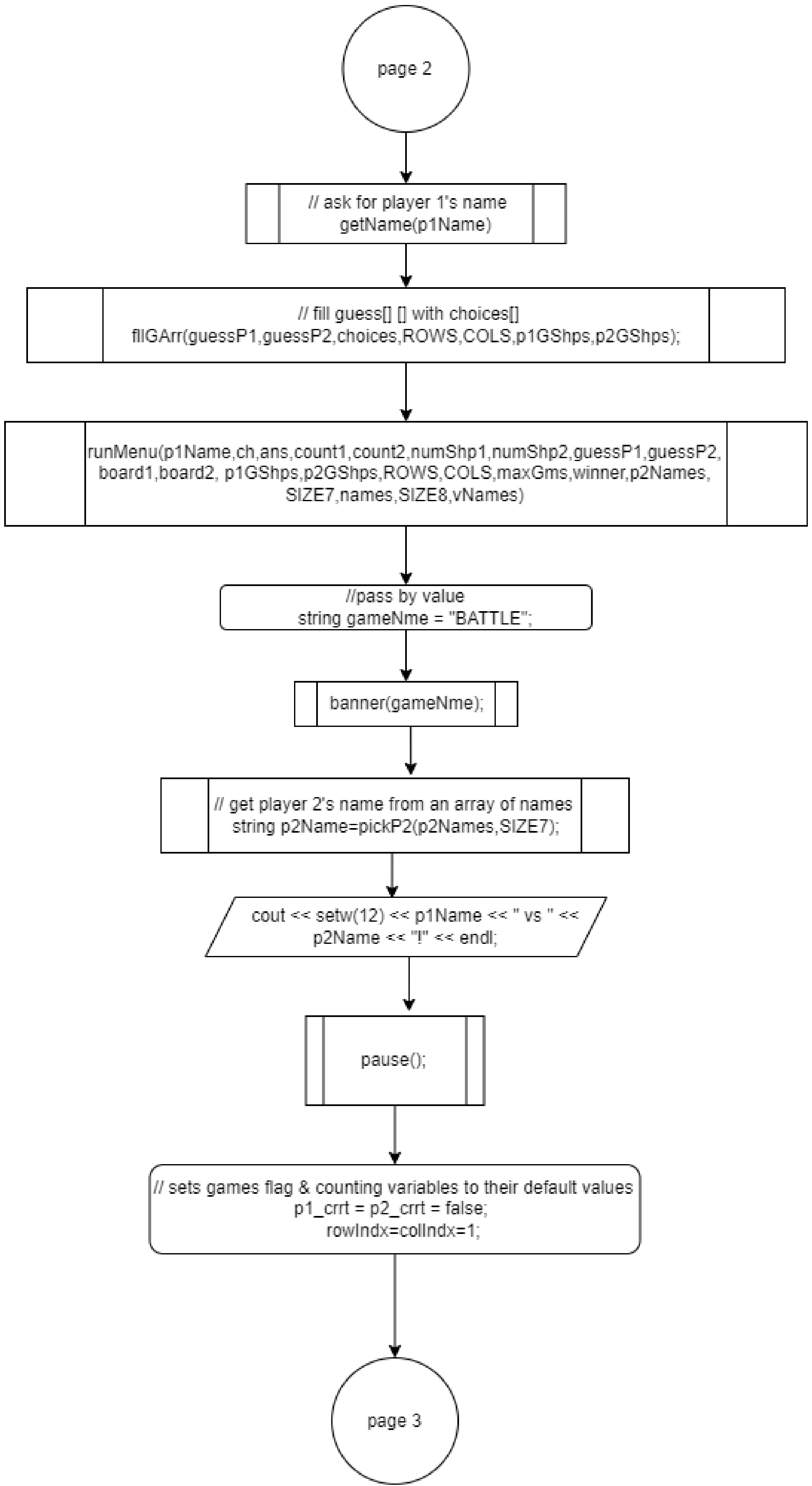
My flowchart is very long, so I have included pictures of the main function. You can find the original in the documents folder within project 2.

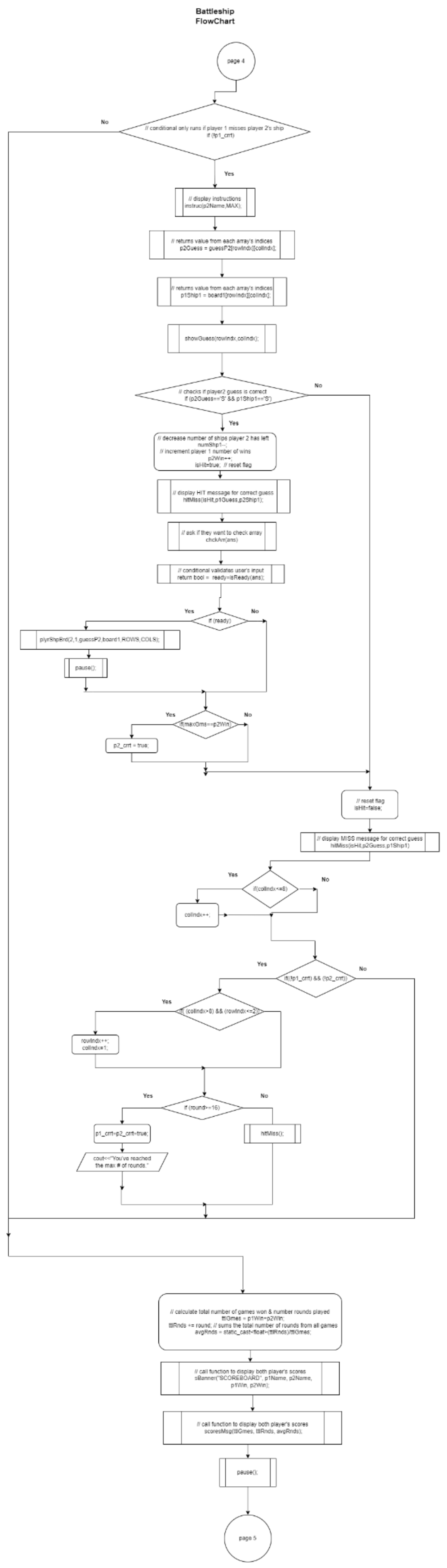
Battleship FlowChart

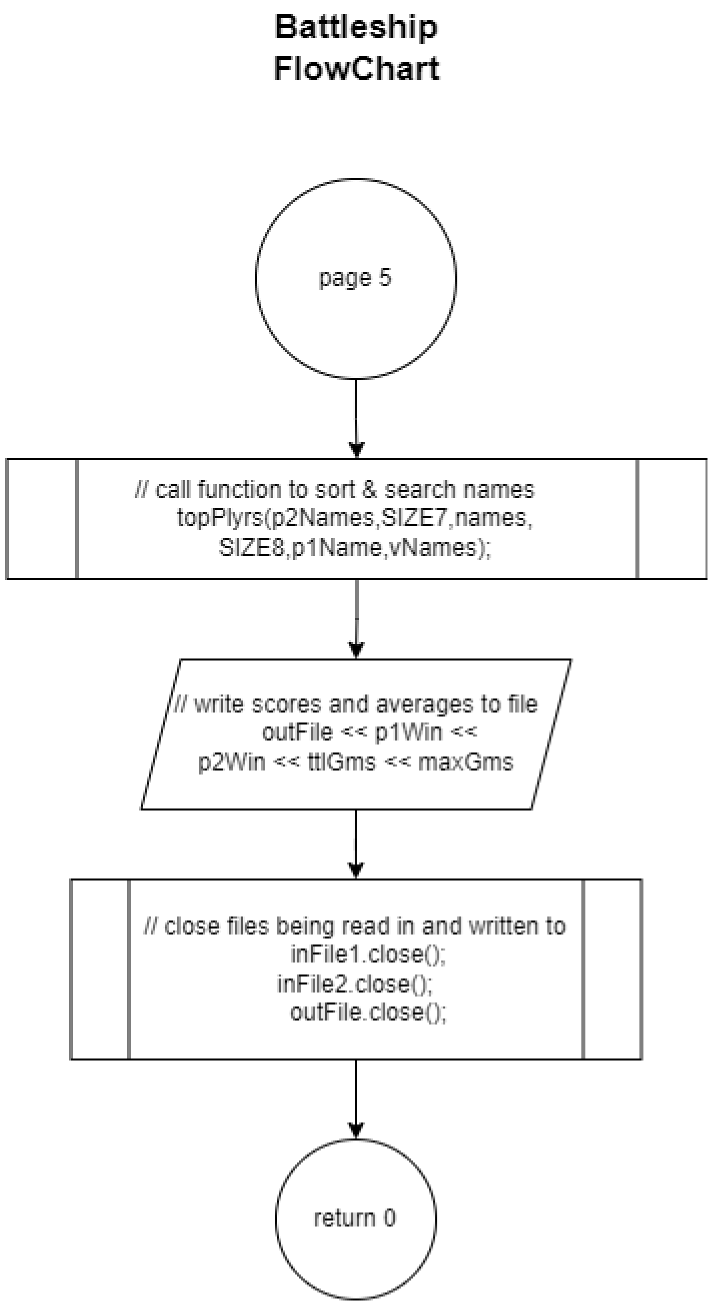


Danielle Fernandez 06/14/22 9:15 PM Project 2 Battleship Flowchart
Include all System Libraries
Declare all Function Prototypes
main
set random number seed
declare ifstream, ofstream variables
declare constant variables
declare bool, char, int, float, string, arrays, vector variables
inFile1.open("board1.txt") inFile2.open("board2.txt")
outFile.open("scores.txt")
void getName(string &)
page 2
int nRows=1
for loop
nRows++
i <= ROWS
int nCols=1
nCols++
for loop
nCols<COLS
read inFile1 data & save to board1[nRows][nCols]
Yes
if board1[nRows][nCols]=='S'
independent if
numShp1++
count1++;
read inFile2 data & save to board2[nRows][nCols]
Yes
if board1[nRows][nCols]=='S'
independent if
numShp2++
count2++;

**Battleship
FlowChart**


page 2
// ask for player 1's name
getName(p1Name)
// fill guess[] [] with choices[]
fllGArr(guessP1,guessP2,choices,ROWS,COLS,p1GShps,p2GShps);
runMenu(p1Name,ch,ans,count1,count2,numShp1,numShp2,guessP1,guessP2,
board1,board2, p1GShps,p2GShps,ROWS,COLS,maxGms,winner,p2Names,
SIZE7,names,SIZE8,vNames)
//pass by value
string gameNme = "BATTLE";
banner(gameNme);
// get player 2's name from an array of names
string p2Name=pickP2(p2Names,SIZE7);
cout << setw(12) << p1Name << " vs " <<
p2Name << "!" << endl;
pause();
// sets games flag & counting variables to their default values
p1_crrt = p2_crrt = false;
rowIndx=colIndx=1;
page 3


Battleship
FlowChart
page 4
No
// conditional only runs if player 1 misses player 2's ship
if (!p1_crrt)
Yes
// display instructions
instruc(p2Name,MAX);
// returns value from each array's indices
p2Guess = guessP2[rowIndx][colIndx];
// returns value from each array's indices
p1Ship1 = board1[rowIndx][colIndx];
showGuess(rowIndx,colIndx);
// checks if player2 guess is correct
if (p2Guess=='S' && p1Ship1=='S')
No
Yes
// decrease number of ships player 2 has left
numShp1--;
// increment player 1 number of wins
p2Win++;
isHit=true; // reset flag
// display HIT message for correct guess
hitMiss(isHit,p1Guess,p2Ship1);
// ask if they want to check array
chckArr(ans)
// conditional validates user's input
return bool = ready=isReady(ans);
Yes
if (ready)
No
plyrShpBrd(2,1,guessP2,board1,ROWS,COLS);
pause();
Yes
if(maxGms==p2Win)
No
p2_crrt = true;
// reset flag
isHit=false;
// display MISS message for correct guess
hitMiss(isHit,p2Guess,p1Ship1)
Yes
if(colIndx<=8)
No
colIndx++;
Yes
if((!p1_crrt) && (!p2_crrt))
No
Yes
if((colIndx>8) && (rowIndx<=2))
rowIndx++;
colIndx=1;
Yes
if (round>=16)
No
p1_crrt=p2_crrt=true;
hitMiss();
cout<<"You've reached
the max # of rounds."
// calculate total number of games won & number rounds played
ttlGmes = p1Win+p2Win;
ttlRnds += round; // sums the total number of rounds from all games
avgRnds = static_cast<float>(ttlRnds)/ttlGmes;
// call function to display both player's scores
sBanner("SCOREBOARD", p1Name, p2Name,
p1Win, p2Win);
// call function to display both player's scores
scoresMsg(ttlGmes, ttlRnds, avgRnds);
pause();
page 5


Battleship
FlowChart
page 5
// call function to sort & search names
topPlyrs(p2Names,SIZE7,names,
SIZE8,p1Name,vNames);
// write scores and averages to file
outFile << p1Win <<
p2Win << ttlGms << maxGms
// close files being read in and written to
inFile1.close();
inFile2.close();
outFile.close();
return 0

Constructs & Concepts Utilized

A copy of this table is located in the documents folder within project 2.

2	2	cout			
	3	libraries	10-18	5	iostream, iomanip, cmath, cstdlib, fstream, string, ctime
	4	variables/literals			No variables in global area, failed project!
	5	Identifiers			
	6	Integers	93	1	
	7	Characters	86	1	
Chapter	**Section**	**Topic**	**Where Line #"s**	**Pts**	**Notes**
	8	Strings	170	1	
	9	Floats No Doubles	109	1	Using doubles will fail the project, floats OK!
	10	Bools	81	1	
	11	Sizeof *****	*****		
	12	Variables 7 characters or less	X		All variables <= 7 characters
	13	Scope ***** No Global Variables	X		
	14	Arithmetic operators	292		
	15	Comments 20%+	X	2	Model as pseudo code
	16	Named Constants	73		All Local, only Conversions/Physics/Math in Global area
	17	Programming Style ***** Emulate	X		Emulate style in book/in class repositiory
3	1	cin			
	2	Math			

		Expression			

2	2	cout			
	3	libraries	10-18	5	iostream, iomanip, cmath, cstdlib, fstream, string, ctime
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3	1	cin			

	2	Math Expression			
	3	Mixing data types ****	*****		
	4	Overflow/Underflow ****	*****		
	5	Type Casting	294	1	
	6	Multiple assignment *****	*****		
	7	Formatting output	175	1	
	8	Strings	170, 297	1	
	9	Math Library	456	1	All libraries included have to be used
	10	Hand tracing ******	*****		
4	1	Relational Operators	271		
	2	if	146	1	Independent if
	4	If-else	203-224	1	
	5	Nesting	203-227	1	
	6	If-else-if	561-570	1	
	7	Flags *****	184		
	8	Logical operators	274	1	
	11	Validating user input	640-645	1	
	13	Conditional Operator	461	1	
	14	Switch	628	1	
5	1	Increment/Decrement	247, 248	1	
	2	While	188	1	

	5	Do-while	421-436	1	
	6	For loop	391	1	
	11	Files input/output both	145,150,310	2	
	12	No breaks in loops ******	X		Failed Project if included
			Total	30	

****** Not required to show

Cross Reference for Project 2 You are to fill-in with where located in code

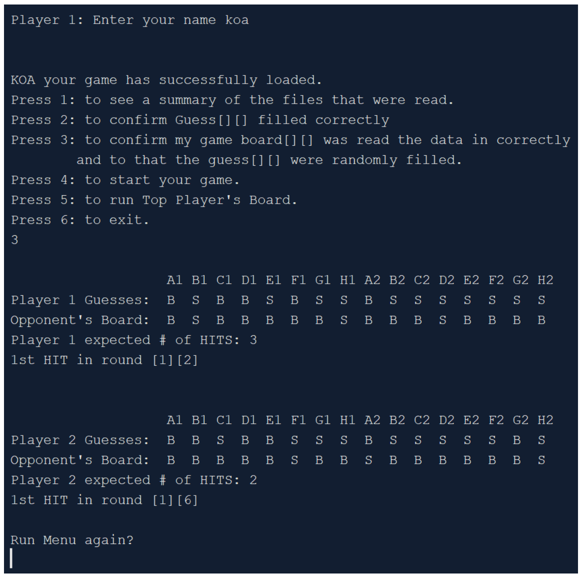
Cha pter	Secti on	Topic	Where Line #"s	Pts	Notes
6		Functions			
	3	Function Prototypes	28-59	4	Always use prototypes
	5	Pass by Value	170	4	
	8	return	793	4	A value from a function
	9	returning boolean	255, 649	4	
	10	Global Variables	X	XXX	Do not use global variables -100 pts
	11	static variables	451,476	4	
	12	defaulted arguments	38	4	
	13	pass by reference	612	4	
	14	overloading	36, 37, 48, 49	5	
	15	exit() function	635	4	
7		Arrays			
	1 to 6	Single Dimensioned Arrays	120	3	
	7	Parallel Arrays	357	2	
	8	Single Dimensioned as	612, 692	2	

		Function Arguments			
	9	2 Dimensioned Arrays	612, 692	2	Emulate style in book/in class repositiory
	12	STL Vectors	123, 342	2	
		Passing Arrays to and from Functions	612	5	
		Passing Vectors to and from Functions	375, 379	5	
8		Searching and Sorting Arrays			
	3	Bubble Sort	416	4	
	3	Selection Sort	379	4	
	1	Linear or Binary Search	767	4	
			Total	70	Other 30 points from Proj 1 first sheet tab

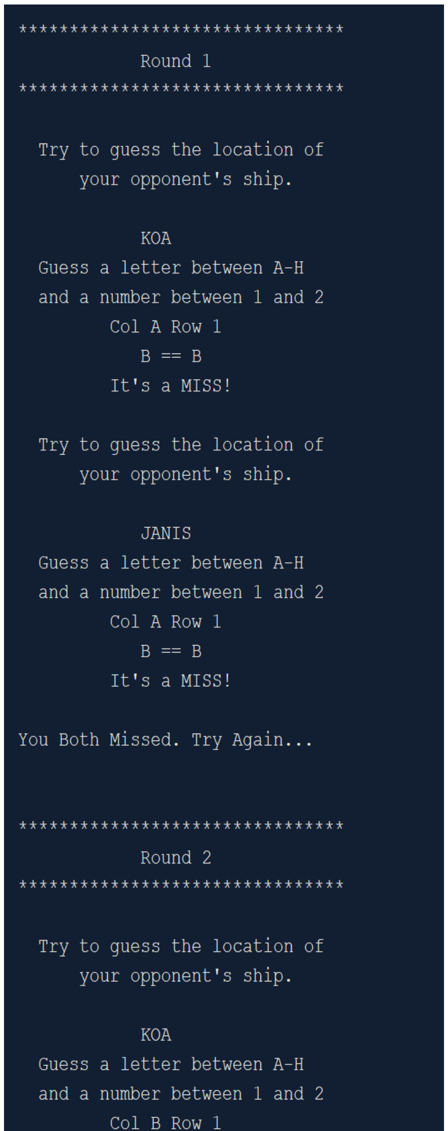
****** Not required to show

Proof of a Working Product

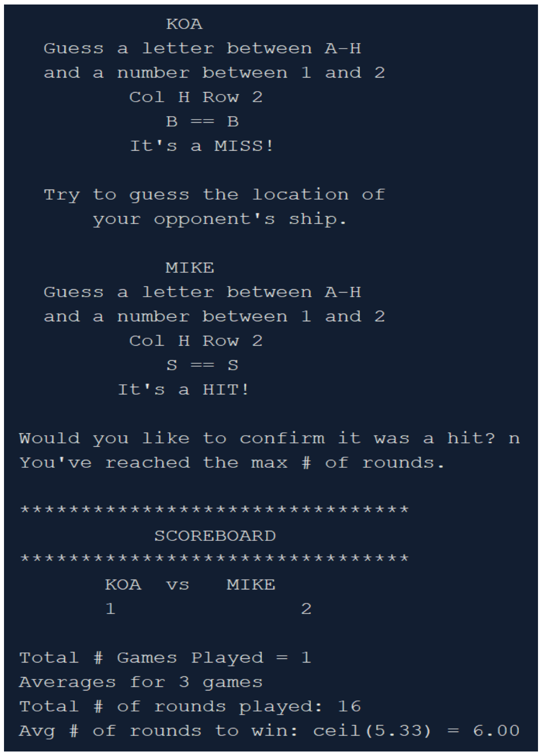
Full images of these screenshots are located in the images folder within project 2 folder.



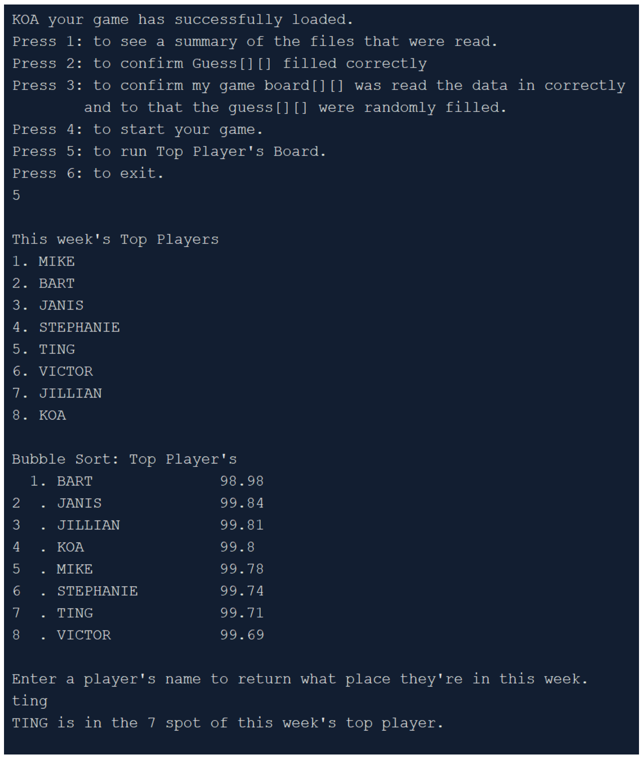
```
Player 1: Enter your name koa


KOA your game has successfully loaded.
Press 1: to see a summary of the files that were read.
Press 2: to confirm Guess[][] filled correctly
Press 3: to confirm my game board[][] was read the data in correctly
        and to that the guess[][] were randomly filled.
Press 4: to start your game.
Press 5: to run Top Player's Board.
Press 6: to exit.
3

                   A1 B1 C1 D1 E1 F1 G1 H1 A2 B2 C2 D2 E2 F2 G2 H2
Player 1 Guesses:  B  S  B  B  S  B  S  S  B  S  S  S  S  S  S  S
Opponent's Board:  B  S  B  B  B  B  B  S  B  B  B  S  B  B  B  B
Player 1 expected # of HITS: 3
1st HIT in round [1][2]


                   A1 B1 C1 D1 E1 F1 G1 H1 A2 B2 C2 D2 E2 F2 G2 H2
Player 2 Guesses:  B  B  S  B  B  S  S  S  B  S  S  S  S  S  B  S
Opponent's Board:  B  B  B  B  B  S  B  B  S  B  B  B  B  B  B  S
Player 2 expected # of HITS: 2
1st HIT in round [1][6]

Run Menu again?
```



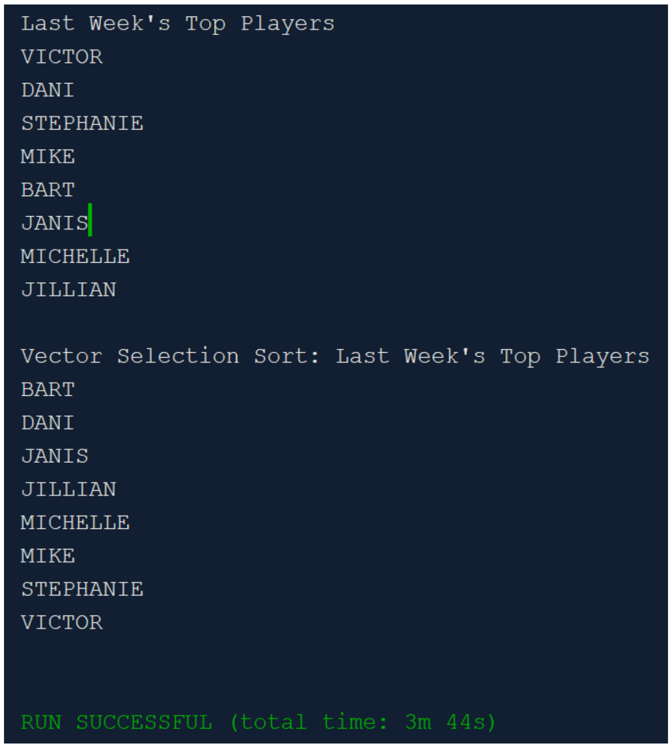
```
********************************
           Round 1
********************************


  Try to guess the location of
      your opponent's ship.

           KOA
  Guess a letter between A-H
  and a number between 1 and 2
        Col A Row 1
           B == B
        It's a MISS!

  Try to guess the location of
      your opponent's ship.

           JANIS
  Guess a letter between A-H
  and a number between 1 and 2
        Col A Row 1
           B == B
        It's a MISS!

You Both Missed. Try Again...


********************************
           Round 2
********************************


  Try to guess the location of
      your opponent's ship.

           KOA
  Guess a letter between A-H
  and a number between 1 and 2
        Col B Row 1
```



```
              KOA
   Guess a letter between A-H
   and a number between 1 and 2
          Col H Row 2
              B == B
          It's a MISS!

   Try to guess the location of
       your opponent's ship.

              MIKE
   Guess a letter between A-H
   and a number between 1 and 2
          Col H Row 2
              S == S
         It's a HIT!

Would you like to confirm it was a hit? n
You've reached the max # of rounds.

********************************
           SCOREBOARD
********************************
       KOA   vs   MIKE
       1               2

Total # Games Played = 1
Averages for 3 games
Total # of rounds played: 16
Avg # of rounds to win: ceil(5.33) = 6.00
```



```
KOA your game has successfully loaded.
Press 1: to see a summary of the files that were read.
Press 2: to confirm Guess[][] filled correctly
Press 3: to confirm my game board[][] was read the data in correctly
        and to that the guess[][] were randomly filled.
Press 4: to start your game.
Press 5: to run Top Player's Board.
Press 6: to exit.
5

This week's Top Players
1. MIKE
2. BART
3. JANIS
4. STEPHANIE
5. TING
6. VICTOR
7. JILLIAN
8. KOA

Bubble Sort: Top Player's
  1. BART              98.98
2  . JANIS             99.84
3  . JILLIAN           99.81
4  . KOA               99.8
5  . MIKE              99.78
6  . STEPHANIE         99.74
7  . TING              99.71
8  . VICTOR            99.69

Enter a player's name to return what place they're in this week.
ting
TING is in the 7 spot of this week's top player.
```



```
Last Week's Top Players
VICTOR
DANI
STEPHANIE
MIKE
BART
JANIS
MICHELLE
JILLIAN

Vector Selection Sort: Last Week's Top Players
BART
DANI
JANIS
JILLIAN
MICHELLE
MIKE
STEPHANIE
VICTOR


RUN SUCCESSFUL (total time: 3m 44s)
```

References

1. Dr. Lehr’s github. https://github.com/ml1150258/2022_Spring_CSC_CIS_5.
2. Hasbro Battleship Instructions. https://www.hasbro.com/common/instruct/battleship.pdf.
3.

Program

```
/*
 * File:   main.cpp
 * Author: Danielle Fernandez
 * Created on June 4, 2022,  4:28 PM
 * Purpose: Project 2. Covers chapters 1-7 in Gaddis.
 * Version 6: implement vector and pass it to and from functions
 */

// System Libraries:
#include <iostream> // cin, cout
#include <iomanip>  // fixed, setprecision()
#include <cmath>    // round()
#include <cstdlib>  // rand(), EXIT_SUCCESS
#include <fstream>  // ofstream
#include <cstring>  // string library
#include <ctime>    // time library for rand()
#include <cctype>   // toupper()
#include <vector>   // vector
using namespace std;

// User libraries

// Global Constants
// Physics/Chemistry/Math/Conversions


// Function prototypes
void banner(string);      // display game
int  binarySrch(string [],string &,int);
void cGssArr(const char [][9], const char [][9],const int,const int,int, int); // confirms guess[][]
filled correctly
void chckArr(char &);
void copyAdd(string [],const int,string[],const int,string);
void fileSum(int,int,int,int);
void fllGArr(char [][9],char [][9],char [], int, int, int &, int&);
void getName(string &);  // get player 1's name using pass by reference
void hitMiss(bool,int,int);  // hit message for correct guess
void hitMiss();        // try again message
void instruc(string, const int, int =1); // instructions for players
bool isReady(char);   // returns bool value
void runMenu(string, char &, char &, int,int,int,int,char [][9],char [][9],
           char [][9],char [][9],int,int,int,int,int &,int&,string [],int,
           string [],int,vector<string> &);
void pause();
string pickP2(string [],int);  // randomly picks a number for player 2
void plyrShpBrd(int,int,const char [][9],const char [][9],const int,const int);
void print2DArr(const char [][9],const char [][9],
             const char [][9],const char [][9],const int,const int,int &,int &);
void prntArr(string []);  // prints names[]
void prntArr(const char [][9],int,int); //prints 2D
void rBanner(int &);      // display the round number
void sBanner(string,string,string,int,int);   // display scoreboard banner
void sortSel(vector<string> &);
void scoresMsg(int,int,float);  // displays scores for both players
void showGuess(int,int);
void showStatic();
void sortBub(string [],int);       // sort names
void swap1(string &,string &);
void topPlyrs(string [],int,string [],int,string,vector<string> &);
void upper(string &); // changes string to all uppercase letters


// Program execution begins here
int main(int argc, char** argv) {

   // set random number seed
   srand(static_cast<unsigned int>(time(0)));

   // declare variables
   ifstream     inFile1; // for reading an existing file
   ifstream     inFile2;
   ofstream      outFile; // for outputting to a file

   const int    MIN = 1, // minimum number for rand()
             MAX = 16; // maximum number for rand()
   const int    SIZE7 = 7,  // size for player 2 names array
             SIZE8 = 8;
   const int    ROWS = 3,
             COLS = 9;  // number of cols in 2D array
   const int    SIZE17=17;    // choice array size

   bool         p1_crrt, // player 1 correct
             p2_crrt, // player 2 correct
```

```
            ready,   // ready to continue playing
            isHit;

   char        ans, // answer
            ch,
            p1Guess=0, // player 1 guess
            p2Guess, // player 2 guess
            p1Ship1, // player 1 ship number 1
            p2Ship1; // player 2 ship number 1

   int         rowIndx,// index for comparing player's guess to their opponent's board
            colIndx, // index for comparing player's guess to their opponent's board
            maxGms=0, // number of games
            round=0, // round
            p1Win=0, // number of wins player 1 has
            p2Win=0, // number of wins player 2 has
            ttlGmes=0,   // sum of both players number of wins
            ttlRnds=0,   // sum of total rounds played
            p1GShps,
            p2GShps,
            numShp1,
            numShp2,
            count1,
            count2,
            winner;

   float       avgRnds;   // average rounds it takes to win

   string      p1Name = " ",
            p2Name = " ";

   char        board1[ROWS][COLS]={};
   char        board2[ROWS][COLS]={};
   char        guessP1[ROWS][COLS]={};
   char        guessP2[ROWS][COLS]={};

   // will be used to fill each player's guess[][]
   char choices[SIZE17]={'S','B','S','S','B','S','S','B','S','S','B','S','S','B','S','S','B'};
   string p2Names[SIZE7]={"MIKE", "BART", "JANIS", "STEPHANIE", "TING", "VICTOR",
"JILLIAN"};
   string names[SIZE8]={};   // create new array to hold player 1 & player 2's names
   vector<string> vNames{"VICTOR", "DANI", "STEPHANIE", "MIKE", "BART", "JANIS",
"MICHELLE", "JILLIAN"};


   // ************************************
   // ****** SET UP GAME STARTS HERE ********
   // ************************************


   // open an existing file that holds max number of games a user can play
   //inFile.open("maxNGms.txt");
   inFile1.open("board1.txt",ios::in);
   inFile2.open("board2.txt",ios::in);
   outFile.open("scores.txt");  // create a file to output to

   // initialize counters to zero
   numShp1=numShp2=count1=count2=0;

   // read in data from file and initialize each player's game board[][]
   // with a S(ship) or a B(blank)
   for(int nRows=1; nRows<ROWS; nRows++){
      for(int nCols=1; nCols<COLS ;nCols++){

         inFile1 >> board1[nRows][nCols];
         if(board1[nRows][nCols]=='S') {
            numShp1++;  // count how many ships player 1 has in their array
         }
         count1++;   // count how many items were read in
         inFile2 >> board2[nRows][nCols];
         if(board2[nRows][nCols]=='S'){
            numShp2++;  // count how many ships player 1 has in their array
         }
         count2++;   // count how many items were read in
      }
   }

   // ask for player 1's name
   getName(p1Name);

   // fill guess[] [] with choices[]
   fllGArr(guessP1,guessP2,choices,ROWS,COLS,p1GShps,p2GShps);

   // show switch menu
   runMenu(p1Name,ch,ans,count1,count2,numShp1,numShp2,guessP1,guessP2,board1,board2,
     p1GShps,p2GShps,ROWS,COLS,maxGms,winner,p2Names,SIZE7,names,SIZE8,vNames);


   // display game's introduction message
   string gameNme = "BATTLE";
   banner(gameNme);
```

```
// get player 2's name from an array of names
p2Name = pickP2(p2Names,SIZE7);
cout << setw(12) << p1Name << " vs " << p2Name << "!" << endl;

pause();

//***************************************
//******** GAME STARTS HERE**************
//***************************************

// sets games flag & counting variables to their default values
p1_crrt = p2_crrt = false;
rowIndx=colIndx=1;

// loops until a player correctly guesses opponents ship location
while((!p1_crrt) && (!p2_crrt)){

   rBanner(round); // display round number banner

   //*************** Player 1's Guess *************
   //*********************************************

   instruc(p1Name,MAX);    // display instructions to player 1

   // set variables to the their 1st array's indices
   p1Guess = guessP1[rowIndx][colIndx];
   p2Ship1 = board2[rowIndx][colIndx];
   showGuess(rowIndx,colIndx); // show players guess

   // checks if player1 guess is correct
   if((p1Guess=='S') && (p2Ship1=='S')){

      numShp2--;  // decrease number of ships player 2 has left
      p1Win++;    // increment player 1 number of wins
      isHit=true;  // reset flag
      hitMiss(isHit,p1Guess,p2Ship1);  // display HIT message for correct guess
      chckArr(ans); // ask if they want to check arrays

      // validates user's input
      ready=isReady(ans);

      if(ready) {

         // display opposing 2D arrays to confirm it was a hit
         plyrShpBrd(1,2,guessP1,board2,ROWS,COLS);
         pause();
```

```
    }

    // checks if player 1's number of wins equals max games
    if(maxGms==p1Win) p1_crrt = true;   // reassign player 1's value for a correct guess

 } else { // else when player 1 guess is wrong
    isHit=false;    // reset flag
    hitMiss(isHit,p1Guess,p2Ship1); // display MISS message for wrong guess
 }

 // conditional only runs if player 1 misses player 2's ship
 if(!p1_crrt){

    //********************************************
    //************** Player 2's Guess ************
    //********************************************

    instruc(p2Name,MAX);  // display instructions to player 2

    // program generates random number guess
    p2Guess = guessP2[rowIndx][colIndx];
    p1Ship1= board1[rowIndx][colIndx];
    showGuess(rowIndx,colIndx);

    // conditional checks if player 2's guess is correct
    // program automatically generated  guess for player 2
     if((p2Guess=='S') && (p1Ship1=='S')){

       numShp1--;  // decrement number of ships player 1 has
       p2Win++;    // increment player 2 number of wins
       isHit=true;   // reset flag
       hitMiss(isHit,p2Guess, p1Ship1);    // display HIT message for correct guess

       chckArr(ans);

       // conditional validates user's input
       ready=isReady(ans);
       if(ready){
          plyrShpBrd(2,1,guessP2,board1,ROWS,COLS);
          pause();
       }

       // checks to see if player has won the
       if(maxGms==p2Win) p2_crrt = true;   // reassign player 1's value for a correct guess

    } else {  // else when player 2 guess is wrong
```

```
            isHit=false;
            hitMiss(isHit,p2Guess,p1Ship1); // display MISS message for player 2's wrong guess
         }
      } // ends player 2's turn

      // increment index that controls the guess[][] & board[][]
      if(colIndx<=8) colIndx++;

      // if both players guessed wrong, then
      if((!p1_crrt) && (!p2_crrt)){

         // increases row and resets column
         if( (colIndx>8) && (rowIndx<=2)) {
            rowIndx++;
            colIndx=1;
         }

         // makes sure game ends if neither player  has guessed their opponents ship's location
correctly
         if(round>=16){
            p1_crrt=p2_crrt=true;
            cout<<"You've reached the max # of rounds.\n\n";

         } else hitMiss();   // display try again message when both players guess wrong
      }
   } // ends while(!p1_crrt) && (!p2_crrt)

   // calculate total number of games won & number rounds played
   ttlGmes = p1Win+p2Win;
   ttlRnds += round; // sums the total number of rounds from all games
   avgRnds = static_cast<float>(ttlRnds)/ttlGmes;

   // call function to display both player's scores
   sBanner("SCOREBOARD", p1Name, p2Name, p1Win, p2Win);
   scoresMsg(ttlGmes, ttlRnds, avgRnds);

   pause();    // pause game so player can see the scores

   // ********************************************
   // ******** SORT & SEARCH NAMES SECTION *********
   // ********************************************

   // call function to sort & search names
   topPlyrs(p2Names,SIZE7,names,SIZE8,p1Name,vNames);

   // write scores and averages to file
```

```
    outFile << fixed << showpoint << setprecision(2);
    outFile << "Player 1 wins: " << p1Win << endl
            << "Player 2 wins: " << p2Win << endl
            << ttlGmes << " of " << maxGms << " max games were played.\n";

    // close files being read in and written to
    inFile1.close();
    inFile2.close();
    outFile.close();

    // exit code
    return 0;
}


//*****************************************************************
//****************** FUNCTION DEFINITIONS ***************************
//*****************************************************************

// changes string to all capital letters
void upper(string &name){
    char ch;
    string temp="";

    for(int i=0;i<name.length();i++){
        ch = toupper(name[i]);
        temp +=ch;
    }
    name=temp;
}

// function controls the sort and search section
void topPlyrs(string p2Names[],int SIZE7,string names[],int SIZE8, string p1Name,
              vector<string> &vNames){
   // copy contents of one array to another array and add player1's name
   copyAdd(p2Names,SIZE7,names,SIZE8,p1Name);

   // print names array
   cout << "\nThis week's Top Players \n";
   prntArr(names);

   // bubble sort names & print sorted array
   sortBub(names,SIZE8);
   float scores[SIZE8]={98.98, 99.84, 99.81, 99.80, 99.78, 99.74, 99.71, 99.69};
   cout << "Bubble Sort: Top Player's \n";
```

```
  // print parallel arrays
  for(int i=0; i<SIZE8; i++){
          cout << setw(3)<< i+1 << ". "<<setw(12)
              << left << names[i] << setw(6) << " "
              << scores[i] << endl;
   }
   cout << endl;

  string sName;
  cout << "Enter a player's name to see their highest score\n";
  cin >> sName;
  int score = binarySrch(names,sName,SIZE8);
  if(score==-1){
     cout << "Sorry, " << sName << " wasn't found.\n";
  } else cout << sName << " is in the " << score+1 << " spot of this week's top player.\n\n";

  pause(); // pause game so player can view the search findings

  // selection sort
  sortSel(vNames);
 }

// selection sort with vectors
void sortSel(vector<string> &vNames){

   cout << "\nLast Week's Top Players \n";
   for(auto ele : vNames)
      cout << ele << endl;
   cout << endl;

   int    minIndx, last=0;
   string minVal;

   last=(vNames.size()-1); // don't need to go the last index cause we check it by the end of loop's
1st run

   for(int start=0; start<last; start++){

      minIndx = start; // set smallest index to zero
      minVal=vNames[start]; // set smallest value to array's 1st index

      // start loop at array's[1]
      for(int indx=(start+1);indx<vNames.size();indx++){

         // if its neighbor index is smaller than it
         if(vNames[indx] < minVal){
            // reassign smallest to that array's index and its value
            minVal = vNames[indx];
            minIndx = indx;
         }
      } // swap their values
      swap1(vNames[minIndx], vNames[start]);
   }
   cout << "Vector Selection Sort: Last Week's Top Players \n";
   for(auto ele : vNames)
      cout << ele << endl;
   cout << endl;
}

// bubble sort. compare neighboring indices one at a time
void sortBub(string names[], int size){

   bool swap;
   int maxElmt=size-1; // (8-1)=7. holds subscript of last element that will be compared to its
neighbor

   do {
      swap=false; // set flag

      // loop 0 thru 7
      for(int i=0;i<maxElmt;i++){
         if(names[i] > names[i+1]){ // "VICTOR" > "JILLIAN" ?

            // swap index values
            swap1(names[i],names[(i+1)]);

            // reset flag value
            swap=true;
         }
      }
      maxElmt--; // decrement. biggest value is at last index, so now restart loop to run to one less
last index
   } while(swap); // while there's still indices to left to swap
}

// swap indices
void swap1(string &a, string &b){

   string temp;
   temp=a;
   a=b;
   b=temp;
}

// displays each players scores and win average
void scoresMsg(int ttlGmes, int ttlRnds, float avgRnds){

   showStatic(); // show how many games have been played
   cout << fixed << showpoint << setprecision(2);
            cout << "Averages for " << ttlGmes << " games \n"
               << "Total # of rounds played: " << ttlRnds << endl
               << "Avg # of rounds to win: ceil(" << avgRnds << ") = "
               << ceil(avgRnds) << endl;
}

// show each players guess
void showGuess(int row,int col){
   char colLttr = col==1 ? 'A':
              col==2 ? 'B':
              col==3 ? 'C':
              col==4 ? 'D':
              col==5 ? 'E':
              col==6 ? 'F':
              col==7 ? 'G':
              col==8 ? 'H': '?';

   cout << setw(13) << "Col " << colLttr
       << " Row " << row <<endl;
}

// static variable for games
void showStatic(){
   static int games=1;
   cout << "\nTotal # Games Played = " << games << endl;
   games++;
}

// display scoreboard banner
void sBanner(string str, string p1Name, string p2Name, int p1Win, int p2Win){


   // Display scoreboard banner
      for(int k=0; k<=2; k++){
         ((k==0)||(k==2)) ? cout << "********************************\n"
                : (k==1) ? cout << setw(21) << str << endl
                : cout << "Error in scoreboard banner.\n";
      }
```

```
        cout << setw(7) << " " << p1Name << setw(4) << "vs" << setw(3) << " "
             << right << p2Name << endl;
        cout << setw(8) << p1Win << setw(16) << p2Win << endl;
}

// banner displays round number
void rBanner(int &r){
        ++r;
        cout << endl << setw(26) << "********************************" << endl;
        cout << setw(18) << "Round " << r << endl;
        cout << setw(26) << "********************************" << endl;
}

// prntArr []
void prntArr(const char arr[][9],int ROWS, int COLS){

    for(int pRows=1; pRows<ROWS; pRows++){
        for(int pCols=1; pCols<COLS; pCols++){
            cout << arr[pRows][pCols] << "  ";
        }
    }
}

// prntArr names[]
void prntArr(string arr[]){

    for(int i=0;i<8;i++){
        cout << i+1 << ". " << arr[i] << endl;
    }
    cout << endl;
}

//
void print2DArr(const char guessP1[][9], const char guessP2[][9],
                const char board1[][9],const char board2[][9],
                const int ROWS,const int COLS,int &maxGms,int &winner){

    unsigned int hit1,hit2,rIndx1,rIndx2,cIndx1,cIndx2;
    char g1,g2,b1,b2;
    hit1=hit2=rIndx1=rIndx2=cIndx1=cIndx2=0;

    // get how many ship hits each player should get during this game
     for(int pRows=1; pRows<ROWS; pRows++){
        for(int pCols=1; pCols<COLS; pCols++){
            g1=guessP1[pRows][pCols];
            b2=board2[pRows][pCols];
            if((g1=='S') && (b2=='S')){
               hit1++;
               if(hit1==1){
               rIndx1=pRows;
               cIndx1=pCols;
               }
            }
         }
      }
      for(int row2=1; row2<ROWS; row2++){
         for(int col2=1; col2<COLS; col2++){
            g2=guessP2[row2][col2];
            b1=board1[row2][col2];
            if((g2=='S') && (b1=='S')){
               hit2++;
               if(hit2==1){
               rIndx2=row2;
               cIndx2=col2;
               }
            }
         }
      }

      // sets max number of games and returns which player to use for a conditional in main()
      if(hit1>hit2){
         maxGms=hit1;
         winner=1;
      }else if(hit1<hit2) {
         maxGms=hit2;
         winner=2;
      } else{
         maxGms=hit1;
         winner=2;
      }

      plyrShpBrd(1,2,guessP1,board2,ROWS,COLS);
      cout << "\nPlayer 1 expected # of HITS: "<< hit1 << endl
           << "1st HIT in round [" << rIndx1<<"]["<<cIndx1<<"]" <<endl<<endl;

      plyrShpBrd(2,1,guessP2,board1,ROWS,COLS);
      cout << "\nPlayer 2 expected # of HITS: " << hit2 << endl
           << "1st HIT in round [" << rIndx2 <<"]["<<cIndx2<<"]" <<endl<<endl;
}

//
void plyrShpBrd(int player,int opponnt,const char guess[][9],const char board[][9],
               const int ROWS,const int COLS){

      cout << endl << setw(19)<<" "<< "A1 B1 C1 D1 E1 F1 G1 H1 A2 B2 C2 D2 E2 F2 G2
H2\n";

      cout << "Player "<<player<< " Guesses:  ";
      prntArr(guess,ROWS,COLS);
      cout << endl;

      cout << "Opponent's Board:  " ;
      prntArr(board,ROWS,COLS);

}

// randomly picks a name from an array as player 2's name
string pickP2(string p2Names[], int SIZE7){

      cout << "\nLocating your opponent online......\n";
      string name2=p2Names[rand()%(SIZE7)];
      return name2;
}

// pause screen before game starts
void pause(){
      cout << "\nPress enter to continue. ";
      cin.ignore();
      cin.get();
}

//  prompt user
void runMenu(string p1Name, char &ch, char &ans, int count1,int count2,int numShp1,int
numShp2,
          char guessP1[][9],char guessP2[][9],char board1[][9],char board2[][9],
          int p1GShps,int p2GShps,int ROWS,int COLS,int &maxGms, int &winner,
          string p2Names[],int SIZE7,string names[],int SIZE8, vector<string> &vNames){
      do {

         cout << endl << p1Name << " your game has successfully loaded. \n"
          << "Press 1: to see a summary of the files that were read.\n"
          << "Press 2: to confirm Guess[][] filled correctly\n"
          << "Press 3: to confirm my game board[][] was read the data in correctly\n"
          << "        and to that the guess[][] were randomly filled.\n"
          << "Press 4: to start your game.\n"
          << "Press 5: to run Top Player's Board.\n"
          << "Press 6: to exit.\n";
         cin  >> ch;
```

```
        switch(ch){
           case '1': fileSum(count1,count2,numShp1,numShp2); break;
           void cGssArr(const char [][9], const char [][9],const int,const int,int, int); // confirms
guess[][] filled correctly

           case '2': cGssArr(guessP1, guessP2,ROWS,COLS,p1GShps,p2GShps);break;
           case '3': print2DArr(guessP1, guessP2,board1,board2,ROWS,COLS,maxGms,winner);
break;
           case '5': topPlyrs(p2Names,SIZE7,names,SIZE8,p1Name,vNames);
           case '6': exit(EXIT_SUCCESS); break;
           default: cout << setw(9)<< " " << "Loading.......\n";
        }

        if(ch=='1' || ch=='2' || ch=='3'|| ch=='5'){
           cout << "Run Menu again?\n";
           cin >> ans;
        } else ans='n';

    // continue doing all the statements above until ans does not equal y or Y
    } while((ans=='y')||(ans=='Y'));
}

// validates user's input
bool isReady(char ans){
    // conditional validates user's input
    if(ans=='y'){
        return true;
    } else if(ans=='Y'){
        return true;
    } else return false;
}

// display instructions to player
void instruc(string player, const int MAX, int min){

    cout << endl << setw(2) << " " << "Try to guess the location of \n"
         << setw(6) << " " << "your opponent\'s ship." << endl
         << endl << setw(12)<< " " << player  << endl
         << setw(2) << " " << "Guess a letter between A-H\n"
         << setw(2) << " " << "and a number between " << min << " and " << MAX/8 << endl;
}

// display hit message when player guesses correctly
void hitMiss(bool isHit, int guess, int shipLoc){
   cout << setw(13) << static_cast<char>(guess) << " == " << static_cast<char>(shipLoc) <<
endl;

   if(isHit) cout << setw(20) << "It\'s a HIT!\n" << endl;
   else cout << setw(22) << "It\'s a MISS!\n";
}

// display try again message when both player's guessed wrong
void hitMiss(){
   cout << endl << "You Both Missed. Try Again..." << endl << endl;
}

// get player 1's name
void getName(string &name1){

   cout << "\nPlayer 1: Enter your name ";
   cin >> name1;
   cout << endl;
   upper(name1);  // call function to convert user input into capital letters
}

// randomly fill guess[][] until at least one of the player's has 3 ships in their array
void fllGArr(char guessP1[][9],char guessP2[][9],char choices[],int ROWS,int COLS,int
&p1GShps, int &p2GShps){
   int size=17;
   p1GShps=p2GShps=0;  // initialize both players number of ships to zero
   bool minMet;        // minimum number of ships==3

   do{
      minMet=false;   // set flag

      for(int gRow=1; gRow<ROWS; gRow++){
         for(int gCol=1; gCol<COLS; gCol++){

            // automatically set player 1's guess[][] randomly from choices[]
            guessP1[gRow][gCol]=choices[rand()%size]; // saves either a 'S' or 'B'

            // track how many ships player 1's array has
            if(guessP1[gRow][gCol]=='S'){
               p1GShps++;
               if(p1GShps==3) minMet=true;   // reassign value to flag
            }
            // automatically set player 2's guess[][] randomly from choices[]
            guessP2[gRow][gCol]=choices[rand()%size];

            // track how many ships player 1's array has
            if(guessP2[gRow][gCol]=='S'){
               p2GShps++;
              if(p2GShps==3) minMet=true;   // reassign value to flag
            }
         }
      }
   } while(!minMet);
}

// confirm data that was read in is even and contains at least 3 ships
void fileSum(int count1, int count2, int numShp1, int numShp2){
   cout << endl << setw(3)<<" " << "Read in " << setw(6)<< " " << "P1 Board" << setw(5)<< " 
"<< "P2 Board" << endl;
   cout << "Total # chars " << setw(8) << right << count1 << "\t \t" << count2 << "\n";
   cout << "Total # ships " << setw(8) << right << numShp1 << "\t \t" << numShp2 << "\n\n";
}

// save player 1 and all of player 2's names to a new array
void copyAdd(string p2Names[],const int SIZE7, string names[], const int SIZE8, string 
p1Name){

  // copy all of player 2's name into a new array
  for(int i=0;i<SIZE7;i++){
     names[i]=p2Names[i];
  }

  // calculate the last index for names[]
  unsigned int last = SIZE8-1;

  // add player 1's name to the end of the names[]
  names[last]=p1Name;
}

//
void chckArr(char &ans){
        cout << "Would you like to confirm it was a hit? ";
        cin >> ans;
}

// display data from both player's guess arrays.
void cGssArr(const char guessP1[][9], const char guessP2[][9],
          const int ROWS,const int COLS, int p1GShps, int p2GShps){

   cout << "\nConfirming Guess arrays are random and have at least 3 S in one array\n";
   cout << setw(4) << " " << "P1 Guesses"<<endl;
   prntArr(guessP1,ROWS,COLS);
   cout <<"\nP1 # Ships : " << p1GShps <<endl<<endl;

   cout << setw(4) << " " << "P2 Guesses\n";
   prntArr(guessP2,ROWS,COLS);
   cout << endl << "P2 # Ships : " << p2GShps << endl<<endl;
}

// binary search
 int binarySrch(string names[], string &name, int SIZE8){

   int indx=0,
      first=0,
      last=SIZE8-1,
      middle,
      position=-1;

   bool found=false;

   upper(name);    // change string to all uppercase letters

   while(!found && first<=last){ // search between indices [0,7]

      middle = (first + last)/2; // middle index
      if(names[middle]==name){ // check if middle indx equals name
         found=true;
         position=middle;

        // if name ASCii value is smaller then its in lower half of array
      } else if(names[middle]>name){
         last= middle-1;

        // if name ASCii value is smaller then its in upper half of array
      } else first = middle+1;
   }
   return position;
}

// displays game's name and instructions in a banner
void banner(string str){

   // reassign variables value
   str="BATTLESHIP";

   for(int i=0; i<=2; i++){
      if(i==0 || i==2){
         for(int j=0; j<32; j++) {
                cout << "*";
            } cout << endl;
        } else  cout << setw(21) << str << endl;
    }
}
```