

Software Engineering

CPS2002

Assignment Report

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Diagram Example

```
~~~Machine Learning 1 Assignment~~~
~~~Created by Martin Bartolo~~~
Enter 1 to see the answer for Question 1, 2 for the answer to Question 2 and 3 for the answer to Question 3
1
How many features would you like? (Please enter a number between 1 and 3)
3
Enter 1 for Sepal Length, 2 for Sepal Width, 3 for Petal Length, 4 for Petal Width
1
2
3
|
```

Code Snippet

```
public class Main{
    public static void main (String args[]){
        System.out.println("Hello World!");
    }
}
```

Introduction

The aim of this assignment was to collaboratively work on a software project, with the main focus being on rigorous software testing and the use of Git. Our first task was to set up our environments, namely our Git repository on Github and our Jenkins environment on the University Jenkins server. First, we initialised our Git repository and ensured that each team member could commit changes and push and pull them from Github. When this was ensured, we set up our Jenkins environment to work with Maven and scan for changes from Github every few minutes. Whenever changes are found, they are built and run with a detailed code coverage report and test results being displayed using the Emma plug-in. Our progress at this point can be seen by viewing the "Part1" tag on our Github repository. After completing our set-up, we were ready to start working on the two remaining tasks which will be discussed in detail throughout the remainder of this report.

Game Design

The design of the game consists of sectioning the game into the classes, here we will talk about the contents of those classes while also explain how they all work together.

The information provided will be regarding the basic version of the game i.e. before any enhancements to the game were made. The basic version of the game can be played by going to the tag "Part2".

The Initial Game Design

This is the code for the basic version of the game, thus this is the game before any enhancements were made.

Game Class

The Game class contains the main game loop and most of the logic regarding the game. The most important functions of the Game class include initialising the tiles and setting up the players, compute the directions of each player, generate the HTML map files for each player (This changes in the future generations of the game) and also exits the program.

Listing 1: The initial code of the Game class

```
import java.io.*;
import java.util.ArrayList;
import java.util.InputMismatchException;
import java.util.Scanner;

public class Game {

    // Amount of turns which have been played
    private int turns = 0;
    // Amount of players
    int playerNum;

    // ArrayList of players
    ArrayList<Player> players = new ArrayList<Player>();

    Map map = new Map();// map object

    final private int minPlayers = 2;
    final private int maxPlayersFirstRange = 4;
    final private int minPlayersSecondRange = 5;
    final private int maxPlayers = 8;

    final private int minMapSizeFirstRange = 5;
    final private int minMapSizeSecondRange = 8;
    final private int maxMapSize = 50;
```

```

private Scanner scanner;// to be used throughout class

//Constructor for the game object
Game() {
}

public static void main(String[] args) {
    //This variable is used to hold the
    //previous directions taken by a given player
    String directions;

    System.out.print("Welcome to the Treasure Map Game by Martin")
    Game game = new Game();

    //Run startGame method to initialise players and map
    game.startGame(game);

    // will be set to true when the treasure
    //is found by one of the players
    boolean foundTreasure = false;

    //An array which holds all the players
    //who found the treasure on a given turn
    //This is just in case more than one
    //player finds it on the same turn
    boolean[] winners = new boolean[game.players.size()];

    //Generating the initial html files here before
    //there are any moves
    //Generating an html file for each player in the game
    for(int i = 0; i < game.players.size(); i++){

        if(game.generateHtmlFile(i, game.map.mapSize, " ") == 0){
            System.err.println("Could not generate HTML files");
        }
    }

    //Main game loop
    while (true) {

        //Increment amount of turns
        //which have been played
        game.turns++;

        System.out.println("-----");

        //Get each players desired direction
        //of movement for the current turn
        game.directionsLoop();

        //Generating an html file for each
        //player's current state
        for(int i = 0; i < game.players.size(); i++){

```

```

        //Obtaining the last 4 directions of each player
        directions = game.getPreviousDirections(i);

        if(game.generateHtmlFile(i, game.map.mapSize,directions) == 0){
            System.err.println("Could not generate HTML files");
        }
    }

    //Go through each player in the
    //game and check if they found the treasure
    //Mark the players who have found the treasure
    int i = 0;
    for(Player player: game.players){

        if(player.foundTreasure){
            foundTreasure = true;
            winners[i] = true;
        }
        i++;
    }

    //If the treasure has been found by one of the players
    if (foundTreasure) {

        for(i = 0; i < winners.length; i++){

            if (winners[i]){
                System.out.println("Congratualtions player " + (i+1) + ",
            }
        }
        break;
    }
}

System.out.println("-----\n");

//After a player wins the game the user is able to prompted to exit the g
game.exitGame(game);
}

//Method to initialise map along with players and
// their starting positions
private void startGame(Game game) {
    game.playerNum = getPlayerNum();

    map.mapSize = getMapSize();
    map.generate();// Generate map

    //In this loop all the Player objects are created
    //along with their starting position in the map
    for (int i = 0; i < game.playerNum; i++) {

        //A new player object is made

```

```

        Player player = new Player();

        //The random position of the player is
        //set to a grass tile
        player.position = player.setStartingPosition(map.getGrassTiles());

        //The created player is added to the ArrayList of players
        players.add(player);
    }
}

// Method to get the amount of players from the user
private int getPlayerNum() {
    int num;
    System.out.println("How many players will be playing? (Pick a number between 2 and 8)");

    while (true) {
        //Get user input
        scanner = new Scanner(System.in);

        //Validate user input
        num = validatePlayerNum(scanner);

        //Return value if it is valid (not an error value)
        if (num > 1) {
            return num;
        }
    }
}

// Method to validate the user's input for the player number
int validatePlayerNum(Scanner scanner) {
    int num;
    try {
        //Set to user input from getPlayerNum
        num = scanner.nextInt();
    }
    //If input is not an integer
    catch (InputMismatchException e) {
        System.err.println("Invalid input. Please enter a number between 2 and 8");
        return 0; //Return error value of 0
    }
    //If input is correct
    if (num >= minPlayers && num <= maxPlayers) {
        return num; //Return value entered by the user
    }
    //If input is not within required range
    else {
        System.err.println("Please enter a number between 2 and 8");
        return 1; //Return error value of 1
    }
}

// Method to get the map size from the user

```

```

private int getMapSize() {
    int size;
    System.out.println("How large would you like the map to be? (Map will be

    while (true) {
        //Get user input
        scanner = new Scanner(System.in);

        //Validate user input
        size = validateMapSize(scanner);

        //Return value if it is valid (not an error value)
        if (size > 4) {
            return size;
        }
    }
}

// Method to validate the user's input for the map size
int validateMapSize(Scanner scanner) {
    int size;
    try {
        //Set to user input from getMapSize
        size = scanner.nextInt();
    }

    //If input is not an integer
    catch (InputMismatchException e) {
        System.err.println("Invalid input. Please enter a number");
        return 0; //Return error value of 0
    }

    //If input is above largest allowed map size
    if (size > maxMapSize) {
        System.err.println("Map too big. Please enter a size below 50");
        return 1; //Return error value of 1
    }

    //If map is too small for 2-4 players
    else if (playerNum <= maxPlayersFirstRange && size <
        minMapSizeFirstRange) {
        System.err.println("Map too small. Please enter a size of 5 or more");
        return 2; //Return error value of 2
    }

    //If map is too small for 5-8 players
    else if (playerNum >= minPlayersSecondRange && size <
        minMapSizeSecondRange) {
        System.err.println("Map too small. Please enter a size of 8 or more");
        return 3; //Return error value of 3
    }

    //If input is correct
    else {

```



```

        return size;//Return value entered by the user
    }
}

// Method to get direction which each player
//would like to move in for the current turn
private void directionsLoop() {
    //(u, d, l or r) depending on user's desired
    //direction of movement
    char direction;
    //Condition to break out of while
    //loop when a valid direction is entered
    boolean validMove;

    //Loop through each player in ArrayList
    for (Player player : players) {
        System.out.println("Player " + (players.indexOf(player) +
            1) + ", please choose a direction (u, d, l or r).");

        validMove = false;
        while (!validMove) {
            direction = 'x';
            //Make sure that user input is
            //valid (i.e. one of u, d, l or r)
            while(direction == 'x' || direction == 'y') {
                scanner = new Scanner(System.in);
                direction = validateDirectionInput(scanner);
            }

            //Check if move is within map and execute if it is
            if (checkOutOfBounds(direction, player, map.mapSize)
                == 1) {
                validMove = true;

                //Change player's position variables
                //to new position
                player.move(direction);

                //Triggers event for corresponding tile type
                map.evaluateCurrentPlayerTile(player);
            }
        }
    }
}

// Method to check whether a move is within the map boundaries
int checkOutOfBounds(char direction, Player player,
    int mapSize) {
    switch (direction) {
        case 'l':
            //If map limit is exceeded
            if (player.position.x - 1 < 0) {

```

```

        System.err.println("Cannot move left. Please
        try another direction.");
        return 0;//Return error value of 0
    }

    //If move is within map
    else {
        System.out.println("Player moved to the left");
        return 1;//Return correct value 1
        //to indicate that move is valid
    }

case 'r':
    //If map limit is exceeded
    if (player.position.x + 1 >= mapSize) {
        System.err.println("Cannot move right.
        Please try another direction.");
        return 0;//Return error value of 0
    }
    //If move is within map
    else {
        System.out.println("Player moved to the right");
        return 1;//Return correct value 1 to
        //indicate that move is valid
    }

case 'u':
    //If map limit is exceeded
    if (player.position.y - 1 < 0) {
        System.err.println("Cannot move up.
        Please try another direction.");
        return 0;//Return error value of 0
    }
    //If move is within map
    else {
        System.out.println("Player moved up");
        return 1;//Return correct value 1 to
        //indicate that move is valid
    }

case 'd':
    //If map limit is exceeded
    if (player.position.y + 1 >= mapSize) {
        System.err.println("Cannot move down. Please
        try another direction.");
        return 0;//Return error value of 0
    }
    //If move is within map
    else {
        System.out.println("Player moved down");
        return 1;//Return correct value 1
        //to indicate that move is valid
    }
}

```

```

        default:
            return 0; //Return error value of 0
    }
}

// Method to check whether an inputted direction is
//valid (i.e. either u, d, l or r)
char validateDirectionInput(Scanner scanner) {
    String direction; //User input
    char c; //User input after it being converted
            //into a character
    String directions = "udlr"; //String containing
            //each accepted direction

    try {
        //Set to user input from getDirections
        direction = scanner.next();

        //Ensure that inputted string is of length 1
        if (direction.length() > 1) {
            throw new RuntimeException("Input too long.
            Please enter a character (u, d, l or r)");
        }

        //Convert input string to char
        c = direction.charAt(0);

        //Ensure that character is a letter
        if (!Character.isLetter(c)) {
            throw new RuntimeException("Input is not a character.
            Please enter a character (u, d, l or r)");
        }
    }

    //If an error is thrown in the try block
    catch (RuntimeException e) {
        System.err.println(e.getMessage());
        return 'y'; //Return an error value which we
            //will associate with an exception
            //when testing
    }

    //Change char input to lowercase to allow U, D, L and R
    c = Character.toLowerCase(c);

    //If input is a char but not one of the directions
    if (!directions.contains(Character.toString(c))) {
        System.err.println("Invalid input. Please enter a
        direction (u, d, l or r)");
        return 'x'; //Return an error value which
            // we will associate with an invalid character when testing
    }

    //If input is correct

```

```

        else {
            return c; //Return valid user inputted character
        }
    }

// This method is used to generate the
//HTML files so that they can be opened in browser
int generateHtmlFile(int playerIndex, int mapSize, String direction) {
    //Value to return to mark if
    //method has run successfully or not
    //Set to 1 by default. This will
    //change to 0 if an error is encountered
    int returnValue = 1;

    //This variable is used to hold
    //the type of tile which the player has landed on
    int tileType;

    //This variable checks if the player
    //is currently on this tile
    boolean playerHere;

    //A file object is being created
    //where the name is given depending
    //on the number of the player
    File file = new File("map_player_" + (playerIndex + 1) + ".html");

    //The actual file is created here
    try {
        //If file already exists set return
        // value to 2 to mark that it is being overwritten
        if(!file.createNewFile()){
            returnValue = 2;
        }
    } catch (IOException e) {
        e.printStackTrace();
        returnValue = 0; //Set return value to error
    }

    //This object is used to be able to add
    //to the string easily
    StringBuilder htmlText = new StringBuilder();

    //This is the html code which is going
    //to be placed in each file
    htmlText.append( "<!doctype html>\n" );
    htmlText.append( "<html>\n" );

    htmlText.append( "<head>\n" );
    htmlText.append( "<style>\n" );

    htmlText.append("div {\n" +
        //The width of the grid is

```

```

// set depending on the inputted map size
//The height is larger than
//the width since we are also goign to
//have to count the header which is above the grid
"    width: ").append(mapSize).append("00px;\n")
.append("    height: ").append(mapSize + 1).append("00px;\n")
.append("}\n")
.append("\n")
.append(".header {\n").append(
//The width of the header is changed
//depending on the size of the map
"    width: ").append(mapSize).append("00px;\n")
.append("    height: 100px;\n")
.append("    outline: 1px solid;\n")
.append("    float: left;\n")
.append("    text-align: center;\n")
.append("    background-color: #1f599a;\n")
.append("    font-family: Arial, sans-serif;\n")
.append("    font-size: 20px;\n")
.append("    color: white;\n")
.append("}\n")
.append("\n")
.append(".cellGray {\n")
.append("    width: 100px;\n")
.append("    height: 100px;\n")
.append("    outline: 1px solid;\n")
.append("    float: left;\n")
.append("    background-color: Gray;\n")
.append("}\n")
.append("\n")
.append(".cellGreen {\n")
.append("    width: 100px;\n")
.append("    height: 100px;\n")
.append("    outline: 1px solid;\n")
.append("    float: left;\n")
.append("    background-color: Green;\n")
.append("}\n")
.append("\n")
.append(".cellBlue {\n")
.append("    width: 100px;\n")
.append("    height: 100px;\n")
.append("    outline: 1px solid;\n")
.append("    float: left;\n")
.append("    background-color: Blue;\n")
.append("}\n")
.append("\n")
.append(".cellYellow {\n")
.append("    width: 100px;\n")
.append("    height: 100px;\n")
.append("    outline: 1px solid;\n")
.append("    float: left;\n")
.append("    background-color: Yellow;\n")
.append("}\n");

```

```

htmlText.append( "</style>\n" );
htmlText.append( "</head>\n\n" );

htmlText.append( "<body>\n" );

htmlText.append("<div>\n" + "        <div class=\"header\"> \n" + "
\n" +
        //First we need to set a header
        //for each game map which each player sees
        "        <p> Player ").append(playerIndex + 1)
        .append("</p>\n")
        .append("        <p> Moves: ").append(direction).append(" </p> \n")
        .append("        </div>\n")
        .append("        \n");

//Now we will build the current
//map depending on the players current position
//We will change colours of new tiles that have
//been stepped on and mark the player's current position
//For loop used to loop through each grid
for (int j = 0; j < mapSize; j++) {
    for (int i = 0; i < mapSize; i++) {

        //playerHere is set to false at each iteration
        playerHere = false;

        //Check if the player went on this tile already
        if(players.get(playerIndex).ifTileExists(i, j)){

            //If the tile exists then the player must
            be on one of these tiles
            //Checking if the current tile is the
            players current position on the map
            if(players.get(playerIndex).position.x == i &&
                players.get(playerIndex).position.y == j){
                playerHere = true;
            }

            //Obtain the tile type of the current tile
            tileType = map.getTileType(i,j);
        }

        else{
            //If not the tile has a default tile type
            tileType = 3;
        }

        switch(tileType){
            //Grass tile
            case 0:

                if(playerHere){

                    htmlText.append("<div class=\"cellGreen\">" +

```

```

        "<img src=\"player.png\" alt=\"player\">" +
        "</div>\n");
    }

    else{

        htmlText.append("<div class=\"cellGreen\"></div>\n");

    }
    break;

//Water tile
case 1:

    if(playerHere){

        htmlText.append("<div class=\"cellBlue\">" +
            "<img src=\"player.png\" alt=\"player\">" +
            "</div>\n");

    }

    else{

        htmlText.append("<div class=\"cellBlue\"></div>\n");

    }
    break;

//Treasure Tile
case 2:

    if(playerHere){

        htmlText.append("<div class=\"cellYellow\">" +
            "<img src=\"player.png\" alt=\"player\">" +
            "</div>\n");

    }

    else{

        htmlText.append("<div class=\"cellYellow\"></div>\n")

    }
    break;

default:
    //No need to check for player here
    //as a player can never be on a gray tile
    htmlText.append("<div class=\"cellGray\"></div>\n");
    break;
    }
}
}

```

```

htmlText.append("\n</div>");
htmlText.append( "</body>\n" );
htmlText.append( "</html>\n" );

try{
    BufferedWriter bw = new BufferedWriter(new FileWriter(file));
    bw.write(htmlText.toString());
    bw.close();
}catch(IOException io){
    io.printStackTrace();
    returnValue = 0;
}

return returnValue;
}

//Method used to get the last n directions
String getPreviousDirections(int playerIndex){
    String directions;
    StringBuilder stringBuilder = new StringBuilder();

    int directionSize = players.get(playerIndex).directions.size();

    //Loop for the last 6 directions the player has moved
    for(int i = 1; i <= 6; i++){
        //If only one direction has been entered
        if(directionSize == 1){
            stringBuilder.append(" ").append(players.get(playerIndex).
                directions.get(directionSize - 1));
            break;
        }
        //If more than 1 directions have been entered
        else if (directionSize >1){
            //Add direction unless there are
            //less than 6 total directions
            if(directionSize - i <0){
                break;
            }
            stringBuilder.append(" ").append(players.get(playerIndex).
                directions.get(directionSize - i));
        }
    }

    directions = stringBuilder.toString();

    return directions;
}

//Method to delete Html files
void deleteHtmlFiles(int playerNum){

    //Loops through all player files
    for(int i = 1; i <= playerNum ; i++){

```



```

        //Delete each file iteratively
        try{
            File file = new File("map_player_" + i + ".html");

            if(!file.delete()) {
                System.out.println("File does not exist");
            }
        }catch(Exception e){
            e.printStackTrace();
        }
    }
}

//Method to exit the game
private void exitGame(Game game){
    if(getExitChar() == 'e'){
        //Delete all Html Files
        deleteHtmlFiles(game.playerNum);
        System.out.println("Thank you for playing!");
    }
}

//Method to get the user to input e to exit the program
private char getExitChar(){
    char exit = 'x';

    System.out.println("Press e if you would like to exit the program");

    //Make sure that user input is valid
    while(exit == 'x' || exit == 'y') {
        scanner = new Scanner(System.in);
        exit = validateExitChar(scanner);
    }

    return exit;
}

//Method to validate user input from getExitChar()
char validateExitChar(Scanner scanner){
    String input;//User input
    char c;//User input after it being converted into a character

    try {
        //Set to user input from getDirections
        input = scanner.next();

        //Ensure that inputted string is of length 1
        if (input.length() > 1) {
            throw new RuntimeException("Input too long.
            Please enter e to exit");
        }

        //Convert input string to char
        c = input.charAt(0);
    }
}

```

```

        //Ensure that character is a letter
        if (!Character.isLetter(c)) {
            throw new RuntimeException("Input is not a character.
            Please enter e to exit");
        }
    }

    //If an error is thrown in the try block
    catch (RuntimeException e) {
        System.err.println(e.getMessage());
        return 'y'; //Return an error value which we will associate with an ex
    }

    //Change char input to lowercase to allow U, D, L and R
    c = Character.toLowerCase(c);

    //If input is a char but not one of the directions
    if (c != 'e') {
        System.err.println("Invalid input. Please enter e to exit");
        return 'x'; //Return an error value which
        //we will associate with an invalid character when testing
    }

    //If input is correct
    else {
        return c; //Return valid user inputted character
    }
}
}

```

Map Class

The Map class is used to generate the tile map which the players use to play the game on. Also the tile events which occur are also taken care of by the Map class.

Listing 2: The initial code of the Map class

```

import java.util.Random;

class Map {

    //Size of the map. Total squares will be mapSize x mapSize
    int mapSize;

    //The map will consist of 2d array of tiles along with each tile's type
    int[][][] tiles;

    //Below are counters used to hold the current number of tiles with the corres
    //The use of these is so that the program does not have more than one treasure
    int grassCount = 0;
    private int waterCount = 0;
}

```

```

private int treasureCount = 0;

//Constructor for the map object
Map(){
}

//This method is used on start up to create the map
//All tiles are randomly assigned a tile type
void generate(){

    tiles = new int[mapSize][mapSize][1];

    Random random = new Random();

    //Holds the current random tile obtained
    int[] randomPair = new int[2];

    //Holds a boolean value which determines if the [i][j] tile has already been
    boolean[][][] generatedTiles = new boolean[mapSize][mapSize][1];

    //This value holds the tile type (grass, water, treasure) which corresponds to
    int tileType;

    //The maximum number of water tiles in a map is set to one less than mapSize
    double waterMaxTiles = Math.ceil(mapSize-1);

    //The maximum number of treasure tiles is one
    int treasureMaxTiles = 1;

    //Initialising the generatedTiles array
    for(int i = 0; i < mapSize; i++) {
        for (int j = 0; j < mapSize; j++) {
            generatedTiles[i][j][0] = false;
        }
    }

    //Keep on looping until all tiles are randomly generated
    while(generatedTilesNum(generatedTiles) != mapSize*mapSize){

        //Randomly generate a pair of tiles
        //Numbers generated will be from 0 to mapSize-1
        randomPair[0] = random.nextInt(mapSize);
        randomPair[1] = random.nextInt(mapSize);

        //Now checking if the tile has already been obtained in the generated tiles
        //This is done by checking if the boolean value of the tile is true
        if(generatedTiles[randomPair[0]][randomPair[1]][0]){
            //Tile has already been generated
            //So the user must get another tile which has not already been generated

            //Keeps on looping until a new tile is generated
            while(generatedTiles[randomPair[0]][randomPair[1]][0]){

```

```

        randomPair[0] = random.nextInt(mapSize);
        randomPair[1] = random.nextInt(mapSize);
    }
}

//Keep on looping until the current tile is given a tile type
do {

    //Set the tile type for the newly generated tile
    //A random number from 0 to 2 is obtained which correspond to a tile type
    tileType = random.nextInt(3);

    //A switch statement is used to go through each of the possible tile types
    switch (tileType) {

        //Grass tile
        case 0:
            tiles[randomPair[0]][randomPair[1]][0] = 0;

            //The counter is updated since another grass tile has been placed
            grassCount += 1;

            break;

        //Water tile
        case 1:
            if (waterCount == waterMaxTiles) {
                //When the maximum number of water tiles is reached the check is
                //This is so that the while loop will continue until the map
                //is not full
                continue;
            } else {
                tiles[randomPair[0]][randomPair[1]][0] = 1;

                //The counter is updated since another water tile has been placed
                waterCount += 1;
            }
            break;

        //Treasure tile
        case 2:
            if (treasureCount == treasureMaxTiles) {
                //When a treasure tile is already placed the check is
                continue;
            } else {
                tiles[randomPair[0]][randomPair[1]][0] = 2;
                //The counter is updated since a treasure tile has been placed
                treasureCount += 1;
            }
            break;
    }
}

```

```

        default:
            //This case is accessed only when a random number which i
            System.err.println("Invalid random number obtained");
            break;

    }

    //add the the tile to the generatedTiles array
    generatedTiles[randomPair[0]][randomPair[1]][0] = true;
}while( tiles[randomPair[0]][randomPair[1]][0] != 0 && tiles[randomPa
}
}

//Method to obtain the current number of elements in the generatedTiles array
int generatedTilesNum(boolean[][][] array){
    int count = 0;

    for(int i = 0; i < mapSize; i++){
        for(int j = 0; j < mapSize; j++){
            if(array[i][j][0]){
                count++;
            }
        }
    }

    return count;
}

//Method used to show the map
void showMap(){
    for (int x = 0; x < mapSize; x++) {
        for (int y = 0; y < mapSize; y++) {
            System.out.println("(" + x + "," + y + ") -> " + tiles[x][y][0])
        }
    }
}

//This method is used to create a 2d array which holds the map location of al
int[][] getGrassTiles(){

    //This array holds the number of grass elements each with 2 spaces for th
    int[][] grassTiles = new int[grassCount][2];

    //Counter used to keep track of the element in grassTiles
    int i = 0;

    //Loop through all the tiles
    for (int x = 0; x < mapSize; x++) {
        for (int y = 0; y < mapSize; y++) {

            //To obtain which tiles are grass just check the tile type indica

            //If the current tile has a grass tile type
            if(tiles[x][y][0] == 0){

```

```

        //Save the x and y coordinates in the grassTiles array
        grassTiles[i][0] = x;
        grassTiles[i][1] = y;

        //The counter is incremented so as to be able to go to the next tile
        i++;
    }
}

return grassTiles;
}

//This method is used to get the tile type of the current tile
int getTileType(int x, int y){
    return tiles[x][y][0];
}

//This method handles the events of when a player lands on each specific tile
void evaluateCurrentPlayerTile(Player player){

    int tileType = tiles[player.position.x][player.position.y][0];

    switch(tileType){

        //When grass tile
        case 0:
            //Nothing happens since a player is able to walk on grass
            break;

        //When water tile
        case 1:
            //Get the start position of the current player
            int startPositionx = player.positions.get(0).x;
            int startPositiony = player.positions.get(0).y;

            //The start position of the current player is added again to the
            player.addToPositions(startPositionx, startPositiony);

            //The current position of the current player is reset to the start
            player.position.x = startPositionx;
            player.position.y = startPositiony;

            //Display message
            System.out.println("Player stepped on a blue tile, moving back to start");
            break;

        //When treasure tile
        case 2:
            //The foundTreasure element is set to true
            player.foundTreasure = true;
            break;
    }
}

```

```

        default:
            break;
    }
}
}

```

Player Class

The Player class manages the individual properties of a player, such as the tile positions the player has moved on and the directions in which the player has moved.

Listing 3: The initial code of the Player class

```

import java.util.ArrayList;
import java.util.Random;

class Player {

    //Player's current position
    Position position;

    //This array list is used to hold the previous positions the player
    ArrayList<Position> positions = new ArrayList<Position>();

    //This array list is used to hold the previous directions of the player
    ArrayList<String> directions = new ArrayList<String>();

    //Check to see if a player has found the treasure
    boolean foundTreasure;

    //Constructor for the player object
    Player(){
    }

    //Constructor for the player object when the player's position is given
    Player(Position position){
        this.position = position;
    }

    //Method used to add a position to the positions ArrayList using the x and y
    void addToPositions(int posx, int posy){
        Position position = new Position(posx, posy);
        positions.add(position);
    }

    //Method to move the player's position according to a given direction
    void move(char direction){

        //A switch statement is used to represent all possible directions
        switch(direction){
            case 'l':
                // change player's position

```

```

        this.position.x --;
        // add position to list of previous positions
        addToPositions(position.x, position.y);
        // add direction to list of previous directions
        directions.add("left");
        break;

    case 'r':
        // change player's position
        this.position.x ++;
        // add position to list of previous positions
        addToPositions(position.x, position.y);
        // add direction to list of previous directions
        directions.add("right");
        break;

    case 'u':
        // change player's position
        this.position.y --;
        // add position to list of previous positions
        addToPositions(position.x, position.y);
        // add direction to list of previous directions
        directions.add("up");
        break;

    case 'd':
        // change player's position
        this.position.y ++;
        // add position to list of previous positions
        addToPositions(position.x, position.y);
        // add direction to list of previous directions
        directions.add("down");
        break;

    default:
        break;
}

//This method sets the starting position of a player
Position setStartingPosition(int[][] grassTiles){

    Random random = new Random();

    Position position = new Position(0, 0);

    //Obtaining the length of grassTiles so as to be able to know from which
    int grassCount = grassTiles.length;

    //random number from 0 to length of grassTiles is obtained
    int grassTilesIndex = random.nextInt(grassCount);

    //The start position is set
    position.x = grassTiles[grassTilesIndex][0];

```



```

        position.y = grassTiles[grassTilesIndex][1];

        //The current position of the player is set to the start position
        this.position = position;

        //The start positions is added to the created player
        addToPositions(position.x, position.y);

        return position;
    }

    //This method is used in the game class to check if a player has already been
    boolean ifTileExists(int x, int y){

        //Create the Position object to use to compare
        Position positionUse = new Position(x,y);

        //Looping through element in the positions array list
        for (Position position : positions) {

            //Comparing the x and y values of the current Position object in the
            if(positionUse.x == position.x && positionUse.y == position.y){

                //If one of the object in the array list matched then it exists i
                return true;
            }
        }
        return false;
    }
}

```

Position Class

The Position class is used to simplify the way in which the program interprets the player's location within the tile map.

Listing 4: The initial code of the Position class

```

public class Position {

    //Value of each coordinate
    int x;
    int y;

    //Method to display a position object
    @Override
    public String toString() {
        return "Position{" +
            "x=" + x +
            ", y=" + y +
            '}';
    }
}

```

```
//Constructor for the player object
Position(){
}

//Constructor for the position object when both x and y values are given
Position(int px, int py) {
    x = px;
    y = py;
}
```

Enhancements

Different Map Types

The design pattern chosen for this enhancement was the **factory design pattern**. Since this enhancement was centred around the map's creation then it was clear that a creational design pattern had to be chosen. The main things which needed to be kept in mind were that 2 initial map types had to be implemented while more map types could easily be added to the future. Therefore, the Factory design pattern was the most suitable for the task.

The class diagram of the enhancement can be seen below.

Our implementation is centred around a *Map* interface which contains each method which will be used by the different map types. Each type of map then has a class which implements this main *Map* interface as can be seen in the class diagram above. This design allows for the easy implementation of additional map types in the future.

A factory method is present in the *MapCreator* class which is passed the map's type and its size. This class has a creator subclass for every map type, allowing for easy creation of additional map types in the future. An instance of the correct creator subclass will then be made and used to create the map. This can be seen in the code snippet below.

```
//Factory Method
Map createMap(String type, int mapSize){

    MapCreator creator;

    if(type.equals("safe")){
        creator = new SafeMapCreator(mapSize);
    }
    else if(type.equals("hazardous")){
        creator = new HazardousMapCreator(mapSize);
    }
    else{
        creator = null;
        System.err.println("Invalid map type");
    }

    if (creator != null) {
        return creator.create();
    }
    else{
        return null;
    }
}
```

The map is then created in the appropriate creator subclass by setting the map size and calling the generate method in the map type's class (either the *SafeMap* or *HazardousMap* class in our implementation but more can easily be added). A code snippet of this create method for the "safe" map type is shown below

```
//Method to create and return a safe map
@Override
public Map create(){
    //getInstance method used here to obtain a
    //static instance of the hazardous map
    SafeMap map = SafeMap.getInstance();
    map.setMapSize(mapSize);
    map.generate();
    return map;
}
```

In the generate method for the safe map, the maximum amount of water tiles is set to 10% and then rounded down to the nearest integer. This code snippet is shown below.

```
//The maximum number of water tiles in a map is set to
//10% of the total tiles
int waterMaxTiles = (int) Math.floor((mapSize*mapSize) * 0.1);
```

In the generate method for the hazardous map, the maximum amount of water tiles is set to 25% and then rounded up to the nearest integer. This code snippet is shown below.

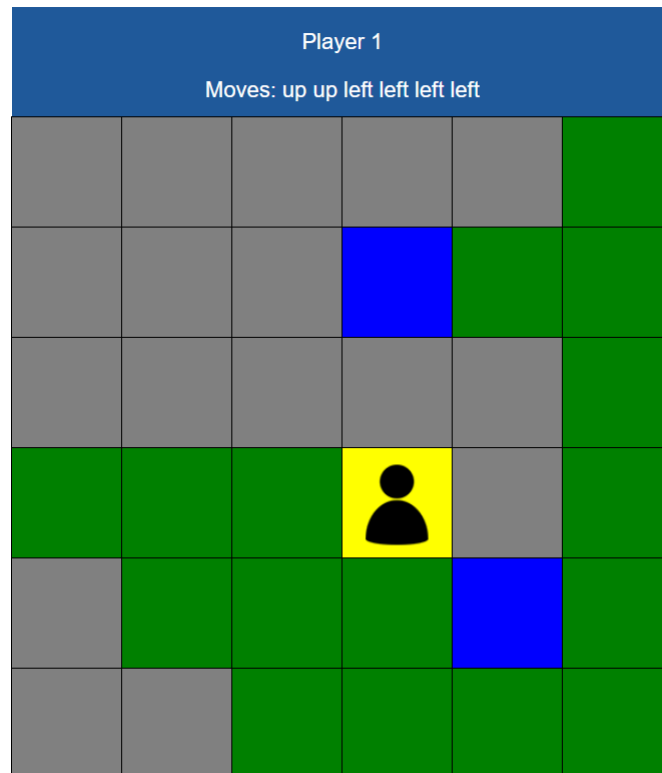
```
//The maximum number of water tiles in a map is set to
//25% of the total tiles
int waterMaxTiles = (int) Math.ceil((mapSize*mapSize) * 0.25);
```

Apart than these changes, the map is generated as it was in the generate method in the basic version of the program before the enhancements.

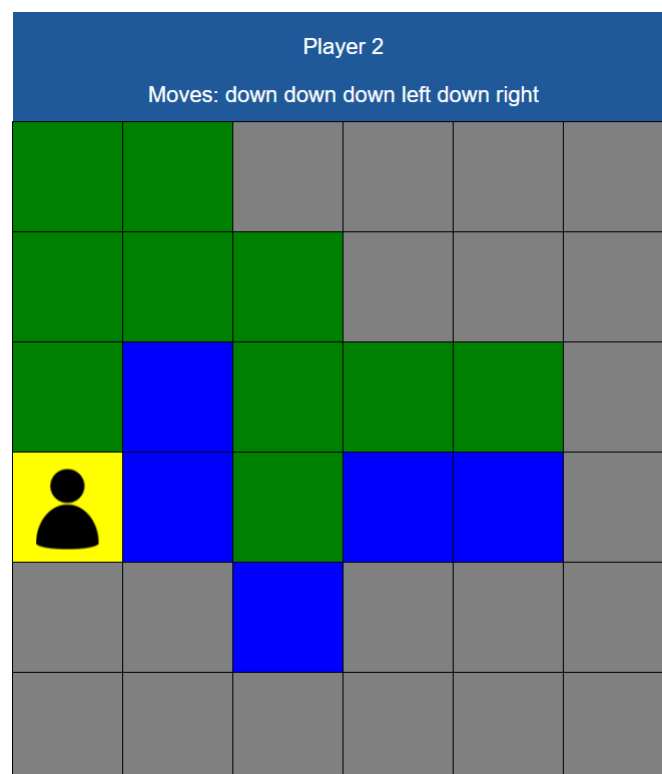
When running the program, the user is asked what map type they would like to play with. This can be seen below.

```
Welcome to the Treasure Map Game by Martin Bartolo and Mikhail Cassar
How many players will be playing? (Pick a number between 2 and 8)
4
How many teams should the players be split into? (Pick a number between 2 and the amount of players in the game)
2
How large would you like the map to be? (Map will be n x n)
6
Would you like to play in
1) a safe map with 10% water squares
2) a hazardous map with 25%-35% water squares
```

After the user chooses the map type, the map is created as discussed on the previous page and then the game can be played. On the next page is a comparison between the ending screen of a game played by 4 players in 2 teams on a 6x6 safe map and a game played by the same players on a 6x6 hazardous map. Notice the different amounts of water tiles encountered between the 2 map types.



Ending screen of game using a safe map



Ending screen of game using a hazardous map

The information provided will be regarding the basic version of the game i.e. be-

fore any enhancements to the game were made. The basic version of the game can be played by going to the tag "Part2".

Single Map File

The design pattern chosen for this enhancement was the **singleton design pattern**. Since the problem involved the creation of only one map file it was clear that a creational design pattern was needed. The problem which needed to be solved here was that there was only one instance of a map file throughout the whole game. This could easily be taken care of using the Singleton design pattern.

Given the first enhancement led to the creation of the *safeMap* class and *hazardousMap* class, a singleton design pattern for each subclass has to be implemented since they produce different objects.

After the user chooses which map type they want, through the process previously defined in the first enhancement, the program goes to the corresponding *Map* subclass through the *MapCreator* class.

In the *SafeMap* class and *HazardousMap* class, a private static instance is initialised. By doing this the *Map* object cannot be used in any other method and since it is static the object will be directly affected at every change which occurs throughout the lifetime of the program. This means that given only one map, and hence one map file, any change which occurs will affect that single map file and so there is only one map file which is being affected.

A *getInstance()* method is also created in the subclasses. This method declares the previously initialised static object created. However, the object is declared only if the object is null. This is so because it would lead to the creation of a new object and so this method takes care of that.

//Code showing safe and hazardous maps with static objects and get instance methods

In the *CreateMap* class, the *getInstance()* method is used so as to create *Map* object. This is the same for each map type. Hence now after going through this a map object is created which is able to be used by the game.

//Show method of get instance method in use

In the initial idea of the game, a map file was created for each player and at the end of each turn the map file gets updated using the *changeHtmlFile()* method.

//SHOW MAP FILE DEFINITION IN HTML CHANGE FILE METHOD

Now instead we have only one file, and that file is changed to the corresponding player's map tile when it is the player's turn to choose their desired direction.

HOWEVER SINCE THERE IS NOT METHOD IN PLACE FOR FILE STORAGE WE COULD NOT IMPLEMENT A METHOD TO ONLY SHOW THE FILE TO THE CURRENT PLAYER.

```
// Method to get direction which each player would like to move in for the cu
private void directionsLoop() {
    char direction;//(u, d, l or r) depending on user's desired direction of
    boolean validMove;//Condition to break out of while loop when a valid dir
    boolean foundTreasure = false;//Condition to check if a player has found

    //Loop through each player in ArrayList
    for (Player player : players) {

        if(!foundTreasure) {
            //At the end of the current player's turn the main html file is c
            teams.get(getTeamIndex(player)).changeHtmlFile(players.indexOf(pl
        }

        System.out.println("Player " + (players.indexOf(player) + 1) + ", ple
```

SHOW SCREENSHOT OF ADDING ONLY ONE FILE BEGIN PRESENT IN REPOSITORY

- create private static map object in safe and hazardous class -implement a method called getInstance which checks if there already exists a map instance, if there is does not build another map. -In the map creator when the map is being creator the get instance method is called which checks if the map is null or full, If full no more classes can be made so the there is only one static map currently

- Talk about having hundreds of people at the same time -Talk about when the map change occurs -Talk about them seeing the parts they discovered

This section required us to implement a design pattern so as to only have one instance of a map running at all times. This way hundreds of users are able to play against each other without having hundreds of map files corresponding to each user.

The best way which made sense to implement this was using the **Singleton** design pattern. The reason for this was that the singleton design pattern provides one static instance of a class, so when implementing this into our system we would end up having only one instance of a map in the main game which is always changed depending on which player is playing.

Class diagram of singleton design pattern is displayed here

The mapCreator sub-classes safeMapCreator and hazardousMapCreator which were developed in enhancement 2.1, were redesigned to create a static map object which can be accessed globally

```
public Map create(){
    //getInstance method used here to obtain a static instance of the hazardous
    SafeMap map = SafeMap.getInstance();
    map.setMapSize(mapSize);
```



```

        map.generate();
        return map;
    }

```

The Map sub-classes call on a method called `getInstance()`. This method and also the static definition of the Map object is what gives the singleton design.

```

private static SafeMap map = null;

//This method is used to obtain the static instance of the object
static SafeMap getInstance(){
    if(map == null){
        map = new SafeMap();
    }

    return map;
}

```

If the Map object created has already been defined then there cannot exist a new object of that type. Thus there is only one static instance of this object which can be changed globally.

change the below paragraph a bit

The singleton Map object here is changed to the current map which the corresponding player has, and the Map is changed after the player has chosen their direction, this is so they would be able to get reference when choosing their next direction.

```

// Method to get direction which each player would like to move in for the current turn
private void directionsLoop() {
    char direction;//(u, d, l or r) depending on user's desired direction of movement
    boolean validMove;//Condition to break out of while loop when a valid direction is found
    boolean foundTreasure = false;//Condition to check if a player has found treasure

    //Loop through each player in ArrayList
    for (Player player : players) {

        if(!foundTreasure) {
            //At the end of the current player's turn the main html file is changed
            teams.get(getTeamIndex(player)).changeHtmlFile(players.indexOf(player) + 1);
        }

        System.out.println("Player " + (players.indexOf(player) + 1) + ", please enter a direction: ");
    }
}

```

Teams

The design pattern chosen for this enhancement was the **composite design pattern**. This enhancement required us to rethink the Player concept of the game. We

needed to find a way how to add players randomly to a team, this problem was a structural one since this problem deals with the composition of different classes.

//CLASS DIAGRAM FOR DESIGN PATTERN

The reason the composite design pattern was a good choice is because this design pattern structures classes into two types:

1. Leaf
2. Composite

In our case the *Player* object corresponds to the Leaf while the *Team* objects corresponds to the Composite. The reason this works is because a Leaf can be thought of as a unit while a composite contains various leaves, this is just like a team having multiple players in it. Thus a team can be seen as a complex object of multiple singular object.

The composite design pattern goes further with this idea as it allows for composite objects to contain other composite objects, however in our case this would not make as much sense since a team containing a team would not really work well in our game. So our design pattern is a basic implementation of the composite design pattern.

A User interface was implemented as the component within the composite design pattern. This interface is implemented by both the *Player* class and the *Team* class as they are both components with the design pattern.

```
import java.util.ArrayList;

public interface User {
    //The User interface is the component of the composite design pattern

    ArrayList<Position> positions = new ArrayList<Position>();

    //Method used to add a position to the positions ArrayList using the x and y
    void addToPositions(int posx, int posy);
}
```

Given this is a basic implementation of the composite design pattern, the component element of the design pattern is not as useful here, since the enhancement could easily be implemented by just using the *Team* class. This is the reason for the *User* interface not having as much common objects between the *Player* subclass and the *Team* subclass.

When running the program, the user is asked how many teams they would like to play with. This can be seen below.

****INPUT TEXT FROM PROGRAM ASKING USER FOR TEAM NUMBER****

After the user chooses the number of teams within the game, the players are randomly distributed among the teams. All of this is done within *startGame()* method, using the *generateTeam()* method and the *distributeRemainder()* method.//

```
//Holds the players which have been added to a team
ArrayList<Player> addedPlayers = new ArrayList<Player>();

//Now to assign all the player objects to a random team
for (int i = 0; i < game.teamNum; i++) {

    //A new team is created
    Team team;

    //Generate the team
    team = generateTeam(addedPlayers, playersInTeamNum);

    //Add the team to the list of teams in the game
    teams.add(team);
}
```

All the *Player* objects which have already been added to a team are taken into account, this is used so as to add a unique *Player* object to each *Team* object. The random distribution of players is taken care of in the *generateTeam()* method which can be seen below.

```

//Method to generate the teams
Team generateTeam(ArrayList<Player> addedPlayers, int playersInTeamNum){

    Random random = new Random();

    //Check if the current player exists in a team
    boolean playerIsInATeam;

    //Holds a random index of a player
    int rand;

    //A new team is created
    Team team = new Team();

    //Randomly add the specified amount of players to a team
    //Get playerInTeamNum random players from the players array list
    for (int j = 0; j < playersInTeamNum; j++) {

        //At each iteration this check is always initialised to true
        //If there is no matching value in the array list then the while
        playerIsInATeam = false;

        //Keep on looping until a new player index is obtained
        do {
            //A random index is obtained
            rand = random.nextInt(playerNum);

            //If no player has currently been added to a team
            if(addedPlayers.size() == 0){

                //A random index is obtained
                rand = random.nextInt(playerNum);

                //An initial player has been added
                team.addPlayer(players.get(rand));

                addedPlayers.add(players.get(rand));

                //If the size of a team is only one player then this team
                //If not then continue adding players until the maximum i
                if(playersInTeamNum== 1){
                    playerIsInATeam = false;
                }
            }

            //If a player has been added to a team
            else {

                //Initialised to false since we are checking if the curre
                playerIsInATeam = false;

                //Loops through all the players which are already in a te
                //Ends when a player which is not in a team is obtained
            }
        } while (playerIsInATeam == false);
    }
}

```

```

        for (Player player : addedPlayers) {

            //If the current player has already been generated
            if (players.get(rand) == player) {
                playerIsInATeam = true;
            }

            if(!playerIsInATeam){
                //Add the player to the team
                team.addPlayer(players.get(rand));

                addedPlayers.add(players.get(rand));

                //The check is false and the loop is broken
                break;
            }
        }

        //Keep on looping while the current player being obtained is
    } while (playerIsInATeam);

    }

    //Returns a team with the player
    return team;
}

```

This method works by first creating a *Team* object, and then iterates for the total number of players to add to each team. A random index from the *players* array list is obtained and compared to the indexes of the players within the *addedPlayers* array list. If the random index does not match with any of those in *addedPlayers*, then that player is not in any team and can be added to a team, the player is also added to *addedPlayers*. This is repeated for each team.

At the beginning of each game in the *startGame()* method, after obtaining the number of players and teams, two more values are obtained. The *playersInTeamNum* variable is the total number of players in each team which can all be equally divided into a team. The *extraPlayersNum* is the total number of players which are removed so as to be able to divide the number of players equally at first.

```

//get number of players from user
game.playerNum = getPlayerNum();

//get number of teams from user
game.teamNum = getTeamNum();

//The remainder of the total number of players divided by the total number
int extraPlayersNum = playerNum % teamNum;

//The total number of player per team is obtained excluding the extra players
int playersInTeamNum = (playerNum - extraPlayersNum)/teamNum;

```

The extra players are then randomly inputted into random teams using the *distributeRemainder* method.

```
// Method to distribute the remaining player if the players are not evenly distributed
void distributeRemainder(ArrayList<Player> addedPlayers, int extraPlayersNum)

    Random random = new Random();

    //Array list which holds the teams which have already been generated
    ArrayList<Team> obtainedTeams = new ArrayList<Team>();

    //Check if the current player exists in a team
    boolean playerIsInATeam;

    //check if an extra player is already added to the team
    boolean teamIsFull;

    //Holds a random index for the player and the team respectively
    int playerIndex;
    int teamIndex;

    //Obtain a player which is not in a team for extraPlayerNum times
    for(int i = 0; i < extraPlayersNum; i++){

        //First obtain a random unique team
        //This is so only one extra player is added to a team so there would be no duplicates

        //Keep on looping until a new team index is obtained
        do {

            teamIsFull = false;

            //A random index is obtained
            teamIndex = random.nextInt(teamNum);

            //This is used so as to set up the obtainedTeams array list
            if(obtainedTeams.size() == 0){

                obtainedTeams.add(teams.get(teamIndex));

            }

            else{

                for (Team team : obtainedTeams) {

                    //If the current player has already been generated
                    if (teams.get(teamIndex) == team) {
                        teamIsFull = true;
                    }

                }

            }

        }

    }

}
```

```

    }while(teamIsFull);

    //Now a new team is obtained with every iteration

    //Keep on looping until a new player index is obtained
    do {
        //At each iteration the checks are set to false
        playerIsInATeam = false;

        //A random index is obtained
        playerIndex = random.nextInt(playerNum);

        for (Player player : addedPlayers) {

            //If the current player has already been generated
            if (players.get(playerIndex) == player) {
                playerIsInATeam = true;
            }
        }

        if(!playerIsInATeam){
            //Add the player to the team
            teams.get(teamIndex).addPlayer(players.get(playerIndex));

            addedPlayers.add(players.get(playerIndex));

            //The check is set to false and the loop is broken
            break;
        }

    }while(playerIsInATeam);

}
}

```

The method works by looping through each extra player, during iteration a unique team is obtained and after that a unique player is obtained. Code similar to that of the *generateTeam()* method is used.

Code Coverage Statistics

Running The Game