Course: Principals of Software Development – ENSF 409
Lab 3
Instructor: M. Moshirpour
Student Names: Mitchell Sawatzky, Connor Newman
Date Submitted: Feb 5, 2016

Exercise B

Point.java

```
/**
 * ENSF 409 - Lab 3 - Winter 2015
 * Started by: Mahmood Moussavi
 * January 22, 2015
 * Completed by: Mitchell Sawatzky & Connor Newman
 */

class Point {
        private int x, y;

        public Point(int x, int y) {
        this.x = x;
        this.y = y;
        }

        static public double distance(Point a, Point b){
                double diffx = a.x - b.x;
                double diffy = a.y - b.y;
                return Math.sqrt(diffx * diffx + diffy * diffy);
        }

        public String toString(){
        String s = "(" + x + ", " + y + ")";
                return  s;
        }
}
```

Line.java

```
/**
 * ENSF 409 - Lab 3 - Winter 2015
 * Started by: Mahmood Moussavi
 * January 22, 2015
 * Completed by: Mitchell Sawatzky & Connor Newman
 */

class Line {

        Point start, end;
        private static int classID = 0;
```

```
        private int objID;


        public Line(Point a, Point b) {
        start = a;
        end = b;
         objID = ++ classID;
        }



        public double distance(){
            return Point.distance(start, end);
    }


    public String toString()
    {
        String s = "Line " + objID + ": starts at " + start.toString() + ", and ends at " +
end.toString();
        return s;
    }
}
```

Polygon.java

```
/**
 * ENSF 409 - Lab 3 - Winter 20115
 * Started by: Mahmood Moussavi
 * January 22, 2015
 * Completed by: Mitchell Sawatzky & Connor Newman
 */
import java.util.*;

class Polygon {
        private final LinkedHashSet <Line> polygon;
        private int objID;
        private static int classID;
        Iterator <Line> it;

        public Polygon(LinkedHashSet<Line> polygon) {
                  this.polygon = new LinkedHashSet<Line>();
                  for(Line l: polygon)
                           this.polygon.add (l);
                  objID = ++ classID;
                  it = this.polygon.iterator();
```

```
        }

        public Iterator <Line> getLine() {
                it = polygon.iterator();
                return it;
        }

        public static int classID(){
                return classID;
        }

    public String toString() {
        String s = "\nThe lines in polygon " + objID + " are:";
        for (Line l : polygon)
            s += "\n    " + l.toString();

        return s;
    }
}
```

Terminal Output

```
        The lines in polygon 1 are:
            Line 1: starts at (20, 30), and ends at (50, 100)
            Line 2: starts at (50, 100), and ends at (105, 30)
            Line 3: starts at (105, 30), and ends at (20, 30)
        The perimeter of the polygon 1 is 250.18:

        The lines in polygon 2 are:
            Line 4: starts at (120, 130), and ends at (150, 200)
            Line 5: starts at (150, 200), and ends at (200, 130)
            Line 6: starts at (200, 130), and ends at (120, 130)
        The perimeter of the polygon 2 is 242.18:

        The lines in polygon 3 are:
            Line 7: starts at (320, 330), and ends at (250, 400)
            Line 8: starts at (250, 400), and ends at (400, 330)
            Line 9: starts at (400, 330), and ends at (320, 330)
        The perimeter of the polygon 3 is 344.52:
```

Exercise C

Important note regarding Game.java:

The UML diagram, sample program output, and exercise instructions for this project did not include the `create_player` method defined in Game.java, nor did it include a `HumanPlayer, RandomPlayer, BlockingPlayer, or SmartPlayer` class. The exercise instructions did not ask us to define 3 types of AI as well as the Player class. In order for the package to compile, the sections of Game.java referring to the method and classes above were commented out.

Constants.java

```
//Constants.java


/**
 * Provides constants to the rest of the Package.
 * @version 1.0
 * @author Originally written by Mahmood Moussavi, modified by Mitchell Sawatzky and Connor Newman
 * @since Originally written in fall 2001, adapted in 2014, modified in 2016
 */
public interface Constants {
    /**
     * The character to use when the board slot is empty.
     */
        static final char SPACE_CHAR = ' ';


    /**
     * The character to use when Player O has entered into the board.
     */
        static final char LETTER_O = 'O';


    /**
     * The character to use when Player X has entered into the board.
     */
        static final char LETTER_X = 'X';
}
```

Player.java

```
//Player.java


import java.util.Scanner;


/**
 * Provides a container to hold a Player's name and preferred mark (X or O), as well as logic to make
moves.
```

```
 * @author Mitchell Sawatzky and Connor Newman
 * @version 1.0
 * @since Feb 5, 2016
 */
public class Player implements Constants {
    /**
     * The name of the player.
     */
    private String name;

    /**
     * The player's mark, either 'X' or 'O'.
     */
    private char mark;

    /**
     * The player's opponent.
     */
    private Player opp;

    /**
     * The Board to play the game on.
     */
    private Board b;

    /**
     * Constructs a Player Object with a given name, mark, and Board.
     * @param name the Player's name
     * @param mark the Player's mark, either 'X' or 'O'
     * @param b the Board to play the game on
     */
    public Player(String name, char mark, Board b) {
        this.name = name;
        this.mark = mark;
        this.b = b;
    }

    /**
     * Getter function for the Player's name.
     * @return the String name of the player
     */
    public String getName() {
```

```
        return this.name;
    }

    /**
     * Sets the opponent of a given Player to another Player.
     * @param opp the Player opponent
     */
    public void setOpponent(Player opp) {
        this.opp = opp;
    }

    /**
     * Initiate a game of tic-tac-toe with the opponent player.
     */
    public void play() {
        String winner;
        Player p = this;
        while (true) {
            if (b.isFull()) {
                winner = "Nobody";
                break;
            } else if (b.xWins() == 1) {
                winner = this.name;
                break;
            } else if (b.oWins() == 1) {
                winner = this.opp.getName();
                break;
            }
            p.makeMove();
            b.display();
            p = p.opp;
        }
        System.out.printf("\nTHE GAME IS OVER: %s is the winner!\n", winner);
    }

    /**
     * Prompt the user to place their mark on a given board slot retrieved through stdin.
     */
    public void makeMove() {
        int row, col;
        Player p = this;
```

```
        while (true) {
            while (true) {
                System.out.printf("%s, what row should your next %c be placed in? ", p.name, p.mark);
                Scanner input = new Scanner(System.in);
                row = input.nextInt();
                if (row < 0 || row > 2)
                    System.out.printf("\nInvalid row: %d, please try again.\n", row);
                else
                    break;
            }

            while (true) {
                System.out.printf("%s, what column should your next %c be placed in? ", name, mark);
                Scanner input = new Scanner(System.in);
                col = input.nextInt();
                if (col < 0 || col > 2)
                    System.out.printf("\nInvalid column: %d, please try again.\n", col);
                else
                    break;
            }

            if (b.getMark(row, col) == SPACE_CHAR) {
                b.addMark(row, col, mark);
                break;
            } else {
                System.out.printf("\nThe coordinate (%d, %d) has already been used.\n", row, col);
            }
        }
    }
}
```

Referee.java

```
//Referee.java

/**
 * Mediates and controls a game of Tic Tac Toe.
 * Begins the game by printing the board, and then asks Player X to choose
 * @author Mitchell Sawatzky and Connor Newman
 * @version 1.0
 * @since Feb 5, 2016
 */
public class Referee {
```

```
    /**
     * Player X of the game.
     */
    private Player x;

    /**
     * Player O of the game.
     */
    private Player o;

    /**
     * The board to play on.
     */
    private Board b;

    /**
     * Construct a Referee object from Players and a Board.
     * @param board the Board for the referee to control
     * @param xPlayer the player with the mark 'X'
     * @param oPlayer the player with the mark 'O'
     */
    public Referee(Board board, Player xPlayer, Player oPlayer) {
        this.b = board;
        this.x = xPlayer;
        this.o = oPlayer;
    }

    /**
     * Initiate a game with Player X as the starting player.
     */
    public void runTheGame() {
        x.setOpponent(o);
        o.setOpponent(x);

        b.display();
        x.play();

        System.out.println("\033[1mGame ended ...\033[0m");
    }
}
```

Board.java

```
// Board.java
// ENSF 409 - LAB 3 - Ex. C
// This file was originally written for ENGG 335 in fall 2001, and was
// adapted for ENSF 409 in 2014
//

/**
 * Provides a tic-tac-toe board and logic to fill, empty, and test if a player has won.
 * @author Originally written by Mahmood Moussavi, modified by Mitchell Sawatzky and Connor Newman
 * @version 1.0
 * @since Originally written in fall 2001, adapted in 2014, modified in 2016
 */
public class Board implements Constants {
    /**
     * Two-Dimensional char array to hold the values of each slot on the board
     */
        private char theBoard[][];

    /**
     * The total number of slots filled in on the board.
     */
        private int markCount;

    /**
     * Constructs a Board object without any spaces filled in.
     */
        public Board() {
                markCount = 0;
                theBoard = new char[3][];
                for (int i = 0; i < 3; i++) {
                        theBoard[i] = new char[3];
                        for (int j = 0; j < 3; j++)
                                theBoard[i][j] = SPACE_CHAR;
                }
        }

    /**
     * Returns the value of a board slot at a given row and column.
     * @param row the row to retrieve the board slot from
     * @param col the column to retrieve the board slot from
     * @return the Character value of the board slot
     */
```

```
    public char getMark(int row, int col) {
            return theBoard[row][col];
    }

/**
 * Returns whether or not the board has values in all 9 slots.
 * @return True if all 9 slots are full, False otherwise
 */
    public boolean isFull() {
            return markCount == 9;
    }

/**
 * Checks whether or not the letter X has won on the current board.
 * @return 0 if X has not won, 1 otherwise
 */
    public int xWins() {
            return checkWinner(LETTER_X);
    }

/**
 * Checks whether or not the letter O has won on the current board.
 * @return 0 if O has not won, 1 otherwise
 */
    public int oWins() {
            return checkWinner(LETTER_O);
    }

/**
 * Prints the board to stdout.
 */
    public void display() {
            displayColumnHeaders();
            addHyphens();
            for (int row = 0; row < 3; row++) {
                    addSpaces();
                    System.out.print("    row " + row + ' ');
                    for (int col = 0; col < 3; col++)
                            System.out.print("|  " + getMark(row, col) + "  ");
                    System.out.println("|");
                    addSpaces();
                    addHyphens();
```

```
            }
    }

/**
 * Sets the value of the board slot at a given row and column.
 * @param row the row to set the slot value
 * @param col the column to set the slot value
 * @param mark the Character to set the slot to
 */
    public void addMark(int row, int col, char mark) {
            theBoard[row][col] = mark;
            markCount++;
    }

/**
 * Resets every value on the board to SPACE_CHAR.
 */
    public void clear() {
            for (int i = 0; i < 3; i++)
                    for (int j = 0; j < 3; j++)
                            theBoard[i][j] = SPACE_CHAR;
            markCount = 0;
    }

/**
 * Uses tic-tac-toe logic to determine if a specific player has won.
 * @param mark the player to check, either LETTER_X or LETTER_O
 * @return 0 if the player has lost, 1 otherwise
 */
    int checkWinner(char mark) {
            int row, col;
            int result = 0;

            for (row = 0; result == 0 && row < 3; row++) {
                    int row_result = 1;
                    for (col = 0; row_result == 1 && col < 3; col++)
                            if (theBoard[row][col] != mark)
                                    row_result = 0;
                    if (row_result != 0)
                            result = 1;
            }
```

```
            for (col = 0; result == 0 && col < 3; col++) {
                    int col_result = 1;
                    for (row = 0; col_result != 0 && row < 3; row++)
                            if (theBoard[row][col] != mark)
                                    col_result = 0;
                    if (col_result != 0)
                            result = 1;
            }

            if (result == 0) {
                    int diag1Result = 1;
                    for (row = 0; diag1Result != 0 && row < 3; row++)
                            if (theBoard[row][row] != mark)
                                    diag1Result = 0;
                    if (diag1Result != 0)
                            result = 1;
            }
            if (result == 0) {
                    int diag2Result = 1;
                    for (row = 0; diag2Result != 0 && row < 3; row++)
                            if (theBoard[row][3 - 1 - row] != mark)
                                    diag2Result = 0;
                    if (diag2Result != 0)
                            result = 1;
            }
            return result;
    }

/**
 * Print the board's column headers to stdout.
 */
    void displayColumnHeaders() {
            System.out.print("          ");
            for (int j = 0; j < 3; j++)
                    System.out.print("|col " + j);
            System.out.println();
    }

/**
 * Adds a line to separate the board's rows.
 */
```

```
        void addHyphens() {
                System.out.print("          ");
                for (int j = 0; j < 3; j++)
                        System.out.print("+-----");
                System.out.println("+");
        }

    /**
     * Adds spacing inside the board to correctly place the values of the slots.
     */
        void addSpaces() {
                System.out.print("          ");
                for (int j = 0; j < 3; j++)
                        System.out.print("|     ");
                System.out.println("|");
        }
}
```

Game.java

```
//Game.java
import java.io.*;

/**
 * @author Started by: M. Moussavi
 * Completed by: Mitchell Sawatzky and Connor Newman
 * Asks the user to select a player type, creates the player, creates the board,
 * assigns a referee to the game, then initiates the game.
 * @version 1.0
 * @since Feb 2016
 */
public class Game implements Constants {
    /**
     * The Board to play the Game on.
     */
        private Board theBoard;

    /**
     * The Referee to control the Game.
     */
        private Referee theRef;

        /**
```

```
     * creates a board for the game.
     */
public Game( ) {
    theBoard  = new Board();

    }

/**
 * calls the referee method runTheGame
 * @param r refers to the appointed referee for the game
 * @throws IOException when a player inputs something unparsable
 */
public void appointReferee(Referee r) throws IOException {
    theRef = r;
    theRef.runTheGame();
}

    public static void main(String[] args) throws IOException {

            Referee theRef;
            Player xPlayer, oPlayer;
            BufferedReader stdin;
            Game theGame = new Game();
            stdin = new BufferedReader(new InputStreamReader(System.in));
            System.out.print("\nPlease enter the name of the \'X\' player: ");
            String name= stdin.readLine();
            while (name == null) {
                    System.out.print("Please try again: ");
                    name = stdin.readLine();
            }

            // xPlayer = create_player (name, LETTER_X, theGame.theBoard, stdin);
    xPlayer = new Player(name, LETTER_X, theGame.theBoard);
            System.out.print("\nPlease enter the name of the \'O\' player: ");
            name = stdin.readLine();
            while (name == null) {
                    System.out.print("Please try again: ");
                    name = stdin.readLine();
            }

            // oPlayer = create_player (name, LETTER_O, theGame.theBoard, stdin);
    oPlayer = new Player(name, LETTER_O, theGame.theBoard);
```

```
            theRef = new Referee(theGame.theBoard, xPlayer, oPlayer);

        theGame.appointReferee(theRef);
        }

        /**
         * Creates the specified type of player indicated by the user.
         *
         * @param name player's name
         * @param mark player's mark (X or O)
         * @param board refers to the game board
         * @param stdin refers to an input stream
         * @return a newly created player
         * @throws IOException
         */
        // static public Player  create_player(String name, char mark, Board board,
        //              BufferedReader stdin)throws IOException {
        //      // Get the player type.
        //      final int NUMBER_OF_TYPES = 4;
        //      System.out.print ( "\nWhat type of player is " + name + "?\n");
        //      System.out.print("  1: human\n" + "  2: Random Player\n"
        //      + "  3: Blocking Player\n" + "  4: Smart Player\n");
        //      System.out.print( "Please enter a number in the range 1-" + NUMBER_OF_TYPES + ": ");
        //      int player_type = 0;
    //
        //      String input;
        //      stdin = new BufferedReader(new InputStreamReader(System.in));
        //      input= stdin.readLine();
        //      player_type = Integer.parseInt(input);
        //      while (player_type < 1 || player_type > NUMBER_OF_TYPES) {
        //              System.out.print( "Please try again.\n");
        //              System.out.print ( "Enter a number in the range 1-" +NUMBER_OF_TYPES + ": ");
        //              input= stdin.readLine();
        //              player_type = Integer.parseInt(input);
        //      }
    //
        //      // Create a specific type of Player
        //      Player result = null;
        //      switch(player_type) {
        //              case 1:
        //                      result = new HumanPlayer(name, mark, board);
```

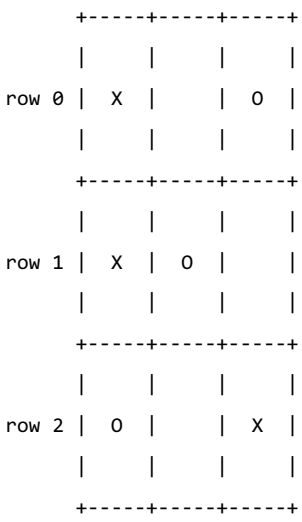
```
        //                      break;
        //              case 2:
        //                      result = new RandomPlayer(name, mark, board);
        //                      break;
        //              case 3:
        //                      result = new BlockingPlayer(name, mark, board);
        //                      break;
        //              case 4:
        //                      result = new SmartPlayer(name, mark, board);
        //                      break;
        //              default:
        //                      System.out.print ( "\nDefault case in switch should not be reached.\n"
        //                      + "  Program terminated.\n");
        //                      System.exit(0);
        //      }
        //      return result;
        // }
}
```

Sample Terminal Output

```
Mitchell@ttys000 11:44 {0} [tic]$ java Game

Please enter the name of the 'X' player: John

Please enter the name of the 'O' player: Sandy
          |col 0|col 1|col 2
          +-----+-----+-----+
          |     |     |     |
    row 0 |     |     |     |
          |     |     |     |
          +-----+-----+-----+
          |     |     |     |
    row 1 |     |     |     |
          |     |     |     |
          +-----+-----+-----+
          |     |     |     |
    row 2 |     |     |     |
          |     |     |     |
          +-----+-----+-----+
John, what row should your next X be placed in? 0
John, what column should your next X be placed in? 0
          |col 0|col 1|col 2
```

```
          +-----+-----+-----+
          |     |     |     |
    row 0 |  X  |     |     |
          |     |     |     |
          +-----+-----+-----+
          |     |     |     |
    row 1 |     |     |     |
          |     |     |     |
          +-----+-----+-----+
          |     |     |     |
    row 2 |     |     |     |
          |     |     |     |
          +-----+-----+-----+
Sandy, what row should your next O be placed in? 0
Sandy, what column should your next O be placed in? 2
          |col 0|col 1|col 2
          +-----+-----+-----+
          |     |     |     |
    row 0 |  X  |     |  O  |
          |     |     |     |
          +-----+-----+-----+
          |     |     |     |
    row 1 |     |     |     |
          |     |     |     |
          +-----+-----+-----+
          |     |     |     |
    row 2 |     |     |     |
          |     |     |     |
          +-----+-----+-----+
John, what row should your next X be placed in? 1
John, what column should your next X be placed in? 0
          |col 0|col 1|col 2
          +-----+-----+-----+
          |     |     |     |
    row 0 |  X  |     |  O  |
          |     |     |     |
          +-----+-----+-----+
          |     |     |     |
    row 1 |  X  |     |     |
          |     |     |     |
          +-----+-----+-----+
          |     |     |     |
```

```
    row 2 |     |     |     |
          |     |     |     |
          +-----+-----+-----+
Sandy, what row should your next O be placed in? 0
Sandy, what column should your next O be placed in? 2

The coordinate (0, 2) has already been used.
Sandy, what row should your next O be placed in? 2
Sandy, what column should your next O be placed in? 0
          |col 0|col 1|col 2
          +-----+-----+-----+
          |     |     |     |
    row 0 |  X  |     |  O  |
          |     |     |     |
          +-----+-----+-----+
          |     |     |     |
    row 1 |  X  |     |     |
          |     |     |     |
          +-----+-----+-----+
          |     |     |     |
    row 2 |  O  |     |     |
          |     |     |     |
          +-----+-----+-----+
John, what row should your next X be placed in? 2
John, what column should your next X be placed in? 2
          |col 0|col 1|col 2
          +-----+-----+-----+
          |     |     |     |
    row 0 |  X  |     |  O  |
          |     |     |     |
          +-----+-----+-----+
          |     |     |     |
    row 1 |  X  |     |     |
          |     |     |     |
          +-----+-----+-----+
          |     |     |     |
    row 2 |  O  |     |  X  |
          |     |     |     |
          +-----+-----+-----+
Sandy, what row should your next O be placed in? 1
Sandy, what column should your next O be placed in? 1
          |col 0|col 1|col 2
```



THE GAME IS OVER: Sandy is the winner!

Game ended ...