CS112 Midterm Examination

GENERAL INSTRUCTIONS

Answer each of the questions below. Write your answers directly on the examination paper, including any work that you wish to be considered for partial credit.

Each question is marked with the number of points assigned to that problem. The total number of points is 50. We intend that the number of points be roughly comparable to the number of minutes you should spend on that problem. Since the problems are not ordered according to difficulty, you may want to first look at all the problems and schedule your time accordingly.

Unless otherwise indicated as part of the instructions for a specific problem, comments will not be required on the exam. Uncommented code that gets the job done will be sufficient for full credit on the problem. On the other hand, comments may help you to get partial credit on a problem if they help us determine what you are trying to do.

The examination is close-book, but you can bring a one-page summary.
YOUR GRADE

PROBLEM 1 (20 points): ____________________

PROBLEM 2 (12 points): ____________________

PROBLEM 3 (18 points): ____________________

TOTAL (50 points): ____________________
Problem 1. Java Expressions and Statements (20 points)

1a [Arithmetic Expression, 3 pt]: What will be printed by the println statement?

```java
int x = 2007;
x = x % 10 + x / 1000 * 1000;
System.out.println( x + " !=" + x / 1000 * 1000.0 );
```

2007 != 2000.0

1b. [Value Conversion, 3 pt] Math.round(double x) returns the closest integer to x. Let n be an integer and x a double. Consider the following two statements:

A) n = (int) (x + 0.5);
B) n = (int) Math.round(x);

Give a value of x so that the two statements will assign n different values. Hint: consider the whole range of x.

x = -0.99

1c. [Strings and Integers, 3 pt] A programmer makes the following two claims (x is an int and s is a String). Which statement is true and which is false?

(A) Integer.parseInt("" + x) is the same as x.

(B) "" + Integer.parseInt(s) is the same as s.

B is false (common error)
1d. [Boolean Expression, 3 pt] Which one of the following conditions does not test whether \( x \) is between 1 and 10 (inclusive)?

A) \( 1 \leq x \ & \ & x \leq 10 \)
B) \( !(x < 1 \ || \ 10 < x) \)
C) \( !(x <= 1 \ || \ x >= 10) \)
D) \( 10 >= x \ & \ & x >= 1 \)

C

1e. [Conditional Statement, 4 pt] Please give values of \( x \) and \( y \) so that the following two code segments will assign \( s \) different values.

```
s = 0;
if (x > 0) s ++;
if (y > 0) s ++;
and
s = 0;
if (x > 0) s ++;
else if (y > 0) s ++;
```

\( x = y = 1 \)

1f. [Loop and Conditional Statement, 4 pt] What is the output of the following code segment?

```
int a = 5;
for (int i = 0; i < 2; i++) {
    a += i;
    switch (a % 4) {
        case 0: System.out.println("zero"); break;
        case 1: System.out.println("one");
        case 2: System.out.println("two"); break;
        default: System.out.println("three"); break;
    } // end of switch
}
```

one
two
two

**Common error:** one

three (assuming jumped to default)
Problem 2. Java Method and Loop (12 points)

In this problem we write a method to find the highest value among the values of all digits of an integer. For example, for integer n = 2077, among the four digits 2, 0, 7, and 7, the largest value is 7. Note that n can be any valid integer value.

public static int largestDigit (int n)

change it to positive: 2 pt    if (n < 0) n = -n;

loop structure:

    initialization: 2 pt    int max = 0;
    termination  2 pt      while (n > 0)
                           {
        update         2 pt         int digit = n % 10;
    maintain max 2 pt      if (digit > max)
                           {
       max = digit;
                           } // end of while

    return: 2pt                return max;
Problem 3. Variables, Object References, Data Scope, and Encapsulation (18 points)

Consider the following two classes representing points and rectangles in a two-dimensional plane. A point is represented as a pair of x and y coordinates, and a rectangle is represented as a pair of points: the points of its top-left and bottom-right corners.

class Point {
  ____ int x;
  ____ int y;
  ____ int totalPointsCreated = 0;
  ____ Point() { A } // a default point at (0, 0)
  ____ Point(int x, int y) { B }
  ____ int getX() { return x; }
  ____ int getY() { return y; }
  ____ int moveX(int dx) { x += dx; return x; }
  ____ int moveY(int dy) { y += dy; return y; }
  ____ int getTotalPointsCreated() { C }
}

class Rectangle {
  private Point tl;
  private Point br;
  public Rectangle() { tl=new Point(); br= new Point(); }
  public Rectangle(Point p1, Point p2) { tl = p1; br = p2; }
  public Point getTopLeft() { return tl; }
  public Point getBottomRight() { return br; }
  public int getWidth() { return br.getX() - tl.getX(); }
  public int getHeight() { return tl.getY() - br.getY(); }
  public int getArea() { return getWidth()*getHeight(); }
}

Consider now the following piece of code:

class Test {
  public static void main(String[] args) {
    Point p1 = new Point(20, 30);
    Point p2 = new Point(80, 5);
    Rectangle r = new Rectangle(p1, p2);
    System.out.println(r.getArea());
    r.getTopLeft().moveX(10);
    r.getBottomRight().moveY(-5);
    System.out.println(r.getArea());
    Rectangle r2 = new Rectangle(r.getTopLeft(), r.getBottomRight());
    r2.getTopLeft().moveX(10);
    System.out.println(r2.getArea());
    System.out.println(r.getArea());
    System.out.println("A total of " + Point.getTotalPointsCreated() + " points were created."); // D
  } // end of main
} // end of class
3.a. [3pt] The method `getTotalPointsCreated()` at point C in the class `Point` is intended to return the total number of `Point` objects ever created. It is used at point D. Give an implementation of the method.

```java
return totalPointsCreated;
```

3.b. [4pt] Please complete the `Point` constructors at places marked A and B. Please consider 3.a.

A: x = 0; y = 0; totalPointsCreated++; 2 pt

B: this.x = x; this.y = y; totalPointsCreated++; 2pt (error: x = x)

3.c. [4pt] Please add access (public/private) and property (static or not) modifiers for the variables and methods defined in class `Point`.

```java
private x;
private y; 1pt
private static totalPointsCreated: 1 pt
public static int getTotalPointsCreated ; 1pt
rest public: 1 pt
```

**common error: private static MoveX()**
3.d. [7pt] What will be printed by the `main()` method?

1500: 1pt
1500: 1pt
1200: 1.5pt
1200: 1.5pt (common error: 1500)
A total of 2 points were created. 2pt (common error: 4 points/7 points)