CSC 1051-001 Algorithms and Data Structures I

Midterm Examination
February 25, 2016

Name:_____________________

<table>
<thead>
<tr>
<th>Question</th>
<th>Value</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Please answer questions in the spaces provided. If you make a mistake or for some other reason need more space, please use the back of pages and clearly indicate where the answer can be found. Good luck!
1. [ /10] What output is produced by the following program?

```java
public class TraceThis {
    public static void main (String[] args) {
        int x = 10;
        int a = 20;
        int b = 30;
        x = a;
        a = b;
        b = 40;
        System.out.println("What gets printed? ");
        System.out.println("x = " + x + " a = " + a + " b = " + b);
        System.out.print ("Let's do this \none\"last time\"");
        System.out.println (".\nPlease count the \"\\\\"s carefully!");
        System.out.println ("Version 1 numbers: " + 4 + 6);
        System.out.println ("Version 2 numbers: " + "4 + 6");
        System.out.println ("Version 3 numbers: " + (4 + 6));
    }
}
```

Output:
2. (_____/ 10)

a) Which of the following code fragments correctly executes three assignments if the condition is true? Mark the correct one and explain your answer, briefly.

i) 
   if (x < 0)
   
   a = b * 2;
   
   y = x;
   
   z = a - y;

ii) 
   if (x < 0)
   
   { 
   a = b * 2;
   
   y = x;
   
   z = a - y;
   }

iii) 
   { 
   if (x < 0)
   
   a = b * 2;
   
   y = x;
   
   z = a - y;
   }

iv) 
   if { (x < 0)
   
   a = b * 2;
   
   y = x;
   
   z = a - y;
   }

b) Which of the code fragments below will add 1 to x if x is positive and subtract 1 from x if x is negative, but leave x alone if x is 0? Explain your answer, briefly.

i) 
   if (x > 0)
   
   x++; 
   
   else 
   
   x--; 

ii) 
   if (x == 0)
   
   x = 0;
   
   else x++; 
   
   x--; 

iii) 
   x++; 
   
   x--; 

iv) 
   if (x > 0)
   
   x++; 
   
   else if (x < 0)
   
   x--;
3. (_____/ 10) What gets printed?
Please show output as it will appear, or indicate “NO OUTPUT”, or show some
of the output followed by “INFINITE LOOP.”

```
int a = 0;
while (a > 0)
{
    System.out.println(a);
    a = a + 3;
}
```

```
int a = 5;
while (a >= 5)
{
    System.out.println(a);
    a++;
}
```

```
int a = 4;
while (a > 0)
{
    System.out.println(a * 2);
    a--;
}
```

```
String word = "ILLUSION";
int x = 0;
while (x < word.length())
{
    System.out.print(word.charAt(x));
    System.out.print(word.charAt(x));
    x++;
}
```
4. (______/10) Using the coordinate system below representing the graphics area of an applet, draw the graphics displayed by the applet, identifying positions MID and TOP (in terms of their use in the applet), and the shapes RECTANGLE, OVAL, LINE.

```java
import javax.swing.JApplet;

public class Quiz4 extends JApplet {
    // Draws something...
    public void paint (Graphics page) {
        final int MID = 40; // MID
        final int TOP = 20; // TOP
        page.drawOval (-20, -20, 40, 40); // OVAL
        page.drawRect (MID, TOP, 20, 40); // RECTANGLE
        page.drawLine (0, 40, 20, 0); // LINE
    }
}
```
5. (_____ / 10) Suppose you look up a class in the Java API and find the following info about the (alas, made-up!) SpringBreak class:

```java
Class SpringBreak
    java.lang.Object
        java.exam.SpringBreak

Constructor Summary
    SpringBreak() Creates a new SpringBreak object.

Method Summary

| void | destination(String x) |
| static boolean | shouldIStayOrShouldIGo(double x) |
```

**a) Write some code to declare variables for two objects of this class, named thing1 and thing2.**

**b) Circle all of the following that are valid Java statements:**

```java
SpringBreak.destination = "Puerto Vallarta";
thing1.destination("Cancun");
thing2.destination(thing1);
SpringBreak.destination("Miami");
System.out.print(thing2.destination("Cancun"));
thing2.shouldIStayOrShouldIGo(21.6) = true;
System.out.print(SpringBreak.shouldIStayOrShouldIGo(32.4));
```
6. [10/10]
a) Given the following declarations:

```java
int iResult, num1 = 7, num2 = 3;
double fResult, val1 = 9.0;
boolean status, part1 = false;
```

What result is stored by each of the following assignment statements?

<table>
<thead>
<tr>
<th>Source code</th>
<th>Result stored</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>fResult = (num1 + 2)/ 2;</code></td>
<td></td>
</tr>
<tr>
<td><code>iResult = num1 % num2;</code></td>
<td></td>
</tr>
<tr>
<td><code>fResult = val1 / 2;</code></td>
<td></td>
</tr>
<tr>
<td><code>fResult = (double) num1 / 2;</code></td>
<td></td>
</tr>
<tr>
<td><code>status = part1 &amp;&amp; (num1 &gt; num2);</code></td>
<td></td>
</tr>
<tr>
<td>`status = part1</td>
<td></td>
</tr>
</tbody>
</table>
7. [ /10] Short answer questions.

a) Given a Random object named gen, what range of values are produced by the following expressions?

- gen.nextInt(4)
- gen.nextInt(20) + 100
- gen.nextInt(4) - 15

b) Write some code that uses the object gen, above, to generate pseudorandom numbers in the following specified ranges (including the endpoints):

- 0 to 9
- -2 to 5

c) Suppose the String variable message is already initialized. Write a Java code fragment that prints out message, one char per line.

d) Write some code that uses the Math class to compute and print out the value of sin(π/2).
8. (_____/ 10) Complete the java code below so that it prints a table for the Investment problem: You put an initial amount (say, $10,000) into a bank account that earns 5% interest per year. Show the yearly returns on your investment until it doubles.

import java.text.NumberFormat;
import java.util.Scanner;
public class Investment
{
    public static void main (String[] args)
    {
        Scanner scan = new Scanner(System.in);

        System.out.print("Enter initial balance:");
double initial = scan.nextDouble();

        int year = 0;
double rate = 0.05;
double balance = initial;

        NumberFormat money = NumberFormat.getCurrencyInstance();
        System.out.println("year" + "	" + "interest" + "	" + "balance");
        System.out.println(year + "	" + money.format(balance));

        ... (keep going until balance >= $20000)
9. [_____/ 10] Write a complete Java program that asks the user to input three integers and then prints the maximum value among the numbers entered. (For example, if the three numbers entered are 7, 43, 7, the program should print 43 as the maximum.

Be sure to write a complete Java program, including class definition, variable and constant declarations, as appropriate, and proper indentation, to make it readable. Include one simple comment describing what the program does (no need need to write lots of comments).
10. [_____/ 10]
Construct an algorithm that inputs some positive numbers from the user, terminated with a zero (sentinel value). The algorithm should print the numbers entered and compute and print their sum. After the sum is printed, print a goodbye message.

**Example:** If the numbers 5 -3 8 0 are entered as input, the algorithm should print:
5
-3
8
Sum = 10
Goodbye

[Note that the terminating zero should NOT be printed.]

**Directions:**
Write your algorithm by rearranging and structuring elements chosen from the list below, using indentation to show structure. Do not use anything else and note that not all of these are needed, but you may use one of them more than once, if necessary.

```
input num
input sum
num = 0
sum = 0
count = 0
num = num + 1
sum = sum + 1
count = count + 1
sum = sum + num
sum = num + 1
if (sum == num)

if (sum < num)
if (num < sum)
else
while (num < sum)
while (sum < num)
while (count < sum)
while (num != 0)
while (num != sum)
print "Sum = " sum
print num
print "Goodbye"
```
REFERENCE MATERIAL

Drawing a Line

\[
\text{page.drawLine (10, 20, 150, 45); page.drawLine (150, 45, 10, 20)};
\]

Drawing a Rectangle

\[
\text{page.drawRect (50, 20, 100, 40)};
\]

Drawing an Oval

\[
\text{page.drawOval (175, 20, 50, 80)};
\]

Drawing an Arc

- An arc is defined by an oval, a start angle, and an arc angle.

\[
\text{An arc is defined by an oval, a start angle, and an arc angle.}
\]
REFERENCE MATERIAL

Random class

<table>
<thead>
<tr>
<th>double</th>
<th>nextDouble()</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns the next pseudorandom, uniformly distributed double value between 0.0 and 1.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>int</th>
<th>nextInt()</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns the next pseudorandom, uniformly distributed int value from this random number generator's sequence.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>int</th>
<th>nextInt(int n)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns a pseudorandom, uniformly distributed int value between 0 (inclusive) and the specified value (exclusive), drawn from this random number generator's sequence.</td>
</tr>
</tbody>
</table>

Some methods and constants of the Math class

<table>
<thead>
<tr>
<th>static double</th>
<th>abs(double a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns the absolute value of a double value.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>static double</th>
<th>cos(double a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns the trigonometric cosine of an angle.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>static double</th>
<th>pow(double a, double b)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns the value of the first argument raised to the power of the second argument.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>static double</th>
<th>random()</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns a double value greater than or equal to 0.0 and less than 1.0.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>static long</th>
<th>round(double a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns the closest long to the argument.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>static double</th>
<th>sin(double a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns the trigonometric sine of an angle.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>static double</th>
<th>sqrt(double a)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns the correctly rounded positive square root of a double value.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>static double</th>
<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value of π (constant)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>static double</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Value of e (constant)</td>
</tr>
</tbody>
</table>

String class

<table>
<thead>
<tr>
<th>boolean</th>
<th>isEmpty()</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns true if, and only if, length() is 0.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>char</th>
<th>charAt(int index)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns the char value at the specified index.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>int</th>
<th>length()</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Returns the length of this string.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>String</th>
<th>toUpperCase()</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Converts all of the characters in this String to upper case using the rules of the default locale.</td>
</tr>
</tbody>
</table>
CSC 1051-002 Algorithms and Data Structures I

Midterm Examination
February 25, 2016

Name:____________________

<table>
<thead>
<tr>
<th>Question</th>
<th>Value</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

Please answer questions in the spaces provided. If you make a mistake or for some other reason need more space, please use the back of pages and clearly indicate where the answer can be found. Good luck!
1. [10] What output is produced by the following program?

```java
public class TraceThis {
    public static void main (String[] args) {
        int x = 10;
        int a = 20;
        int b = 30;
        x = a;
        a = b;
        b = 40;
        System.out.println("What gets printed? ");
        System.out.println("x = " + x + " a = " + a + " b = " + b);
        System.out.print ("Let\'s do this \none\"last time\" ");
        System.out.println (".\nPlease count the \"\\\\\"s carefully! ");
        System.out.println ("Version 1 numbers: " + 4 + 6);
        System.out.println ("Version 2 numbers: " + "4 + 6");
        System.out.println ("Version 3 numbers: " + (4 + 6));
    }
}
```

Output:
2. (_____/ 10)

a) Which of the following code fragments correctly executes three assignments if the condition is true? Mark the correct one and explain your answer, briefly.

i) 
   if (x < 0)
   a = b * 2;
   y = x;
   z = a - y;

ii) 
   if (x < 0)
   {
   a = b * 2;
   y = x;
   z = a - y;
   }

iii) 
   { 
   if (x < 0) 
   a = b * 2;
   y = x;
   z = a - y;
   }

iv) 
   if { (x < 0) 
   a = b * 2;
   y = x;
   z = a - y ;
   }

b) Which of the code fragments below will add 1 to x if x is positive and subtract 1 from x if x is negative, but leave x alone if x is 0? Explain your answer, briefly.

i) 
   if (x > 0)
   x++;
   else
   x--;
3. (_____ / 10) What gets printed?
Please show output as it will appear, or indicate “NO OUTPUT”, or show some of the output followed by “INFINITE LOOP.”

int a = 0;
while (a > 0) {
    System.out.println(a);
    a = a + 3;
}

int a = 5;
while (a >= 5) {
    System.out.println(a);
    a++;
}

int a = 4;
while (a > 0) {
    System.out.println(a * 2);
    a--;
}

String word = "ILLUSION";
int x = 0;
while (x < word.length()) {
    System.out.print(word.charAt(x));
    System.out.print(word.charAt(x));
    x++;
}
4. (____/10) *Using the coordinate system below representing the graphics area of an applet, draw the graphics displayed by the applet, identifying positions MID and TOP (in terms of their use in the applet), and the shapes RECTANGLE, OVAL, LINE.*

```java
import javax.swing.JApplet;
import java.awt.*;

public class Quiz4 extends JApplet
{
    //-----------------------------------------------
    // Draws something...
    //-----------------------------------------------
    public void paint (Graphics page)
    {
        final int MID = 40;       // MID
        final int TOP = 20;       // TOP

        page.drawOval (MID-10, TOP-20, 20,40);  // OVAL
        page.drawRect (0, 0, 30, 40);           // RECTANGLE
        page.drawLine (0, 60, 100, 60) ;         // LINE
    }
}
```

*0 20 40 60 80 100 120 140*

*0 20 40 60 80 100 120 140*
5. (_____/ 10) Suppose you look up a class in the Java API and find the following info about the (alas, made-up!) SpringBreak class:

```java
Class SpringBreak
java.lang.Object
    java.exam.SpringBreak

Constructor Summary
SpringBreak()
    Creates a new SpringBreak object.

Method Summary
void destination(String x)
static boolean shouldIStayOrShouldIGo(double x)
```

a) Write some code to declare variables for two objects of this class, named thing1 and thing2.

b) Circle all of the following that are valid Java statements:

```java
SpringBreak.destination = "Puerto Vallarta";
thing1.destination("Cancun");
thing2.destination(thing1);
SpringBreak.destination("Miami");
System.out.print(thing2.destination("Cancun"));
thing2.shouldIStayOrShouldIGo(21.6) = true;
System.out.print(SpringBreak.shouldIStayOrShouldIGo(32.4));
```
6. [       /10]
a) Given the following declarations:

```java
int iResult, num1 = 7, num2 = 3;
double fResult, val1 = 9.0;
boolean status, part1 = false;
```

What result is stored by each of the following assignment statements?

<table>
<thead>
<tr>
<th>Source code</th>
<th>Result stored</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>fResult = (num1 + 2)/ 2;</code></td>
<td></td>
</tr>
<tr>
<td><code>iResult = num1 % num2;</code></td>
<td></td>
</tr>
<tr>
<td><code>fResult = val1 / 2;</code></td>
<td></td>
</tr>
<tr>
<td><code>fResult = (double) num1 / 2;</code></td>
<td></td>
</tr>
<tr>
<td><code>status = part1 &amp;&amp; (num1 &gt; num2);</code></td>
<td></td>
</tr>
<tr>
<td>`status = part1</td>
<td></td>
</tr>
</tbody>
</table>
7. [ /10] Short answer questions.

a) Given a Random object named \texttt{gen}, what range of values are produced by the following expressions?

- \texttt{gen.nextInt(4)}
- \texttt{gen.nextInt(20) + 100}
- \texttt{gen.nextInt(4) - 15}

b) Write some code that uses the object \texttt{gen}, above, to generate pseudorandom numbers in the following specified ranges (including the endpoints):

- 0 to 9
- -2 to 5

c) Suppose the \texttt{String} variable \texttt{message} is already initialized. Write a Java code fragment that prints out \texttt{message}, one char per line.

d) Write some code that uses the Math class to compute and print out the value of $\sin(\pi/2)$. 
8. (_____/ 10) Complete the java code below so that it prints a table for the Investment problem: You put an initial amount (say, $10,000) into a bank account that earns 5% interest per year. Show the yearly returns on your investment until it doubles.

import java.text.NumberFormat;
import java.util.Scanner;
public class Investment {
    public static void main (String[] args) {
        Scanner scan = new Scanner(System.in);

        System.out.print("Enter initial balance:");
        double initial = scan.nextDouble();

        int year = 0;
        double rate = 0.05;
        double balance = initial;

        NumberFormat money = NumberFormat.getCurrencyInstance();

        System.out.println("year\tinterest\tbalance");
        System.out.println (year + "\t" + money.format(balance));

        } }
9. [______/ 10] Write a complete Java program that asks the user to input three integers and then prints the maximum value among the numbers entered. (For example, if the three numbers entered are 7, 43, 7, the program should print 43 as the maximum.

Be sure to write a complete Java program, including class definition, variable and constant declarations, as appropriate, and proper indentation, to make it readable. Include one simple comment describing what the program does (no need need to write lots of comments).
10. [____/ 10]
Consruct an algorithm that inputs some positive numbers from the user, terminated with a zero (sentinel value). The algorithm should print the numbers entered and compute and print their sum. After the sum is printed, print a goodbye message.

Example: If the numbers 5 -3 8 0 are entered as input, the algorithm should print:

```
5
-3
8
Sum = 10
Goodbye
```

[Note that the terminating zero should NOT be printed.]

Directions:
Write your algorithm by rearranging and structuring elements chosen from the list below, using indentation to show structure. Do not use anything else and note that not all of these are needed, but you may use one of them more than once, if necessary.

```
input num
input sum
num = 0
sum = 0
count = 0
num = num + 1
sum = sum + 1
count = count + 1
sum = sum + num
sum = num + 1
if (sum == num)

if (sum < num)
if (num < sum)
else
while (num < sum)
while (sum < num)
while (count < sum)
while (num != 0)
while (num != sum)
print “Sum = ” sum
print num
print “Goodbye”
```
REFERENCE MATERIAL

Drawing a Rectangle

\[
\begin{align*}
\text{page.drawLine} & \quad (10, 20, 150, 45) ; \\
\text{page.drawLine} & \quad (150, 45, 10, 20) ;
\end{align*}
\]

Drawing an Arc

- An arc is defined by an oval, a start angle, and an arc angle.

Drawing a Line

\[
\begin{align*}
\text{page.drawLine} & \quad (10, 20, 150, 45) ; \\
\text{page.drawLine} & \quad (150, 45, 10, 20) ;
\end{align*}
\]

Drawing an Oval

\[
\begin{align*}
\text{page.drawOval} & \quad (175, 20, 50, 80) ;
\end{align*}
\]

Drawing an Arc

- An arc is defined by an oval, a start angle, and an arc angle.
REFERENCE MATERIAL

Random class

<table>
<thead>
<tr>
<th>double</th>
<th><code>nextDouble()</code></th>
</tr>
</thead>
<tbody>
<tr>
<td>Returns the next pseudorandom, uniformly distributed <code>double</code> value between 0.0 and 1.0</td>
<td></td>
</tr>
</tbody>
</table>

| int | `nextInt()` |
| Returns the next pseudorandom, uniformly distributed `int` value from this random number generator's sequence. |

| int | `nextInt(int n)` |
| Returns a pseudorandom, uniformly distributed `int` value between 0 (inclusive) and the specified value (exclusive), drawn from this random number generator's sequence. |

Some methods and constants of the Math class

| static double | `abs(double a)` |
| Returns the absolute value of a `double` value. |

| static double | `cos(double a)` |
| Returns the trigonometric cosine of an angle. |

| static double | `pow(double a, double b)` |
| Returns the value of the first argument raised to the power of the second argument. |

| static double | `random()` |
| Returns a `double` value greater than or equal to 0.0 and less than 1.0. |

| static long | `round(double a)` |
| Returns the closest `long` to the argument. |

| static double | `sin(double a)` |
| Returns the trigonometric sine of an angle. |

| static double | `sqrt(double a)` |
| Returns the correctly rounded positive square root of a `double` value. |

| static double | `PI` |
| Value of π (constant) |

| static double | `E` |
| Value of e (constant) |

String class

| boolean | `isEmpty()` |
| Returns true if, and only if, `length()` is 0. |

| char | `charAt(int index)` |
| Returns the char value at the specified index. |

| int | `length()` |
| Returns the length of this string. |

| String | `toUpperCase()` |
| Converts all of the characters in this String to upper case using the rules of the default locale. |