CSC 1051 Algorithms and Data Structures I

Midterm Examination
March 2, 2017

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>
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<tr>
<td>2</td>
<td>10</td>
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<td>3</td>
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<td>4</td>
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<td>20</td>
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</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 gets printed? Please show output as it will appear, or indicate “NO OUTPUT”, or show some of the output followed by “INFINITE LOOP.”

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

Output:

```java
int a = 3;
while (a > 0)
{
    System.out.println(a * 2);
    a--;
}
```

Output:

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

Output:

```java
String word = "visual";
int x = 0;
while (x < word.length())
{
    System.out.print(word.charAt(x));
    System.out.print(word.charAt(x));
    x++;
}
```

Output:
2. (_____/ 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 FunShapes 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
    }
}
```

![](image)
3. [________/ 20]

Construct an algorithm that inputs three integers n, m, and d. The algorithm should count up by increments of d, starting from n and stopping at m. After it is done printing the numbers, it should print a goodbye message. You can assume that the numbers entered will be positive integers with n < m, so you do NOT need to check for mistakes in the input.

Example 1: If the inputs are 7, 25, 4, then the algorithm should print:

7  11  15  19  23
Goodbye

Example 2: If the inputs are 12, 32, 5, then the algorithm should print:

12  17  22  27  32
Goodbye

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 n  
input m  
input d  
input n + d  
n = 0  
m= 0  
d = 0  
n = n + d  
n = m  
m = n  
d = d + 1  
n = n +1  
if (n > 0)  
if (n < m)  
else  
while (n < m)  
while (n <= m)  
while (n > m)  
while (d > 0)  
while (d >= 0)  
while (d < m)  
print n  
print m  
print d  
print "Goodbye"
4. [ /20] What output is produced by the following program?

```java
public class OneMoreTime
{
    public static void main (String[] args)
    {
        int x = 12, a = 13, b = 14, c = 15;

        System.out.println("Howdy, here are some numbers: ");
        System.out.println("x = " + x + " a = " + a + " b = " + b
                          + " c = " + c);
        System.out.println ("I promise\nthis is the \n"last time\n ");

        System.out.println ("you have to do this ");
        System.out.println ("so\nplease count the \"\\"s carefully!");

        if (a>0)
            if (b<0)
                x = x + 5;
        else
            if (a>5)
                x = x + 4;
        else
                x = x + 3;
        else
            x = x + 2;

        System.out.println();
        System.out.println("Here are the numbers after the if/else: ");
        System.out.println("x = " + x + " a = " + a + " b = " + b
                          + " c = " + c);
        System.out.println();
        c = a;
        a = b;
        b = 2000;
        System.out.println("Here are the final values: ");
        System.out.println("x = " + x + " a = " + a + " b = " + b
                          + " c = " + c);
    }
}
```

**Output:**
5. [ /20] Short answer questions.

a) For each of the following expressions, indicate the order in which the operations are performed by writing a number beneath each operator.

\[
\frac{a}{b - c} / e + f
\]

\[
\frac{a}{b - d * e + f}
\]

b) The code below is supposed to print the numbers from 1 to 10, but it has an error.

```java
int count = 1;
while (count <= 10)
{
    System.out.println (count);
    count++;
}
```

i) Describe the error and how to correct it?

ii) If not corrected, what, if anything gets printed?

iii) Is this a syntax, runtime, or logical error?

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

- \texttt{gen.nextInt(6)}
- \texttt{gen.nextInt(30) + 10}
- \texttt{gen.nextInt(3) - 8}

a) Given the following declarations:

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

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

<table>
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</tr>
</thead>
<tbody>
<tr>
<td>\texttt{fResult = (num1 + 2)/ 2;}</td>
<td></td>
</tr>
<tr>
<td>\texttt{iResult = num1 % num2;}</td>
<td></td>
</tr>
<tr>
<td>\texttt{fResult = val1 / 2;}</td>
<td></td>
</tr>
<tr>
<td>\texttt{fResult = (double) num1 / 2;}</td>
<td></td>
</tr>
<tr>
<td>\texttt{status = part1 &amp;&amp; (num1 &gt; num2);}</td>
<td></td>
</tr>
<tr>
<td>\texttt{status = part1</td>
<td></td>
</tr>
</tbody>
</table>

a) Fill in the blanks

```java
String word = "overdrive";
int num = word.length();

num ___ word.charAt(1)___
word.charAt(4) ___ word.charAt(num-1) ___

int n = 0;
while (n < word.length())
{
    if(word.charAt(n) > 'p')
        System.out.print(word.charAt(n) + "a");
    n++;
}
```

Output: 

b) Suppose the String variable `word` is already initialized (similar to part (a), but not necessarily with the same value). Write a Java code fragment to prints `word`, BACKWARDS.

c) Suppose you would like to display 1000 "snowflakes" on your applet by drawing white ovals of varying sizes, 2-5 pixels in width and height. Fill in the blanks to complete the following code fragment to do this.

```java
final int WIDTH = 500, HEIGHT = 300; // applet dimensions
Random rand = new Random();
int count = 1;
while (count ______________)
{
    int x = rand.nextInt(___________________);
    int y = _______________________________
    int size = ______________________________
    page.fillOval(_______,________,_______,_______);
    count++;
}
```
Drawing a Line

```javascript
page.drawLine (10, 20, 150, 45);
page.drawLine (150, 45, 10, 20);
```

Drawing a Rectangle

```javascript
page.drawRect (50, 20, 100, 40);
```

Drawing an Oval

```javascript
page.drawOval (175, 20, 50, 80);
```

Drawing an Arc

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

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

**Math class**

<table>
<thead>
<tr>
<th>Type</th>
<th>Method</th>
<th>Description</th>
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<td>static double</td>
<td><code>abs(double a)</code></td>
<td>Returns the absolute value of a double value.</td>
</tr>
<tr>
<td>static double</td>
<td><code>cos(double a)</code></td>
<td>Returns the trigonometric cosine of an angle.</td>
</tr>
<tr>
<td>static double</td>
<td><code>pow(double a, double b)</code></td>
<td>Returns the value of the first argument raised to the power of the second argument.</td>
</tr>
<tr>
<td>static double</td>
<td><code>random()</code></td>
<td>Returns a double value greater than or equal to 0.0 and less than 1.0.</td>
</tr>
<tr>
<td>static long</td>
<td><code>round(double a)</code></td>
<td>Returns the closest long to the argument.</td>
</tr>
<tr>
<td>static double</td>
<td><code>sin(double a)</code></td>
<td>Returns the trigonometric sine of an angle.</td>
</tr>
<tr>
<td>static double</td>
<td><code>sqrt(double a)</code></td>
<td>Returns the correctly rounded positive square root of a double value.</td>
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**String class**

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<tr>
<td>char</td>
<td><code>charAt(int index)</code></td>
<td>Returns the char value at the specified index.</td>
</tr>
<tr>
<td>int</td>
<td><code>compareTo(String anotherString)</code></td>
<td>Compares two strings lexicographically.</td>
</tr>
<tr>
<td>int</td>
<td><code>indexOf(int ch)</code></td>
<td>Returns the index within this string of the first occurrence of the specified character.</td>
</tr>
<tr>
<td>boolean</td>
<td><code>isEmpty()</code></td>
<td>Returns true if, and only if, length() is 0.</td>
</tr>
<tr>
<td>int</td>
<td><code>length()</code></td>
<td>Returns the length of this string.</td>
</tr>
<tr>
<td>String</td>
<td><code>replace(char oldChar, char newChar)</code></td>
<td>Returns a new string resulting from replacing all occurrences of oldChar in this string with newChar.</td>
</tr>
<tr>
<td>String</td>
<td><code>startsWith(String prefix)</code></td>
<td>Tests if this string starts with the specified prefix.</td>
</tr>
<tr>
<td>String</td>
<td><code>substring(int beginIndex)</code></td>
<td>Returns a new string that is a substring of this string.</td>
</tr>
<tr>
<td>String</td>
<td><code>substring(int beginIndex, int endIndex)</code></td>
<td>Returns a new string that is a substring of this string.</td>
</tr>
<tr>
<td>String</td>
<td><code>toLowerCase()</code></td>
<td>Converts all of the characters in this String to lower case using the rules of the default locale.</td>
</tr>
<tr>
<td>String</td>
<td><code>trim()</code></td>
<td>Returns a copy of the string, with leading and trailing whitespace omitted.</td>
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</table>
# CSC 1051 Algorithms and Data Structures I

## Midterm Examination

*March 2, 2017*

**Name:**

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</tr>
<tr>
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<td>20</td>
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</tr>
<tr>
<td>4</td>
<td>20</td>
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<td>5</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td></td>
</tr>
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*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 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 = 3;
while (a >= 0)
{
    System.out.println(a);
    a++;
}

int a = 3;
while (a > 0)
{
    System.out.println(a * 2);
    a--;
}

String word = "whywhy";
int x = 0;
while (x < word.length())
{
    System.out.print(word.charAt(x));
    System.out.print(word.charAt(x));
    x++;
}
```

Output:

```text
NO OUTPUT
```

Output:

```
3
4
5
... INFINITE LOOP
```

Output:

```
6
4
2
```

Output:

```
wwhhyywwhhyy
```

Villanova University    CSC 1051    www.csc.villanova.edu/~map/1051    Dr. Papalaskari
2. (_____/ 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 FunShapes 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
    }
}
```

3. [________/ 20]
Construct an algorithm that inputs three integers n, m, and d. The algorithm should count up by increments of d, starting from n and stopping at m. After it is done printing the numbers, it should print a goodbye message. You can assume that the numbers entered will be positive integers with n<m, so you do NOT need to check for mistakes in the input.

Example 1: If the inputs are 7, 25, 4, then the algorithm should print:

7 11 15 19 23
Goodbye

Example 2: If the inputs are 12, 32, 5, then the algorithm should print:

12 17 22 27 32
Goodbye

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 n  
input m  
input d  
input n + d  
n = 0  
m = 0  
d = 0  
n = n+ d  
n = m  
m = n  
d = d + 1  
n = n +1  
if (n > 0)
if (n < m)  
else  
while (n < m)  
while (n <= m)  
while (n > m)  
while (d > 0)  
while (d >= 0)  
while (d < m)  
print n  
print m  
print d  
print "Goodbye"

input n  
input m  
input d  
while (n <= m)  
  print n  
  n = n + d  
print "Goodbye"

NOTE: other correct solutions are possible.
What output is produced by the following program?

```java
public class OneMoreTime {
    public static void main (String[] args) {
        int x = 12, a = 13, b = 14, c = 15;

        System.out.println("Howdy, here are some numbers: ");
        System.out.println("x = " + x + " a = " + a + " b = " + b + " c = " + c);
        System.out.println ("I promise\nthis is the \n"last time\" ");
        System.out.print ("you have to do this ");
        System.out.println ("so\nplease count the \"\"s carefully!\" ");

        if (a>0)
            if (b<0)
                x = x + 5;
            else
                if (a>5)
                    x = x + 4;
                else
                    x = x + 3;
        else
            x = x + 2;

        System.out.println();
        System.out.println("Here are the numbers after the if/else: ");
        System.out.println("x = " + x + " a = " + a + " b = " + b + " c = " + c);
        System.out.println();
        c = a;
        a = b;
        b = 2000;
        System.out.println("Here are the final values: ");
        System.out.println("x = " + x + " a = " + a + " b = " + b + " c = " + c);
    }
}
```

Output:

```
Howdy, here are some numbers: 
x = 12 a = 13 b = 14 c = 15
I promise
this is the "last time"
you have to do this so please count the "\"s carefully!

Here are the numbers after the if/else:
x = 16 a = 13 b = 14 c = 15

Here are the final values:
x = 16 a = 14 b = 2000 c = 13
```
5. [ /20] Short answer questions.

a) For each of the following expressions, indicate the order in which the operations are performed by writing a number beneath each operator.

\[
\begin{align*}
\frac{a}{b-c}/e+f & \quad \underline{2} & \underline{1} & \underline{3} & \underline{4} \\
\frac{a}{b-d* e+f} & \quad \underline{1} & \underline{3} & \underline{2} & \underline{4}
\end{align*}
\]

b) The code below is supposed to print the numbers from 1 to 10, but it has an error.

```java
int count = 1;
while (count <= 10)
{
    System.out.println (count);
    count++;
}
```

i) Describe the error and how to correct it? __
   Incorrect semicolon after while __
ii) If not corrected, what, if anything gets printed? ____Nothing -- infinite loop____
iii) Is this a syntax, runtime, or logical error? Logic

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

- `gen.nextInt(6)` ________ 0 to 5
- `gen.nextInt(30) + 10` ________ 10 to 39
- `gen.nextInt(3) - 8` ________ -8 to -6

d) Given the following declarations:

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

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

<table>
<thead>
<tr>
<th>Source code</th>
<th>Result stored</th>
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<tr>
<td><code>fResult = (num1 + 2)/ 2;</code></td>
<td>4.0</td>
</tr>
<tr>
<td><code>iResult = num1 % num2;</code></td>
<td>1</td>
</tr>
<tr>
<td><code>fResult = val1 / 2;</code></td>
<td>4.5</td>
</tr>
<tr>
<td><code>fResult = (double) num1 / 2;</code></td>
<td>3.5</td>
</tr>
<tr>
<td><code>status = part1 &amp;&amp; (num1 &gt; num2);</code></td>
<td>false</td>
</tr>
<tr>
<td>`status = part1</td>
<td></td>
</tr>
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</table>

a) Fill in the blanks

```java
String word = "blank";
int num = word.length();

num _5_ word.charAt(1) _1_
word.charAt(2) _a_ word.charAt(num-1) _k_
```

```java
int n = 0;
while (n < word.length())
{
    if(word.charAt(n)< 'k')
        System.out.print(word.charAt(n) + "$");
    n++;
}
```

b) Suppose the String variable word is already initialized (similar to part (a), but not necessarily with the same value). Write a Java code fragment to prints word, BACKWARDS.

```java
int count = word.length();
while (count >= 0)
{
    System.out.print(message.charAt(count));
    count --;
}
```

c) Suppose you would like to display 1000 “snowflakes” on your applet by drawing white ovals of varying sizes – 2-5 pixels in width and height. Fill in the blanks to complete the following code fragment to do this.

```java
final int WIDTH = 500, HEIGHT = 300; // applet dimensions
Random rand = new Random();
int count = 1;
while (count __<=1000__________)
{
    int x = rand.nextInt(__WIDTH_________);
    int y = __rand.nextInt(__HEIGHT_________);
    int size = _rand.nextInt(_4______) + 2;
    page.fillOval(__x__,__y__,__size__,__size______);
    count++;
}
```
Drawing a Line

```
page.drawLine (10, 20, 150, 45);
```

or

```
page.drawLine (150, 45, 10, 20);
```

Drawing a Rectangle

```
page.drawRect (50, 20, 100, 40);
```

Drawing an Oval

```
page.drawOval (150, 20, 50, 80);
```

Drawing an Arc

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

```
drawArc(10, 10, 60, 30, 30, 90)
```
### Random class

<table>
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<tr>
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<th>Method</th>
<th>Description</th>
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<td>double</td>
<td><code>nextDouble()</code></td>
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<td>int</td>
<td><code>nextInt(int n)</code></td>
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### Math class

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<td><code>cos(double a)</code></td>
<td>Returns the trigonometric cosine of an angle.</td>
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<tr>
<td><code>pow(double a, double b)</code></td>
<td>Returns the value of the first argument raised to the power of the second argument.</td>
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<td><code>random()</code></td>
<td>Returns a double value greater than or equal to 0.0 and less than 1.0.</td>
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<tr>
<td><code>round(double a)</code></td>
<td>Returns the closest long to the argument.</td>
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<td><code>sin(double a)</code></td>
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<td><code>sqrt(double a)</code></td>
<td>Returns the correctly rounded positive square root of a double value.</td>
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### String class

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<th>Method</th>
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<tbody>
<tr>
<td>char <code>charAt(int index)</code></td>
<td>Returns the char value at the specified index.</td>
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<tr>
<td>int <code>compareTo(String anotherString)</code></td>
<td>Compares two strings lexicographically.</td>
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<tr>
<td>int <code>indexOf(int ch)</code></td>
<td>Returns the index within this string of the first occurrence of the specified character.</td>
</tr>
<tr>
<td>boolean <code>isEmpty()</code></td>
<td>Returns true if, and only if, <code>length()</code> is 0.</td>
</tr>
<tr>
<td>int <code>length()</code></td>
<td>Returns the length of this string.</td>
</tr>
<tr>
<td>String <code>replace(char oldChar, char newChar)</code></td>
<td>Returns a new string resulting from replacing all occurrences of oldChar in this string with newChar.</td>
</tr>
<tr>
<td>boolean <code>startsWith(String prefix)</code></td>
<td>Tests if this string starts with the specified prefix.</td>
</tr>
<tr>
<td>String <code>substring(int beginIndex)</code></td>
<td>Returns a new string that is a substring of this string.</td>
</tr>
<tr>
<td>String <code>substring(int beginIndex, int endIndex)</code></td>
<td>Returns a new string that is a substring of this string.</td>
</tr>
<tr>
<td>String <code>toLowerCase()</code></td>
<td>Converts all of the characters in this String to lower case using the rules of the default locale.</td>
</tr>
<tr>
<td>String <code>trim()</code></td>
<td>Returns a copy of the string, with leading and trailing whitespace omitted.</td>
</tr>
</tbody>
</table>