CSC 1051 Algorithms and Data Structures I

Midterm Examination
March 1, 2018

Name:________________________________________

<table>
<thead>
<tr>
<th>Question</th>
<th>Value</th>
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<tbody>
<tr>
<td>1</td>
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<td>20</td>
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</tr>
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<td>TOTAL</td>
<td>100</td>
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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. (_____/ 20) What gets printed? Please show output as it will appear, or indicate “NO OUTPUT”. If there is an infinite loop, be sure to show some lines of the output followed by “… INFINITE LOOP”.

```java
int a = 1;
while (a < 7)
{
    if ((a%2)==0)
        System.out.println(a);
    a++;
}
```

```java
int a = 1;
while (a <= 20)
{
    System.out.println(a);
    a += 5;
}
```

```java
int a = 8;
do
{
    System.out.println(a);
    a--;
} while (a < 5);
```

```java
size = 14;
do
{
    System.out.print(size + " => ");
    int category = size / 4;
    switch(category)
    {
    case 3:
        System.out.print ("X");
        // note: no break here
    case 2:
        System.out.println ("L");
        break;
    case 1:
        System.out.println ("M");
        break;
    case 0:
        System.out.print ("S");
    }
    size = size - 2;
} while (size >= 2);
```

```java
for (int a = 3; a > 8; a++)
    System.out.print(a);
```
2. [20] What output is produced by the following program?

```java
public class OneMoreTime {
    public static void main (String[] args) {
        int x = 1, a = 2, b = 3, c = 4;

        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.println ("you have to do this ");
        System.out.println ("so please 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 = 100;
        System.out.println("Here are the final values: ");
        System.out.println("x = " + x + " a = " + a + " b = " + b + " c = " + c);
    }
}
```

Output:

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

\[ \frac{a}{b} - d \times e + f \quad \frac{a}{(b + c)} / e - f \]

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 `gen`, what range of values are produced by the following expressions?

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

d) Fill in the blanks

```java
String word = "plaintalkin";
int num = word.length();
num __ word.charAt(1)____ word.charAt(4)____
word.subString(1)________________________

for (int n = 0; n < word.length(); n +=4)
    System.out.println(word.charAt(n) + ":");
```

Output:


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

a) Given the following declarations:
\[
\begin{align*}
\text{int } & \text{iResult, num1 = 7, num2 = 3;} \\
\text{double } & \text{fResult, val1 = 9.0;} \\
\text{boolean } & \text{status, part1 = false;}
\end{align*}
\]

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

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<td></td>
</tr>
<tr>
<td>( iResult = \text{num1} % \text{num2}; )</td>
<td></td>
</tr>
<tr>
<td>( fResult = \text{val1} / 2; )</td>
<td></td>
</tr>
<tr>
<td>( fResult = (\text{double}) \text{num1} / 2; )</td>
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<tr>
<td>( \text{status} = \text{part1} &amp;&amp; (\text{num1} &gt; \text{num2}); )</td>
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</tr>
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BE SURE TO INDICATE RESULTS OF TYPE double BY USING A DECIMAL POINT
For example: 3.0 (for double) vs. 3 (for int).

b) Consider the following code fragments to compute the GPA of a student:

<table>
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<td>( \text{int qp = 35;} )</td>
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</tr>
<tr>
<td>( \text{int credits = 10;} )</td>
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<td>( \text{double gpa = (double) qp / credits;} )</td>
<td>( \text{double gpa = (double)(qp / credits);} )</td>
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- Which version will compute the correct value for the GPA? ________________
- What is the value calculated by the other one? ________________

c) Suppose your code has already calculated the value of \( \text{num} \) as the number of dimes to give out as change. Rewrite the following output statement using the conditional operator, so that it prints “1 Dime” instead of “1 Dimes” in cases where \( \text{num} = 1. \)

\( \text{System.out.println ("Your change is " + num + "Dimes");} \)
Construct an algorithm that inputs a number num and then prints “Hello” that many times. After the “Hello”s are printed, print a goodbye message.

Example: If num (i.e., the input) is 5, the algorithm should print something like this:

Hello
Hello
Hello
Hello
Hello
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 num
input count
count = 1
count = 0
count = count + 1
num = num + 1
if (count < num)
else
while (count <= num)
while (count != 5)
while (count <= 5)
print "Hello"
print num
print "Goodbye"
```
## Random class

<table>
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<th>Method</th>
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<td>double <code>nextDouble()</code></td>
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<td>int <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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<td>Returns the trigonometric cosine of an angle.</td>
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<td>static double <code>pow(double a, double b)</code></td>
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<td>static double <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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<td>static long <code>round(double a)</code></td>
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<td>Returns the char value at the specified index.</td>
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<td>int <code>compareTo(String anotherString)</code></td>
<td>Compares two strings lexicographically.</td>
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<td>int <code>indexOf(int ch)</code></td>
<td>Returns the index within this string of the first occurrence of the specified character.</td>
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<tr>
<td>boolean <code>isEmpty()</code></td>
<td>Returns true if, and only if, <code>length()</code> is 0.</td>
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<td>int <code>length()</code></td>
<td>Returns the length of this string.</td>
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<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>
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<td>boolean <code>startsWith(String prefix)</code></td>
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<td>String <code>substring(int beginIndex)</code></td>
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<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>
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<td>String <code>trim()</code></td>
<td>Returns a copy of the string, with leading and trailing whitespace omitted.</td>
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1. (_____/ 20) What gets printed? Please show output as it will appear, or indicate “NO OUTPUT”. If there is an infinite loop, be sure to show some lines of the output followed by “... INFINITE LOOP”.

```java
int a = 2;
while (a < 4)
{
    System.out.println(a + 3);
    a++;
}
```

```java
int a = 1;
while (a > 10)
{
    System.out.println(a);
    a = a + 15;
}
```

```java
int a = 6;
do
{
    System.out.println(a);
    a--;
}
while (a < 5);
```

```java
for (int a = 3; a < 6; a++)
    System.out.print(a);
```

```java
int size = 10;
do
{
    System.out.print(size + " => ");
    int category = size / 3;
    switch(category)
    {
    case 0:
        System.out.print("X");
        // note: no break here
    case 1:
        System.out.println("S");
        break;
    case 2:
        System.out.println("M");
        break;
    case 3:
        System.out.println("L");
    }
    size = size - 2;
}
while (size >= 0);
```
2. [ /20] What output is produced by the following program?

```java
public class OneMoreTime {
    public static void main(String[] args) {
        int x = 10, a = 20, b = 30, c = 40;

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

        System.out.println("you have to do this ");
        System.out.println("so please 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 = 100;
        System.out.println("Here are the final values: ");
        System.out.println("x = " + x + " a = " + a + " b = " + b
                         + " c = " + c);
    }
}
```

Output:

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

\[
a / (b - d) \times e + f \quad a / b + c / e - f
\]

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 `gen`, what range of values are produced by the following expressions?

- `gen.nextInt(8)`
- `gen.nextInt(50) + 10`
- `gen.nextInt(8) - 10`

d) Fill in the blanks

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

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

for (int n = 0; n < word.length(); n++)
    if (word.charAt(n) == 'e')
        System.out.print(word.charAt(n) + "a");

```
Output:
```

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

a) Given the following declarations:
\[
\text{int } iResult, \text{ num1 } = 7, \text{ num2 } = 3; \\
\text{double } fResult, \text{ val1 } = 9.0; \\
\text{boolean } status, \text{ part1 } = \text{false};
\]

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

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<td>fResult = val1 / 2;</td>
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<td>fResult = (double) num1 / 2;</td>
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</tr>
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<td>status = part1 &amp;&amp; (num1 &gt; num2);</td>
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BE SURE TO INDICATE RESULTS OF TYPE double BY USING A DECIMAL POINT
For example: 3.0 (for double) vs. 3 (for int).

b) Rewrite the following code to use the conditional operator to compute the value of the variable outcome (instead of if/else):
\[
\text{int } a = \text{rand.nextInt}(100); \\
\text{int } b = \text{rand.nextInt}(100); \\
\text{int } \text{number} = \text{scan.nextInt}(); \\
\text{int } \text{outcome}; \\
\text{if } (\text{number} == a + b) \\
\quad \text{outcome} = 1; \\
\text{else} \\
\quad \text{outcome} = 0;
\]

c) Consider the following code fragments to compute the GPA of a student:

<table>
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<th>Version A</th>
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<tr>
<td>int qp = 28;</td>
<td>int qp = 28;</td>
</tr>
<tr>
<td>int credits = 10;</td>
<td>int credits = 10;</td>
</tr>
<tr>
<td>double gpa = (double) (qp / credits);</td>
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- Which version will compute the correct value for the GPA? ________________
- What is the value calculated by the other one? ________________
5. [________/ 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"
## Reference Material

### Random Class

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<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>
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<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>
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<td>static long</td>
<td><code>round(double a)</code></td>
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<td>Returns the char value at the specified index.</td>
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<td>int</td>
<td><code>compareTo(String anotherString)</code></td>
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