# CSC 1051 Algorithms and Data Structures I

## Midterm Examination
March 1, 2018

Name: __________ KEY __________

<table>
<thead>
<tr>
<th>Question</th>
<th>Value</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>20</td>
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<tr>
<td>3</td>
<td>20</td>
<td></td>
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<tr>
<td>4</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

**TOTAL** | 100 |

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++;
}
```

```
Output:
2
4
6
```

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

```
Output:
1
6
11
16
```

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

```
Output:
8
```

```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);
```

```
Output:
14 => XL
12 => XL
10 => L
8 => L
6 => M
4 => M
2 => S
```

```java
for (int a = 3; a > 8; a++)
    System.out.print(a);
```

```
Output:
NO output
```
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 this is the \"last time\" ");
        System.out.println ("you have to do this ");
        System.out.println ("\"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:

```
Howdy, here are some numbers:
 x = 1  a = 2  b = 3  c = 4
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 = 4  a = 2  b = 3  c = 4

Here are the final values:
 x = 4  a = 3  b = 100  c = 2
```

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

\[
\begin{array}{ccc}
a / b - d \times e + f &=& 1 \ 3 \ 2 \ 4 \\
a / (b + c) / e - f &=& 2 \ 1 \ 3 \ 4 \\
\end{array}
\]

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(4)` ___________ 0 to 3
- `gen.nextInt(20) + 100` ___________ 100 to 119
- `gen.nextInt(4) - 15` ___________ -15 to -12

d) Fill in the blanks

```java
String word = "plaintalkin";
int num = word.length();
num _11_ word.charAt(1) _l word.charAt(4) _n_ word.subString(1) _laintalkin_
```

Output:

```
p:
n:
k:
```

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.

```java
for (int count = word.length() - 1; count>=0; count--)
    System.out.print(message.charAt(count));
```
4. [ /20] Short answer questions.

a) Given the following declarations:
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>
</tr>
</thead>
<tbody>
<tr>
<td>fResult = (num1 + 2)/ 2;</td>
<td>4.0</td>
</tr>
<tr>
<td>iResult = num1 % num2;</td>
<td>1</td>
</tr>
<tr>
<td>fResult = val1 / 2;</td>
<td>4.5</td>
</tr>
<tr>
<td>fResult = (double) num1 / 2;</td>
<td>3.5</td>
</tr>
<tr>
<td>status = part1 &amp;&amp; (num1 &gt; num2);</td>
<td>false</td>
</tr>
<tr>
<td>status = part1</td>
<td></td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Version A</th>
<th>Version B</th>
</tr>
</thead>
<tbody>
<tr>
<td>int qp = 35; int credits = 10; double gpa = (double) qp / credits;</td>
<td>int qp = 35; int credits = 10; double gpa = (double)(qp / credits);</td>
</tr>
</tbody>
</table>

- Which version will compute the correct value for the GPA? **A**
- What is the value calculated by the other one? **3.0**

c) Suppose your code has already calculated the value of 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 num = 1.

```
System.out.println ("Your change is " + num + "Dimes");
```

```
System.out.println ("Your change is " + num + "Dime" + (num != 1? "s" : "));
```
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”
```

```
input num
count = 1

while (count <= num)
  print “Hello”
  count = count + 1

print “Goodbye”
```

NOTE: other correct solutions are possible.
**Random class**

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

**Math class**

<table>
<thead>
<tr>
<th>Type</th>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<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>
</tr>
</tbody>
</table>

**String class**

<table>
<thead>
<tr>
<th>Type</th>
<th>Method</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<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, <code>length()</code> 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>boolean</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>
</tr>
</tbody>
</table>
CSC 1051 Algorithms and Data Structures I

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Name: _____ KEY _____ B _______

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</tr>
<tr>
<td>3</td>
<td>20</td>
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<tr>
<td>4</td>
<td>20</td>
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<tr>
<td>5</td>
<td>20</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. (_____/ 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++;
}
```

```
Output:
5
6
```

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

```
Output: NO OUTPUT
```

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

```
Output: 6
```

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

```
Output:
3
4
5
```

```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
            break;
        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);
```

```
Output:
10 => L
8 => M
6 => M
4 => S
2 => XS
0 => XS
```

Villanova University     CSC 1051     www.csc.villanova.edu/~map/1051     Dr. Papalaskari
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\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 = 100;
        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 = 10 a = 20 b = 30 c = 40
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 = 14 a = 20 b = 30 c = 40
```

```

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

\[
\begin{align*}
\text{a} / \ (b - d) & \times e + f \\
\text{a} / \ b + c & \times e - f
\end{align*}
\]

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

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

i) Describe the error and how to correct it? **missing braces in body of while**

ii) If not corrected, what, if anything gets printed? **1, over and over -- 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(8)` **0 to 7**
- `gen.nextInt(50) + 10` **10 to 59**
- `gen.nextInt(8) - 10` **-10 to -3**

d) Fill in the blanks & show output

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

num _9_ word.charAt(1) _v_
word.charAt(4) _d_ word.charAt(num-1) _e_
```

Output:

```
eaea
```

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.

```
for (int count = word.length() - 1; count>=0; count--)
    System.out.print(message.charAt(count));
```

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?

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<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>

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 (in the box) to use the conditional operator to compute the value of the variable `outcome` (instead of if/else):
```java
int a = rand.nextInt(100);
int b = rand.nextInt(100);
int number = scan.nextInt();

int outcome;
if (number == a + b) outcome = 1;
else outcome = 0;

int outcome = (number == a + b? 1: 0);
```

c) Consider the following code fragments to compute the GPA of a student:
```
Version A
```java
int qp = 28;
int credits = 10;
double gpa = (double) (qp / credits);
```

Version B
```java
int qp = 28;
int credits = 10;
double gpa = (double) qp / credits;
```

- Which version will compute the correct value for the GPA? **B**
- What is the value calculated by the other one? **2.0**
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:

\[
7 \quad 11 \quad 15 \quad 19 \quad 23 \\
\text{Goodbye}
\]

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

\[
12 \quad 17 \quad 22 \quad 27 \quad 32 \\
\text{Goodbye}
\]

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.

- \( \text{input } n \)
- \( \text{input } m \)
- \( \text{input } d \)
- \( \text{input } n + d \)
- \( n = 0 \)
- \( m = 0 \)
- \( d = 0 \)
- \( n = n + d \)
- \( n = m \)
- \( m = n \)
- \( d = d + 1 \)
- \( n = n + 1 \)
- \( \text{if } (n > 0) \)
- \( \text{if } (n < m) \)
- \( \text{else} \)
- \( \text{while } (n < m) \)
- \( \text{while } (n <= m) \)
- \( \text{while } (n > m) \)
- \( \text{while } (d > 0) \)
- \( \text{while } (d >= 0) \)
- \( \text{while } (d < m) \)
- \( \text{print } n \)
- \( \text{print } m \)
- \( \text{print } d \)
- \( \text{print } \text{"Goodbye"} \)

```
input n
input m
input d

while (n <= m)
    print n
    n = n + d

print "Goodbye"
```

NOTE: other correct solutions are possible.
Random class

```java
double nextDouble()
Returns the next pseudorandom, uniformly distributed double value between 0.0 and 1.0
```

```java
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.
```

Math class

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

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

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

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

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

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

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

String class

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

```java
int compareTo(String anotherString)
Compares two strings lexicographically.
```

```java
int indexOf(int ch)
Returns the index within this string of the first occurrence of the specified character.
```

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

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

```java
String replace(char oldChar, char newChar)
Returns a new string resulting from replacing all occurrences of oldChar in this string with newChar.
```

```java
boolean startsWith(String prefix)
Tests if this string starts with the specified prefix.
```

```java
String substring(int beginIndex)
Returns a new string that is a substring of this string.
```

```java
String substring(int beginIndex, int endIndex)
Returns a new string that is a substring of this string.
```

```java
String toLowerCase()
Converts all of the characters in this String to lower case using the rules of the default locale.
```

```java
String trim()
Returns a copy of the string, with leading and trailing whitespace omitted.
```