CSC 1051 Algorithms and Data Structures I

Midterm Examination
October 6, 2016

Name:__KEY___A______

<table>
<thead>
<tr>
<th>Question</th>
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<tbody>
<tr>
<td>1</td>
<td>20</td>
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<td>4</td>
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<td>20</td>
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<tr>
<td>TOTAL</td>
<td>100</td>
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</tbody>
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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] Refer to the program below. Next to each word in the list, choose the most fitting description:
   • reserved word
   • constant
   • variable
   • method

age __Variable_______ int __Reserved Word__

nextInt __Method_______ if __Reserved Word__

scan __Variable_______ println __Method_______

import __Reserved Word__ public __Reserved Word__
MINOR __Constant________ class __Reserved Word__

import java.util.Scanner;

public class Age
{
   //-------------------------------
   // Reads the user's age and prints comments accordingly.
   //-------------------------------

   public static void main (String[] args)
   {
      final int MINOR = 21;

      Scanner scan = new Scanner (System.in);

      System.out.print ("Enter your age: ");
      int age = scan.nextInt();

      System.out.println ("You entered: " + age);

      if (age < MINOR)
         System.out.println ("Youth is a wonderful thing.");

      System.out.println ("Age is a state of mind.");
   }
}
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\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 = 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

Here are the final values:
x = 14  a = 30  b = 100  c = 20
3. [ /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.

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

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

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? \_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) 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 = 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>
<td>double gpa = (double) qp / credits;</td>
</tr>
</tbody>
</table>

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

d) 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

e) Complete the code for the applet that produces the image to the left.

```java
import javax.swing.JApplet;
import java.awt.*;
public class Mystery extends JApplet {
    public void paint (Graphics page) {
        page.drawLine (10, 60, 90, 60);
        page.drawLine (40, 40, 70, 0);
        page.drawRect (60, 50, 50, 60);
        page.fillOval (0, 60, 40, 60);
    }
}
```

Villanova University  CSC 1051  www.csc.villanova.edu/~map/1051  Dr. Papalaskari
4. [ /20] Trace through some computations.

Suppose you have the following declarations:
String word = "kitten";
String line = "511.3";
String line2 = line.replaceAll(".","6");
int number = Integer.parseInt(line2);

What is the value of the following expressions?

word.length() _6__ word.charAt(1) _i__ word.charAt(0) _k_

word.toUpperCase()_KITTEN__word.replace("e","E")_kittEn_

line _511.3____ line2 _51163_____

number _51163___
line + 4 _511.34________
line2 + 4 _511634________ number + 4 _51167________

int a = 1;
while (a < 5)
{
    System.out.println(4*a);
    a++;
}

String hope = "puppy";
int n = 0;
while (n < hope.length())
{
    System.out.print(hope.charAt(n) + "x");
    n++;
}

String fear = "kitten";
int x = 0, y = fear.length() - 1;
while (x < y)
{
    System.out.print(fear.charAt(x));
    System.out.print(fear.charAt(y));
    x++;
    y--;
}
Construct an algorithm that inputs several positive integers terminated with a -1 (sentinel value). The algorithm should print the numbers entered and determine and print the minimum value. After the minimum is printed, print a goodbye message. You can assume that the numbers entered will be between 1 and 100 (except for the terminating -1), so you do not need to check for mistakes in the input.

Example: If the numbers 25 86 13 54 -1 are entered as input, the algorithm should print:

```
25
86
13
54
Min = 13
Goodbye
```

Note: that the terminating -1 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.

```python
input num
input min
num = 0
min = 0
num = 100
num = num + 1
min = num
num = min
if (num < min)
if (num > min)
if (num != -1)
if (num != min)
else
while (num < min)
while (num > min)
while (num != -1)
while (num != min)
print "Min = " min
print "Min = " num
print num
print "Goodbye"
```

```python
input num
min = 100
while (num !=-1)
    print num
    if (num < min)
        min = num
    input num
print "Min = " min
print "Goodbye"
```

NOTE: other correct solutions are possible.
 Drawing a Line

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

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

 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.

\[ \text{bounding rectangle} \]

\[ \text{page.drawArc}(175, 20, 50, 80); \]
### Random class

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

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

<table>
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<th>Method</th>
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<tr>
<td><code>char charAt(int index)</code></td>
<td>Returns the char value at the specified index.</td>
</tr>
<tr>
<td><code>int compareTo(String anotherString)</code></td>
<td>Compares two strings lexicographically.</td>
</tr>
<tr>
<td><code>int 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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<td><code>boolean isEmpty()</code></td>
<td>Returns true if, and only if, <code>length()</code> is 0.</td>
</tr>
<tr>
<td><code>int length()</code></td>
<td>Returns the length of this string.</td>
</tr>
<tr>
<td><code>String 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><code>boolean startsWith(String prefix)</code></td>
<td>Tests if this string starts with the specified prefix.</td>
</tr>
<tr>
<td><code>String substring(int beginIndex)</code></td>
<td>Returns a new string that is a substring of this string.</td>
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<tr>
<td><code>String substring(int beginIndex, int endIndex)</code></td>
<td>Returns a new string that is a substring of this string.</td>
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<tr>
<td><code>String 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><code>String trim()</code></td>
<td>Returns a copy of the string, with leading and trailing whitespace omitted.</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] Refer to the program below. Next to each word in the list, choose the most fitting description:
   • reserved word
   • constant
   • variable
   • method

```java
import java.util.Scanner;

public class Age {
    // Reads the user's age and prints comments accordingly.
    public static void main (String[] args) {
        final int MINOR = 21;

        Scanner scan = new Scanner (System.in);

        System.out.print ("Enter your age: ");
        int age = scan.nextInt();

        System.out.println ("You entered: " + age);

        if (age < MINOR)
            System.out.println ("Youth is a wonderful thing.");

        System.out.println ("Age is a state of mind.");
    }
}
```

nextInt  __Method______
if      __Reserved Word__
scan    ___Variable___
println __Method______
import __Reserved Word__
public __Reserved Word__
MINOR __Constant_______
class __Reserved Word__
age __Variable_______
int   __Reserved Word__
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 \n this is the \n "last time\" ");

        System.out.print ("you have to do this ");
        System.out.println ("so \n 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:

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.

\[
\begin{array}{c}
a / b - d * e + f \\
1 \ \ 3 \ \ 2 \ \ 4
\end{array}
\]

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

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

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

```
Version A
int qp = 35;
int credits = 10;
double gpa = (double) qp / credits;
```

```
Version B
int qp = 35;
int credits = 10;
double gpa = (double)(qp / credits);
```

- Which version will compute the correct value for the GPA? ___A________
- What is the value calculated by the other one? ____3.0___________

d) 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____

e) Complete the code for the applet that produces the image to the left.

```
import javax.swing.JApplet;
import java.awt.*;
public class Mystery extends JApplet {
    public void paint (Graphics page) {
        page.drawLine (10, 60, 90, 60);
        page.drawLine (20, 20, 40, 80);
        page.drawRect (0, 40, 60, 40);
        page.fillOval (40, 0, 80, 40);
    }
}
```

Suppose you have the following declarations:
String word = "dance";
String line = "B52";
String line2 = line.replaceAll("B","7");
int number = Integer.parseInt(line2);

What is the value of the following expressions?

word.length() 5  word.charAt(1) a  word.charAt(0) d
word.toUpperCase()DANCE  word.replace("e","E") dance
line B52  line2 752
number 752
line + 4 B524
line2 + 4 7524  number + 4 756

String hope = "someday";
int n = 0;
while (n < hope.length())
{
    System.out.print(hope.charAt(n) + "*");
    n++;
}

int a = 1;
while (a < 4)
{
    a++;
    System.out.println(5*a);
}

String fear = "someday";
int x = 0, y = fear.length() - 1;
while (x < y)
{
    System.out.print(fear.charAt(x));
    System.out.print(fear.charAt(y));
    x++;
    y--;
}
5. [_____/20]

Construct an algorithm that inputs several positive integers terminated with a -1 (sentinel value). The algorithm should print the numbers entered and determine and print the minimum value. After the minimum is printed, print a goodbye message. You can assume that the numbers entered will be between 1 and 100 (except for the terminating -1), so you do not need to check for mistakes in the input.

Example: If the numbers 25 86 13 54 -1 are entered as input, the algorithm should print:

```
25
86
13
54
Min = 13
Goodbye
```

[Note: that the terminating -1 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 min
num = 0
min = 0
num = 100
min = 100
num = num + 1
min = num
if (num < min)
if (num > min)
else
while (num < min)
while (num > min)
while (num != min)
if (num != min)
print “Min = ” min
print “Min = ” num
print num
print “Goodbye”
```

```
input num
min = 100
while (num != -1)
    print num
    if (num < min)
        min = num
input num
print “Min = “ min
print “Goodbye”
```

NOTE: other correct solutions are possible.
Drawing a Line:

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

Drawing a Rectangle:

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

Drawing an Oval:

```java
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

- **nextDouble()**
  - Returns the next pseudorandom, uniformly distributed double value between 0.0 and 1.0.

- **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

- **abs(double a)**
  - Returns the absolute value of a double value.

- **cos(double a)**
  - Returns the trigonometric cosine of an angle.

- **pow(double a, double b)**
  - Returns the value of the first argument raised to the power of the second argument.

- **random()**
  - Returns a double value greater than or equal to 0.0 and less than 1.0.

- **round(double a)**
  - Returns the closest long to the argument.

- **sin(double a)**
  - Returns the trigonometric sine of an angle.

- **sqrt(double a)**
  - Returns the correctly rounded positive square root of a double value.

String class

- **charAt(int index)**
  - Returns the char value at the specified index.

- **compareTo(String anotherString)**
  - Compares two strings lexicographically.

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

- **isEmpty()**
  - Returns true if, and only if, length() is 0.

- **length()**
  - Returns the length of this string.

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

- **startsWith(String prefix)**
  - Tests if this string starts with the specified prefix.

- **substring(int beginIndex)**
  - Returns a new string that is a substring of this string.

- **substring(int beginIndex, int endIndex)**
  - Returns a new string that is a substring of this string.

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

- **trim()**
  - Returns a copy of the string, with leading and trailing whitespace omitted.