INTRODUCTION TO COMPUTER SCIENCE II - CS 112
Final Exam Review

In Lab23 you compared time taken to MergeSort 50k elements to time taken to BubbleSort 50k elements. We know BubbleSort is an $O(N^2)$ sort while MergeSort is an $O(Nlog(N))$ sort. BubbleSort took about 170x longer than MergeSort. $50000^2/(50000*log2(50000))$ is 3000. Explain what might cause this discrepancy in a few sentences.

Write a method that calculates Fibonacci numbers without using recursion

Write a method that adds a Node 'n' to the end of a LinkedList.

Answer whether each of the following errors is a syntax error, run-time error, or logic error:
```
int value = 64.0;
System.out.println("Can't wait for Wednesday!);
int[] array = new int[10]; System.out.println("Last value is " +
array[10]);
int[] array = new int[10]; System.out.println("First value is " +
array[1]);
```

Which of the following code snippets could cause a runtime, but *not* a compile time error? More than one might be correct. Assume the necessary import statements are present.
```
a) Scanner scan = new Scanner(System.in);   int num =
scan.nextLine();
b) int num = Integer.parseInt(args[0]);
c) String[] arr = new String[4];
d) int[] arr = new int[2];   arr[2] = 100;
e) ArrayList<string> ls = new ArrayList<string>();
```

Write a class for a `Circle`. A `Circle` is described only by a `radius`, which should be a `double`. The constructor should allow a user to create a `Circle` of any desired size. The `Circle` class should only have two methods besides the constructor: `perimeter()`, which should return the value of the perimeter; and `area()`, which should return the value of the area. (Recall that the formula for perimeter is 2*p*r, the formula for area is p*(r*r), and the approximate value of p is 3.14.) Throw an exception if the given radius is < 0.

Use the modulus operator '%' to complete the following method:

```
// Input is a number of seconds.  Print a number of hours, minutes, and seconds
void PrintTime(int time) {
        int hours = ???
        int minutes = ??
        int seconds = ??
        System.out.println(
```

What is printed by the following code?
```
String blastOff = "Three, two, one, go!";
System.out.println(blastOff.length());
```

1. If a method does not have a return statement, then
        a.   it will produce a syntax error when compiled
        b.   it must be a void method
        c.   it cannot be called from outside the class that defined the method
        d.   it must be defined to be a public method
        e.   it must be an int, double, float, or String method

6. Which is the correct syntax to declare a Scanner object?
```
        a. Scanner objectName = Scanner();
        b. Scanner objectName = new Scanner();
        c. Scanner objectName = Scanner(System.in);
        d. Scanner objectName = new Scanner(System.in);
```

Problems #1 and #2 use the following code:
```
class Animal { }
class Cat extends Animal { }
```

1. The following code is legal: `Cat tom = new Animal();`

2. The following code is legal: `Animal garfield = new Cat();`

3.   To determine the type that a polymorphic variable refers to, the decision is made
            a) by the programmer at the time the program is written
            b) by the compiler at compile time
            c) by the operating system when the program is loaded into memory
            d) by the Java run-time environment at run time
            e) by the object

True or False (1 point each)

The following statement will display the value 127.
```
System.out.println("123" + 4);
```
ANS: _____

A method defined in a class can access the class's instance variables without needing to pass them into the method as parameters or declare them as local variables.
ANS: _____

While multiple objects of the same class type can exist, in a given program there can only be one version of each class.
ANS: _____

Multiple Choice (1 point each)

What is the value of `total` if the value of `count` is 15 before the following statement is executed:
```
total = count++;
```
   a) 16
   b) 17
   c) 18
   d) 14
   e) 15

What is the value of z after the following assignment statement is executed?
```
float z = 5/10;
```

   a) 0.0
   b) 0.5
   c) 5.0
   d) 0.05
   e) None of these; a run-time error will occur because z is a float and 5/10 is an int.

Short answer (2 points each)

What is the difference between "volatile memory" and "nonvolatile memory" in your computer?

_____

What is the value of myVar?
```
int myVar =  1 + 5 / 3;
```

_____

What is the value of the variable c ?
```
int a = 1;
int b = a++;
int c = a++ + b++;
```

_____

What type of error is in the following code? How could you fix this error in the creation of nearPi?

```
final double PI = 3.14159265;
int nearPi = PI;
```

_____

Given `class DoMath`, what gets printed when the constructor is called? Is there an error?
```
class DoMath {
    void mathFunc(int a, int b) { System.out.println("int, int"); }
    void mathFunc(double c, double d) {
        System.out.println("double, double");
    }
    DoMath() {
        mathFunc(1.1, 2*3);
    }
}
```

_____

How would you create an object named `myObject` of type `DoMath`, from the previous question?

_____

What is the type of each of the following constants?

`'4'`   _____

`4.0`   _____

`4`   _____

`"4"`   _____

What gets printed when the constructor is called? Is there an error?
```
class StringQuestion {
     StringQuestion () {
          String a = "I am";
          String b = "I am string b";
          a += " string b";
          System.out.println(a == b);
     }
}
```

_____

What is the value of x?
```
int a = 9;
int b = 12;
double x = (double) a / b;
```

_____

What gets printed when the constructor is called? Is there an error?

```
class PBJ {
    void change(String var) {
        var += " and jelly";
    }
    PBJ() {
        String s = "peanut butter";
        change(s);
        System.out.println(s);
    }
}
```

_____

If the following program is compiled, and then run with the command lines given below, what is printed in each case? Is there an error? What type?

```
class MyFeelings {
    static public void main(String[] args) {
        System.out.println(args[2].charAt(3));
    }
}
```

> java MyFeelings I cannot wait until this test is over

_____

> java MyFeelings I think I can finish in time

_____

> java MyFeelings "I think I can finish in time"

_____

You have a job writing software for the campus library. Your first task is to design a Java class to represent a library book. Please list three member variables you might put in your class, and three methods you might include. Just give good names for the methods, do not implement them.

_____

_____

_____

What is printed by the following code?

```
int index = 0;
int max = 10;
while (index < max) {
        System.out.print(index);
        max -= 2;
}
System.out.println();
```

_____

List 4 different sort methods and say whether each is $O(N^2)$ or $O(NlogN)$

List two key characteristics of OOP, as distinguished from Procedural Programming.

What are the two basic Java graphics classes used in almost every graphics program? What is the role of each?

List two types of events that may be handled in a Java graphics program

Coding (10 points each)

Write the code for a constructor that prints out the cubes of the integers, starting with 1 and increasing. Your code should stop before it prints any number >= 2000.

```
class Cubes {
      Cubes() {
```

Write code for the main() method that reads a string with one word from the command line and prints it out with alternating lowercase and uppercase, e.g.
wAsHiNgToN

```
class FunnyCaps {
    static public void main(String[] args) {
```

The following `class Node` is used to build a binary tree:
```
class Node {
    String value;
    Node left, right;
}
```
Write a method to check a tree to see if the `String name` is contained in it.

The following `class Node` is used to build a non-binary tree:
```
class Node {
    int value;
    ArrayList<Node> children;
}
```
Write a method to return the sum of all values in the tree.

Write a base class and 2 child classes. Show an example of polymorphism with suitable member functions in your classes.

Write a checker for a sort method that takes as input an array of doubles and that raises an Exception if the input is not sorted.