CSE 15L
Final
Summer 2011

Page 1 _________ (14 points)
Page 2 _________ (10 points)
Page 3 _________ (12 points)
Page 4 _________ (17 points)
Page 5 _________ (17 points)
Page 6 _________ (12 points)
Page 7 _________ (14 points)
Page 8 _________ (15 points)
Page 9 _________ (9 points)

Total __________ (120 points = 114 base points + 6 points EC [>5%])
(114 points = 100%)

This exam is to be taken by yourself with closed books, closed notes, no electronic devices.
You are allowed both sides of an 8.5"x11" sheet of paper handwritten by you.
Assume we have class Point's move() and hasValidState() methods defined as follows:

```java
// Move this Point by xDelta and yDelta
public void move( int xDelta, int yDelta )
{
    this.x = this.x + xDelta;
    this.y = this.y + yDelta;
    assert hasValidState() : "move() failed - not valid state.";
}
```

And we have this test case in TestPoint.java:

```java
log.info("Testing: p2.move(-25, 25)");
Point p2 = new Point(); // Get a Point with (0,0)
p2.move(-25, 25);
test("Point: (-25,25)", p2.toString());
```

We compile and run: `java TestPoint`

Why would the above test case Pass? You can assume getX(), getY(), Point() and Point(Point p) ctors, and test() are implemented correctly.

Write the body of getCenter() to correctly return a deep copy of this Circle object's center Point.

```java
/*
 * Return deep copy of this center Point
 */
public Point getCenter()
{
    return new Point(this.x, this.y);
}
```

Write a single line JUnit test with assertEquals() to test `BinaryString.toBinaryString(10)` from Lab 9 (no array)

Write a single line JUnit test with assertEquals() to test `BinaryString.toBinaryString(-0)` from Lab 9 (no array)

Once you have implemented a JUnit 4 Test Case in eclipse, can you run these unit test cases outside of eclipse or do you need to run them only in eclipse? (Circle the correct answer)

What is a possible advantage of using our homegrown unit tests with logging like we did in many of the labs vs. using a series of JUnit assertEquals() statements in a single Test Case?

What is the (default) name of the directory where we had eclipse create all of our Java projects?

In eclipse, how do you know you have a syntax error somewhere in your code? (Many possible answers.)
In eclipse, what did we use the "Run Configurations…" option to do?

What command line option to diff gives us some context showing 3 lines above and below the differences?

```diff
    diff ________ file1 file2
```

When diff'ing two files, old-version and new-version, which order is usually used?  _____

1) diff new old
2) diff old new

What command line option to wc prints the number of newlines (number of lines)?

```bash
    wc __________ file
```

Why is the result of an expression like `x = a++ + a;` or `array[i] = i++;` considered to have undefined behavior in C and C++, and thus a prime target for a static code analysis tool like lint or splint? Assume all variables are properly initialized and array access is within the array bounds.

What is the general name of the type of tool you would use to find bottlenecks/performance bugs in a program?

If you have unit tests, then you do not need assertions, and vice versa. True or False. (Circle the correct answer)

If you use assertions in your program, then you do not need to use precondition checks and throw different types of exceptions because the AssertionException thrown by the assertion will take care of this. True or False. (Circle the correct answer)

Method `int findMax(int[] intArray)` takes an array of ints as an argument and returns the value of the largest int in the array. You do not have access to the source code to this method. You write some test cases and find it correctly returns the value 9 when you pass it the following arrays:

```
[9]
[9, 5]
[9, 9]
[1, -1, 7, 9, 4]
[2, 9, 8, 2, 8, 9]
```

But it incorrectly returns the value 5 when you pass it the following arrays:

```
[5, 3, 9]
[3, 0, 5, 9]
```

Hypothesize what might be causing this observed behavior:

Based on your hypothesis, you experiment/test with the array `[1, 2, 3, 4]`. What return value would you expect that would support your hypothesis?
Because many of you did not do as well as you had hoped on the quizzes and midterm, and many of you asked me how you could redeem yourselves, I give you many of the same types of questions from the quizzes and midterm to show yourselves (not me) you learned from your mistakes (just like in debugging). Enjoy!

You type in `java Foo2` at the command/shell prompt and you get the following:

```
Exception in thread "main" java.io.FileNotFoundException: line35 (No such file or directory)
at java.io.FileInputStream.open(Native Method)
at java.io.FileInputStream.<init>(FileInputStream.java:135)
at java.io.FileInputStream.<init>(FileInputStream.java:95)
at java.io.FileReader.<init>(FileReader.java:64)
at FooBar.foo2(BarNone.java:69)
at Foo2.main(Foo2.java:28)
```

What is the name of the file this program tried to read from? _____________________

What method in what class in what file and line number in your code did this occur?

Method _______________________________
Class  _______________________________
File ________________________________
Line # ________________________________

What does (Native Method) tell us about the java.io.FileStream.open method?

What do all the `<init>` symbols indicate?

Explain the following Java compile error. How do you fix it?

```
$ javac Test.java
Test.java:19: cannot find symbol
symbol   : method size()
location: class java.lang.String[]
   if (arrayOfString.size() == 0)
   ^
1 error
```

Explain:

Fix:

What does KISS stand for? __________________________________________________________________

What does Agans and Butcher and just about every author say is the first and most important aspect of debugging if you want to figure out why a program does not work the way it is supposed to?

Name a Java run time support feature that makes Java programs easier to debug compared to C.
Based on the following Java compile error, is IOException a checked or unchecked exception? ____________

$ javac Test.java
Test.java:19: unreported exception java.io.IOException; must be caught or declared to be thrown
    readInput( args );
    
1 error

What are the two ways to deal with this kind of error? Be specific.

1)

2)

In general, when should you use == and when should you use .equals() to check for equality? There may be more than one correct answer for each. If so, give multiple answers on the line separated by commas.

_________ Use ==
          1) constants only
          2) primitives
          3) to check if two references are referencing the same single object
          4) to check if two references are referencing objects with the same state

_________ Use .equals()

A method needs to be tested by you. You wrote the method and you have access to the source code. What general kind of testing is this considered?

The specs/docs for this method state it accepts a single int argument, and will throw an IllegalArgumentException if the argument is not within the range of 0 to 100, inclusive.

To ensure this, the method should have a ______ check.

1) precondition
   2) postcondition
   3) class invariant
   4) assertion

List 6 different values you should pass to this method to perform corner case testing based on these specs.

_____ _____ _____ _____ _____ _____

Class IllegalArgumentException extends directly from RuntimeException. Is this a checked or unchecked exception? ________________

You write a test program that calls the above method and you put the method call in a try block and define your catch block as

    catch ( IllegalArgumentException iae ) { }

What line of code should you put in the body of this catch block to print out the detail message string of this exception to stderr?
Your pointy-haired manager gives you code to read a line at a time in a loop:

```java
while ( inFile != null )
{
    String input = inFile.readLine();
...}
```

Assuming `inFile` has been properly initialized to a valid BufferedReader (say, System.in for example), fix the above code to reflect the standard template/pattern to read input as shown in class and multiple labs.

The debugging strategy of divide and conquer is similar to what search algorithm (give the name of the alg)?

Both authors recommend starting at ____

1) the bad spot where an exception was thrown or bad output is seen and work upstream
2) a known good spot or the beginning of the program and work downstream

At what point is it best to build instrumentation in? ______

1) during coding/development
2) during testing
3) during debugging
4) during design

Unlike the C/C++ compilers, the Java compiler follows "definite assignment" analysis for certain entities. What common problem in C/C++ does this solve in Java?

What do you type in at the bash shell prompt to display the exit status of the previous command?

What do you type in at the bash shell prompt to (re)execute the previous command (whatever it was) again?

In the Java run time environment, where are the following stored

_____ static variables
_____ instance variables
_____ formal parameters
_____ method/constructor code
_____ objects
_____ local variables

A) Class Area
B) Heap
C) Run Time Stack
What specific type of bug was found in a relay panel and taped in a log book and popularly (though somewhat erroneously) used as one of the first bugs found in a computer system and hence the term debugging?

What is probably the easiest/surest way to determine if a method you wrote expecting to override a method from the superclass is really being called?

If the debugging mechanism in the previous question indicates that your method is not being called, then you must have mistakenly done what?

What is the 80/20 rule?

Given the following array definition (mostly unimportant other than the name of the array):
```java
int[] bar = {0, 1, 2};
```

How do you print out the entire contents of the array object (helpful for debugging) such that it looks like a comma-separated list enclosed in square brackets (for example: [0, 1, 2]) using a single statement vs. a loop?

In eclipse, what is the keyboard shortcut for

- Content Assist (Auto Completion/Suggestion)?
- Quick Fix?

Which is the correct predicate to check if a year is a leap year?
- A) return year % 400 == 0 || year % 4 == 0 && year % 100 != 0;
- B) return year % 400 == 0 && year % 4 == 0 || year % 100 != 0;
- C) return year % 400 != 0 || year % 4 != 0 && year % 100 == 0;
- D) return year % 400 != 0 && year % 4 != 0 && year % 100 == 0;
- E) return year % 400 == 0 || year % 4 == 0 && year % 100 == 0;

Which operator has higher precedence: logical AND (&&) or logical OR (||)?

In eclipse, after setting a breakpoint and running the program in debug mode, the line that is highlighted and the program is stopped at

- 1) has just been executed
- 2) is about to be executed
- 3) has an error (that is why it is highlighted)
- 4) will not execute unless we Step Thru
- 5) indicates an impending exception
You are debugging in eclipse. You set a breakpoint at line 45 and run such that the program is stopped at line 45 and line 45 is highlighted.

You perform a Step Return. Which line number is now highlighted and the program is stopped at? _____

Another different run. You are once again stopped at line 45 highlighted. You perform a Step Over. Which line number is now highlighted and the program is stopped at? _____

Another different run. You are once again stopped at line 45 highlighted. You perform a Step Into. Which line number is now highlighted and the program is stopped at? _____

What is the main menu option and overall name of the process we used in eclipse to add getters and setters for instance variables (Encapsulate Field) that also automatically changed our code to use these getters and setters instead of directly accessing the instance variables?

Match the shell metacharacters with their meanings

1) redirect stdout & stderr to the same file
2) egrep
3) diff
4) wc
5) redirect stdin
6) redirect stdout
7) redirect stderr
8) pipe

Write a for loop statement to complete the code below. The body of the loop is given, just write the for loop statement.

```java
int[] intArray = new int[/* Some value not directly known */]; // value not important
// Write the for loop statement here to index each element of the array in order
```

```java
{  
    System.out.println( intArray[k] ); // Prints each element in the array at index k  
}
```

If you were to get an `ArrayIndexOutOfBoundsException` when the above code is run, what common type of programming logic error does this usually indicate?
Identify when various errors can occur in a compiled language like Java:

- cannot find symbol
- NullPointerException
- stack backtrace displayed
- variable might not have been initialized
- infinite loop
- missing semicolon

Assertions should **not** be used for

- checking precondition of public methods/ctors
- checking precondition of private methods/ctors
- checking postcondition of private methods/ctors
- checking postcondition of public methods/ctors
- checking class invariants
- they should be used for any and all of the above

**What is a heisenbug?**

1) a bug that seems to disappear when you start looking for it
2) a bug that is caused by Heisenberg level 5 sun spots
3) buggy print statements printing the wrong thing
4) reassembling more than necessary will need to be disassembled again
5) all other things being equal, the simplest explanation is the best

In Java, what type must `var1` and `var2` be for the following piece of code to compile?

```java
if ( var1 = var2 )
    doSomething();
```

Program testing can be used to show

1) the presence of bugs
2) the absence of bugs
3) how the program is supposed to work
4) proof that the program is correct
5) all of the above

You should always put a space around all binary operators. For example, `a+++b` will be parsed as `a + ++b` even though we may have wanted `a + ++b`. In C/C++, if `a` and `b` are pointers, `x=*a/*b; /* comment */` will be parsed as `x =* a /* b; /* comment */ with /* b; /* comment */ all being a comment. What is the name of the parsing principle being used by the compiler?

---

You are given the task of testing a method in Java. The method takes a String as its only argument. Before even looking at what this method is supposed to do with the String being passed in, what two argument values should be used in your test suit to check a couple corner cases? Assume the name of the method is `bar`:

```java
bar( __________ )
bar( __________ )
```

Assertions are **off** (on) by default.

Logging is **off** (on) by default.
The structure of an assert statement is

\[
\text{assert Expression1 : Expression2 ;}
\]

Expression1 is a Boolean expression. Expression2 is used as the detail message for the AssertionError.
Give/state an example of what cannot be used in Expression2.

In Lab 4 Uniq, we had a test run that looked like:

\$ java Uniq yyy > /dev/null

What is /dev/null known as? ______________________________

Assuming there is no file named yyy in the current directory, why would we have this test run with the " > /dev/null " vs. without the " > /dev/null "?

You execute the ls command at the Linux bash shell prompt with several command line arguments (possibly using regular expressions to match various file names). Without using the arrow keys to edit previous commands and without typing in all the same command line arguments again, what do you type in at the shell prompt to execute the rm command with all the same command line arguments as the previous ls command. The $ is the shell prompt.

\$ ________________________

From Lab 5 WordAnalyzer, how do you fix the bug in the ctor below without changing the name of the formal parameter (word)?

public WordAnalyzer(String word)  // Cannot change anything on this line!
{  
    word = word;
}

Write the corrected line of the body of the ctor in the space below here.

What is the name of the type of testing that attempts to uncover new errors/bugs in previously working functionality/code after a change has been made to the system?

What approach to debugging (that we want to avoid) makes lots of [relatively undirected] changes hoping that one of them fixes the bug?

What is the name of the process of improving the design of existing code (to make it clearer or better structured which often makes it easier to spot and fix a bug) without changing its behavior?