CIS 110 Spring 2013 Final Exam, 29 April 2013, Answer Key

Miscellaneous

0. (1 points)

(a) Write your name, recitation number, and PennKey (username) on the front of the exam.

(b) Sign the certification that you comply with the Penn Academic Integrity Code

Multiple Choice

1. (10 points) For each of the following questions, circle the correct answer:

(a) What happens if you try to access a private variable from outside the class in which it is declared?

   i. The program runs normally.
   ii. The program runs, but treats the variable as having the value 0 or null.
   iii. The program runs, but the statement accessing the private variable is ignored.
   iv. The program runs, but behaves unpredictably.
   v. The program compiles, but a run-time error occurs.
   vi. The program does not compile. ⇐

(b) $5 / 2 \times Math.random()$ generates a random number between...

   i. 0 and 2.5.
   ii. 0 and 2. ⇐
   iii. 2 and 5.
   iv. 2.5 and 5.
   v. 2 and $\infty$.
   vi. 2.5 and $\infty$. 
Multiple Choice (Cont’d)

(c) What does the following function return?

```java
public static boolean foo(boolean x, boolean y, boolean z) {
    if (x && y) return !x || z;
    else return (x && y) || z;
}
```

i. x  
ii. y  
iii. z ✗
iv. x && y  
 v. true  
vi. true if either x and y are both true or z is true, and false otherwise

(d) The `toString()` method of an object should do which of the following?

i. Print the object to standard output in a sensible way.  
ii. Return a sensible `String` representation of the object. ✗
iii. Print the object to standard output in a sensible way and return that output as a `String`.  
iv. Whatever the object’s designer wants it to do.  
v. Read in the contents of the object from standard input.  
vi. None of the above

(e) Which of the following expressions computes the length of a string `s`?

i. `s.length`  
ii. `s.length()` ✗  
iii. `String.s.length`  
iv. `String.s.length()`  
v. `String.length`  
vi. `String.length()`
Easy as ABC

2. (12 points)
For each question below, what will the code snippet print out? If there is an error, your answer should show that you know what causes the error, but you do not need to reproduce Java’s error message exactly. Put a box around your answer so we can distinguish it from your scratch work.

(a) B b = new B(7, "bad");
A a = new A(b);
System.out.println(a.get());
Exception in thread "main" java.lang.NullPointerException
  at A.get(....)
  ...

(b) B b = new B(7, "bad");
A a = new A(b, b.c);
System.out.println(a.get());
bad bad

(c) B b = new B(7, "bad");
A a = new A(b, b.c);
System.out.println(a.c);
bad

(d) C b = new C();
System.out.println(b.c);
Exception in thread "main" java.lang.NullPointerException
  at C.<init>(....)
  ...
Toying With TOY

3. (20 points)
Consider the following TOY program, then answer the questions on the following page. You may assume that all assembly comments are correct.

```
10: 81FF read R[1]
11: 82FF read R[2]
16: D31B if (R[3] > 0) goto 1B
18: C31C if (R[3] == 0) goto 1C
1A: C015 if (R[0] == 0) goto 15
1C: 94FF write R[4]
1D: C622 if (R[6] == 0) goto 22
21: C01D if (R[0] == 0) goto 1D
22: C226 if (R[2] == 0) goto 26
25: C022 if (R[0] == 0) goto 22
27: 95FF write R[5]
28: 0000 halt
```

(a) For each pair of numbers below, what will the program write to standard output? Write your answers in decimal (base 10) and put a box around it.

i. 1 and 1  1 and 4
ii. 2 and 1  2 and 8
iii. 1 and 2  0 and 4
iv. 0 and 1  0 and 0
v. 0 and 0  1 and 0
vi. 1 and 0  infinite loop (we also accepted the answer “nothing”)

(b) In simple formulas, what values are outputted if the first input is larger than the second? a / b and 4 * a

(c) In simple formulas, what values are outputted if the first input is smaller than the second? 0 and 4 * a
The Tree of Knowledge

4. (25 points)

(a) If the following code is executed:

```java
int[] vals = { 3, 7, 8, 2, 9, 1, 6, 4 };
Knowledge k = new Knowledge();
k.apple = 5;
for (int i = 0; i < vals.length; i++) k.insert(vals[i]);
```

i. What will k.A() print? 9 8 7 6 5 4 3 2 1
ii. What will k.B() print? 5 7 8 9 6 3 4 2 1
iii. What will k.C() print? 1 2 4 3 6 9 8 7 5

(b) For each of the outputs below, say which of A(), B(), and/or C() could have produced it. For each answer, give an order in which you could insert the elements to produce the output. Write “none” if none of them could have produced it. Put a box around your answer so we can distinguish it from your scratch work.

Assume you create a single Knowledge object, then progressively add values using the insert() method, just like the code snippet in part (a).

i. 1 2 3 4 5  B() (insert e.g. 1, 2, 3, 4, 5) or
    C() (insert e.g. 5, 4, 3, 2, 1)
i. 5 4 3 2 1  A() (insert in any order),
    B() (insert e.g. 5, 4, 3, 2, 1), or
    C() (insert e.g. 1, 2, 3, 4, 5)
i. 2 3 4 3  B() (insert e.g. 2, 3, 4, 3), or
    C() (insert e.g. 3, 4, 2, 3)
Leave and Let Leave

5. (30 points)

(a) Write a recursive version of `interleave()`.

```java
public static Leave interleave(Leave a, Leave b) {
    if (a == null) return b; // base case
    a.next = interleave(b, a.next); // this is clever; draw a picture
    return a; // all done!
}
```

(b) Write an iterative version of `interleave()`.

```java
public static Leave interleave(Leave a, Leave b) {
    if (a == null) return b; // special case for a is null
    Leave head = a, tail = a; // interleaved lists starts at first node of a
    a = a.next; // advance a because we already took its first node
    // as long as both lists have at least one more element
    while (a != null && b != null) {
        tail.next = b; // append first node of b to interleaved list
        b = b.next; // advance to next node of b
        tail.next.next = a; // append first node of a to interleaved list
        a = a.next; // advance to next node of a
        tail = tail.next.next; // update tail of list (we just added two nodes)
    }
    if (b == null) tail.next = a; // append anything left at end of a or b
    else tail.next = b;

    return head; // return interleaved list
}
```

-- or --

```java
public static Leave interleave(Leave a, Leave b) {
    if (a == null) return b; // special case for a is null
    Leave head = a, tail = a; // interleaved lists starts at first node of a
    for (a = a.next; b != null; tail = tail.next) {
        tail.next = b; // append first node of b to interleaved list
        // swap a and remaining nodes of b
        Leave tmp = a;
        a = b.next;
        b = tmp;
    }

    tail.next = a; // append rest of a to the end of the interelaved list
    return head; // return the interleaved list
}
```