CSE 401 - Semantics, Type Checking, & Vtables Worksheet – Week 7

1. Suppose we have the following global scope:

```
class Bar { boolean field; public int method(int i, int j); }
class Foo extends Bar { int val; public boolean whoop(int x); }
```

Now, consider the following hypothetical method definition for `Bar.method`:

```
public int method(int i, int j) {
  int r;
  boolean b;
  Foo o;
  if (this.field) {
    o = this;
    b = o.whoop(i + j);
    r = o.val;
  } else {
    r = i * j + 3;
  }
  return r;
}
```

    a. What variables (locals, parameters, etc.) are defined in the *local* scope in the `method` body?

    b. When we execute this method body, a runtime error could result. Explain how something could go wrong by giving values of the parameters and/or variables involved that would cause a runtime error.

    c. The method body also has type errors. Can you describe which type check(s) the compiler could use to deduce this fact?

    d. Does *every* possible execution of this method produce a runtime error? Can you describe any that happen to be statically correct? (Again, possible runtime values for parameters/variables would suffice.)

    e. Suppose that we replaced the use of **this**.field in the method body to call a boolean method that always returns false. How would this change your answers to the previous questions?

2. Consider the following Java program:

```java
class A {
  int n;
  public void f1() { System.out.println("A.f1"); this.f2(); }
  public void f2() { System.out.println("A.f2"); }
}
class B extends A {
  int x;
  public void f3() { System.out.println("B.f3"); this.f1(); }
  public void f2() { System.out.println("B.f2"); x = 11; n = 22; }
}
class C extends B {
  int x;
  public void f1() { System.out.println("C.f1"); this.f2(); x = 33; }
}
class Main {
  public static void main(String[] args) {
    A aa = new A();
    A ab = new B();
    B bc = new C();
  }
}
```

a. Complete the diagram below to show the layout of objects and vtables by the end of the main function:
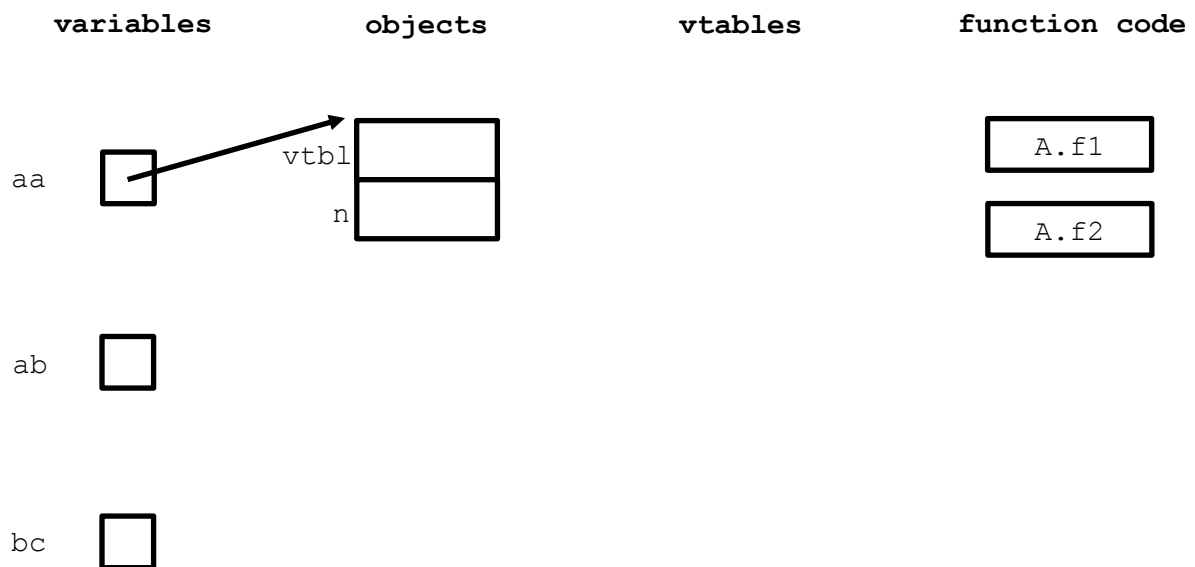
b. If we added each of the lines below to the end of main, what would the output of the program be? If the line would cause an error, describe why.

`aa.f1();`	
`ab.f1();`	
`ab.f3();`	
`bc.f3();`	

c. Suppose we call `bc.f1()`. Draw the `bc` object after the call, including both its layout in memory and the value stored at each location.