CS2030 Programming Methodology II
Semester 1 2024/2025

Week of 16 – 20 September 2024
Problem Set #4
Inheritance and Substitutability

1. The `equals(Object obj)` method defined in the `Object` class returns `true` only if the object from which `equals` is called, and the argument object is the same.

   https://docs.oracle.com/en/java/javase/21/docs/api/java.base/java/lang/Object.html#equals(java.lang.Object)

   Now we define an *overloaded* `equals` method, as well as an *overriding* `equals` method in the `Circle` class.

```
class Circle {
    private final int radius;

    Circle(int radius) {
        this.radius = radius;
    }

    boolean equals(Circle circle) {
        System.out.println("Running equals(Circle) method");
        return circle.radius == radius;
    }

    @Override
    public boolean equals(Object obj) {
        System.out.println("Running equals(Object) method");
        if (obj == this) { // trivially true since it's the same object
            return true;
        }
        if (obj instanceof Circle circle) { // is obj a Circle?
            return circle.radius == this.radius;
        }
        return false;
    }

    @Override
    public String toString() {
        return "Circle with radius " + this.radius;
    }
}
```

   Given the following program fragment,

```
Circle c1 = new Circle(10);
Circle c2 = new Circle(10);
Object o1 = c1;
Object o2 = c2;
```

what is the output of the following statements?

(a) `o1.equals(o2);`

(b) `o1.equals(c2);`

(c) `o1.equals(c1);`

(d) `c1.equals(o2);`

(e) `c1.equals(c2);`

(f) `c1.equals(o1);`

2. Consider the following program.

```
class A {
    protected final int x;

    A(int x) {
        this.x = x;
    }

    A method() {
        return new A(x);
    }
}

class B extends A {
    B(int x) {
        super(x);
    }

    @Override
    B method() {
        return new B(super.x);
    }
}
```

Does it compile? What happens if we swap the entire definitions of `method()` between class `A` and class `B`? Does it compile now? Give reasons for your observations.

3. Which of the following program fragments will result in a compilation error?

(a)
```
class A1 {
    void f(int x) {}
    void f(boolean y) {}
}
```

(b)
```
class A2 {
    void f(int x) {}
    void f(int y) {}
}
```

(c)
```
class A3 {
    private void f(int x) {}
    void f(int y) {}
}
```

(d)
```
class A4 {
    int f(int x) {
        return x;
    }
    void f(int y) {}
}
```

(e)
```
class A5 {
    void f(int x, String s) {}
    void f(String s, int y) {}
}
```