

## Serie 9 - Objects and Types

### 1 Theoretical Questions (6 points)

1. What is the difference between subtyping and subclassing? Provide an example for your explanation.
2. Using the Java class-interface hierarchy given in Figure 1, explain what is the relationship between classes and interfaces.

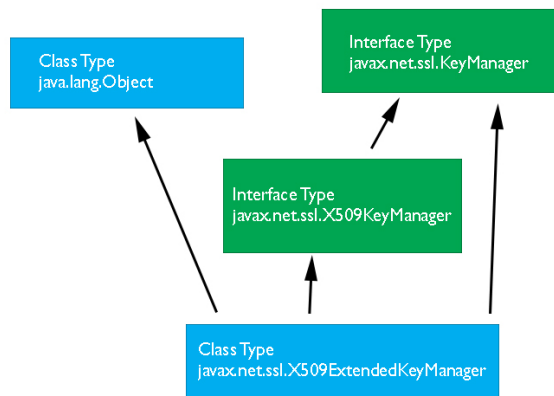


Figure 1: Java interface hierarchy

3. Which forms of polymorphism are used in the Java code in Listing 1? Explain each of the forms.

```
public class Bern<TT> { // Hint 2
    private TT var1;
    public void set(TT mh) { this.var1 = mh; }
    public TT get() { return var1; }

    public static void main(String[] args) {
        int a = 3;
        float b = 2F;
        b = a; // Hint 1
        System.out.println(b);
        Bern<Integer> mj = new Bern();
        mj.set(12);
        System.out.println(mj.get());
    }
}
```

Listing 1: Forms of polymorphism

4. Use Java subclassing to better structure the code in Listing 2 and avoid code cloning.
5. In the code in q5.zip explain how covariant and contravariant are used in each code block. Why are there compile-time errors if you try to run the code?

```
class Bicycle {
    private int frame_size;

    // the price of this bicycle
    public float price() { return 100 * 2; }

    // the sales tax on this bicycle
    public float salesTax() { return price() * .08; }
}

class RacingBicycle {
    private int frame_size;
    private int pieces_count;

    // the price of this bicycle
    public float price() { return 100 * 2; }

    // the sales tax on this bicycle
    public float salesTax() { return price() * .08; }

    // returns the weight of this bicycle
    public void calculateWeight();
}
```

Listing 2: Subclassing