Worksheet: Immutability

In class, you have seen various advantages of immutable objects. In the widely used OOP languages (as e.g. Java and C#), immutables are supported neither by the language nor by the type system directly. They must be designed as classes that follow specific rules. The aim of this worksheet is to identify such rules.

1. Immutable Line (using class `java.awt.Point`)

Given is class `MutableLine` (you find this class in package `patterns.clone.immutable` in this week's project on the active directory).

```
public class MutableLine implements Cloneable {
    public Point start, end;

    public MutableLine(Point start, Point end) {
        this.start = start;
        this.end = end;
    }

    public Point getStartPoint() { return start; }
    public Point getEndPoint() { return end;}

    public void setStartPoint(Point start) { this.start = start; }
    public void setEndPoint(Point end) { this.end = end; }

    @Override
    public MutableLine clone() {
        try {
            MutableLine p = (MutableLine) super.clone();
            p.start = (Point)start.clone();
            p.end = (Point)end.clone();
            return p;
        } catch (CloneNotSupportedException e) {
            throw new InternalError();
        }
    }

    @Override
    public String toString() {
       return String.format("Line[start=%s, end=%s]", start, end);
    }
}
```

Design and program on the basis of the given class `MutableLine` a new class `ImmutableLine` whose instances are immutable.

As immutables cannot be modified, "modifying methods" return new instances.
Hint: Look at the signatures of methods `concat` and `substring` of the immutable class `String` in order to understand this pattern.

Formulate the arrangements you made to make the instances of class `ImmutableLine` immutable as rules.

2. Immutable Line (using an immutable Point class)

How could class `ImmutableLine` be simplified if instead of a mutable point class an immutable one would be used to represent the start and end points of the line?