

Homework # 9

due Monday, April 6th, 11:00 AM

1 Covariance and Contravariance

Do Exercise 4 of Chapter 16 in the textbook (page 318), changed as follows:

Suppose we have a class C_1 with a method m of type $A_1 \rightarrow B_1$. Suppose further that a derived class C_2 overrides this method with one of type $A_2 \rightarrow B_2$. Different languages have different rules about how the types A_1 and A_2 , and B_1 and B_2 must be related. Investigate and report on this aspect of inheritance, citing the sources you used. Answer the following questions:

- Explain how this works in Java: what are the restrictions on A_2 and B_2 assuming m is overridden.
- What is the rule called *covariance*? Explain the advantage of this rule. (Hint: see Eiffel)
- What is the rule called *contravariance*? Explain the advantage of this rule. (Hint: see Sather)
- What are *parasitic methods*? How do they address the problem of “covariant overriding” ?
- What are *symmetric multimethods*? How do they address the problem of “covariant overriding” ? What new problem do they cause?

Turn in your answers on paper.

2 Exception Handling

Write a program that does tests to see what happens for the 18 situations outlined in Exercise 4 on page 357. The program should have the following structure:

```
class ExceptionTest {
    static class Exception1 extends Exception { };
    static class Exception2 extends Exception { };
    static class Exception3 extends Exception { };
    static class Exception4 extends Exception { };
    private static String test(...) throws Exception {
        System.out.print("A");
        try {
            System.out.print("B");
            ... // do something: return "1", or throw Exception1 or 2
            System.out.print("C");
        } catch (Exception2 ex) {
            System.out.print("D");
            ... // do something: return "2", or throw Exception3
            System.out.print("E");
        } finally {
```

```
        System.out.print("F");
        ... // do something: return "3", or throw Exception4
        System.out.print("G");
    }
    System.out.print("H");
    return "4";
}
private static void dotest(String t, ...) {
    System.out.print(t + ". ");
    try {
        String s = test(...);
        System.out.println(" return " + s);
    } catch (Exception ex) {
        System.out.println(" throw " + ex);
    }
}
public static void main(String[] args) {
    dotest("a",...);
    dotest("b",...);
    ...
    dotest("r"...); // 18 times
}
}
```

Leave your code in the `homework9` directory of your AFS volume.

Question: to be answered in written Homework:

There are four pairs of situations which have the same effect. What are these pairs?
Explain why they have the same effect.

I found the “`sort -k 2`” Unix command to be very useful; “`man sort`” for more information

3 Submitting Your Work

Leave your code in the directory `homework9` in your AFS folder: `ExceptionTest.java`. Turn in your written solution to Exercise 4 and the question to the Exception Test results on paper.