

Suppose that the following test fails in the buggy version:

```
// IllegalArgumentException is expected to be thrown
@Test(expected = IllegalArgumentException.class)
public void testBadEndpoints() throws Exception {
    // f refers to a sin function
    UnivariateRealFunction f = new SinFunction();
    BrentSolver brentSolver = new BrentSolver();

    // Executing the following line should cause an exception.
    brentSolver.solve(/* function */ f, /* min */ 1, /* max */ 1.5, /* initial */ 1.2);
}
```

In the above test, the solve method (i.e., `brentSolver.solve`) takes the following 4 parameters:

1. f: a function to solve
2. min: the lower bound for the interval
3. max: the upper bound for the interval
4. initial: an initial value

The solve method finds the root of function f (in Korean: 함수 f의 해) between the interval [min, max], using the given initial value as the starting point.

Note that `brentSolver.solve(f, min, max, initial)` should throw `IllegalArgumentException`, when `f(min)`, `f(max)`, and `f(initial)` have the same sign (i.e., either all three values are positive or all three values are negative). Meanwhile, if `f(min)`, `f(max)`, and `f(initial)` do not have the same sign, `IllegalArgumentException` is not thrown.

In the above test, function f refers to the sin function, and  $\sin(1) = 0.8414709848$ ,  $\sin(1.5) = 0.9974949866$ , and  $\sin(1.2) = 0.93203908596$ . Since all three values are positive, `IllegalArgumentException` should be thrown. However, `IllegalArgumentException` is not thrown in the current buggy implementation, and the test fails.

Now suppose that we have a patch for this bug, and we are going to use the following test to validate this patch. Complete the test by filling in the two underlined blanks. **In your answer, separate the two boolean conditions with a comma (e.g.,  $x > 0$ ,  $x < 0$  if two boolean conditions are  $x > 0$  and  $x < 0$ ).**

Note that given a function f of the `UnivariateRealFunction` type and an arbitrary input x to function f, `f(x)` can be computed through `f.value(x)`.

```
public void testBadEndpoints(int min,int max, int initial) throws Exception {
    UnivariateRealFunction f = new SinFunction();
    BrentSolver brentSolver = new BrentSolver();
    try {
        double root = brentSolver.solve(f, min, max, initial);
        // Fill in the following blank with a boolean expression.
        // Note that under the given condition, the original version is assumed to
        // run correctly, and we expect that the same output will be produced
        // from the patched version.
        assertEquals(_____, /* output */ root);
    } catch (IllegalArgumentException ex) {
        // Fill in the following blank with a boolean expression.
    }
}
```