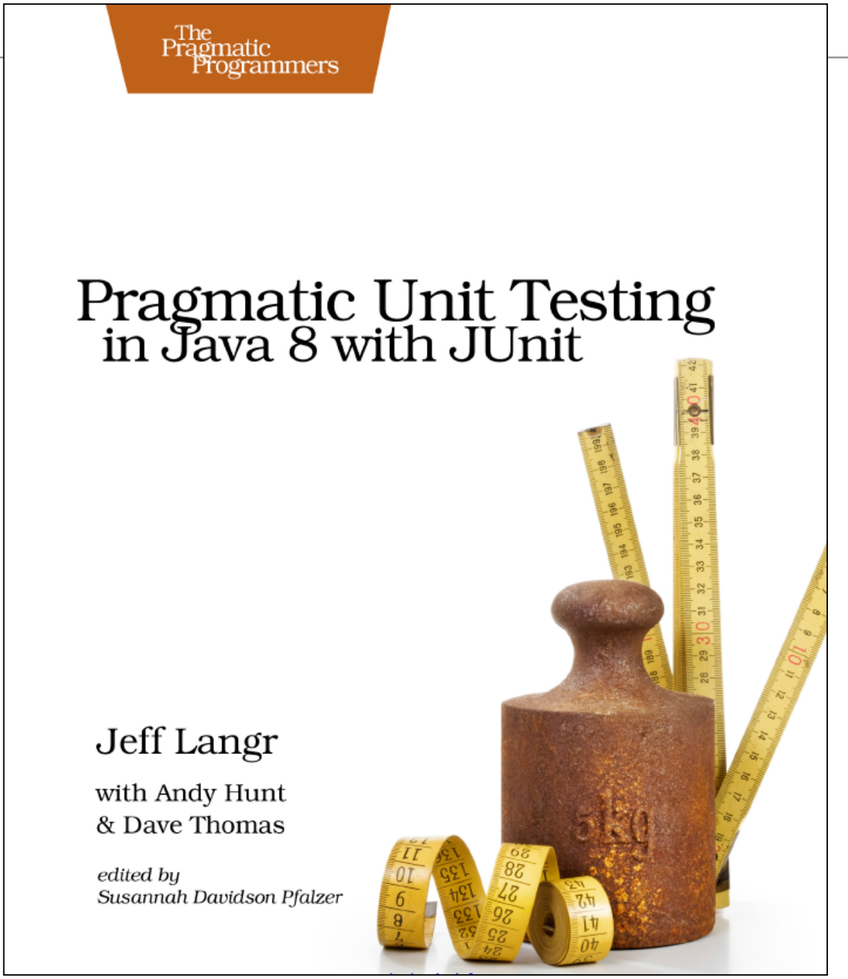
Right BICEP

Full Stack Web Development

Right B.I.C.E.P.

It’s essential to understand what’s important to test.

Right BICEP helps you ask the right questions about what to test.



Source Code: https://pragprog.com/titles/utj2/source_code

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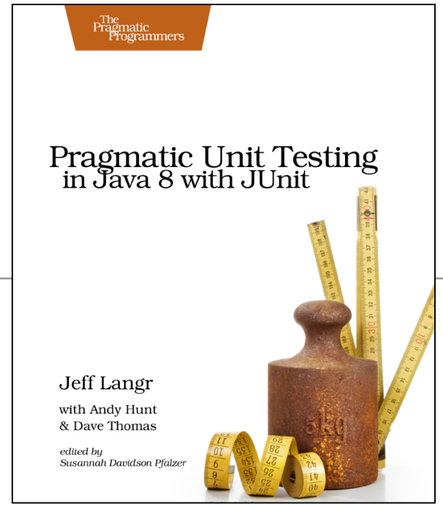

- Guidelines of some areas that are important to test:
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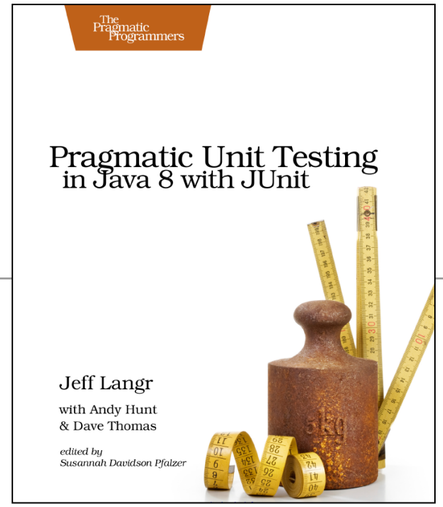

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[Right] – B.I.C.E.P

- Key question : *If the code ran correctly, how would the developer know?*
  - If this question cannot be answered satisfactorily, then writing the code or the test may be a complete waste of time.

- *Does that mean code cannot be written until all the requirements are in?*
  - Nothing stops you from proceeding without answers to every last question.
  - Use your best judgment to make a choice about how to code things, and later refine the code when answers do come.

- The definition of correct may change over the lifetime of the code in question, but at any point, developer should be able to prove that it's doing what he/she thinks it should be doing.

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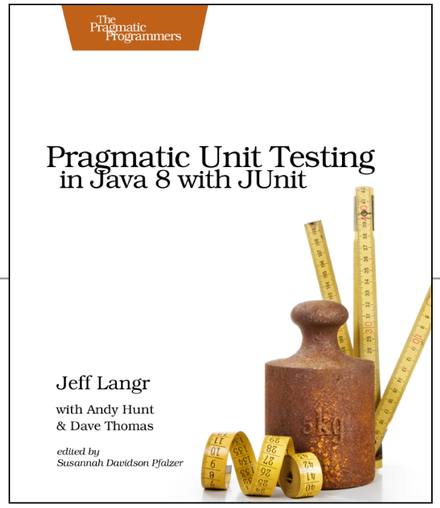

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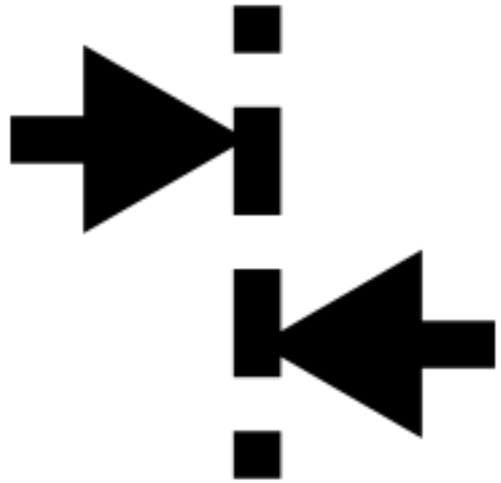
B. Boundary Conditions

- Identifying boundary conditions is one of the most valuable parts of unit testing, because this is where most bugs generally live - at the edges.

```
public void testOrder (){
  assertEquals(9, Largest.largest(new int[] { 9, 8, 7 }));
  assertEquals(9, Largest.largest(new int[] { 8, 9, 7 }));
  assertEquals(9, Largest.largest(new int[] { 7, 8, 9 }));
}

public void testDups (){
  assertEquals(9, Largest.largest(new int[] { 9, 7, 9, 8 }));
}

public void testOne (){
  assertEquals(1, Largest.largest(new int[] { 1 }));
}

public void testNegative (){
  int[] negList = new int[] { -9, -8, -7 };
  assertEquals(-7, Largest.largest(negList));
}

public void testEmpty (){
  try
  {
    Largest.largest(new int[] {});
    fail("Should have thrown an exception");
  }
  catch (RuntimeException e)
  {
    assertTrue(true);
  }
}
```

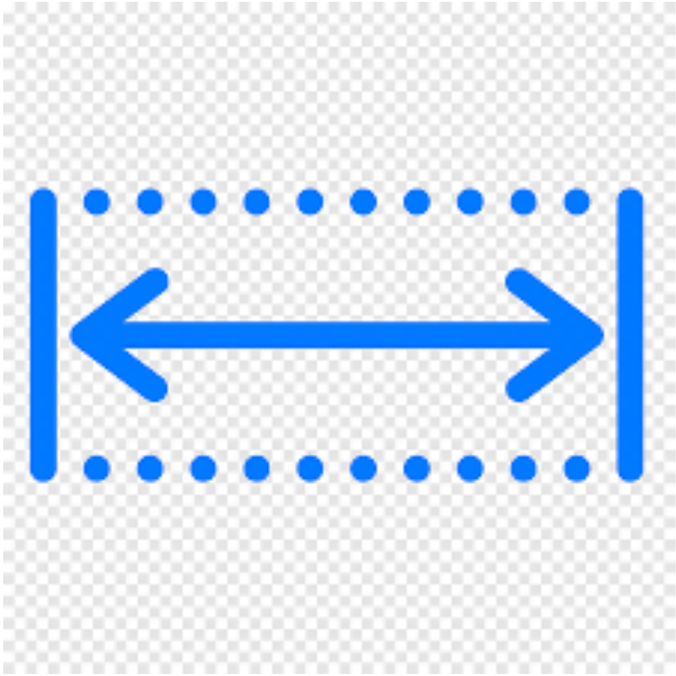
Example Boundaries:

- Totally bogus or inconsistent input values, such as a file name of "!*W:Xn&Gi/w>g/h#WQ@".
- Badly formatted data, such as an e-mail address without a top-level domain ("fred@foobar.").
- Computations that can result in numeric overflow.
- Empty or missing values (such as 0, 0:0, "", or null).
- Values far in excess of reasonable expectations, such as a person's age of 150 years.
- Duplicates in lists that shouldn't have duplicates e.g. class attendance.
- Ordered lists that aren't, and vice-versa. Try handing a pre-sorted list to a sort algorithm, for instance, or even a reverse-sorted list.
- Things that arrive out of order, or happen out of expected order, such as trying to print a document before logging in.



You can remember Boundary Conditions with C.O.R.R.E.C.T.

- **C**onformance - Does the value conform to an expected format?
- **O**rdering - Is the set of values ordered or unordered as appropriate?
- **R**ange - Is the value within reasonable minimum and maximum values?
- **R**eference - Does the code reference anything external that isn't under direct control of the code itself?
- **E**xistence - Does the value exist (e.g., is non-null, nonzero, present in a set, etc.)?
- **C**ardinality - Are there exactly enough values?
- **T**ime (absolute and relative) - Is everything happening in order? At the right time? In time?



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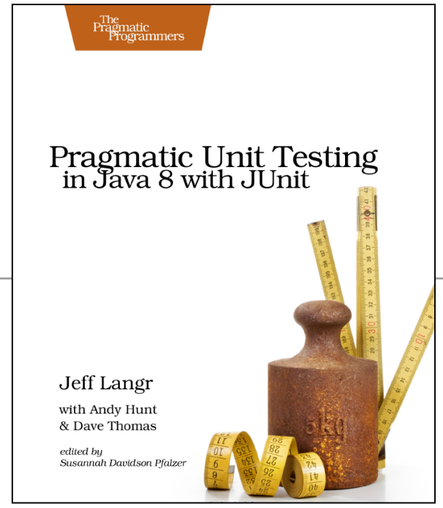

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I. Check Inverse Relationships

Some methods can be checked by applying their logical inverse.

- e.g. check a method that calculates a square root by squaring the result, and testing that it is tolerably close to the original number.
- or – verify division by performing multiplication.
- or - check that some data was successfully inserted into a database by then searching for it.

```
public void testSquareRootUsingInverse()
{
   double x = mySquareRoot(4.0);
   assertEquals(4.0, x * x, 0.0001);
}
```

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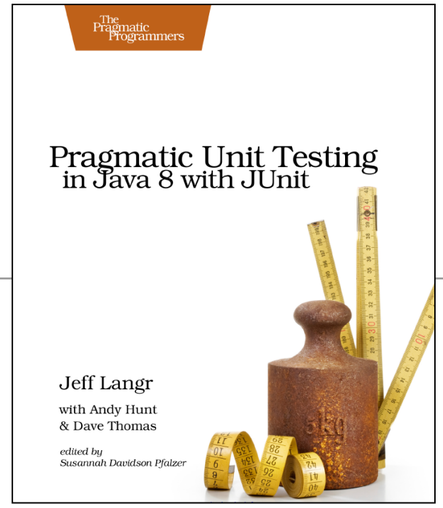

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C. Cross-check Using Other Means

- Where possible, use a different source for the inverse test (bug could be in original and in inverse).

- Usually there is more than one way to calculate some quantity;
  - pick one algorithm over the others because it performs better, or has other desirable characteristics - use that one in production.
  - use one of the other versions to cross-check our results in the test system.

- Especially helpful when there's a proven, known way of accomplishing the task that happens to be too slow or too complex to use in production code.

```
public void testSquareRootUsingStd()
{
   double number = 3880900.0;
   double root1 = mySquareRoot(number);
   double root2 = Math.sqrt(number);
   assertEquals(root2, root1, 0.0001);
}
```

C. Cross-check Using Other Means (2)

Another example - a library database system:

- The number of copies of a particular book should always balance:

  e.g. number of copies that are checked out + number of copies sitting on the shelves should always equal the total number of copies.

- These are separate pieces of data, and they may even be reported by objects of different classes, but they still have to agree, and so can be used to cross-check one another.

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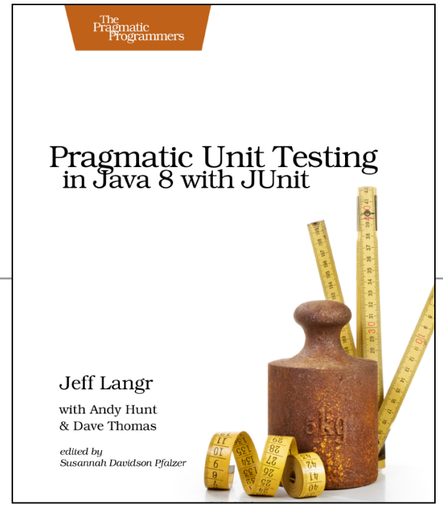

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E. Force Error Conditions

- In the real world, errors happen:
    - disks fill up,
    - network lines drop,
    - e-mail goes down,
    - and programs crash.

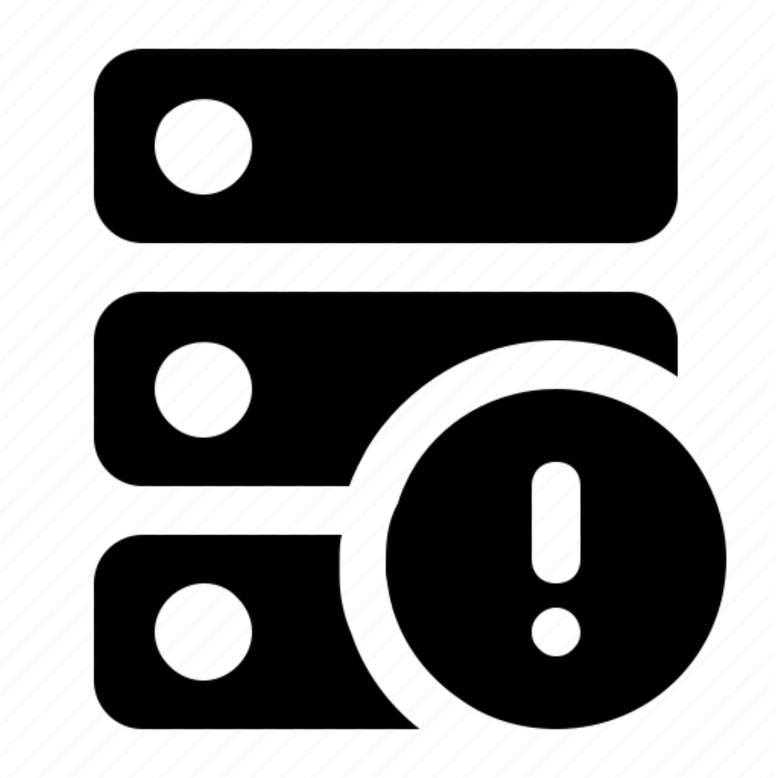
- Developers should test that code handles many of these real world problems by forcing errors to occur.

    That's easy enough to do with invalid parameters and the like, but to simulate specific network errors without unplugging any cables takes some special techniques (e.g. mocking, test doubles etc).

E. Force Error Conditions

Some scenarios you might consider when writing tests:

- Running out of memory.
- Running out of disk space.
- Issues with wall-clock time.
- Network availability and errors.
- System load.
- Limited color palette.
- Very high or very low video resolution.



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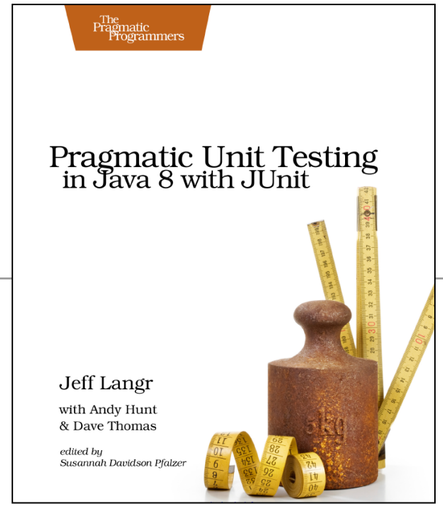

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P. Performance Characteristics

- Performance characteristics - does not necessarily mean measuring performance itself - but rather performance trends as input sizes grow, as problems become more complex.

- The approach is not to objectively measure performance, but to incorporate general tests just to make sure that the ***performance curve remains stable***.

Performance example

- A filter that identifies web sites to block.
- The code may works well with a few dozen sample sites, but will it work as well with 10,000? 100,000?
- This test may take 6-7 seconds to run, so may run only nightly.
- See JUnitPerf for tools to simplify unit-level performance measurement.

```
public void testURLFilter()
{
  Timer timer = new Timer();
  String naughty_url = "http://www.xxxxxxxxxx.com";

  // First, check a bad URL against a small list
  URLFilter filter = new URLFilter(small_list);
  timer.start();
  filter.check(naughty_url);
  timer.end();
  assertTrue(timer.elapsedTime() < 1.0);

  // Next, check a bad URL against a big list
  URLFilter f = new URLFilter(big_list);
  timer.start();
  filter.check(naughty_url);
  timer.end();
  assertTrue(timer.elapsedTime() < 2.0);

  // Finally, check a bad URL against a huge list
  URLFilter f = new URLFilter(huge_list);
  timer.start();
  filter.check(naughty_url);
  timer.end();
  assertTrue(timer.elapsedTime() < 3.0);
}
```

P. Performance Characteristics

- A better use of a unit-level performance measurement is to provide baseline information for purposes of making changes.

- Suppose you suspect that a specific javascript data store solution is suboptimal. You'd like to replace it with an imporved compnent to see if the performance improves. Approach:

    1. Before making optimizations, first write a performance "test" that simply captures the current elapsed time as a baseline. (Run it a few times and grab the average.)

    2. Change the code, run the performance test again, and compare results. You're seeking relative improvement—the actual numbers themselves don't matter.

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