

Mutation Testing

CS585 Software Verification and Validation
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How to verify the quality of tests?





Code Coverage



statement
branch
condition

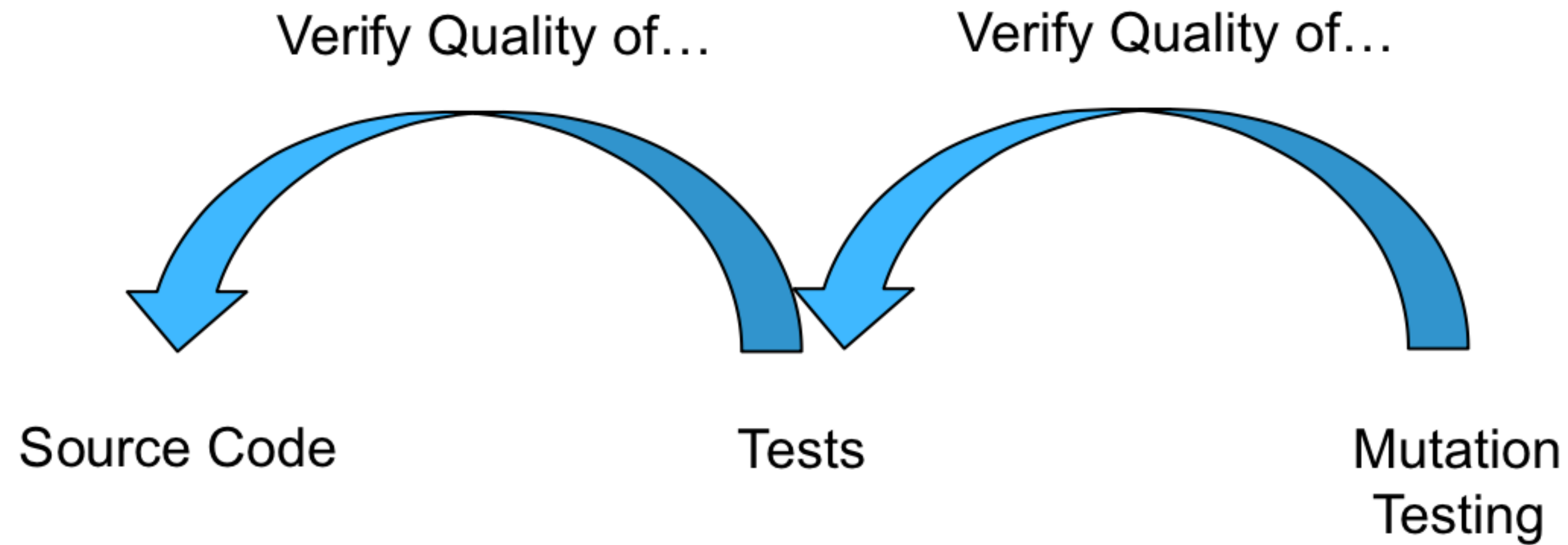
Package	# Classes	Line Coverage ▾		Branch Coverage		Complexity
hudson.tools	6	89%	50/56	81%	13/16	0
hudson.views	15	75%	45/60	N/A	N/A	0
hudson.search	28	67%	197/295	60%	77/128	1.421
hudson.scheduler	7	67%	286/426	40%	95/240	2.294
hudson.node_monitors	28	61%	156/254	39%	29/74	0
hudson.slaves	50	52%	327/634	37%	74/202	1.6
hudson.model.listeners	5	52%	33/63	46%	12/26	1.667
hudson.triggers	18	51%	133/259	37%	28/76	1.5
hudson.widgets	5	50%	27/54	17%	3/18	1
hudson.matrix	27	50%	343/684	32%	103/318	1
hudson	125	49%	1393/2820	43%	485/1135	2.645
hudson.model	303	48%	3602/7534	39%	1234/3139	1.46
hudson.tasks	68	46%	623/1363	32%	178/552	1
hudson.security	84	45%	529/1172	28%	110/391	1.724
hudson.tasks.junit	17	43%	218/511	36%	68/190	3
hudson.maven	79	43%	894/2056	32%	252/790	1.406
hudson.util	167	35%	1030/2907	29%	297/1028	1.832
hudson.scm	83	35%	754/2150	25%	230/932	3
hudson.util.spring	10	34%	159/473	24%	49/208	1.238
hudson.diagnosis	3	31%	12/39	7%	1/14	0
hudson.maven.reporters	37	29%	167/579	19%	37/198	2.182
hudson.tasks.test	15	19%	54/288	6%	6/103	0
hudson.scm.browsers	20	8%	16/200	2%	1/66	2
hudson.logging	6	8%	13/172	4%	2/54	0
hudson.os.solaris	10	6%	13/226	5%	3/58	0
hudson.os.windows	4	3%	4/123	0%	0/14	0
hudson.lifecycle	11	2%	6/252	2%	1/66	0
hudson.util.ina	20	0%	0/157	0%	0/42	1
hudson.tasks.labelers	3	0%	0/39	0%	0/28	0
hudson.org.apache.tools.ant.taskdefs.cvslib	8	0%	0/402	0%	0/153	1.667
hudson.org.apache.tools.ant.taskdefs	1	0%	0/246	0%	0/118	0
hudson.fsp	5	0%	0/59	0%	0/12	0

Mutation Testing

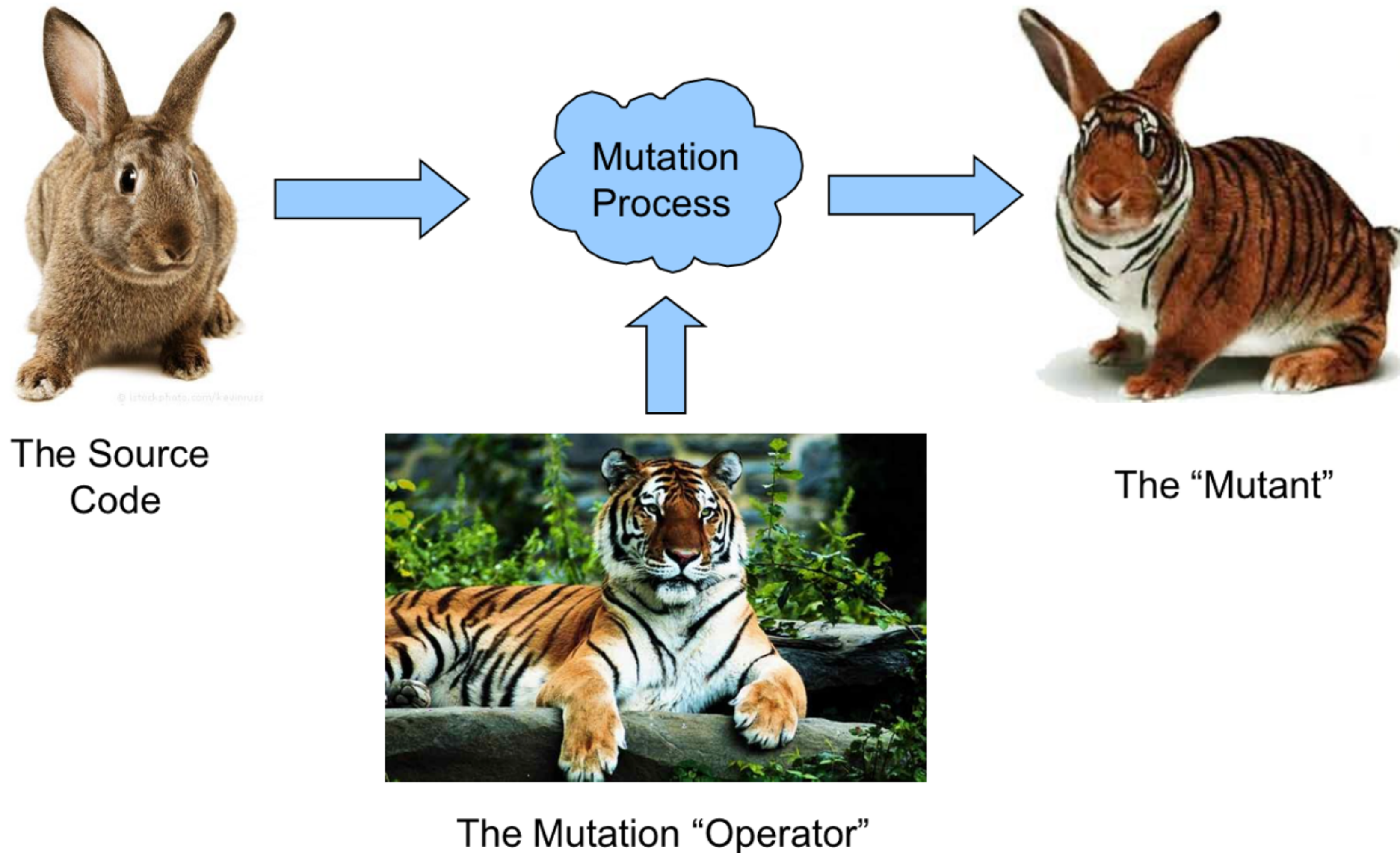
inject errors
catch errors



What is Mutation Testing?



Step 1: Create the Mutant



Example

```
if (a && b) {  
    c = 1;  
} else {  
    c = 0;  
}
```

```
if (a || b) {  
    c = 1;  
} else {  
    c = 0;  
}
```


Step 2: Try to Kill the Mutant



The "Mutant"



A Killer
tries to kill the Mutant!



The Test Suite

All tests run → The Mutant Survives!!!

A test fails or errors → The Mutant Dies

Meaning

The Mutant Survives → The case generated by the mutant is not tested

The Mutant Dies → The case generated by the mutant is tested

Pitest Demo

```
<plugin>
  <groupId>org.pitest</groupId>
  <artifactId>pitest-maven</artifactId>
  <version>1.1.4</version>
  <configuration>
    <targetClasses>
      <param>edu.csupomona.cs585.*</param>
    </targetClasses>
    <targetTests>
      <param>edu.csupomona.cs585.*</param>
    </targetTests>
  </configuration>
</plugin>
```