



# Final Project Report

<https://github.com/jeffrey790609/TicTacToe>

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## Software Testing & Maintenance

csci-540-fall-2019

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## Coverage

- Tools: gcov & lcov
- Line Coverage reached **62.5%**
- Function Coverage reached **64.0%**

64.0%

```
Processing file /usr/local/include/gtest/gtest.h
Processing file /usr/local/include/gtest/gtest-message.h
Processing file /usr/local/include/gtest/gtest-printers.h
Processing file /usr/local/include/gtest/internal/gtest-port.h
Processing file /usr/local/include/gtest/internal/gtest-internal.h
Writing directory view page.
Overall coverage rate:
  lines.....: 64.0% (326 of 509 lines)
  functions...: 62.5% (178 of 285 functions)
```

### LCOV - code coverage report

Current view: [top level](#)

Test: [ex\\_test.info](#)

Date: 2019-12-05 22:50:34

	Hit	Total	Coverage
Lines:	326	509	64.0 %
Functions:	178	285	62.5 %

Directory	Line Coverage ↕		Functions ↕	
<a href="#">/home/jeffrey/Desktop/Software Testing &amp; Maintenance/TicTacToe</a>	<div><div></div></div>	46.2 % 91 / 197	82.5 % 33 / 40	
<a href="#">/usr/local/include/gtest</a>	<div><div></div></div>	25.5 % 14 / 55	26.1 % 12 / 46	
<a href="#">/usr/local/include/gtest/internal</a>	<div><div></div></div>	86.4 % 19 / 22	93.1 % 27 / 29	
<a href="#">I</a>	<div><div></div></div>	100.0 % 27 / 27	84.6 % 22 / 26	
<a href="#">I/bits</a>	<div><div></div></div>	84.0 % 163 / 194	58.9 % 76 / 129	
<a href="#">I/ext</a>	<div><div></div></div>	85.7 % 12 / 14	53.3 % 8 / 15	

Generated by: [LCOV version 1.13](#)

62.5%

## Test Cases

### 5 Test Cases:

- 1 easylevel::is\_winning
- 2 easylevel::make\_move
- 3 tictactoe::if\_won
- 4 tictactoe::do\_last\_move
- 5 tictactoe::print\_grid

- This program is not written with the Test-Driven concept so some parts of the code were edited by me in order to generate test cases.
- One of the five test cases failed.

1

```
=====] Running 5 tests from 5 test suites.  
[-----] Global test environment set-up.  
[-----] 1 test from iswinning  
[ RUN    ] iswinning.test1  
[       OK ] iswinning.test1 (0 ms)  
[-----] 1 test from iswinning (0 ms total)
```

2

```
-----] 1 test from makemove  
[ RUN    ] makemove.test1  
[       OK ] makemove.test1 (0 ms)  
[-----] 1 test from makemove (0 ms total)
```

3

```
-----] 1 test from ifwon  
[ RUN    ] ifwon.test1  
gtest.cpp:43: Failure  
Value of: result == 1  
  Actual: false  
 Expected: true  
[ FAILED ] ifwon.test1 (0 ms)  
[-----] 1 test from ifwon (0 ms total)
```

4

```
-----] 1 test from lastmove  
[ RUN    ] lastmove.test1  
[       OK ] lastmove.test1 (0 ms)  
[-----] 1 test from lastmove (0 ms total)
```

5

```
-----] 1 test from printgrid  
[ RUN    ] printgrid.test1  
- - -  
[       OK ] printgrid.test1 (4 ms)  
[-----] 1 test from printgrid (4 ms total)
```

# Mutant Testing

1. I create a mutant folder.
2. I rewrote the code by adding four mutants, and retested it.
3. One of the four test cases failed, one mutant was missed.

```
[-----] 1 test from ifwon
[ RUN      ] ifwon.test1
gtest.cpp:43: Failure
Value of: result == 1
  Actual: false
Expected: true
[  FAILED  ] ifwon.test1 (0 ms)
[-----] 1 test from ifwon (0 ms total)

[-----] 1 test from lastmove
[ RUN      ] lastmove.test1
[ OK       ] lastmove.test1 (0 ms)
[-----] 1 test from lastmove (0 ms total)

[-----] 1 test from printgrid
[ RUN      ] printgrid.test1

- - -
[ OK       ] printgrid.test1 (4 ms)
[-----] 1 test from printgrid (4 ms total)

[-----] Global test environment tear-down
[=====] 5 tests from 5 test suites ran. (5 ms total)
[ PASSED  ] 4 tests.
[  FAILED  ] 1 test, listed below:
[  FAILED  ] ifwon.test1

1 FAILED TEST

profile: /Software Testing & Maintenance: Cannot create directory
profile: /Software Testing & Maintenance/TicTacToe/data/TicTacToe/gtest.gcda: Skip
jeffrey@jeffrey-ORTEGE-R30-A:~/Desktop/Software Testing & Maintenance/TicTacToe$
```

```
- - -
gtest.cpp:59: Failure
Expected equality of these values:
  0
  abc.print_grid()
  Which is: 1
[  FAILED  ] printgrid.test1 (2 ms)
[-----] 1 test from printgrid (2 ms total)

[-----] Global test environment tear-down
[=====] 5 tests from 5 test suites ran. (3 ms total)
[ PASSED  ] 1 test.
[  FAILED  ] 4 tests, listed below:
[  FAILED  ] iswinning.test1
[  FAILED  ] ifwon.test1
[  FAILED  ] lastmove.test1
[  FAILED  ] printgrid.test1

4 FAILED TESTS

profile: /Software Testing & Maintenance: Cannot create directory
profile: /Software Testing & Maintenance/TicTacToe/data/TicTacToe/mutant/gtest
jeffrey@jeffrey-ORTEGE-R30-A:~/Desktop/Software Testing & Maintenance/TicTacToe$
```



A person is shown from the chest down, sitting at a wooden desk and typing on a silver laptop. They are wearing a light-colored sweater and a gold-toned wristwatch on their left wrist. To the left of the laptop is a dark cup with a tea bag. In the foreground, there are some papers and a yellow sticky note. The entire image is covered with a semi-transparent teal overlay. The text "Thank You Merry Christmas" is written in a large, bold, white sans-serif font across the center of the image. Two thin white horizontal lines are positioned above and below the text.

**Thank You  
Merry Christmas**