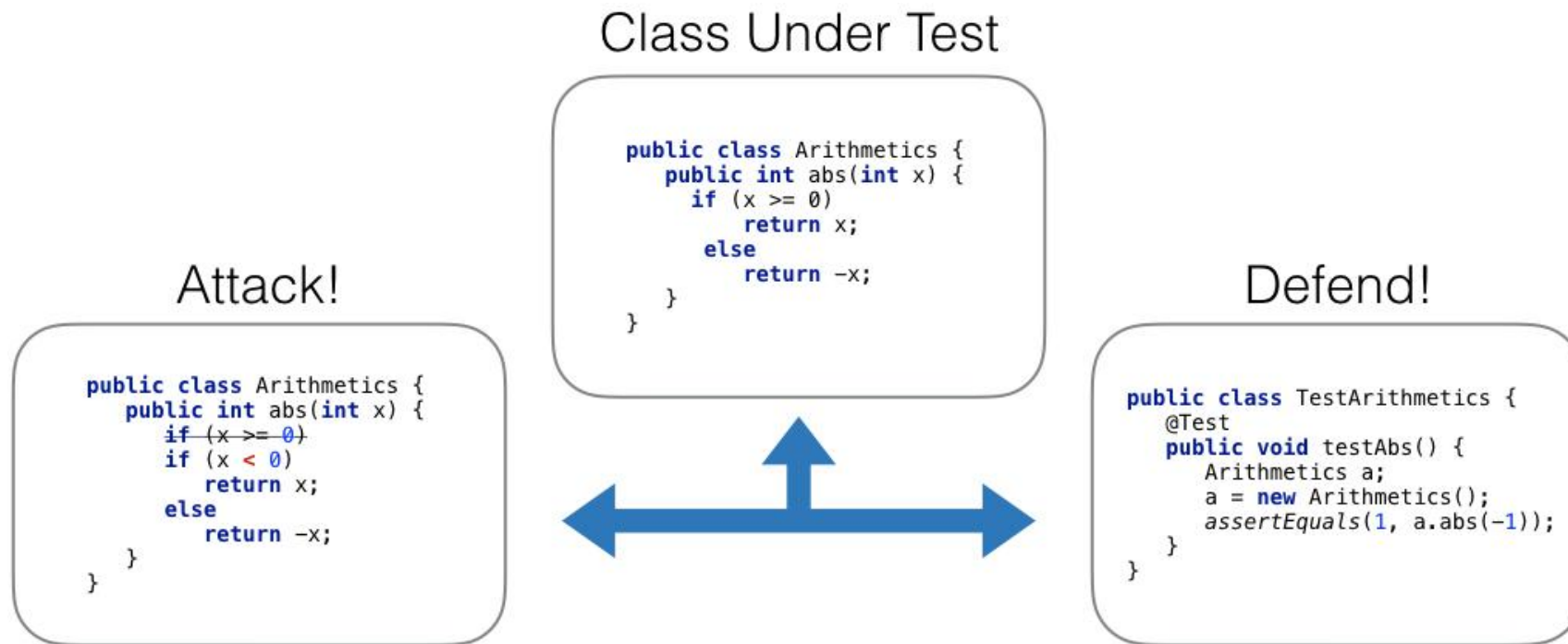# CS409
Software Testing

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Slides adapted from Introduction to Software Testing, Edition 2 (Ch 9)

Mutation Testing Game

- Today you will learn about mutation testing through a game!

Class Under Test

```
public class Arithmetics {
    public int abs(int x) {
        if (x >= 0)
            return x;
        else
            return -x;
    }
}
```

Attack!

```
public class Arithmetics {
    public int abs(int x) {
        if (x >= 0)
        if (x < 0)
            return x;
        else
            return -x;
    }
}
```

Defend!

```
public class TestArithmetics {
    @Test
    public void testAbs() {
        Arithmetics a;
        a = new Arithmetics();
        assertEquals(1, a.abs(-1));
    }
}
```

Introduction to the game

From: https://www.youtube.com/watch?v=BGOy8FV68Go&t=192s

Code Defender

- Integrate 3 aspects of mutation testing
  - Create mutants
  - Killing mutants
  - Checking equivalent mutants
- 2 roles:
  - Attackers
  - Defenders

Attackers	Defenders
• Write mutants (edit source code) • Prove non-equivalence or accept that it is equivalent	• Write JUnit tests for killing mutants • Claim equivalence of mutants

Rules for Creating Tests

- Tests are limited by the following rules:
  - They cannot contain loops.
  - They cannot make calls to System.*
  - They cannot contain new methods or conditionals.
  - They can only make two assertions each.

Rules for Creating mutants

- Relaxed
  - No calls to System.*,Random.*
- Moderate (I have selected this rule)
  - No comments
  - No additional logical operators (&&, ||)
  - No ternary operators
  - No new control structures (switch, if, for, ...)
- Strict
  - No reflection
  - No bitwise operators (bitshifts and logical)
  - No signature changes

Start Playing!

- Create an account at http://code-defenders.org/
- Play against others:
  - Battleground
    - Attackers: 5-6 people
    - Defenders: 5-6 people
    - id: 4767-4774
- Go to http://code-defenders.org/help for more informations on the rules

My Games

ID	Creator	Class	Players	Level	
❯ 4767	tanshinhwei	SubjectParser	0 Attackers 0 Defenders	Hard	Start battleground game
❯ 4768	tanshinhwei	Lift	0 Attackers 0 Defenders	Hard	Start battleground game
❯ 4769	tanshinhwei	ByteArrayHashMap	0 Attackers 0 Defenders	Hard	Start battleground game
❯ 4770	tanshinhwei	XmlElement	0 Attackers 0 Defenders	Hard	Start battleground game
❯ 4771	tanshinhwei	ImprovedStreamTokenizer	0 Attackers 0 Defenders	Hard	Start battleground game

Choosing your Game

My Games

ID	Creator	Class	Players	Level	
❯ 4767	tanshinhwei	SubjectParser	0 Attackers 0 Defenders	Hard	Start battleground game
❯ 4768	tanshinhwei	Lift	0 Attackers 0 Defenders	Hard	Start battleground game
❯ 4769	tanshinhwei	ByteArrayHashMap	0 Attackers 0 Defenders	Hard	Start battleground game
❯ 4770	tanshinhwei	XmlElement	0 Attackers 0 Defenders	Hard	Start battleground game
❯ 4771	tanshinhwei	ImprovedStreamTokenizer	0 Attackers 0 Defenders	Hard	Start battleground game

- Choose to join between Game with id between 4767-4774