Putting Testing First

Idaho State University | Computer Science

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Outcomes

At the end of Today's Lecture you will be able to:

- Understand the basic concepts of TDD
- Understand the basic concepts of CI
- Understand how to marry TDD and CI

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Inspiration

"If you don't like unit testing your product, most likely your customers won't like to test it either." – Anonymous

WHAT IS TDD?

what is

UNIT TESTING?

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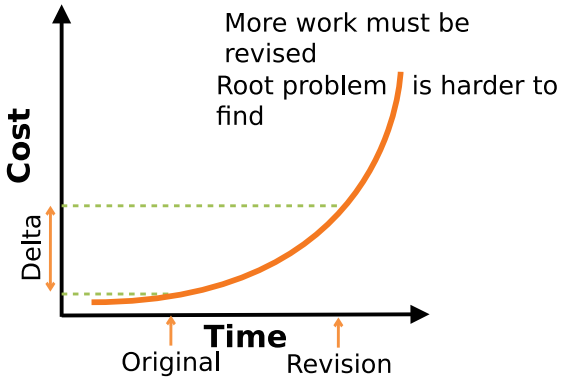
The Increased Emphasis on Testing

- Philosophy of **traditional** software development methods
  - **Upfront** analysis
  - Extensive **modeling**
  - Reveal **problems** as early as possible



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Traditional Assumptions

1. Modeling and analysis can identify potential problems early in development
2. Savings implied by the cost-of-change curve justify the cost of modeling and analysis over the life of the project

- These are true if requirements are always complete and current
- But customers always change their minds!
  - Humans are naturally good at approximating
  - But pretty bad at perfecting
- These two assumptions have made software engineering frustrating and difficult for decades

Thus, Agile Methods…

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Why Be Agile?

- Agile methods start by recognizing that **neither assumption** is valid for many current software projects
  - Software engineers are **not good at developing requirements**
  - We do not anticipate many **changes**
  - Many of the changes we do anticipate are **not needed**
- Requirements (and other “non-executable artifacts”) tend to go **out of date** very quickly
  - We seldom take time to **update** them
  - Many current software projects **change continuously**
- Agile methods expect software to **start small and evolve** over time
  - Embraces **software evolution** instead of fighting it.

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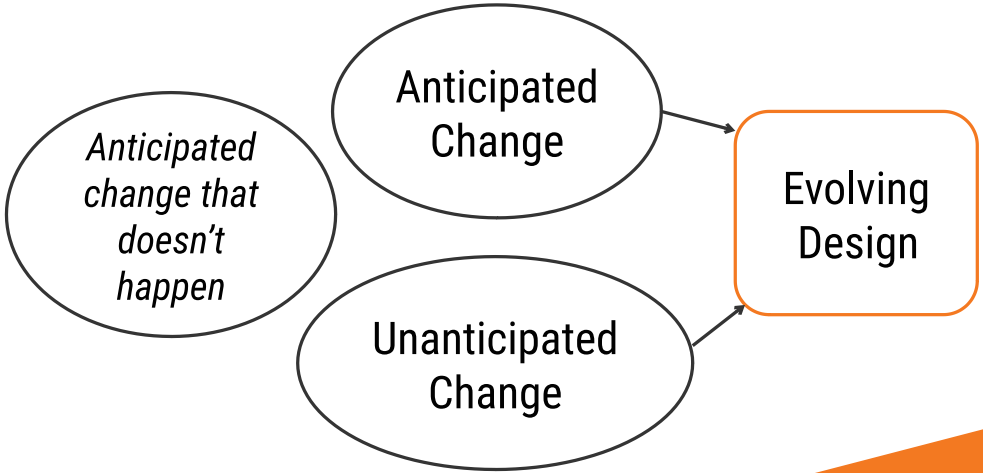
Supporting Evolutionary Design

- Traditional design advice says to anticipate changes
- Designers often anticipate changes that don't happen



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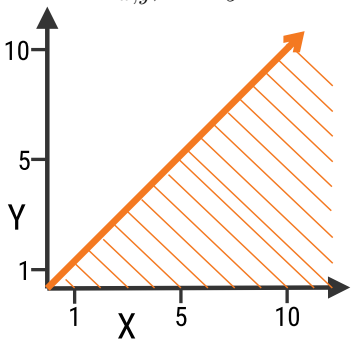
The Test Harness as Guardian

What is Correctness?

Traditional Correctness
(Universal)

$$\forall_{x,y}, x \geq y$$



Agile Correctness
(Existential)

```
{ (1, 1) -> T
  (1, 0) -> T
  (0, 1) -> F
  (10, 5) -> T
  (10, 12) -> F }
```

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A Limited View of Correctness

- In **traditional** methods, we try to define **all correct behavior** completely, at the beginning
  - What is **correctness**?
  - Does "correctness" **mean anything** in large engineering products?
  - People are **VERY BAD** at completely defining correctness
- In **agile** methods, we redefine correctness to be **relative** to a specific set of tests
  - If the software behaves correctly **on the tests**, it is "correct"
  - Instead of **defining all** behaviors, we **demonstrate some** behaviors
  - **Mathematicians** may be disappointed at the lack of completeness

But software engineers ain't mathematicians!

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In-Class Exercise

Group Discussion: **Limited Correctness**

- Do you understand the distinction?
- How does limited correctness relate to evolutionary design?

You have ten minutes

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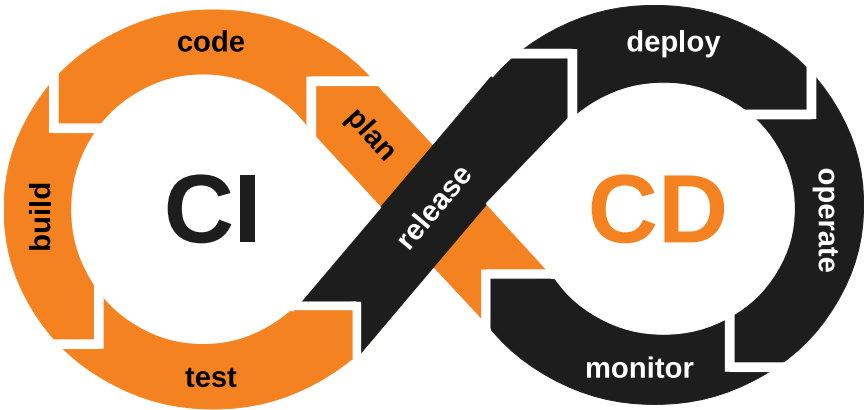
Test Harnesses Verify Correctness

A **test harness** runs all automated tests and reports results to the developers

- Tests must be **automated**
  - Test automation is a **prerequisite** to test driven development
- Every test must include a **test oracle** that can evaluate whether that test executed correctly
- The tests replace the **requirements**
- Tests must be **high quality** and must **run quickly**
- We run tests **every time** we make a change to the software



Continuous Integration

- Agile methods work best when the current version of the software can be run against all tests at any time

A **continuous integration server** rebuilds the system, returns, and re-verifies tests whenever any update is checked into the repository

- Mistakes are caught earlier
- Other developers are aware of changes early
- The rebuild and re-verify must happen as soon as possible
  - Thus, tests need to execute quickly

A **continuous integration server** doesn't just run tests, it decides if a modified system is **still correct**

CI Reduces Risk

TDD encourages incremental integration of functionality

Non-integrated functionality is dangerous

Are there any questions?