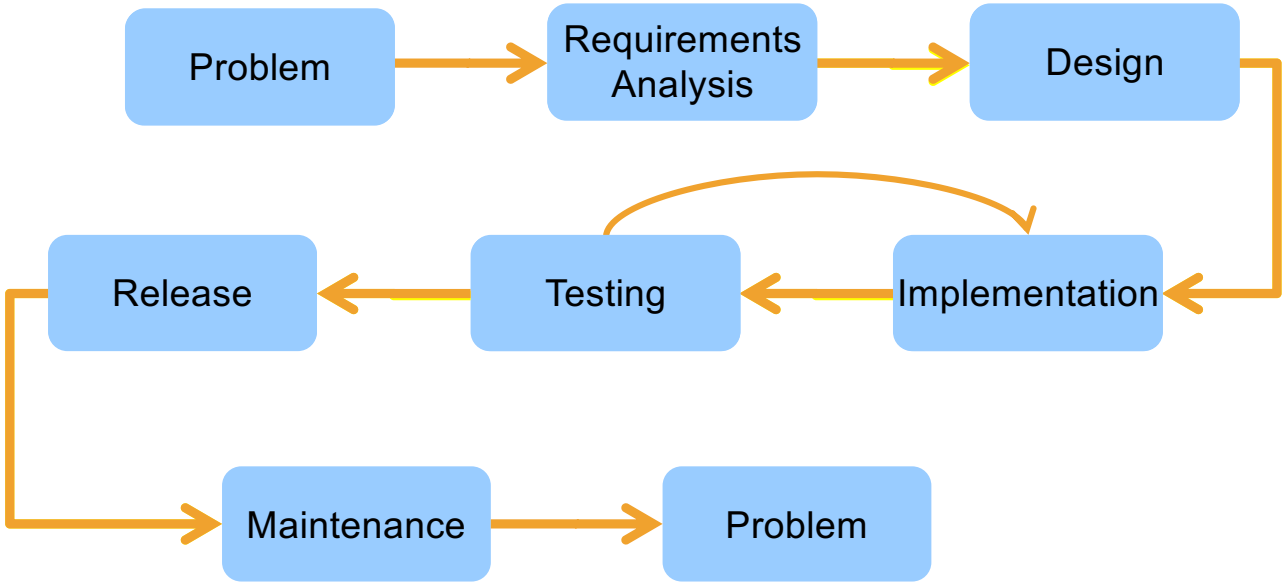
CS 4320 / 7320 Software Engineering

Module 7 – *Construction and* Testing

What is the SDLC?
Where does Testing fit?



Testing is....

... dynamic verification (or validation) that a program provides expected behaviors on a finite set of test cases, suitably selected from the (usually) infinite execution domain.

Software is designed to produce desired output from a set of inputs, based on the instructions *you think you have implemented*

The Test Target can vary in granularity:
a unit, a combinations of components,
a sub-system, the whole system

Testing Goals

- Demonstrate the software meets the requirements
- Discover failures in the software
- *Faults cause failures*
- *Testing reveals failures*
- *The cause, the fault, may be hard to find*

Test Levels

- Unit Testing
- Integration Testing
- System Testing

Unit Testing: What is it?

Testing program components at the smallest functional unit

Unit tests are organized into test suites of related tests, for example…

- For OOP, a class should have its own test suite(s) that exhaustively cover *every method*, with multiple tests!

In MVC design, models and controllers can be unit tested.

DB stored procedures can be unit tested.

Unit Testing: How to do it?

Units must be de-coupled to do unit testing.

A driver is a program that feeds test data to the test target and prints results.

A stub replaces modules that are invoked by the component to be tested, substituting dummy results for the test target to use

Good interfaces are essential

Units with High Cohesion are easier to test. *(Why?)*

Test Driven Development

1. Identify new functionality needed in software / component
2. Write tests for new functionality
   - Functionality tests, unit tests
3. Run tests, which should ALL FAIL
4. Implement functionality in proper components and re-factor as necessary
5. Repeat step 3 and 4 until all tests pass

Integration Testing

Testing if program components integrate & interact as expected

- Stubs are replaced with actual components
- Can include UI events driving behavior, database calls

These tests begin to represent test-cases of the requirements

As software/system complexity increases, more opportunities for components to interact

Each interaction between components may affect the state of the system or components

System Testing

All components of the system are functioning together

For testing:

- Non-functional requirements – security, speed, accuracy, reliability.
- System configurations
- External interfaces

Oops, we failed a test....

What do you do?

- If coding is “done” - create an issue/bug
  - *Is it a design or code issue?*
  - *Fix the design and/or fix the code*

Then what?

- **Regression testing**
  - *If tests pass.. close the issue/bug*

When are we done with testing?

Does it do what it is supposed to do?

Who is the ultimate authority on this?

Client product: client representative(s)

Consumer product: selected target user(s)

User Acceptance Testing

Not automated, typically scenario or story-board driven

Validation vs Verification

Verification: Does it meet the detailed specifications?

Validation: Does it do what it is supposed to do?

If it meets specifications, how could it not do what it is supposed to do?

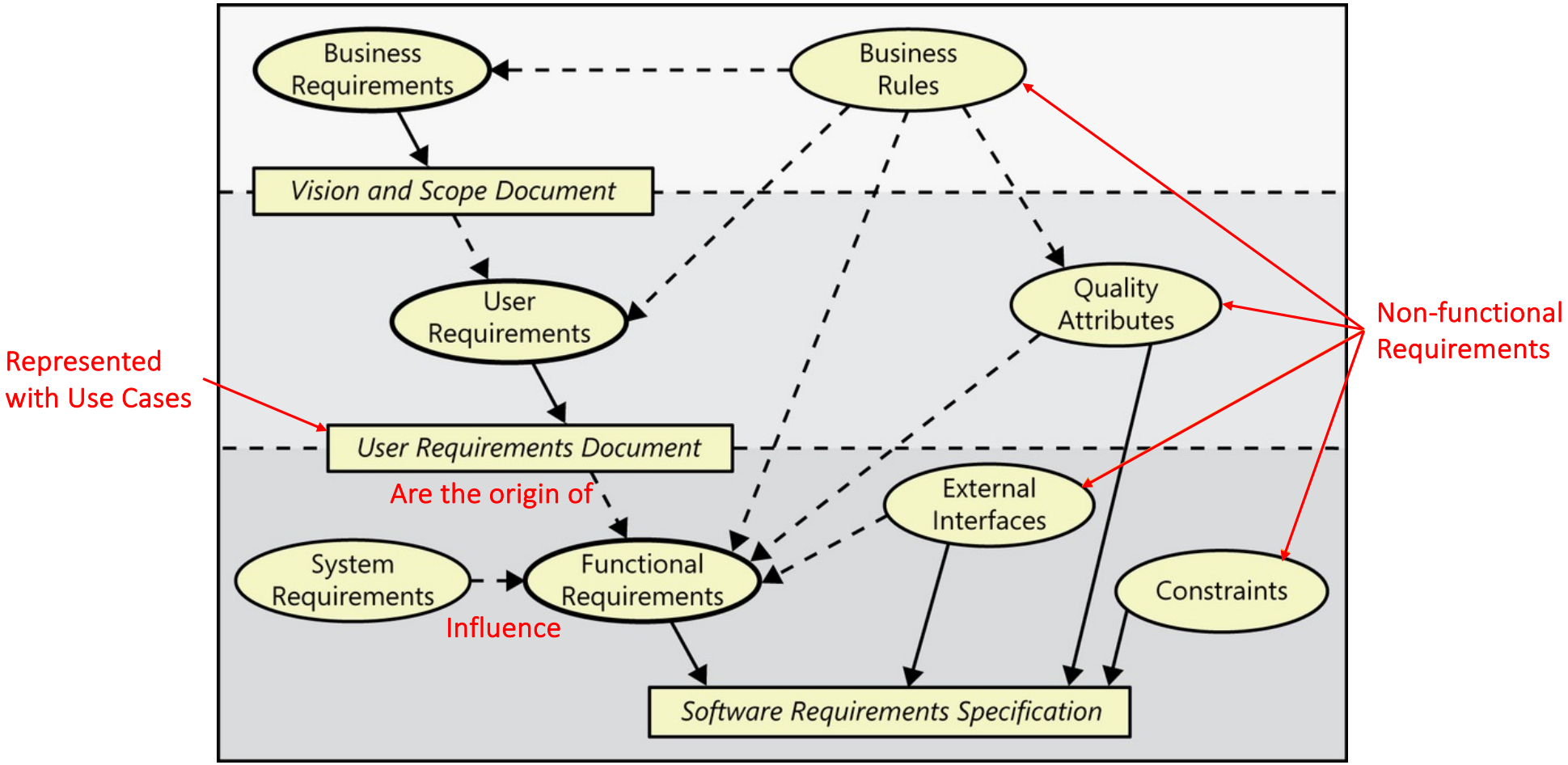


Figure 1-1. Relationships among several types of requirements information.
Solid arrows mean "are stored in"; dotted arrows mean "are the origin of" or "influence."
Source: K. E. Wiegers and J. Beatty, Software Requirements, 3rd ed.,
Redmond, Washington: Microsoft Press, 2013.

Validation vs Verification

Which test(s) are validation?

Which test(s) are verification?

Test levels and objectives we've covered:

Unit tests, integration tests, system tests, regression tests, user acceptance tests

Other testing objectives

Performance testing

Security testing**

Stress testing

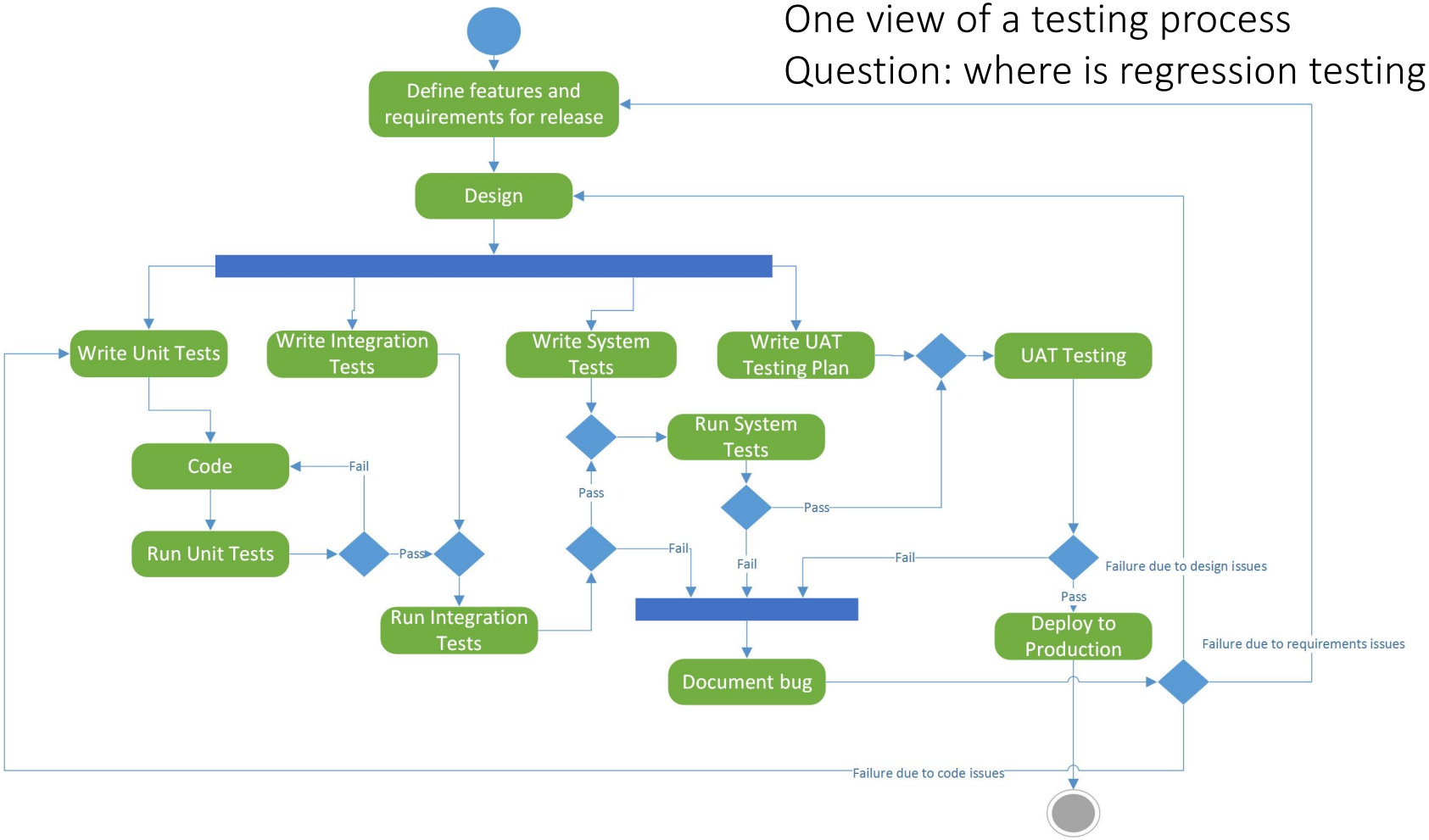
Interface testing

Configuration testing

Usability and Human Computer Interaction Testing

One view of a testing process

Question: where is regression testing?



Limitations of tests

Program testing can be used to show the *presence* of bugs,
but never to show their *absence.*

Edsger Dijkstra

Testing is dynamic verification that a program provides expected behaviors on a finite set of test cases, suitably selected from the (usually) infinite execution domain.

SWEBOK Chapter 4

Designing Tests: Black Box vs. White Box

Black Box Testing:

Tests are designed based on input / output only

White Box (or Clear Box) Testing:

Tests are designed based on the software design and coding

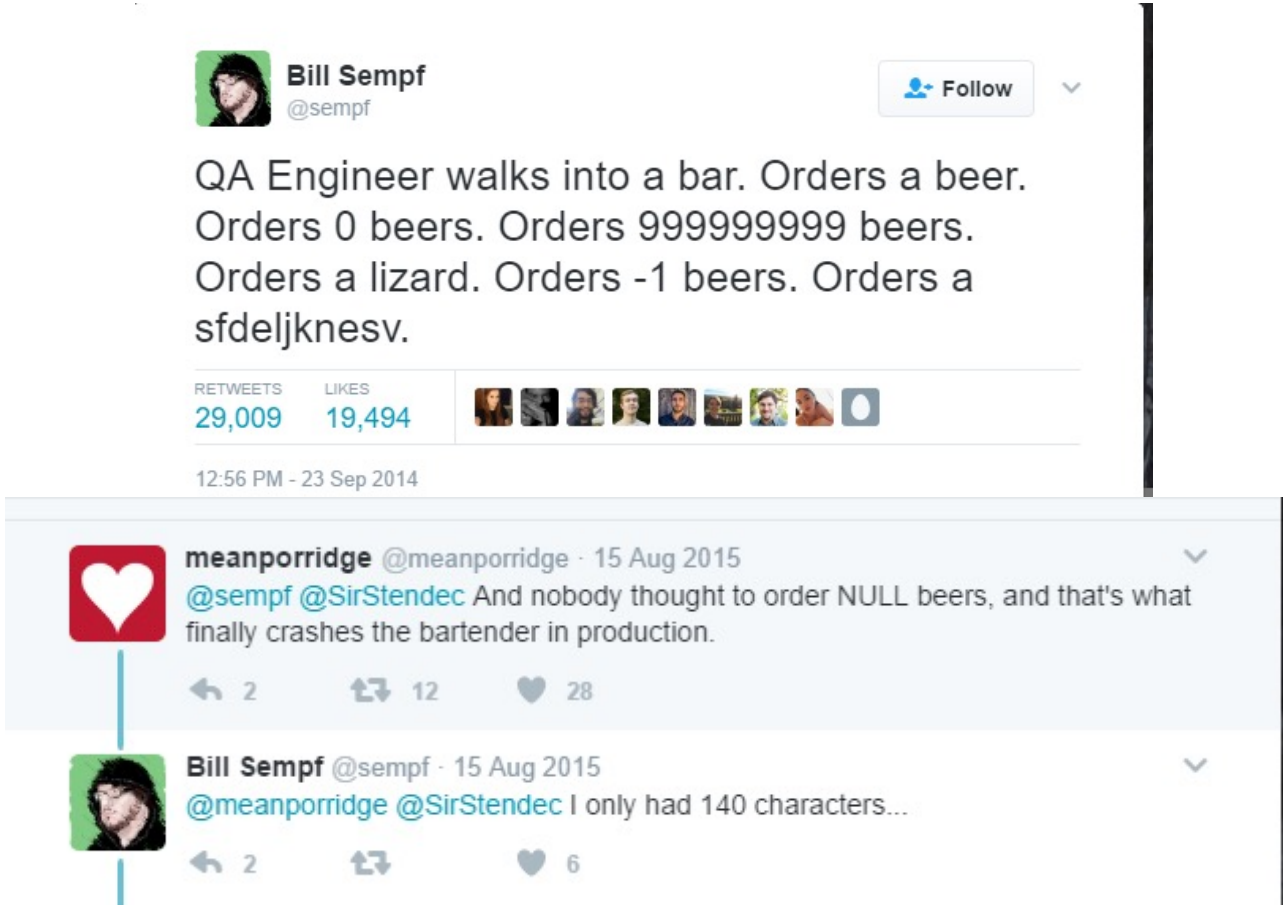
Designing Tests: Input-based techniques

Equivalence Partitioning:
Divide the input into logical subsets and take a sample from each subset

Pairwise Testing:
Combine interesting values of input variables (rather than all combinations)

Boundary-Value Analysis:
Choose input values on or near boundaries of the variable domains. Also choose values outside the boundaries.

Random Testing:
Random input values from the domain


Bill Sempf
@sempf
Follow
QA Engineer walks into a bar. Orders a beer. Orders 0 beers. Orders 999999999 beers. Orders a lizard. Orders -1 beers. Orders a sfdeljknesv.
RETWEETS
29,009
LIKES
19,494
12:56 PM - 23 Sep 2014
meanporridge @meanporridge · 15 Aug 2015
@sempf @SirStendec And nobody thought to order NULL beers, and that's what finally crashes the bartender in production.
2
12
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Bill Sempf @sempf · 15 Aug 2015
@meanporridge @SirStendec I only had 140 characters...
2
6

Designing Tests: Code-based techniques

Control flow-based criteria:

Cover all statements, or statement blocks, or some combinations of statements.

Path testing: test all entry-to-exit control flow paths

All is usually not feasible – limit loops, aim for a % coverage

Designing Tests: Code-based techniques

Data flow-based criteria:

Select paths to explore the sequence of events related to variable status.
When do variables receive values? When are these values used?

Helps find:

- *Variables that are declared but never used*
- *Variables that are used but never declared*
- *Variables that are defined multiple times before being used*
- *Variables that are deallocated before being used*

Designing Tests: Test the unhappy path

Don’t just think about what the code is supposed to do, but the error and exception handling that should happen if something goes wrong.

Automated Testing

Advantages of automated testing

Once tests have been developed, can be run quickly and repeatedly

Allows easy regression testing

Easy -> testing more likely to get done -> defects more likely to be found

Kinds of automated testing

Graphical User Interface testing – a testing framework records or generates UI events

API driven testing –tests using a programming interface to the application (whole application, classes, modules, or libraries) , might use a framework

What is “Done”?

Done:

With coding… but what if a test fails?

Done, Done:

With coding and testing.. But is it ready to be used?

Done, Done, **Done:**

With code, testing, and deployment… In production! DONE!