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FIT2107
Software Quality and Testing

Lecture 2– Software Testing

- What is Software Testing
- Objectives
- Test Levels
- Testing Pyramids
- Some definitions and terminologies

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Announcement

- Please finish the survey: https://forms.gle/qirn6YFokai64GpM9
- Quiz 1: Due 11:55PM this Friday.
- Assignment 1 (Blackbox Testing).
- Groups (Pairs) formation.

Recap

- Last week we talked about
  - What is software quality?
  - What SQA
  - The Quality Attributes
  - Limitations of SQA.

Software Testing

- Software testing consists of the **dynamic** verification that a program provides **expected behaviours** on a **finite set** of test cases, suitably selected from the usually infinite execution domain.
  - Dynamic: program is actually executed
  - Expected Behaviour: behaviour matches the requirements
  - Finite Set: inputs that results in outputs
- In practice, much testing is not conducted on a complete software system, but some component of it.
- In most of the cases, testing on a complete software is done in the end.

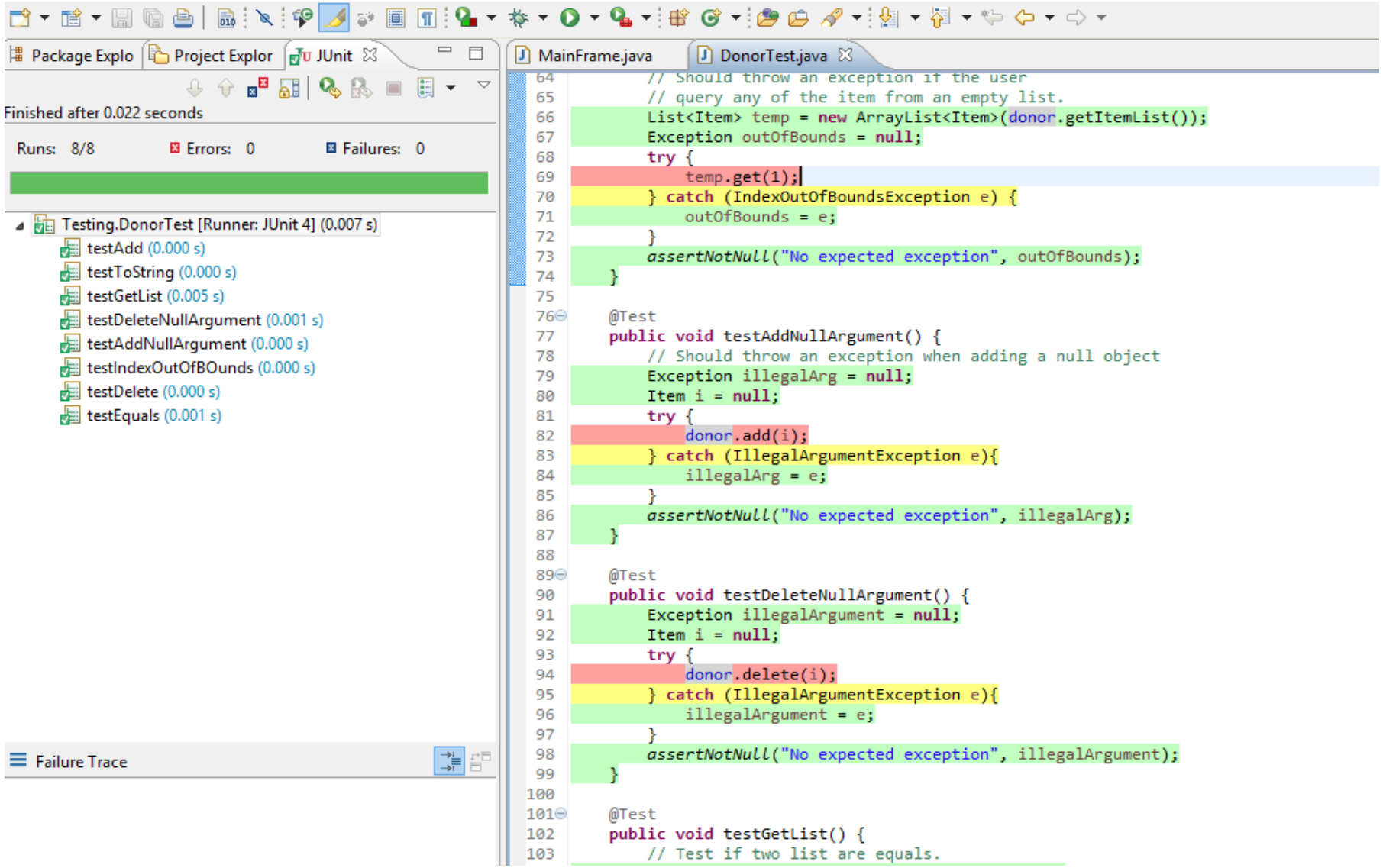
Testing not prioritized by students

- Emerging results from 40 software engineering students show that students overestimate their testing time threefold, and 50% of them test as little as 4% of their time, or less.

  - Beller, Gousios, Zaidman, 2015

- M. Beller, G. Gousios, and A. Zaidman. How (much) do developers test? 37th IEEE/ACM International Conference on Software Engineering, ICSE 2015, Florence, Italy, May 16-24, 2015, Volume 2, pages 559–562. IEEE Computer Society, 2015.

Testing from a Developers Perspective



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Testing from the User's Perspective

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Objectives/Goals of Testing

- Functional Correctness
- User Acceptances
- Performance
- Security
- Reliability
- Robustness
- Regression

Objectives of Testing – Functional Correctness

- Does the software produce the outputs consistent with the software specification, given the inputs?
- Testing directed at revealing as many bugs in the software under test as possible given the available testing resources.
- It is the basis for many common testing methods.

Objectives of Testing – User Acceptance

- System as a whole is tested to ensure that it meets users' high-level business requirements.
- Often conducted by that client or client representative.

Objectives of Testing – Performance

- System as a whole is tested to ensure that it meets users high-level business requirements.
- Often conducted by that client or client representative.

Objectives of Testing – Security

“Anyone, from the most clueless amateur to the best cryptographer, can create an algorithm that he himself can't break.” -- Bruce Schneier

- In practice, security is one of the hardest things to provide as a developer, and hardest to assess from a QA perspective

Objectives of Testing – Usability

- Usability Testing is manual in nature.
- Users are asked to provide feedback and the system is improved on the basis of feedback provided by the users.
- Finding appropriate representative group is challenging
  - An interface that is good for Adult English speaking programmers may not be useful for aged care residents.

Objectives of Testing – Reliability

- Reliability testing is designed to assess how reliable the software under test is.
- How often it breaks?
- Mathematical model of how the software is going to be used.
- More related to verification & validation testing.

Objectives of Testing – Robustness

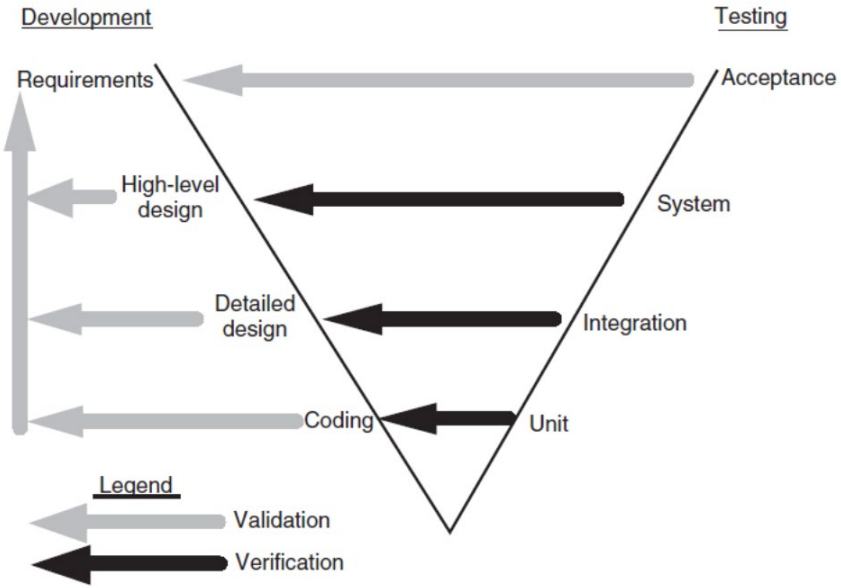
- Here we look at the consequences of the breakage as opposed to reliability.
- Failures are injected (for examples the system is shutdown in the middle of operation) and the behavior is monitored.

Objectives of Testing – Regression

- Repeating some tests to verify if the system behavior isn't changed after modifications.
- Automated regression testing is a standard practice in industry.

Levels of Testing

- Level is a scope of the piece of software being tested
- A software test might be targeted at anything from an individual method, to the entire system under development.
  - a device controlled by embedded software being tested as a whole, or a network utility tested to ensure that it is compatible with pre-existing network devices.
- There are four major levels that are
  - Unit Testing
  - Integration Testing
  - System Testing
  - Acceptance Testing



Testing Levels - Unit Testing

- Individual **units** of a software are tested.
- Each **unit** of the software performs as designed.
- Advantages
  - Speed of Execution
  - Easy to control
  - Easy to write
  - Automated tools
- Disadvantages
  - Different behavior in test and real program.
  - Some bugs can’t be caught (at integration level)

Testing Levels - Integration Testing

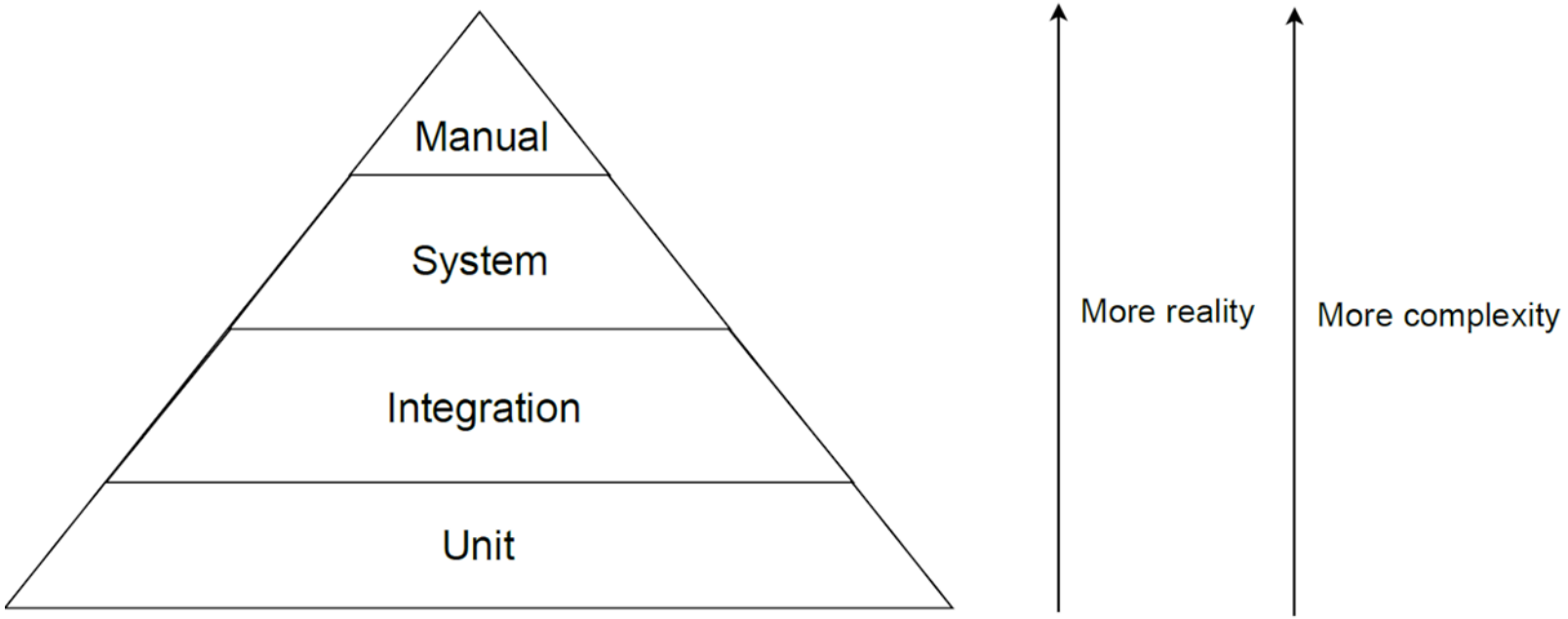
- Interactions between components
  - CI/CD
- Done after unit testing
- Expose faults in the interaction between integrated units
- Advantages
  - devising tests just for a specific integration is easier than devising tests for all the components together
- Disadvantages
  - Requires more effort than unit tests.

Testing Levels – System Testing

- Testing of a whole system.
- System's compliance with the requirements.
- Blackbox in nature.
- Advantages
  - Test cases are realistic so the real system is tested as a whole.
  - Captures users' perspective
  - Faults can be fixed before the users pick it.
- Disadvantages
  - Slower than unit tests
  - Harder to write
  - Flaky in nature

Testing Pyramids

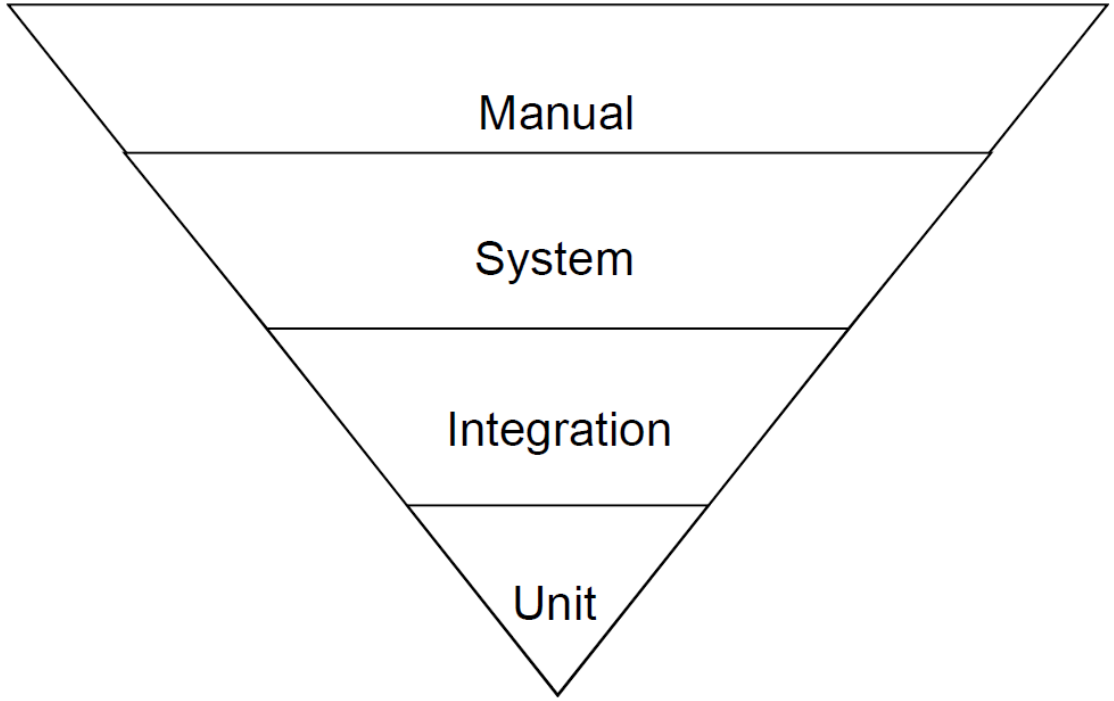
- How much should we do each?



- The more you go to the top, the more real the test is; however, the more complex it is to devise it

Ice Cream Cone

- Avoid ice cream cone i.e. upside down pyramid?



- system was so badly designed, that unit and integration tests are just impossible to be automated

Some Definitions

- **Failure** is an event, **error** is an erroneous state of the software caused by a **fault**, caused by a **human error**. Error (mistake)
  - Human error -> Mistake by an engineer -> ClassCastException.
  - Fault/Defect/Bug -> Anomaly in Software -> Missing/Incorrect Code
  - Error - > Faulty State
- Defect (fault, bug):
  - flaw in a code that cause a system to behave incorrectly
  - missing / incorrect code
  - Anomaly in the Software
- Bug and Defect are synonyms
  - Testing: Attempt to trigger failures
  - Debugging: Attempt to find faults given a failure -> Fault Localisation

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Some Definitions (Cont…)

- A test case consists of:
  - A set of inputs
  - Expected outputs
  - (Execution conditions)
- • Additional attributes:
  - Purpose
  - Scope
  - Origin
  - Priority
  - …

Some Definitions (Cont…)

- A traceability matrix is generated to make an association between requirements and test objectives to provide the highest degree of confidence. A test case consists of:

Requirements	RQ1	RQ2	RQ3	RQ4	RQ5
Test1			×		
Test2	×				
Test3		×			×
Test4				×	

Summary

- Testing is to conform the system to required specifications
- Testing is done for many purposes such as to test if the system is functionally correct, reliable, robust etc.
- Testing is done at three major levels that are unit, integration and system level.
- Manual testing is rarely done, expensive and discouraged to do.
- Testing Pyramid tells how much effort to put on each level while testing the system.
- Avoid Ice Cream Cone.
- Some definitions such as errors, faults, failures etc are important to know and useful in Testing.

Next Week

- Black Box Testing
- Types of black box testing
- Examples

Questions

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