SWE 637 Software Testing
Activities, week 3

Unit Testing with JUnit

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(Dr. B for short)

https://go.gmu.edu/SWE637
Adapted from slides by Jeff Offutt and Bob Kurtz
Consider the `Point` class

- What should the implementation of `equals()` look like?
- Develop some JUnit tests for `equals()`
- Develop some parameterized (data-driven) JUnit tests for `equals()`
- Develop some JUnit theories about `equals()`
  - hint: overriding `equals()` means you must override `hashCode()` also

Focus on what you want to test, not the JUnit syntax
SWE 637 Software Testing

System Testing with Cucumber

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Boeing 737 MAX MCAS System

Maneuvering Characteristics Augmentation System (MCAS)

Automatic system intended to prevent excessive nose-up aircraft attitude which can lead to aerodynamic stall
Boeing 737 MAX MCAS System

MCAS takes 3 inputs:

- **Autopilot status (on/off)**
  - MCAS is only active when the autopilot is **off** and the pilot is hand-flying the aircraft

- **Flaps position (up/down)**
  - When lowered, flaps allow the aircraft to fly slower
  - MCAS is only active when flaps are **up**

- **Angle of attack (AOA)**
  - Angle of the wing relative to the airflow
  - Wing will stall (stop generating lift) if the AOA is too high
  - MCAS activates when AOA is **high** and activates the electric trim system to push the aircraft nose down to reduce AOA
Boeing 737 MAX MCAS System

Measuring AOA
- The 737 has one AOA vane on each side of the nose
- MCAS (in 2018/2019) used *only* the pilot’s side AOA vane

AOA vane troubles
- On the Lion Air flight, the AOA vane had not been properly calibrated after replacement
- On the Ethiopian Airlines flight, it is likely that a bird strike during takeoff damaged the AOA vane
- Both aircraft thought the AOA was too high
Boeing 737 MAX MCAS System

AOA vane failures and trim system failures happen, and they’re part of flight training.

MCAS can be disabled by flipping off the trim switches:

- The Lion Air pilots never disabled the trim system.
- The Ethiopian Airlines pilots did disable the trim system, but then re-enabled it.
Boeing 737 MAX MCAS System

Simplified MCAS state diagram
Testing MCAS with Gherkin

Using the Gherkin system test language, design a system test to verify that MCAS activates (that is, produces a trim-down input) as desired

**Scenario:** McasActivates

**Given** ...

**When** ...

**Then** ...
Testing MCAS with Gherkin

Using the Gherkin system test language, design system tests to verify that MCAS does not activate when it should not:

1. When flaps are down
2. When auto-pilot is on
3. When AOA is normal
Testing MCAS with Gherkin

Scenario: McasDoesNotActivate
Given ...
When ...
Then ...

Scenario: McasDoesNotActivate
Given ...
When ...
Then ...

Scenario: McasDoesNotActivate
Given ...
When ...
Then ...
Testing MCAS with Gherkin

Scenario: McasActivates
Given ...
When ...
Then ...