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

Class Activity #3

Consider the `Point` class

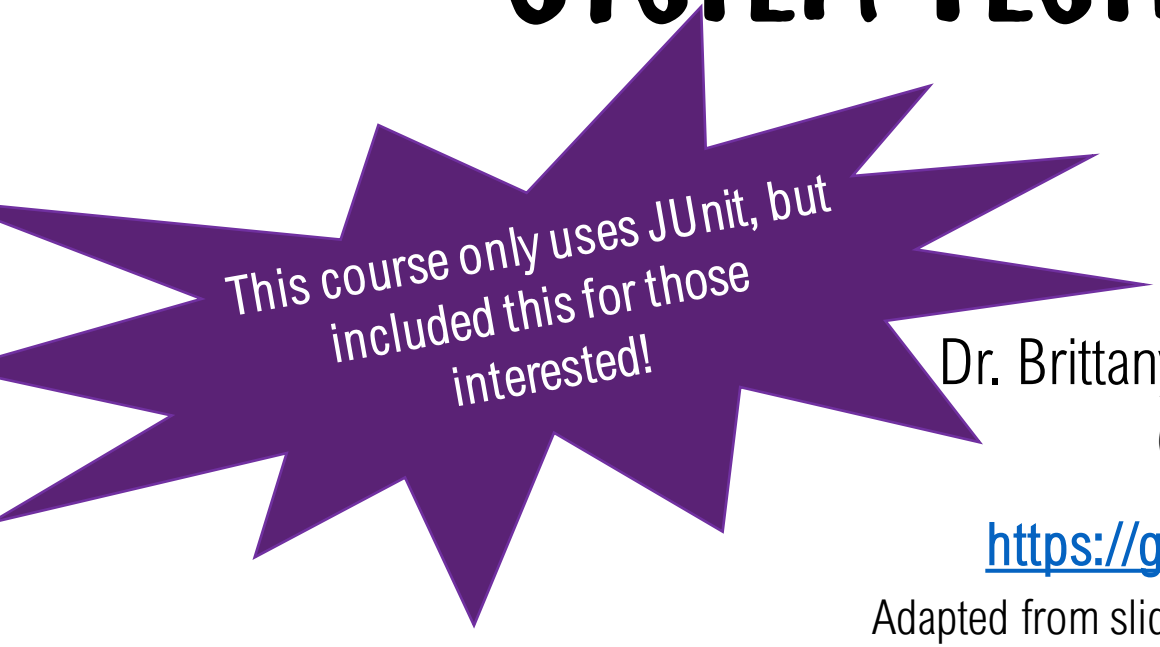
- What should the implementation of `equals()` look like?
- Develop some JUnit tests for `equals()`
- Develop some parameterized (data-driven) JUnit tests for `equals()`
- Develop some JUnit theories about `equals()`
  - hint: overriding `equals()` means you must override `hashCode()` also

```
class Point
{
   private int x;
   private int y;

   public Point(int x, int y)
   {
      this.x=x;
      this.y=y;
   }

   @Override public boolean equals(Object o)
   {
      // What should the implementation be?
   }
}
```

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

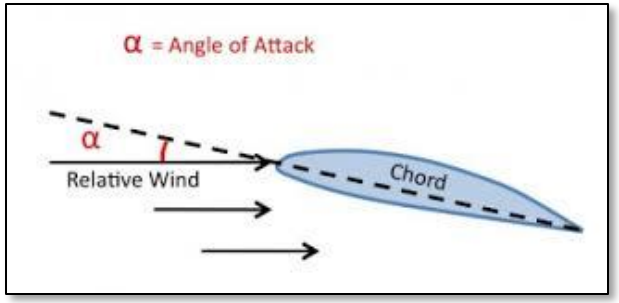
Maneuvering Characteristics Augmentation System (MCAS)

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

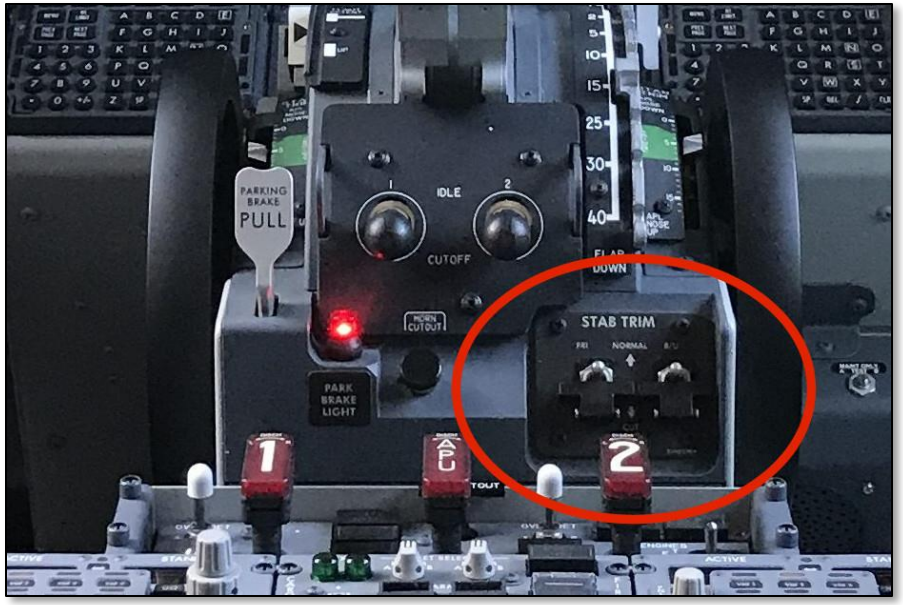
- On the Lion Air flight, the AOA vane had not been properly calibrated after replacement
- On the Ethiopian Airlines flight, it is likely that a bird strike during takeoff damaged the AOA vane
- Both aircraft thought the AOA was too high

Boeing 737 MAX MCAS System

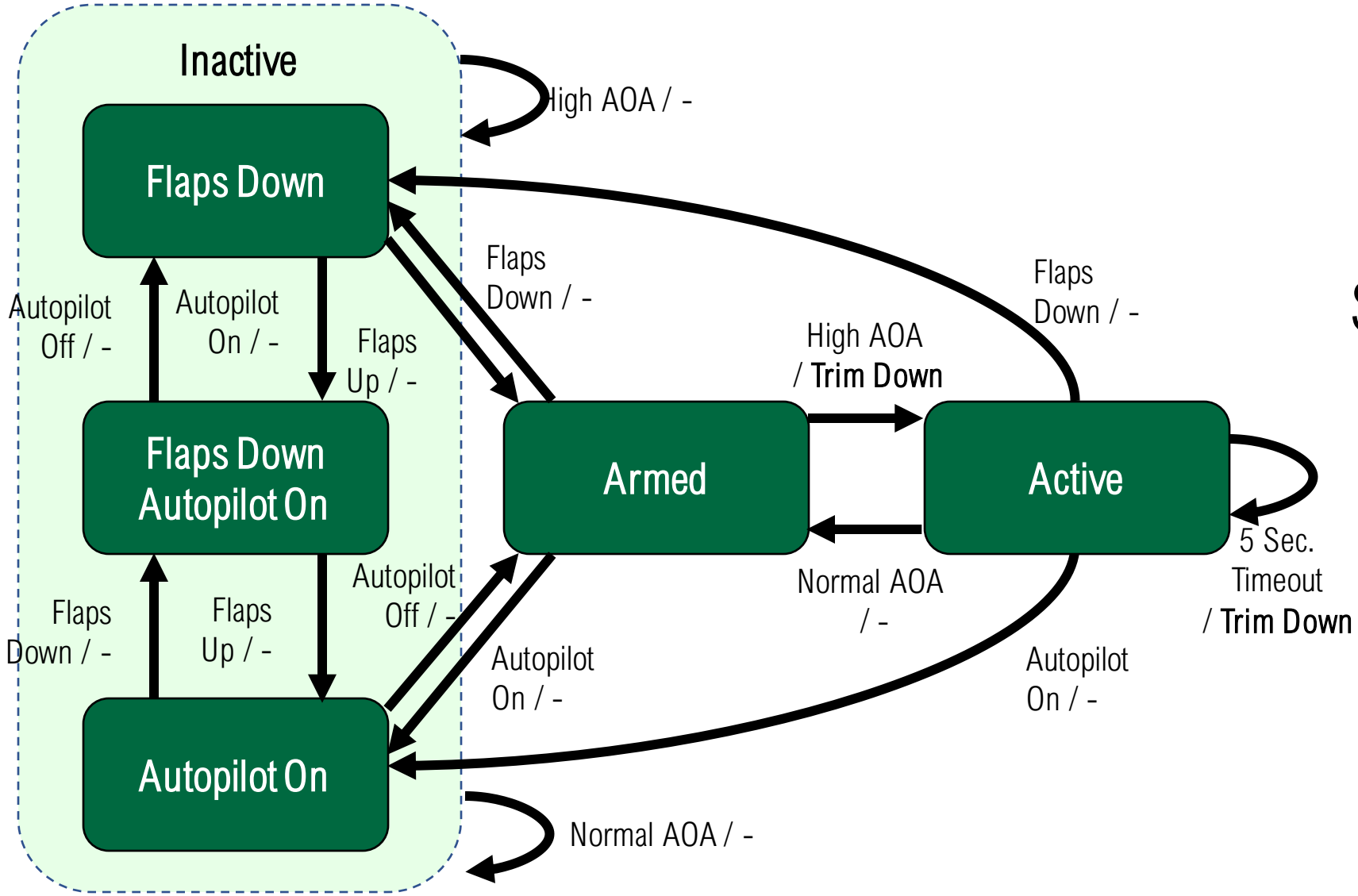
AOA vane failures and trim system failures happen, and they're part of flight training

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 …
```