

Class Testing

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What Is Class Testing?

- ▶ Unit Testing for Object-Oriented Systems
 - ▶ Test all features of a class object
 - ▶ Units should be tested in isolation
 - ▶ Test sequences of methods
- ▶ Inheritance presents problems in testing
 - ▶ Flattened classes
- ▶ Units
 - ▶ The smallest chunk that can be compiled by itself
 - ▶ A single procedure/function
 - ▶ Something so small it would be developed by one person
- ▶ Classes and Methods = Units?

Functional or Structural?

- ▶ Functional Testing
 - ▶ Test methods as black boxes
 - ▶ Tests based on specification
- ▶ Structural Testing
 - ▶ 'Set' and 'Get' methods for attributes

When? Who? What?

- ▶ Unit Level
- ▶ Extreme Programming...
 - ▶ Test cases designed before coding begins
- ▶ More normally...
 - ▶ Test cases designed after coding is complete
- ▶ Tester \neq Programmer

Goals

- ▶ Check attributes get set correctly
 - ▶ Initialised to the right value, eg:
`sizeIndex = [31, 28, 31, 30, 31, 30, 31, 31, 30, 31, 30, 30]`
- ▶ Find errors in calculation
 - ▶ `+` instead of `*`
- ▶ Wrong method calls
 - ▶ `year.increment()` instead of `month.increment()`
- ▶ Redundant code
- ▶ Incorrect boundary values
 - ▶ `for (int i = 0; i \leq 5; i++)` VS `for (int i = 0; i < 5; i++)`
- ▶ Error Messages
- ▶ Program efficiency is not so important

Windshield Wiper Example

c2.Lever	OFF	INT	INT	INT	LOW	HIGH
c2.Dial	n/a	1	2	3	n/a	n/a
a1.Wiper	0	4	6	12	30	30

- ▶ Lever has four positions: OFF, INT, LOW and HIGH
- ▶ Dial is only relevant when lever is on INT

Windshield Wiper Pseudocode

```
1 class windshieldWiper
2
3     private wiperSpeed
4     private leverPosition
5     private dialPosition
6
7     windshieldWiper(wiperSpeed,
8                     leverPosition, dialPosition)
9
10    getWiperSpeed()
11    setWiperSpeed()
12
13    getLeverPosition()
14    setLeverPosition()
15
16    getDialPosition()
17    setDialPosition()
18
19    senseLeverUp()
20    senseLeverDown()
21
22    senseDialUp()
23    senseDialDown()
24
25 End class windshieldWiper
```

- ▶ Maintain the state of lever and dial
- ▶ 'Sense' methods for lever and dial
- ▶ Get/Set operations for each variable

Windshield Wiper Pseudocode 2

```
29 senseLeverUp()
30   Case leverPosition Of
31     Case 1: Off
32       leverPosition = Int
33       Case dialPosition Of
34         Case 1: 1
35           wiperSpeed = 4
36         Case 2: 2
37           wiperSpeed = 6
38         Case 3: 3
39           wiperSpeed = 12
40       EndCase 'dialPosition
41     Case 2: Int
42       leverPosition = Low
43       wiperSpeed = 30
44     Case 3: Low
45       leverPosition = High
46       wiperSpeed = 60
47     Case 4: High
48       (impossible; error condition)
49   EndCase 'leverPosition
```

Methods for testing Windshield Wiper

- ▶ Test the get/set methods
 - ▶ wiperSpeed
 - ▶ leverPosition
 - ▶ dialPosition
- ▶ Driver (main program)
- ▶ Test individual methods
- ▶ Test classes that don't rely on others first
- ▶ Then test classes that use the already tested classes
- ▶ Stubs
 - ▶ Dummy subprograms

Test senseLeverUp

```
52 class testSenseLeverUp
53     wiperSpeed
54     leverPos
55     dialPos
56     testResult 'boolean
57 main()
58     testCase = instantiate windshieldWiper(0,Off,1)
59     windshieldWiper.senseLeverUp()
60     leverPos = windshieldWiper.getLeverPosition()
61     If leverPos = Int
62         Then testResult = Pass
63         Else testResult = Fail
64     EndIf
65 End 'main
```

Test Case	Preconditions	Method	Expected Value of leverPos
1	windshieldWiper(0,Off,1)	senseLeverUp()	INT
2	windshieldWiper(0,Int,1)	senseLeverUp()	LOW
3	windshieldWiper(0,Low,1)	senseLeverUp()	HIGH
4	windshieldWiper(0,High,1)	senseLeverDown()	LOW
5	windshieldWiper(0,Low,1)	senseLeverDown()	INT
6	windshieldWiper(0,Int,1)	senseLeverDown()	OFF

Test windshieldWiper

<i>Event Sequence</i>	<i>User Action</i>	<i>System Response</i>
1	move lever to INT	Wiper speed is 4
2	move dial to 2	Wiper speed is 6
3	move dial to 3	Wiper speed is 12
4	move lever to LOW	Wiper speed is 20
5	move lever to INT	Wiper speed is 12
6	move lever to OFF	Wiper speed is 0

Test windshieldWiper Sequences

```
85 class testScenario
86     wiperSpeed
87     leverPos
88     dialPos
89     step1OK 'boolean
90     step2OK 'boolean
91     step3OK 'boolean
92     step4OK 'boolean
93     step5OK 'boolean
94     step6OK 'boolean
95
96 main()
97     testCase = instantiate windshieldWiper(0,Off,1)
98     windshieldWiper.senseLeverUp()
99     wiperSpeed = windshieldWiper.getWiperSpeed()
100     If wiperSpeed = 4
101         Then step1OK = Pass
102         Else step1OK = Fail
103     EndIf
104
105     windshieldWiper.senseDialUp()
106     wiperSpeed = windshieldWiper.getWiperSpeed()
107     If wiperSpeed = 6
108         Then step2OK = Pass
109         Else step2OK = Fail
110     EndIf
111
112     windshieldWiper.senseDialUp()
113     wiperSpeed = windshieldWiper.getWiperSpeed()
114     If wiperSpeed = 12
115         Then step3OK = Pass
116         Else step3OK = Fail
117     EndIf
118
119     windshieldWiper.senseLeverUp()
120     wiperSpeed = windshieldWiper.getWiperSpeed()
121     If wiperSpeed = 20
122         Then step4OK = Pass
123         Else step4OK = Fail
124     EndIf
125
126     windshieldWiper.senseLeverDown()
127     wiperSpeed = windshieldWiper.getWiperSpeed()
128     If wiperSpeed = 12
129         Then step5OK = Pass
130         Else step5OK = Fail
131     EndIf
132
133     windshieldWiper.senseLeverDown()
134     wiperSpeed = windshieldWiper.getWiperSpeed()
135     If wiperSpeed = 0
136         Then step6OK = Pass
137         Else step6OK = Fail
138     EndIf
139 End 'main
140
```

Pros/Cons of writing a test driver

- ▶ Automated testing
- ▶ Drivers and Stubs = Overhead
- ▶ Manual Testing

In Summary...

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Any Questions?