Enhancing Testing of VDM-SL models

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Agenda

Problem/motivation

Unit/integration testing in VDM

VDMUnit and code-generation extensions

Conclusion and future plans

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Background: unit and integration testing in VDM

- Testing SL models
  - Tedious and error-prone
  - Lack of tool support
- VDM++/VDM-RT is supported by VDMUnit
- VDMUnit does not work for VDM-SL
  - Relies on features not available in VDM-SL
    - Object-orientation and exception handling

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Objectives

- Improve unit/integration testing in VDM-SL
  - by extending VDMUnit
- Reuse model tests to validate model realisation
  - by extending Overture's VDM-to-Java code-generator
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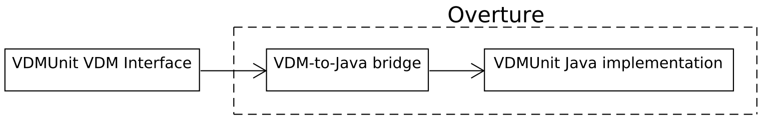
VDMUnit architecture



- Consists of a *VDM* and a *Java* component
  - VDM: exposes VDMUnit features
  - Java: identifies/executes tests using Java reflection
- VDM and Java connected via Overture's *Java bridge*

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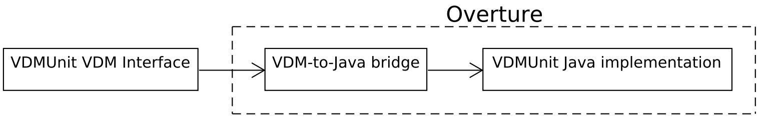

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VDMUnit tests in VDM++

```
class MyTest is subclass of TestCase
operations
public testOne : () ==> ()
testOne () == Assert`assertTrue("Expected `someFeature` to generate " ^
  "an even number ", someFeature() mod 2 = 0);
end MyTest
```

- Test classes extend `TestCase`
  - Test operations begin with “test”
  - Features valided using assertions
- `setUp` and `tearDown` invoked before/after each test
- Tests execution: all vs. selectively
  - All: `new TestRunner.run()`
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VDM-SL modules expose VDMUnit features

```
module Assert
imports from TestRunner all
exports all

definitions

operations

assertTrue: bool ==> ()
assertTrue (pbool) ==
  if not pbool then
    TestRunner`markFail();

assertTrueMsg: seq of char * bool ==> ()
assertTrueMsg (pmessage, pbool) ==
  if not pbool then (
      TestRunner`setMsg(pmessage);
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  ...other assertion omitted

end Assert
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markFail : () ==> ()
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setMsg : seq of char ==> ()
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VDM-SL test example

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setUp : () ==> ()
setUp () == initState();

tearDown : () ==> ()
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testOdd: ()==>()
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testInverse: ()==>()
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end MyTest
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VDM-SL test example

Java/JUnit4 translation

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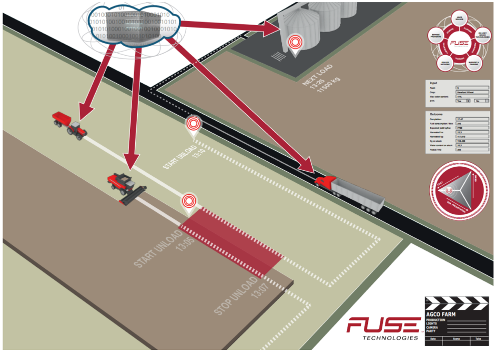
Harvest planning case study

- Master algorithm in VDM
  - Code-generated to Java
- 4200 lines of VDM
  - ≈ 3100 lines of model
  - ≈ 1100 lines of tests
- 134 VDM-SL tests
  - VDM tests: ≈ 7 hours
  - Java versions: ≈ 30 min.



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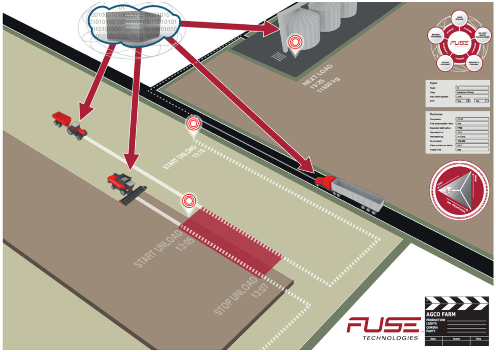

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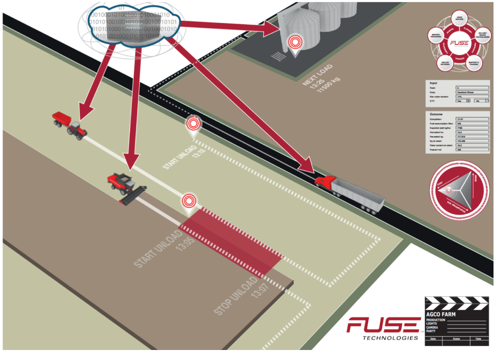

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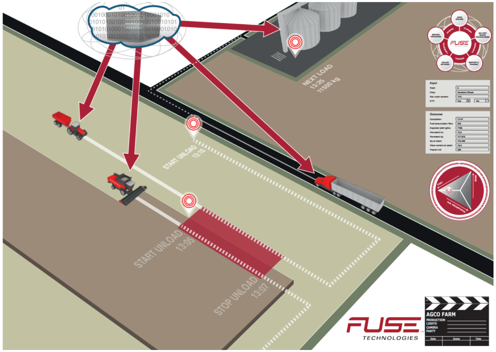
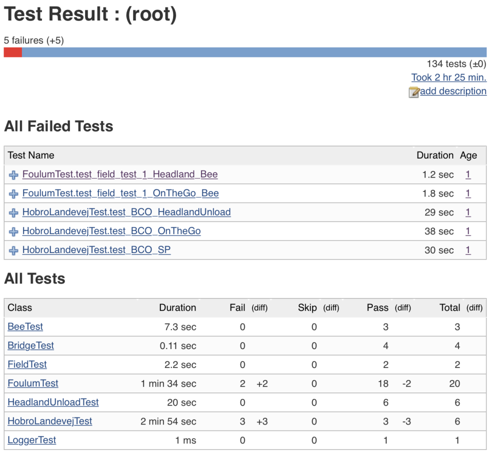


Jenkins integration

- Overture CLI extension
  - Pass property `-Dvdm.unit.report`
- VDM test reports
  - Generate XML reports
  - Jenkins visualisation



Test Result : (root)

5 failures (+5)

134 tests (±0)
Took 2 hr 25 min.
add description

All Failed Tests

Test Name	Duration	Age
FoulumTest.test_field_test_1_Headland_Bee	1.2 sec	1
FoulumTest.test_field_test_1_OnTheGo_Bee	1.8 sec	1
HobroLandevejTest.test_BCO_HeadlandUnload	29 sec	1
HobroLandevejTest.test_BCO_OnTheGo	38 sec	1
HobroLandevejTest.test_BCO_SP	30 sec	1

All Tests

Class	Duration	Fail	(diff)	Skip	(diff)	Pass	(diff)	Total	(diff)
BeeTest	7.3 sec	0		0		3		3	
BridgeTest	0.11 sec	0		0		4		4	
FieldTest	2.2 sec	0		0		2		2	
FoulumTest	1 min 34 sec	2	+2	0		18	-2	20	
HeadlandUnloadTest	20 sec	0		0		6		6	
HobroLandevejTest	2 min 54 sec	3	+3	0		3	-3	6	
LoggerTest	1 ms	0		0		1		1	

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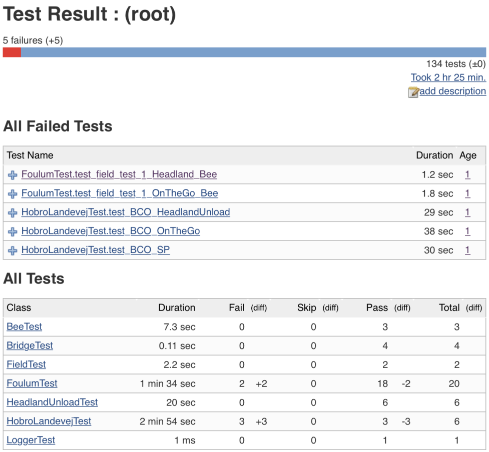

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Thank you

VDMUnit for VDM-SL:

`https://github.com/overturetool/overture/pull/671`