Measuring the Effectiveness of ACATS

ACM SIGAda 2004
Intro

Rational Software, part of IBM since Feb 2003

Rational Apex
- now bundled as “IBM Rational Ada Developer”
- 7 self-hosted platforms + embedded
- Version 4.4.0 released Oct 2004
ACATS

- Ada Conformity Assessment Test Suite

- Standard test suite for Ada compilers

- Required for certification
  - “Certificate of Conformance”
But …

How good is ACATS?
Measuring a Test Suite

- **Requirements Coverage**
  - white box approach

- **Structural Coverage**
  - black box approach
Requirements Coverage

- For Ada, LRM95 = Requirements

Algorithm:

- Tally the Requirements
- Count # covered by test cases
- Coverage = # covered / # covered
Requirements Coverage - Methodology

- Use the file COVERAGE.TXT provided with ACATS 
  *(downloaded from adaic.org)*

- Details tests by LRM95 paragraph numbers

- Adjust for non-requirement sections
Structural Coverage

- **Structural coverage = how much code executed**
- **Statement Coverage**

```ada
if (A or B > 12) then
    Text_Io.Put_Line(“yes”);
if (B > 20) then
    raise Program_Error;
else
    Something_Something;
end if;
end if;
```
Structural Coverage

- Cover what?
Anatomy of an Executable

```
procedure Hello is
begin
    Text_Io.Put_Line("Hello");
end;
```

<table>
<thead>
<tr>
<th>Application code (user code)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Predefined</th>
<th>Runtime</th>
</tr>
</thead>
</table>
Structural Coverage

- Cover what?
  - Implicit
  - Provided by/with the compiler
  - Predefines + Runtime
  - Chose Linux (self-hosted) compiler
Structural Coverage - Methodology

- Get the source for runtime & predefines
- Include runtime source in Ada closure
  (Predefines are already in the closure)

```ada
with Rts_Closure; -- add to report

package Rts_Closure is
  with Image_Funcs;
  with Tasking_Stuff;
  with Exception_Handler;
  with Storage_Manager;
...```

Structural Coverage – Methodology (Cont’d)

- Use Rational TestMate (Test manager/coverage analysis tool)
- It automates the execution of tests and coverage instrumentation/collection
- Limit coverage to predefines + runtime units
- Approx. 17,000 basic blocks
Results

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Structural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Covered 61%</td>
<td>Covered 24-31%</td>
</tr>
<tr>
<td>Not Covered 39%</td>
<td>Not Covered</td>
</tr>
</tbody>
</table>

Measuring the Effectiveness of ACATS

Nov. 17, 2004

© 2004 IBM Corporation
Conclusions

- **Requirements Coverage**
  - Over 60%
  - Not surprising, as ACATS were designed to the LRM
  - Actual coverage is higher (because “legacy” Ada83 tests are not detailed in coverage.txt)

- **Structural**
  - 24-31%
  - Very respectable for system test
Other Conclusions

- Suggests Future Work
  - Beef up ACATS
  - Map the “Legacy” Ada83 tests to LRM95

- Safety-Critical Test Suites (full-coverage) are still valuable, should be run routinely
Final Thoughts

- Certification process is unique to Ada
- Should provide a competitive advantage for Ada
  - … but, vendors (IBM included) are neglecting it
  - The last certificates expired in September
  - Current situation is shameful
- Let’s revive it!

(This slide has not been approved by IBM management, legal, or lackeys thereof.)