
Mutating Automated Tests

STAR East '00

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Automated Software Tests

- No intervention needed after launching tests
- Automatically sets-up and/or records relevant test environment
- Runs test exercise
- Captures relevant results
- Evaluates actual against expected results
- Reports analysis of pass/fail

Levels of Automation

- Fully automated software testing
- Semi-automated software testing
- Manual software testing


Advantages To Automation

- Repeatable
- Faster running
- Reusable components
- Standardized formats
- Easy to generalize
- Better environment control

Disadvantages To Automation

- Requires test tools
 - Expensive
 - Confine the paradigm
- Time consuming test creation
- Does the same thing each time
- Limit possible observations
- Tests and tools require real maintenance


First Generation Automation

- Automate existing tests by creating equivalent exercises
- Small improvements 
- Test scripting
- Reuse test components
- Hard coded oracles

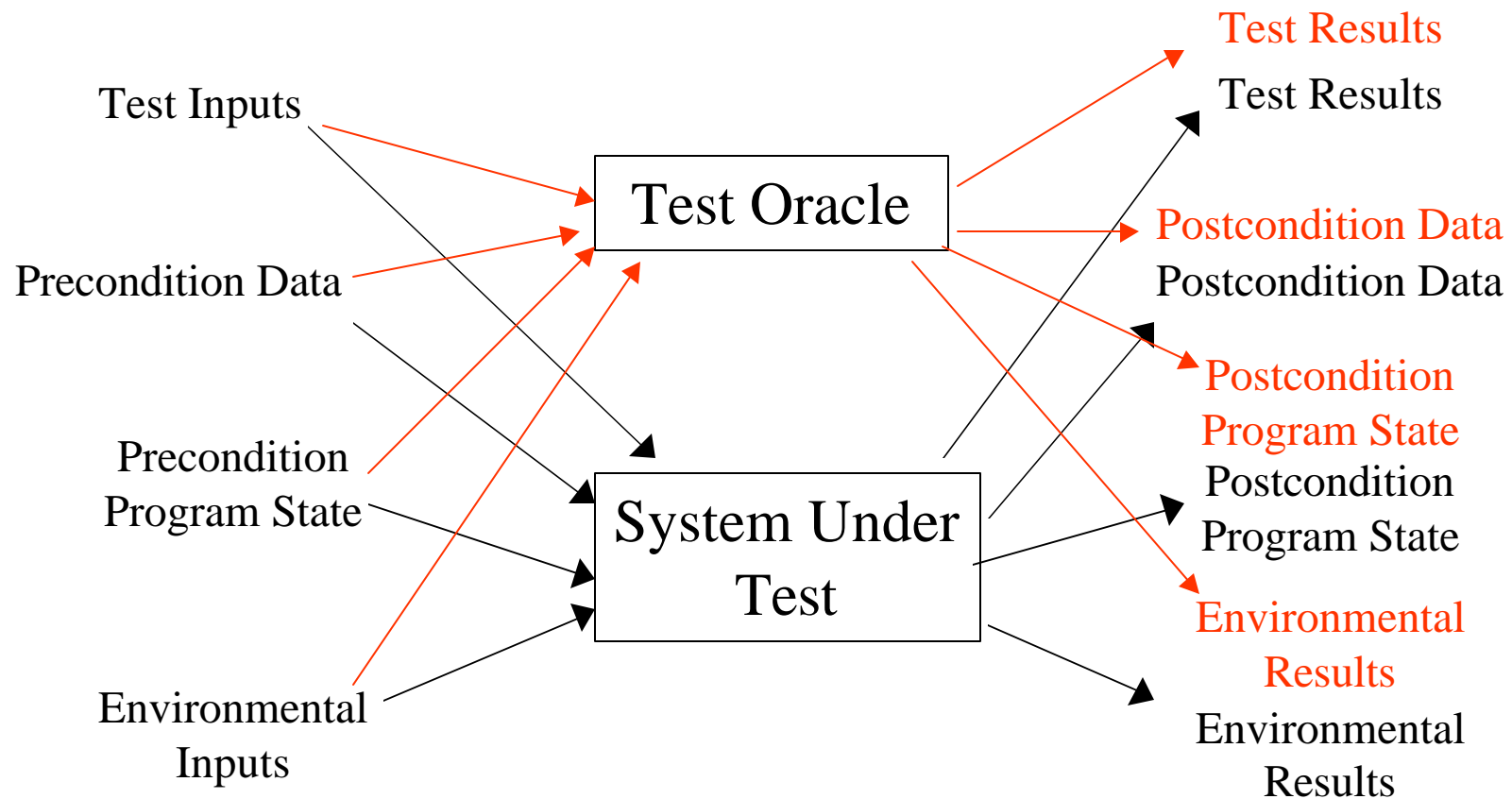
The Power Of Tests

- Self verifying tests
 - Check results ASAP in the test
 - Dump data only on errors
- More general exercises
 - All alternatives in turn
 - “Walk the tree” approach
- Include positive and negative cases

Second Generation Automation

- Automated oracles 
- Exhaustive/extensive/intensive exercises
- Auto generated tests and data
- More powerful exercises
- Random selections among alternatives

Testing With An Oracle



More Powerful Exercises

- Increase the number of combinations
- Self-verifying tests and diagnostics
- More frequency, intensity, duration
- Increase the variety in exercises

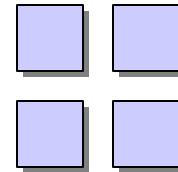
Random Selection Among Alternatives

- Partial domain coverage
- Small number of combinations
- Requires an oracle for verification
- Pseudo random number generation

The beginnings of mutating tests!

Third Generation Tests

- System instrumentation
- Multi-threaded tests
- Fall back compares
- Heuristic oracles
- Diagnostics

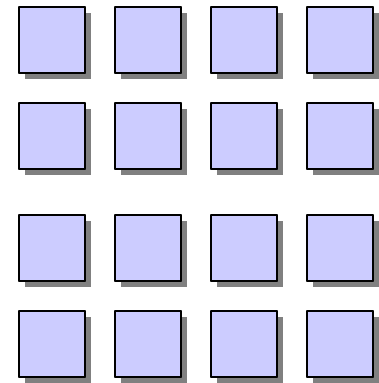


Tools For Third Generation

- Software instrumentation
 - Observations
 - Controls
- Oracles and comparators
- Test execution control

Mutating Automated Tests

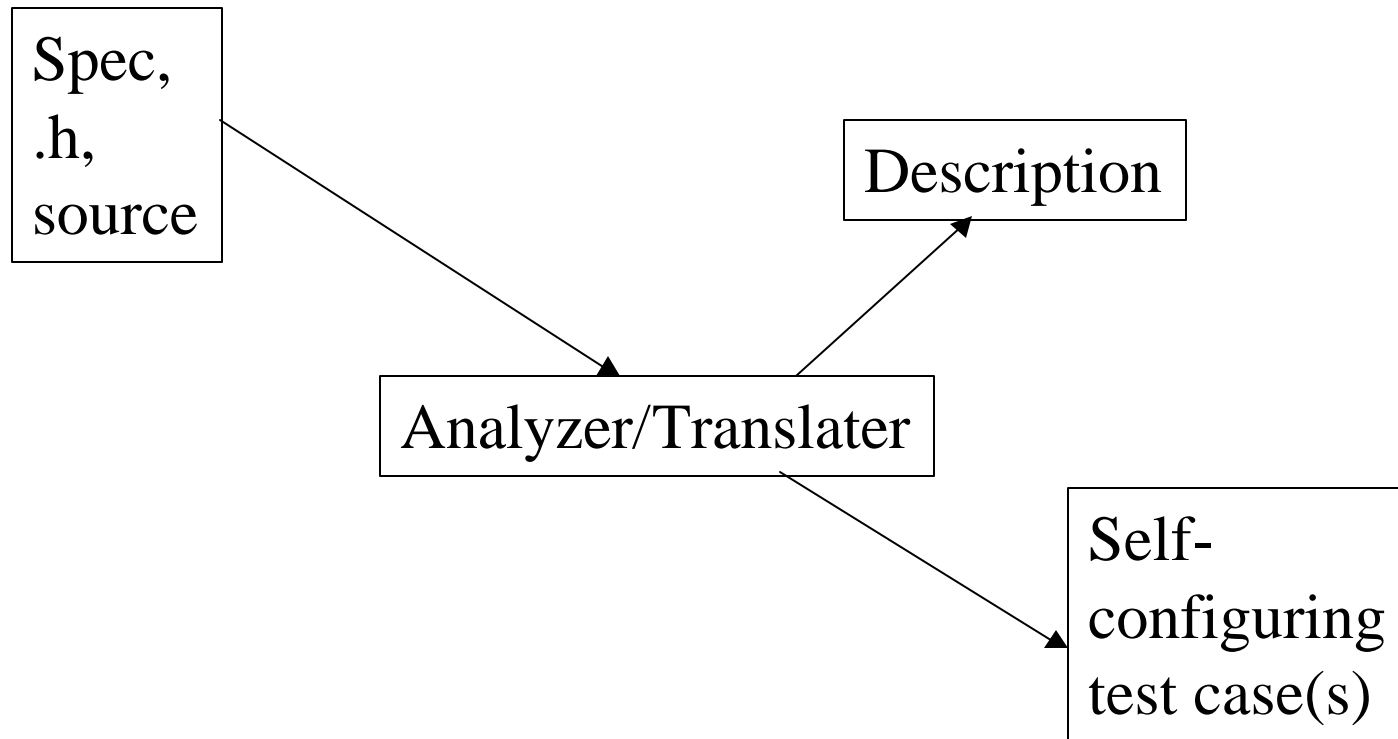
- Closely tied to instrumentation and oracles
- Using pseudo random numbers
 - Random selection from domains
 - Nesting and looping
 - With and without replacement
- Positive and negative cases possible
- Drill down on error



Mutating Tests Examples

- Data base contents
- Processor instruction sets
- Compiler language syntax
- Stacking of data objects

Auto-Configuring Tests



Summary

- Automated tests can be powerful
- Static automated tests are unlikely to find defects
- More powerful automated tests cannot be duplicated manually

