Technology and Processes for Software Assurance Evaluations

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Technology and Processes for Software Assurance Evaluations

- Evaluation Problems
- Some Solution Requirements
- Use of Tools & Techniques
- Building an Evaluation Service Community

Evaluation Problems

- Vast amount of software
  - Growing diversity of program languages and characteristics
  - Growing dependence on external components
  - Software release cycles are approaching continuous evolution
  - More software is yet to be written than has been written so far

Evaluation Problems

- Current evaluation services are either inadequate or incommensurable or both
  - Many services look only at documentation and functional tests
  - Security evaluations generally rely on substantial manual review
  - Standard approach is to look for vulnerabilities vs. assess positive assurance
  - Software program managers are not able to separate the wheat from the chaff in evaluation tools
  - Skilled security evaluators are rare—evaluator training is even more rare
  - Evaluation results don't have a common meaning

Evaluation Problems

- Evaluation science is inadequate and fragmented
  - Measurement of software assurance properties not widely studied or applied
  - Formal methods still a few years away from wide applicability

Some Solution Requirements

- Software Assurance Evaluations need to be:
  - Scalable
  - Repeatable
  - Goal-based vs. Flaw-based
  - Criteria-based vs. Tool-based
  - Useful
  - Measurably effective
  - Rational

Use of Tools & Techniques

- Assurance evaluations are served by the use of tools across the lifecycle
  - Requirements, Design, Implementation, Testing, Deployment
  - The use of tools early in the lifecycle can make evaluations later in the lifecycle more thorough, more efficient, and more accurate.
  - The use of tools later in the lifecycle verifies the correctness of the implementation.

Use of Tools & Techniques

- Tool evaluations
  - Tools need to be assessed to determine their true strengths and weaknesses
  - Tool standards are helpful for integration or interoperability
- Scientific Methods
  - Assurance evaluation techniques need to be grounded in accepted science, not conventional wisdom

Building an Evaluation Service Community

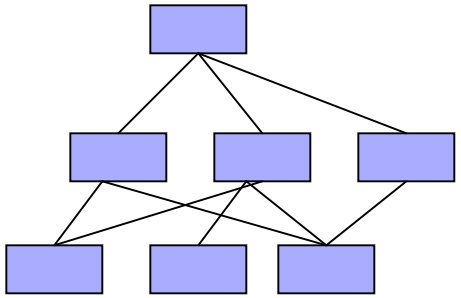
- Sharing results
  - Common goals
  - Common metrics
  - Accepted well-documented processes
  - Common assessment languages
- Process improvement
  - Evaluation framework within which incremental improvements can be shared and accumulated

Building an Evaluation Service Community

- Example: The Virtual Binder
  - Assurance Goals
  - Assessment Languages/Interpretive Methodologies
  - Assurance Metrics
  - Measurement Strategies

Building an Evaluation Service Community

- Hierarchy of Assurance Goals
  - A community of evaluation service providers agrees on a hierarchy of assurance goals
  - Each goal definition includes a set of terms that express degrees of partial goal achievement.



Building an Evaluation Service Community

- Assessment Languages
  - A suite of report formats for communicating assurance evaluation results that are useful for a specific set of customer decisions
    - Binary: Deploy/Don't deploy
    - Unidimensional: 1-7, 
    - Multidimensional: "Consumer Reports" style comparison of multiple applications or of multiple aspects of a single application
  - Interpretive methods for expressing degrees of partial goal achievement in terms of a chosen assessment language

Building an Evaluation Service Community

- Assurance Metrics
  - For each goal, metrics are identified that serve as proxies for direct goal measurement
  - Metrics are applicable to an identified class of software
  - Metrics are documented with specific configurations of tools and environments
  - A catalog of metrics can be collected from diverse sources and published throughout the evaluation community

Building an Evaluation Service Community

- Measurement Strategies
  - For each goal, an evaluation service provider selects a set of metrics that will represent a reasonably independent suite of proxy measurements
  - These strategies are published with the report
  - Measurements are captured with respect to these metrics and the results are reported in an assessment language appropriate to the needs of the evaluation customer

Building an Evaluation Service Community

- Applying the process
  - Determine if suitable measurement strategies are available to evaluate the customer's class of software
  - Select an assessment language compatible with the customer's purpose for the evaluation
  - Select measurement strategies for the class of software and apply them using principles of Bayesian inference to determine a probability distribution over the goal achievement terms given the measurement results. This distribution characterizes the relative likelihood that a given goal achievement term is the most accurate description of the software under evaluation
  - Probabilities for degrees of goal achievement are combined in the goal hierarchy to derive distributions over parent goals
  - The resulting likelihoods of partial goal achievement are expressed in the assessment language

Building an Evaluation Service Community

- Collaboration within the community
  - Evaluation service providers can produce reports that have a known degree of commensurability—critical for informed comparisons
  - Measurements for individual metrics can be captured at multiple locations and then combined to generate goal and overall results
  - A measurement strategy used by one provider can be extended by another with almost no duplication of work
  - Raw tool output need not be distributed with the report in order for it to be meaningful and useful

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