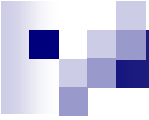


A Multi-Criteria Decision Making Framework for Real Time Model-Based Testing

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TAIC PART 2010



Testing Real-Time Systems

- Time adds a new dimension to the complexity of the testing process
 - *Timing behavior of a system needs to be tested in addition to functional behaviour*
- Car Airbag
 - Should open within a very specific and short time interval
- Choice of 'timing' values
 - Allowable time and budget for testing are a real consideration



Analytical Hierarchy Process (AHP)


- An approach for multi-criteria decision making (Saaty, 1982)
 - Reduces the complexity of a problem by decomposing it into sub-problems
 - Establishes judgments based on decision-makers' opinions
 - Opinions can then be validated, questioned and reviewed by others
 - Allows mixture of measurable and subjective values
 - Similar to Basili's Goal-Question-Metric (GQM)
 - NASA and SEL University of Maryland
 - For deciding on what aspects of software we want to capture/measure
 - Performance evaluation of security mechanisms in web services



Problem Context

- Previous research

- Divided test values into three separate sets depending on the constraints:
 - Boundary values (*on* the constraints boundary)
 - Out-boundary (*outside* the constraints boundary)
 - In-boundary (*within* the boundary)
- Considers the testing environment by enabling the tester to choose between the proposed test sets based on that choice
- A trade-off between increasing confidence in SUT correctness and limited testing resources (time, effort and cost)



AHP features (decomposed)

- **Hierarchy** at the root of which is the goal or objective of the problem being studied
 - *Choose the best-suited test set to be deployed for a particular SUT*
- **Criteria** for:
 - Test adequacy
 - Test performance
 - Complexity
- **Sub-criteria** (for each of the above three criteria)
- **Alternatives** (specific test set options)



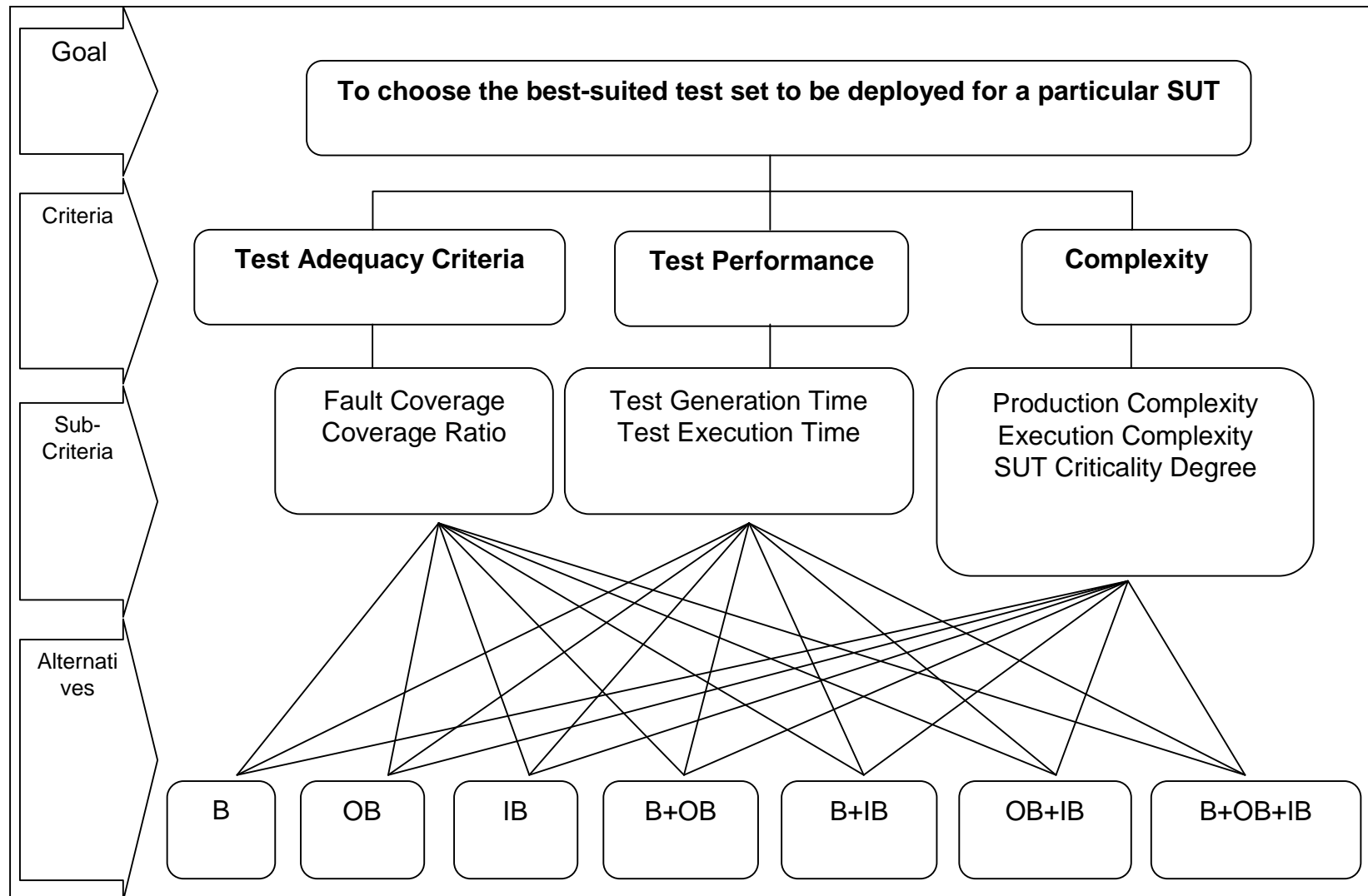
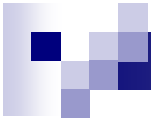
Criteria

- *Test adequacy*
 - *E.g., sub-criteria: Fault coverage (measurable)*
- *Test performance. A tester will always prefer a test set that needs minimum time to execute*
 - *E.g., sub-criteria: Test execution time (measurable)*
- *Complexity*
 - *E.g., sub-criteria: SUT Criticality degree (subjective)*
 - *The more critical the SUT, the more test points we need in order to increase confidence in SUT correctness*



Alternatives

- Any possible combination of Boundary, Out-Boundary, In-Boundary:
 - B, OB, IB, B+OB, B+IB, OB+IB, B+OB+IB



The alternatives, sub-criteria and criteria can all be weighted.



Why the big deal (about AHP)?

- Current set of plans

- Fault analyses (based on the boundary model) for a cluster of connected robots
- Work co-ordination application where timing is critical
 - Manipulating and moving objects around
- Part of a collaboration effort
 - Not our robots
 - Need to make our test plans rigorous
 - Competing for resources
- Need to plan, select test sets for the set of experiments very carefully



Future work

- Two strands:
 - Employ AHP on a number of case studies
 - Develop a tool to assist in the decision making process



■ Thanks!