Combinatorial Test Design in the TOSCA Testsuite

Lessons Learned and Practical Implications

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Overview

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- Basics – the mash
- What are the Requirements?
  - The distillate
  - Grouped by: containing the combinatorial explosion, risk and business value, understandability, changeability and maintainability, fault localization
- What is TOSCA?
  - The software
  - Test generation strategies
    - Combination
    - Linear Expansion
- Conclusion
  - How do the generation strategies compare?

Basics - the Mash

- Company TRICENTIS
  - Company offering tools and services in the SQA market
  - ca. 200 employees in Austria, subsidiaries in Europe, Australia, and the US
  - 15 years of experience in testing large SW applications
    - Financial domain (such as banking and insurance), healthcare, public sector and industry
  - Customers all over the world
  - Projects with # of test cases ranging from ca. 250 to 6000
- Product TOSCA
  - Includes wide range of features that support
    - Test automation, test case management,
    - Test data management as well as
    - Test case design
- SCCH
  - Software Competence Center Hagenberg GmbH
  - Common project on concept analysis

REQ: Containing the Combinatorial Explosion (Beware of KABOOM!)

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- REQ-1: High coverage of input parameters, data values and combinations
  - Core requirement of combinatorial techniques
  - Cost of full coverage nearly always prohibitive
- REQ-2: Minimal number of combinations to test
  - Linear increase of test case # would be ideal
    - Test effort easy to estimate -> basis for test planning and management
- REQ-3: Dealing with dependencies
  - Dependencies add complexity
  - Need ways to cope with dependencies

REQ: Focus on Risk and Business Value

- REQ-4: Support for the value-based paradigm
  - Requirements have different business values and different risks
  - So have the associated test cases
  - Standard test scenario accounts for 40-60% of overall value of requirement acc. to TRICENTIS
- REQ-5: Estimation of contribution of a test
  - Needed for test case prioritization and test case selection
- REQ-6: Robustness of the test suite for a selective execution of tests

REQ: Understandability

- REQ-7: Ease of understandability of a technique for test design
  - Necessary for adequate and correct application of technique by tester
  - Influences quality of tests
- REQ-8: Understandability of produced output
  - Influences refinement of test activity
  - Transition to automated test scripts
  - etc.

REQ: Changeability and Maintainability

- REQ-9: Ease of extending a set of tests with new input parameters or new data values
  - + Identify missing combinations
  - In practice changes to existing tests tend to be avoided
    - Costly post processing
    - Makes comparing different test runs more difficult
- REQ-10: Ease of reducing tests
  - Input parameter or data values become obsolete

Support for fault localization

- REQ-11: Side effects of a failing test should be minimal
  - Mass failures (not only in huge test suites) hinder analysis
    - e.g. as part of a daily test execution
    - Number of passed/failed test is often used as indicator for progress progress and health
      - Gives wrong picture
- REQ-12: Identifying the root cause of a failure
  - Failures not only due to combination of input values but as well due to
    - Script problems
    - Interface incompatibilities between test system and SUT
    - Data conversion problems
    - Infrastructure changes
    - Environmental problems (e.g. out of disk space for log)
    - etc.

A Very Short Introduction to TOSCA

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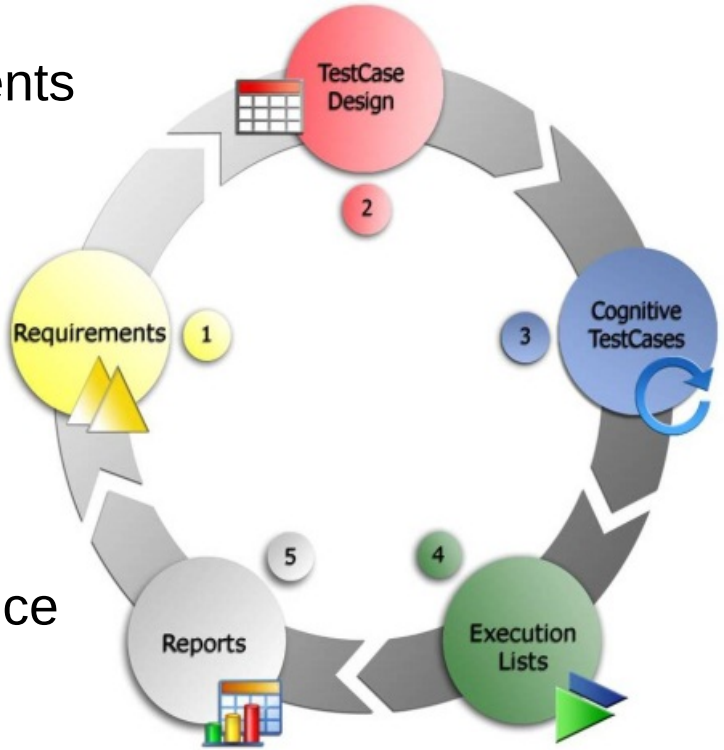
- Comprehensive suite for test management and test automation
- Test process in TOSCA
  - Build risk-based structure of requirements
  - Design test cases
  - Specify/automate designed test cases
  - Execute test cases
  - Project execution results on defined requirements
- Handling of input parameters
  - Derived from business logic, equivalence partitions, boundary values
  - Character of values can be specified
  - Can be hierarchically structured (like classes)



Combination Strategies Supported by TOSCA

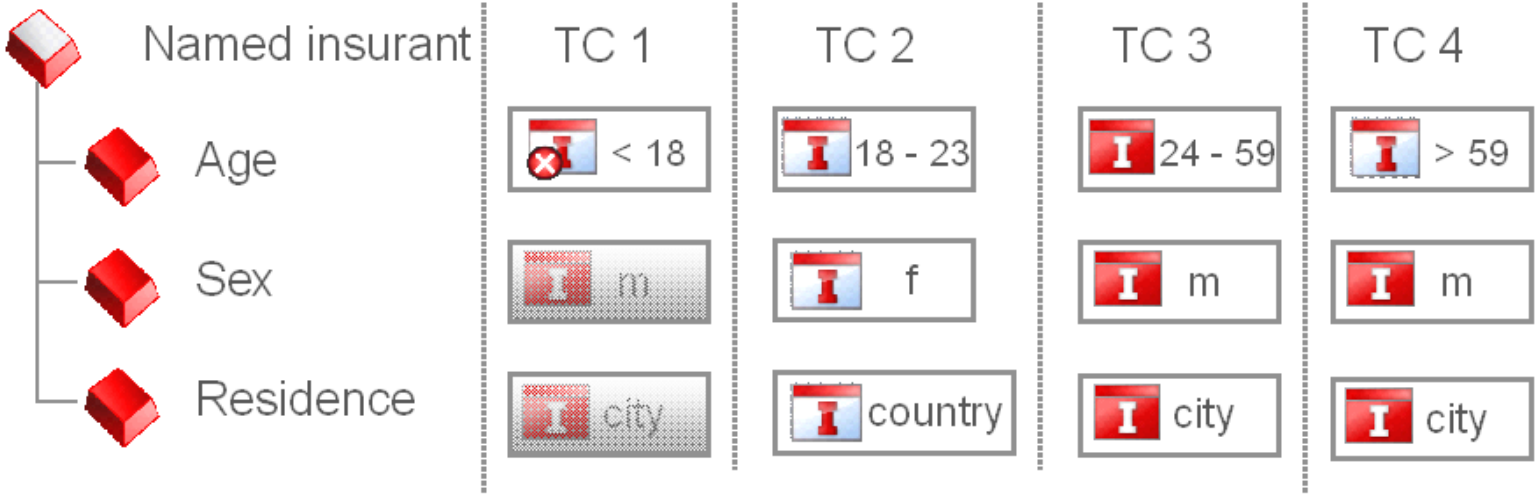
- Full combination
  - Every possible combination of instances of business-relevant attributes
  - Combinatorial explosion
  - Only for small sets of input parameter
- Pair-wise combination
  - Each pair of instances of business-relevant attributes at least once
- Orthogonal combination and
- Linear expansion

Short Example

- Test cases for calculating the annual premium of a vehicle insurance policy (liability insurance).
- Greatly simplified specification from the business perspective
  - Owners younger than 18 years of age are not insured.
  - Owners between 18 and 23 pay an additional 20 % (beginners' license).
  - Owners 60 and older receive a 10 % discount (seniors' discount).
  - Women receive a 5 % women's discount.
  - Owners living in the city pay an additional 15 % (higher risk of accidents).

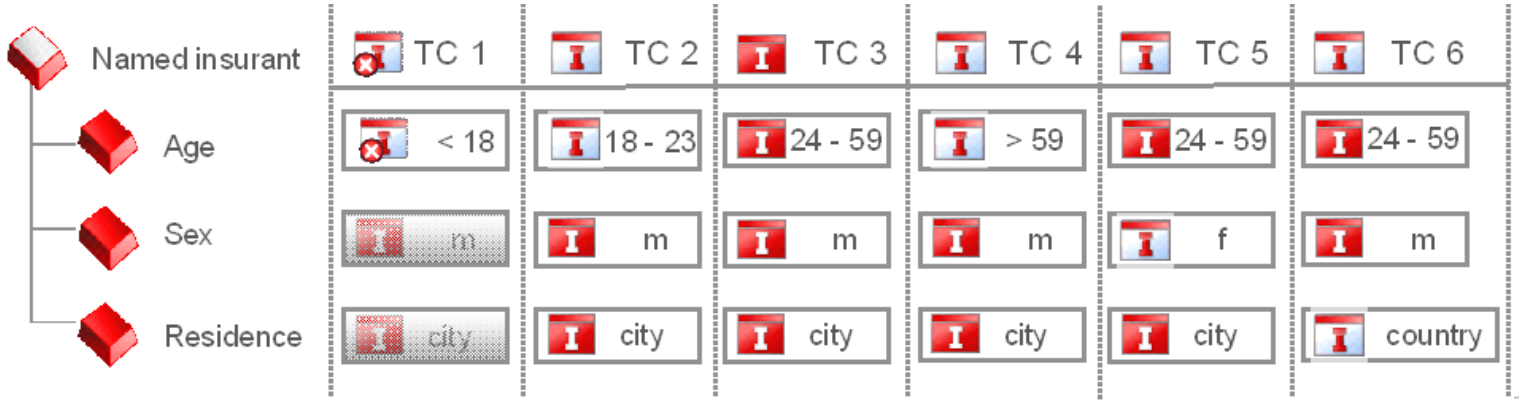
Orthogonal Combination

- Each instance of each business-relevant attribute at least once
- May lead to an acceptable functional coverage as long as attributes are independent



Linear Expansion

- Test case with most important equivalence classes for all attributes => “straight through”
- Minimum requirement of testing
  - Straight through runs all the way through without error
- All straight throughs can form a smoke test portfolio
  - Can be executed with the highest priority
- Each test case differs from the straight through in exactly one test relevant feature.



Conclusion: Strength / Weaknesses of CT wrt. Practical Requirements

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		Full combination	Orthogonal combination	Pair-wise	Linear Expansion
A. Combinations and dependencies	REQ-1	+	–	+	~
	REQ-2	–	+	+	+
	REQ-3	+	–	~	–
B. Value- and risk-based	REQ-4	–	–	–	+
	REQ-5	+	+	–	+
	REQ-6	+	+	–	+
C. Understandability	REQ-7	+	+	~	+
	REQ-8	+	~	–	+
D. Changeability	REQ-9	+	+	~	+
	REQ-10	–	~	–	+
E. Fault localization	REQ-11	–	+	–	~
	REQ-12	+	–	~	+
Score (+/-)		8/4	6/4	2/6	9/1

Thank you

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