



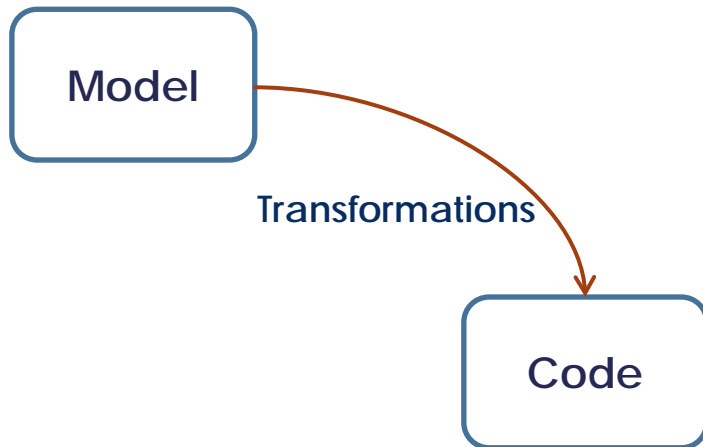
MODEL TRANSFORMATION TESTING, THE STATE OF THE ART

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INTRODUCTION

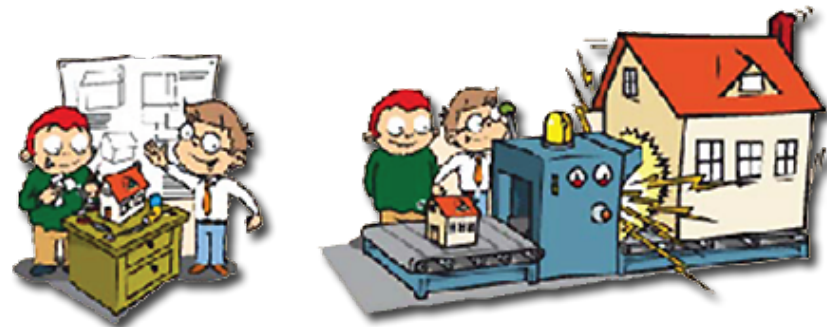
Model Driven Development



Programming



Modeling → Generating



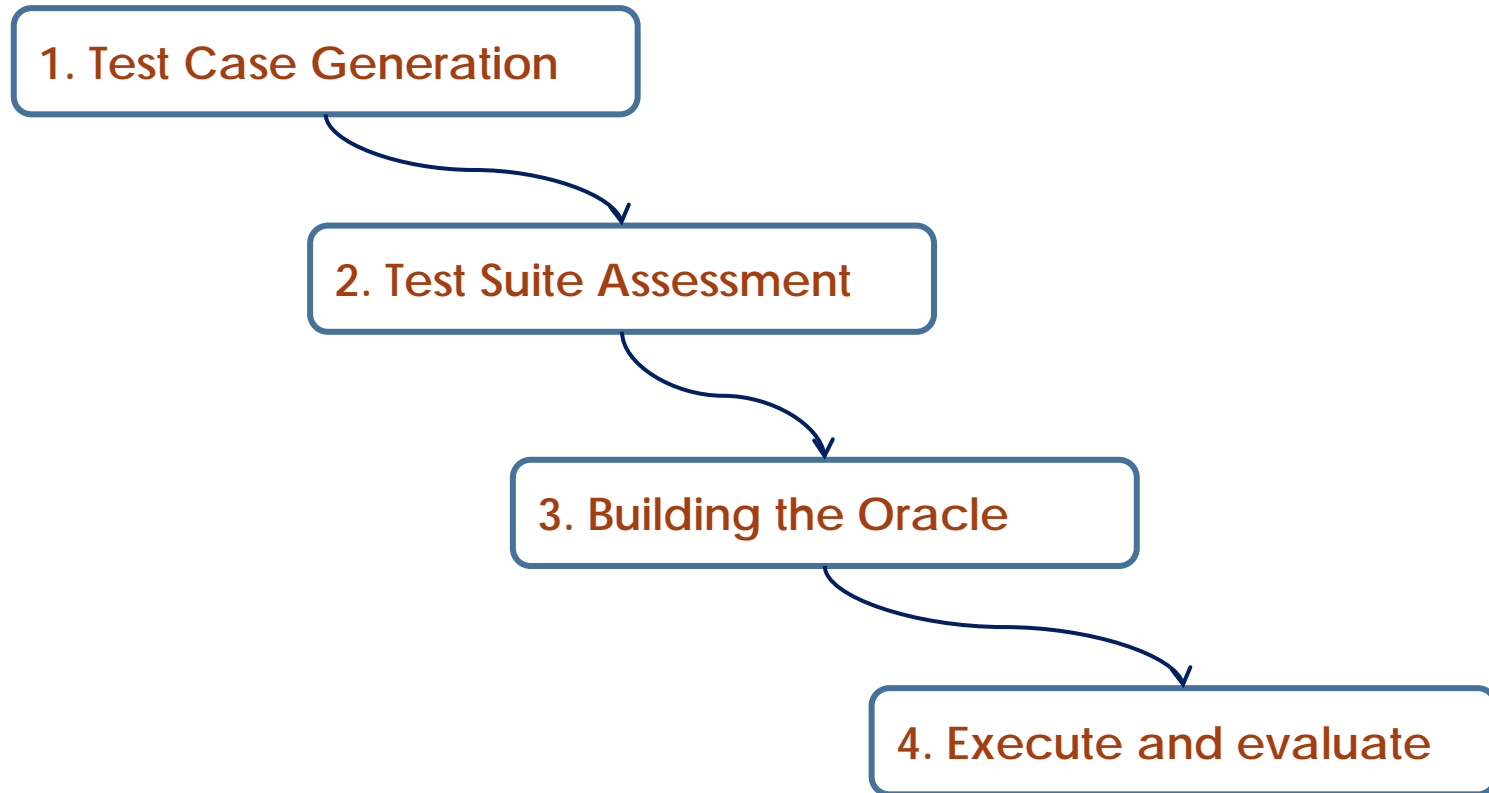
TRANSFORMATION CORRECTNESS

Formal Methods : Heavyweight

Testing :

- executes a transformation on input models then validates the actual output matches the expected output.
- Automatable test activities
- Lightweight, Low computational complexity

PHASES OF MODEL TRANSFORMATION TESTING



PHASE 1: TEST CASE GENERATION

- Define test adequacy criteria, then Build test cases that achieves its coverage. And it can be done by using:
 - **Black-Box testing:** based on transformation specification.
 - **Gray-box testing:** based on the accessible parts of transformation implementation.
 - **White-Box testing:** based on transformation implementation

BLACK- BOX TEST CASE GENERATION

METAMODEL COVERAGE

- Adequacy criteria for Class diagrams
 - Association end multiplicity criterion
 - Generalization criterion
 - Class attribute criterion

BLACK- BOX TEST CASE GENERATION

METAMODEL COVERAGE

- Adequacy criteria for Interaction diagrams
 - Each message on a link
 - All message path
 - Collection coverage
 - Condition coverage
 - Full predicate coverage
 - Transition coverage

BLACK- BOX TEST CASE GENERATION

METAMODEL COVERAGE

- Adequacy criteria for statecharts
 - Full predicate coverage
 - All content- dependency relationships
 - Transition coverage
 - transition- pair coverage
 - Complete sequence coverage
 - All configurations transition coverage

BLACK- BOX TEST CASE GENERATION

CONTRACT COVERAGE

Achieving input contracts of Model transformation

- Constructing metamodel of only those elements are actually used in pre/post conditions of transformation
- Combine contract-based and metamodel based.
And footprints(number of times test model covers each criterion).

WHITE-BOX TEST CASE GENERATION

- Most of the Studies are done without case studies and no detailed results.
- Transforming rules to a source metamodel template.
- Assessing ATL rules by profiling:
 1. Compilation resulted XML file to extract the rules.
 2. Transformation to be executed. And using the resulted log file to assess the coverage(rule, instruction, decision).
- Grammar testing, Each rule to be triggered in every possible context.

PHASE 2: TEST SUITE ASSESSMENT

- Achieved Coverage to assess the test suite quality.
- Mutation analysis, evaluate the sensitivity of the test case to faults in transformation.
- Injecting faults by applying mutation operators and generate mutants.
 - Different results: Killed mutant.
 - No faults: the mutant is alive

PHASE 3: BUILDING THE ORACLE FUNCTION

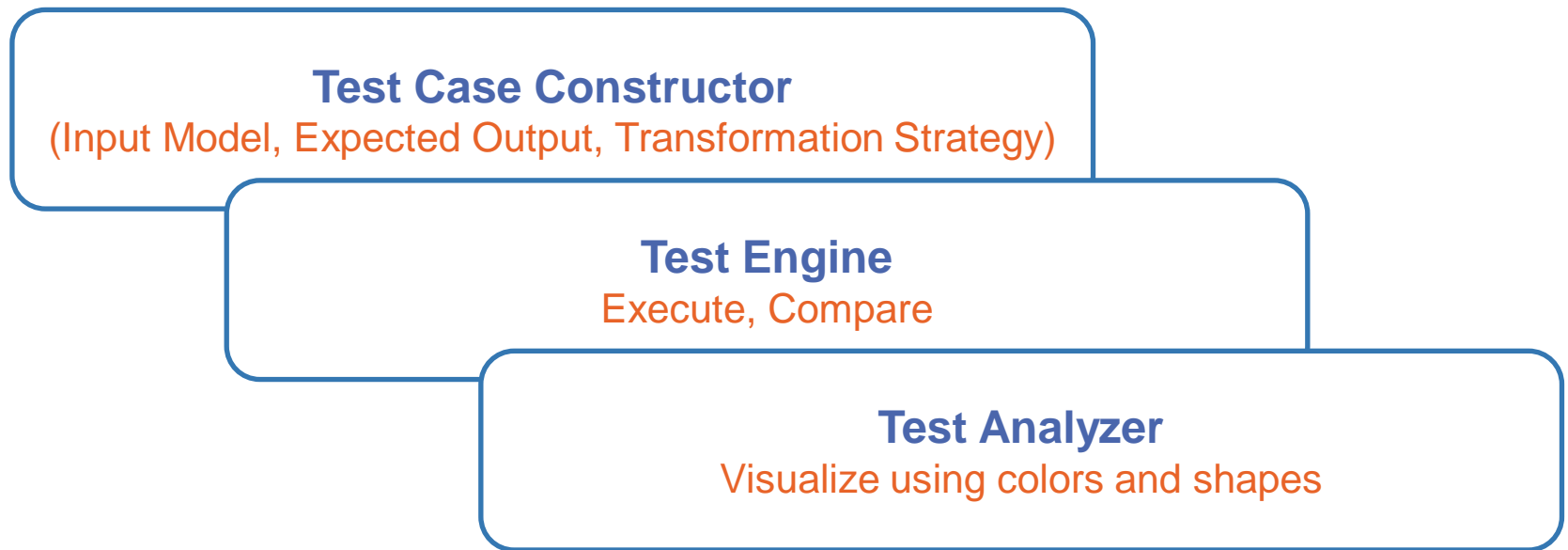
Compares The actual output with expected one.

- if the expected output is available, then Compare.
- If it is not available, validates the resulted output with the predefined output properties or contracts

PHASE 3: BUILDING THE ORACLE FUNCTION

COMPARISON

if the expected output is available, then Compare:



A framework uses Model comparison

PHASE 3: BUILDING THE ORACLE FUNCTION

CONTRACTS

If the expected output is not available, validates the result with the predefined output properties or contracts.

- Tracts, set of OCL constraints and a tract test suite.
- Improving Transformation contracts:
 1. Vigilance: dynamically detect errors
 2. Diagnosability: effort to locate a fault

PHASE 3: BUILDING THE ORACLE FUNCTION

CONTRACTS

- Vigilance can be improved by Analyzing a test suit and repeatedly using mutation analysis, until achieving an acceptable mutation score.
- Other proposed an improved vigilance and diagnosability by using mathematical modeling.

QUESTIONS

- Gray-Box Testing , is it feasible to depend on partial implementation while considering other parts as black box testing?
- Class diagrams, statecharts, and sequence diagrams are the common used while testing transformation, what about other types of diagrams?
- Is Model comparison as oracle function clear enough?
- Since 2012 when this paper was written, and many related studies were without case studies or reliable results, any new updates were added to testing MDT?