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AGATHA

Statemate specification analysis and automated test generation

- Validation and Test from Specification
- Calculus Explosion : Problems and Solutions
- Architecture and Mechanism of AGATHA
- Examples
- STATEMATE/AGATHA connexion

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Automata languages :

ESTELLE

SDL

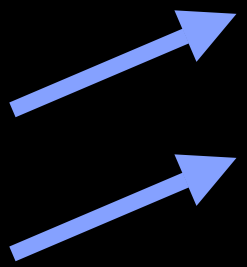
STATECHARTS

AGATHA

INDUSTRIAL TOOLS

ObjectGEODE & TAU

STATEMATE



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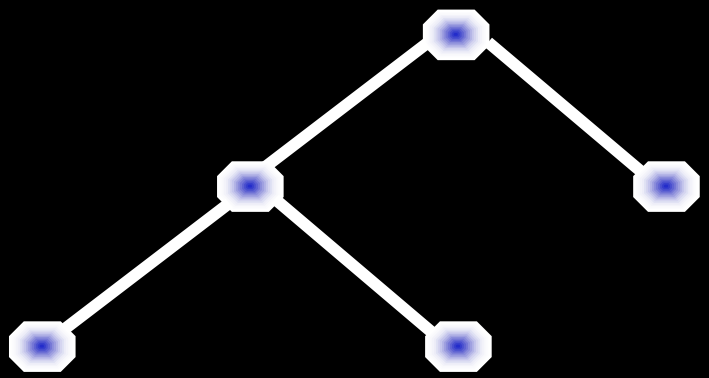
Automata

Formal Model:
SDL, STATECHARTS...



Objectives :

- **Validation**
- **Verification of Properties**
- **Test Generation**

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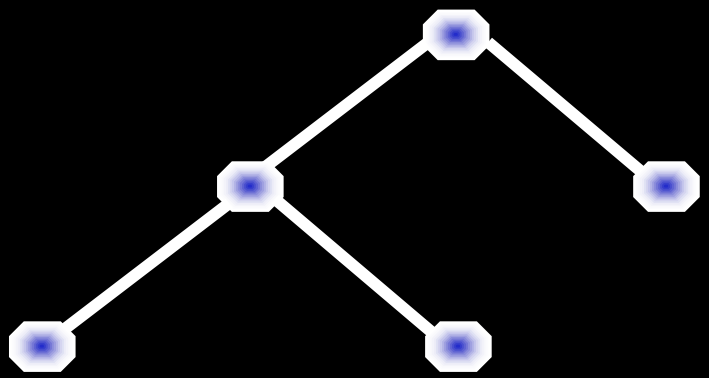
Automata

Verification : Model-Checking

Reduction of State Number :



- **BDD (symbolic calculus : boolean, finite domains)**
- **Polyhedric (abstractions : integers)**

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GOAL :Validation & Test Generation

To check Behaviours of the system :

Validate them on specification (simulation)

Generate test to check the implementation (conformance testing)

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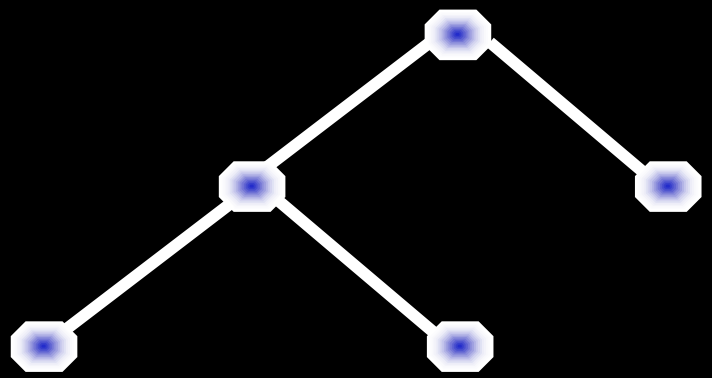
Conformance testing : implementation

One test purpose = A property to test



Test Purpose :
Reduce the State explosion

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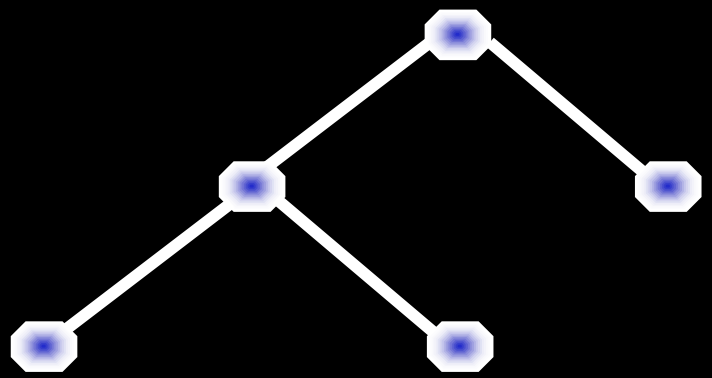
All systems behaviours : structural method

Branch coverage: possible but non exhaustive

Path coverage: exhaustive but impossible



To be Exhaustive :

We need Path coverage

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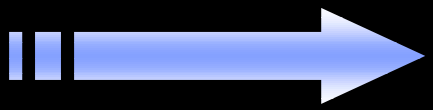
Path coverage => Big Calculus Explosion

Least Reduction: one test = one behaviour

Symbolic calculus (Automatic)



Abstractions (Manual & Automatic)

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Path coverage

2 Factors of Calculus Explosion:

- **Parallelism**
- **Variables Impact**

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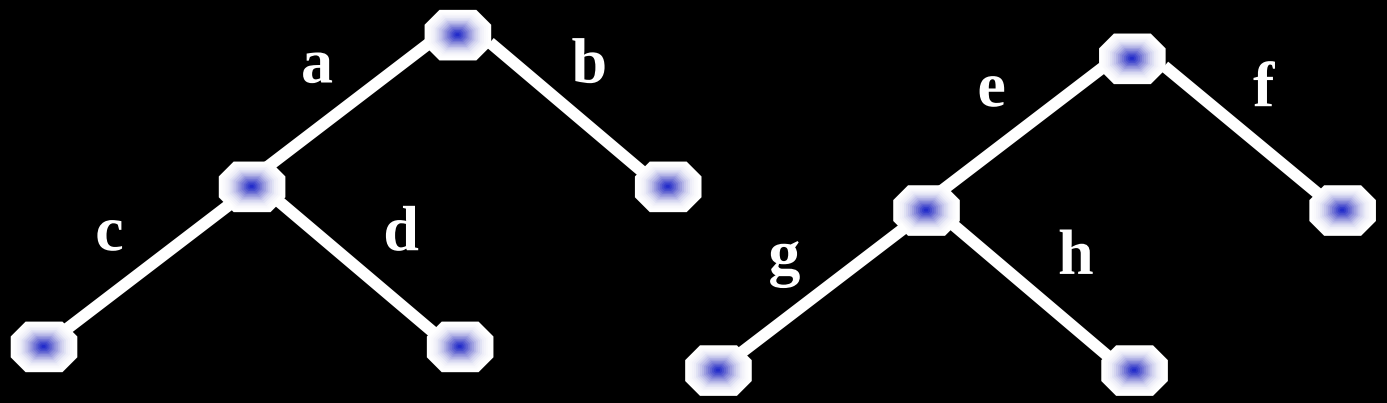
Interleavings (Parallelism)



a c e g
or
a e c g
or
a e g c
Etc.

Partial Order Method : Preserve deadlocks

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Variables Explosion

Symbolic calculus: SYMBOLIC EXECUTION

Symbolic Execution : Calculate symbolic states Tree (Lori Clarke, King, in years 70)

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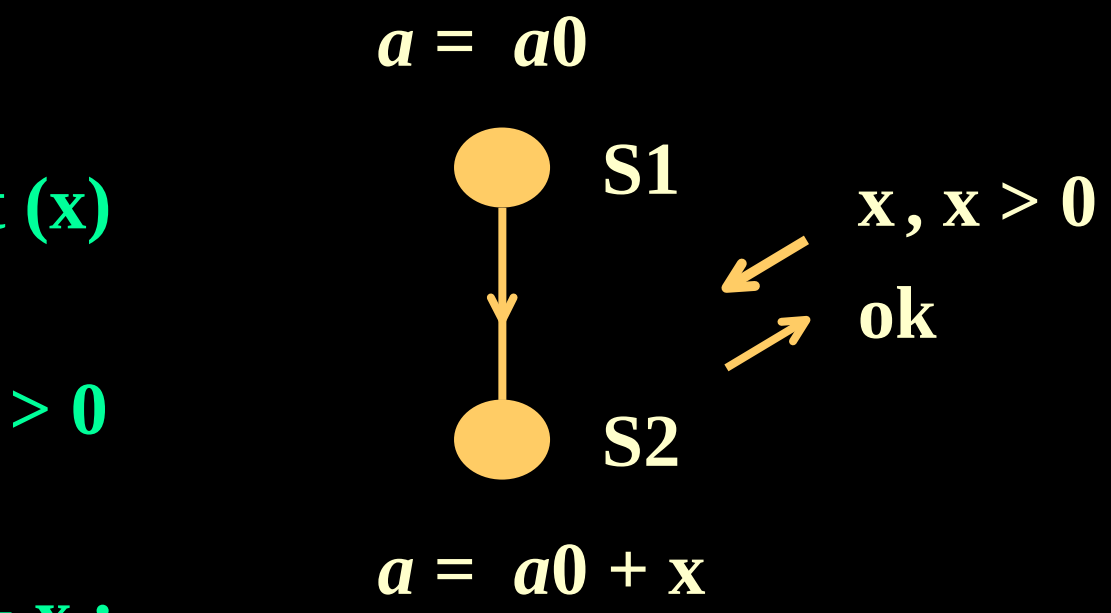
Example of Symbolic execution on a Transition

From S1
To S2
When input (x)
Output ok
Provided x > 0
Begin
    a : = *a* + x ;
End;



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Extended Automata

Numerical State =

State
Numerical Values of Variables

Symbolic State =

State
Symbolic Values of Variables
Path Conditions

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In the last example

For initial State :

Numerical = ***State*** **S1,** ***a*** **=** ***a*****0 = 0,**
Extended State = (S1, 0)

Symbolic = ***State*** **S1,** ***a*** **=** ***a*****0**
Extended State = (S1, ***a*****0)** → **include (S1,0)**

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Extended State

Final State :

Numerical =

***State* S2, *a* = *a*0 + 1 = 1**
Extended State = (S1, 1)

Symbolic =

***State* S2, *a* = *a*0 + x, x > 0**
Extended State
(S1, *a*0 + x, x > 0)

→ **include (S1,1)**

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Path Condition PC

PC = x > 0 → Condition on the entries

Second transition *a = a + y, y < 0*

a = *a*0 + x + y, x > 0, y < 0

PC = x > 0 *and* y < 0

IF y = x THEN

PC = *(* x > 0) *and* (x< 0) = FALSE

→ This branch is suppressed

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Symbolic execution

Symbolic Tree

→ Set of Symbolic States

Symbolic States

→ State,Symbolic values of variables, Path Condition

Criteria of Stop

→ Symbolic State Loop

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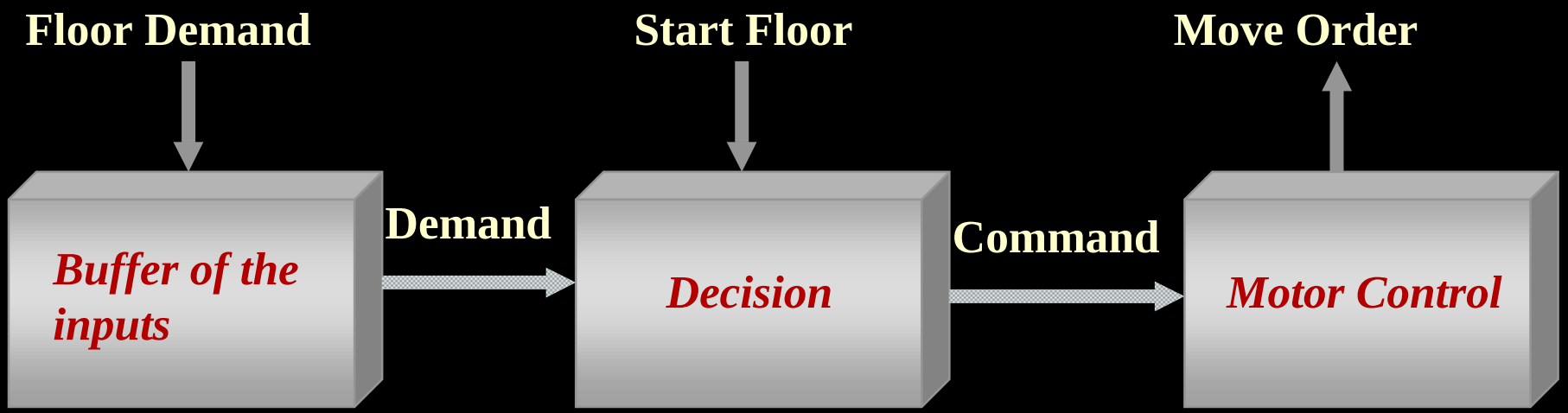
The Elevator

3 Parallel Automatas communicating



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The Elevator

Two parameters

Start Floor

Required Floor

Domain of variation

Set of Floors, which cardinality is N

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The Elevator

Enumerated Calculus

If FIFO size = 1

Law in N^2

If FIFO size = P

Law in N^{P+1}

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The Elevator

Symbolic Calculus

FIFO size = 1

Constant

FIFO size = P

Law in P^2

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PCCN

Protection and Numerical Control and Command

Electrical Distribution

- Circuit Breakers
- Set of Circuit Breakers

Their number are variable

- Explosive Numerical Calculus

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PCCN

5 Modules - 50 Variables – 1500 lines of ESTELLE

Solution : Abstract Circuit Breakers and Sets (permutations)

Numéric

10^{13} States

Symbolic

28 Pathes of a few 10 States, which means
less than 1000 symbolic states

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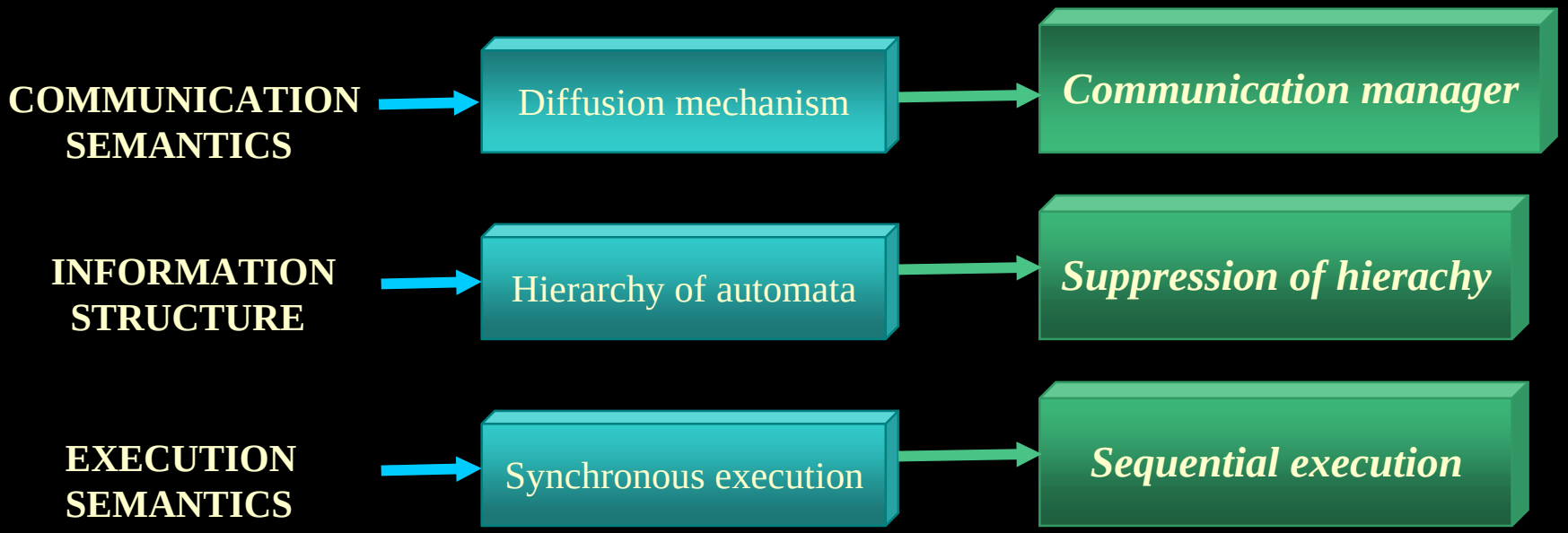
Differences between STATECHARTS and other classical automata



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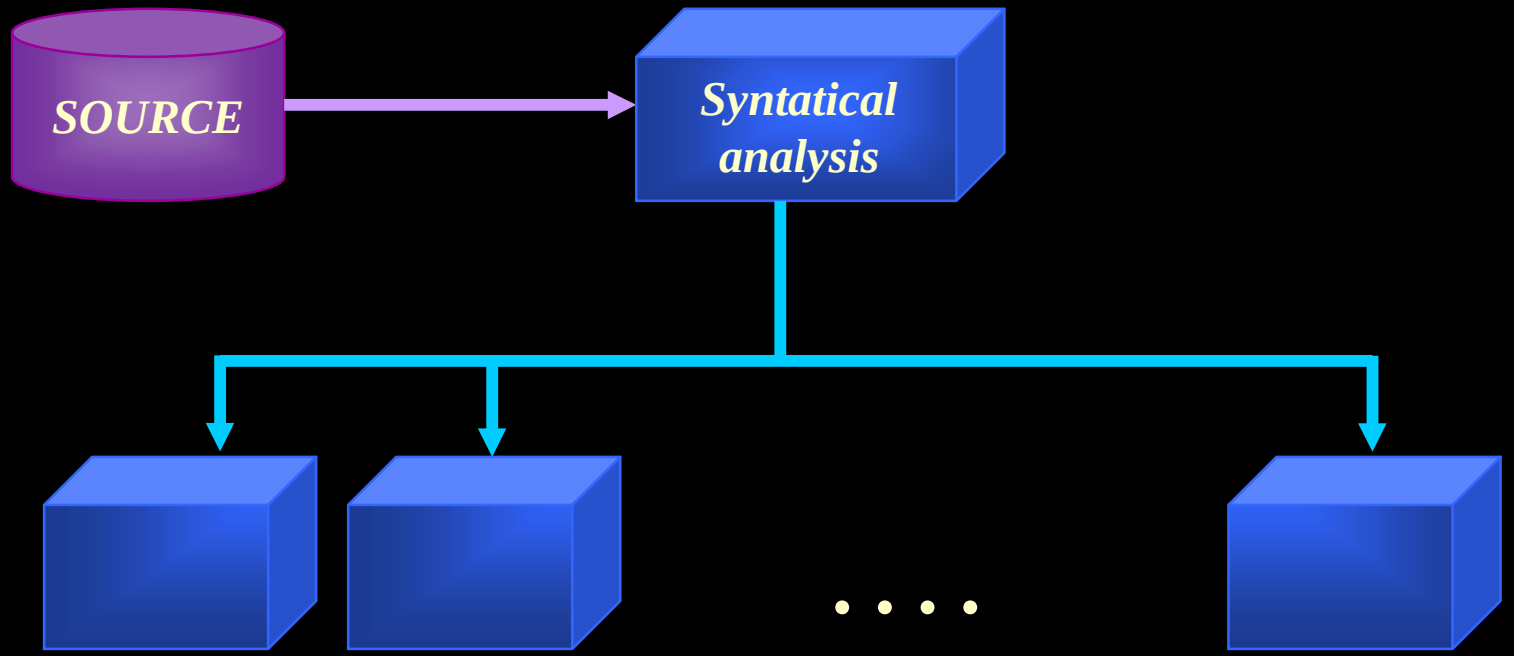
STATECHARTS ANALYSIS



N Hierarchical Automata

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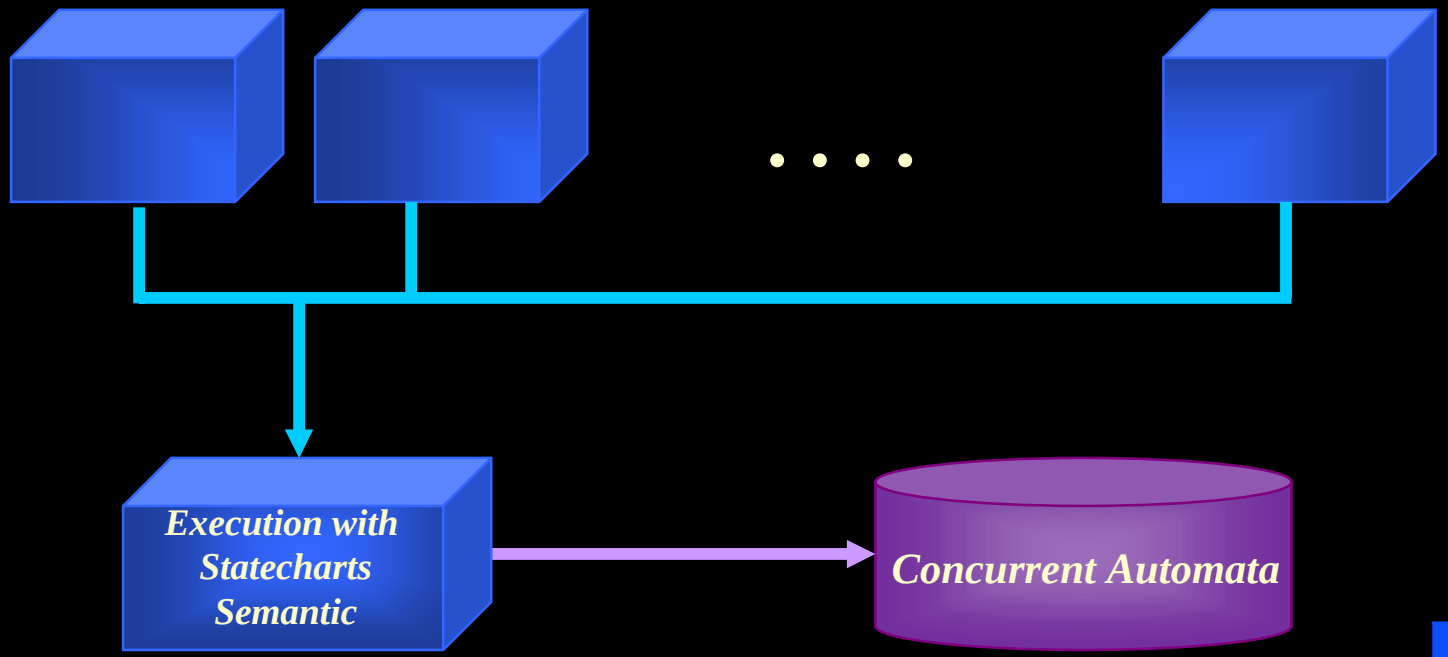
Calculus with statecharts without data

N hierarchical Automata



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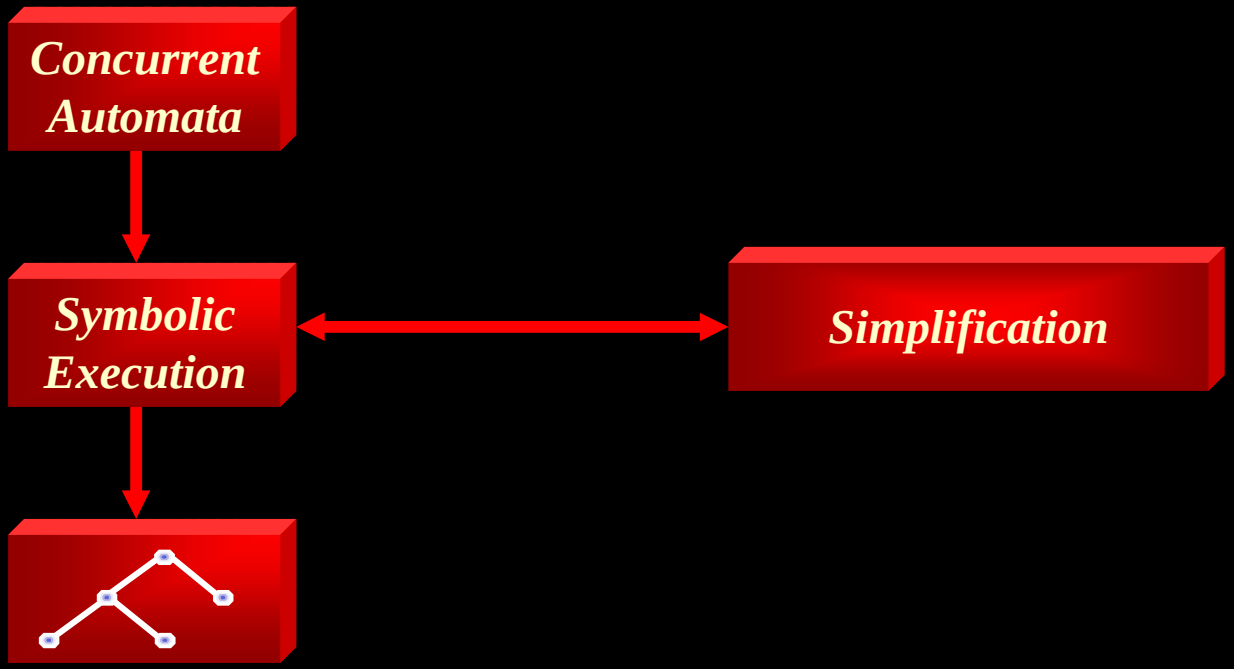
Calculus with data : re-execute the model with data



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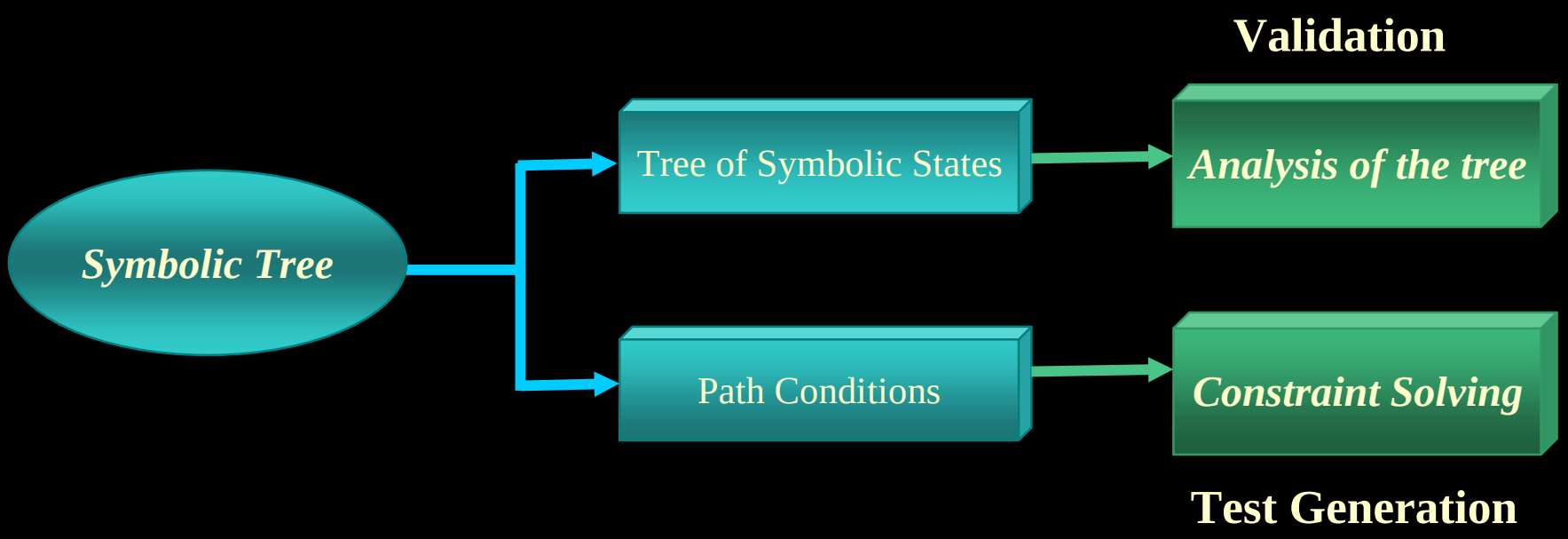
Final Result



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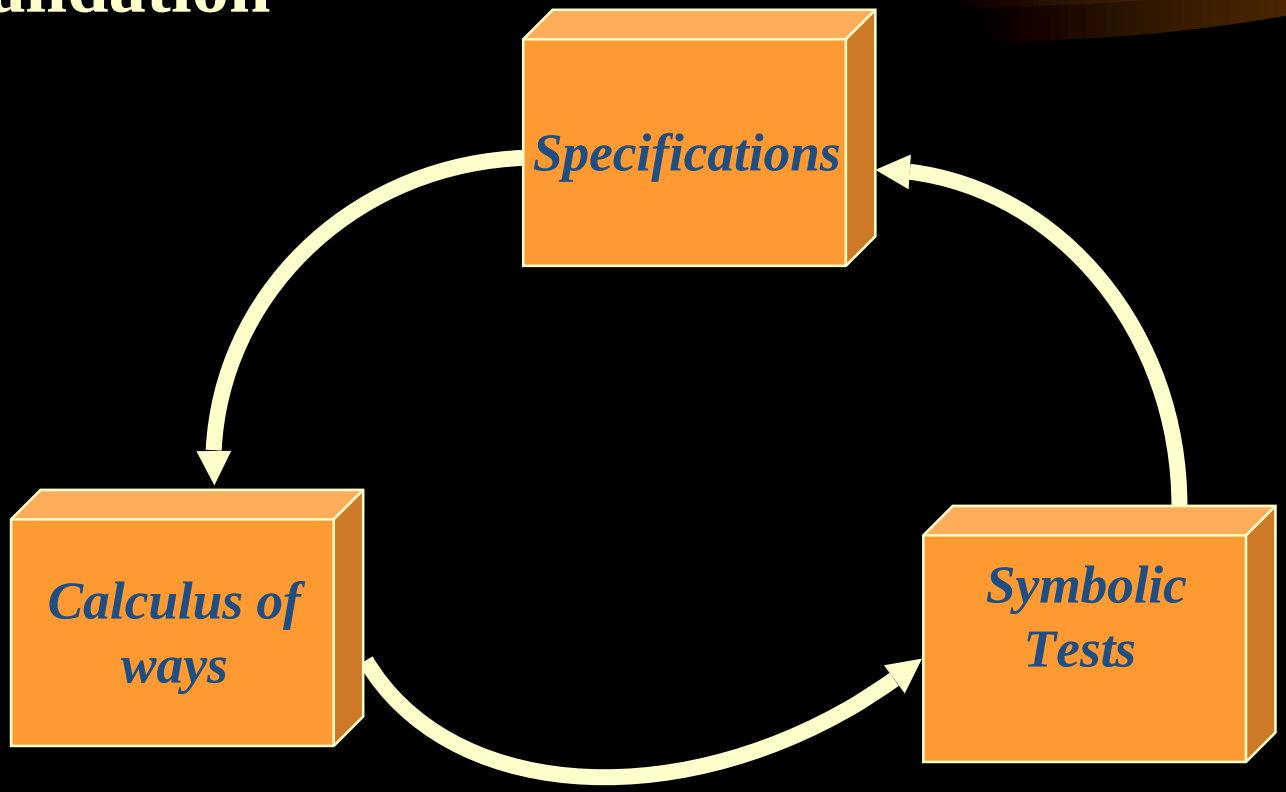
Validation



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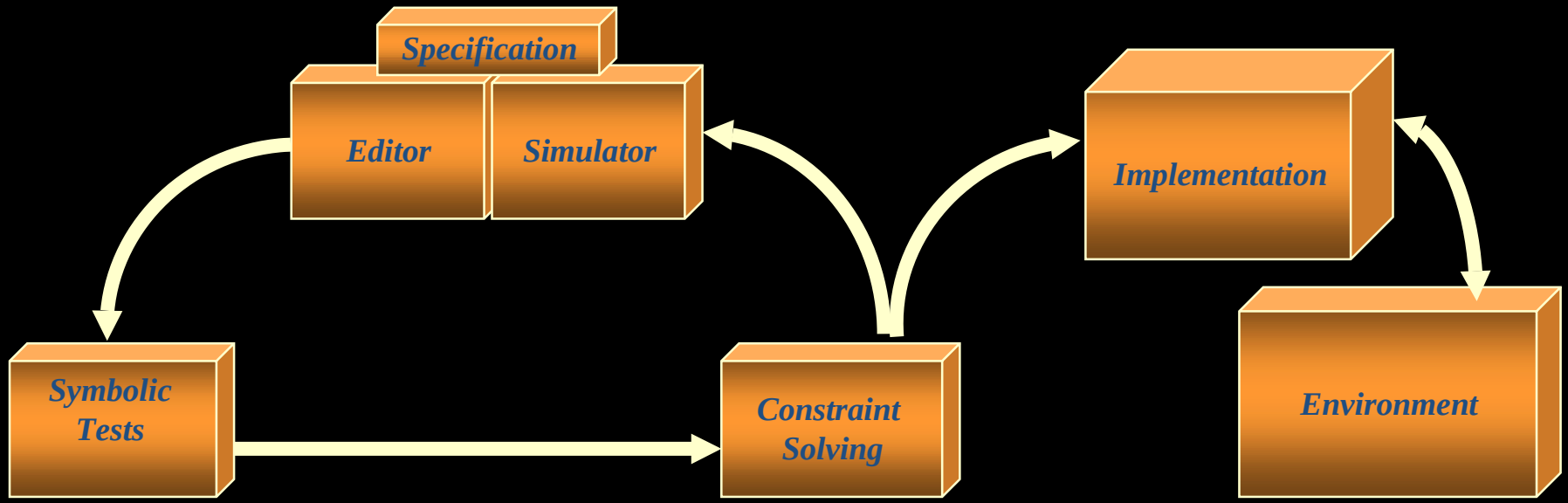
Test Generation



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