Automated Reliability Prediction from Formal Architectural Descriptions

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Introduction

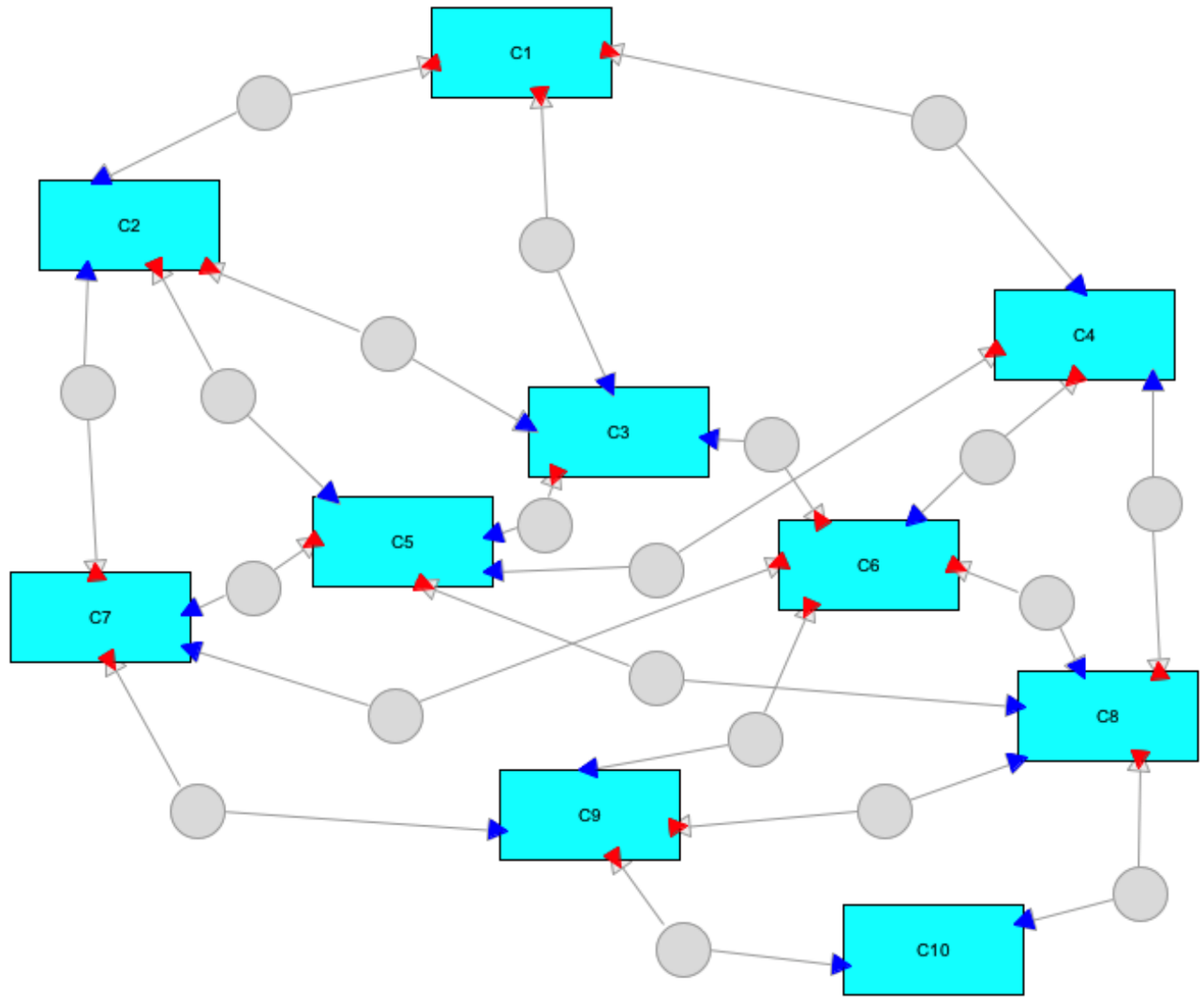
- SwA supports the specification of quality attributes
- Early architectural decisions

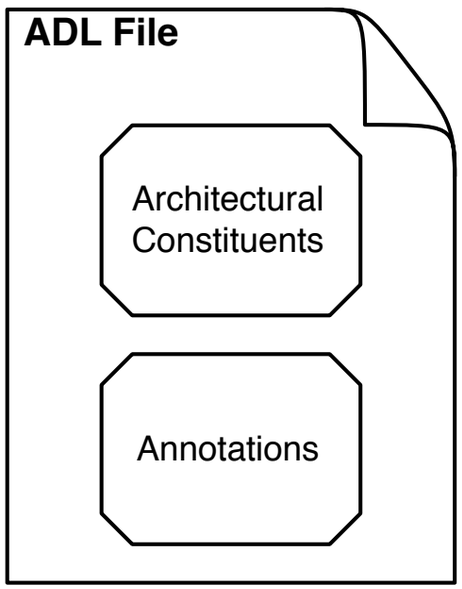
  Influence software quality

  Prevent additional costs

  Assure architects on stakeholder requirements
- **Problem -** In current practice, very few software quality attributes are automatically checked

Architectural Description To Reliability Prediction





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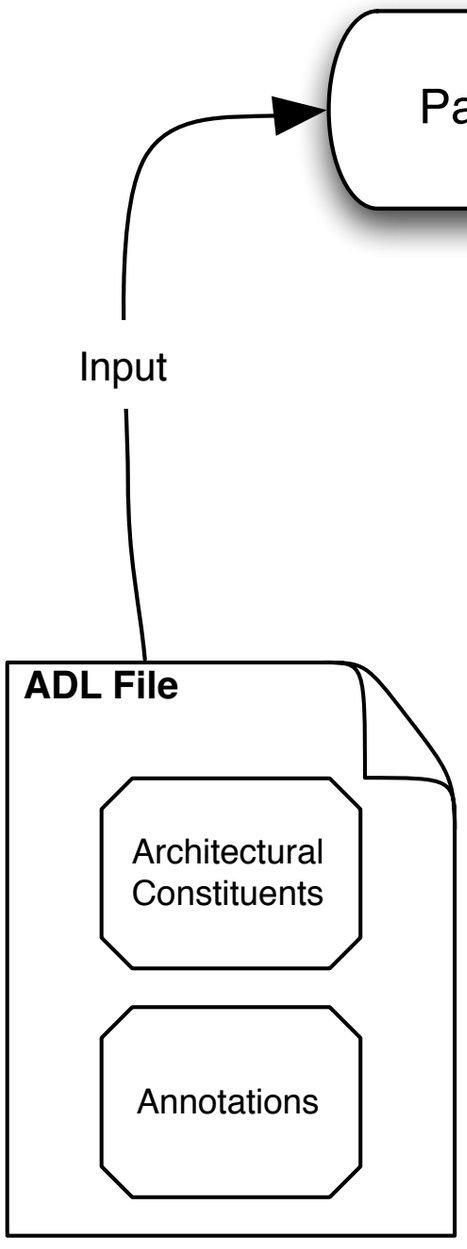

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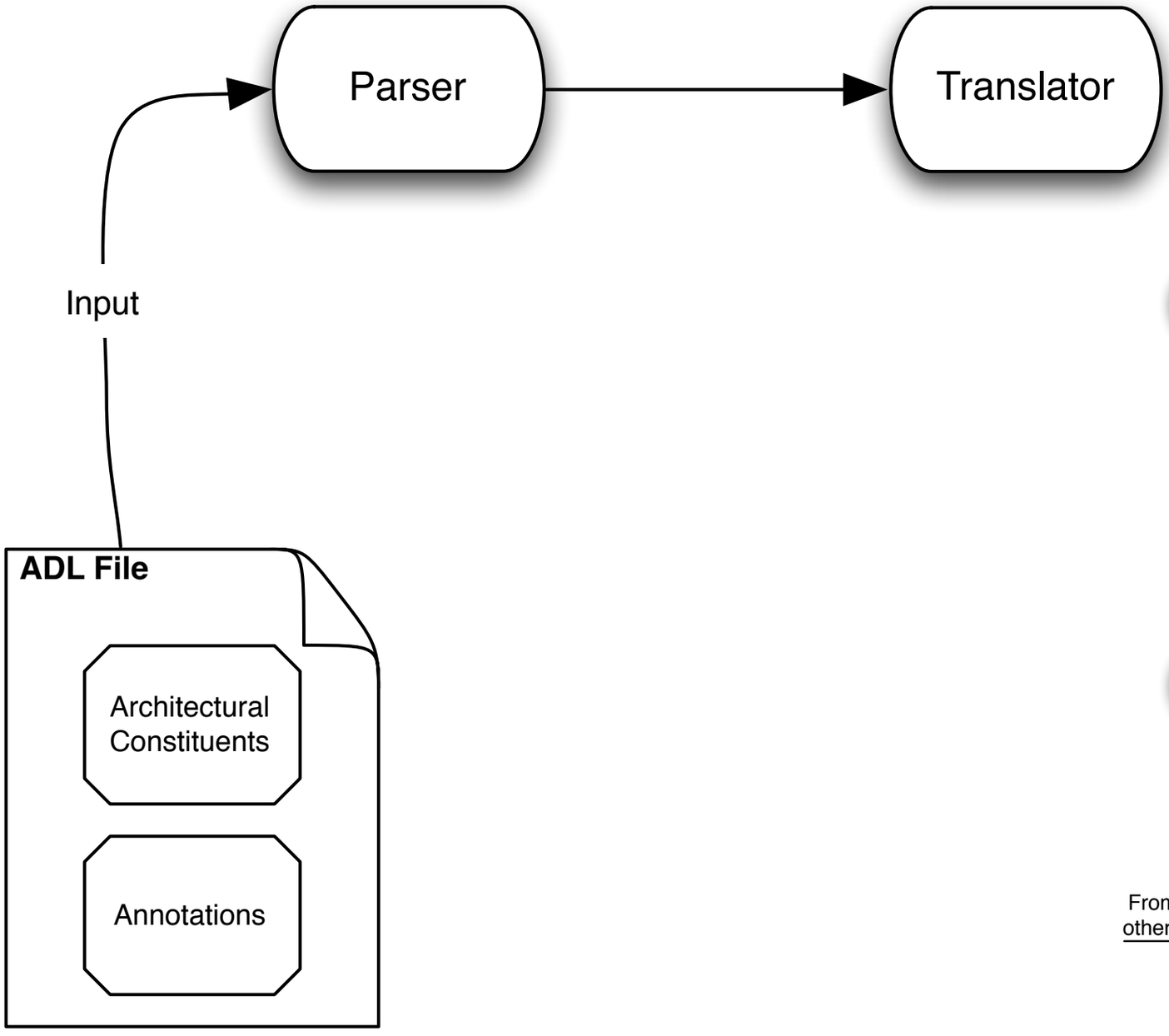

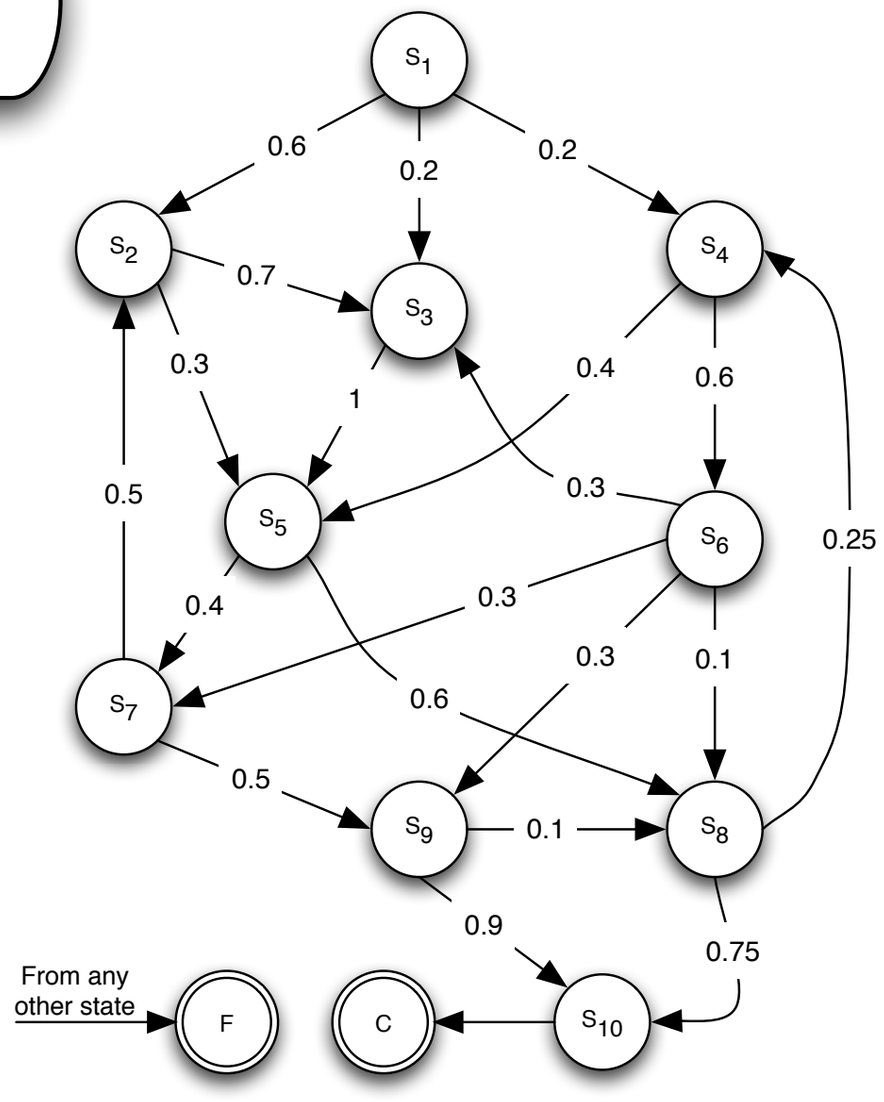

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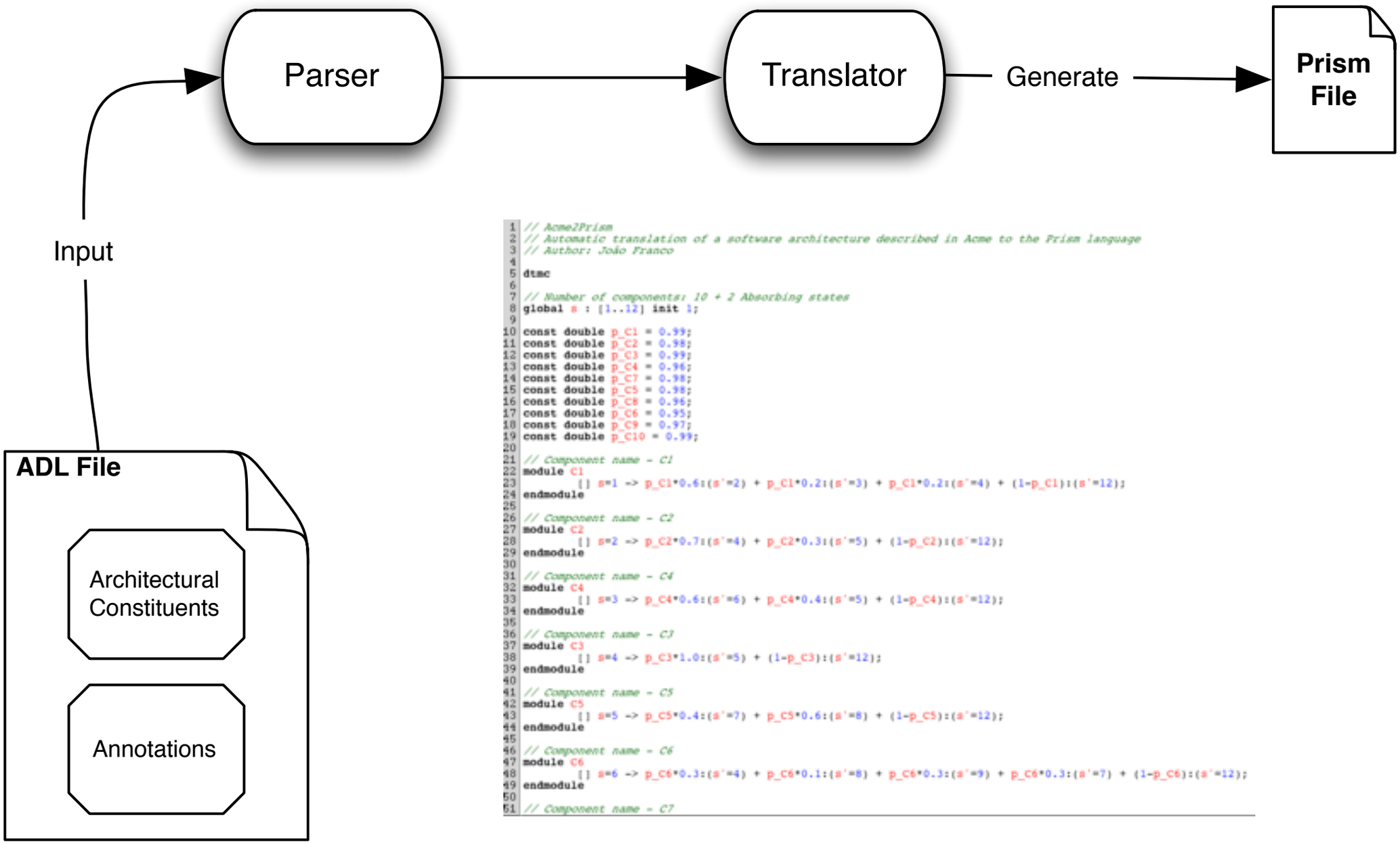
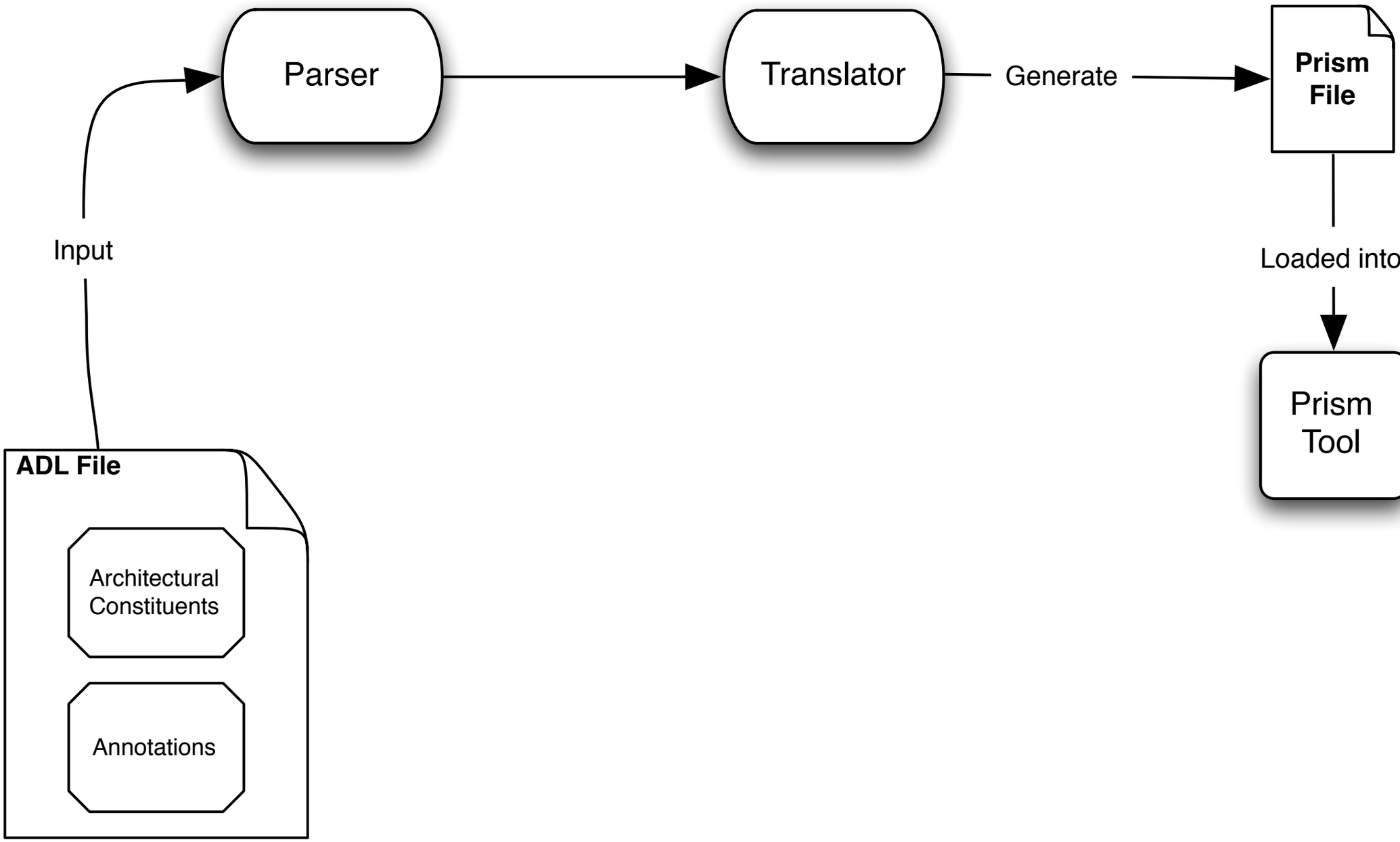



```
// Acme2Prism
// Automatic translation of a software architecture described in Acme to the Prism language
// Author: João Franco

dtmc

// Number of components: 10 + 2 Absorbing states
global s : [1..12] init 1;

const double p_C1 = 0.99;
const double p_C2 = 0.98;
const double p_C3 = 0.99;
const double p_C4 = 0.96;
const double p_C7 = 0.98;
const double p_C5 = 0.98;
const double p_C8 = 0.96;
const double p_C6 = 0.95;
const double p_C9 = 0.97;
const double p_C10 = 0.99;

// Component name - C1
module C1
        [] s=1 -> p_C1*0.6:(s'=2) + p_C1*0.2:(s'=3) + p_C1*0.2:(s'=4) + (1-p_C1):(s'=12);
endmodule

// Component name - C2
module C2
        [] s=2 -> p_C2*0.7:(s'=4) + p_C2*0.3:(s'=5) + (1-p_C2):(s'=12);
endmodule

// Component name - C4
module C4
        [] s=3 -> p_C4*0.6:(s'=6) + p_C4*0.4:(s'=5) + (1-p_C4):(s'=12);
endmodule

// Component name - C3
module C3
        [] s=4 -> p_C3*1.0:(s'=5) + (1-p_C3):(s'=12);
endmodule

// Component name - C5
module C5
        [] s=5 -> p_C5*0.4:(s'=7) + p_C5*0.6:(s'=8) + (1-p_C5):(s'=12);
endmodule

// Component name - C6
module C6
        [] s=6 -> p_C6*0.3:(s'=4) + p_C6*0.1:(s'=8) + p_C6*0.3:(s'=9) + p_C6*0.3:(s'=7) + (1-p_C6):(s'=12);
endmodule

// Component name - C7
```

Architectural Description To Reliability Prediction



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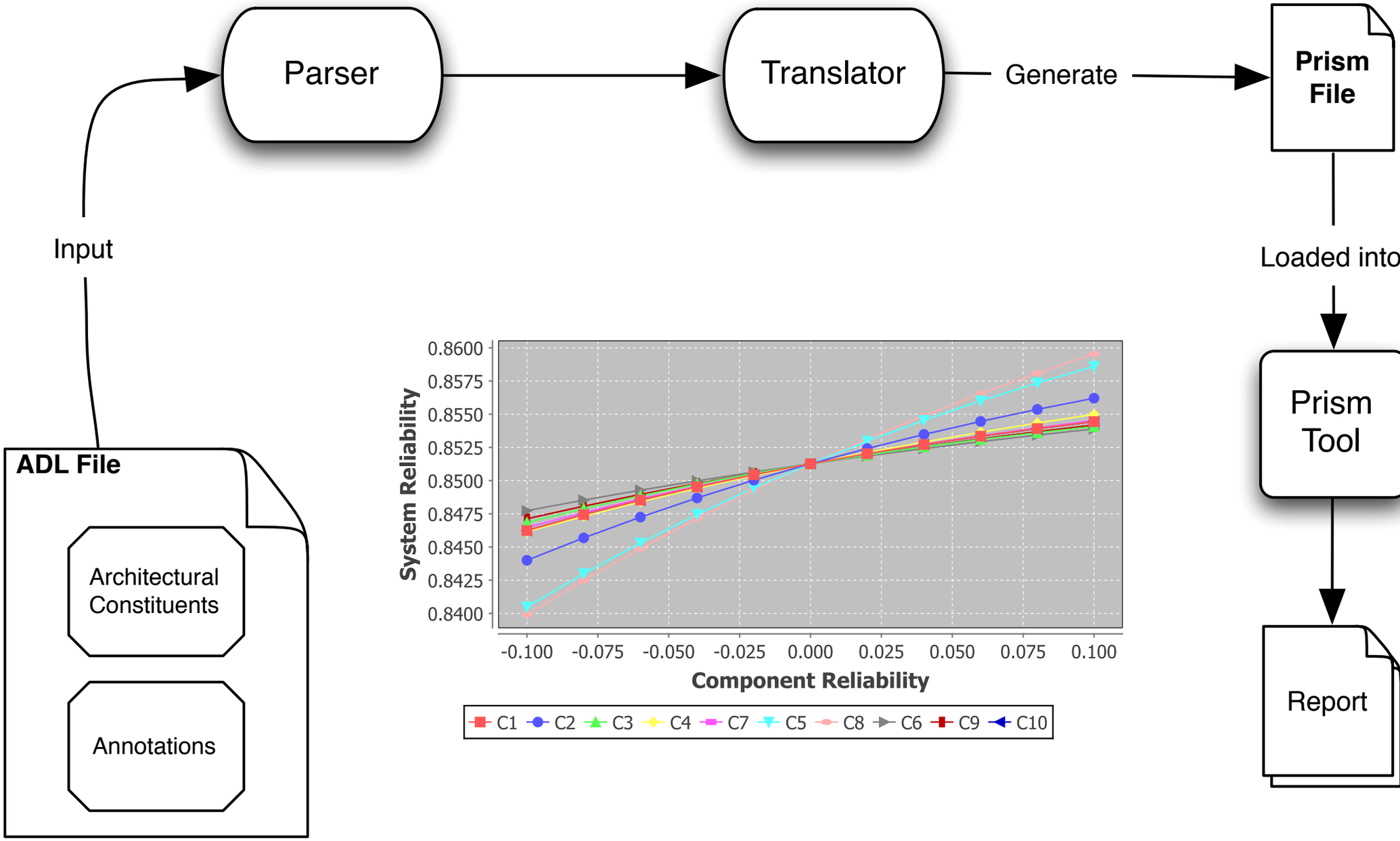

Validation

Reliability Prediction

		Literature	Our Approach	Difference
Gokhale 2002	Composite	0.8299	0.8299	0.00%
	Hierarchical	0.8280		0.22%
Lo *et al.* 2005		0.8482	0.8512	0.35%

Architectural Styles

Style	**Wang *et al.* 2006**	**Our approach**	
		Reliability	*Diff.*
Batch-sequential	0.9248722	0.9248722	0.0%
Parallel	0.8945088	0.8945088	0.0%
Fault-tolerance	0.9503923	0.9503923	0.0%
Call-and-return	0.9317644	0.9317631	$\sim$ 0.0%

What to Remember?

- Automated stochastic model generation
- Integration with different arch. styles
- Validation with < 1% diff.

Questions ?