Diagnosis, Synthesis and Analysis of Probabilistic Models

Tingting Han

University of Twente, The Netherlands

September 25, 2009

What do I do?

What do I do?

Mom

Fixing computers

What do I do?

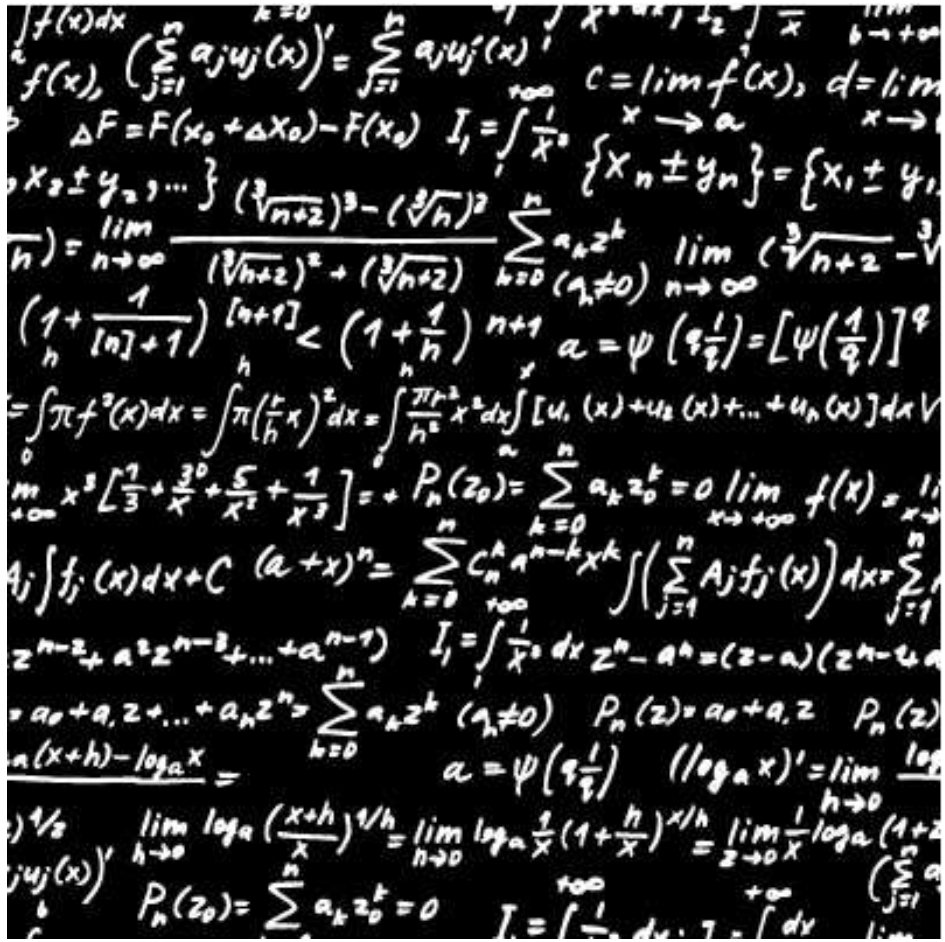
Programming

Mom

What do I do?

A college mate

Mom



Applied mathematics, Formal methods

What do I do?

A college mate

Mom

What do I do?

A college mate

Mom

Correctness!

What do I do?

A college mate

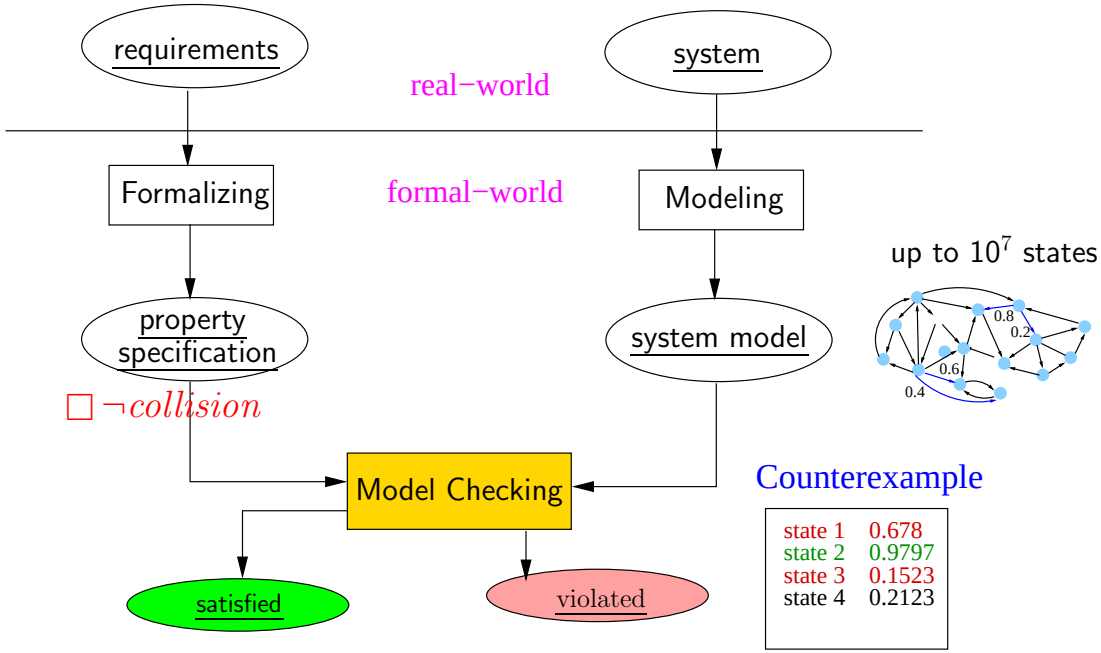
Mom

What do I do?

There should be no collisions!

A college mate

Mom



Model checking

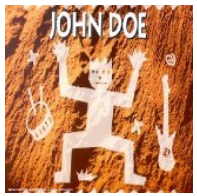
What do I do?

A college mate

Mom

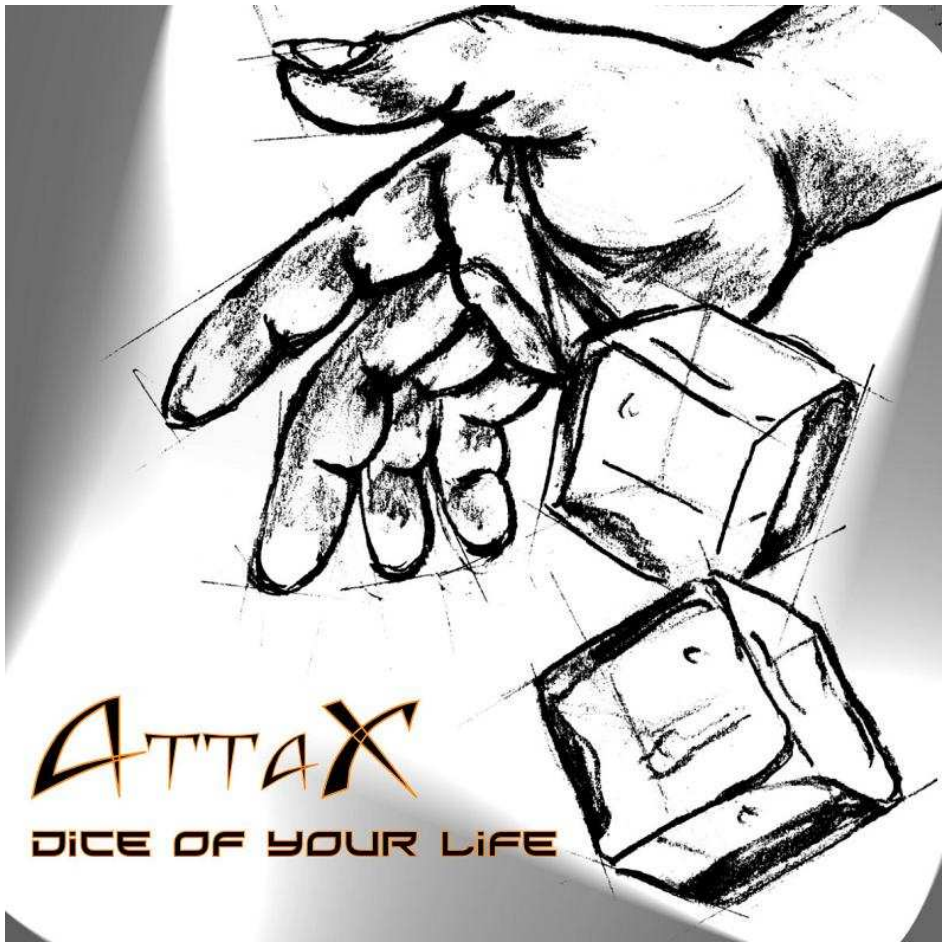
What do I do?

A researcher in a workshop



A college mate

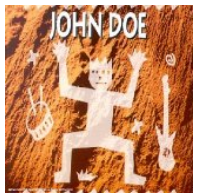
Mom



add Probability!

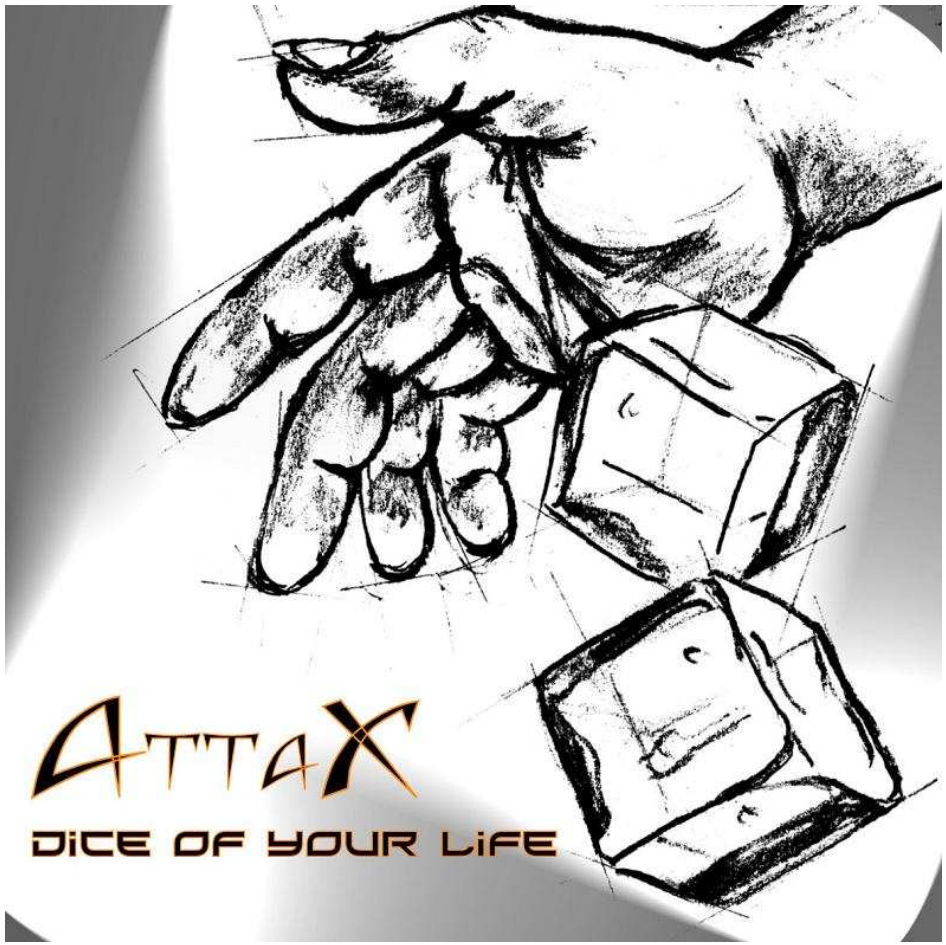
What do I do?

A researcher in a workshop



A college mate

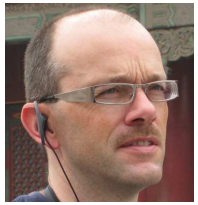
Mom



add Probability! $\Rightarrow$ probabilistic model checking

What do I do?

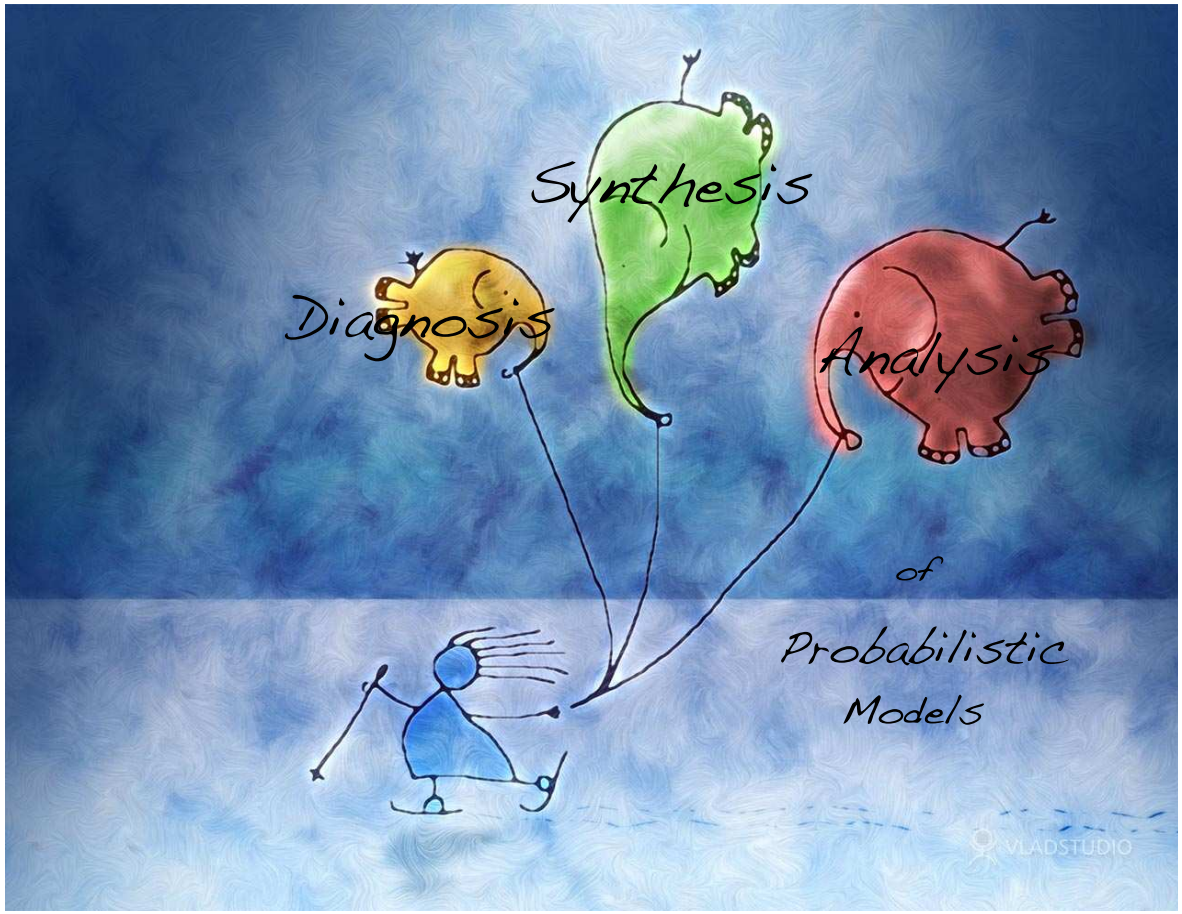
Boss



A researcher in a workshop

A college mate

Mom



Analysis

Analysis

Specifications

	branching-time		linear-time	
logic				
automata				
	untimed	real-time	untimed	real-time

Analysis

How to model check $\overbrace{\text{CTMC}}^{\text{model}}$ against ?

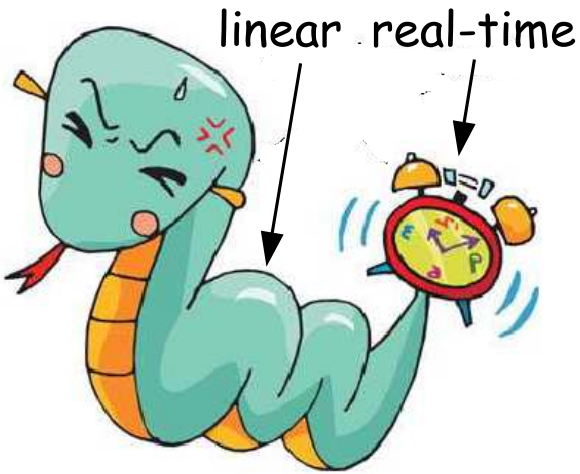
For CTMC model:

	branching-time		linear-time	
logic				
automata				
	untimed	real-time	untimed	real-time

Analysis

How to model check CTMC (model) against linear real-time specification (specification)?

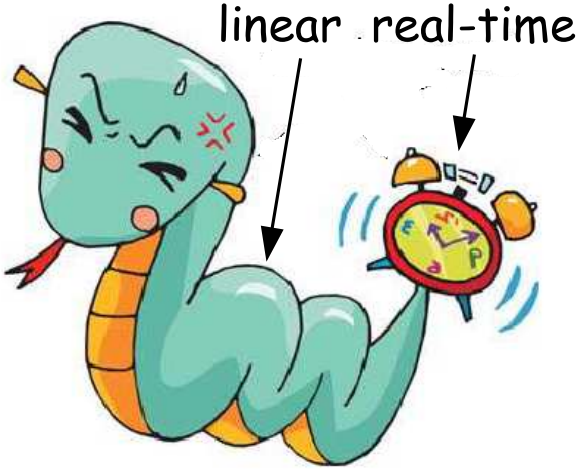
For CTMC model:



	branching-time		linear-time	
logic	☺	☺	☺	
automata			☺	Here!
	untimed	real-time	untimed	real-time

Analysis

How to model check CTMC (model) against linear real-time specification (specification)?



For CTMC model:

	branching-time		linear-time	
logic	☺	☺	☺	
automata			☺	Here!
	untimed	real-time	untimed	real-time

CTMC $\Longrightarrow$ probabilistic model checking $\Longleftarrow$ deterministic timed automata

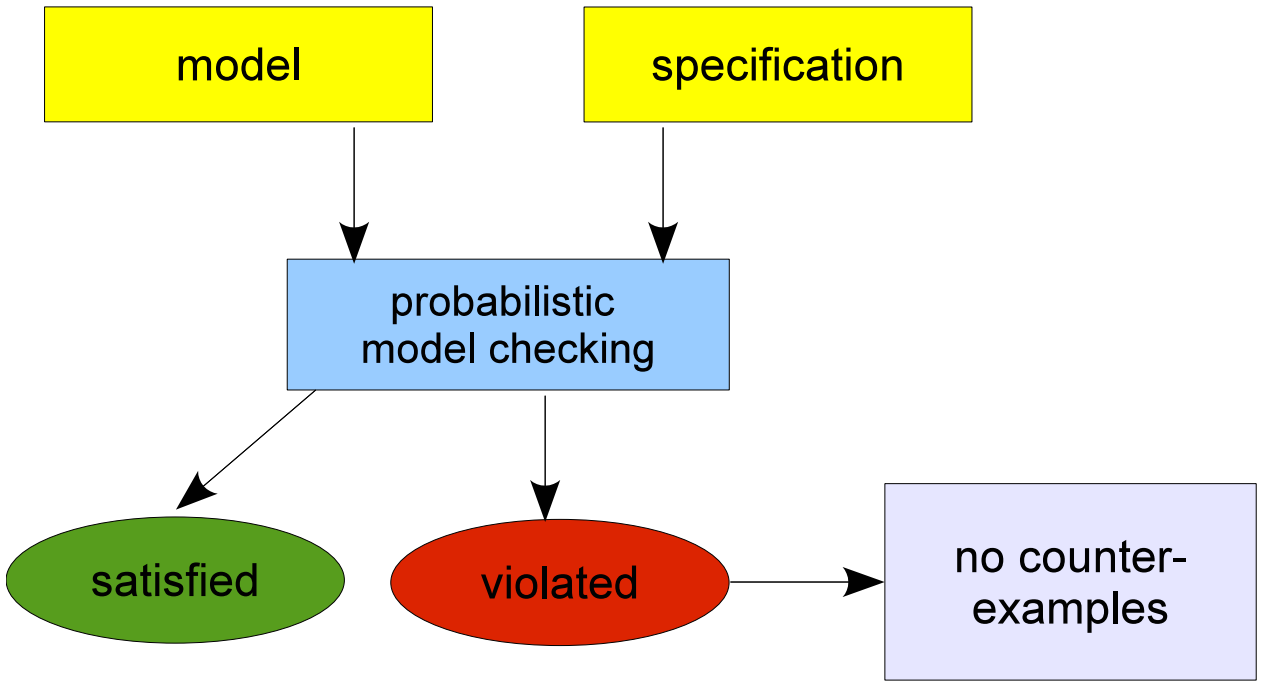
Diagnosis

Diagnosis

What's wrong with your model?

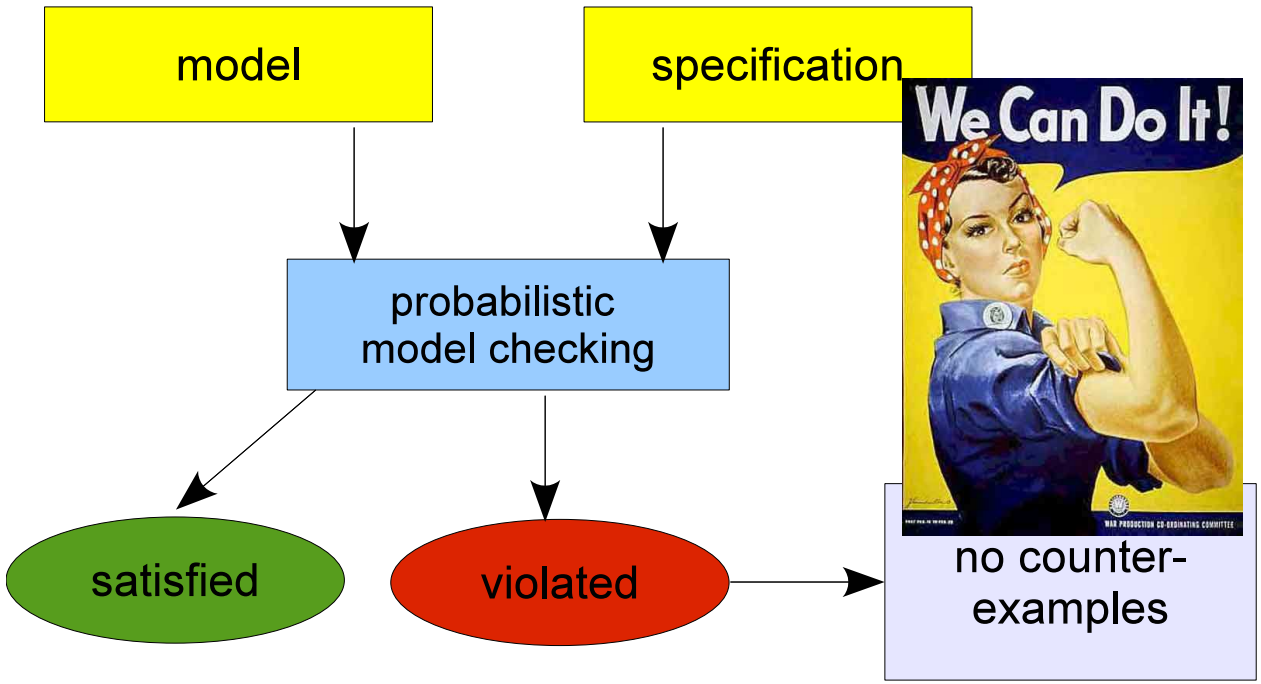
Diagnosis

What's wrong with your model?



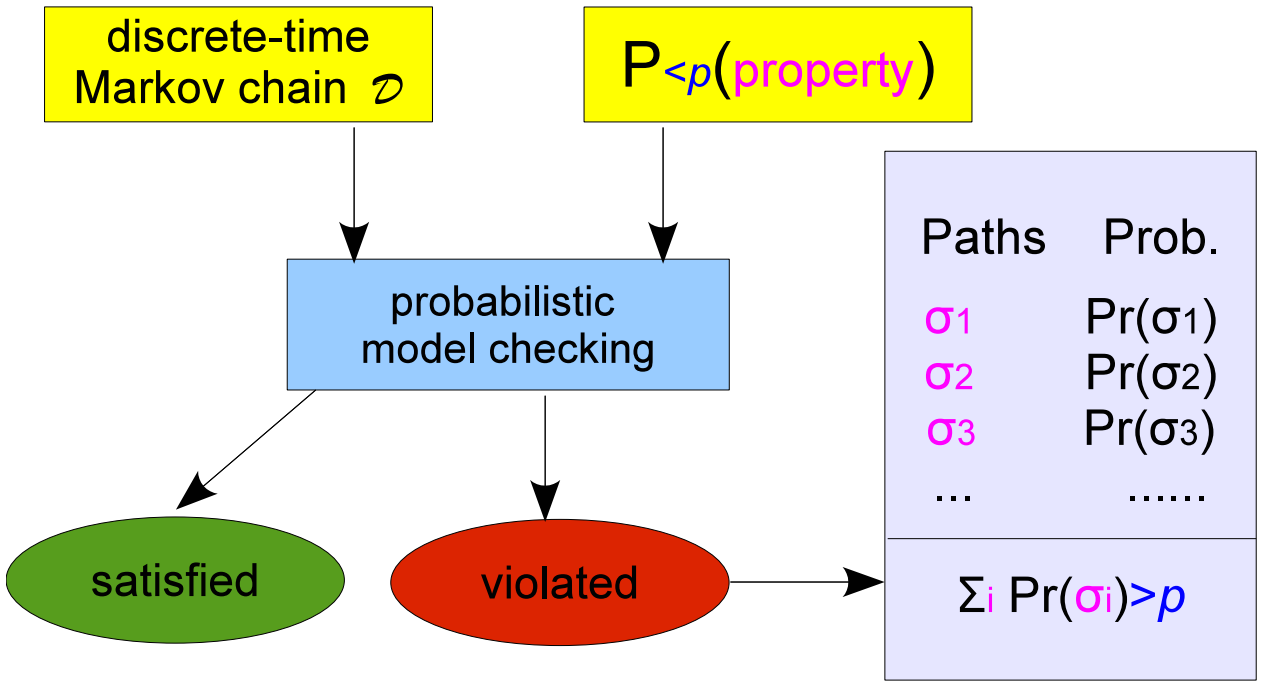
Diagnosis

What's wrong with your model?



Diagnosis

What's wrong with your model?

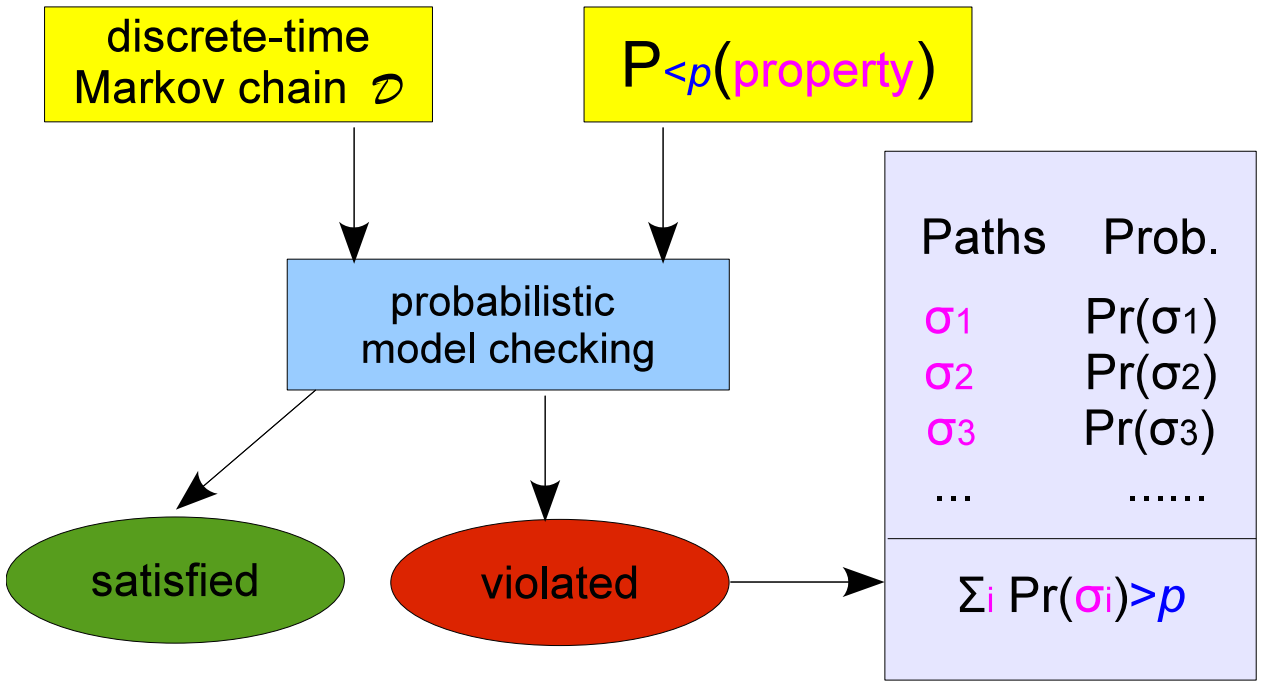


What has been done?

– Define a counterexample

Diagnosis

What's wrong with your model?



What has been done?

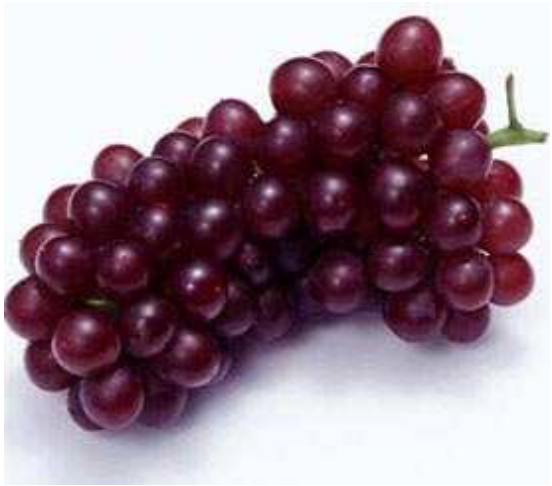
– Define a counterexample – Design algorithms

Diagnosis

What's wrong with your model?

Compact representation

Before:



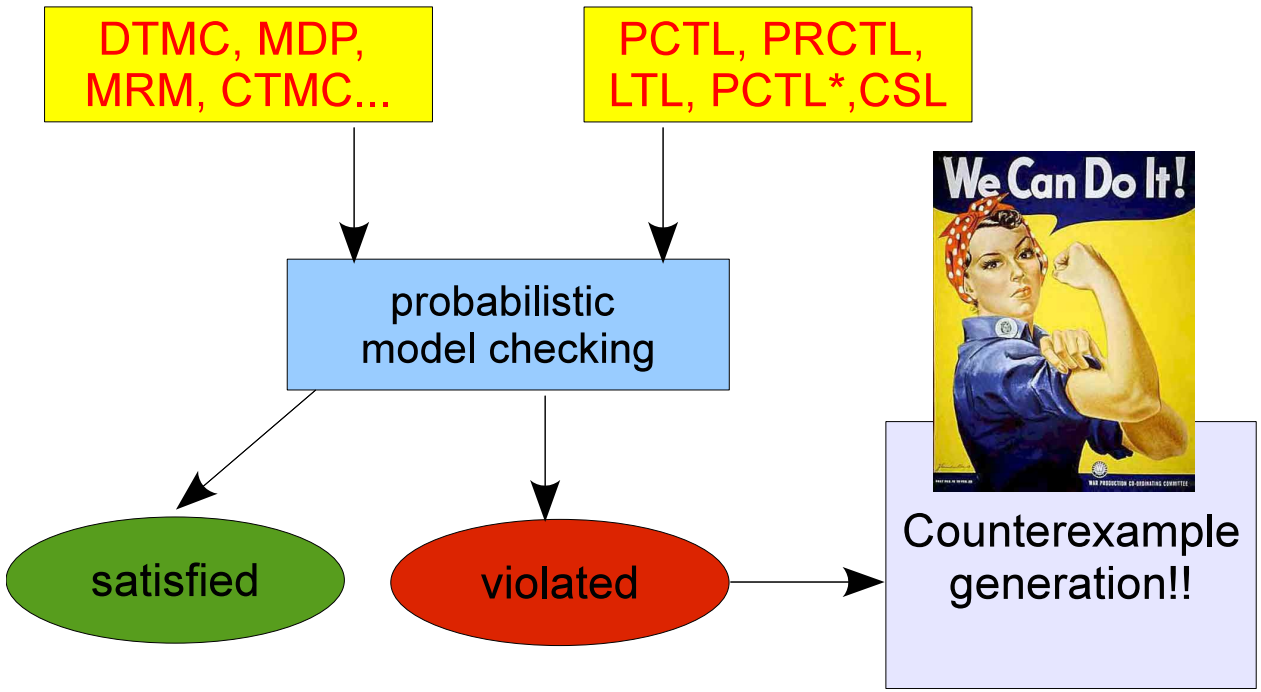
After:

What has been done?

- Define a counterexample
- Compact representation
- Design algorithms

Diagnosis

What's wrong with your model?



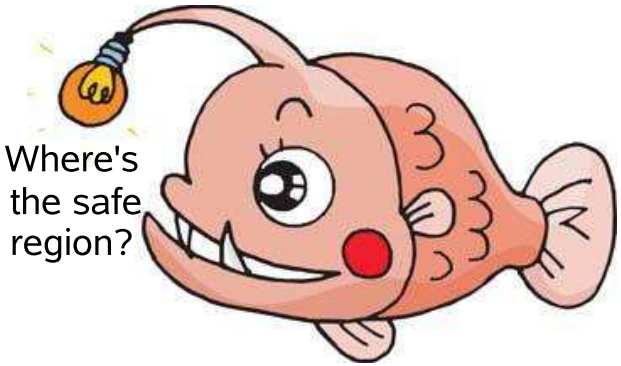
What has been done?

- Define a counterexample
- Compact representation
- Design algorithms
- Generalization

Synthesis

Synthesis

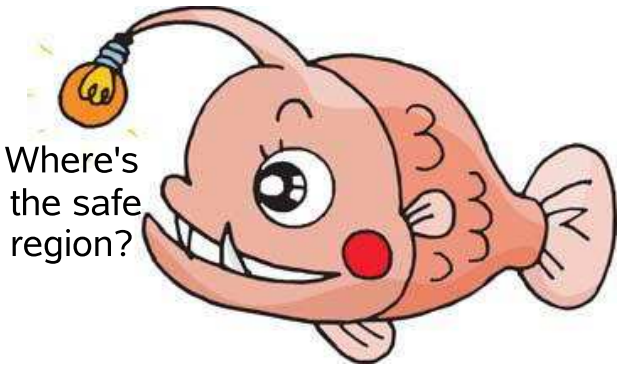
What parameter values can make the model "safe"?

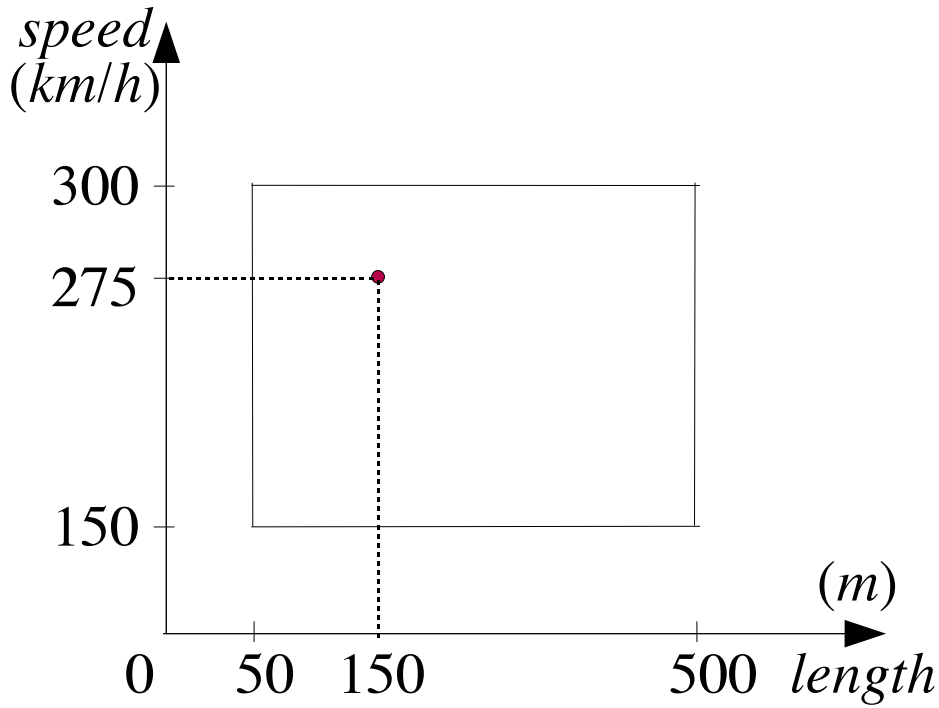


Synthesis

What parameter values can make the model "safe"?

$trains[speed = ?, length = ?]$ satisfies $\mathcal{P}_{>0.9999}(\textit{no collision})$

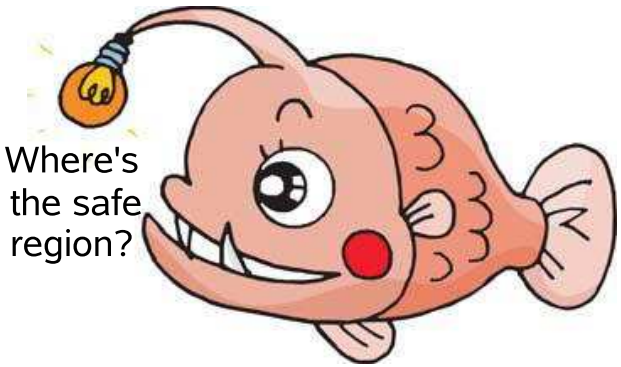


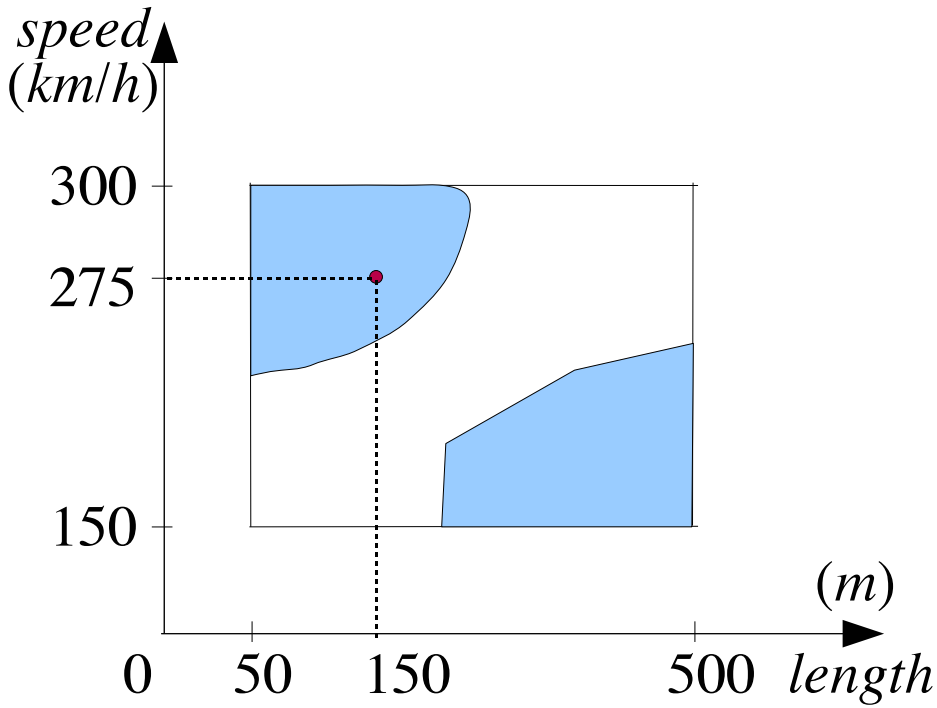


Synthesis

What parameter values can make the model "safe"?

$trains[speed = ?, length = ?]$ satisfies $\mathcal{P}_{>0.9999}(\textit{no collision})$

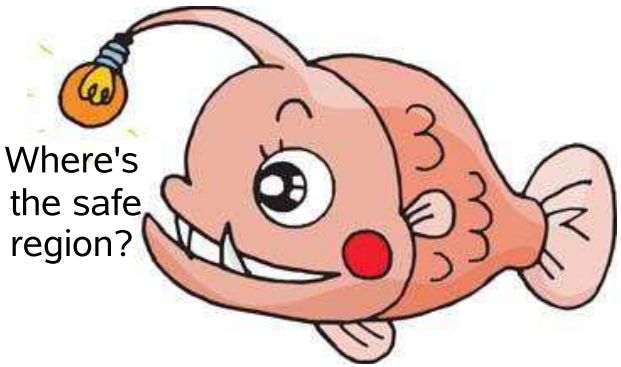


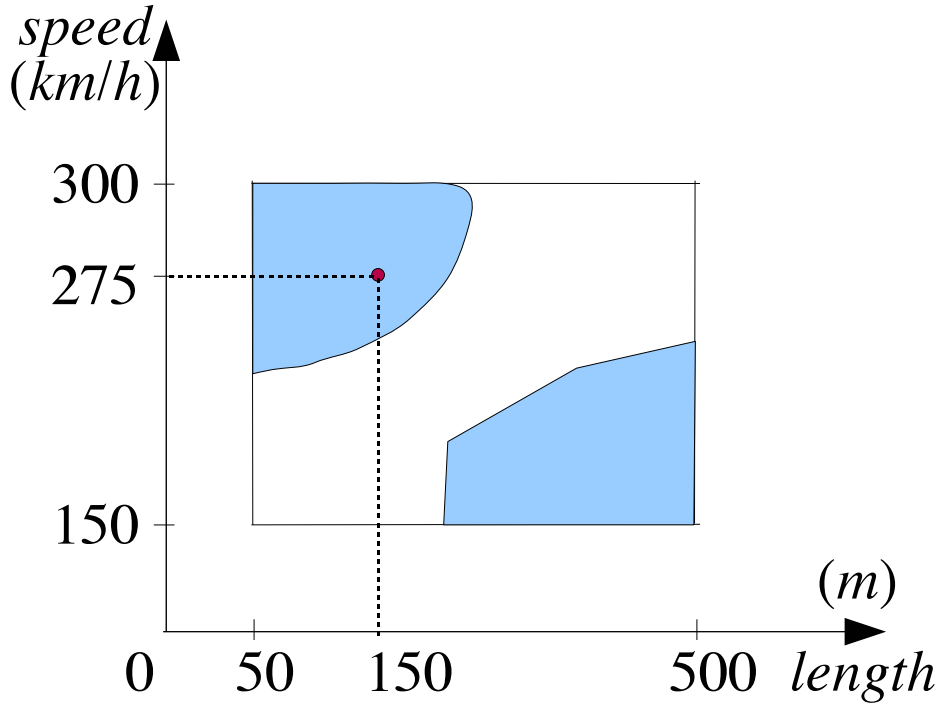


Synthesis

What parameter values can make the model "safe"?

$trains[speed = ?, length = ?]$ satisfies $\mathcal{P}_{>0.9999}(\textit{no collision})$





Parameter synthesis is much harder than model checking!


köszönöm תודה! děkuji
mahalo 고맙습니다
thank you
merci 谢谢 danke
Ευχαριστώ شكرا
どうもありがとう gracias
Bedankt
2008
EDUCATOR OF
YEAR
PRINCIPAL