Cyber Security for Europe

Using statistical model checking for cybersecurity analysis

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CS4E: Cybersecurity Skills and Capability Building

Modern cybersecurity: nowhere to run

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Hack Brief: Hackers Stole $40 Million from Binance Cryptocurrency Exchange

One of the biggest cryptocurrency exchanges got hit, as thieves nabbed $40 million of bitcoin —along with two-factor user codes and API tokens.

"The hackers used a variety of techniques, including phishing, viruses and other attacks," Binance CEO Zhao Changpeng wrote in a blog post. AKIO KON/BLOOMBERG/GETTY IMAGES

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… but security is not Boolean,

there is a **degree of resilience to cyberattacks**

Technical Leverage in a Software Ecosystem: Development Opportunities and Security Risks

Fabio Massacci
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Ivan Pashchenko
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***Abstract*—In finance, *leverage* is the ratio between assets borrowed from others and one's own assets. A matching situation is present in software: by using free open-source software (FOSS) libraries a developer leverages on other people's code to multiply the offered functionalities with a much smaller own**

that third party code inherited through dependencies is four times larger than the size of the own code base as an industry average [9]. It can be up to four orders of magnitude in our FOSS sample.

Measurement of Cyber Resilience from an Economic Perspective

Adam Z. Rose and Noah Miller

Center for Risk and Economic Analysis of Terrorism Events (CREATE), University of Southern California, Los Angeles, CA, USA

10.1 Introduction

All segments of society are becoming increasingly vulnerable to cyber disruptions from malicious actors, natural disasters, and technological accidents. Although significant efforts are being made to protect cyber systems from threats, increasing cyber usage and increasing frequency and potential magnitude of threats appears to be more than offsetting these initiatives. There is a growing realization in the cyber area, as well as in other domains, that we cannot protect complex systems against all threats, so some attention has

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How much $€£¥฿ covers the degree of security I want?

How much security I want/need?

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How much security I want/need?

How valuable am I?

How vulnerable am I?

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Measuring SW security vulnerability

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Empirical approach: assess existent IT framework

e.g. known vulnerabilities in code

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An Attack Surface Metric

Pratyusa K. Manadhata

CMU-CS-08-152

November 2008

IP address and domains, SSL certificates, ports & services, etc.

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MOBILE TECH T-MOBILE

Another T-Mobile cyberattack reportedly exposed customer info and SIMs

Documents say the company has contacted impacted customers

By Mitchell Clark | Dec 28, 2021, 6:30pm EST

Dec 28, 2021, 6:30pm EST

Measuring SW security vulnerability

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How vulnerable ~~am I?~~ shall I be?

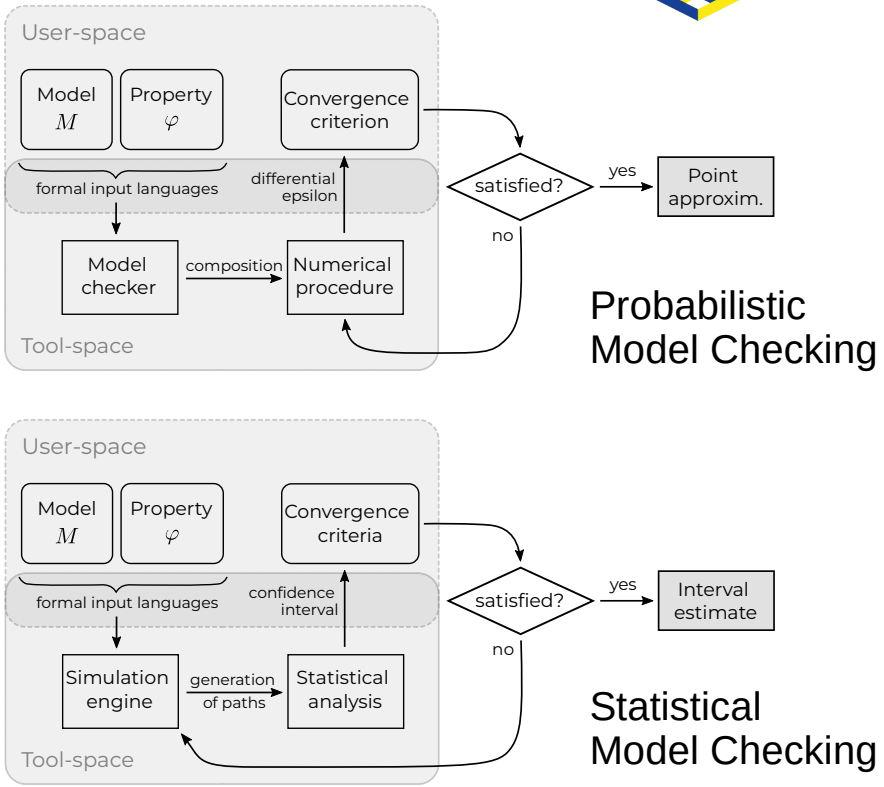
Proposal: let's model & check

Fit attack patterns and distributions within a formal framework

(**model checking** in formal methods)

Model checking for safety, liveness, etc.

$$M \models \varphi$$



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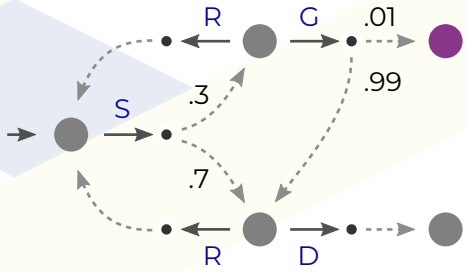
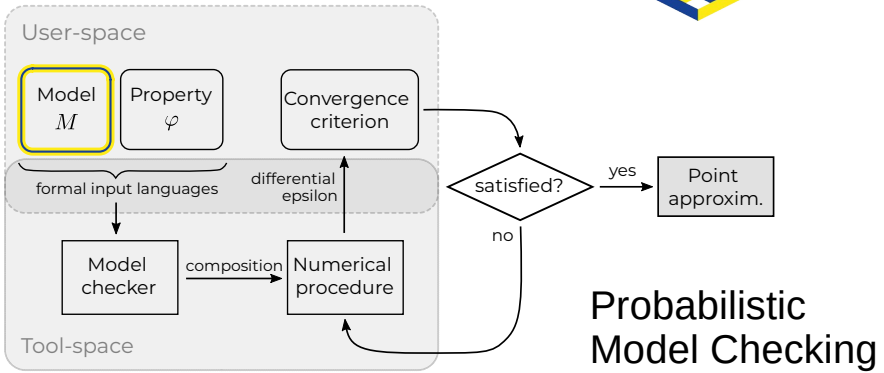
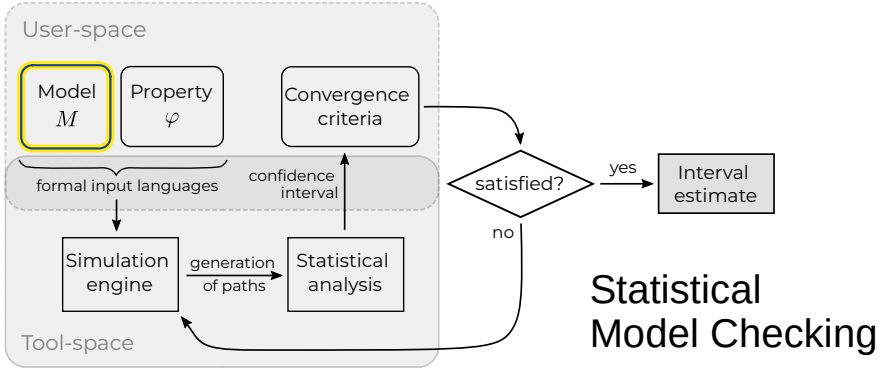




Probabilistic Model Checking



Statistical Model Checking

Model checking for safety, liveness, etc.

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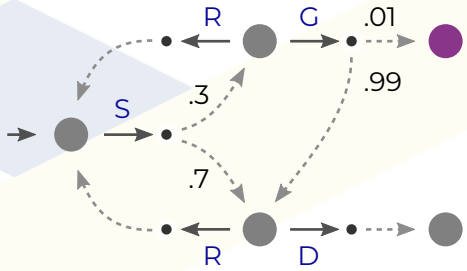
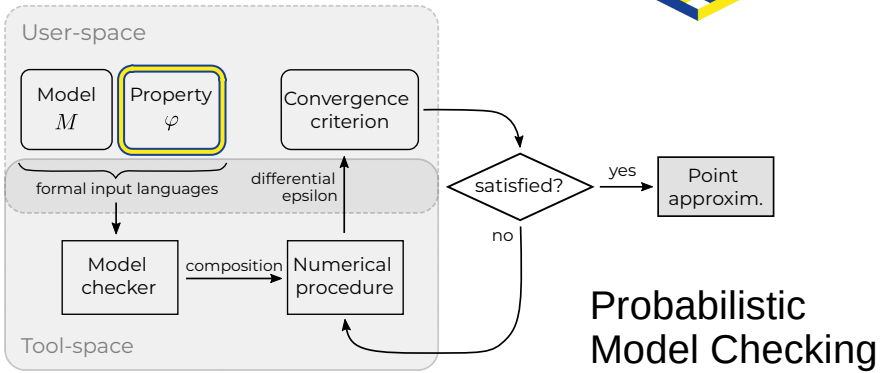
$\square\neg\text{unsafe}$ $\square\Diamond\text{alive}$





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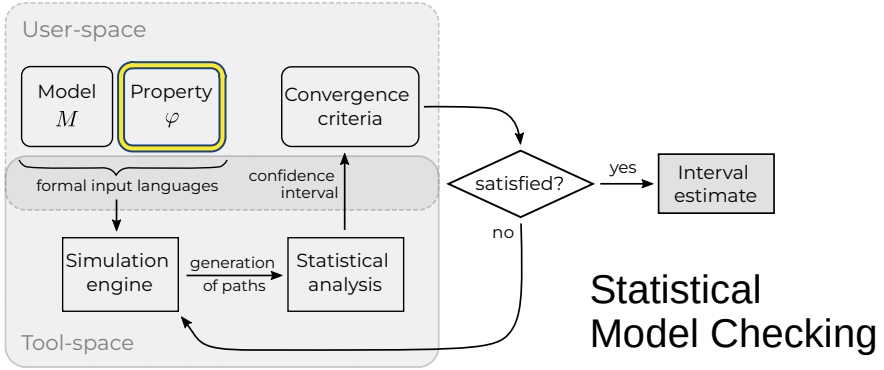

Statistical Model Checking

Model checking for safety, liveness, etc.

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$$P(\text{unsafe}) \leqslant 0.02$$

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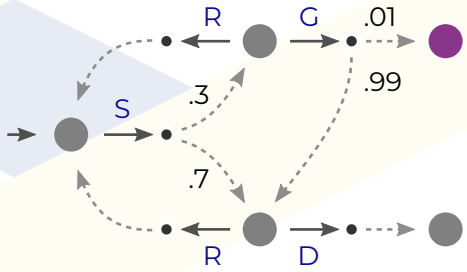

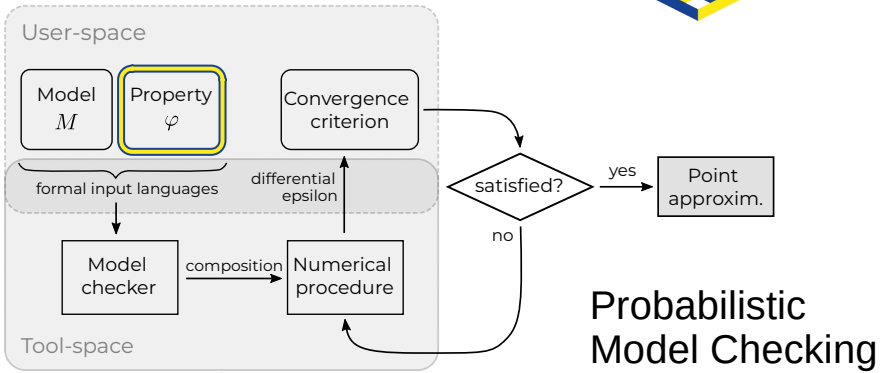

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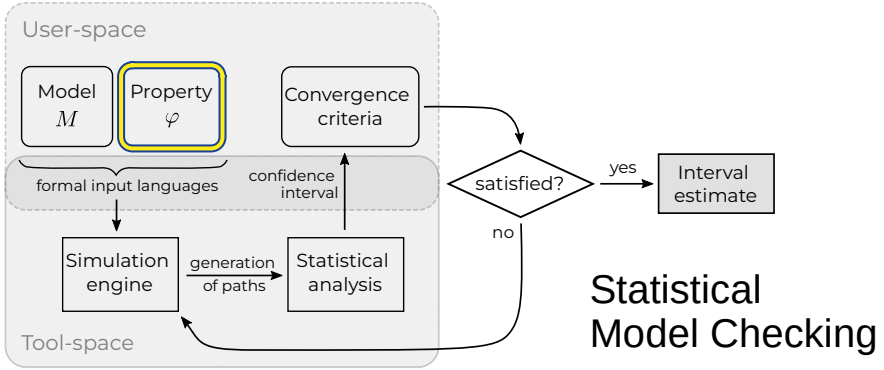

Statistical Model Checking

Model checking for security

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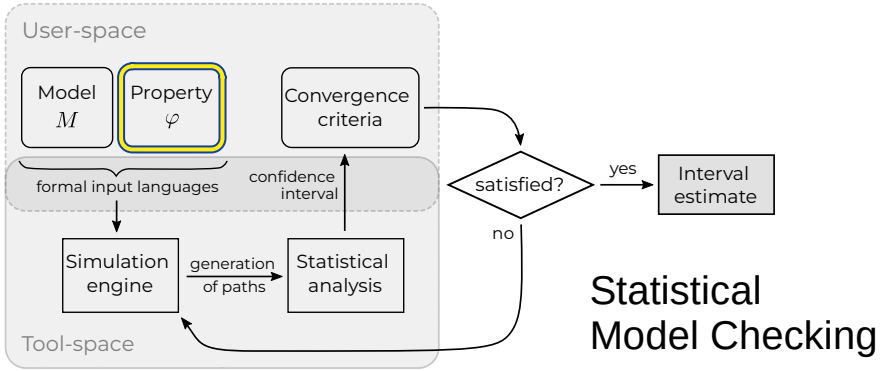
$$P(\text{unsafe}) \leqslant 0.02 \qquad \boxed{P(\text{exploit}) \leqslant 0.02}$$



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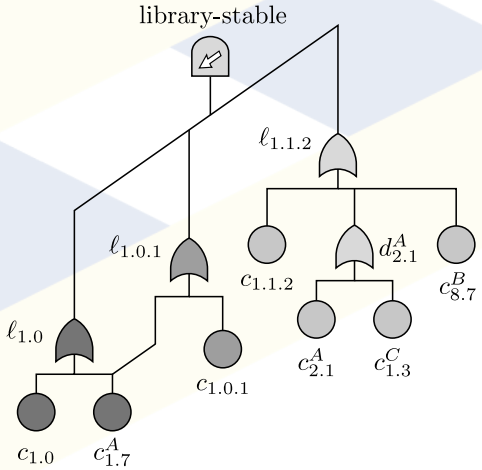

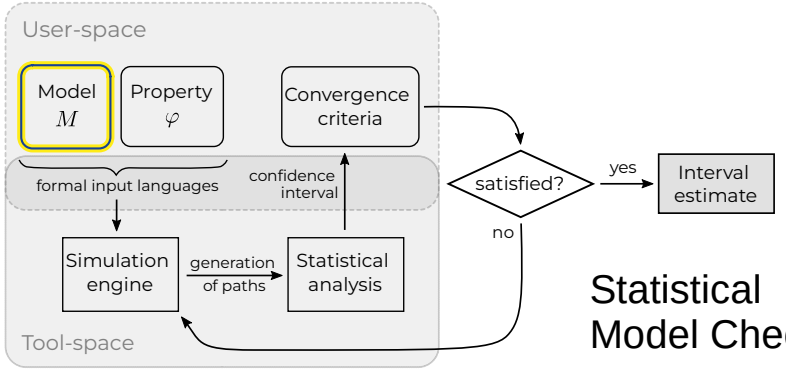

Statistical Model Checking

A statistical model checker for are events

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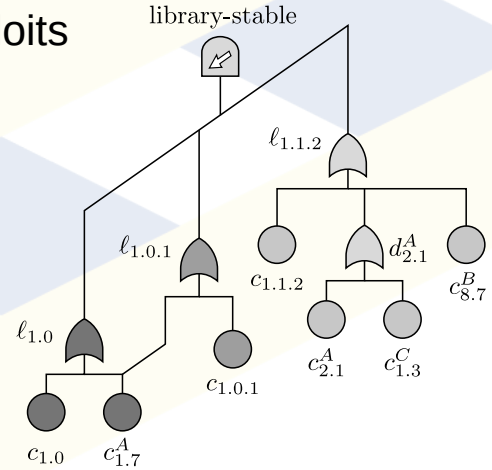
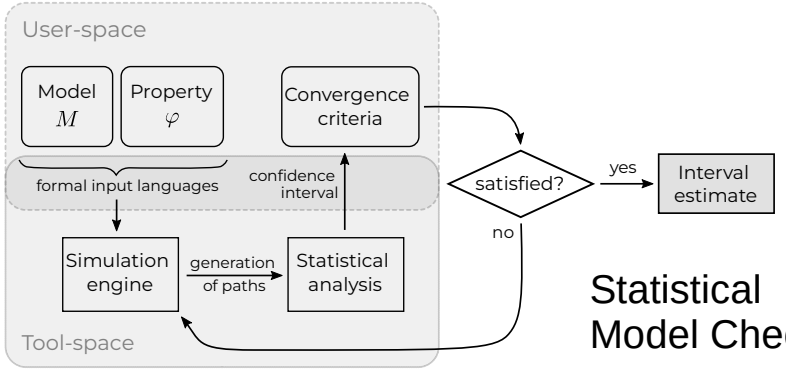
$$P(\text{exploit}) \leqslant 0.02$$

Attack Trees to model exploits





Statistical Model Checking

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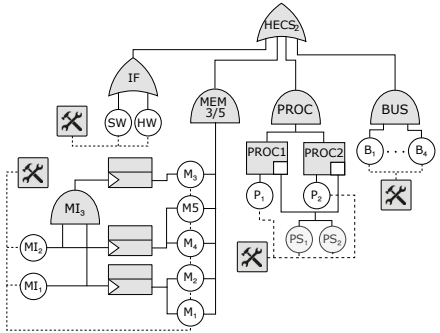
FIG



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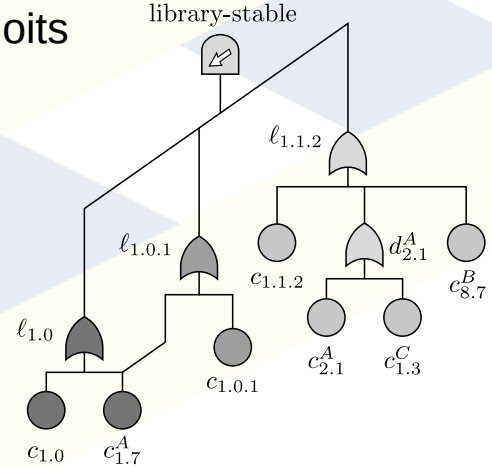

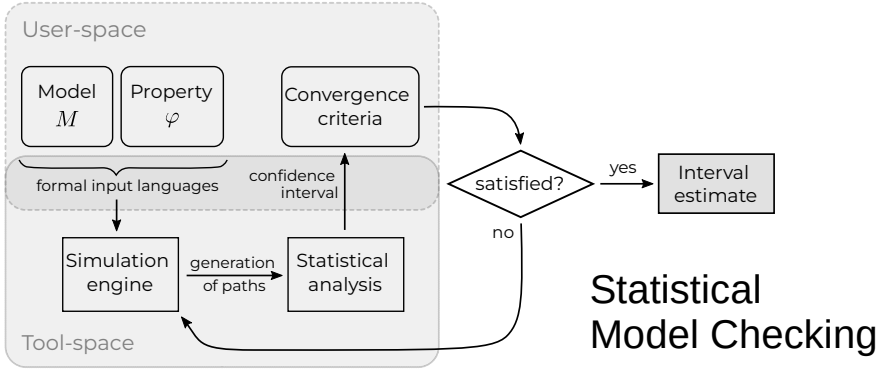

Statistical Model Checking

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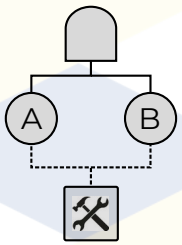
CS4E: Cybersecurity Skills and Capability Building (WP6)
https://webapps.unitn.it/du/en/Persona/PER0235360/Curriculum <carlosesteban.budde@unitn.it>

.bkp: FT syntax to IOSA semantics



Kepler:

```
"TLE" and "A" "B";
"A" fail~gamma(9,1) repair~exponential(6);
"B" fail~exponential(1) repair~uniform(1,2);
"R" rbox prio "A" "B";
```

f_A fail_A

r_A rep_A

f_B fail_B

r_B rep_B

Property query:

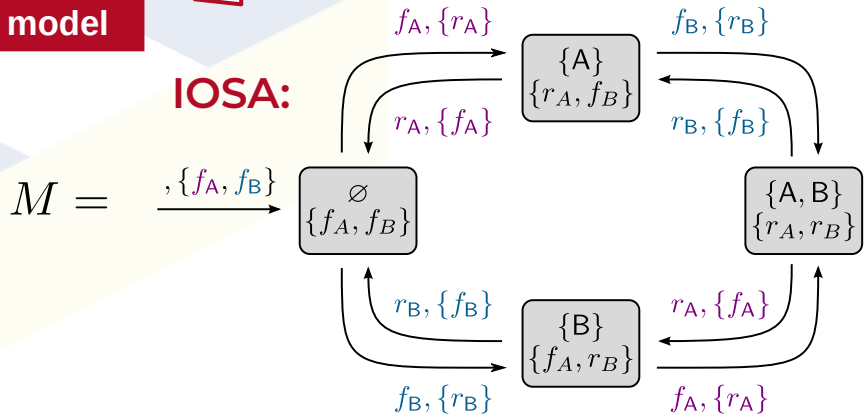
```
P( time<8 U TLE )
```

Formalise the query

$\varphi = Prob(\mathsf{A}_t \wedge \mathsf{B}_t \mid t < 8)$,
where $\mathsf{A}_t, \mathsf{B}_t$ are stochastic processes with Boolean state space

Formalise the model

IOSA:



CTMC: