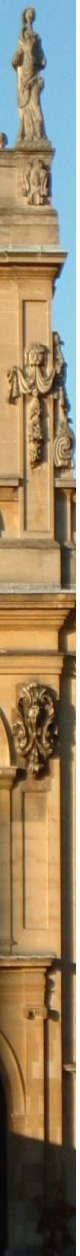


PRISM

Probabilistic symbolic model checker

Dave Parker, Gethin Norman, Marta Kwiatkowska, et al.

University of Oxford

VOSS Meeting, Leiden, November 2007

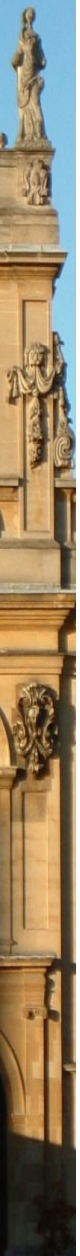
www.prismmodelchecker.org

Overview

- What's in PRISM
  - models, properties, functionality, implementation
- What's not in PRISM
  - limitations, planned future additions
- Tool architecture + connections
- Getting PRISM + more info

What's in PRISM

- Probabilistic models:
  - discrete/continuous-time Markov chains (DTMCs/CTMCs), Markov decision processes (MDPs), plus costs/rewards
  - PRISM modelling language: simple state-based language + (a)synchronous parallel comp., process-algebraic operators
  - many examples and case studies available
- Probabilistic specification formalisms
  - PCTL, CSL, expected costs/rewards, quantitative extensions
  - e.g. $P_{=?}$ [$F^{\leq t}$ "elected" {tokens$\leq$k}{min}] – "what is the minimum probability of the leader election algorithm completing within t steps from any state where there are at most k tokens"



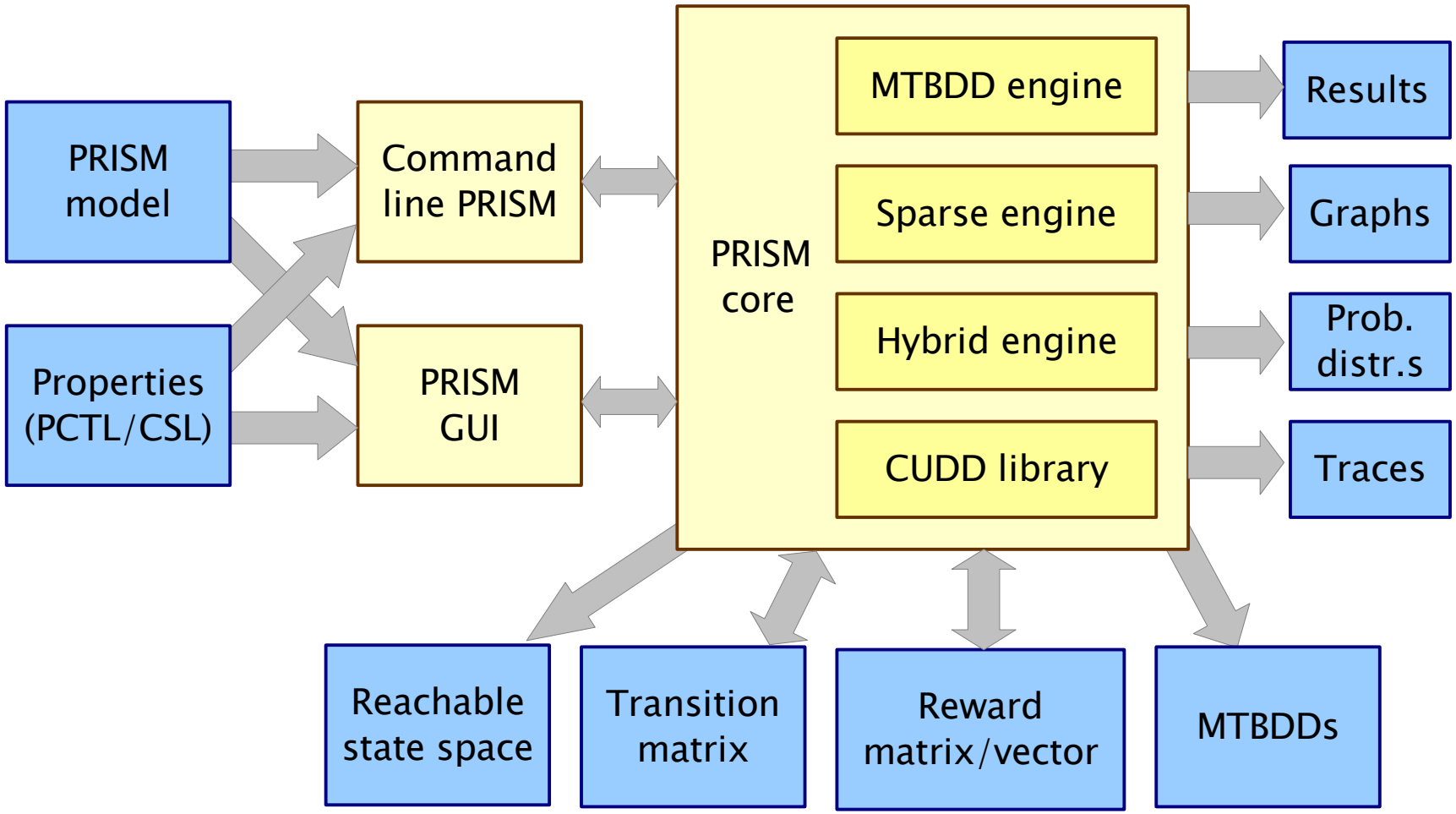
What's in PRISM...

- Solution mechanisms
  - iterative methods: Jacobi/Gauss-Seidel/etc. (DTMCs/CTMCs), uniformisation (CTMC transient), value iteration (MDPs)
  - graph-based analysis (qualitative verification, precomputation)
  - approximations (Monte Carlo & discrete event simulation)
- Symbolic implementation
  - multiple engines (MTBDDs, sparse matrices, hybrid)
  - MTBDDs: quantitative solution for up to 10^{12} states (esp. MDPs)
  - hybrid: approx. 10^{7} states (usually best option for CTMCs)
- Other functionality
  - experiments (automation of multiple checks) + graph plotting
  - manual/random simulation for debugging

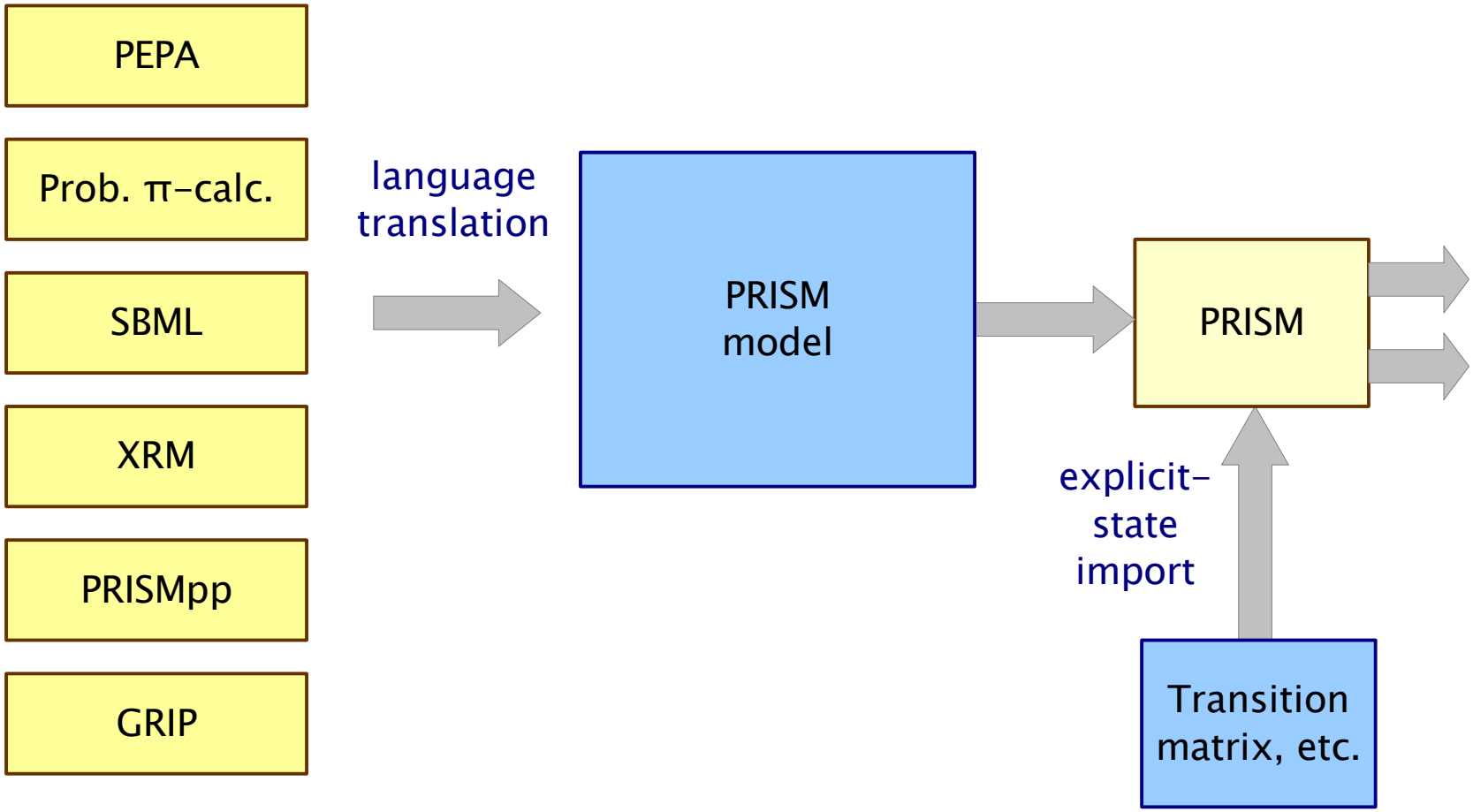
What's not in PRISM (yet)

- PRISM modelling language
  - arrays + other data structures, communication over channels, user-defined functions, control-flow constructs, ...
  - (currently only solution to this is PRISM preprocessor/XRM)
- Property specifications
  - linear time properties (LTL, PCTL*)
  - CSRL etc. (e.g. reward-bounded probabilistic reachability)
  - long-run average properties for MDPs
- Other functionality
  - bisimulation minimisation
  - counterexample/adversary generation
  - explicit-state reachability/model generation

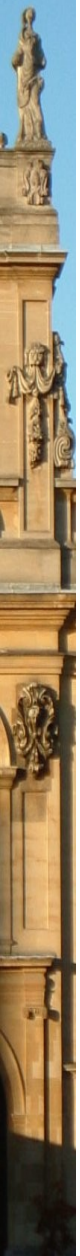
Tool architecture



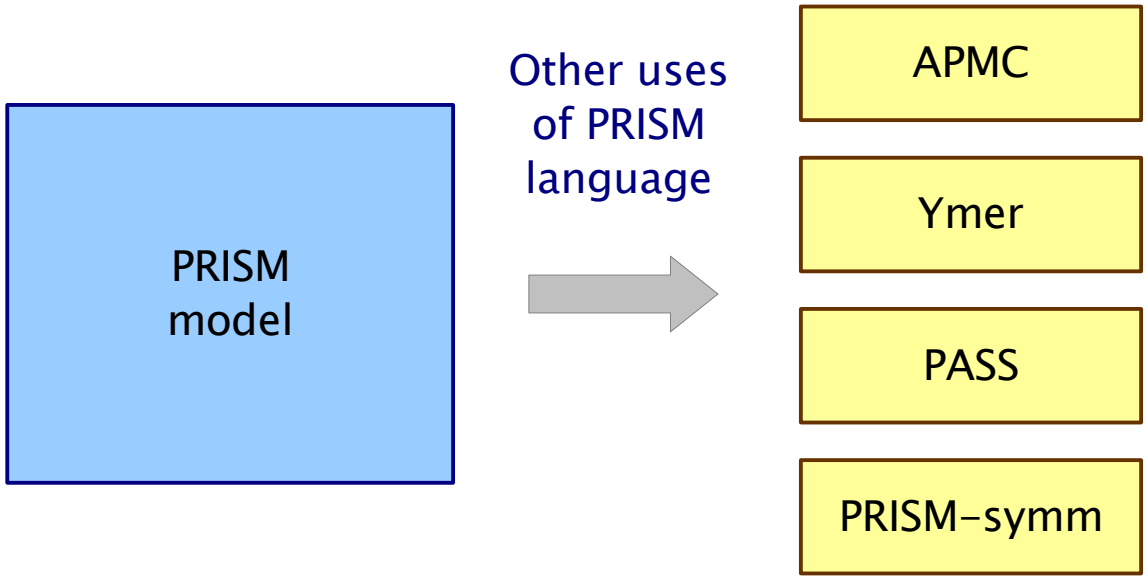
Tool connections (inputs)



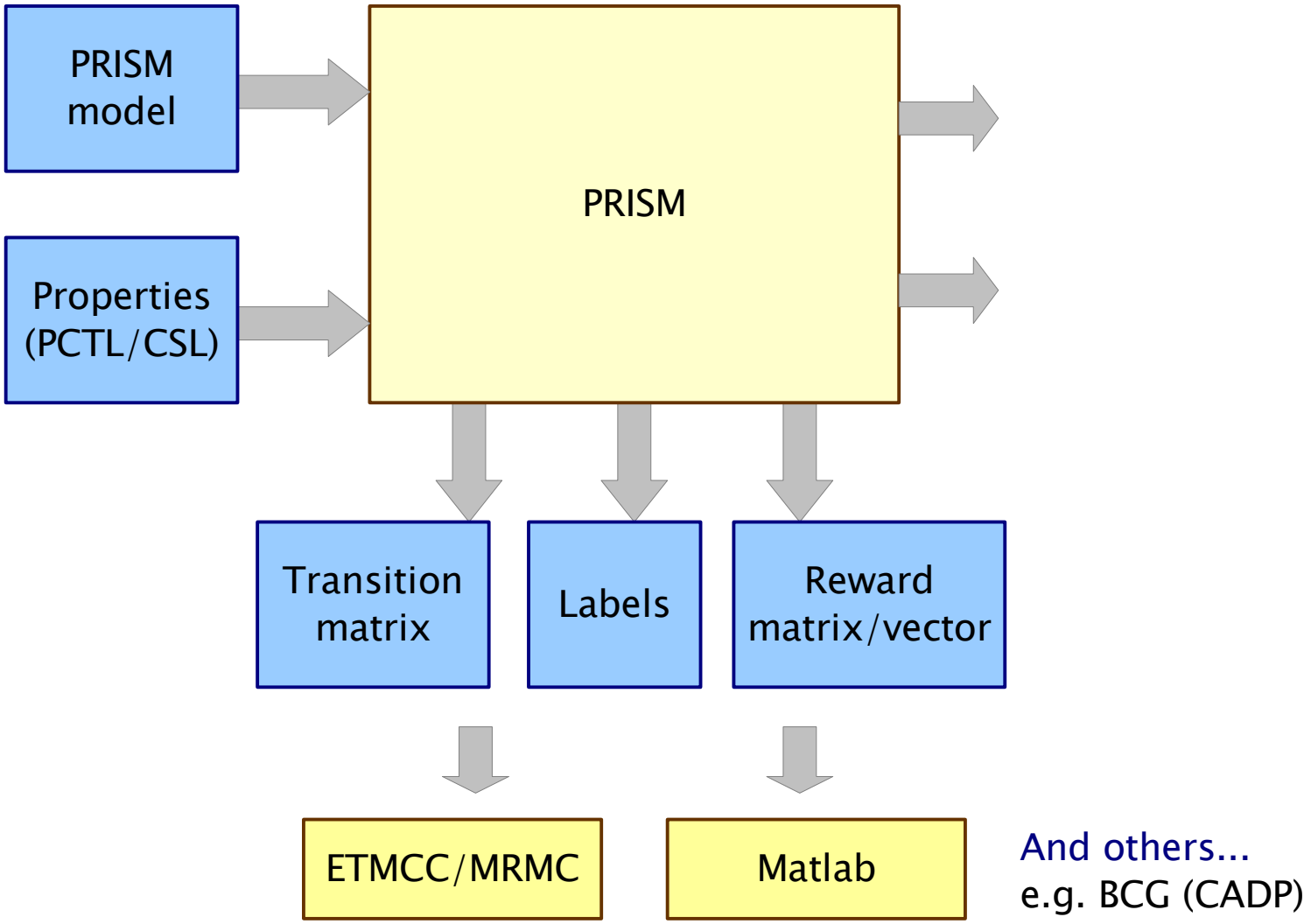
Also in progress: Prob. CSP, Probmela, graphical models for wireless networks, ...



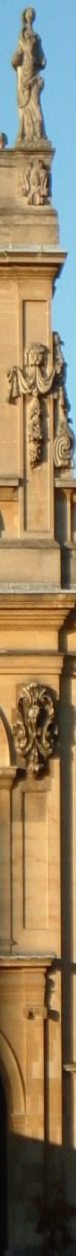
PRISM language connections



Tool connections (outputs)



And others...
e.g. BCG (CADP)



Getting PRISM + more info

- Free and open source (GPL)
- Support for Linux, Windows, Mac OS X, 64-bit, Solaris, ...
- Stable releases and development versions available
- PRISM website: www.prismmodelchecker.org
  - manual, tutorial, FAQ, lectures, papers, talks, case study repository, downloads
  - help forum (SourceForge-hosted)
- Questions? Demos? Please ask me or Gethin...