Julius-Maximilians-
UNIVERSITÄT
WÜRZBURG

Descartes
research

Flexible Performance Predictions at Run-time

Vision Talk

Simon Eismann

HotCloudPerf-2018

09.04.2018

http://se.informatik.uni-wuerzburg.de/

Motivation

Descriptive Performance Model

DML

models

Cloud Application

QPN

LQN

QN

Markov Chain

Simulation

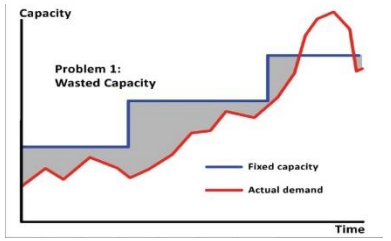
MVA

....

Performance Prediction

enables

Capacity Planning



Which approach should we use?

Problem

- User preferences influence solver choice
  - Accuracy
  - Time-to-result
- Brosig et al. [1] showed:
  - Significant time-to-result and accuracy differences between different simulation-based solvers
  - Time-to-result and accuracy depend on model properties

→ No static order for solvers

→ Best suited solver depends on model structure and user preferences

[1] Brosig, Fabian, et al. "Quantitative evaluation of model-driven performance analysis and simulation of component-based architectures." *IEEE Transactions on Software Engineering* 41.2 (2015): 157-175.

In a nutshell …

Problem

- Best suited solver depends on model structure and user preferences

Idea

- Automate solver selection

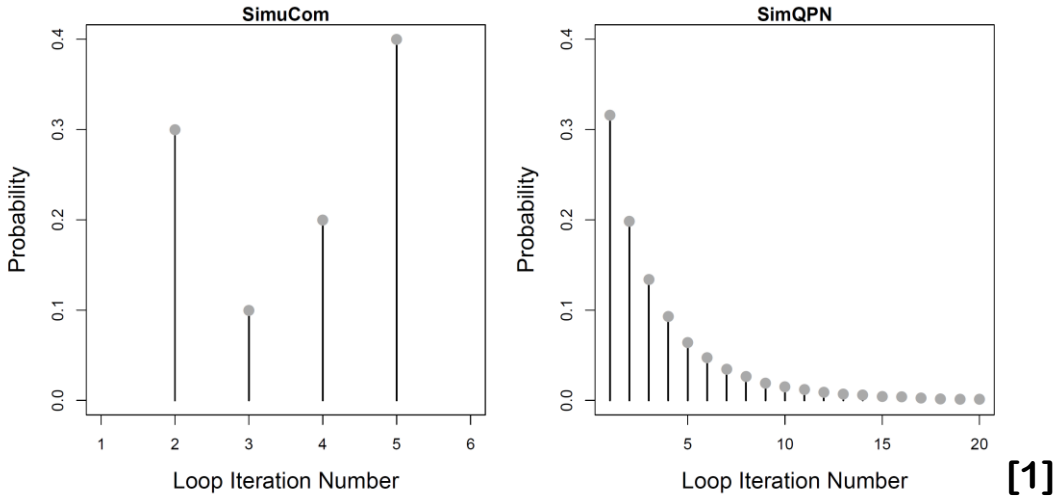
Benefit

- Reduces expert knowledge required
- Improved accuracy and time-to-result

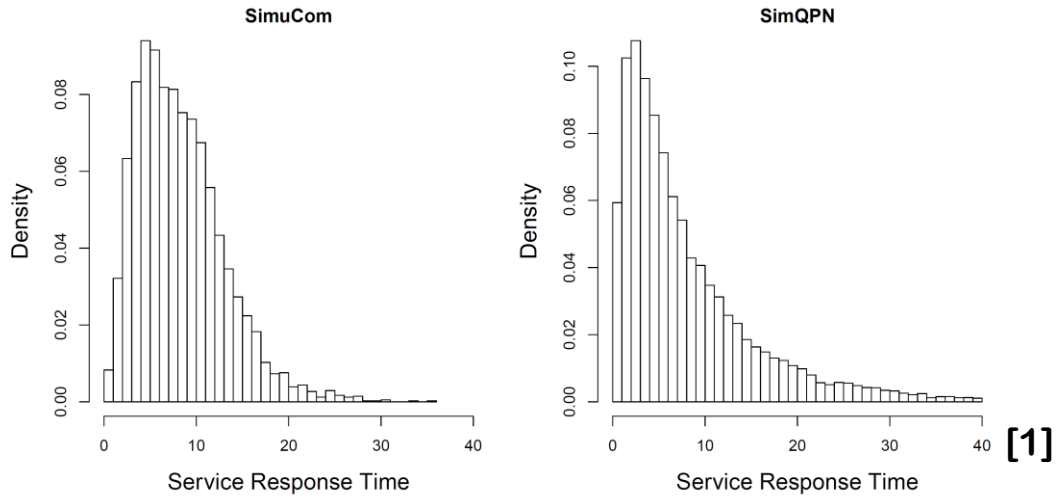
Action

- Predict accuracy
- Predict time-to-result
- Design solver selection algorithm

Accuracy Prediction Challenge



[1]



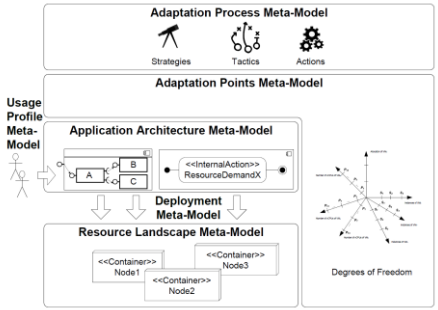
[1]

- Exact loop iteration vs probabilistic approximation
- Same mean response time
- Different response time distribution

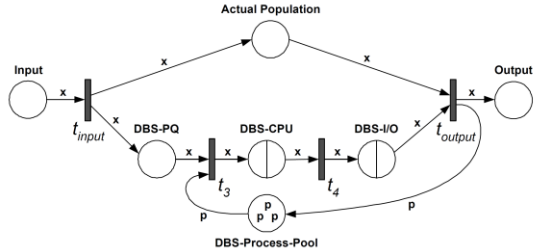
[1] Brosig, Fabian, et al. "Quantitative evaluation of model-driven performance analysis and simulation of component-based architectures." *IEEE Transactions on Software Engineering* 41.2 (2015): 157-175.

Accuracy Prediction Idea

- Estimate accuracy based on:
  - Information loss during transformation
  - Expert knowledge about solvers
- Develop smart transformations
  - Knowledge about transformation steps with information loss
  - Number of occurrences for specific model
  - Derive accuracy score
- Why not machine learning?
  - Not enough training data
  - Feature selection challenging

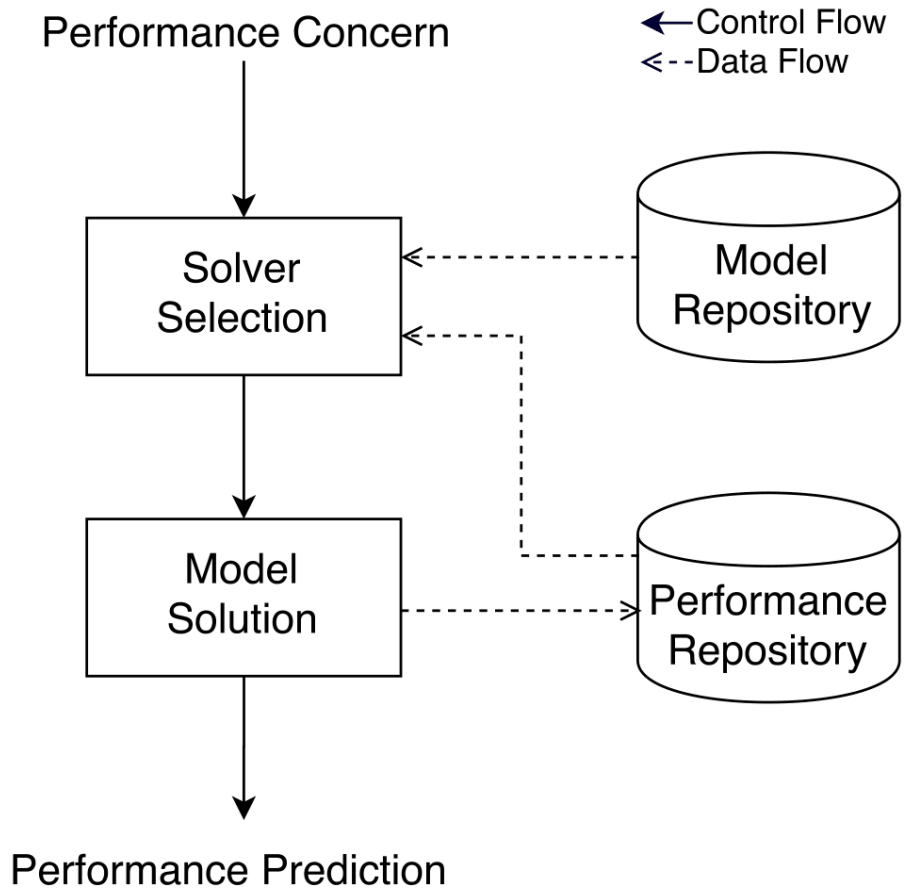


Loop simplified:	4
Semaphore ignored:	0
Fork approximated:	7



Time-to-result Prediction Scenario

- Online Scenario
  - Running system
  - Evolving performance model
  - Performance queries concerning reconfigurations
  - Recurring performance queries
- Model repository contains all model iterations
- Performance repository contains
  - Performance query
  - Target model
  - Selected solver
  - Time-to-result



Time-to-result Prediction Idea

- System evolves, but only stepwise
- Time-to-result for previous queries contained in the performance repository
- Idea: Use machine learning to predict time-to-result based on historic data
- Challenges:
  - Limited training data, but highly relevant
  - Limited prediction time
  - Feature selection

Conclusion

- Selecting the best suited solver is challenging
- Predict accuracy based on
  - Information loss during transformation
  - Expert knowledge about solvers
- Predict time-to-result using
  - Historic information about previous queries
  - Machine learning
- Automatically select best suited solver based on these predictions
- Reduces expert knowledge required and improves performance predictions

Thank you for your attention!

Slides are available at
https://descartes.tools/

HotCloudPerf-2018
Berlin, April 09, 2018
http://se.informatik.uni-wuerzburg.de/