TECHNISCHE UNIVERSITÄT DRESDEN

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The journey has just begun

RACR - MQUAT

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Agenda

1 Start and Problems

2 Ideas and Current State

3 The future

Where we started

- MQuAT concept [GKP+14]
  - Self-adaptive system optimizing for multiple qualities
  - Component-based design for both hardware and software
  - Quality contracts capturing requirements and guarantees of components
- THEATRE [GWC+10] as a Java-based implementation of MQuAT
  - Knowledge represented with EMF-Models
  - Optimization problem solved by transformation to ILP
  - Designed for distributed operation (see HAECubie) using Master-Slave-Pattern [Sah96]

What was the problem

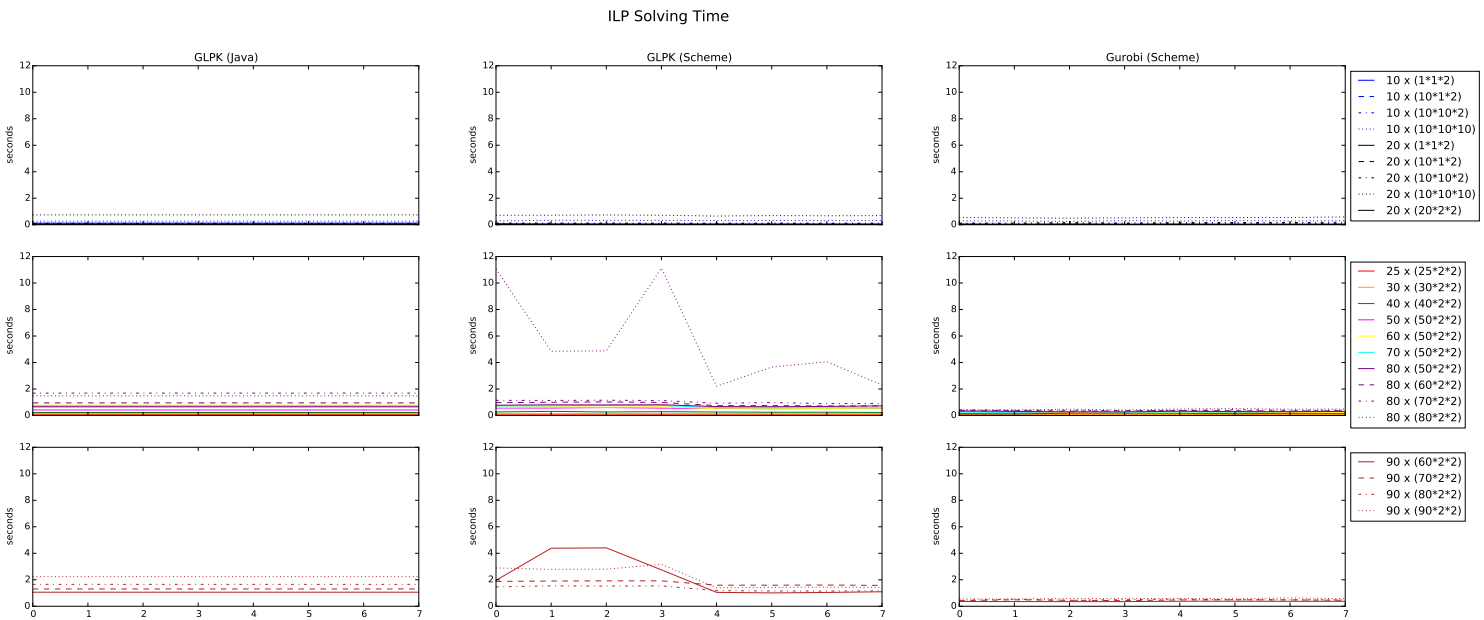
- ILP-Solution branded “unuseable” for bigger systems
  - current measurements disprove this, see next slides
  - ILP still generated from skretch for each request
  - measurements on Cubieboards still to be done for new approach
- EMF-Model (element)s somewhat ambiguous or superfluous
  - component requirement possible both, on component- and on mode-level
  - structure and variant model contain similar information
  - general approach of structural model not easy to use (especially for ILP-Generation)

What was the problem (2)

- Measurement on solving times
  - Context: Java-based System Generator to generate ILP for increasing size of systems, solved by lp_solve and glpk
  - Format of ILP adopted for glpk via own Python script
- Result
  - lpsolve: 14/23 timed out at 2 minutes, others solved took 0.003 to 80s
  - glpk: all solved within 3 seconds
- Further investigation needed
  - Both solvers do not compute the same solution

What was the problem (3)

- Even better performance using Gurobi (commercial solver)



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What is the idea to solve the problem

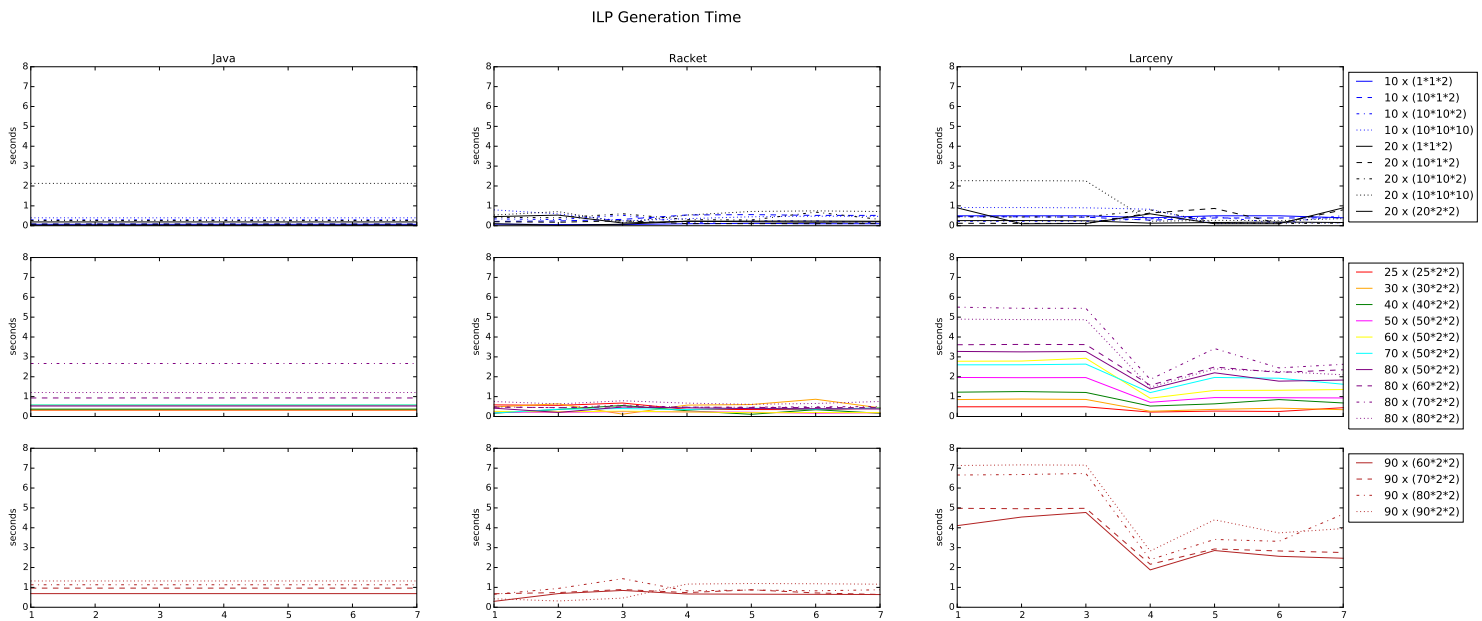
- Use RACR [Bür12]
  - **R**eference **A**ttribute Grammer **C**ontrolled **R**ewriting
  - specify knowledge as an ASG[1] whose structure is defined by a RAG[2]
  - RAG is a combination of structural and variant model, avoiding duplicate information
  - analyses run on ASG now inherently incremental

[1] Abstract Syntax Graph, i.e. an Abstract Syntax Tree with references

[2] Reference Attribute Grammer

How that this improved the existing work

- Hm, not quite there yet:



Some Facts

- repository:
  `https://bitbucket.org/rschoene/racr-mquat`
- IPython Notebook[3] used for measurement plots
- Main language: Scheme
  - implementations used: Racket[4], Larceny[5]
- Measurement and test scripts: Python

[3] http://nbviewer.ipython.org/urls/bitbucket.org/rschoene/racr-mquat/raw/master/ilp-measurement.ipynb

[4] http://racket-lang.org/

[5] http://www.larcenists.org/

Code Facts

Using cloc[6]

Language	files	blank	comment	code
Scheme	13	190	247	2124
Python	8	77	45	489
Bourne Again Shell	1	0	0	2
SUM:	22	267	292	2615

[6] http://cloc.sourceforge.net/

Current pitfalls

- different input formats accepted by lp_solve and glpk
  - transformation (mostly syntactical) needed
  - still, different solution computed (GLPK occasionally let binary variable's value e.g. 0.348485)
- slow running Larceny
  - quite unexpected as Larceny compiles to machine code

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Where we should go next

- Do not transform to ILP
  - Implement an heuristic similar to HAEC demo of Daniel and Johannes
- Apply static analysis where appropriate, e.g.
  - Abstract Interpretation [CC77, Ros90] to estimate energy consumption [JM06, RMM03]
  - Describe decisions [Dan15]
  - Find configurations, which can never be used
  - Unify constraints (in contracts) of modes
- Extend AG
  - Describe multiple systems and their interaction [WSG+13]
  - Include behaviour model

References I

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