TTC 2018 SOLUTION PRESENTATION

A JastAdd- and ILP-based Solution to the Software-Selection and Hardware-Mapping-Problem

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Idea

Step 1

• Transform problem into Integer Linear Program (ILP)

Step 2

• Solve ILP
Idea

Diagram:

- M2M
- ILP Model
- Problem Model
- glpk API
- Interpretation
- ILP Solution
- external
Step 1: Problem → ILP

• Utilize reference attribute grammars
  – Transform model with higher order attributes:
    1. Extend grammar to store ILP as subtree
    2. Transform problem into ILP using nonterminal attributes
    3. Use subtree to load ILP into solver
    4. Profit
Step 2: ILP → Solution

- Enumerate all mappings
- Assign one binary variable to choose an implementation for a request deploying it on a resource

Name = request#implA0#res2
Validity and Optimization

Architectural constraints
- Max. 1 Impl/Component and max. 1 Impl/Resource

Request constraints
- Request target component chosen fulfilling requirements

Negotiation constraints
- Deploy required components
- Fulfill component requirements

Optimize generation
- Exclude mappings with invalid hardware constraints
ILP intermediate model (Text form)

Minimize 123 req0#implA1#r1 + 125 req0#implA1#r2
Subject To
  req0#implA0+ req0#implA1 <= 1
Bounds
  0 <= req0#implA1#r1 <= 1
Generals
  req0#implA1#r1
End
Backup
Grammar Hardware

HW

- ResourceType
  - container: boolean
- Resource
- General::Property
- CurrentResourceValue
- HardwareModel
  - type
  - Exp::Literal::Expression

1 - 1
Grammar Expression

Exp

0..1
General::Instance

1
General::Property

1
SW::MetaParameter

SoftwareDesignator

Designator

LiteralExpression
value: double

Expression

BinaryExpression
left
right

AddExpression
SubExpression
MultExpression
DivExpression
PowExpression
Grammar General

General

Objective
  agg: PropertyAggregation

Property
  unit: String
   1

Model

HW::HardwareModel

SW::SoftwareModel

Request
  name: String

  *

SW::Component

  1

MetaParameterAssignment

  1

SW::Clause

Exp::LiteralExpression

SW::MetaParameter

Solution

enum
  PropertyAggregation
  SUM, MAX

enum
  ClauseComparator
  LT, LE, EQ, NE, GE, GT

enum
  ClauseType
  REQUIRING, PROVIDING

General::Model
<table>
<thead>
<tr>
<th>Scenario</th>
<th>ACO</th>
<th>EMFeR</th>
<th>ILP (direct/ext)</th>
<th>Simple</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 trivial</td>
<td>6 🌟</td>
<td>194 🌟</td>
<td>24 / 21 🌟</td>
<td>1 🌟</td>
</tr>
<tr>
<td>1 small</td>
<td>8 🌟/❌</td>
<td>212 🌟</td>
<td>37 / 40 🌟</td>
<td>6 🌟</td>
</tr>
<tr>
<td>2 small-hw</td>
<td>11 🌟</td>
<td>240 🌟</td>
<td>44 / 61 🌟</td>
<td>8 🌟</td>
</tr>
<tr>
<td>3 small-sw</td>
<td>451 🌟</td>
<td>7min52s</td>
<td>377 / 572 🌟</td>
<td>15min</td>
</tr>
<tr>
<td>4 medium</td>
<td>1min33 🌟/❌</td>
<td>8min22s</td>
<td>8min28s 🌟/❌</td>
<td>15min</td>
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<tr>
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<td>11min15s</td>
<td>15min 🌟/❌</td>
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<tr>
<td>6 medium-sw</td>
<td>15min ❌</td>
<td>11min15s</td>
<td>15min ❌</td>
<td>15min</td>
</tr>
</tbody>
</table>

= valid and in time  = valid, but timeout  = invalid
= optimal (if known from ILP solver)