Travelling Salesman: Planning with Drools
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Agenda

• A Bit of Theory
• Drools Planner
• Travelling Salesman Problem
• The Solution
Scheduling and Planning

• Finding good enough solutions to complex problems.
• Typical problems: Nurse rostering, Bin Packing, Travelling Salesman.
• Techniques:
  • Brute force – impractical for large problems,
  • Branch and bound,
  • Local search
    • Tabu search
    • Simulated annealing
What's Drools?

- Rule-Based Programming
- Define rules (decision points) outside of program logic
- Makes code maintenance easier - change the rules, not the code

```
rule "a simple rule"
  when
    Some condition
  then
    Some action
end
```

- Open-source project
Drools Planner

- Simple way to solve complex problems.
- Implementation of local search.
- You provide:
  - Starting solution,
  - acceptable moves (Java code),
  - scoring function (Rules).
- You get the best found solution.
Solution

- One possible result of the planning algorithm.
- Need not be optimal.
- Move may transform it into a better one.
- Score determines its usefulness.
- Starting solution:
  - Helps “guide” the algorithm.
  - Use appropriate heuristics or just intuition.
Scoring function

- Measure of solution quality.
- Simple score (X):
  - Single number,
  - Higher == Better.
- Hard and soft score (-X/-Y):
  - Number of hard and soft constraints broken.
  - Hard constraints more important.
Travelling Salesman

- $N$ places.
- Has to visit them all, return to start.
- Shortest route?

<table>
<thead>
<tr>
<th>$N$</th>
<th>Possible solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>24</td>
</tr>
<tr>
<td>10</td>
<td>3,628,800</td>
</tr>
<tr>
<td>15</td>
<td>1,307,674,368,000</td>
</tr>
<tr>
<td>20</td>
<td>2,432,902,008,176,640,000</td>
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</table>
Demo time

- Is it a bird?
- Is it a plane?
- It's Eclipse!
The Result ($N = 13$)
Sources

- Planner documentation:
  - http://www.jboss.org/drools/documentation
- Google Maps
- and a little Wikipedia here and there...
Questions?

- Both these slides and demo will be available for download.
- More information about Drools and JBoss to be found on [http://www.jboss.org/](http://www.jboss.org/)
Czech JBoss User Group

Now in your city!
Come to the first session on March 2\textsuperscript{nd}
at 6 p.m., FI MU

Kick-off planned: RESTEasy
<table>
<thead>
<tr>
<th>Time</th>
<th>Lecture Room</th>
<th>D2 (80)</th>
<th>D3 (150)</th>
<th>A107 (50)</th>
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<tbody>
<tr>
<td>9:00-9:45</td>
<td></td>
<td>Perl packaging for developers – Marcela Mašláňová</td>
<td>MythTV - User view – Lukáš Doktor</td>
<td></td>
</tr>
<tr>
<td>9:50-10:35</td>
<td></td>
<td>Java packaging for developers – Stanislav Ochotnicky</td>
<td>Gnome 3.0 (r)evolution - Tomáš Bžatek</td>
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<td>11:30-12:30</td>
<td></td>
<td>lunch</td>
<td>lunch</td>
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<td>14:10-14:55</td>
<td></td>
<td>PicketLink and PicketBox – Peter Škopek</td>
<td>Discussion: Bootloader and Dracut Future Plans - Harald Hoyer (session ends 10 minutes sooner)</td>
<td>Bug hunting &amp; static analysis – Ondřej Vašík and Petr Muller</td>
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<tr>
<td>15:00-15:45</td>
<td></td>
<td>Web Services for Remote Portlets - Michal Vančo</td>
<td>XXX</td>
<td>System vs Session - Lessons learned - David Zeuthen</td>
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<td>15:50-16:35</td>
<td></td>
<td>Infinispan 4 - Data Grids – Radoslav Husar, Michal Linhard</td>
<td>XXX</td>
<td>SysVinit, upstart and systemd in Fedora and RHEL – Petr Lautrbach</td>
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<tr>
<td>16:40-17:25</td>
<td></td>
<td>Deltacloud API – Michal Fojtik</td>
<td>XXX</td>
<td>Modern Linux Desktop alphabet – Tomáš Bžatek, Jaroslav Řezník</td>
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</tbody>
</table>