Solving Optimization Problems

with Drools Planner

Lukáš Petrovický, Red Hat Czech
January 9, 2013

Agenda

- Optimization problems?
- Drools Planner 101
- Multi-track Railway Dispatching
- Task Scheduling
- Good Old Travelling Salesman

What are these “optimization problems”?

- Discrete variables
- Lots of constraints
- Large state space
- Measurable solution quality
- Not requiring best possible solution

Such as?

- Pizza delivery
- Conference scheduling
- Cargo loading
- ...


THE FAILBOAT
HAS ARRIVED

But that's hard, isn't it?

Well, not really...

- Drools Planner
  - http://www.jboss.org/drools/drools-planner
- Java-based
- Declarative
- Powerful
- While easy

Define your problem

- Planning entity
  - Cargo Container
- Planning variable
  - Slot in the ship
- Planning value
  - Available slots
- All POJOs

Know your states

- “Move” changes variable(s) on an entity
  - Switch containers
  - Add/remove container
- Can be generated automatically
  - And then filtered.

Measure your solution

- Is it feasible?
  - Boat doesn't sink.
- How good it is?
  - Is the boat full?
  - How long to unload?
  - ...
- “Score”

Run it

- Input data and let it crunch...
  - Moves traverse solutions.
    - Local search.
  - Solutions are improved.
  - Best solutions are recorded.
  - Results available on-the-fly.

Let's see something!

Railway dispatching

- RAS2012 Competition
  - http://tinyurl.com/6lo4emf
- Objective:
  - Minimize total cost.
- Shows:
  - Basic Planner.
  - Benchmarking.

Situation

- Multiple tracks
  - Preferred direction
  - Pay for time used
- Different trains
  - Different speed on different track
  - Priorities
- Penalties for timeliness


FAIL
failpix.net

Model

- All possible routes
- Places where train can wait
- Various wait periods
- Moves:
  - Change train's route
  - Change train's delay at a point

Results

- Toy problem:
  - 30 % improvement.
  - In a couple seconds.
- Big problem:
  - Planner solution: $10777
  - Winning solution: $7050
  - Damn you, scientists! ;-)

And now for something completely different...

Jenkins queue

- Jenkins Continuous Integration Tool:
  - http://jenkins-ci.org/
- Objective:
  - Maximize throughput.
- Shows:
  - Continuous planning.
  - Real-time.

Situation

- Multiple machines
  - Labels (“RHEL”, “Windows”, “Firefox” etc.)
- Multiple jobs to the queue:
  - “RHEL5 && Firefox”
  - “Windows && 2008 && IE10”
- Each job to pick the least specific machine (= no congestion)

Real-time

- On-demand
  - Jenkins sends updates.
  - Queries Planner for results.
- Planner runs in background.
  - Listens for changes over REST.
  - Determines which job goes where.

And to get the picture...

The Good Old TSP

- Planner Example
- Objective:
  - Minimize distance travelled.
- Shows:
  - DRL Score Function
  - Chaining

Situation

- Multiple cities
- Have to go to all of them
- Return back home or not?

All in all...

Planner is...

- Straight-forward
- Powerful
- Easy
- Improving all the time!

Try it yourself

- Drools Planner & Examples:
  - github.com/droolsjbpm/drools-planner
- RAS2012:
  - github.com/triceo/ras12
- Jenkins queue:
  - github.com/rsynek/hudson-queue-planning

And don't forget

DevConf.cz
FUTURE AHEAD
February 23rd & 24th 2013 . Brno
www.devconf.cz