StarExec
A Web Service for Evaluating Logic Solvers

Aaron Stump and Cesare Tinelli
Computer Science
The University of Iowa
The StarExec Project

• $1.85 million NSF project.
  ▶ $1.7 million at U. Iowa.
  ▶ $150k at U. Miami (Prof. Geoff Sutcliffe).
  ▶ Started September 2011.
  ▶ Based on 1-year planning grant 2010-2011.

• Goal: build a web service for evaluating logic solvers.
High-Performance Logic Solvers

- Software tools for testing logical validity.

\[ \phi \]

Logic Solver

- Example formulas \( \phi \):
  - \( a = b \land b = c \rightarrow a = c \)
  - \( x > 0 \land x + y < z \rightarrow y < z \)
  - much more

- Why are these useful?
  - Logic is a universal language.
  - Solve problems by translating to logic.
  - Modern solvers can handle large formulas.
Large formulas (50 megabytes or more).
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Many Applications

• Industrial design: view design correctness as a logic problem.
  ▶ Avionics software.
  ▶ Integrated circuits (computer chips, controllers).
  ▶ Subway and train control systems.

• Academic uses.
  ▶ Many researchers using solvers in past 5 years.
  ▶ Software verification, program analysis, combinatorics, and more.
Different Logics, Different Subcommunities

• Logic problems are, in general, unsolvable.
  ▶ This can be proven mathematically.
  ▶ Intuitively: cannot put mathematicians out of work.

• But: many special cases can be solved in practice.
  ▶ **SAT.** Just boolean reasoning: \( p \land (p \rightarrow q) \rightarrow q \).
  ▶ **SMT.** Satisfiability Modulo Theories: \( a = b \land b = c \rightarrow a = c \).
  ▶ **First-order.** “If all men are mortal and Socrates is a man, then ...”
  ▶ Many more: **QBF, CSP, ASP, Termination, Confluence.**

• Different subcommunities (separate workshops, conferences).
Challenges

• For users of solvers:
  ▶ What are the available solvers?
  ▶ Which solvers work best for my problem?

• For solver implementors:
  ▶ How can I compare my solver with the state of the art?
  ▶ How can I conveniently test my solver on benchmark formulas?

• For community leaders:
  ▶ Where can I store my library of benchmark formulas?
  ▶ How can I run an annual solver competition?
  ▶ How can I build infrastructure for my community?
Solution: StarExec

- **Goal:** design a single piece of infrastructure for logic solving.
  - Different communities, but similar needs.
  - Invest more resources in better infrastructure.
  - Create a single destination for solver users.

- **Concretely, StarExec will be:**
  - A public web service.
  - Backed by a medium-sized compute cluster (150 nodes).
  - Serving many different communities.

- **Funding for significant hardware resources, software development.**
Current Status

- **Advisory committee** formed:
  - Ian Horrocks (Oxford)
  - Jürgen Giesl (RWTH Aachen)
  - Ewen Denney (NASA Ames)
  - Giovambattista Ianni (University of Calabria)
  - Nikolaj Björner (Microsoft Research)
  - Daniel Le Berre (University of Artois)
  - Aarti Gupta (NEC Labs)

- **First-round hardware purchase** in progress now.
  - 30 dual-processor multicore compute nodes.
  - 3 head nodes to accept incoming web requests.
  - 23TB NetApp network-attached storage device.

- **Software development** proceeding Fall 2012 to present.
  - Graduate and undergraduate student programmers (currently Todd Elvers, Tyler Jensen, Vivek Sardeshmukh, Ruoyu Zhang).
  - Professional staff person (Ben McCune).

- **Goal**: run SMT competition this summer.
Some Questions

- Can StarExec be self-supporting after the grant (August, 2015)?
  - Can we charge for non-academic use of the service?
  - Can we license the software itself for non-academic use?
  - Other models?
- How do we prepare for this now?
- Other intellectual property issues we should consider?

www.starexec.org