

StarExec

A Web Service for Evaluating Logic Solvers

Aaron Stump and Cesare Tinelli

Computer Science

The University of Iowa

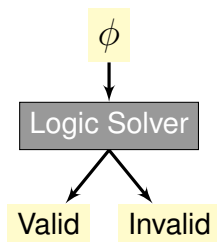
The StarExec Project

- \$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.



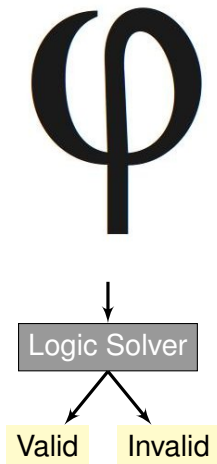
- Example formulas ϕ :
 - ▶ $a = b \wedge b = c \rightarrow a = c$
 - ▶ $x > 0 \wedge x + y < z \rightarrow y < z$
 - ▶ much more
- Why are these useful?
 - ▶ Logic is a universal language.
 - ▶ Solve problems by translating to logic.
 - ▶ Modern solvers can handle large formulas.



Large formulas (50 megabytes or more).



Large formulas (50 megabytes or more).



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: $p \wedge (p \rightarrow q) \rightarrow q$.
 - ▶ **SMT**. Satisfiability Modulo Theories: $a = b \wedge b = c \rightarrow a = c$.
 - ▶ **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

