

**ICML 2005 Student Scholarship and
Volunteer Program Application**

Name: Scott Sanner
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Education Stage: PhD Computer Science, 3rd year
Advisor: Craig Boutilier

Paper: "Simultaneous Learning of Structure and Value in Relational
Reinforcement Learning", Scott Sanner
*Appearing in the Proceedings of the Rich Representations for
Reinforcement Learning Workshop (at ICML 2005).*

*Note: This document does not contain the advisor letter of support which was attached
separately in the application email.*

Research Abstract

The core of my current research concerns decision-theoretic planning and learning in environments with stochastic action outcomes and a first-order logic policy language. Such a formalism allows one to solve (or approximately solve) for policies in stochastic planning domains containing thousands or even an infinite number of objects – problems that any state-of-the-art STRIPS or propositional planner could not even begin to solve. In an effort to make this very expressive reasoning tractable in practice, my advisor, other colleagues and I have developed novel data structures and approximation algorithms for efficiently performing first-order decision theoretic regression and we are currently in the process of applying these techniques to probabilistic planning and logistics domains.

In the future, we are also looking at extending our solution techniques to handle decision-theoretic planning domains with the following types of modeling constructs:

- Modeling languages with cardinality and counting aggregators.
- Modeling languages with description logic constructs.
- Turing-equivalent program constraints on policies.
- Hierarchy and abstraction in the state and action space.
- Environments with partial observability (e.g., for use in both Semantic Web and robotics planning applications).

In addition to this work, I am also concerned with integrating the above techniques for decision-theoretic planning with the Semantic Web, specifically for the purposes of planning with Semantic Web Services (SWSs). To this extent, my research also involves efficient reasoning techniques for hybrid combinations of first-order and description logic that are required for the specification of SWSs. The purpose of this work is to leverage the prior work on reasoning optimizations in each of the individual languages to build an optimized and integrated logical inference system. The ultimate goal of such a system is to be integrated with decision-theoretic planning algorithms that are the core of my research so that they can scale to the unprecedented quantities of information that the Semantic Web will be able to provide.

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OBJECTIVE To work in applied research and development in an area related to artificial intelligence, machine learning, and algorithms.

EDUCATION *University of Toronto • Toronto, ON, Canada*

- Ph.D. in Computer Science
- Thesis Supervisor: Craig Boutilier
- Research Area: Planning under Uncertainty
- Cumulative GPA: 4.08 / 4.33
- Ph.D. CS expected August 2006

Stanford University • Stanford, CA, USA

- Master of Science in Computer Science
- Specialization: Artificial Intelligence
- Cumulative GPA: 3.86 / 4.33
- M.S. CS received June 2002

Carnegie Mellon University • Pittsburgh, PA, USA

- Bachelor of Science in Electrical and Computer Engineering
- Bachelor of Science in Computer Science (Double Degree)
- Cumulative GPA: 3.92 / 4.00
- B.S. CS and B.S. ECE received December 1999 (with University Honors)

PUBLICATIONS S. Sanner, and D. McAllester (2005). **Affine algebraic decision diagrams (AADDs) and their application to structured probabilistic inference.** *In Proceedings of the 19th International Joint Conference on AI (IJCAI-05).*

S. Sanner, and C. Boutilier (2005). **Approximate linear programming for first-order MDPs.** *In Proceedings of the 21st Conference on Uncertainty in AI (UAI-05).*

S. Sanner (2005). **Simultaneous learning of structure and value in relational reinforcement learning.** *In Proceedings of the Workshop on Rich Representations. for Relational Reinforcement Learning (at ICML-05).*

D. Anguelov, R. Biswas, D. Koller, B. Limketkai, S. Sanner, and S. Thrun (2002). **Learning hierarchical object maps of non-stationary environments with mobile robots.** *In Proceedings of the 18th Conference on Uncertainty in AI (UAI-02).*

R. Biswas, B. Limketkai, S. Sanner, and S. Thrun (2002). **Towards object mapping in dynamic environments with mobile robots.** *In Proceedings of the Conference on Intelligent Robots and Systems (IROS-02).*

S. Sanner, J. R. Anderson, C. Lebiere, and M. Lovett (2000). **Achieving efficient and cognitively plausible learning in backgammon.** *In Proceedings of the 17th International Conference on Machine Learning (ICML-00).*

EXPERIENCE	<p><i>Intern • Toyota Technological Institute at Chicago</i> <i>Summer 2004 • Supervisor: Dr. David McAllester</i></p> <ul style="list-style-type: none"> • Development of a novel data structure (AADD) and algorithms for efficient structured probabilistic inference in the presence of context-specific, additive, and multiplicative independence. • Implementation of an efficient Bayes net inference engine and MDP solver based on the AADD data structure and algorithms. <p><i>Intern • Sun Microsystems Research Labs</i> <i>Summer 1999, 2001 & 2002 • Supervisor: Dr. Bill Woods</i></p> <ul style="list-style-type: none"> • Design and Java implementation of a structural subsumption classifier for natural language concepts extracted from text and web documents. • Co-design of an efficient algorithm for indexing web pages based on a taxonomic knowledge representation framework <p><i>Research Assistant • Stanford University</i> <i>September 2000 - Present • Supervisor: Dr. Richard Fikes</i></p> <ul style="list-style-type: none"> • Integration of special purpose subsumption reasoning utilities into a Java-based first-order logic theorem prover. • Extension of structural subsumption techniques to handle description logics with disjunction. <p><i>Research Programmer • Lawrence Livermore National Labs</i> <i>January 2000 - September 2000 • Supervisor: Dr. Rowland Johnson</i></p> <ul style="list-style-type: none"> • Design and implementation of a system for integrating computer network vulnerability data from the web and compiling this information to perform vulnerability inference on passively collected network data. <p><i>Research Assistant • Carnegie Mellon University</i> <i>January 1998 - December 1999 • Supervisor: Dr. John R. Anderson</i></p> <ul style="list-style-type: none"> • Design of an efficient reinforcement learning algorithm for efficiently integrating structured information into state representation. <p><i>Intern • Lockheed Martin</i> <i>Summer 1998 • Supervisor: Dr. Dan Bondy</i></p> <ul style="list-style-type: none"> • Design, C++ coding, and verification of optimization and numerical methods for use in satellite operations scheduling. <p><i>Intern • National Cancer Institute</i> <i>Summer 1997 • Supervisor: Matt Fivash</i></p> <ul style="list-style-type: none"> • Implementation of numerical and signal processing algorithms for analysis of protein chemistry experiments
SERVICE	<ul style="list-style-type: none"> • Reviewer for IJCAI-2005 • Reviewer for UAI-2005
HONORS	<ul style="list-style-type: none"> • Carnegie Mellon University Presidential Scholarship recipient • Armed Forces Communications Electronics Association (AFCEA Washington Chapter) Scholarship recipient • Elected to Tau Beta Pi Engineering and Phi Kappa Phi Honor Societies
EXTRACURRICULAR	<ul style="list-style-type: none"> • Capoeira (Afro-Brazilian Martial Art), Taekwondo

References Available Upon Request

Travel Costs Estimate

I am applying for both the student scholarship and volunteer program. I have not included the conference registration fee below, which I assume is included in the scholarship.

Exact Travel Costs:

Plane Fare: US \$ 274.00 (*Roundtrip from Edinburgh to Bonn only*)

Accommodation: US \$ 363.00

Total Requested: US \$ 637.00

Statement of other travel funding:

- I am requesting a travel grant from IJCAI to cover the roundtrip plane fare between Toronto and Edinburgh (amount unknown at this time). *I am only requesting ICML to cover the expense of the roundtrip between Edinburgh and Bonn and accommodation while at the conference.*
- As a publicly funded Canadian University, the University of Toronto relies on conference travel grants to fund student conference travel. It guarantees no funding for such travel.