

Joshua Taylor

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EDUCATION

Ph.D. Program in Computer Science, January 2008–present
Rensselaer Polytechnic Institute, Troy, NY

M.S. Program in Computer Science, August 2005–August 2007
Rensselaer Polytechnic Institute, Troy, NY

B.S., Computer Science, Magna Cum Laude; Economics Minor, September 2001–May 2005
Rensselaer Polytechnic Institute, Troy, NY

EXPERIENCE

Graduate Research Assistant, 2008–present

**Department of Computer Science
Rensselaer Polytechnic Institute
Troy, NY, USA**

Graduate Research Assistant, 2005–2007

**Department of Computer Science
Rensselaer Polytechnic Institute
Troy, NY, USA**

A primary developer of Slate, a system for formal and informal argument mapping, for use by professionals and students in the domains of intelligence analysis and mathematics.

A primary developer of Solomon, an advanced question and answer dialogue system for intelligence analysts.

Graduate research in provability based interoperability culminated in my MS thesis, *Provability-Based Semantic Interoperability Between Knowledgebases and Databases via Translation Graphs*, and *Provability-Based Semantic Interoperability via Translation Graphs*. Worked with RAIR Lab colleagues and teams from IBM, Stanford University, Pacific Northwest National Laboratories, and Oculus Inc. to achieve semantic interoperability between software systems developed for intelligence analysis, including Slate and Solomon.

Graduate Teaching Assistant, Fall 2006

**Department of Computer Science
Rensselaer Polytechnic Institute
Troy, NY, USA**

Teaching assistant for CSCI 4150, Artificial Intelligence in Fall 2006. Graded student assignments, examinations, final projects, and term papers. Held office hours. Course covered techniques in AI including: search, game theory, logic, knowledge representation, and basic programming in Scheme and Prolog.

Co-lecturer for Introduction to Logic, Fall 2005

**Department of Cognitive Science
Rensselaer Polytechnic Institute
Troy, NY, USA**

Instructed students in the use of Slate in PHIL 2140, Introduction to Logic. Students learned to construct and check arguments and proofs in formal logic using Slate.

Sunday School Teacher, 2004–2005

**Korean Presbyterian Church of Albany
7 Knox Drive
Schenectady, NY, USA**

Under direction of deacon responsible for junior and senior high youth group, prepared and taught weekly lessons for a group of five to fifteen students in grades 6–8.

Undergraduate Research Assistant, 2003–2005

**Department of Cognitive Science
Rensselaer Polytechnic Institute
Troy, NY, USA**

Started development of Slate.

Undergraduate Teaching Assistant, 2002–2005

**Department of Cognitive Science
Rensselaer Polytechnic Institute
Troy, NY, USA**

Teaching assistant for PHIL 2140, Introduction to Logic in Fall 2002, 2003, and 2004. Graded student assignments and examinations. Held office hours. Course covered traditional propositional, predicate, and first-order logics, and introduced visual formalisms such as Peirce's existential graphs, and the RAIR Lab's Slate.

Teaching assistant for PHIL 4963, Intermediate Logic in Spring 2005. Graded student assignments, examinations, and final projects. Held office hours. Course covered axiom systems, modal logics, soundness and completeness theorems for proof systems, and axiom independence proofs.

Undergraduate Teaching Assistant, 2002–2003

**Department of Computer Science
Rensselaer Polytechnic Institute
Troy, NY, USA**

Teaching assistant for CSCI 1190, Beginning C Programming for Engineers in Fall 2003. Graded student assignments and examinations. Held office hours by appointment. Present during class to aid students with in class assignments.

Teaching assistant for CSCI 2300, Data Structures and Algorithms in Spring 2002. Helped students during lab/recitation sessions with programming assignments.

SKILLS

Programming Languages

Common Lisp, Scheme, C, C++, Java

Knowledge Representation

IKRIS Knowledge Language (IKL), Common Logic

Operating Systems

MacOS X, Unix (Linux, FreeBSD), Microsoft Windows 95/98/XP

Tools

Emacs, LaTeX, LispWorks

SCIENTIFIC

SOFTWARE

S. Bringsjord, A. Shilliday, J. Taylor. Slate. System for Logic and Theorem Extraction; a logic-based application for assisting reasoners in the fields of Intelligence Analysis, Logic, Math, etc. <http://www.cogsci.rpi.edu/slate/>. 2003–present.

S. Bringsjord, M. Clark, A. Shilliday, J. Taylor, D. Werner. Solomon. A Next-Generation Q&A

PUBLICATIONS

Selmer Bringsjord, Joshua Taylor, Andrew Shilliday, Micah Clark, and Konstantine Arkoudas. *Slate: An Argument-Centered Intelligent Assistant to Human Reasoners*. In Proceedings of CMNA 08, 8th Workshop on Computational Models of Natural Argumentation., held in conjunction with ECAI 2008, 18th European Conference on Artificial Intelligence. University of Patras, Patras, Greece. July 21, 2008.

We describe Slate, a logic-based, robust interactive reasoning system that allows human “pilots” to harness an ensemble of intelligent agents in order to construct, test, and express various sorts of natural argumentation. Slate empowers students and professionals in the business of producing argumentation, e.g., mathematicians, logicians, intelligence analysts, designers and producers of standardized reasoning tests. We demonstrate Slate in several examples, describe some distinctive features of the system (e.g., reading and generating natural language, immunizing human reasoners from “logical illusions”), present Slate's theoretical underpinnings, and note upcoming refinements.

S. Bringsjord, A. Shilliday, J. Taylor, D. Werner, M. Clark, E. Charpentier, and A. Bringsjord. *Toward Logic-Based Cognitively Robust Synthetic Characters in Digital Environments*. Artificial General Intelligence 2008 — Proceedings of the First AGI Conference. In the series of Frontiers in Artificial Intelligence and Applications, 171:87–98. IOS Press. 2008.

With respect to genuine cognitive faculties, present synthetic characters inhabiting online virtual worlds are, to say the least, completely impaired. Current methods aimed at the creation of “immersive” virtual worlds only avatars and NPCs the illusion of mentality and, as such, will ultimately fail. Like behaviorism, this doomed approach focuses only on the inputs and outputs of virtual characters and ignores the rich mental structures that are essential for any truly realistic social environment. While this “deceptive” tactic may be suitable so long as a human is in the driver's seat compensating for the mental deficit, truly convincing autonomous synthetic characters must possess genuine mental states, which can only result from a formal theory of mind. We report here on our attempt to invent part of such a theory, one that will enable artificial agents to have and reason about the beliefs of others, resulting in characters that can predict and manipulate the behavior of even human players. Furthermore, we present the “embodiment” of our recent successes: Eddie, a four year old child in Second Life who can reason about his own beliefs to draw conclusions in a manner that matches human children his age.

A. Shilliday, J. Taylor, S. Bringsjord. *Toward Automated Probability-Based Semantic Interoperability between Ontologies for the Intelligence Community*. In Proceedings of the Second International Ontology for the Intelligence Community (OIC-2007), 66–72. CEUR Workshop Proceedings. November 28–29, 2007.

The need for interoperability is dire: Knowledge representation systems employ ontologies that use disparate formalisms to describe related domains; to be truly useful to the intelligence community, they must meaningfully share information. Ongoing research strives toward the holy grail of complete interoperability, but has been hindered by techniques that are specialized for particular ontologies, and that lack the expressivity needed to describe complex ontological relationships. In the sequel, we describe provability-based semantic interoperability, a means to surmount these hindrances; translation graphs, one of our key formalism for describing the complex relationships among arbitrary ontologies; and ways in which these techniques might be automated.

J. Taylor, A. Shilliday, and S. Bringsjord. *Provability-based Semantic Interoperability via Translation Graphs*. In Proceedings of the 2007 International Workshop on Ontologies and Information Systems for the Semantic Web, 180–189. November 2007.

Provability-based semantic interoperability (PBSI) is a kind of interoperability that transcends mere syntactic translation to allow for robust, meaningful information exchange across systems employing ontologies for which mappings or matchings may not exist, and which can be evaluated by provability-based (PB) queries. We introduce a system of translation graphs to formalize the relationships between diverse ontologies and knowledge representation and reasoning systems, and to automatically generate the translation axioms governing PB information exchange and inter-system reasoning. We demonstrate the use of translation graphs on a small number of simple systems to achieve interoperability.

S. Bringsjord, K. Arkoudas, D. Mukherjee, A. Shilliday, J. Taylor, M. Clark, and E. Bringsjord. *The Multi-Mind Effect*. In Proceedings of the 2007 International Conference on Artificial Intelligence, 43–49. CSREA Press. June 25–28, 2007.

Courtesy of experiments carried out by such thinkers as Wason, Johnson-Laird, and Kahneman & Tversky, there is overwhelming empirical evidence that the vast majority of logically untrained humans are unable to reason in context-independent, normatively correct fashion. However, the multi-mind effect, which is predicted by our earlier success at teaching this kind of reasoning, and also by our general theory of human and machine reasoning, shows that while individual persons (with rare exceptions) are unable to solve problems that demand context-independent reasoning, groups of persons can often solve such problems.

S. Bringsjord, K. Arkoudas, M. Clark, A. Shilliday, J. Taylor, B. Schimanski, and Y. Yang. *Reporting on Some Logic-Based Machine Reading Research*. In Proceedings of the 2007 AAAI Spring Symposium on Machine Reading. 2007.

Much sponsored research in our lab either falls under or intersects with machine reading. In this short paper we give an encapsulated presentation of some of the research in question, leaving aside, for the most part, the considerable detailed technical information that underlies our work. Demonstrations of our technology will be provided at the symposium itself.

S. Bringsjord, A. Shilliday, J. Taylor, P. Bello, Y. Yang, and K. Arkoudas. *Harnessing Intelligent Agent Technology to ‘Superteach’ Reasoning*. International Journal of Technology in Teaching and Learning, 2(2):88–116. 2006.

After briefly explaining our ultimate educational goal with respect to reasoning (to “superteach” reasoning), and our theoretical foundation, we give an overview of some of our attempts to build and harness intelligent agents in order to reach this goal. We end with coverage of the Slate system, which inherits its power from lessons learned in connection with the engineering of its more primitive predecessors.

S. Bringsjord, O. Kellett, A. Shilliday, J. Taylor, B. van Heuveln, Y. Yang, J. Baumes, and K. Ross. *A new Gödelian argument for hypercomputing minds based on the Busy Beaver problem*. Applied Mathematics and Computation, 176(2):516–530. May 15, 2006.

Do human persons hypercompute? Or, as the doctrine of computationalism holds, are they information processors at or below the Turing Limit? If the former, given the essence of hypercomputation, persons must in some real way be capable of infinitary information processing. Using as a springboard Gödel’s little-known assertion that the human mind has a power “converging to infinity”, and as an anchoring problem Rado’s Turing-uncomputable “busy-beaver” (or Σ) function, we present in this short paper a new argument that, in fact, human persons can hypercompute. The argument is intended to be a formidable, not conclusive: it brings Gödel’s intuition to a greater level of precision, and places it within a sensible case against computationalism.

PRESENTATIONS

S. Bringsjord, J. Taylor, A. Shilliday, M. Clark, and K. Arkoudas. *Slate: An Argument-Centered*

Intelligent Assistant to Human Reasoners. Presented at the 18th European Conference on Artificial Intelligence (ECAI 2008) in the 8th International Workshop on Computational Models of Natural Argument (CMNA 8). University of Patras, Patras, Greece. July 21, 2008. (Clark presented.)

S. Bringsjord, A. Shilliday, J. Taylor, and M. Clark. *Updates on Advanced Knowledge Representation and Reasoning for Interactive Visualization*. Presented at IARPA/DTO ASpace-X site visit. February 7, 2008.

J. Taylor, A. Shilliday, S. Bringsjord, M. Clark, and D. Werner. *Provability-Based Semantic Interoperability via Translation Graphs*. Presented at the 26th International Conference on Conceptual Modeling (ER 2007), in the Ontologies and Information Systems for the Semantic Web (ONISW) workshop, Auckland, New Zealand. November 5–9, 2007. (Shilliday presented.)

S. Bringsjord, K. Arkoudas, D. Mukherjee (presenter), A. Shilliday, J. Taylor, M. Clark, E. Bringsjord. *The Multi-Mind Effect*. 2007 International Conference on Artificial Intelligence, in the Extending Computational Cognitive Modeling to Issues of Multi-agent Interaction workshop. June 28, 2007.

S. Bringsjord, D. Werner, A. Shilliday, J. Taylor, M. Clark. *The Solomon QA System: Updates (Blue Sky PoC Project)*. Solomon site visit, Rensselaer Polytechnic Institute, Troy, NY. May 2007.

S. Bringsjord, K. Arkoudas, M. Clark, A. Shilliday, J. Taylor, B. Schimanski, Y. Yang. *Some Remarks on Logic-Based Machine Reading Research*. 2007 Association for the Advancement of Artificial Intelligence (AAAI) Spring Symposium on Machine Reading, Stanford University, Palo Alto, CA. March 27, 2007. (Bringsjord and Taylor presented.)

S. Bringsjord, M. Clark, A. Shilliday, J. Taylor, and T. Houston. *The Solomon QA System: Updates*. Presented at DTO InfoX Principal Investigator Meeting. March 15, 2007. (Bringsjord presented.)

S. Bringsjord, A. Shilliday, J. Taylor, M. Clark. *On Slate*. DTO ARIVA Principal Investigator Meeting, Falls Church, VA. June 14, 2006.

S. Bringsjord, A. Shilliday, J. Taylor, K. Arkoudas, S. Khemlani, E. Pratt, B. Schimanski, G. Mulley. *Artificial Intelligence and the Future of Intelligence Analysis and Wargaming*. Pacific Northwest National Laboratory, August 8, 2005. (Bringsjord presented.)

S. Bringsjord, K. Arkoudas, Y. Yang, B. van Heuveln, P. Bello, J. Taylor. *Introducing CHOGIC: A Primitive Part of the MARMML Machine Reasoning System*. Delivered at the University of Pavia, Pavia, Italy, June 4, 2004. (Bello presented.)

S. Bringsjord, A. Shilliday, and J. Taylor. *On Model Building-Based Hypothesis Generation*. NIMD PI Meeting, Orlando, Florida, November 30, 2004. (Bringsjord presented.)

A. Shilliday, J. Taylor, E. Pratt, and S. Bringsjord. *Slate - "Core" Development Directions*. IBM, T.J. Watson Research Center, Hawthorne, NY. June 6, 2005.

J. Taylor, S. Bringsjord, A. Shilliday, K. Arkoudas, and S. Khemlani. *An Overview of Slate*. Undergraduate Research Presentations, Minds and Machines Seminar, Rensselaer Polytechnic Institute, Troy, NY. March 30, 2005. (Taylor and Khemlani presented.)

A. Shilliday, J. Taylor, and S. Bringsjord. *Slate: An Intelligent Assistant to Professionals and Students in the Fields of Intelligence Analysis, Mathematics, and Logic*. For The Institute for Informatics, Logics and Security Studies, Albany, NY. March 18, 2005.

S. Bringsjord, K. Arkoudas, Y. Yang, A. Shilliday, J. Taylor, M. Destefano. *New Architectures, Algorithms, and Designs that Lead to Implemented Machine Reasoning over Knowledge in Epistemic and Deontic Formats, in the Service of Wargaming*. AFRL Rome, February 23 2005. (Bringsjord and Arkoudas presented.)

S. Bringsjord, J. Taylor, A. Shilliday. *Two Types of Tacit Knowledge in the Analytic Process*. NIMD PI Meeting, Orlando, Florida. November 30, 2004. (Bringsjord presented.)

S. Bringsjord, J. Taylor, A. Shilliday. *On Model Building-Based Hypothesis Generation*. NIMD PI Meeting, Orlando, Florida. November 30, 2004. (Bringsjord presented.)

S. Bringsjord, K. Arkoudas, Y. Yang, A. Shilliday, J. Taylor. *Toward Engineering a System for the 'Commander's Predictive Environment' that Not Only Issues Predictions, But Justifies Those Predictions*. Syracuse NY, organized and sponsored by Gene Santos, AFRL/AFOSR. November 4, 2004. (Bringsjord presented.)

S. Bringsjord, A. Shilliday, J. Taylor, K. Arkoudas. *Intelligence Analysis is Plagued by Bias, and Logic (Embodied in Slate) is the Antidote*. Booz Allen Hamilton, to BAH's intelligence analysts and wargamers, McLean, VA. October 21, 2004.

S. Bringsjord, A. Shilliday, J. Taylor, S. Khemlani, M. Destefano, K. Arkoudas. *The Status of Slate*. ARDA Review, University of Maryland, College Park. April 5, 2004.

S. Bringsjord, A. Shilliday, J. Taylor, J. Wodicka, M. Destefano. *Status Update of RAIR Lab's NIMD/Sage R&D*. ARDA review, San Diego, CA. November 12, 2003. (Taylor presented.)