

Curriculum Vitae and Research Statement

Dr. Alexandre Riazanov

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1. Research profile

Topics:	<ul style="list-style-type: none">○ efficient implementation techniques for automated reasoning○ practical commonsense reasoning and NLP-oriented knowledge engineering (industrial R&D)○ scalable semantic querying of relational DB applied to Semantic Web and semantic data integration
Publications:	3 journal articles, 11 conference papers
Programme committees:	5 international workshops
Software:	<ul style="list-style-type: none">○ world-leading theorem prover Vampire○ prototype for semantic querying of relational DB○ commonsense reasoning and semantics computation components of an NLP toolkit

Since 1998 I have been doing research in efficient implementation techniques for automatic theorem proving, which is one of my main areas of expertise. My contributions to the area include novel *methods of organising proof-search*, which dramatically improves its effectiveness, state-of-the-art *indexing techniques* for the key data retrieval-based operations underlying proof search, and efficient solutions to other core algorithmic problems, such as handling

¹In my current passport my name is spelled as “Alexander Ryazanov”, whereas in the previous passport it was “Alexandre Riazanov”.

term ordering constraints.

I have a strong interest in the Semantic Web-oriented reasoning technologies and semantic technologies in general. In particular, I am doing both experimental and theoretical research on *query answering over large relational databases/data description sets modulo expressive knowledge bases*, such as OWL ontologies and rule bases, using adapted classical reasoning techniques². This research is advancing the state of the art in Web-scale *semantic search*, which is envisioned as one of the cornerstone technological components of the Semantic Web, and corporate-scale *semantic access to and integration of databases*.

I am exploring possibilities of applying this technology (i) to enable more efficient processing of medical and biological research data³ and (ii) to integrate distributed and heterogeneous data for business intelligence and e-marketing. This has led to a working prototype allowing to semantically query a large conventional relational database or an OWL data set, modulo arbitrary knowledge bases expressed in first-order logic.

As part of my current industrial work, I have been developing practical methods for commonsense reasoning in natural language processing (NLP) applications, more specifically - natural language understanding (NLU). This work includes research and creative engineering in (i) *semantic modelling of the English language*, (ii) *knowledge representation and acquisition*, (iii) *practical methods of reasoning with large expressive ontologies and rule sets*, (iv) NLU-oriented *nonmonotonic, temporal and taxonomic reasoning*.

In the recent past I developed a high-performance resolution- and paramodulation-based prover, in collaboration with Prof. Andrei Voronkov, to support our research in implementation techniques. The system is used as the kernel of the *theorem prover Vampire*, which has been the *first place winner in the main divisions of the world cup for theorem provers (CASC)* for the last ten years. A new theorem prover for temporal logic, TeMP, implemented in Liverpool, is also built around the Vampire kernel. Vampire has been used in a number of research projects in leading universities and research institutions (e. g., Manchester University, Cambridge University, MIT, NASA Ames Research Center), and industrially.

I have published 3 refereed journal articles, 11 peer-reviewed conference papers (the three most cited publications have Google Scholar citation index 224, 64 and 46), and numerous technical reports and abstracts. I have given presentations at a number of prestigious international events, including an invited talk at one of the main workshops in the area. I have worked in programme committees of 5 major workshops on the implementation and applications of automated reasoning. I have reviewed several dozen international conference papers

²This work started when I was in Manchester – in our ISWC 2004 paper (see the publication list below) we describe experiments with Vampire on a biochemistry and medical terminology ontology.

³This is one of the most promising applications, at least in the short run. Note also that in the literature a very large proportion of experiments with semantic access and retrieval is concerned with the use of biomedical knowledge bases, such as BioPAX, UniProt, Snowmed CT and UMLS. My current work will give a new edge to this area due to its emphasis on higher expressiveness, in particular by enabling the use of rule-based knowledge bases.

and journal articles on various subjects in Artificial Intelligence and Automated Reasoning.

2. Employment and study

2005-to date	North Side Inc, Montreal, Canada	R&D Engineer
2002-2005	Manchester University, Comp. Sci. Dept.	Research Associate
1999-2002	Manchester University, Comp. Sci. Dept.	PhD student
1998-1999	Uppsala University, Comp. Sci. Dept.	Visiting Researcher
1995-1998	Ershov's Inst. of Informatics Systems	PhD stud. (unfinished)
1992-1995	Shadrinsk State Pedagogical Inst., Phys. and Math. Dept.	TA, Lecturer
1988-1992	Novosibirsk State Uni., Mech. and Math. Dept.	undegr. student

Since May 2005 I have been working as a Research and Development Engineer for North Side Inc., based in Montreal, Canada. The company is developing a technology for deep semantic analysis of English texts and support of interactive dialogues, and applying it for on-line game development. My role in the project is the development and implementation of efficient *practical methods of commonsense reasoning* as applied to *natural language understanding*. In the course of this work I have conducted a number of research projects on semantic modelling of natural languages, related reasoning support, knowledge acquisition from lexical resources and logic-based knowledge representation formalisms suitable for semantic modelling of the English language. I have also implemented a number of experimental computational semantics and reasoning systems in Java and C++.

In 2002-2005 I was working as a *Research Associate* at the *School of Computer Science, The University of Manchester*, within an EPSRC funded project "Development of a Next Generation Theorem Prover" led by Prof. Andrei Voronkov. The project was aimed at extending the range of applications of automatic theorem provers. My work within the project was focused on *extending the functionality and improving the performance* of the theorem prover Vampire (http://en.wikipedia.org/wiki/Vampire_theorem_prover), based on *state-of-the-art theory and novel implementation techniques*. This work strengthened the position of Vampire as a world-leading prover. I also did several smaller projects jointly with colleagues from the UK and Europe, including (i) the creation of the testing and benchmarking framework COMPIT for term indexing, (ii) the implementation of the temporal theorem prover TeMP, based on the Vampire kernel, and (iii) a case study on using Vampire for reasoning with OWL ontologies (two biomedical ontologies were used) and SWRL.

In 1999-2002 I was a *PhD student* at the *Computer Science Department of The University of Manchester* under the supervision of Prof. Andrei Voronkov. For my PhD project I was doing research in *efficient implementation techniques for resolution- and paramodulation-based automated theorem proving* (http://www.freewebs.com/riazanov/Riazanov_PhD_thesis.pdf). I was developing the Vampire kernel as the main experimental vehicle for this research.

In 1998-1999 I was working as a *visiting researcher* in the *Computer Science Department, Uppsala University*, where I started my work on Vampire by reimplementing the original prototype written by Andrei Voronkov into a fully functional system. This implementation proved very competitive as it won the main division in CASC – the world cup for theorem provers – in 1999, after only one year of development.

In 1995-1998 I was working on the design and implementation of a concurrent logic programming language intended for integration of heterogeneous deductive components. This work was done as a part of a PhD course at the *Ershov's Institute of Informatics Systems, Novosibirsk*, which I left because of the opportunity to work on Vampire.

In 1992-1995 I was teaching programming and numerical analysis at the Department of Physics and Mathematics of the *Shadrinsk State Pedagogical Institute (Shadrinsk, Russia)*, first as an assistant and later as a lecturer.

Since 1988 I studied applied mathematics at the *Novosibirsk State University, Russia*, with specialisation in Computer Science, and in 1992 graduated with a degree equivalent to the British MSc.

4. Teaching experience

In 1993-1995 I did a lot of teaching (up to 18 hours of class work per week, all year round) for undergraduate Mathematics, Physics and Informatics students in a small university in my home town (Shadrinsk State Pedagogical Institute). The class work included lectures, tutorials and lab demonstration for programming courses at all levels and a basic numerical analysis course. I also supervised the course and diploma work of several students and mentored a group of programming enthusiasts on a voluntary basis. More recently I did lab demonstrations at Manchester University to refresh my teaching experience.

5. Programming experience

I have been developing software for more than 20 years in many languages and on many platforms. In particular, I have extensive experience in programming large systems with extreme efficiency requirements, very complex data flow, sophisticated data structures and nontrivial memory management in C++ (Vampire is fully implemented in this language). Recently I have been programming a lot in Java. In the past I did a lot of programming in Lisp and Standard/Concurrent ML. I occasionally program in C and Prolog.

6. Selected publications⁴

The list includes neither small abstracts, nor technical reports fully superseded by conference or journal publications.

PhD thesis

- A. Riazanov, Implementing an Efficient Theorem Prover, PhD thesis, The University of Manchester, 2003, available as http://www.freewebs.com/riazanov/Riazanov_PhD_thesis.pdf

Refereed journal articles

- A. Riazanov and A. Voronkov, The Design and Implementation of Vampire, *AI Communications*, 15:2-3, 2002.
- A. Riazanov and A. Voronkov, Limited Resource Strategy in Resolution Theorem Proving, *Journal of Symbolic Computation*, 36:1-2, 2003.
- A. Riazanov and A. Voronkov, Efficient Instance Retrieval with Standard and Relational Path Indexing, *Information and Computation*, 199:1-2, 2005.

Refereed conference papers

- A. Riazanov and A. Voronkov, Vampire, *Proc. CADE-16, LNAI 1632*, 1999.
- A. Riazanov and A. Voronkov, Partially Adaptive Code Trees, *Proc. JELIA, LNAI 1919*, 2000.
- A. Riazanov and A. Voronkov, Vampire 1.1 (System Description), *Proc. IJCAR-1, LNAI 2083*, 2001.
- R. Nieuwenhuis, T. Hillenbrand, A. Riazanov and A. Voronkov, On the Evaluation of Indexing Techniques for Theorem Proving, *Proc. IJCAR-1, LNAI 2083*, 2001.
- A. Riazanov and A. Voronkov, Splitting without Backtracking, *Proc. IJCAI-17, vol. 1*, 2001.
- A. Riazanov and A. Voronkov, Adaptive Saturation-Based Reasoning, *Proc. PSI 2001, LNCS 2244*, 2001.
- A. Riazanov and A. Voronkov, Efficient Instance Retrieval with Standard and Relational Path Indexing, *Proc. CADE-19, LNAI 2741*, 2003.

⁴See also <http://www.freewebs.com/riazanov/publications.htm>.

- A. Riazanov and A. Voronkov, Efficient Checking of Term Ordering Constraints, Proc. IJCAR 2004, LNAI 3097, 2004.
- U. Hustadt and B. Konev and A. Riazanov and A. Voronkov, **TeMP**: A Temporal Monodic Prover, Proc. IJCAR 2004, LNAI 3097, 2004.
- D. Tsarkov and A. Riazanov and S. Bechhofer and I. Horrocks, Using Vampire to Reason with OWL, Proc. ISWC 2004, 2004.
- A. Riazanov, Efficient Semantic Querying of Relational Databases with Resolution, Proc. CSWWS 2009, 2009.

Electronically published (not refereed)

- A. Riazanov, New Implementation Framework for Saturation-Based Reasoning, ArXiv preprint arXiv:0802.2127, available from <http://arxiv.org/>, 2006.
- A. Riazanov, Resolution-based Query Answering for Semantic Access to Relational Databases: A Research Note, ArXiv preprint arXiv:0901.0339, available from <http://arxiv.org/>, 2009.

7. Conference presentations

- System Description: Vampire 1.0, *Seventh Workshop on Automated Reasoning (ARW 2000)*, 2000.
- Partially Adaptive Code Trees, *European Workshop on Logics in Artificial Intelligence (JELIA 2000)*, 2000.
- Vampire 1.1 (System Description), *First International Joint Conference on Automated Reasoning (IJCAR-1)*, 2001.
- Making Your Prover Meet the Deadline, *Eighth Workshop on Automated Reasoning (ARW 2001)*, 2001.
- Splitting without Backtracking, *Seventeenth International Joint Conference on Artificial Intelligence (IJCAI 17)*, 2001.
- Adaptive Saturation-Based Reasoning, *Perspectives of System Informatics, 4th International Andrei Ershov Memorial Conference (PSI 2001)*, 2001.
- Path-indexing with database joins for efficient retrieval of instances and backward subsumption, *Deduction, Schloss Dagstuhl seminar no. 01101*, 2001, jointly with A. Voronkov.
- Splitting without backtracking, *Semantic Foundations of Proof-search, Schloss Dagstuhl seminar no. 01141*, 2001.
- Invited talk: Towards efficient backward demodulation, *3rd International Workshop*

on the Implementation of Logics (associated with LPAR), 2002.

- Efficient Instance Retrieval with Standard and Relational Path Indexing, *19th International Conference on Automated Deduction (CADE-19)*, 2003.
- Efficient Checking of Term Ordering Constraints, *Second International Joint Conference on Automated Reasoning (IJCAR 2004)*, 2004.
- Efficient Semantic Querying of Relational Databases with Resolution, *The Second Canadian Semantic Web Working Symposium (CSWWS 2009)*, 2009.

8. Acknowledgments

I have been supported by the following grants:

- publication and conference travel support from *RuleML Inc*, 2009
- the EPSRC grant “Development of a next generation theorem prover”
- the EPSRC grant “Efficient first-order theorem proving”
- an Overseas Research Student Award (ORS), 1999
- the Swedish TFR grant “Technology for Implementing Proof-Search”

9. Personalia

I was born in June 12, 1971, in Shadrinsk, Russia, and have Russian nationality. I am a Permanent Resident in Canada. I am married and have a 7 year old daughter. My hobbies are hiking, camping, caving, fishing, cooking and history.

10. Referees

The following people kindly agreed to give me a reference:

Prof. Ian Horrocks,

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