ACADEMIC / INDUSTRIAL CURRICULUM VITAE

BIOGRAPHICAL:

Surname: Spencer   **Given Names:** E. Bruce

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World Wide Web Addresses:
> http://www.cs.unb.ca/~bspencer
> http://www.linkedin.com/in/brucespencerca
> Professional CV http://www.cs.unb.ca/~bspencer/CV.pdf

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> Fredericton, New Brunswick
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Marital Status: Married   **Citizenship**: Canadian

EDUCATION

1991 - Ph.D.   Computer Science (Waterloo)
                "Assimilation in Plan Recognition via Truth Maintenance with
                Reduced Redundancy", supervised by Robin Cohen.
                Accepted October 1990.
1983 - M.Math Computer Science (Waterloo)
1980 - B.Sc.   Mathematics (Dalhousie)

Areas of Specialization:
Automated reasoning, artificial intelligence, semantic web, service computing,
social network analysis, time series, machine learning, statistical modelling

EMPLOYMENT:

July 15, 2016-Present   Senior Consultant to iPSNP Technology

April 28, 2014-Sept 30, 2015   Lead Data Scientist and CoFounder,
Fiddlehead Technology

Sept 16, 2013-April 25, 2014   Senior Research Scientist and Instructor,
Faculty of Comupter Science, University of New
Brunswick

Feb 18-Aug 23 2013   Research and Architecture Team Lead,
Introhive, Fredericton

Aug 21, 2001-Feb 8, 2013 Senior Research Officer, National Reseach Council
Canada, Fredericton

July 1, 2002 to present   Adjunct Professor UNB.

July 1, 2000   Promotion to Full Professor UNB

July1 1996-July 1, 1997   Sabbatical Leave UNB

July 1, 1996   Tenure UNB

July 1, 1994   Promotion to Associate Professor UNB

Sept. 1, 1990   Assistant Professor, Initial Appointment UNB

1988-1990   Research Assistant, University of Waterloo

1986-1988   Teaching Assistant in artificial intelligence, University of
Waterloo

1983-1986   Bell-Northern Research, Computing Technology
Division, Ottawa. Design and implementation of LISP
and Prolog interpreters, Prolog application support.

Jan – April 1983   Lecturer in introductory programming and statistics,
Dalhousie University.

1981-1982   Teaching Assistant, University of Waterloo.

May1980 - Aug1981   Research Assistant, full time. Design and
implementation of software for statistical modeling and
estimation, Dalhousie University.

Narrative CV
Bruce has both a Masters (1983) and a PhD (1990) from the University of Waterloo, industrial experience (1983-1986) at Bell Northern Research, university research and teaching experience (1980-81, 1983, 1990-2001) and leadership experience (2001-2012) with government-industry projects. At UNB he earned a merit award, three nominations for teaching awards, and achieved tenure and Full Professor. His NSERC Discovery grant in 2001 was second highest at UNB Computer Science.

Bruce joined NRC in 2001 and founded the Internet Logic group in 2002, which focused on applying logic to find and use resources on the Internet. He was its Group Leader for over six years and won two IIT awards: general and industrial partnership.

He develops technologies that contribute to Canadian companies and to the success of the NRC e-Business Cluster in New Brunswick. Bruce led the development of six prototypes transferred to NRC's clients with licensing agreements. The Eucalyptus project with Carleton University won an ORION R&D award. The ReCIRC project provided core technology and staff for a startup company, Kibokko, to successfully attract Venture Capital funding and launch.

As part of his contributions to Cluster development, he has been instrumental in fostering the collaborative and productive relationship between IIT Fredericton and the Computer Science Faculty at UNB. He has also served as (co)chair or (co)organzer of 14 international conferences and workshops, as area editor for the Computational Intelligence Journal, as president of the Canadian Artificial Intelligence Society from 2002 through 2005, on many conference and journal review committees, on two industrial advisory boards, and three years on the influential NSERC Discovery Grant Selection Committee.

He is recognized for research with publications in the most prestigious journals and conferences in Automated Reasoning [10,11,12,39,40,41,42,51], the Semantic Web [25,28,32,37], and e-Commerce [1,8,9,17,23,26]. He also focuses on the Service Computing area and publishes in high-level venues visible to this sector [2,3,18,21].

A. Contributions to Science and Technology
While at BNR in 1983-1986, Bruce developed Artificial Intelligence tools, including BNR Lisp and BNR Prolog systems, and applications such as a software configuration system within BNR cited for saving hundreds of man-hours. Bruce directed work that deductively verified the correctness of BNR Prolog's constraint reasoning engine, after identifying a hard-to-find bug.

A1. Automated Reasoning is the scientific basis for the Semantic Web and other reasoning technologies and provides deep reasoning ability, simulating a mathematician proving theorems. A well-known problem with AR's most important reasoning method, resolution, is redundancy -- generation of the same result many times, cited as problem 5 on Larry Wos's list of 33 challenge problems. To counter it, the search must be restricted. Bruce and Dr. Joe Horton

developed the Clause Tree data structure and restricted resolution to a single proof [11,41], the first restriction to have this property. This solution of the redundancy problem gives insight into building faster theorem provers.

In addition, Bruce solely developed two Automated Reasoning prototypes: (1) ALCAS is a reasoner for Description Logic relevant to the knowledge representation part of the Semantic Web and used in the $3.6M ACOA funded 3-year Business Domain Ontology project. (2) jDREW is an open-source rule engine relevant to the rule-reasoning part of the Semantic Web community which has been downloaded over 3400 times from SourceForge since 2004.

Working with Weihong Song and Dr. Weichang Du, he co-developed WSReasoner, which won the Live competition for classifying the most ontologies in two hours, at the international Semantic Web competition as part of the 2013 OWL Reasoner Evaluation Workshop.

A2. Web 2.0/3.0 includes recommendations for Web resources based on Web usage trends, needs and availabilities. Bruce led the development of three recommendation prototypes: (1) RACOFI (Rule Applying Collaborative Filtering) technology creates recommendations from the history of how resources were used, and then uses rules to improve the recommendations. Bruce led the development from 2004; it has been transferred to four Canadian companies including Bell Sympatico / MSN and Kibboko. (2) inCommune technology creates online communities (social networks). Bruce proposed the vision and led the team that developed adapted fuzzy clustering technology for inCommune and delivered it to Sympatico. The impact for Bell is the identification of new consumer niches giving competitive knowledge to promoters in the music industry, which was the first technology from NRC IIT Atlantic to generate revenue. (3) ReCIRC (Recommendations from Customer Intelligence and Ratings, Collaboratively) is an e-commerce technology that combines multi-dimensional clustering and on-line machine learning to identify and track the associations between customers and the items they access. Bruce convinced Kibboko to support developing the technology and led a team of four, two of whom were later hired by Kibboko. Experiments on client data show recommendations are 90% accurate.

A3. Service Computing Bruce co-led the team that developed Eucalyptus for a Canarie-funded $1.2M project led by Carleton University with partners CRC Ottawa and IIT Ottawa. The technology creates collaborative sessions among widely distributed users and integrates Canarie's user-controlled lightpaths to provide dedicated bandwidth. Eucalyptus won the 2007 Ontario Research and Innovation Optical Network (ORION) Discovery Award. It has been the subject of seven conference papers by Bruce and his team [15,16,18,19,20,21,22].

Bruce co-lead the development team of the two-year $2M Canarie-funded SAVOIR platform for the NEP-11 Health Services Virtual Organization project, with lead Northern Ontario School of Medicine, and partners including McGill Electrical Engineering and McGill School of Medicine, University of Wisconsin,

and Stanford University. The project delivers services for collaborative training of health professionals and delivery of health services to distributed and remote locations. It integrates and schedules access by health professionals and students to 3D interactive video content, to Laerdal's SimMan medical mannequin, camera arrays and lightpaths. It has been recognized in New Brunwswick's Knowledge Industry Awards as a 2009 finalist.

According to Canarie's former CTO Bill St. Arnaud, *"Bruce Spencer is one of the world's leading researchers in the development and application of service oriented architectures and tools in the use of network, instrumentation and environmental solutions. His work has been cited by several leading researchers and the US National Science Foundation in the development of cyber-infrastructure for instrumentation and networks."*

A4. Semantic Web IIT Fredericton and the University of New Brunswick collaborated on a $3.6M three-year ACOA funded project entitled Business Domain Ontology Development Framework, with client Exigen Coroporation, which employs 2000 people in 15 countres.This project's inception and success at receiving funding was significantly influenced by Bruce. NRC staff led two work packages. Bruce was responsible for the ontology validation step and is supervising one graduate student, addressing Exigen's real world need for a closed-world reasoning engine.

A5. Time Series Analysis Bruce co-founded Fiddlehead Technology in 2014 and engineered a solution of food demand analytics that employed time series analysis.

A6. Temperature Forecasting with Linear Regression
In 2016 I became interested in green technology, and specifically in generating forecasts of temperature in building using sensor data. In 2016 we published two conference papers and one journal paper on this topic, with another conference paper and journal paper in submission. The potential for energy savings is high as we feed these forecasts into a model-predictive controller, which can exploit the foreknowledge to overcome thermal interia.

A7. Semantic Web Services for Precision Agriculture
In the summer of 2016, Chris Baker and Sadnan Al Manir came to me with a proposal for applying SADI web services to gather all of the information relevant that allows a small-holder farmer to maxmimize crop productivity and profitability, including market data, crop yield, pests, selection of effective agricultural practices, and least-harmful pesticides. We presented our prototype at the GODAN Summit in September 2016 in New York, and are pursing MOU's with interested parties.

B Contribution to Clients
Bruce led the development of the ReCIRC Prototype between June-Dec 2007 for Kibboko Inc. Based on the accuracy of its recommendations, Kibboko changed

their business model, halted all activities except for those associated with ReCIRC, hired two of the developers into fulltime positions, received $1.5M in venture capital funding from GrowthWorks, and relocated the company temporarily in IIT's Fredericton Industrial Partnership Facility. They moved to Toronto and used this tool to recommend information sources to clients and to pursue more VC funding.

The RACOFI prototype developed in 2003-4 led to the first inDiscover website, to dynamically recommend music. Bell Sympatico / MSN selected the inDiscover.net website to launch its music portal and to promote Canada's independent music industry. Bruce led the the bilingual extension and the technology transfer, and introduced music / fan clustering. inDiscover was Sympatico's brand for presenting the annual Canadian Independent Music Awards, "The Indies", and the monthly feature on Canadian artists. InDiscover has since teamed up with Orange Records to become an independent music record label. RACOFI has also been licensed to GreenNexxus of Fredericton, which uses the recommendation technology for people to share ideas and best practices in environmentally focused projects. They provide the logic, calculations and social networking functions for the One Million Acts Of Green which so far has prevented almost one billion pounds of green house gas emissions.

The Eucalyptus system, developed by a team co-led by Bruce, and licensed to Carleton University, has led to presentations at conferences in San Diego, Chicago, Montreal and Ottawa (2005 - 2007) and to corporations including Boeing and CAE. The SAVOIR system, for the Health Services Virtual Organization

jDREW, developed by Bruce, is an open source tool that has influenced RACOFI, and is the basic technology behind MenuMaestro, developed in 2006, a food and menu costing tool, sponsored by McCain and used by restaurants in Atlantic Canada. Over a dozen clients' testimonials report benefits, such as $100K savings per year, and 5% increase of profit margins. It has been downloaded over 3500 times and was influential in the development of OO-jDREW, another open source prototype.

C Contribution to Outreach and Influence

Bruce has been instrumental in setting up the close collaboration that exists between Fredericton IIT staff and UNB, particularly the Faculty of Computer Science, a major cluster partner. He has set up and co-taught two different graduate courses at UNB which were delivered seven times with a total enrollment of about 90. In 2014, Bruce co-developed "Social Netowrk Analysis", a course offered through UNB's Facultis of Administration and of Computer Science. Bruce has (co)supervised 17 completed Masters degrees and five completed PhD's. While at NRC he contributed $70,000 in NSERC grants toward support of UNB graduate students, and hired 16 UNB students for NRC projects.

Bruce served on the NSERC Discovery Grant Selection Committee 331 in 2007-2009, having a direct influence on computer science in Canada.

Bruce has organized 13 international workshops, conferences or tracks. Three events are particularly notable: (1) Bruce helped to bring the 2006 International Conference on Electronic Commerce to Fredericton, Canada, recognized as one of the leading e-commerce conferences with over 120 registrants. Bruce served as General Chair, oversaw the conference, secured funding, defined tracks, selected prominent scientists as track chairs, created the program committee, invited speakers, and chaired the meeting of the Conference's steering committee. This event put Fredericton and IIT "on the map" in the e-commerce research community. (2) Bruce was CASCON 2007 Program Co-chair. This event showcases IBM's Centre for Advanced Studies lab which is a strong partner of IIT. (3) Bruce was Canadian AI 2002 Program Co-Chair, which is the main venue for Canadian AI researchers.
Bruce is also an Editorial Board Member for Computational Intelligence Journal since 2002, and a Scientific Board member for the Ontario Research Network For ECommerce (ORNEC). Bruce also served 2009-2011 on the advisory board for the VENUS and NEPTUNE Canada seafloor observatories at the University of Victoria, one of Canada's "big science" projects. He has edited four journal issues, including the inaugural issue of Journal of Business and Technology, on papers from BASeWEB workshop 2004 and 2005, and Electronic Commerce Research and Applications Journal, Vol 7:3 based on papers from the ICEC06 conference.

D Contributions to Teamwork

The Internet Logic group at NRC active from 2002-2012, formed by Bruce, was known for its scientific, industrial and collaborative contributions. Bruce nurtured group members' scientific output, and fostered a culture of cooperation within IIT and between IIT and the business and academic community. Bruce mentored and supported group members and others in five very productive.

Research Contracts with Industry while at UNB

1.   With Martin Marietta Canada Limited Co-principal Investigators B.G. Nickerson and R.H. Cooper. Awarded July 1, 1991 ($209,000).
2.   With Bell-Northern Research, Theorem-proving Techniques for Verification of Hardware and Software Systems, Principal Investigator. Awarded July 1, 1991 ($10,000), renewed July 1, 1992 ($10,000), and July 1, 1993 ($10,000).

Research Grants with Government while at UNB

1. NSERC Operating Grant OGP0106290 Improvements to automated theorem proving and truth maintenance through reduced redundancy. Awarded March 1991 for three years ($11,000 p.a.)
2. NSERC Operating Grant OGP0106290 Development and Evaluation of Automated Reasoning Systems based on Clause Trees. Awarded March 1994 for four years ($17,000 p.a.)
3. NSERC Equipment Grant, with J. D. Horton. Awarded March 1996 for the purchase of a SUN workstation and laptop computer ($19,055)

4. Study Visit Grant, Deutscher Akademischer Austauschdienst, DM 10,500 to cover expenses while visiting Germany on sabattical.
5. NSERC Operating Grant OGP0106290 Development and Evaluation of Automated Reasoning Systems based on Clause Trees. Awarded March 1998 for four years ($19,635 p.a.)
6. NSERC Discovery Grant, Internet Logic and the e-Marketplace, April 2003 to March 2010 ($10,000 p.a.).
7. NRC IRAP C2Org with Fiddlehead Technology, March 2014, $3000.
8. NRC IRAP C2Org with GoSecureAtlantic, May 2016, $3000.
9. NRC IRAP C2Org EyesOver, Oct 2016, $3000

   Total NSERC Grants $278,660 over 18 years.

Service to the Research Community
Committee and Board Memberships

1. Member of editorial board for Computational Intelligence since September 2003.
2. Member of Advisory Board for the International Joint Conference on Artificial Intelligence, the premier AI conference, April 2004 – April 2005.
3. President of the Canadian Society for the Computational Study of Intelligence, 2002-2005.
4. Member of the International Committee on Electronic Commerce, 2005-2007, which oversees the International Conference on Electronic Commerce.
5. Member of NSERC Discovery Grant Selection Committee 331 Sept 2006 – Sept 2009.
6. Member of the Scientific Board of Directors for the Ontario Research Network for Electronic Commerce.
7. Member of the Scientific Advisory Board for the VENUS and NEPTUNE Canada seafloor observatories, 2007-2011.

Service Outside the University of Scholarly or Academic Significance

1. Judged the Fredericton Area Science Fair, 1991 and 1996.
2. Elected member of Garden Creek School Parent Advisory Committee, Sept. 18, 1996 until June 1998.
3. Co-chair of Garden Creek School Community Access Centre, June 1998 until Aug. 2000.
4. Consultant for Science East Exhibit on Global Warming, May 2002.
5. Member of the Board of Directors of Science East, 2002-2005. Science East Association is a non-profit organization that built a permanent science museum in Fredericton.

PUBLICATIONS

Trademarks

Daniel Lemire, Sean McGrath, Harold Boley, Marcel Ball, Bruce Spencer, inDiscover™. A computer software program for personalized song recommendations. Trade-mark, issued in Canada, copyright number: 916517, filed: 11 Feb 2005, published: 25 May 2005.

Daniel Lemire, Sean McGrath, Harold Boley, Marcel Ball, Bruce Spencer, RACOFI Composer™ ⚊ A framework for rating-based collaborative filtering and rule-based recommendation. Trade-mark, issued in Canada, copyright number: 915456, filed: 10 Sep 2004, published: 16 Feb 2005.

Journal Issues Edited

1. Edited special issue of the journal Electronic Commerce Research and Applications, 2007 7:3, best papers from the International Conference on Electronic Commerce, held in Fredericton in 2006.
2. Edited Computational Intelligence Vol. 18, No. 4, Nov 2002, including best papers from Novel E-Commerce Applications of Agents Workshop, held in May 2001.

Articles Published in Refereed Journals

1. MS Al Manir, B Spencer, CJO Baker, Decision Support for Agricultural Consultants With Semantic Data Federation, International Journal of Agricultural and Environmental Information Systems. (Impact Factor)
2. F Al-Obeidat, B Spencer, O Alfandi, Consistently accurate forecasts of temperature within buildings from sensor data using ridge and lasso regression, Future Generation Computer Systems, 2018. (Impact Factor)
3. F Al-Obeidat, B Spencer, E Kafeza, The Opinion Management Framework: Identifying and addressing customer concerns extracted from online product reviews, , Electronic Commerce Research and Applications 27, 52-64, 2018
4. F Al-Obeidat, B Spencer, M Al Taei, Identifying major tasks and minor tasks within online reviews, Future Generation Computer Systems, 2017. (Impact Factor)
5. B Spencer, F Al-Obeidat, O Alfandi, Accurately forecasting temperatures in smart buildings using fewer sensors, Personal and Ubiquitous Computing, 1-9, 2017.(Impact Factor)
6. Sandro Rama Fiorini, Julita Bermejo-Alonso, Paulo Gonçalves, Edison Pignaton de Freitas, Alberto Olivares Alarcos, Joanna Isabelle Olszewska, Edson Prestes, Craig Schlenoff, S. Veera Ragavan, Signe Redfield, Bruce Spencer, and Howard Li,
A Suite of Ontologies for Robotics and Automation, IEEE Robotics & Automation Magazine, pp 8-11, March 2017,
7. Bruce Spencer, Feras Al-Obeidat, Omar Alfandi, Short Term Forecasts of Internal Temperature with Stable Accuracy in Smart Homes, International

Journal of Thermal & Environmental Engineering, Vol 13-2, pp. 81-89, 2016. DOI: 10.5383/ijtee.13.02.002.

8. Behzad Bayat, Julita Bermejo-Alonso, Joel Luis Carbonera, Tullio Facchinetti, Sandro R. Fiorini, Paulo Gonçalves, Vitor A. M. Jorge, Maki Habib, Alaa Khamis, Kamilo Melo, Bao Nguyen, Joanna Isabelle Olszewska, Liam Paull, Edson Prestes, S. Veera Ragavan, Sajad Saeedi, Ricardo Sanz, Mae Seto, Bruce Spencer, Michael Trentini, Amirkhosro Vosughi, and Howard Li, "Requirements for Building an Ontology for Autonomous Robots", Industrial Robot, 2016.

9. Harzallah, Y.; Horton, Joseph D.; Spencer, B., "Assigning Routes and Wavelengths for Collaboration over Optical Networks". *Photonic Network Communications*, November 2010, pp 1-12. (Impact Factor 0.793)

10. Buffett, S., Spencer, B. "A Bayesian Classifier for Learning Opponents' Preferences in Multi-Object Automated Negotiation," Electronic Commerce Research and Applications Journal. Volume 6, Number 3. 2007. pp. 274-284. (5-year Impact Factor 2.34)

11. Wang, Y., Zang, H., Spencer, B., Yan, Y. "A Text Categorization Approach for Match-Making in Online Business Tendering," Journal of Business and Technology. Volume 1, Number 1. October 2005.

12. Liu, S., Spencer, B., Adsett, C., Bernardi, A. "Realizing Agile Workflow with DeFleX to Support Adaptive Business Processes," Journal of Business and Technology. Atlantic Academic Press. ISSN 1712-1116. October 2005.

13. Scott Buffett, Keping Jia, Sandy Liu, Bruce Spencer, Fang Wang, 2004, "Negotiating Exchanges of P3P-labeled Information for Compensation", Computational Intelligence, 20:4, 663-677. (Impact Factor 0.673)

14. Scott Buffet and Bruce Spencer, 2004 "A Decision Procedure for Bundle Purchasing with Incomplete Information on Future Prices" International Journal of Electronic Commerce, 8:4, 131-144. (Impact Factor 1.872)

15. Bruce Spencer and J. D. Horton, 2000, "Efficient algorithms to detect and restore *minimality*: an extension of the regular restriction of resolution" Journal of Automated Reasoning, 25:1-34. (Impact Factor 0.881)

16. J. D. Horton and Bruce Spencer, 1997 "Clause Trees: A Tool for Understanding and Implementing Resolution in Automated Reasoning", Artificial Intelligence, 92:25-89. (Impact Factor 3.371)

17. B. Spencer, 1994, "Avoiding Duplicate Proofs with the Foothold Refinement", Annals of Mathematics and Artificial Intelligence, 12:117-140. (Impact Factor 0.691)

18. Robin Cohen, Fei Song, Bruce Spencer and Peter van Beek, 1991, "Exploiting Temporal and Novel Information from the User in Plan Recognition", *User Modeling and User-Adapted Interaction*, Kluwer Academic Publishers, 1:125-148. (Impact Factor 0.037)

19. Robin Cohen, Marlene Jones, Bruce Spencer, Amar Sanmugasunderam, and Lisa Dent, 1989, "Providing Responses Specific to a User's Goals and Background", *International Journal of Expert Systems: Research and Applications*, 2:135-162.

Articles Published in Refereed Conferences

20. B Spencer, O Alfandi, F Al-Obeidat A Refinement of Lasso Regression Applied to Temperature Forecasting, 8th International Conference on Sustainable Energy Information Technology (SEIT 2018), 2018, Porto, Portugal.
21. Joanna Isabelle Olszewska, Marcos Barreto, Julita Bermejo-Alonso, Joel Carbonera, Abdelghani Chibani, Sandro Fiorini, Paulo Goncalves, Maki Habib, Alaa Khamis, Alberto Olivares, Edison Pignaton de Freitas, Edson Prestes, S. Veera Ragavan, Signe Redfield, Ricardo Sanz, Bruce Spencer, and Howard Li
Ontology for Autonomous Robotics, 26th IEEE International Symposium on Robot and Human Interactive Communication, Lisbon, Portugal.
22. Feras Al-Obeidata, Bruce Spencer, Identifying Major Tasks from On-line Reviews, The 8th International Conference on Emerging Ubiquitous Systems and Pervasive Networks (EUSPN), September 18-20, 2017, Lund, Sweden.
23. Fera Al-Obeidat, Eleanna Kafeza, Bruce. Spencer, Opinions Sandbox: Turning Emotions on Topics into Actionable Analytics, in: The 1st EAI International Conference on Emerging Technologies for Developing Countries, Springer, March 27–28, 2017, Marrakech, Morocco.
24. Mohammad Sadnan Al Manir, Bruce Spencer and Christopher Baker, Decision Support for Agricultural Consultants with Semantic Data Federation, IN-OVIVE 2017 – the International Workshop On Sources And Data Integration In Agriculture, Food And Environment Using Ontologies, July 2nd-6th, Montpellier, France.
25. Bruce Spencer, Feras Al-Obeidat, Omar Alfandi, Selecting Sensors when Forecasting Temperature in Smart Buildings, 7th International Conference on Sustainable Energy Information Technology (SEIT 2017), May 16-19, 2017, Madeira, Portugal.
26. Bruce Spencer and Feras Al-Obeidat, "Temperature Forecasts with Stable Accuracy in a Smart Home", International Conference on Sustainable Energy Information Technology, Madrid, May 2016.
27. Bruce Spencer and Omar Alfandi, "Forecasting Internal Temperature in a Home with a Sensor Network", International Workshop on Machine Learning and Data Mining for Sensor Networks, Madrid, May 2016.
28. Weihong Song, Bruce Spencer, Weichang Du, "Complete Classification of Complex ALCHO Ontologies Using a Hybrid Reasoning Approach", Description Logics 2013, 942-961.
29. Weihong Song, Bruce Spencer, Weichang Du, "A Transformation Approach for Classifying ALCHI(D) Ontologies with a Consequence-based ALCH Reasoner", ORE 2013, 39-45.
30. Bruce Spencer and Scott Bufffett, "Simulating Social Commerce Applied to Buyer Group Pricing, Recommendation Incentives, and Bundling", Proceeedings of the International Conference on Electronic Commerce, August 6-8, 2012, Singapore, 95-98.

31. Weihong Song, Bruce Spencer and Weichang Du: "WSReasoner: A Prototype Hybrid Reasoner for ALCHOI Ontology Classification using a Weakening and Strengthening Approach", OWL Reasoner Evaluation Workshop, Collocated with the 6th International Joint Conference on Automated Reasoning, Manchester England, July 1, 2012, 6:1-13.

32. Yuanyuan Guo, Huajie Zhang, Bruce Spencer, "Cost-Sensitive Self-training", Proceedings of the Canadian Artificial Intelligence Conference, Toronto, Canada, May 28-30, 2012: 61-73. *Nominated for Best Paper.*

33. Xiping Hu, Weichang Du, Bruce Spencer, "A Multi-Agent Framework for Ambient Systems Development", International Conference on Ambient Systems, Networks and Technologies, September 19-21, 2011, Niagara Falls, Ontario, Canada.

34. Weihong Song, Bruce Spencer, Weichang Du, "Hybrid Reasoning for Ontology Classification" Canadian Artificial Intelligence Conference Graduate Student Symposium, pp 372-376, May 24, 2011, Saint John's, Canada. *Best Paper Award Winner.*

35. Rachel Ellaway, Jeremy Cooperstock, Bruce Spencer. "Simulation Integration for Healthcare Education, Training and Assessment" International Conference in Digital Information Management, July 2010, Thunderbay Ontario.

36. Bruce Spencer, Bryan Copeland, Yosri Harzallah, Justin Hickey and Sandy Liu, "Health Training with SAVOIR and the RSM," Fifth International Conference on Semantics, Knowledge and Grid, ZuHai, China, Oct 10-12, 2009.

37. Sandy Liu, Bruce Spencer: SAVOIR: Coordination of Collaboration as a Service" Proceedings of ACM Conference on Computer Supported Cooperative Work 2010. Savannah, Georgia. February 6-10, 2010.

38. Harzallah, Y, Horton, J and Spencer B, "Collaboration over a Service-Oriented Fibre Optic Networking Platform", IEEE International Conference on Digital Ecosystems and Technologies, Istanbul, Turkey, 31 May-3 June 2009.

39. Spencer, B and Sandy Liu "Modeling and Managing Collaborative Sessions for a Virtual Organization", Fourth International Conference on Semantics, Knowledge and Grid, Beijing, China, Dec 3-5, 2008.

40. Spencer, B and Sandy Liu "Modeling the Sharing of Resource across Collaborative Sessions", Asian Pacific Service Computing Conference, Yilan, Taiwan, December 9-12, 2008.

41. Bin Wang, Bruce Spencer, Charles X. Ling, Harry Zhang: "Semi-supervised Self-training for Sentence Subjectivity Classification" Canadian Conference on AI 2008, Windsor, Ontario, May 28-30, 2008: 344-355.

42. Spencer, B. "Assimilating Ontological Additions in Convergent Negotiation Protocols," The 9th International Conference on Electronic Commerce (ICEC'07). Minneapolis, Minnesota, USA. August 19-22, 2007.

43. Liu, S., Spencer, B., Liang, Y., Xu, B., Zhang, L., Brooks, M.F. "Towards an Agile Infrastructure to provision Devices, Applications and Networks: A Service-Oriented Approach," The First IEEE International Workshop on Requirements Engineering for Services (REFS'07)The 31st Annual IEEE

International Computer Software and Applications Conference. Beijing, China. July 23-27, 2007.

44. Sandy Liu, Yong Liang, Bo Xu, Libo Zhang, Bruce Spencer, Martin Brooks, "On Demand Network and Application Provisioning Through Web Services," The Proceedings of the IEEE International Conference on Web Services (ICWS 2007). Salt Lake City, Utah, USA. July 9-13, 2007.

45. Michael Jemtrud, Philam Nguyen, Bruce Spencer, Martin Brooks, Sandy Liu, Yong Liang, Bo Xu, and Libo Zhang, "Eucalyptus: Intelligent Infrastructure Enabled Participatory Design Studio", WinterSIM 2006 (Winter Simulation Conference), Dec 3-6, 2006/Monterey, California.

46. Michael Jemtrud, Martin Brooks, Bobby Ho, Sandy Liu, Philam Nguyen, John Spence, Bruce Spencer, "Eucalyptus: Intelligent Infrastructure Enabled Participatory Design Studio", Centre for the Study of Architecture in the Arab Region(CSAAR) Nov 14-16, 2006, Rabat, Morocco.

47. Michael Jemtrud, Martin Brooks, Bobby Ho, Sandy Liu, Philam Nguyen, John Spence, Bruce Spencer, "Eucalyptus: User Controlled Lightpath Enabled Participatory Design Studio", Work in progress session of The Association for Computer-Aided Design in Architecture (ACADIA), Oct 12-15, 2006, Louisville, Kentucky.

48. Sandy Liu, Bruce Spencer, Martin Brooks, Michael Jemtrud, Konstantin Privalov, John Spence, Michel Savoie, Bobby Ho. "Towards a Service-oriented Participatory Design Studio Supported by UCLP." Proceedings of the IEEE International Conference on Services Computing (SCC'06). Sep 18 2006. Chicago. IEEE Computer Society.

49. Michael Jemtrud, Martin Brooks, Bobby Ho, Sandy Liu, Philam Nguyen, John Spence, Bruce Spencer, "Eucalyptus: Collaborating at the speed of light" Conference: eCAADE (Education and Research in Computer Aided Architectural Design in Europe) Sept 6-9, 2006/Volos, Greece.

50. Scott Buffett, Bruce Spencer, Luc Comeau, Michael Fleming. "Detecting Opponent Concessions in Multi-Issue Automated Negotiation," The 8th International Conference on Electronic Commerce (ICEC'06). Fredericton, New Brunswick, Canada. August 14, 2006. NRC 48552.

51. Scott Buffett, Luc Comeau, Michael W. Fleming, Bruce Spencer, "MONOLOGUE: A Tool for Negotiating Exchanges of Private Information in E-Commerce", Proceedings of Second Annual Conference on Privacy, Security and Trust (PST 2005), October 12-14, 2005, pp 79-88.

52. Ball, M., Boley, H., Hirtle, D., Mei, J., Spencer, B. "The OO jDREW Reference Implementation of RuleML," Proceedings of the International Conference on Rules and Rule Markup Languages for the Semantic Web (RuleML 2005). Galway, Ireland. Springer LNCS 3791. November 10-12, 2005. pp. 218-223. NRC 48284.

53. Buffett, S., Spencer, B. "Learning Opponents' Preferences in Multi-Object Automated Negotiation," Seventh International Conference on Electronic Commerce (ICEC'05). Xi'an, China. August 15-17, 2005. NRC 48260.

54. Bruce Spencer and Sandy Liu, "Inferring Data Transformation Rules to Integrate Semantic Web Services" In Proceedings of the International

Semantic Web Conference, ISWC 2004, Hiroshima, Japan, November 2004, Lecture Notes in Computer Science 3298 Springer, pp 456-470.

55. Scott Buffett, Nathan Scott, Bruce Spencer, Michael Richter and Michael Fleming, "Determining Internet Users' Values for Private Information", Proceedings of Second Annual Conference on Privacy, Security and Trust (PST 04), October 13-15, 2004, pp 79-88.

56. Yue Wang, Huajie Zhang, Bruce Spencer and Yuhong Yan, "Text Categorization for an Online Tendering System", In Proceedings of the Business Agents and Semantic Web Workshop (BASeWEB 04), London, Canada, May 2004, pp 55-71.

57. Connie Adsett, Ansgar Bernardi, Sandy Liu and Bruce Spencer, "Realizing Weak Workflow with Declarative Flexible XML Routing in SOAP", In Proceedings of the Business Agents and Semantic Web Workshop (BASeWEB 04), London, Canada, May 2004, pp 31-44.

58. Bruce Spencer and Sandy Liu, "Inference Queues for Communicating and Monitoring Declarative Information among Web Services", In Proceedings of Rules and Rule Markup Languages for the Semantic Web, (RuleML03), Sanibel Island, FL, USA, October 2003, pp 121-135.

59. Scott Buffett and Bruce Spencer, "Efficient Monte Carlo Decision Tree Solution in Dynamic Purchasing Environments" International Conference on Electronic Commerce (ICEC'03), Pittsburgh, PA, October 2003, pp. 31-39.

60. Fang Wang and Bruce Spencer, "A Proposal and Evaluation Engine for Adding Negation to P3P / APPEL" In Proceedings of the Business Agents and Semantic Web Workshop (BASeWEB 03), Halifax, Canada, June 2003, pp 35-41.

61. Scott Buffett, Keping Jia, Sandy Liu, Bruce Spencer, Fang Wang, "Negotiating Exchanges of P3P-labeled Information for Measureable Benefits". In Proceedings of the Business Agents and Semantic Web Workshop (BASeWEB 03), Halifax, Canada, June 2003, pp 25-34.

62. Keping Jia and Bruce Spencer, "Negotiating Exchanges of Private Information for Web Service Eligibility", In Proceedings of the 16th Conference of the Canadian Society for the Computational Study of Intelligence (AI 03), Halifax, Canada, June 2003, pp 252-267.

63. Bruce Spencer, "The Design of j-DREW: A Deductive Reasoning Engine for the Web" The International Workshop/Symposium on Logic-Based Program Synthesia and Transformation. CBD ITCLS 2002, First CologNET Workshop on Component-Based Software Development and Implementation Technology for Computational Logic Systems. Madrid, Spain. September 20, 2002. pp. 155-166.

64. Charlie Obimbo and Bruce Spencer, "T-Priority Resolution: A Resolution Strategy for Deductive Databases", In Proceedings of IC-AI'2000 The 2000 International Conference on Artificial Intelligence, Monte Carlo Resort, Las Vegas, Nevada, USA, June 25, 2000, pages 1550-1556.

65. Bruce Spencer and J. D. Horton, "Support Ordered Resolution", Prodeedings of 17th International Conference on Automated Deduction, Pittsburgh, PA, USA, June 2000 LNAI 1831, pp 385-400.

66. Peter Baumgartner, J. D. Horton and Bruce Spencer, "Merge Path Improvements for Minimal Model Hypertableaux", Proceedings of Tableaux '99, Albany, New York, pages 51-65, Springer-Verlag LNAI 1617, June 8, 1999.

67. J.D. Horton and Bruce Spencer, "Rank/Activity: A Canonical Form for Binary Resolution", Proceedings of 15th International Conference on Automated Deduction, Lindau, Germany, pages 412-426, Springer-Verlag LNAI 1421, July 1998.

68. Bruce Spencer and J.D. Horton, "Extending the Regular Restriction of Resolution to Non-Linear Sub Deductions", Proceedings of the Fourteenth National Conference on Artificial Intelligence, July 1997, Providence, Rhode Island, USA.

69. Charlie F. Obimbo and Bruce Spencer "Access Clause Trees in Disjunctive Deductive Databases", Proceedings of the workshop DDLP '96 on Deductive Databases and Logic Programming, in conjunction with the Joint International Conference on Logic Programming, Bonn, Germany, pages 15-28, GMD – For Shungszentrum Informations technik, GMBH, Sept. 1996

70. J.D. Horton and Bruce Spencer "A Top Down Algorithm to Find Only Minimal Clause Trees", 1995, Proceedings of CPL 95, held in conjunction with KI-95, Bielefeld, Germany, Sept. 11-13, pp. 77-78.

71. Robin Cohen, Bruce Spencer and Pay Hoyt, "Designing a Tool to Allow Updates During Plan Recognition – Challenges and Applications", Proceedings of the IEEE Conference on Tools with Artificial Intelligence, Nov. 1994, New Orleans, Louisiana, pp. 63-70.

72. Bruce Spencer and Robin Cohen, "A Non-Horn ATMS which Allows Flexible Specification of Required Completeness", Proceedings of the Tenth Canadian Conference on Artificial Intelligence, May 1994, Banff, Alberta, pp. 233-240.

73. Bruce Spencer, "The Ordered Clause Restriction of Model Elimination and SLI", International Symposium of Logic Programming, Oct. 1993, Vancouver, B.C. This is a poster session paper and appears on p. 678 of the Proceedings.

74. Robin Cohen and Bruce Spencer, "Specifying and Updating Plan Libraries for Plan Recognition Tasks", IEEE Conference on Artificial Intelligence Applications, March 1-5, 1993, Orlando, Florida, pp. 27-33

75. Bruce Spencer, "Linear Resolution With Ordered Clauses", 4th UNB Artificial Intelligence Symposium, September 20-21, 1991, pp. 223-233. This also appears in Proceedings of the Workshop on Disjunctive Logic Programming, held in conjunction with the International Logic Programming Symposium, San Diego, California, Nov. 1, 1991.

76. Robin Cohen, Bruce Spencer and Peter van Beek, "In Search of Practical Specifications", AAAI Spring Symposium Series on Implemented Knowledge Representation and Reasoning Systems, March 26-28, 1991, Stanford University, pp. 313-316.

77. Bruce Spencer, "Avoiding Duplicate Proofs", Proceedings of the North American Conference on Logic Programming, October 29 – November 1, 1990, Austin, Texas, pp. 569-584.

78. Robin Cohen and Bruce Spencer, "Research Interests in Plan Recognition: Assimilating Novel Plans", Proceedings of the 2nd AAAI Workshop on Plan Recognition, International Joint Conference on Artificial Intelligence, August 21, 1989.
79. Bruce Spencer and Peter van Beek, "Applying Truth Maintenance to a Network of Constraints", Proceedings of the Workshop on Constraint Processing Algorithms and Their Applications, International Joint Conference on Artificial Intelligence, August 20, 1989.
80. Bruce Spencer, "Combining Dependency Directed Backtracking with the ATMS", In Experiments in the Theorist Paradigm: A collection of student papers in the Theorist Project, David Poole (ed.), Department of Computer Science, University of Waterloo Research Report CS-87-30, May 1987.

Refereed by Editor
- "What does Software Engineering Practice offer to Semantic Web Service Composition?" Bruce Spencer, Sandy Liu, Semantic Web Services Workshop in conjunction with the 3rd International Semantic Web Conference (ISWC2004). Hiroshima, Japan. November 7-11, 2004. NRC 48057.
- "Minimal Binary Resolution Trees" Bruce Spencer and J.D. Horton, Proceedings of workshop Deduction Internal Report WV-96-09 Technical University of Dresden, held in conjuction with Kunstliche Intelligenz Sept. 1996, Dresden, Germany. This is a one page abstract appearing on page 5.
- "A Security Policy Model From a NIAM Representation of Access Control", Bruce Spencer, William Stewart, Rod Cooper, Brad Nickerson, Kirby Ward, Elton Ashby and Don Cumming, Proceedings of the 4th Canadian Computer Security Symposium, Ottawa, May 12-15, 1992, pp. 329-344.
- "Model Elimination with Labels", S. Shi and B. Spencer, Proceedings of the APICS Computing Science Conference, October 26, 1991, Halifax, NS, pp. 84-90.

Invited Talks (Career)
1. "Parallelism, Prolog and the ATMS", Bell Northern Research, Ottawa, September, 1987.
2. "AND Parallelism and the ATMS", University of Waterloo ICR Student Presentations, May 31, 1988.
3. "Assimilation in Plan Recognition", Bell Northern Research, Ottawa, May 5, 1989.
4. "Plan Recognition with an Oracle", University of Toronto, July 13, 1989.
5. "Avoiding Duplicate Proofs", NRC IIT Ottawa, Bell Northern Research Ottawa, May 1991
6. "Extended Truth Maintenance Systems", Université de Moncton, April 23, 1992.
7. "Completeness and Non-Horn Truth Maintenance", University of Saskatchewan, May, 1992.
8. "The Ordered Clause Restriction of Resolution", University of Waterloo, ICR Colloquium, June 9, 1993,

9.   –   Bell Northern Research, Ottawa, June 7, 1993.
10. "Avoiding Redundancy in a Compiler for Automated Theorem Proving", University of Guelph, June 11, 1993.
11. "Clause Trees", Workshop on Logic Programming with Incomplete Information, held in conjunction with ILPS 1993, Vancouver, British Columbia, October 30, 1993.
12. J.D. Horton and Bruce Spencer, "Clause Trees - A Tool for Doing and Understanding Automated Theorem Proving", UNB Faculty of Computer Science Seminar, Sept. 1994
13. –   UNB Dept. of Mathematics and Statistics Departmental Seminar, Nov. 1, 1994.
14. "Clause Trees - A Tool for Automated Reasoning", AIDA Forum, T.H. Darmstadt, Germany, Sept 6, 1995 and
15. –   Computer Science Department Seminar, University of Koblenz, Germany, Sept 8, 1995.
16. "Minimal Binary Resolution Trees", University of Kaiserslautern, July 2, 1996
17. –   AIDA Forum, T.H. Darmstadt, Germany, July 9, 1996 and
18. –   University of Koblenz, September 20, 1996 Artificial Intelligence Seminar and
19. –   Computer Science Department Seminar, U. Saarbruecken, October 15, 1996.
20. "Winning at Proving Theorems with Computers" St. Francis Xavier University, March 2000
21. –   University of Saskatchewan, April 2000.
22. "The Design of j-DREW: a Deductive Reasoning Engine for the Semantic Web" Dagstuhl-Seminar 02061, Rule Markup Techniques, 3-8 Feb 2002, Schloss Dagstuhl, Germany.
23. "Why Automated Reasoning is Absolutely Essential for Building Web Applications" at CASCON 2003 workshop "Automated Reasoning and its Applications" held October 9, 2003.
24. Semantic Web Interest Group Panel: The Semantic Web: When, Where and How Will It Have Impact, Université de Quebec à Montreal, 19 November 2004.
25. "Software Engineering for Semantic Web Service Composition" Kitamura Laboratory, Kwansei Gakuen University, Sanda, Japan, Nov 4, 2004;
26. –   Institute for Computing Technology, Chinese Academy of Sciences, Beijing, China, Nov 15, 2004;
27. –   Recherche Appliquée en Linguistique Informatique, Université de Montreal, Nov 18, 2004;
28. –   Simon Fraser University, Burnaby, B.C., March 15, 2005;
29. –   McDonald Detweiler and Associates, Richmond, BC, March 16, 2005;
30. –   Acadia University Feb 17, 2006.
31. "Eucalptus: A Middleware for the NEP" Canarie Network-Enabled Platforms Workshop, June 26, 2007.
32. "SAVOIR: Coordination of Collaboration" April 9, 2008 at Computer Science Departmental Colloquium, Concordia University, Montreal.

33. "Services in Support of Collaborative Virtual Organizations" Computer Science Faculty Colloquium, University of New Brunswick, Fredericton, Nov 5, 2008.
34. – Research Institute of Southeast University SuZhou, China, Nov 28, 2008.
35. – International Workshop on Collaboration, Health and Knowledge Grid Beijing, China, Institute for Computing Technology, Chinese Academy of Sciences, Dec 2, 2008.
36. "SAVOIR: Coordination of Collaboration" April 9, 2008 at Departmental Colloquium, Concordia University, Montreal.
37. Building the Health Services Virtual Organization: Lessons and Opportunities" Jodrey School of Computer Science, Acadia University, February 4, 2011.
38. ……… Text Analysis and Machine Learning Group Seminar, U of Ottawa, March 31, 2011.
39. "The REM Project", Medical Imaging Informatics Teleradiology Conference, Toronto, Ontario, May 14, 2011.
40. "Mashing up Collaboration with Federated Modeling and Simulation" IEEE-NB Seminar, University of New Brunswick, Fredericton, March 28, 2012.
41. Keynote Address : "Shallow and Deep Semantics : Semantic Search Engines and Beyond", 3rd IEEE International eConference on Computer and Knowledge Engineering, Ferdowsi University of Mashhad, Iran, Oct 31, 2013.
42. Invited : "Competing at Semantic Search", UNB Faculty of Computer Science Research Expo, April 2014.
43. Invited : "Data Science Workshop in R", CyberSocial, Moncton, Canada, January 14, 2015.
44. "The OWL Reasoner Evaluation Competition and WSReasoner", Atlantic Workshop on Semantics and Services, Fredericton, December 9, 2015.
45. "WSReasoner: Strategically Using Faster Reasoners For Harder Logics" Semantic Web Meetup, Massachusetts Institute of Technolgy, Artificial Intelligence Lab, Sept 12, 2016.

Training of Highly Qualified Personnel Master's Students

1. Suping SHI	Oct 1993	MCS	Avoiding Redundancy in Compilers for Automated Theorem Proving
2. Amit SARDESAI	Oct 1995	MCS	Building an Object Layer on Top of a Relational Database System: The VEDA Prototype
3. It Fung SIOW	Dec 1995	MCS	Incorporating deductive queries into relational databases
4. Baoyun SUN	Oct 1996	MCS	Program Verification Using Otter 2.0
5. Scott BUFFETT	Oct 1998	MCS	Investigating iterative deepening in top-down automated reasoning
6. Qiao Liang ZHANG	May 2001	MCS	
7. Keping JIA	Oct 2003	MCS	A business rule explanation system for Web services
8. Fang WANG	Oct 2003	MCS	Detecting and preventing rule conflicts in APPEL
9. Yue WANG	Oct 2003	MCS	Learning the ontological positions of natural language objects
10. Bo XU	Oct 2006	MCS	Slope one in collaborative filtering
11. Bin LIAO	July 2007	MCS	Using clustering methods to define social networks from ratings of music
12. Biao WANG	Nov 2007	MCS	Multi-level Online Learning
13. Yosri HARZALLAH	Jan 2009	MCS	Assigning Routes and Wavelengths for Collaboration over Optical Networks
14. Cheng LU	May 2009	MCS	Ontology Validation under the Closed-World Semantics
15. Xiping HU	May 2011	MCS	Agent Based Application Programming Network for Ad-hoc Networks
16. Lei Wang	In Progress	MCS	Transfer Learning
17. Pratik SHAH	May 2015	MSC	Twitter Network Analysis for Online Community Structure

Training of Highly Qualified Personnel PhD Students

1. Charlie OBIMBO	April 2000	PhD	Access Clause Trees in Disjunctive Deductive Databases
2. Scott BUFFETT	May 2004	PhD	Monte Carlo Algorithms for Expected Utility Estimation in Dynamic Purchasing
3. Bin WANG	July 2009	PhD	Semi-supervised learning and Opinion-oriented Information Extraction
4. Yuanyuan GUO	July 2012	PhD	Semi-supervised Bayesian Learning
5. Weihong SONG	October 2015	PhD	Efficient Classification of Complex Ontologies

Courses Taught

For the Faculty of Computer Science at UNB
Each course is at least 39 contact hours.

CS1003 Introduction to Programming (FORTRAN) 3x
CS1013 Intermediate Programming (FORTRAN)   4x
CS1053 Introduction to Programming (Modula-2) 2x
CS1063 Intermediate Programming (Modula-2)   2x
CS1073 Introduction to Programming (Java)   2x
CS1083 Intermediate Programming (Java)   3x
CS2013 Software Engineering   4x
CS1303 Discrete Structures   3x
CS3323 Data Structures   3x
CS3995 Professional Practice   1x
CS4725 Artificial Intelligence   2x
CS5015 Introduction to Logic Programming   7x
CS6905 Advanced Technologies for E-Business   2x (*)
CS6999 Semantic Web Techniques   6x (*)
CS6999 Social Network Analysis   2x (*)

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