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RESEARCH INTERESTS

Database systems, conceptual modeling, query languages, and data provenance.

EDUCATION

Ph.D., M.Sc. Computer Science and Engineering — 2003
OGI School of Science and Engineering, OHSU
Advisor: Prof. Lois Delcambre; Co-Advisor: Prof. David Maier

B.Sc. Computer and Information Science — 1998
University of Oregon
Thesis Advisor: Prof. Arthur Farley
Research Advisor: Prof. Stephen Fickas

WORK EXPERIENCE

Full Professor — Sept. 2019 – present
Dept. of Computer Science, Gonzaga University

Department Chair — Sept. 2015 – May 2021
Dept. of Computer Science, Gonzaga University

Associate Professor — Sept. 2014 – Aug. 2019
Dept. of Computer Science, Gonzaga University

Assistant Professor — Sept. 2009 – Aug. 2014
Dept. of Computer Science, Gonzaga University

Associate Project Scientist — 2008 – Sept. 2009
University of California, Davis, Genome Center

Assistant Project Scientist — 2004 – 2008
University of California, Davis, Genome Center

Lecturer — Fall 2008
Dept. of Computer Science, University of California, Davis

Postdoctoral Researcher — 2003 – 2004
San Diego Supercomputer Center, University of California, San Diego

Research Assistant 1998 – 2003
OGI School of Science and Engineering

Adjunct Instructor 2001 – 2003
OGI School of Science and Engineering

Adjunct Instructor 2002 – 2003
Oregon Institute of Technology

Adjunct Instructor 2001
Portland State University

Researcher 2000
WireX/Immunix, Inc., Portland, OR (acquired by Novell)

PUBLICATIONS

Many of the following papers are available via Google Scholar and DBLP.

Refereed Conference and Workshop Publications

1. E.S. Skvortsov, Y. Xia, **S. Bowers**, B. Ludäscher. 2024. The Logica System: Elevating SQL Databases to Declarative Data Science Engines. *Proceedings International Workshop on the Resurgence of Datalog in Academia and Industry (Datalog-2.0)*, CEUR Workshop Proceedings 3801.

2. E.S. Skvortsov, Y. Xia, **S. Bowers**, B. Ludäscher. 2024. From Logic Programming to Programming in Logica: A First-Course in Declarative Data Science & Engineering. *Proceedings of the International Conference on Logic Programming Workshops*, CEUR Workshop Proceedings (to appear).

3. **S. Bowers**, Y. Xia, B. Ludäscher. 2024. The Skeptic's Argumentation Game or: Well-Founded Explanations for Mere Mortals. *The 5th International Workshop on Systems and Algorithms for Formal Argumentation (SAFA 2024)*, CEUR Workshop Proceedings 3757.

4. **S. Bowers**, Y. Xia, B. Ludäscher. 2024. On the Structure of Game Provenance and its Applications. *The 16th International Workshop on Theory and Practice of Provenance (TaPP 2024)*, Proceedings of the IEEE European Symposium on Security and Privacy Workshops (EuroS&P).

5. Y. Xia, D. Oderkerken, **S. Bowers**, B. Ludäscher. 2024. Layered Visualization of Argumentation Frameworks (Demo Paper). *The 10th International Conference on Computational Models of Argument (COMMA 2024)*, Frontiers in Artificial Intelligence and Applications 388, IOS Press.

6. Y. Xia, **S. Bowers**, L. Li, B. Ludäscher. 2024. Reconciling Conflicting Data Curation Actions: Transparency Through Argumentation. *The 18th International Data Curation Conference*. To appear in International Journal of Digital Curation.

7. B. Ludäscher,**S. Bowers**, Y. Xia. 2023. Games, Queries, and Argumentation Frameworks: Towards a Family Reunion. *The 7th Workshop on Advances in Argumentation in Artificial Intelligence (AI^3 2023)*, CEUR Workshop Proceedings, 3546.

8. **S. Bowers**, T. McPhillips, B. Ludäscher. 2018. Validation and Inference of Schema-Level Workflow Data-Dependency Annotations. *7th International Provenance and Annotation Workshop (IPAW)*, Lecture Notes in Computer Science (LNCS), Springer. Winner of the Best Paper Award.

9. **S. Bowers**, E. Maccarone, K. Besmer, G. Ricco. 2016. On the Integration of Ethical, Legal, and Societal Issues into a Computer Science Senior Design Capstone Program. *ASEE Conference*.

10. T. McPhillips, **S. Bowers**, K. Belhajjame, B. Ludäscher. 2015. Retrospective Provenance Without a Runtime Provenance Recorder. *Proceedgins of the 7th USENIX Workshop on the Theory and Practice of Provenance (TaPP)*.

11. S. Dey, S. Köhler, **S. Bowers**, B. Ludäscher. 2014. Computing Location-Based Lineage from Workflow Specifications to Optimize Provenance Queries. *Proceedings of the International Provenance and Annotation Workshop (IPAW)*, Springer LNCS, vol. 8628, pp. 180–193, ISBN 978-3-319-16461-8.

12. T. Song, S. Dey, **S. Bowers**, B. Ludäscher. 2014. Improving Workflow Design Using Abstract Provenance Graphs (Extended Abstract). *Proceedings of the USENIX Workshop on the Theory and Practice of Provenance*, Springer LNCS, vol. 8628, pp. 226–228, ISBN 978-3-319-16461-8.

13. M. Chen, S. Yu, P. Kianmajd, N. Franz, **S. Bowers**, B. Ludäscher. 2014. Provenance for Explaining Taxonomy Alignments (Extended Abstract). *Proceedings of the USENIX Workshop on the Theory and Practice of Provenance*, Springer LNCS, vol. 8628, pp. 258–260, ISBN 978-3-319-16461-8.

14. M. Chen, S. Yu, N. Franz, **S. Bowers**, B. Ludäscher. 2014. A Hybrid Diagnosis Approach Combining Black-Box and White-Box Reasoning. *Proceedings of the International Web Rule Symposium (RuleML)*, LNCS vol. 8620, pp. 127–141.

15. M. Chen, S. Yu, N. Franz, **S. Bowers**, and B. Ludäscher. 2013. Euler/X: A Toolkit for Logic-based Taxonomy Integration. *Proceedings of the International Workshop on Functional and and (Constraint) Logic Programming*, 2014.

16. **S. Bowers**, R. Englin, C. Fonseca, P. Jewell, L. Joplin, P. Mosca, T. Pacheco, J. Troxel, and T. Weeks. 2013. Lightweight Ontology-Based Tools for Managing Heterogeneous Observational Data. *Proceedings of the International Workshop on Semantics for Biodiversity* (S4BioDiv), CEUR Workshop Proceedings, vol. 979, ISSN 1613-0073.

17. M. Anand, **S. Bowers**, and B. Ludäscher. 2012. Database Support for Exploring Scientific Workflow Provenance Graphs. *Proceedings of the International Conference on Scientific and Statistical Database Management* (SSDBM), vol. 7338, LNCS, pp. 343–360.

18. **S. Bowers**, T. McPhillips, and B. Ludäscher. 2012. Declarative Rules for Inferring Fine-Grained Data Provenance from Scientific Workflow Execution Traces. *Proceedings of the International Provenance and Annotation Workshop* (IPAW), vol. 7525, LNCS, pp. 82–96.

19. S. Dey, S Köhler, **S. Bowers**, B. Ludäscher. 2012. Datalog as a Lingua Franca for Provenance Querying and Reasoning. *Proceedings of the USENIX Workshop on the Theory and Practice of Provenance* (TaPP).

20. H. Cao, **S. Bowers**, M. Schildhauer. 2011. Approaches for Semantically Annotating and Discovering Scientifc Observational Data. *Proc. of the International Conference on Database and Expert Systems Applications* (DEXA), LNCS vol. 6860, pp. 526–541.

21. M. Agun, **S. Bowers**. 2011. Approaches for Implementing Persistent Queues within Data-Intensive Scientific Workflows. *Proc. of the IEEE World Congress on Services* (SERVICES), pp. 200-207, IEEE Computer Society.

22. L. Dou, D. Zinn, T. McPhillips, S. Köhler, S. Riddle, **S. Bowers**, B. Ludäscher. 2011. Scientific Workflow Design 2.0: Demonstrating Streaming Data Collections in Kepler. *Proc. of the International Conference on Data Engineering* (ICDE), pp. 1296-1299, IEEE Computer Society.

23. W. Saunders, **S. Bowers**, M. O'Brien. 2011. Protégé Extensions for Scientist-Oriented Modeling of Observation and Measurement Semantics. *Proc. of the 8th International Workshop on OWL: Experiences and Directions* (OWLED), CEUR Workshop Proceedings, vol. 796.

24. B. Leinfelder, **S. Bowers**, M. O'Brien, M. Jones, M. Schildhauer. 2011. Using Semantic Metadata for Discovery and Integration of Heterogeneous Ecological Data. *Proc. of the Environmental Information Management Conference* (EIM), pp. 92–97.

25. M. Anand, **S. Bowers**, B. Ludäscher. 2010. Techniques for efficiently querying scientific workflow provenance graphs. *Proc. of the ACM International Conference on Extending Database Technology* (EDBT), pp. 287-298, ISBN 978-1-60558-945-9.

26. **S. Bowers**, J. Kudo, H. Cao, M. Schildhauer. 2010. ObsDB: A system for uniformly storing and querying heterogeneous observational data. *Proc. of the IEEE International Conference on e-Science* (e-Science), pp. 261–268, IEEE Computer Society.

27. M. Anand, **S. Bowers**, B. Ludäscher. 2010. Provenance browser: Displaying and querying scientific workflow provenance graphs. *Proc. of the IEEE International Conference on Data Engineering* (ICDE), pp. 1201-1204, IEEE Computer Society, ISBN 978-1-4244-5444-0.

28. D. Zinn, **S. Bowers**, Bertram Ludäscher. XML-based computation for scientific workflows. *Proc. of the IEEE International Conference on Data Engineering* (ICDE), pp. 812-815, IEEE Computer Society, ISBN 978-1-4244-5444-0.

29. P. Missier, C. Goble, S. Dey, A. Sarkar, B. Shrestha, B. Ludäscher, **S. Bowers**, I. Altintas, M. Anand. 2010. Linking multiple workflow provenance traces for interoperable collaborative science. *Proc. of the ACM International Workshop on Workflows in Support of Large-Scale Science* (WORKS), ACM Press, ISBN 978-1-60558-717-2.

30. M. Anand, **S. Bowers**, I. Altintas, B. Ludäscher. 2010. Approaches for exploring and querying scientific workflow provenance graphs. *Proc. of the International Provenance and Annotation Workshop* (IPAW), Revised Selected Papers, LNCS 6378, pp. 17-26.

31. I. Altintas, M. Anand, D. Crawl, **S. Bowers**, A. Belloum, P. Missier, B. Ludäscher, C. Goble, P. Sloot. 2010. Understanding collaborative studies through interoperable workflow provenance. *Proc. of the International Provenance and Annotation Workshop* (IPAW), Revised Selected Papers, LNCS 6378, pp. 42-58.

32. D. Thau, **S. Bowers**, B. Ludäscher. 2010. Towards best-effort merge of taxonomically organized data. *Proc. of the International Workshop on New Trends in Information Integration* (NTII), ICDE Workshops, pp. 151–154.

33. **S. Bowers**, H. Cao, M. Schildhauer, M. Jones, B. Leinfelder, M. O'Brien. 2010 A semantic annotation framework for retrieving and analyzing observational datasets. *Proc. of the Workshop on Exploiting Semantic Annotations in Information Retrieval* (ESAIR), pp. 31-32, ACM Press, ISBN 978-1-4503-0372-9.

34. M. Anand, **S. Bowers**, B. Ludäscher. 2009. A navigation model for exploring scientific workflow provenance graphs. *Proc. of the ACM International Workshop on Workflows in Support of Large-Scale Science* (WORKS), ACM Press, ISBN 978-1-60558-717-2.

35. D. Zinn, **S. Bowers**, T. McPhillips, B. Ludäscher. 2009. Scientific workflow design with data assembly lines. *Proc. of the International Workshop on Workflows in Support of Large-Scale Science* (WORKS), ACM 2009, ISBN 978-1-60558-717-2.

36. D. Thau, **S. Bowers**, B. Ludäscher. 2009. Merging Sets of Taxonomically Organized Data Using Concept Mappings under Uncertainty. *Proc. of the International Conference on Ontologies, DataBases, and Applications* (ODBASE), pp. 1103-1120.

37. M. Anand, **S. Bowers**, T. McPhillips, B. Ludäscher. 2009 Exploring Scientific Workflow Provenance using Hybrid Queries over Nested Data and Lineage Graphs. *Proceedings of the International Conference on Scientific and Statistical Database Management (SSDBM)*, LNCS 5566, pp. 237–254.

38. B. Ludäscher, M. Weske, T. McPhillips, **S. Bowers**. Scientific Workflows: Business as Usual? 2009. *Proceedings of the International Conference on Busineess Process Management (BPM).*

39. M. Anand, **S. Bowers**, T. McPhillips, B. Ludäscher. 2009. Efficient provenance storage over nested data collections. *Proceedings of the International Conference on Extending Database Technology (EDBT)*, ACM Proceedings, vol. 360, pp. 958–969.

40. D. Zinn, **S. Bowers**, T. McPhillips, B. Ludäscher. 2009. X-CSR: Dataflow optimization for distributed XML processing pipelines. *Proceedings of the International Conference on Data Engineering (ICDE).*

41. **S. Bowers**, J. Madin, M. Schildhauer. 2008. A conceptual modeling framework for expressing observational data semantics. *Proceedings of the International Conference on Conceptual Modeling (ER)*, LNCS 5231, pp. 41–55.

42. D. Thau, **S. Bowers**, B. Ludäscher. 2008. Merging taxonomies under RCC-5 algebraic articulations. *Proceedings of the CIKM Workshop on Ontologies and Information Systems for the Semantic Web (ONISW).*

43. C. Berkeley, **S. Bowers**, M. Jones, J. Madin, M. Schildhauer. Improving data discovery for metadata repositories through semantic search. Submitted. *Proceedings of the International Workshop on Intelligent Systems for Environmental Knowledge Engineering and Ecoinformatics (i-SEEK).*

44. A.H.H. Ngu, **S. Bowers**, T. McPhillips, T. Critchlow, N. Haasch. 2008. Flexible scientific workflow modeling using frames, templates and dynamic embedding. *Proceedings of the International Conference on Scientific and Statistical Database Management (SSDBM)*, LNCS 5069, pp. 566–572

45. **S. Bowers**, T. McPhillips, S. Riddle, M. Anand, B. Ludäscher. 2008. Kepler/pPOD: Scientific workflow and provenance support for assembling the tree of life. *Proceedings of the International Provenance and Annotation Workshop (IPAW)*, LNCS 5272, pp. 70–78.

46. **S. Bowers**, T. McPhillips, M. Wu, B. Ludäscher. 2007. Project histories: Managing data provenance across collection-oriented scientific workflow runs. *Proceedings of the International Workshop on Data Integration in the Life Sciences (DILS)*, LNCS 4544, pp. 122–138.

47. **S. Bowers**, T. McPhillips, B. Ludäscher, S. Cohen, S.B. Davidson. 2006. A model for user-oriented data provenance in pipelined scientific workflows. *Proceedings of the International Provenance and Annotation Workshop (IPAW)*, LNCS 4145, pp. 133–147

48. T. McPhillips, **S. Bowers**, B. Ludäscher. 2006. Collection-oriented scientific workflows for integrating and analyzing biological data. *Proceedings of the International Workshop on Data Integration in the Life Sciences (DILS)*, LNCS 4075, pp. 248–263.

49. **S. Bowers**, B. Ludäscher. 2006. A calculus for propagating semantic annotations through scientific workflow queries. *Proceedings of the EDBT Workshop on Query Languages and Query Processing (QLQP)*, LNCS 4245, pp. 712–723.

50. **S. Bowers**, B. Ludäscher, A.H.H. Ngu, T. Critchlow. 2006. Enabling scientific workflow reuse through structured composition of dataflow and control-flow. *Proceedings of the ICDE Workshop on Workflow and Data Flow for Scientific Applications (SciFlow)*, IEEE Computer Society.

51. B. Ludäscher, **S. Bowers**, T. McPhillips, N. Podhorszki. 2006. Scientific workflows: More e-Science mileage from cyberinfrastructure. *IEEE International Conference on e-Science, Workshop on Scientific Workflows and Business Workflow Standards*, IEEE Computer Society, pp. 145–153.

52. **S. Bowers**, B. Ludäscher. Actor-oriented design of scientific workflows. 2005. *Proceedings of the International Conference on Conceptual Modeling (ER)*, LNCS 3716, pp. 369–384.

53. **S. Bowers**, B. Ludäscher. 2005. Towards automatic generation of semantic types in scientific workflows. *Proceedings of the WISE Workshop on Scalable Semantic Web Knowledge Base Systems*, LNCS 3807, pp. 207–216.

54. C. Berkley, **S. Bowers**, M. Jones, B. Ludäscher, M. Schildhauer, J. Tao. 2005. Incorporating semantics in scientific workflow authoring. *Proceedings of the 17th International Conference on Scientific and Statistical Database Management (SSDBM)*, pp. 75–78.

55. W. Michener, J. Beach, **S. Bowers**, L. Downey, M. Jones, B. Ludäscher, D. Pennington, A. Rajasekar, S. Romanello, M. Schildhauer, D. Vieglais, J. Zhang. 2005. Data integration and workflow solutions for ecology. *Proceedings of the International Workshop on Data Integration in the Life Sciences (DILS)*, LNCS/LNAI 3615, pp. 321–324.

56. S. Romanello, J. Beach, **S. Bowers**, M. Jones, B. Ludäscher, W. Michener, D. Pennington, A. Rajasekar, M. Schildhauer. 2005. Creating and providing data management services for the biological and ecological sciences: Science environment for ecological knowledge. *Proceedings of the International Conference on Scientific and Statistical Database Management (SSDBM)*, pp. 28–31.

57. **S. Bowers**, B. Ludäscher. 2004. An Ontology-driven framework for data transformation in scientific workflows. *Proceedings of the International Workshop on Data Integration in the Life Sciences (DILS)*, LNCS/LNAI 2994, pp. 1–16.

58. **S. Bowers**, L. Delcambre. 2004. Incremental navigation: Providing simple and generic access to heterogeneous structures. *Proceedings of the International Conference on Conceptual Modeling (ER)*, LNCS 3288, pp. 668–681.

59. S. Murthy, L. Delcambre, D. Maier, **S. Bowers**. 2004. Putting integrated information in context: Superimposing conceptual models with SPARCE. *Proceedings of the Asia-Pacific Conference on Conceptual Modeling (APCCM)*, pp. 71–80.

60. S. Murthy, D. Maier, L. Delcambre, **S. Bowers**. 2004. Superimposed applications using SPARCE. *Proceedings of the International Conference on Data Engineering (ICDE)*, pp. 861.

61. **S. Bowers**, D. Thau, R. Williams, B. Ludäscher. 2004. Data procurement for enabling scientific workflows: On exploring inter-ant parasitism. *Proceedings of the VLDB International Workshop on the Semantic Web and Databases (SWDB)*, LNCS 3372, pp. 57–63.

62. **S. Bowers**, K. Lin, B. Ludäscher. 2004. On integrating scientific resources through semantic registration. *Proceedings of the International Conference on Scientific and Statistical Database Management (SSDBM)*, pp. 349–352.

63. **S. Bowers**, L. Delcambre. 2003. The Uni-Level description: A uniform framework for representing information in multiple data models. *Proceedings of the International Conference on Conceptual Modeling (ER)*, LNCS 2813, pp. 45–58.

64. **S. Bowers**, B. Ludäscher. 2003. Towards a generic framework for semantic registration of scientific data. *Proceedings of the ISWC Workshop on Semantic Web Technologies for Searching and Retrieving Scientific Data*, CEUR Workshop Proceedings, Vol. 83.

65. M. Koch, L. Delcambre, P. Toccalino, E. Landis, F. Phillips, T. Tolle, L. Shapiro, N. Steckler, D. Maier, M. Weaver, **S. Bowers**, B. Banga, J. Brewster, A. Gutema, S. Murthy, W. Howe, R. Tummala, J. Norman, K. Zilman, D. Drake, C. Palmer, A. Burt. 2003. The forest portal:

A multidisciplinary project. *Proceedings of the National Conference on Digital Government Research (dg.o)*, pp. 351–354.

66. **S. Bowers**, L. Delcambre, D. Maier. 2002. Superimposed schematics: Introducing E-R structure for *in situ* information selections. *Proceedings of the International Conference on Conceptual Modeling (ER)*, LNCS 2503, pp. 90–104.

67. **S. Bowers**, L. Delcambre, D. Maier. 2002. Enriching documents in an information portal using superimposed schematics. *Proceedings of the National Conference on Digital Government Research (dg.o)*, pp. 493–498.

68. L. Delcambre, D. Maier, **S. Bowers**, L. Deng, M. Weaver. 2001. Bundles in captivity: An application of superimposed information. *Proceedings of the International Conference on Data Engineering (ICDE)*, IEEE Computer Society, pp. 111–120.

69. L. Delcambre, M. Weaver, T. Tolle, D. Maier, E. Landis, **S. Bowers**, P. Toccalino, F. Phillips, N. Steckler, C. Palmer, J. Norman, R. Tummala, S. Varde. 2001. Similarity search for harvesting information to sustain our forests. *Proceedings of the National Conference on Digital Government Research (dg.o)*, pp. 155–158.

70. **S. Bowers**, L. Delcambre. 2000. Representing and transforming model-based information. *Proceedings of the ECDL International Workshop on the Semantic Web*, pp. 1–16.

71. **S. Bowers**, L. Delcambre, D. Maier, C. Cowan, P. Wagle, D. McNamee, A.F. LeMeur, H.M. Hinton. 2000. Applying adaptation spaces to support quality of service and survivability. *Proceedings of the DARPA Information Survivability Conference and Exposition (DISCEX)*, Vol. 2, pp. 1271–1286.

72. H.M. Hinton, C. Cowan, L. Delcambre, **S. Bowers**. 1999. SAM: Security adaptation manager. *Proceedings of the Annual Computer Security Applications Conference (ACSAC)*, pp. 361–370.

Refereed Journal Publications and Book Chapters

73. N. Franz, M. Chen, S. Yu, **S. Bowers**, B. Ludäscher. 2016. Names are not good enough: Reasoning over Taxonomic Change in the Andropogon Complex. *Semantic Web Journal*, 7(6):645–667.

74. N. Franz, N. Pier, D. Reeder, M. Chen, S. Yu, P. Kianmajd, **S. Bowers**, B. Ludäscher. 2016. Two Influential Primate Classifications Locally Aligned. *Systematic Biology*, 65(5):561-582.

75. K. Yerion, R. Bryant, **S. Bowers**. 2016. The Development of a B.A. in Computer Science and Computational Thinking. In *New Directions for Computing Education: Embedding Computing Across Disciplines*, Springer, pp. 187–199, ISBN 978-3-319-54225-6.

76. N. Franz, M. Chen, S. Yu, P. Kianma, **S. Bowers**, B. Ludäscher. 2014. Reasoning over Taxonomic Change: Exploring Alignments for the *Perelleschus* Use Case. *PLoS One*, 10(2): e0118247.

77. R. Walls, J. Deck, R. Guralnick, S. Baskauf, R. Beaman, S. Blum, **S. Bowers**, P. Buttigieg, N. Davies, D. Endresen, M. Gandolfo, R. Hanner, A. Janning, L. Krishtalka, A. Matsunaga, P. Midford, N. Morrison, E. Tuama, M. Schildhauer, B. Smith, B. Stucky, A. Thomer, J. Wieczorek, J. Whitacre, J. Wooley. 2014. Semantics in Support of Biodiversity Knowledge Discovery: An Introduction to the Biological Collections Ontology and Related Ontologies. *PLoS One* 9(3):e89606, doi: 10.1371/journal.pone.0089606.

78. **S. Bowers**, K. Yerion. 2013. Programming Personal Robots within an Introductory Computer Science Course for Engineering Majors. *Journal of Computing Sciences in Colleges* 29(1):133–139.

79. H. Cao, **S. Bowers**, M. Schildhauer. 2012. Database Support for Enabling Data-Discovery Queries over Semantically-Annotated Observational Data. *Transactions on Large-Scale Data- and Knowledge-Centered Systems*, vol. 7600, LNCS, pp. 198-228.

80. P. Missier, B. Ludäsher, S. Dey, M. Wang, T. McPhillips, **S. Bowers**, M. Agun, and I. Altintas. 2012. Golden Trail: Retrieving the Data History that Matters from a Comprehensive Provenance Repository. *International Journal of Digital Curation* 7(1):139-150.

81. **S. Bowers**. 2012. Scientific Workflow, Provenance, and Data Modeling Challenges and Approaches. *Journal on Data Semantics* 1:19-30.

82. I. Altintas, M. Anand, T. Vuong, **S. Bowers**, B. Ludäscher, P. Sloot. 2011. A Data Model for Analyzing User Collaborations in Workflow-Driven eScience. *International Journal of Computers and Their Applications* (IJCA) 18(3):160–179.

83. D. Zinn, **S. Bowers**, S. Köhler, B. Ludäscher. 2010. Parallelizing XML Data-Streaming Workflows via MapReduce. *Journal of Computer and System Sciences* 76(6):447-463.

84. **S. Bowers**, J. Madin, M. Schildhauer. 2010. Owlifier: Creating OWL-DL ontologies from simple spreadsheet-based knowledge description. *Ecological Informatics* 5(1):19–25.

85. B. Ludäscher, I. Altintas, **S. Bowers**, J. Cummings, T. Critchlow, E. Deelman, D. De Roure, J. Freire, C. Goble, M. Jones, S. Klasky, T. McPhillips, N. Podhorszki, C. Silva, I. Taylor, M. Vouk. Scientific Process Automation and Workflow Management. *Scientific Data Management: Challenges, Technology, and Deployment*, Chapman & Hall, 2009, ISBN 978-1420069808.

86. D. Thau, **S. Bowers**, B. Ludäscher. 2009. Merging Taxonomies under RCC-5 Algebraic Articulations. *Journal of Computing Science and Engineering* 3(2).

87. T. McPhillips, **S. Bowers**, D. Zinn, B. Ludäscher. 2008. Scientific workflow design for mere mortals. *Future Generation Computer Systems* 25(5):541–551.

88. B. Ludäscher, **S. Bowers**, T. McPhillips. 2008. Scientific workflows. *Encyclopedia of Database Systems*, M. Tamer Özsu, L. Liu (Eds.), Springer-Verlag, pp. 2507-2511.

89. D. Pennington, I. Athanasiadis, **S. Bowers**, S. Krivov, J. Madin, M. Schildhauer, F. Villa. 2008. Indirectly-driven knowledge models in Ecology. *International Journal of Metadata, Semantics, and Ontologies* 3(3):210–222.

90. S. Davidson, S. Boulakia, A. Eyal, B. Ludäscher, T. McPhillips, **S. Bowers**, M. Anand, J. Freire. 2007. Provenance in scientific workflow systems. *IEEE Data Engineering Bulletin*, 30(4):44–50

91. J. Madin, **S. Bowers**, M. Schildhauer, M. Jones. 2008. Advancing ecological research with ontologies. *Trends in Ecology and Evolution* 23(3):159–168

92. J. Madin, **S. Bowers**, M. Schildhauer, S. Krivov, D. Pennington, F. Villa. 2007. An ontology for describing and synthesizing ecological observation data. *Ecological Informatics*, 2(3):279–296

93. **S. Bowers**, T. McPhillips, B. Ludäscher. 2008. Provenance in collection-oriented workflows. *Concurrency and Computation: Practice and Experience* 20(5):519–529

94. B. Ludäscher, N. Podhorszki, I. Altintas, **S. Bowers**, T. McPhillips. 2008. From computation models to models of provenance: The RWS approach. *Concurrency and Computation: Practice and Experience* 20(5):507–518

95. D. Pennington, D. Higgins, A. T. Peterson, M. Jones, B. Ludäscher, **S. Bowers**. 2007. Ecological niche modeling using the Kepler workflow system. *Workflows for e-Science: Scientific Workflows for Grids*, I. Taylor, D. Gannon, E. Deelman, M. Shields (eds.), Springer-Verlag, pp. 91–108

96. M. Jones, M. Schildhauer, O.J. Reichman, **S. Bowers**. 2006. The new bioinformatics: Integrating ecological data from the gene to the biosphere. *Annual Review of Ecology, Evolution, and Systematics* 37:519–544

97. **S. Bowers**, L. Delcambre. 2006. Using the Uni-Level Description (ULD) to support data-model interoperability. *Data & Knowledge Engineering* 59(3):511–533

98. B. Ludäscher, K. Lin, **S. Bowers**, E. Jaeger-Frank, B. Brodaric, C. Baru. 2006. Managing scientific data: From data integration to scientific workflows. *GSA Special Papers, Geoinformatics: Data to Knowledge* 397:109–130

99. T. McPhillips, **S. Bowers**. 2005. An approach for pipelining nested collections in scientific workflows. *SIGMOD Record* 34(3):12–17

100. **S. Bowers**, L. Delcambre. 2002. On modeling conformance for flexible transformation over data models. *Knowledge Transformation for the Semantic Web, Frontiers in Artificial Intelligence and Applications*, IOS Press, 95:34–48

101. L. Delcambre, T. Tolle, D. Maier, F. Phillips, P. Toccalino, N. Steckler, M. Koch, L. Shapiro, E. Landis, B. Banga, **S. Bowers**, J. Brewster, A. Gutema, W. Howe, S. Murthy, J. Norman, R. Tummala, M. Weaver, K. Zillman. 2003. Harvesting information to save our forests. *Communications of the ACM* 46(1):38–39

102. J. Ash, P. Gorman, M. Lavelle, J. Lyman, L. Delcambre, D. Maier, **S. Bowers**, M. Weaver. 2001. Bundles: Meeting clinical information needs. *Bulletin of the Medical Library Association* 89(3):294–296

103. **S. Bowers**, L. Delcambre. 2001. A generic representation for exploiting model-based information. *Electronic Transactions of Artificial Intelligence* 5:1–34

104. P. Gorman, J. Ash, M. Lavelle, J. Lyman, L. Delcambre, D. Maier, M. Weaver, **S. Bowers**. 2000. Bundles in the wild: Managing information to solve problems and maintain situation awareness, *Library Trends: Assessing Digital Library Services* 49(2):266–289

Additional Publications

105. A. Ailamaki, **S. Bowers** (eds). 2012. *Proc. of the 24th International Scientific and Statistical Database Management Conference*, Springer LNCS Series, vol. 7338.

106. J. Cushing, J. French, **S. Bowers** (eds). 2011. *Proc. of the 23rd International Scientific and Statistical Database Management Conference*, Springer LNCS Series, vol. 6809.

107. D. Thau, **S. Bowers**, B. Ludäscher. 2009. CLEANTAX: A Framework for Reasoning about Taxonomies (Demo). *AAAI Spring Symposium on Benchmarking of Qualitative Spatial and Temporal Reasoning systems.*

108. L. Moreau, B. Plale, S. Miles, C. Goble, P. Missier, R. Barga, Y. Simmhan, J. Futrelle, R. McGrath, J. Myers, P. Paulson, **S. Bowers**, B. Ludäscher, N. Kwasnikowska, J. Van den Bussche, T. Ellkvist, J. Freire, P. Groth. 2008. The Open Provenance Model, Technical Report 16148, University of Southampton.

109. **S. Bowers**, L. Delcambre. 2002. JustBrowsing: A Generic API for Exploring Information. Demonstration system presented at the *International Conference on Conceptual Modeling (ER).*

GRANTS AND CONTRACTS

- **III:Small: A Logic-Based, Provenance-Aware System for Merging Scientific Data under Context and Classification Constraints** (*Co-PI*, GU Subcontract), National Science Foundation, $439,000, with UC Davis (10/1/2011–9/30/2014).

- **A Community-driven Scientific Observations Network to achieve Interoperability of Environmental and Ecological Data** (*Co-PI*, GU Subcontract), National Science Foundation, #0753144, $750,000 (8/2008–7/2011), with National Center for Ecological Analysis and Synthesis (UCSB), Arizona State University, Monterey Bay Aquarium Research Institute, Rensselaer Polytechnic Institute.

- **Semantic Enhancements for Ecological Data Management**, (*Co-PI*, GU Subcontract), National Science Foundation, #0743429, $599,999 (8/2008–7/2011), with National Center for Ecological Analysis and Synthesis and Marine Science Institute (UCSB).

- **Development of Kepler CORE – A Comprehensive, Open, Robust, and Extensible Scientific Workflow Infrastructure**, *Co-PI*, National Science Foundation, #0722079, $1,700,000 (9/2007–8/2010), with San Diego Supercomputer Center (UCSD), National Center for Ecological Analysis and Synthesis (UCSB), University of New Mexico.

- **A Collaborative Scientific Workflow Environment for Accelerating Genome-Scale Biological Research**, *Co-PI*, National Science Foundation, #0612326, $600,139 (7/2006–6/2009).
- **Core Database Technologies to Enable the Integration of AToL Information**, *Co-PI*, National Science Foundation, #0630033, $462,000 (10/2006–9/2009), with University of Pennsylvania and Yale.
- **A Workshop for Advancing a Unified Model for Observational Data in the Ecological and Environmental Sciences**, *Co-PI*, National Science Foundation, #0733489, $50,000 (4/2007–3/2008, workshop held 7/9–12/2007).
- **DataONE Prov-Explorer Development** (GU Subaward under the DataONE National Science Foundation project), University of New Mexico, $2,009 (12/1/2012–2/1/2013).
- **A Dynamic Web-Based Application for Exploratory Analysis of De-Identified Spokane Community Clinical Data Repository (SCCDR)** (*PI*, GU Subcontract), Institute for Systems Medicine, $21,936 (11/2010–9/2011).
- **Gonzaga University KEEN Proposal for Developing and Adopting Robotics Modules into CPSC 121 (Computer Science I)** (*PI*), GU internal funding through the KEEN Foundation Grant, $10,494 (1/1/2011–12/1/2013).

PROGRAM COMMITTEE MEMBERSHIP AND SERVICE (SELECTED EXAMPLES)

- Intl. Conf. on Data Engineering (ICDE), PC Member, 2023/2024.
- Intl. Conf. on Conceptual Modeling (ER), PC Member, 2005–2006, 2008–2024.
- ACM SIGMOD/PODS Conference, Registration Chair, 2020.
- Journal of Data Semantics, Co-Editor-In-Chief, 2011-2013, Ed. Board Member, 2006-2010
- USENIX Theory and Practice of Provenance (TaPP) Workshop, PC Member, 2016, 2018.
- Extended Semantic Web Conference (ESWC), PC Member, 2018.
- International Conference on Scientific and Statistical Database Management (SSDBM), PC Member, 2008, 2009, 2010, 2014, Proceedings Chair 2011 and 2012.
- Journal Reviewer for ACM Transactions on Database Systems (TODS), Data and Knowledge Engineering (DKE), IEEE Transactions on Knowledge & Data Engineering (TKDE), Information Systems (IS), Journal of Web Semantics (JoWS), Concurrency and Computation: Practice and Experience (CCPE), VLDB Journal (VLDBJ), Journal of Universal Computer Science (JUCS), ACM Computing Surveys (CSUR), Future Generation Computing Systems (FGCS), IEEE/ACM Transactions on Computational Biology and Bioinformatics (TCBB).

COURSES TAUGHT (AT GONZAGA UNIVERSITY)

- Computer Science 1 (CPSC 121)

- Computer Science 2 (CPSC 122)
- Algorithms and Abstract Data Structures (CPSC 223)
- Software Development / Object Oriented Programming (CPSC 224)
- Computer Organization (CPSC 260)
- Data Mining (CPSC 310)
- Database Management Systems (CPSC 321)
- Data Science Algorithms (CPSC 322)
- Big Data Analytics (CPSC 324)
- Organization of Programming Languages (CPSC 326)
- Java Programming (CPSC 315)
- Software Engineering (CPSC 330)
- Theory of Computation (CPSC 351)
- Design and Analysis of Algorithms (CPSC 450)
- Computer Science Senior Design I and II (CPSC 491/492)
- Computers and Society (CPSC 499)
- Strategies for Success (UNIV 099)