

# CHRISTINE E. HEITSCH

## Contact Information

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## Research Interests

General description: discrete mathematics, algebra, and combinatorics with applications to or motivated by theoretical computer science and computational biology / bioinformatics.

Particular area: combinatorics on words with an emphasis on string algorithms.

Specific problems: encoding information in short nucleotide sequences; design, analysis, and prediction of RNA secondary structures; plane tree combinatorics; computational complexity of generalized pattern matching; algorithms for unavailability testing.

## Education

- University of California at Berkeley, Ph.D. in Mathematics, December 2000. Advisor: John Rhodes. Thesis: *Computational Complexity of Generalized Pattern Matching*.
- University of Illinois at Urbana-Champaign, B.S. with Highest Distinction in Mathematics, Magna Cum Laude, May 1994.

## Professional Experience

- Postdoctoral Fellow, “Computation and Informatics in Biology and Medicine” National Library of Medicine Training Grant, University of Wisconsin – Madison, 2002 – present.
  - Proposed research: *The Design and Analysis of Short Oligonucleotides, with Applications to DNA-Based Computation and RNA Secondary Structure Algorithms*
  - In collaboration with: Rob Corn and the Corn Research Group in the Department of Chemistry.
- Honorary Fellow, Mathematics Department, University of Wisconsin – Madison, 2002 – present.
- Postdoctoral Fellow, Department of Computer Science, University of British Columbia, 2000 – 2002.
  - Instructor for Alternate Routes to Computing (ARC) version of department’s discrete mathematics course, Spring 2001.
  - Instructor for department’s discrete mathematics course, Fall 2001, Fall 2000.
- Graduate Student Instructor, Department of Mathematics, University of California at Berkeley, 1994 – 2000.
  - Instructor for department’s teaching pedagogy and practice course, Fall 1998, Fall 1999. Planned and developed the revised curriculum and course materials.

- Assistant for department’s teaching pedagogy and practice course, 1997 – 1998.  
Responsible for the individual videotaping and consultation program.
- Head Graduate Student Instructor, 1996 – 1997.  
Provided training and support for initial offering of workshop-based calculus sequence.
- Section leader, 1994 – 1996.  
Taught two calculus sections a semester for large lecture course.
- Course assistant, Mentoring Program for Women in Mathematics, Park City Mathematics Institute / Institute for Advanced Study, May 1999.  
Supervised problem sessions for the undergraduate “Codes and Curves” course.
- Calculus Development Team, Department of Mathematics, University of California at Berkeley, Summer 1996, Summer 1997.  
Independently created a complete set of supplemental course materials for the two semester introductory calculus sequence.

### Refereed Publications

- *From RNA Secondary Structure to Coding Theory: A Combinatorial Approach*, with A. E. Condon and H. H. Hoos, in Proceedings of the Eighth International Meeting on DNA Based Computers (DNA8), Lecture Notes in Computer Science, Springer-Verlag, Sapporo, Japan, June 2002.
- *Exact Distribution of Deletion Sizes for Unavoidable Strings*, in Proceedings of the 8th International Symposium on String Processing and Information Retrieval (SPIRE’01), IEEE Computer Society Press, Laguna de San Rafael, Chile, November 2001.
- *Generalized Pattern Matching and the Computational Complexity of Unavoidability Testing*, in Proceedings of the 12th Annual Symposium on Combinatorial Pattern Matching (CPM 2001), Lecture Notes in Computer Science, Springer-Verlag, Jerusalem, Israel, July 2001.
- *The Global Arrangement of Local Reconfigurations under an RNA Secondary Structure Design Procedure*, submitted to the Thirty-Fifth Annual ACM Symposium on Theory of Computing (STOC03), Nov. 2002.
- *The Limits of Simplicity: a Combinatorial Solution to RNA Secondary Structure Design*, submitted to the Seventh Annual International Conference on Research in Computational Molecular Biology (RECOMB 2003), Sept. 2002.
- *Intractability of the Reductive Decision Procedure for Unavoidability Testing, a Special Case of Generalized Pattern Matching*, submitted to Journal of Algorithms, May 2002.
- *Insufficiency of Four Known Necessary Conditions on String Unavoidability*, submitted to Journal of Algorithms, May 2002.
- *Exact Distribution of Deletion Sizes for Unavoidable Strings*, submitted to Fundamenta Informaticae Special Issue – Computing Patterns in Strings, April 2002.
- *Plane Trees and the Combinatorics of RNA Secondary Structure*, in preparation.

## **Fellowships & Grants**

- Graduate Fellowship, Department of Mathematics, University of California at Berkeley, Fall 1999.  
Covered university fees and provided funding for a semester.
- Julia Robinson Fellowship, Department of Mathematics, University of California at Berkeley, Spring 1999.  
Covered university fees and provided funding for a semester.
- Graduate Student Research Grant, Department of Mathematics, University of California at Berkeley, Summer 1995, Summer 1996.  
Provided two months of summer funding.
- Departmental Grant, GSI Teaching and Resource Center, University of California at Berkeley, Fall 1996.  
Funded the “GSI Preparation and Support Program for Math 1AW.”
- Departmental Grant, GSI Teaching and Resource Center, University of California at Berkeley, Fall 1998.  
Funded improvements to departmental teaching resources including equipment for the videotaping program.

## **Honors & Awards**

- Incredible Instructor Honourable Mention, Department of Computer Science, University of British Columbia, February 12, 2002.
- Nikki Kose Memorial Teaching Prize, University of California at Berkeley, May 2000.  
Departmental award for “exceptional teaching as a graduate student instructor.”
- Outstanding Graduate Student Instructor, University of California at Berkeley, May 1996.
- H. R. Brahana Prize in Mathematics, University of Illinois at Urbana-Champaign, May 1994.  
Departmental award for “exceptional performance by the most outstanding graduating senior.”
- Bronze Tablet, University of Illinois at Urbana-Champaign, May 1994.  
University honors; top three percent of graduating class.
- Phi Beta Kappa Award, University of Illinois at Urbana-Champaign, May 1994.  
One of four chapter awards recognizing the achievements of graduating seniors.
- Phi Beta Kappa, May 1994.

## **Invited Programs**

- Semigroups, Automata, and Formal Languages Special Session, First Joint International Meeting of the American Mathematical Society and Unione Matematica Italiana, Pisa, Italy, June 12 – 16, 2002.
- Graduate Summer School in Computational Complexity Theory, Park City Mathematics Institute / Institute for Advanced Study, Princeton, NJ, July 16 – Aug. 5, 2000.

- Summer Graduate Program in Mathematical and Computational Challenges in Molecular and Cell Biology, Florida State University Program in Mathematics and Molecular Biology / Mathematical Sciences Research Institute, Berkeley, CA, June 12 – June 23, 2000.
- Mentoring Program for Women in Mathematics, Park City Mathematics Institute / Institute for Advanced Study, Princeton, NJ, May 30 – June 9, 2000.

### **Selected Presentations**

- *A Road Less Travelled? – Following an Interdisciplinary Mathematical Career Path*, Vigre Seminar, Madison, WI, Nov. 6, 2002.
- *From RNA Secondary Structure to Coding Theory: A Combinatorial Approach*, Computation and Informatics in Biology and Medicine Seminar, Madison, WI, Oct. 8, 2002.
- *The Unavoidability of Generalized Zimin Word Constructions*, Seminar, Institut d'électronique et d'informatique Gaspard-Monge, Marne-la-Vallée, France, June 25, 2002.
- *An Application of Combinatorics on Words to RNA Secondary Structure Design*, Semigroups, Automata, and Formal Languages Special Session, American Mathematical Society and Unione Matematica Italiana First Joint International Meeting, Pisa, Italy, June 13, 2002.
- *Towards the Design of RNA Molecules*, with A. E. Condon and H. H. Hoos. Abstract and Poster. Mathematics and Molecular Biology VII: Modeling Across the Scales – Atoms to Organisms, Santa Fe, NM, January 9, 2002.
- *Catalan Numbers and the Tree of Life*, Computer Science Theory Seminar, University of British Columbia, Vancouver, BC, October 16, 2001.
- *Generalized Pattern Matching and the Computational Complexity of Unavoidability Testing*, Computer Science Theory Seminar, University of Wisconsin – Madison, Madison, WI, February 20, 2001.
- *Computational Complexity of Generalized Pattern Matching*, Association for Women in Mathematics Workshop, Joint Mathematics Meetings, New Orleans, LA, January 13, 2001.
- *Computational Complexity of Generalized Pattern Matching, and an Exponential Lower Bound on One Algorithmic Approach*, International Conference on Geometric and Combinatorial Methods in Group Theory and Semigroup Theory, Lincoln, NE, May 15, 2000.
- *Infinite Sequences Without Patterns*, Series of three lectures for the Semigroup and Automata Theory research seminar, Berkeley, CA, April 1998.
- *The Undecidability of the Word Problem for Finite Semigroups*, Series of three lectures for the Semigroup and Automata Theory research seminar, Berkeley, CA, March 1997.

### **Professional Service & Committee Work**

- Reviewer, Journal of Algorithms.
- Organizing Committee, Ninth International Meeting on DNA Based Computers (DNA9), Madison, WI, June 1-4, 2003.

- Review Panel, Genomes to Life Program, Department of Energy, May 29 – 31, 2002.
- Supporting Women in InFormation Technology (SWIFT), Department of Computer Science, University of British Columbia, 2000 – 2002.
- Graduate Assembly, University of California at Berkeley, 1995 – 1997.  
Served as departmental delegate and elected graduate representative on the Graduate Council, Executive Committee, Academic Planning Board, and the Committee on Educational Policy.
- Officer, Noetherian Ring, Department of Mathematics, University of California at Berkeley, Spring 1999, 1995 – 1997.  
As president and vice-president, invited and hosted eight female colloquium speakers; wrote articles for publication; organized outreach efforts and mentoring opportunities.

### Professional Societies

- Association for Computing Machinery Special Interest Group on Algorithms and Computational Theory (ACM SIGACT)
- American Mathematical Society (AMS)
- Association for Women in Mathematics (AWM)

### References

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 Professor Emeritus  
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