

## Charles A. Cusack

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### Education

- 2000 Ph.D. in Computer Science, University of Nebraska—Lincoln  
Dissertation: *Group Factorizations in Cryptography* (Advisor: Spyros Magliveras)
- 1998 M.S. in Computer Science, University of Nebraska—Lincoln  
Thesis: *Semiregular Large Sets* (Advisor: Spyros Magliveras)
- 1994 M.S. in Discrete Mathematics, Michigan Technological University  
Thesis: *PSL(2,q) As An Automorphism Group Of A 3-design With Blocksize 5*  
(Advisor: Donald Kreher)
- 1992 B.S. in Pure Mathematics, Michigan Technological University

### Employment

- 2007- Assistant Professor, Computer Science, Hope College, Holland, MI
- 2005-2007 Visiting Assistant Professor, Computer Science, Hope College, Holland, MI
- 2005-2006 Software Engineer, Westshore Design, LLC, Holland, MI
- 2003-2004 Lecturer, Computer Science and Engineering, University of Nebraska—Lincoln
- 2001-2003 J.D. Edwards Professor and Lecturer, Computer Science and Engineering,  
University of Nebraska—Lincoln
- 2000-2001 Lecturer, Computer Science and Engineering, University of Nebraska—Lincoln

### Publications

- **C.A. Cusack**, A. Bekmetjev, “Pebbling Algorithms in Diameter Two Graphs,” *SIAM J. Discrete Math.*, 23(2), 634-646, 2009.
- **C.A. Cusack**, E. Peck, M. Riolo, “Volunteer Computing Games: Merging Online Casual Gaming with Volunteer Computing,” *Proceedings of the International Academic Conference on Meaningful Play*, East Lansing, MI, October 9-11, 2008.
- **Charles Cusack**, Chris Martens, Priyanshu Mutreja, “Volunteer Computing Using Casual Games,” presented at *Future Play 2006 International Conference on the Future of Game Design and Technology*, London, Ontario, Canada, Oct 10-12, 2006. Published in Conference Proceedings.
- Gretchen C. Foley, **Charles A. Cusack**, “Computer-Assisted Analysis of Music in George Perle’s System of Twelve-Tone Tonality,” *Computer Music Journal*, 30(3), 53-66, 2006.
- **C.A. Cusack**, S.M. Magliveras, “Semiregular Large Sets”, *Designs, Codes, and Cryptography*, 18, 81-87, 1999.

- **C.A. Cusack**, S.W. Graham, D.L. Kreher, “Large Sets of 3-Designs from  $PSL(2,q)$  with Block Sizes 4 and 5,” *The Journal of Combinatorial Designs*, 3(2), 147-160, 1995.
- C.J. Colbourn, **C.A. Cusack**, D.L. Kreher, “Partial Steiner Triple Systems with Equal-Sized Holes,” *The Journal of Combinatorial Theory Series A*, 70(7), 56-65, 1995.

### Presentations

- **C.A. Cusack**, “Solving Combinatorial Problems with Online Games,” *Combinatorial Configurations and their Applications*, Michigan Technological University, August 5-8, 2009.
- **C.A. Cusack**, A. Foster, J. Largent, K. Browder, E. Peck, “Pebble It,” game and poster exhibited at the *International Academic Conference on Meaningful Play*, East Lansing, MI, October 9-11, 2008.
- **Charles Cusack**, “Volunteer Computing Games: Merging Online Casual Gaming with Volunteer Computing,” Department of Computer Science and Engineering Colloquium Series, University of Nebraska—Lincoln, March 13, 2008.
- E. Peck, M. Riolo, **C.A. Cusack**, “Wildfire Wally: A Volunteer Computing Game,” poster presentation at *Future Play 2007 International Conference on the Future of Game Design and Technology*, Toronto, Ontario, Canada, Nov 15-17, 2007.
- **Charles Cusack**, “Video Games and Culture,” Lansing Community College, October 15, 2007.
- C. Martens, P. Mutreja, **C.A. Cusack**, “Using a Volunteer Computing Game to Solve the Maximum Clique Problem,” poster presentation at *Future Play 2006 International Conference on the Future of Game Design and Technology*, London, Ontario, Canada, Oct 10-12, 2006.
- **C. Cusack**, “Quantum Computing: How to do  $2^n$  things all at the same time,” *Third Annual Regional Workshop in the Mathematical Sciences*, University of Nebraska—Lincoln, Lincoln, NE, Oct 27-28, 2000.

### Research Activities

- *Computing Games for NP-Complete Problems*, 2006-ongoing  
The goal of this research is to use crowdsourcing techniques to allow a diverse audience to assist in developing more efficient algorithms to solve NP-complete problems. This is being done by creating online games based on instances of NP-complete problems, recording player actions, and developing algorithms based on players’ strategies. Additionally, unsolved instances of problems will be presented to see if players are able to solve them when the best-known algorithms cannot. The current focus is on graph related problems, and graph pebbling problems in particular.
- *Graph Pebbling*, 2007-ongoing  
Studying various problems related to graph pebbling, including pebbling numbers and thresholds for certain classes of graphs. I am particularly interested in finding polynomial-time algorithms for pebbling specific classes of graphs.
- *Group Factorizations in Cryptography*, 1998-2000  
Classified logarithmic signatures of permutation groups; studied the structure of the subgroup of  $S_{|G|}$  induced by the set of tame logarithmic signatures of a group  $G$ ;

evaluated the potential of creating a secure public-key cryptosystem based on logarithmic signatures of certain types of groups.

- *Automorphism Groups of Combinatorial Designs*, 1993-1998  
Developed the notion of  $t$ -homogeneous,  $G$ -semiregular large sets of  $t$ -designs; proved that there exist infinitely many 3-homogeneous  $\text{PSL}(2,q)$ -semiregular large sets; found all  $t$ -homogeneous,  $G$ -semiregular large sets with  $t \geq 3$ . Also gave necessary and sufficient conditions for the existence of large sets of 3–designs with block size 5 in which each design admits  $\text{PSL}(2,q)$  as an automorphism group.

## Software Development

- *Pebble It*, 2007-2009  
Supervised Evan Peck (undergraduate, Gordon College), Andrew Foster, Jeff Largent, Kevin Browder, Kim Klask, Ryan Alfuth, Eric Depree, Brenda Cuellar (undergraduates, Hope College), and Josh Visscher (West Ottawa High School) to design and implement a human computing game that records player moves so that their strategies can be studied and algorithms based on those strategies can be gleaned. The software was implemented so that games based on other graph based problem can be implemented fairly easily.
- *Wildfire Wally*, 2006-2007  
Supervised Chris Martens (undergraduate, Carnegie Mellon), Priyanshu Mutreja (undergraduate, Valparaiso), Evan Peck (undergraduate, Gordon College), and Maria Riolo (undergraduate, Cal Tech) to design and implement a volunteer computing game that solves instances of the Maximum Clique Problem.
- *SmartSensor*, 2005-2006  
Developed a Java-based interface to an industrial control to perform data viewing, data logging and calibration.
- *T3RevEng*, 2004-2005  
Worked with Gretchen Foley (Music, UNL) to develop a Java application to assist in the analysis of music in George Perle's System of *Twelve Tone Tonality*.
- *Webhandin*, 2003-2005  
Supervised Cory Lueninghoener and Ryan Lim (graduate students, UNL) to develop a web-based submission system for homework assignments for courses in the Department of Computer Science and Engineering at UNL; modified for use at Hope College.
- *Web-Based Programming Contests Judge*, 2002-2004  
Supervised Chris Hammack (graduate student, UNL) and Andrew Watt (undergraduate, UNL) to create a web-based submission and execution platform to judge programming contests.
- *TACSE (Tutorials and Applets for Computer Science Education)*, 2001-2003  
Supervised Chris Hammack (graduate student, UNL) to create an online repository of tutorials, lecture notes, applets, and links related to computer science and mathematics topics which allowed users to view, submit, and rate content.
- *Discrete Structures Applets*, 2001-2002  
Supervised Chris Hammack and Cory Lueninghoener (graduate students, UNL) to create Java applets to help students learn about functions, truth tables, and set operations; created Java applet that allows users to apply logical equivalences to arbitrary propositions.

## Funding

- CAREER: Human Computing Games for NP-Complete Problems, *National Science Foundation*, 2009-2014, \$497,736 (submitted).
- Algorithms for Graph Pebbling, with Airat Bekmetjev, *HHMI Faculty Development Grant for Interdisciplinary Case Study Development*, Hope College, 2007, \$2500.
- Simulations and Probabilistic Algorithms in Graph Pebbling, with Airat Bekmetjev *HHMI Interdisciplinary Research Grant*, Hope College, 2007, \$10,000.
- *National Center for Information Technology in Education Grant*, UNL, 2001-2002, \$15,000.

## Awards

- *Outstanding Teaching Award for Lower Division Courses*, Department of Computer Science and Engineering, UNL, 2002-2003.
- *Beta Theta Pi Faculty Recognition Award*, UNL, 2003.
- *Outstanding Contributions to the J.D. Edwards Honors Program*, UNL, 2001-2002.

## Pedagogical, Curricular Development and Outreach Activities

- *3D Computer Programming, Hope College/Black River Public School, 2008-2009.*  
Worked with Randall Bos (Teacher, Black River Public Schools) to teach a two week course to local high school students to introduce them to the fundamentals of programming as a way to encourage them to consider computer science as a potential major in college. This was done using the ALICE programming environment.
- *REACH (Research Experience Across Cultures at Hope College), Hope College, 2009.*  
Incorporated high school students into my research group for six weeks during the summer. REACH builds connections between high school students and teachers and Hope College faculty and students, and seeks to get students excited about doing research in science and mathematics, and better prepare them for college. One of the goals of the program is to increase the diversity of students studying science and mathematics.
- *Graph Pebbling Interdisciplinary Case Study, 2007-2008*  
Worked with Airat Bekmetjev (Mathematics, Hope College) to develop an interdisciplinary case study related to graph pebbling for use in an algorithms course.
- *Redesigned Introduction to Computer Science Laboratory, Hope College, 2006-2007*  
Worked with Ryan McFall and Mike Jipping (Computer Science, Hope College) to improve the delivery of our introductory programming lab by incorporating both Alice and Java into the course.
- *Retoiled Introduction to Computer Science II, UNL, 2004*  
Created a new CS2 (second introductory) course which included the traditional object-oriented programming and data structures topics, but revolved around building a web-based, 3-tier application; Worked with Joyita Mallik, Saket Das, and Xuli Liu (graduate students, UNL) to develop labs for the course.
- *Improved Introduction to Discrete Structures course, UNL, 2003-2004*  
To make the material more relevant, added programming assignments which required

students to implement one or more concepts from the course and apply course concepts; required students to create a web-based tutorial on a discrete mathematics topic to help them learn and communicate better.

- *Improved Data Structures and Algorithms courses, UNL, 2003*  
Reorganized the course to group topics by algorithmic technique rather than the traditional problem-based approach; added introductory sections on distributed algorithms, computability theory, and complexity theory.
- *Quantum Computing, UNL, 2003*  
First time taught in department; students included graduate and undergraduate students in computer science, mathematics, and physics; theoretical course, with subjects including foundational mathematics and quantum physics, quantum gates, quantum algorithms, and quantum error correction.
- *Curriculum Development, J.D. Edwards Honors Program, UNL, 2001-2002*  
Designed three new courses for the program; integrated discrete mathematics topics throughout the courses; worked with faculty from Business to integrate business concepts into each course.
- *Course Supplements Websites, 2000-ongoing*  
Maintain a website with programming examples in Java, C++, PHP, and MySQL for students who learn by example; maintain a website with lecture notes and supplements for discrete mathematics, data structures, algorithms, and other topics.

## Teaching

### Hope College

Fall 2009	CSCI 225	Software Design & Implementation
	CSCI 250	Discrete Structures
	CSCI 385	Advanced Data Structures and Algorithms
Spring 2009	CSCI 225	Software Design & Implementation
	CSCI 235	Software Design & Data Structures
Fall 2008	CSCI 225	Software Design & Implementation
	CSCI 250	Discrete Structures
	CSCI 495	Cryptography
Spring 2008	CSCI 235	Software Design & Data Structures
	CSCI 385	Advanced Data Structures and Algorithms
Fall 2007	CSCI 235	Software Design & Data Structures
	CSCI 112/114	Introduction to Computer Science (2 sections)
	CSCI 114	Introduction to Computer Science Lab
Spring 2007	CSCI 470	Languages and Machines
	CSCI 112/114	Introduction to Computer Science (2 sections)
	CSCI 114	Introduction to Computer Science Lab
Fall 2006	CSCI 235	Software Design & Data Structures
	CSCI 112/114	Introduction to Computer Science (3 sections)
Spring 2006	CSCI 385	Advanced Data Structures and Algorithms

	CSCI 114	Introduction to Computer Science Lab
Fall 2005	CSCI 295	Software Design & Data Structures
	CSCI 114	Introduction to Computer Science Lab (2 sections)

### University of Nebraska—Lincoln

Fall 2004	CSCE 235	Introduction to Discrete Structures
Spring 2004	CSCE 156	Introduction to Computer Science II
Fall 2003	CSCE 101	Computer Science Fundamentals
	CSCE 235	Introduction to Discrete Structures
	CSCE 310	Data Structures and Algorithms
	CSCE 310J	Data Structures and Algorithms, JDE Section
Spring 2003	CSCE 423/823	Design and Analysis of Algorithms
	CSCE 469/896	Quantum Computing
Fall 2002	CSCE 155J	Introduction to Computer Science I, JDE Section
	CSCE 235	Introduction to Discrete Structures
Spring 2002	CSCE 156J	Introduction to Computer Science II, JDE Section
	CSCE 310J	Data Structures and Algorithms, JDE Section
Fall 2001	CSCE 155J	Introduction to Computer Science I, JDE Section
	CSCE 235J	Introduction to Discrete Structures, JDE Section
Spring 2001	CSCE 423/823	Design and Analysis of Algorithms
	CSCE 156H	Introduction to Computer Science II, Honors Section
Fall 2000	CSCE 310	Data Structures and Algorithms
	CSCE 156	Introduction to Computer Science II
Spring 2000	CSCE 310	Data Structures and Algorithms
Fall 1999	CSCE 310	Data Structures and Algorithms
Summer 1999	CSCE 310	Data Structures and Algorithms
Spring 1998	CSCE 235	Introduction to Discrete Structures (T.A.)
Fall 1997	CSCE 251U	UNIX Programming
Summer 1997	CSCE 251U	UNIX Programming
	CSCE 251K	C Programming
Spring 1997	CSCE 230	Computer Organization (T.A.)
Fall 1996	CSCE 230	Computer Organization
Spring 1996	CSCE 252D	FORTRAN Programming
Fall 1995	CSCE 110	Introduction to Data Processing
Spring 1995	MATH 101	College Algebra
Fall 1994	MATH 106	Calculus 1 (T.A.)

### Michigan Technological University

Spring 1994	MATH 151	Calculus 2
Winter 1994	MATH 151	Calculus 2

Fall 1993	MATH 150	Calculus 1 (T.A.)
Summer 1993	MATH 151	Calculus 2
Spring 1993	MATH 131	Trigonometry
Winter 1993	MATH 130	College Algebra
Fall 1992	MATH 133	Pre-Calculus (T.A.)

### Professional Societies

- Association for Computing Machinery (ACM)
- ACM Special Interest Group on Computer Science Education (SIGCSE)
- ACM Special Interest Group on Algorithms and Computational Theory (SIGACT)

### Service

- Reviewer, Consortium for Computing Sciences in Colleges: Midwest Conference, 2009.
- Member, Program Committee, Meaningful Play Conference, 2008.
- Member, Scholarship Committee, Natural and Applied Sciences, Hope College, 2008.
- Coordinator, Teaching Assistants, Computer Science, Hope College, 2008.
- Coordinator, CSE Day Committee, CSE, UNL, 2001-2004
  - Organized annual high school programming contest and outreach event which attracts 75-100 students from 15-25 high schools across the state of Nebraska each year
- Member, Curriculum Committee, CSE, UNL, 2001-2004
  - Led initiative to update curriculum to bring it in line with the *ACM/IEEE Computing Curricula 2001*
- Chair, Outreach Committee, CSE, UNL, 2003
  - Oversaw CSE Day, Technology Fair, Department Newsletter
- Member, Services Committee, CSE, UNL, 2001-2003
- Member, Curriculum Committee, JDE, UNL, 2001-2002
  - Developed 3 courses for the J.D. Edwards Honors Program in Computer Science and Management
- Member, Admissions Committee, JDE, UNL, 2001-2002
  - Screened files, interviewed candidates
- Member, Academic Integrity Policy Committee, CSE, UNL, 2001
  - Developed the policy for the department
- Member, Equipment Committee, CSE, UNL, 2000-2001
- Member, Undergraduate Advising Committee, CSE, UNL, 2000-2001
- Member, Computer Science and Engineering Chair Search Committee, UNL, 1999-2000
- Member, Faculty Search Committee, CSE, UNL, 1997-1998
- Member, Equipment Committee, CSE, UNL, 1997-1998

## **Collaborators and Other Affiliations**

### **Collaborators**

- Bekmetjev, Airat (Hope College)
- Magliveras, Spyros (Florida Atlantic University)
- Kreher, Donald (Michigan Technological University)
- Graham, Sidney (Central Michigan University)
- Colbourn, Charlie (Arizona State University)
- Foley, Gretchen (University of Nebraska—Lincoln)

### **Graduate Advisors:**

- Magliveras, Spyros (Florida Atlantic University)
- Kreher, Donald (Michigan Technological University)