

Computer Science  
Furman University  
3300 Poinsett Highway  
Greenville, SC, 29613, USA

Phone: (864) 294 - 2269  
Email: chris.alvin@furman.edu

## Education

**Ph.D. Computer Science**, Louisiana State University at Baton Rouge, August 2015.

**Thesis:** *Synthesis with Hypergraphs*

**Advisor:** Supratik Mukhopadhyay

**M.S. Mathematics**, Marquette University, May 2011.

**M.S. Computer Science**, University of Wisconsin at Madison, May 2001.

**B.A. Mathematics, Computer Science**, Ripon College, May 1999.

## Employment

**2018 - Present** Assistant Professor, Furman University, Greenville, SC.

**2016 - 2018** Assistant Professor, Bradley University, Peoria, IL.

**2015 - 2016** Visiting Assistant Professor, Bradley University, Peoria, IL.

**2013 - 2015** Research Assistant, Louisiana State University, Baton Rouge, LA.

**2012 - 2013** Teaching Assistant Level 3, Louisiana State University, Baton Rouge, LA.

**2011 - 2012** Mathematics Teacher, McGill-Toolen Catholic High School, Mobile, AL.

**2006 - 2011** Teacher of Mathematics, Statistics, and Engineering, Divine Savior Holy Angels High School, Milwaukee, WI.

**2005 - 2006** Mathematics Teacher, New Berlin West High School, New Berlin, WI.

**2001 - 2003** Associate Software Engineer, Lakota Technical Solutions, Inc., Laurel, MD.

**1999 - 2001** Graduate Teaching Assistant, Department of Computer Sciences, University of Wisconsin at Madison.

## Journal Publications

1. Whitmire D.<sup>1</sup>, Alvin C., *A Case Study in Software Testing: Verification of a Face Identification Algorithm for Planar Graphs*, The Journal of Computing Sciences in Colleges, 2019, 35(3).
2. Alvin C., *Student Generation of an Optimal Decision Procedure using Guess Who?*, The Journal of Computing Sciences in Colleges, 2019, 34(6): 26-34.

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<sup>1</sup>Undergraduate students are underlined.

3. Liu T., Naderi M., Alvin C., Mukhopadhyay S., Brylinski M., *Break Down in Order To Build Up: Decomposing Small Molecules for Fragment-Based Drug Design with eMolFrag*, Journal of Chemical Information and Modeling, 57(4): 627-631, 2017.
4. Naderi M., Alvin C., Ding, Y., Mukhopadhyay S., Brylinski M., *A Graph-Based Approach to Construct Target-Focused Libraries for Virtual Screening*, Journal of Cheminformatics, 8(1): 14:1-14:16, 2016.

## Conference Proceedings

1. Glueck B., Alvin C., *Synthesis of Limit Problems for Single-Variable Calculus*, Proceedings of the 32nd International Florida Artificial Intelligence Research Society Conference, FLAIRS 2019, Sarasota, Florida, USA, May 19-22, 2019.
2. Stocker, A., Alvin C., *Non-Linear Quest Generation*, Proceedings of the 31st International Florida Artificial Intelligence Research Society Conference, FLAIRS 2018, Melbourne, Florida, USA, May 21-23, 2018.
3. Alvin C., Gulwani S., Majumdar R., Mukhopadhyay S., *Synthesis of Problems for Shaded Area Geometry Reasoning*, Proceedings of Artificial Intelligence in Education - 18th International Conference, AIED 2017, Wuhan, China, June 28 - July 1, 2017.
4. Alvin C., Gulwani S., Majumdar R., Mukhopadhyay S., *Synthesis of Solutions for Shaded Area Geometry Problems*, Proceedings of the Thirtieth International Florida Artificial Intelligence Research Society Conference, FLAIRS 2017, Marco Island, Florida, USA, May 22-24, 2017.
5. Alvin C., Peterson B., Mukhopadhyay S., *StaticGen: Static Generation of UML Sequence Diagrams*, Proceedings of Fundamental Approaches to Software Engineering - 20th International Conference, FASE 2017, Held as Part of the European Joint Conferences on Theory and Practice of Software, ETAPS 2017, Uppsala, Sweden, April 22-29, 2017.
6. Alvin C., Gulwani S., Majumdar R., Mukhopadhyay S., *Synthesis of Geometry Proof Problems*, Proceedings of the Association for the Advancement of Artificial Intelligence (AAAI) Conference on Artificial Intelligence, July 27 -31, 2014, Québec City, Québec, Canada., 2014.

## Invited and Conference Talks

- *Student Generation of an Optimal Decision Procedure using Guess Who?* at CCSC:NE, April, 2019.
- *Synthesis of Solutions for Shaded Area Geometry Problems* at FLAIRS-30, May, 2017.
- *StaticGen: Static Generation of UML Sequence Diagrams* at FASE, April, 2017.
- *Data-Driven Abstract Interpretation* at Spring Topology and Dynamical Systems Conference, March, 2017.
- *Synthesis of Geometry Proof Problems* at AAAI-14, July 31, 2014.
- *Synthesis of Geometry Proof Problems* at LSU Computer Science Department Industrial Advisory Board Meeting, April 4, 2014.

- *Synthesis of Geometry Proof Problems* at LSU Seminar on Software Verification, Logic, Cognitive and Distributed Systems, March 12, 2014.
- *Discovering Equivalences between Program Sub-Expressions and Interprocedural Analysis Using Random Interpretation* at LSU Seminar on Software Verification, Logic, Cognitive and Distributed Systems, April 23, 2013.
- *Random Testing + Abstract Interpretation = Random Interpretation* at LSU Seminar on Software Verification, Logic, Cognitive and Distributed Systems, April 16, 2013.
- *Introduction to Abstract Interpretation* at LSU Seminar on Software Verification, Logic, Cognitive and Distributed Systems, February 19 and 26, 2013.

## Furman University Summer Research Fellows

### **Analysis and Generation of Trigonometric Identity Problems, 2019**

Students: Meredith Pearce, Jonathan McKinney

Using a graph-based model, we explored the space of trigonometric identities symbolically seeking new and interesting models (templates) for such problems. We then developed a relative difficulty model of this problem type.

### **A Recommender System for Walt Disney World Hotels, 2019**

Computer Science Students: Noah Johnson and Maddie Preston

Applied Mathematics Students: Annie Phillips and Rebecca Wilhelmi

Co-Faculty Mentors: Dr. Liz Bouzarth and Dr. Kevin Hutson

Notes: Noah Johnson was partially funded (\$2500) by the South Carolina Independent Colleges and Universities Research Grant

Developed a recommender system for Walt Disney World hotels using more than 26000 completed user survey from touringplans.com. This system was implemented in Python using Scikit-Learn.

### **Semantically Valid Non-Linear Quest Generation, 2019**

Students: Bridget Kennerly and Ethan Kohrt

Built on prior quest-generation work to ensure that generated quests followed a valid narrative progression.

### **A Computational Approach to the Reconstruction of Proto-Japano-Koreanic, 2019**

Students: Alicia Key

Co-Faculty Mentor: Dr. Alexander Francis-Ratte

Notes: Funded by the Furman University Computer Science Computing in Community initiative

We defined scoring mechanisms and a clustering model for candidate cognates en route to addressing the question: “Are the Japanese and Korean languages related?”

## Independent Study Courses and Other Project Research

**Synthesis of Trigonometric Identity Problems**, Meredith Pearce, Furman University, October 2018 - May 2019

We defined a graph-based model to explore the space of trigonometric identities symbolically seeking new and interesting models (templates) for such problems.

**Computer Vision**, John Markey, Bradley University, Spring 2018

An independent study on Computer Vision. Topics included: cameras and optics, light and color image filtering, frequency, points of interest and corners, image features, transformations, and detection.

**Non-Linear Quest Generation**, Alex Stocker (Undergraduate), January 2016 - September 2017

We developed a hypergraph-based technique for generating non-linear game quests supporting concurrency, parallelism, and dependence among player activities.

**Synthesis of Limit Problems for Calculus**, Blake Glueck, Bradley University, January 2016 - May 2017

A sophomore-level student implemented a framework for generating functions and corresponding limit problems using a genetic approach; see submitted publications.

**Introduction to Computational Geometry Algorithms**, Drew Whitmire, Bradley University, Spring 2017

Independent study content included fundamental geometry and geometric processing algorithms related to figure decomposition.

**Fundamentals of Synthesis**, Tom Nielsen, Bradley University, Fall 2016

The course discussed current fundamental (hyper)graph-based algorithms in program synthesis with an emphasis on implementation.

**Gateway Test Generator**, Srikanth Kancharla (Graduate), Spring 2016

The student implemented a front-end interface for uploading Latex-based mathematics questions, generating mastery-driven multiple-choice quizzes and answers, as well as a back-end database in Apache Tomcat to support caching of questions.

## Undergraduate Capstone Projects

**Sequence Analysis for Dynamical Systems**, 4 Seniors, August 2017 - May 2018

Students designed an interpreted language and implement an interactive, command-line interpreter for analyzing dynamical characteristics of string-based representations.

**Minimizing Regular Polytope Coverage**, 4 Seniors, August 2017 - May 2018

Students attempted to answer the minimization question, *for a given regular polytope, what is a minimal set of vertices such that each facet contains at least one of the vertices?* Students designed and implemented algorithms to search this space which may be as vast as  $2^{120}$ .

**Re-Engineering a Proof of Concept Codebase**, 5 Seniors, August 2016 - May 2017

Given a proof of concept codebase in C# implementing geometry problem synthesis, students re-engineered that code base into Java in order to support a more robust, open-source user interface. Simultaneously, students established a robust, automated test framework.

## Grants and Awards

**Bradley University Special Emphasis (SE): Faculty-Student Engagement**, January 2018 - May 2018

Funded project (\$9725) titled *Gene Ontology Analysis* through Bradley University to support an interdisciplinary research project: systematic analysis of the annotations of genes in the Tetrahymena Genome Database.

**Caterpillar Fellowship Award**, May 2017 - May 2018

Recipient of \$5000 through Bradley University to support research on *Synthesis of Region-Based Calculus Problems*.

**Bradley University Special Emphasis (SE): Faculty-Student Engagement**, January 2016 - May 2017

Funded project (\$7380) titled *Synthesis of Limit Problems for Calculus* through Bradley University to support engaging students meaningfully in research. This work was submitted for publication to FLAIRS, 2019.

**Economic Development Assistantship**, Louisiana State University, August 2013 - August 2015.

A prestigious 4-year fellowship for those whose study and/or research will directly affect the economic development of the state of Louisiana.

### Other Awards

Awarded \$200 student scholarship from AAAI for AAAI-14.

Awarded 1,500€ from NATO for living expenses, participation fee, and travel grant for Summer School in Software Systems Safety, Marktobendorf, Germany 2013.

## Submitted Proposals

PI for Small Project *Design Patterns and Vulnerability Analysis in Legacy Code*. Submitted to NSF Computing and Communication Foundations, November, 2016. Not funded.

PI for Small Project *Discovering Design Patterns in Legacy Code*. Submitted to NSF Computing and Communication Foundations, November, 2015. Not funded.

## Service

**Accepted New Course Proposals**, Furman University, Department of Computer Science, August 2018 - May 2019.

MXP-281: You Sunk My Battleship! Board Game Analysis and Design

CSC-348: Game Design and Development

CSC-364: Compilers

CSC-348: Machine Learning with Big Data

**Member, Curriculum Committee**, Department of Computer Science and Information Systems, Bradley University, January 2016 - May 2018.

**Representative, Faculty Senate**, Bradley University, May 2017 - Present.

## Other Teaching

**Assistant Professor**, Bradley University, August 2015 - May 2018.

CS 101 Introduction to Programming (Java) (5)

CS 102 Data Structures (Java) (1)

CS 140 Advanced Programming Concepts (C++) (4)

CS 210 Advanced Data Structures and Algorithms (C++) (4)

CS 390 Introduction to Software Engineering (2)

CS 490 / 491 Capstone Project (3)

CS 498 Directed Individual Studies (5)

CS 698 Directed Individual Studies (1)

**Adjunct Instructor**, University of West Florida, Spring 2012 - Spring 2014.

Adjunct Instructor for *Programming Using C++* and *Programming Using Java*. All courses were taught 100% online.

**Teaching Assistant**, Louisiana State University, Fall 2012 - Spring 2013.

Instructor of record for *Computers in Society*, a course focused on computers, their applications, and impact on people and social institutions.

**Teacher**, McGill-Toolen Catholic High School, 2011 - 2012.

Taught four sections of Pre-Calculus and one section of Geometry.

**Teacher**, Divine Savior Holy Angels High School (DSHA), 2006 - 2011.

Taught all courses at DSHA with a focus on integrating technology into the classroom. Each classroom was equipped with Smart Boards where I focused on delivery of material using interactive tools. Classes taught include:

- AP Calculus BC
- AP Statistics
- Honors Trigonometry and Pre-Calculus
- Introduction to Engineering
- Honors Algebra II
- Trigonometry and Pre-Calculus
- Advanced Mathematical Topics
- Algebra I
- Academic Support

Mentored a group of 10-13 students each year. The focus is to create a supportive environment for students outside of the normal classroom.

Moderated the DSHA Robotics Club which participated in the National FIRST Robotics competition. This included organizing student participation at the

school level with the intent of students gaining hands-on experience with mechanical, electrical, and software engineering.

Leader and facilitator of an accreditation team that addressed a required action to investigate the use of data to drive decision-making around student learning through the use of standardized tests and in-house common assessments.

**Instructor,** CTD at Northwestern University, Summers 2008-2010.

Taught the following courses during a three week accelerated summer program for gifted and talented middle and high school students.

- AP Statistics
- Honors Trigonometry and Pre-Calculus

**Instructor,** WCATY, Summers 2003 - 2008.

The curricula for these courses were developed specifically for the accelerated environment expected by these programs. All courses were instructed using individually paced, differentiated instructional techniques.

Taught the following courses during a three week summer program for gifted and talented high school students (Accelerated Learning Program).

- AP Computer Science A
- AP Computer Science AB
- Artificial Intelligence for Games
- A Study in Programming Languages (ML, Scheme, C, Ada, Prolog, C#)

Taught the following courses during a three week summer program for gifted and talented middle school students (Summer Transitional Enrichment Program): (a) *Games, Strategy, and Logic*, (b) *Programming in Java*, and (c) *Cryptology: Codemakers and Codebreakers*.

**Teacher,** New Berlin West High School, 2005-2006.

Instructed four sections of Pre-Calculus and one section of Algebra I.

**Teaching Assistant,** University of Wisconsin at Madison, 1999-2001.

Instructed over 300 students in *Introduction to Programming in C++*.

## Industry Experience

**Associate Engineer,** Lakota Technical Solutions, Inc., 2001-2003.

Worked on several projects related to data compression using static analysis techniques, static analysis of critical real-time systems, and new business acquisition through grant proposals.

## Professional Memberships

Institute of Electrical and Electronics Engineers (IEEE).

Association for the Advancement of Artificial Intelligence (AAAI).