Aaron J. Smith

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Research interests

Receiver-driven scalable video coding, peer teaching tools, scalable and equitable teaching, entrepreneurship, software engineering, web technology, cloud services

Education

University of North Carolina at Chapel Hill — Chapel Hill, NC
Doctor of Philosophy, Computer Science — August 2021
Master of Science, Computer Science — December 2019
Advisor: Ketan Mayer-Patel

Coastal Carolina University — Conway, SC
Bachelor of Science, Computer Science — May 2014
Bachelor of Science, Applied Mathematics — May 2014
Honors Program graduate, 4.00 GPA

Employment

Teaching Assistant Professor — July 2021 – Present
University of North Carolina at Chapel Hill

Teaching Fellow — August 2020 – May 2021
University of North Carolina at Chapel Hill

Teaching Assistant — January 2019 – May 2020
University of North Carolina at Chapel Hill

Research Assistant — August 2015 – December 2018
University of North Carolina at Chapel Hill

Teaching Assistant — August 2014 – May 2015
University of North Carolina at Chapel Hill

Publications and Patents

Methods, Systems, and Computer Readable Media for Decoding Video using Rate Sorted Entropy Coding
Ketan Dasharath Mayer-Patel and Aaron Joseph Smith
Patent Application filed in June 2020

My Digital Hand: A Tool for Scaling Up One-to-One Peer Teaching in Support of Computer Science Learning
Aaron J. Smith, Kristy Elizabeth Boyer, Jeffrey Forbes, Sarah Heckman, and Ketan Mayer-Patel
Proceedings of the 2017 ACM SIGCSE Technical Symposium on Computer Science Education
DOI: https://doi.org/10.1145/3017680.3017800

A System Model for Frameless Asynchronous High Dynamic Range Sensors

Aaron Smith, Montek Singh, and Ketan Mayer-Patel

Proceedings of the 27th Workshop on Network and Operating Systems Support for Digital Audio and Video, 2017

DOI: https://doi.org/10.1145/3083165.3083178

Research experience

Receiver-Driven, Scalable Video Coding

University of North Carolina at Chapel Hill — Fall 2016 – August 2021

Academic Advisor: Ketan Mayer-Patel

My PhD thesis makes the case that existing video systems and infrastructure can be adapted to better support novel clients and situations simply by exposing the underlying representation originally captured at the source. I present a new rate-limited arithmetic entropy coding scheme for Motion-JPEG, demonstrate a fast transcoding algorithm for HEVC based on residual re-encoding, and describe a fully receiver-driven video encoding system

My Digital Hand

University of North Carolina at Chapel Hill — Fall 2015 – Present

Collaborators: Peer Teaching Fellows - Sarah Heckman (North Carolina State University), Ketan Mayer-Patel, Kristy Elizabeth Boyer (University of Florida), Jeff Forbes (Duke University)

I am the sole designer, creator, and maintainer of My Digital Hand (MDH), a cloud-hosted, web-based application for managing and recording office hours interactions in large university introductory computer science courses. MDH is currently used at universities in North America including UNC, Duke, NC State, University of Toronto, and Virginia Tech University. I was the Project Coordinator at UNC for this project. The high-level education research goal was to identify common help-seeking behaviors in large-scale, cross-discipline, introductory programming courses, and design interventions to promote diversity and equity through these learning avenues; and additionally, to design evidence-based classroom tools like MDH that encourage equity, diversity, and productive behavior in one-on-one peer teaching office hours for large-scale CS1 and CS2 courses. This project was funded by grants from Google and the NSF

Frameless Video Representation

University of North Carolina at Chapel Hill — Fall 2015 – Spring 2016

Collaborators: Ketan Mayer-Patel, Montek Singh

Designed a novel compression system for representing ultra-high dynamic range frameless video captured by an asynchronous event-based light sensor

Applying the Poincaré Recurrence Theorem to Billiards
Coastal Carolina University Spring 2013 – Spring 2014
Faculty Mentor: David Duncan
Applied the Poincaré Recurrence Theorem to a frictionless, perfectly elastic system of pool balls on a billiards table to show how seemingly innocuous assumptions can result in non-intuitive, unexpected behavior. Undergraduate senior thesis

MATLAB Coral Reef Simulation
Coastal Carolina University Fall 2013 – Spring 2014
Collaborators: Tessa Weinstein, Chelsea Beese
Designed an agent-based simulation in MATLAB to model the long-term health of Caribbean coral reef. Used hexagon-based cells for computing organism interactions to more accurately model spatial competition on the reef

Inferring Attention from Wrist-Worn Accelerometer Data
University of Houston, Computational Physiology Lab Summer 2012
Collaborators: Ioannis Pavlidis, Panagiotis Tsiamyrtzis
Analyzed accelerometer data in MATLAB from a wrist-worn Q-Sensor to assess attention during a longitudinal experiment in which subjects were asked to monitor security cameras while their physiological responses were recorded. Funded by an educational NSF grant

MATLAB Blackjack Simulation
Coastal Carolina University Spring 2011 – Spring 2012
Collaborators: Tessa Weinstein
Designed a Blackjack simulator in MATLAB. Conducted a user study in which subjects were asked to play the simulator and their strategy decisions were recorded. Recorded data was turned into a player strategy so that the expected return could be compared against optimal basic strategy.

Teaching experience

Instructor of Record, Department of Computer Science
University of North Carolina at Chapel Hill

COMP 455 Models of Languages and Computation Fall 2021

COMP 301 Foundations of Programming Fall 2020 – Fall 2021
Piloted a new course on structuring large projects in Java. Topics include inheritance, testing, design patterns, MVC, GUIs, asynchronous programming. Designed all course material from scratch, including lectures, assignments, quizzes, exams, and concept videos. Managed a team of 7-10 paid undergraduates to help administer the course and provide support through office hours. 100-160 students per semester

COMP 110 Introduction to Programming Summer I 2019
Accelerated summer offering of a CS1 course taught in TypeScript. 20 students

Teaching Assistant, Department of Computer Science
University of North Carolina at Chapel Hill
COMP 523 Software Engineering Lab — Spring 2020
COMP 426 Modern Web Programming — Fall 2014, Fall 2019
COMP 590 Data Compression — Spring 2019
COMP 401 Foundations of Programming — Spring 2015

Teaching Assistant, Department of Mathematics
Coastal Carolina University — Fall 2011 – Spring 2014
MATH 344 Linear Algebra
MATH 320 Differential Equations
MATH 260 Calculus III

Physics Learning Assistant, Department of Physics
Coastal Carolina University — Fall 2012 – Spring 2013
Department-sponsored peer teacher. Offered office hours for students needing physics homework help. Concepts tutored include kinematic, rotational, and harmonic motion; Newton's laws of motion; forces; energy; work; thermodynamics; fluid dynamics; waves; optics; electricity and magnetism.

Lab Teaching Assistant, Department of Computer Science
Coastal Carolina University — Fall 2010
CSCI 140L Introduction to Algorithmic Design I
Administered and proctored timed introductory programming lab assignments in Python

Talks, posters, and presentations

A System Model for Capturing, Representing, and Compressing Frameless, High Dynamic Range Video — May 2017
Master's Thesis Presentation
University of North Carolina at Chapel Hill

My Digital Hand: A Tool for Scaling Up One-to-One Peer Teaching in Support of Computer Science Learning — March 2017
Conference Presentation
Special Interest Group on Computer Science Education (SIGCSE). Seattle, WA

How to Violate the Second Law of Thermodynamics While Shooting Pool — March 2014
Undergraduate Paper Session
MAA Southeastern Section Spring Meeting. Cookeville, TN

An Agent-Based Model for a Caribbean Coral Reef — January 2014
Undergraduate Poster Session
Joint Mathematics Meeting. Baltimore, MD

Blackjack Card Counting Techniques March 2012
Undergraduate Paper Session
MAA Southeastern Section Spring Meeting. Morrow, GA

Conferences

Special Interest Group on Computer Science Education (SIGCSE) March 2020
Portland, OR

ACM's Celebration of 50 Years of the ACM Turing Award June 2017
San Francisco, CA

Special Interest Group on Computer Science Education (SIGCSE) March 2017
Seattle, WA

Special Interest Group on Computer Science Education (SIGCSE) March 2016
Memphis, TN

MAA Southeastern Section Spring Meeting March 2014
Cookeville, TN

Joint Mathematics Meeting January 2014
Baltimore, MD

MAA Southeastern Section Spring Meeting March 2012
Morrow, GA

Honors and scholarships

Computer Science Undergraduate Faculty Award 2020 – 2021
Department of Computer Science
University of North Carolina at Chapel Hill

Distinguished Student Award 2013 – 2014
Coastal Carolina University

Student of the Year 2013 – 2014
Department of Mathematics
Coastal Carolina University

President's Scholar Award 2010 – 2014
Coastal Carolina University

Palmetto Fellows Scholarship 2010 – 2014
State of South Carolina

REU Poster Competition Winner Summer 2012
University of Houston REU Program

Skills

Select Programming Languages

Java, Python, JavaScript, MATLAB, PHP, Ruby, SQL, C/C++, HTML, CSS

Libraries, Frameworks, Environments, & Tools

JavaScript: React.js, Node.js, Express, Socket.io, Ember.js, TypeScript
Java: Maven, JavaFX, NumPy, Keras, Rails
Python: NumPy, Keras
Ruby: Rails
CSS: Bootstrap, SCSS, Bulma, BEM
Cloud: AWS, Heroku