Blake Holman

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Education

Purdue University August 2021–Present, GPA 4.0
PhD in Computer Science
Ross Fellow
Advisor: Jeremiah Blocki

The University of Texas at Austin May 2021, GPA 3.85
Bachelor of Science in Computer Science with Special Departmental Honors
Bachelor of Science in Mathematics
Ronald E. McNair Scholar

Research Interests

- Password Hashing and Memory-Hard Functions
- Post-Quantum Cryptography
- Securing/Incentive-driven Analysis of Blockchains

Relevant Coursework: Cryptography (Graduate), Complexity Theory (Graduate), Randomized Algorithms (Graduate), Quantum Computing III Algorithms & Software (Graduate), Quantum Information & Computing, Cryptography, Theory of Computation, Symbolic Logic & Computability, Combinatorics & Graph Theory (Graduate), Algorithms & Complexity Theory, Algebraic Structures, Real Analysis, Numerical Analysis in Scientific Computation

Publications and Academic Work

Current Projects

[1] **B. Holman** and J. Katz. "The Evolution of the Gap Game".

[2] J. Blocki and **B. Holman**. "Direct Proofs of the Sustained Memory and Cumulative Memory Complexity Tradeoffs for Data-Dependent Memory-Hard Functions".

[3] J. Blocki, Seunghoon Lee, and **B. Holman**. "Better Security Bounds for Security of Proofs of Sequential Work in a Post-Quantum World".

[4] J. Blocki, Seunghoon Lee, and **B. Holman**. "Parallel Quantum Pebbling: Analyzing the Post-Quantum Security of iMHFs".

Papers

[5] J. Blocki and **B. Holman**. "Sustained Space and Cumulative Complexity Trade-offs for Data-Dependent Memory-Hard Functions". *CRYPTO (under review)*. Aug. 2022.

[6] **B. Holman**, A. Anwar, A. Singh, M. Tec, J. Hart, and P. Stone. "Watch Where You're Going! Gaze and Head Orientation as Predictors for Social Robot Navigation". *IEEE International Conference on Robotics and Automation (ICRA)*. May 2021.

[7] **B. Holman**. "" *UT Austin Ronald E. McNair Scholars Research Journal*. Aug. 2020.

[8] **B. Holman**, A. Toribio, and B. Bullock. "Muchos están mixing but few are mezclando: A data-driven analysis of AUX-V switching". *Linguistic Symposium on Romance Languages Workshop on Big Data*. May 2019.

Talks

[14] **B. Holman** and J. Katz. "On Mining Gaps and 51% Attacks". *Talk at the Combinatorics and Algorithms for Real Problems (CAAR) Symposium*. Aug. 2021.

Poster Presentations

[9] **B. Holman**. "Sustained Space and Cumulative Complexity Trade-offs for Data-Dependent Memory-Hard Functions". *Poster to be presented at CERIAS Symposium*. Mar. 2022.

[10] **B. Holman**. "The Relationship Between Popular and Stable Matchings in Three-Dimensional Stable Marriage". *Poster presented at the UCLA Ronald E. McNair Scholars Research Conference*. July 2020.

[11] **B. Holman**. "Popularity in Three-Dimensional Stable Marriage with Ties". *Poster presented at the Baylor University Ronald E. McNair Scholars Research Conference*. Oct. 2020.

[12] **B. Holman**. "Predictive Models for Radioisotope Identification". *Poster presented at the Sandia National Laboratories Intern Symposium*. July 2020.

[13] **B. Holman** and K. Schaub. "GPU-Accelerated Overlapping Speech Transcription". *Poster presented at the Nvidia GPU Technology Conference*. Mar. 2019.

Service

- Reviewer for the 2021 International Conference on Robotics and Automation (ICRA)

Work Experience

Sandia National Laboratories May 2022 – August 2022
Research and Development Intern *Albuquerque, NM*

- Working in the Fundamental Algorithmic Research for Quantum Computing (FAR-QC) in the Discrete Mathematics and Optimization department.

Combinatorics and Algorithms For Real Problems (CAAR) May 2021 – August 2021
Supervisor: Prof. Jonathan Katz *Collage Park, MD*

- Characterized the effects on mining gaps on the feasibility of 51% attacks on proof-of-work (PoW) protocols.
- Determined the relationship between the difficulty parameter of a PoW protocol and incentive-driven miners.
- Adversaries can force incentive-driven miners to stop mining, increasing the feasibility of 51% attacks.

Sandia National Laboratories May 2019 – June 2020
Research and Development Intern; L Clearance *Albuquerque, NM*

- Developed CNN classifiers (Keras) and a Poisson Naive Bayes Classifier on measured and synthetic data for radioisotope identification (RIID)
- Outperformed currently used RIID systems in accuracy and run-time
- Developed visualizations (Seaborn) for model accuracy on varied isotope source strengths
- Characterized unknown sources in model output, making the system usable when unexpected radioisotopes are present

Advantest May 2018 – June 2019
Artificial Intelligence Research Intern *Austin, TX*

- Developed one of the only accurate speech labeling and transcription systems that supports multiple people speaking simultaneously, presented at **Nvidia's 2019 GPU Technology Conference (GTC)**
- Developed CNN classifier for wafer defect detection (Keras) to detect whether a CPU wafer is defective or not based on an image and achieved 97% accuracy in defect detection
- Developed application to recognize people from a single picture to display relevant information, used as company demo at AI Summit 2018 and ITC 2018

Bilingual Annotation Tasks Force January 2018 – January 2019
Undergraduate Researcher *Austin, TX*

- Developed an algorithm to generate code-switching phrases using observed patterns in previous research
- Retrieved over 16000 tweets Spanish-English code-switching Tweets

Building-Wide Intelligence Lab
May 2018 – May 2022

Undergraduate Researcher - PI: Prof. Peter Stone; Supervisor: Prof. Justin Hart *Austin, TX*

Virtual Reality Study on Human Gaze Fall 2020

- Constructed experiments in virtual reality, using Unity, to measure participants' gaze while completing various tasks
- Used two-way mixed-factor ANOVA and Tukey tests to determine the significance of gaze as a predictor of motion compared to other common features
- Used multivariate Gaussian time-series to predict the endpoint of the participant's trajectory
- Submitted to the **IEEE International Conference on Robotics and Automation (ICRA)**

Pedestrian Tracking May 2018 – May 2019

- Obtained 2D image points of pedestrians feet in security camera footage using OpenPose
- Used perspective geometry to calculate the homography for 3D localization
- Implemented Kalman filters for tracking pedestrian movement
- Built a recurrent neural network to predict pedestrians' paths based on their previous paths

BBSLAM: Selective Mapping And Localization August 2018 – January 2019

- Developed a SLAM algorithm that only selects static portions of the environment for mapping
- Used maps generated by ORB-SLAM for self-localization on robot startup
- Implemented weighted ORB features based on the variability of objects based on YOLO detection

Teaching Experience

Autonomous Intelligent Robotics I/II (CS 309/378)
Spring/Fall 2019 – 2021

Teaching Assistant; Prof. Justin Hart *UT Austin*

- Held weekly office hours and graded assignments
- Supervised research projects: Active Tracking and Re-Identification for Mobile Robot Person Following (**Best CS Poster URF 2020**); Imitation Learning with UAV Path Planning

Awards and Honors

- **Ross Fellowship**, Fall 2021 – Summer 2022: "Doctoral applicants to Purdue are considered for the Ross Fellowship, which recognizes academic excellence"
- **Ronald E. McNair Scholar**, Fall 2019 – Spring 2021: Admitted into the Ronald E. McNair Post-baccalaureate Achievement Program at the University of Texas at Austin
- **Unrestricted Endowed Presidential Scholarship Award Winner**, Spring 2020: Nominated and won a competitive scholarship across over 2000 juniors and seniors at UT Austin on the basis of scholastic merit, extracurricular involvement, and leadership qualities
- **Best Computer Science Poster Award**, Spring 2020: Best CS poster at the CNS Undergraduate Research Forum
- **College Scholar**, Spring 2019: Awarded for ranking top 20 percent at UT Austin's Annual Honors Day Ceremony
- **Second-Year Excellence Award**, Spring 2019: Nominated and Recognized for high first and second-year performance
- **University Honors**, Fall 2017, Spring 2018, Spring 2020: Recognized for achieving a high GPA

Technical Skills

Languages: Python, Java, C/C++, C#, LaTeX
Technologies: Numpy, Numba, Tensorflow, Keras, scikit-learn, OpenCV, Librosa, Seaborn, Unity (VR), ROS

Activities and Leadership

- **Purdue Black Graduate Association (BGA)**, Fall 2022 – Present: Exploring and studying areas in pure mathematics
- **Directed Reading Program:** Paired with PhD Student to explore areas of pure mathematics
  - Fall 2019: Studied computational geometry, specifically Voronoi diagrams
  - Spring 2019: Studied random graphs
  - Fall 2018: Studied the genus of a graph as an extension of planarity
- **UT Math Club**, Fall 2018 – Spring 2021: Exploring and studying areas in pure mathematics
- **Association of Black Computer Scientists (ABCS)**, Fall 2017 – Spring 2021: Seeking educational and professional success for underrepresented students