Benjamin (Ben) W. Priest

CONTACT INFORMATION

Postdoctoral Researcher
Center for Applied Scientific Computing
Lawrence Livermore National Laboratory

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RESEARCH INTERESTS

Efficient analysis of large, dynamic datasets: sketching, streaming algorithms, machine learning, high performance computing, graph algorithms, numerical linear algebra, compressed sensing, graph theory, optimization, network analysis, and theory of deep learning.

EDUCATION

Thayer School of Engineering at **Dartmouth College**, Hanover, VT, USA

Ph.D., Engineering (GPA 4.0) **09/2015 – 02/2019**

- Advisor: Professor George Cybenko
- Thesis: Sublinear Approximations of Vertex Centrality in Evolving Graphs
- Demonstrated novel, sublinear-space sketching algorithms to efficiently estimate local triangle counts and vertex centrality on large, distributed graphs
- Implemented novel HPC algorithms on cutting-edge architectures

The Ohio State University, Columbus, OH, USA

B.S., Mathematics, (GPA 3.62 *Cum Laude*) **09/2011 – 06/2011**

B.S., Computer and Information Science, (GPA 3.62 *Cum Laude*) **09/2011 – 06/2011**

RESEARCH EXPERIENCE

Lawrence Livermore National Laboratory, Livermore, CA, USA
Center for Applied Scientific Computing. Supervisors: Dr. Geoff Sanders , Dr. Michael Schneider and Dr. Roger Pearce

Postdoctoral Researcher **04/2019 – Present**

- Designed and implemented novel efficient Gaussian process estimation models
- Built DegreeSketch, an HPC library for fast local query approximation in labeled graphs

Computation Student Intern **05/2018 – 01/2019**

- Built novel distributed codes for estimating local triangle counts using cardinality sketches
- Developed sophisticated communication protocols in a big-data environment
- Designed YGM library for improving performance of HPC algorithms with irregular computational load

Dartmouth College, Hanover, NH, USA
Thayer School of Engineering. Advisor: Professor George Cybenko

Research and Teaching Assistant **09/2015 – 02/2019**

- Developed novel sublinear-space sketching algorithms to estimate popular centrality indices and local structural features including triangle counts in large distributed graphs
- Contributed to Moving Target and Adaptive Cyber Defense research, designing game- and graph-theoretic models to quantify and track advanced persistent threats
- Taught courses in applied machine learning, with an emphasis on deep learning while leading a team of TAs

MIT Lincoln Laboratory, Lexington, MA, USA
Cyber Analytics and Decision Systems. Supervisor: Dr. Kevin M. Carter

Assistant Research Scientist **08/2011 – 07/2015**

- Designed and implemented novel machine learning algorithms to educe human and machine behavior from network protocol traffic
- Planned and implemented cognitive multi-agent systems to perform high-fidelity network traffic generation for network-scale simulation experiments
- Evaluated moving target cyber defenses by building a multi-agent simulation platform

Air Force Institute of Technology, Wright-Patterson Air Force Base, OH, USA
Program Encryption Group. Supervisor: Professor J. Todd McDonald

Engineering Technician GS-05 **Summer, 2008 & 2009**

- Developed encryption metrics for circuits using abstract interpretation semantic models

TECHNICAL EXPERTISE

Mathematics
Applied Mathematics
Real Analysis
Measure Theory
Graph Theory
Combinatorics

Computer Science and Engineering
Distributed & parallel algorithms
Streaming algorithms & sketching
Data structures

Data Science and Processing
Probability & Random Variables
Statistics & Estimation
Machine learning & deep learning
Numerical Optimization
Stochastic Processes
Information Theory
Communication Theory

Programming Languages
C/C++, Java, MATLAB, R

Scripting Languages
Python, Bash, Julia

Distributed Computing
MPI, Hadoop MapReduce, Lustre

Analytical Software
Keras, TensorFlow, Mathematica

Utility Software
Git, GitHub/Bitbucket
LaTeX, BibTeX

Operating Systems
Apple OS X
Linux, RedHat, and other UNIX variants

Interpersonal
Teamwork and communication
Leadership and mentoring
Public and technical speaking

PEER-REVIEWED CONFERENCE PUBLICATIONS

[1] Trevor Steil, Scott McMillan, Geoffrey Sanders, Roger Pearce, and **Benjamin W. Priest**. Kronecker Graph Generation with Ground Truth for 4-Cycles and Dense Structure in Bipartite Graphs. In *2020 IEEE International Parallel and Distributed Processing Symposium Workshops*, IPDPSW. 2020.

[2] Roger Pearce, Trevor Steil, **Benjamin W. Priest**, and Geoffrey Sanders. One Quadrillion Triangles Queried on One Million Processors. In *Proceedings of the IEEE High Performance Extreme Computing Conference*, HPEC. **Graph Challenge Champion**. 2019.

[3] **Benjamin W. Priest**, Trevor Steil, Geoffrey Sanders, and Roger Pearce. You've Got Mail (YGM): Building missing asynchronous communication primitives. In *2019 IEEE International Parallel and Distributed Processing Symposium Workshops*, IPDPSW. 2019.

[4] Trevor Steil, **Benjamin W. Priest**, Geoffrey Sanders, Roger Pearce, Timothy La Fond, and Keita Iwabuchi. Distributed Kronecker graph generation with ground truth of many graph properties. In *2019 IEEE International Parallel and Distributed Processing Symposium Workshops*, IPDPSW. 2019.

[5] **Benjamin W. Priest**, Roger Pearce, and Geoffrey Sanders. Estimating edge-local triangle count heavy hitters in edge-linear time and almost-vertex-linear space. In *Proceedings of the IEEE High Performance Extreme Computing Conference*, HPEC. 2018.

[6] Luan Hoy Pham, Massimiliano Albanese, and **Benjamin W. Priest**. A quantitative framework to model advanced persistent threats. In *Proceedings of the 15th International Conference on Security and Cryptography*, SECRYPT. 2018.

[7] **Ben W. Priest**, Era Vuksani, Neal Wagner, Brady Tello, Kevin M. Carter, and William W. Streilein. Agent-based simulation in support of moving target cyber defense technology development and evaluation. In *Proceedings of the 18th Symposium on Communications & Networking, 2015 ACM Spring Simulation Multi-Conference*, CNS/SpringSim. 2015.

[8] Kevin M. Carter, Ramona S. Caceres and **Ben Priest**. Characterization of latent social networks discovered through computer network logs. In *Networks in the Social and Information Sciences workshop of the 29th Annual Conference on Neural Information Processing Systems*, NIPS. 2015.

[9] **Ben Priest** and Kevin M. Carter. Characterizing latent user interests on enterprise networks. In *Proceedings of the Twenty-Seventh International Florida Artificial Intelligence Research Society Conference*, FLAIRS. 2014.

[10] Kevin M. Carter, Rajmonda S. Caceres, and **Ben Priest**. Latent community discovery through enterprise user search query modeling. In *Proceedings of the 37th International ACM SIGIR Conference on Research & Development in Information Retrieval*, SIGIR. 2014.

[11] Kevin Gold, Zachary J. Weber, **Ben Priest**, Josh Ziegler, Karen Sittig, William W. Streilein, and Mark Mazumder. Modeling how thinking about the past and future impacts network traffic with the GOSMR architecture. In *International conference on Autonomous Agents and Multi-Agent Systems*, AAMAS. 2013.

[12] **Ben Priest** and Kevin Gold. Utility discounting explains informational website traffic patterns before a hurricane. In *Proceedings of the 22nd International World Wide Web Conference*, WWW. 2013.

[13] Kevin Gold, **Ben Priest**, and Kevin M. Carter An expectation maximization approach to detecting compromised remote access accounts. In *Proceedings of the Twenty-Sixth International Florida Artificial Intelligence Research Society Conference*, FLAIRS. 2013.

SUBMITTED PAPERS

[14] **Benjamin W. Priest**. DegreeSketch: Distributed Cardinality Sketches on Massive Graphs with Applications. [**Submitted to Very Large Databases 2020**].

[15] Imene Goumiri, **Benjamin W. Priest**, and Michael Schneider. Reinforcement Learning via Gaussian Processes with Neural Network Dual Kernels. [**Submitted to IEEE Transactions on Neural Networks and Learning Systems 2020**].

PAPERS IN PREPARATION

[16] **Benjamin W. Priest**. Track Linking via Locality Sensitive Hashing. [**In Preparation for Advanced Maui Optical and Space Surveillance Technologies Conference 2020**].

[17] Imene Goumiri, **Benjamin W. Priest**, and Michael Schneider. Star-Galaxy Separation via Gaussian Prcesses with Neural Network Dual Kernels. [**In Preparation for Advanced Maui Optical and Space Surveillance Technologies Conference 2020**].

[18] **Benjamin W. Priest**. Parallel simulation of many random walks in the semi-streaming model. [**In Preparation**].

OTHER CONFERENCE PUBLICATIONS

[19] **Benjamin W. Priest** and George Cybenko. Approximating centrality in evolving graphs: toward sublinearity. In *Proceedings of the 2017 SPIE Defense + Security Conference*, SPIE D+S. 2017.

[20] **Benjamin W. Priest** and George Cybenko. Efficient inference of hidden Markov mod- els from large observation sequences. In *Proceedings of the 2016 SPIE Defense + Security Conference*, SPIE D+S. 2016.

BOOK CHAPTERS

[21] **Bejamin W. Priest**, George Cybenko, Satinder Singh, Massimiliano Albanese and Peng Liu. Online and Scalable Adaptive Cyber Defense. In: Michael Wellman (Ed.), *Adversarial and Uncertain Reasoning in Adaptive Cyber-Defense*, ch. 11, pp. xxx–xxx. 2019. Anticipated.

Conference Talks

[22] **Benjamin W. Priest** and George Cybenko Approximating centrality in evolving graphs: toward sublinearity. At: *2017 SPIE Defense + Security Conference*, SPIE D+S. Anaheim, CA, USA, 9–13 April 2017.

[23] **Benjamin W. Priest** and George Cybenko Efficient Inference of hidden Markov models from large observations sequences. At: *2016 SPIE Defense + Security Conference*, SPIE D+S. Anaheim, CA, USA, 17–21 April 2016.

[24] **Benjamin W. Priest**, Era Vuksani and Neal Wagner. Agent-based simulation in support of moving target cyber defense technology development and evaluation. At: *18th Symposium on Communications & Networking, 2015 ACM Spring Simulation Multi-Conference*, CNS/SpringSim. Alexandria, VA, USA, 12–15 April 2015.

[25] **Benjamin W. Priest** and Kevin M. Carter. Characterizing latent user interests on enterprise networks. At: *2014 International Florida Artificial Intelligence Research Society Conference*, FLAIRS. Pensacola Beach, FL, USA, 21–23 May 2014.

Invited Talks

[26] **Benjamin W. Priest**. High-fidelity enterprise network emulation using the GOSMR architecture. In: *2014 MIT Lincoln Laboratory Cyber and Net-Centric Workshop*, CNW. June, 2014.

Conference Poster Presentations

[27] **Benjamin W. Priest**, Roger Pearce, and Geoffrey Sanders. Estimating edge-local triangle count heavy hitters in edge-linear time and almost-vertex-linear space. At: *GraphChallenge Workshop at the IEEE High Performance Extreme Computing Conference*, HPEC. 25–27 September 2018.

[28] **Benjamin W. Priest**, Roger Pearce, and Geoffrey Sanders. Efficient Sublinear Estimation of Local Triangle Count Heavy Hitters. At: *2018 Summer Student Poster Symposium at Lawrence Livermore National Laboratory*. 9 August 2018.

[29] Kevin M. Carter, Rajmonda Caceres and **Ben Priest** Characterization of latent social networks discovered through computer network logs. At: *Networks in the Social and Information Sciences workshop of the 29th Annual Conference on Neural Information Processing Systems*, NIPS. Montreal, Canada, 12 December 2015.

[30] **Ben Priest** and Kevin Gold Utility discounting explains informational website traffic patterns before a hurricane. At: *22nd International World Wide Web Conference*, WWW. 2013. Rio de Janeiro, Brazil, 13–17 May 2013.

Professional Service

Conference Service

- Program Committee: 28th International AAAI Florida Artificial Intelligence Research Symposium Conference, FLAIRS-28. Hollywood, Florida, USA. May 18-20, 2015.

Teaching Experience

Thayer School of Engineering at **Dartmouth College**, Hanover, VT, USA

Teaching Assistant

Instructor for ENGS/QBS 108: Applied Machine Learning **Autumn 2017**

- Collaborated with instructors to develop course curriculum aimed at graduate engineering and computer science students
- Designed and taught approximately twenty-five percent of the course lecture content, including all practical implementation content
- Led team of 4 teaching assistants
- Provided one-on-one assistance to students covering lecture topics
- Planned, wrote, and graded all student assignments

Instructor for ENGS 177: Decision Making Under Risk and Uncertainty **Winter 2017**

- Planned and taught a weekly recitation covering practical machine learning topics
- Provided ground and one-on-one assistance to students covering lecture topics
- Wrote student assignments with the assistance of the instructor and provided grading

The Ohio State University, Columbus, OH, USA

Teaching Assistant

Instructor for CSE 625: Automata and Formal Languages **Summer & Autumn 2010**

- Planned and taught a weekly recitation covering details and proofs of lecture topics
- Graded student assignments

Grader for CSE 560: System Software Design and Devlopment **Summer 2010**

- Graded student assignments and held office hours

AWARDS

HPEC Graph Challenge

Graph Challenge Champion, 2019.

SECRYPT

Best Paper Award, 2018.

MIT Lincoln Laboratory

Lincoln Scholar Program recipient, 2015

- (declined)

The Ohio State University

- Phi Beta Kappa Inductee, 2010
- Bingham Award in Philosophy, 2010
- Kenneth Cummings Scholarship, 2008–2011
- Distinguished Merit Scholarship, 2007–2011
- Ohio Academic Scholarhship, 2007-2011

CITIZENSHIP

USA