Benjamin (Ben) Wesley Priest

CONTACT INFORMATION

Postdoctoral Researcher
Center for Applied Scientific Computing
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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

The Ohio State University, Columbus, OH, USA
B.S., Mathematics, (GPA 3.62 *Cum Laude*) **09/2007 – 06/2011**
B.S., Computer and Information Science, (GPA 3.62 *Cum Laude*) **09/2007 – 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**
- Wrote an efficient HPC software library implementing novel algorithms using random matrix projections to approximately cluster graphs according to their spectrum
- Built DegreeSketch, an HPC library for fast local query approximation in labeled graphs
- Designed and implemented software computing Gaussian Process kernels dual to the infinite width limit of deep neural networks
- Utilized GP neural kernels to solve problems in reinforcement learning and image classification, and working on applications to deep learning on quantum computing hardware

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] **Benjamin W. Priest**, Alec Dunton, and Geoffrey Sanders. Scaling Graph Clustering with Distributed Sketches. In *Proceedings of the IEEE High Performance Extreme Computing Conference*, HPEC. **Graph Challenge Champion**. 2020.

[2] 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.

[3] 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.

[4] **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.

[5] 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.

[6] **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.

[7] 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. **Best Paper Award**. 2018.

[8] **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.

[9] 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.

[10] **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.

[11] 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.

[12] 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.

[13] **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.

[14] 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.

ARXIV PAPERS

[15] **Benjamin W. Priest**. DegreeSketch: Distributed Cardinality Sketches on Massive Graphs with Applications. 2020. arXiv:2004.04289.

[16] Iméne R. Goumiri, **Benjamin W. Priest**, and Michael D. Schneider. Reinforcement Learning via Gaussian Processes with Neural Network Dual Kernels. 2020. arXiv:2004.05198. [Submitted to IEEE Transactions on Neural Networks and Learning Systems]

[17] Matthew Otten, Iméne R. Goumiri, **Benjamin W. Priest**, and Michael D. Schneider. Quantum Machine Learning using Gaussian Processes with Performant Quantum Kernels. 2020. arXiv:2004.11280. [Submitted to Nature Communications]

WORKING PAPERS

[18] **Benjamin W. Priest**, Alec Dunton, and Geoffrey Sanders. Distributed Clustering of Scale-Free Graphs using Subspace Embeddings. [**In Preparation**].

[19] Imène R. Goumiri, Amanda L. Muyskens, Michael D. Schneider, **Benjamin W. Priest**, Robert E. Armstrong, and Jason M. Bernstein. Star-Galaxy Separation with Gaussian Processes. [**In Preparation**].

[20] Amanda Muyskens, **Benjamin W. Priest**, Imène R. Goumiri, and Michael D. Schneider. A Sensitivity Analysis of Matern Gaussian Process Hyperparameters on Prediction. [**In Preparation**].

[21] Imène R. Goumiri, Amanda L. Muyskens, Michael D. Schneider, **Benjamin W. Priest**, and Robert E. Armstrong. Star-Galaxy Separation via Gaussian Prcesses with Model Reduction. [**Submitted to Advanced Maui Optical and Space Surveillance Technologies Conference 2020**].

OTHER CONFERENCE PUBLICATIONS

[22] **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.

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

BOOK CHAPTERS

[24] Geoffrey Sanders, Roger Pearce, **Bejamin W. Priest**, and Trevor Steil. Massive-Scale Distributed Triangle Enumeration and Applications. In: David Bader (Ed.), *Processing Very Large Graphs*, [In Preparation]

[25] **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 for Adaptive Cyber Defense*, ch. 11, pp. 232-261. 2019. Springer.

CONFERENCE TALKS

[26] **Benjamin W. Priest**, Alec Dunton, and Geoffrey Sanders. Scaling Graph Clustering with Distributed Sketches. At: *2020 High Performance Extreme Computing Conference*, HPEC 2020. Waltham, CA, USA (virtual conference), 21–25 September 2020.

[27] **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.

[28] **Benjamin W. Priest** and George. 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.

[29] **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.

[30] **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

[31] **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.

POSTER PRESENTATIONS

[32] **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.

[33] **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.

[34] 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.

[35] **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.

GRANTS

Awaiting Decision

[1] Co-PI, "Scientific Applications of Gaussian Processes at Scale", LLNL LDRD ER, $400,000/year. October 1, 2021 to September 30, 2023.

Awarded

[2] Co-I, "Interactive Exploratory Graph-Engabled Data Analytics at HPC Scales", LLNL LDRD 21-ER-020, $500,000/year. October 1, 2020 to September 30, 2022.

[3] Co-PI, "Scalable Approximate Graph Clustering", LLNL LDRD 20-FS-037, $150,000. February 1, 2020 to September 30, 2020.

MENTORING

Students

[1] **Alec Dunton**, Graduate student in Applied Mathematics, University of Colorado Boulder. Parameter sensitivity of stochastic block models under subspace embeddings. 2020.

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, 2020.
Graph Challenge Champion, 2019.

SECRYPT

Best Paper Award, 2018.

MIT Lincoln Laboratory

Lincoln Scholar Fellowship, 2015

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