

# Nathaniel Hudson

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## ABOUT ME

I am a computer scientist, currently serving as a Postdoctoral Scholar at Globus Labs out of the University of Chicago's Department of Computer Science. My research focuses on designing solutions for AI at the network edge for smart city applications.

## PROFESSIONAL EMPLOYMENT

2022– *Postdoctoral Scholar*, Department of Computer Science, University of Chicago; Chicago, Illinois, USA (Joint Appointment with Argonne National Laboratory)

2017–'22 *Graduate Assistant*, Department of Computer Science, University of Kentucky; Lexington, Kentucky, USA

## EDUCATION

Ph.D. Computer Science, University of Kentucky, 2022  
Advisor: Dr. Hana Khamfroush  
Dissertation: "Smart Decision-Making via Edge Intelligence for Smart Cities"

M.S. Computer Science, University of Kentucky, 2021

B.S. Computer Science, Northern Kentucky University, 2017  
*Cum Laude*, Mathematics Minor, Honors Distinction

## RESEARCH AREAS

Edge Computing, Resource Management, Service Placement, Internet-of-Things

Federated learning, Deep Learning, Machine Learning

Network Science, Complex/Interdependent Networks, Online Social Networks, Diffusion Processes

## EXPERIENCE

### Computer Languages

Python

Java

C/C++

ℒ<sub>T</sub><sub>E</sub>X

## Frameworks

PyTorch, PyTorch Lightning

TensorFlow, Keras

SciKit-Learn

NumPy, SciPy, SymPy

Pandas

NetworkX

## PEER-REVIEWED PUBLICATIONS

### Journal Articles

- 2024 N. Hudson, H. Khamfroush, M. Baughman, D. E. Lucani, K. Chard, and I. Foster, “QoS-aware edge AI placement and scheduling with multiple implementations in FaaS-based edge computing,” *Future Generation Computer Systems*, vol. 157, pp. 250–263, 2024
- 2023 P. Oza, N. Hudson, T. Chantem, and H. Khamfroush, “Deadline-aware task offloading for vehicular edge computing networks using traffic lights data,” *ACM Transactions on Embedded Computing Systems*, 2023
- 2020 N. Hudson and H. Khamfroush, “Behavioral information diffusion for opinion maximization in online social networks,” *IEEE Transactions on Network Science and Engineering*, 2020
- 2019 H. Khamfroush, N. Hudson, S. Iloo, and M. R. Naeini, “Influence spread in two-layer interdependent networks: designed single-layer or random two-layer initial spreaders?,” *Applied Network Science*, vol. 4, no. 1, pp. 1–21, 2019

### Conference and Workshop Proceedings

- 2023 N. Hudson, J. G. Pauloski, M. Baughman, A. Kamatar, M. Sakarvadia, L. Ward, R. Chard, A. Bauer, M. Levental, W. Wang, W. Engler, O. P. Skelly, B. Blaiszik, R. Stevens, K. Chard, and I. Foster, “Trillion parameter AI serving infrastructure for scientific discovery: A survey and vision,” in *Proceedings of the IEEE/ACM International Conference on Big Data Computing, Applications and Technologies*, Association for Computing Machinery, 2023
- 2023 M. P.-L. Ooi, S. Sohail, V. G. Huang, N. Hudson, M. Baughman, O. Rana, A. Hinze, K. Chard, R. Chard, I. Foster, T. Spyridopoulos, and H. Nagra, “Measurement and applications: Exploring the challenges and opportunities of hierarchical federated learning in sensor applications,” *IEEE Instrumentation & Measurement Magazine*, vol. 26, no. 9, pp. 21–31, 2023
- 2023 M. Sakarvadia, A. Khan, A. Ajith, D. Grzenda, N. Hudson, A. Bauer, K. Chard, and I. Foster, “Attention Lens: A tool for mechanistically interpreting the attention head information retrieval mechanism,” 2023
- 2023 M. Sakarvadia, A. Ajith, A. Khan, D. Grzenda, N. Hudson, A. Bauer, K. Chard, and I. Foster, “Memory injections: Correcting multi-hop reasoning failures during inference in transformer-based language models,” in *Proceedings of the 6th BlackboxNLP Workshop: Analyzing and Interpreting Neural Networks for NLP*, pp. 342–356, Association for Computational Linguistics, Dec. 2023

- 2023 S. Rajani, D. Dematties, N. Hudson, K. Chard, N. Ferrier, R. Sankaran, and P. Beckman, “Adversarial predictions of data distributions across federated internet-of-things devices,” in *2023 IEEE World Forum on Internet of Things (WF-IoT)*, Institute of Electrical and Electronics Engineers, Oct. 2023
- 2023 J. G. Pauloski, V. Hayot-Sasson, L. Ward, N. Hudson, C. Sabino, M. Baughman, K. Chard, and I. Foster, “Accelerating communications in federated applications with transparent object proxies,” in *Proceedings of the International Conference on High Performance Computing, Networking, Storage and Analysis*, Association for Computing Machinery, 2023. (Accepted for publication)
- 2023 A. Bauer, M. Straesser, M. Leznik, M. Hadry, L. Beierlieb, N. Hudson, K. Chard, S. Kounev, and I. Foster, “Searching for the ground truth: Assessing the similarity of benchmarking runs,” in *2023 ACM/SPEC International Conference on Performance Engineering (ICPE) Data Challenge Track*, ACM, 2023
- 2023 M. Baughman, N. Hudson, I. Foster, and K. Chard, “Balancing federated learning trade-offs for heterogeneous environments,” in *2023 IEEE International Conference on Pervasive Computing (PerCom) Work in Progress (WiP)*, IEEE, 2023. (Winner of Best WiP Paper)
- 2022 N. Kotsehub, M. Baughman, R. Chard, N. Hudson, P. Patros, O. Rana, I. Foster, and K. Chard, “FLoX: Federated learning with FaaS at the edge,” in *2022 IEEE International Conference on eScience*, IEEE, 2022. (Nominated for Best Student Paper)
- 2022 N. Hudson, P. Oza, H. Khamfroush, and T. Chantem, “Smart edge-enabled traffic light control: Improving reward-communication trade-offs with federated reinforcement learning,” in *2022 IEEE International Conference on Smart Computing (SMARTCOMP)*, pp. 40–47, IEEE, 2022
- 2022 M. Hosseinzadeh, N. Hudson, S. Heshmati, and H. Khamfroush, “Communication-loss trade-off in federated learning: A distributed client selection algorithm,” in *2022 IEEE Consumer Communications & Networking Conference (CCNC) Workshop SONATAI*, IEEE, 2022
- 2021 M. Hosseinzadeh, N. Hudson, X. Zhao, H. Khamfroush, and D. E. Lucani, “Joint compression and offloading decisions for deep learning services in 3-tier edge systems,” in *2021 IEEE International Symposium on Dynamic Spectrum Access Networks (DySPAN)*, IEEE, 2021. (Invited, equal contribution as first author)
- 2021 N. Hudson, M. J. Hossain, M. Hosseinzadeh, H. Khamfroush, M. Rahnamay-Naeini, and N. Ghani, “A framework for edge intelligent smart distribution grids via federated learning,” in *2021 30th International Conference on Computer Communications and Networks (ICCCN)*, IEEE, 2021. (Invited)
- 2021 N. Hudson, H. Khamfroush, and D. E. Lucani, “QoS-aware placement of deep learning services on the edge with multiple service implementations,” in *2021 30th International Conference on Computer Communications and Networks (ICCCN) 1st International Workshop on Big Data & Machine Learning for Networking (BDMLN)*, IEEE, 2021
- 2020 X. Zhao, M. Hosseinzadeh, N. Hudson, H. Khamfroush, and D. E. Lucani, “Improving the accuracy-latency trade-off of edge-cloud computation offloading for deep learning services,” in *2020 IEEE Globecom Workshops (GC Wkshps)*, pp. 1–6, IEEE, 2020
- 2020 N. Hudson, H. Khamfroush, B. Harrison, and A. Craig, “Smart advertisement for maximal clicks in online social networks without user data,” in *2020 IEEE International Conference on*

- Smart Computing (SMARTCOMP)*, pp. 172–179, IEEE, 2020
- 2020 E. Hufbauer, N. Hudson, and H. Khamfroush, “A proximity-based generative model for online social network topologies,” in *2020 International Conference on Computing, Networking and Communications (ICNC)*, pp. 648–653, IEEE, 2020
- 2019 N. Hudson, M. Turner, A. Nkansah, and H. Khamfroush, “On the effectiveness of standard centrality metrics for interdependent networks,” in *2019 International Conference on Computing, Networking and Communications (ICNC)*, pp. 842–846, IEEE Computer Society, 2019

## PREPRINTS AND OTHER WORKS

- 2024 D. King, D. Grzenda, R. Zhu, N. Hudson, I. Foster, and L. Gagliardi, “Deep learning for molecular orbitals,” 2024
- 2024 H. Devaraj, S. Sohail, B. Li, N. Hudson, M. Baughman, K. Chard, R. Chard, E. Casella, I. Foster, and O. Rana, “Ruralai in tomato farming: Integrated sensor system, distributed computing and hierarchical federated learning for crop health monitoring,” *IEEE Sensors Letters*, pp. 1–4, 2024
- 2023 M. P.-L. Ooi, A. H. S. Nagra, S. Sohail, V. G. Huang, N. Hudson, M. Baughman, R. Chard, K. Chard, I. Foster, O. Rana, and T. Spyridopoulos, “Exploring the challenges and opportunities of hierarchical federated learning in sensor applications,” *IEEE Instrumentation and Measurement Magazine*, 2023
- 2023 O. Rana, T. Spyridopoulos, N. Hudson, M. Baughman, K. Chard, I. Foster, and A. Khan, “Hierarchical and decentralised federated learning,” 2023

## GRANTS AND AWARDS

### Awards and Honors

- 2024 *2024 Cyber-Physical Systems (CPS) Rising Star*,
- 2023 *Best Work-in-Progress Paper Award*, (“Balancing Federated learning trade-offs for heterogeneous environments”), 2023 IEEE PerCom conference.
- 2022 *2022 Diverse: Issues In Higher Education Rising Graduate Scholar*, one of the ten selected for this honor of that year.
- 2022 *Leadership Award*, Graduate Student Association for Computer Science, Department of Computer Science, University of Kentucky.
- 2021 *Outstanding Student Paper Award* (“Behavioral information diffusion for opinion maximization in online social networks”), Department of Computer Science, University of Kentucky.
- 2021 *Service Award*, Graduate Student Association for Computer Science, Department of Computer Science, University of Kentucky.
- 2019 *Runner-Up Best Poster Award* (“Content-Aware Click-Through Prediction on Online Social Networks Using Learning Techniques”), Commonwealth Computational Summit 2019, University of Kentucky.

## **Grants and Fellowships**

- 2023 NSF IEEE PerCom 2023 Travel Grant (\$1000.00)
- 2021 University of Kentucky Graduate Student Congress Conference Travel Award (\$500.00)
- 2021 NSF IEEE INFOCOM 2021 Student Travel Grant (\$225.00)
- 2020 NSF IEEE SMARTCOMP 2020 Student Travel Grant
- 2019 WINE 2019 Conference Student Travel Grant
- 2019 University of Kentucky Computer Science Departmental Travel Grant ( $\times 2$ )

## **TEACHING**

### **University of Kentucky (Teaching Assistant)**

- Computer Graphics and Multimedia (CS 335)
- Discrete Mathematics (CS 275)
- Introduction to Computer Networking (CS 371)
- Systems Programming (CS 270)

### **Northern Kentucky University (Academic Tutor)**

- Pre-Calculus
- Elementary Programming
- Object-Oriented Programming I (w/Lab)
- Object-Oriented Programming II
- Data Structures and Algorithms (*also served as teaching assistant*)
- Discrete Mathematics
- Theory of Computation

## **SERVICE**

### **Technical Program Committees**

- 2024 IEEE EDGE Conference
- 2024 IEEE International Conference on Computer Communications and Networks (ICCCN)
- 2024 IEEE Mobile Ad-Hoc and Smart Systems (MASS)
- 2024 IEEE PerCom Work-in-Progress Session
- 2023 IEEE International Conference on Sensing, Communication, and Networking (SECON)
- 2023 IEEE Cluster, Cloud and Internet Computing (CCGrid)
- 2023 IEEE EDGE
- 2023 IEEE International Conference on Distributed Computing in Smart Systems and the Internet-of-Things (DCOSS-IoT)

- 2023 IEEE International Conference on Pervasive Computing and Communications (PerCom) Work in Progress Session
- 2022 IEEE International Conference on Sensing, Communication, and Networking (SECON)

### **Academic Journal Peer Review**

*ACS Journal of Chemical Theory and Computation*  
*Elsevier Parallel Computing*  
*Elsevier Pervasive and Mobile Computing*  
*IEEE Transactions on Computers*  
*IEEE Transactions on Cloud Computing*  
*IEEE Transactions on Mobile Computing*  
*IEEE Transactions on Network Science & Engineering*  
*Physica A: Statistical Mechanics and Its Applications*  
*PLOS One*

### **Conference Proceedings Peer Review**

*IEEE International Conference on Pervasive Computing and Communications (PerCom)*  
*IEEE International Conference on Computer Communications (INFOCOM)*  
*IEEE Global Communications Conference (GLOBECOM)*  
*IEEE International Conference on Communications (ICC)*  
*IEEE International Conference on Computer Communications and Networks (ICCCN)*  
*IEEE/ACM International Symposium on Quality of Service (IWQoS)*  
*IEEE International Conference on Smart Computing (SMARTCOMP)*  
*IEEE Conference on Wireless On-Demand Network Systems and Services (WONS)*

### **Conference Participation**

- 2021 Volunteer Judge for the 41st IEEE International Conference on Distributed Computing Systems (ICDCS)

### **Campus (University of Kentucky)**

- 2021–‘22 President, Graduate Student Association for Computer Science
- 2020–‘21 Secretary, Graduate Student Association for Computer Science

### **Campus (Northern Kentucky University)**

- 2016 Honors College Peer Mentor
- 2014–‘16 Student Panelist for GEM high school scholars
- 2014–‘15 LGBTQ Student Ambassador
- 2014 Student Representative, Data Science Faculty Search Committee

**Community**

2014-20 Ignite Academy Computer Science Academy Judge and Volunteer; Kenton County Schools, Kentucky, USA.

**MEMBERSHIPS**

Institute of Electrical and Electronics Engineers (IEEE)

Updated May 2024