Robert Canady

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Education

Bachelor of Arts in Physics and Mathematics **May 2017**
Transylvania University, Lexington, Kentucky
Overall GPA: 3.652/4.00; Dean's List: 2014-2017; President's Scholarship.
Graduated with Honors in Mathematics and Physics.
Study Abroad Summer 2015, Stirling, Scotland studied Scottish History and Scottish Film.
Relevant Coursework: Calculus I, II, and III, The Mathematician's Toolkit, Organic Chemistry I and II, Differential Equations, Linear Algebra, Number Theory, Abstract Algebra, Higher Analysis, University Physics I and II, Optics, Classical Mechanics, Electricity and Magnetism, Logic and Problem Solving, Quantum Mechanics, Special Relativity, Senior Seminar and Junior/Senior Research in Physics.

Doctorate of Philosophy in Electrical Engineering **August 2024**
Masters of Science in Electrical Engineering **May 2023**
Vanderbilt University, Nashville, Tennessee
Overall GPA: 3.808/4.00.
Relevant Coursework: Random Processes, Foundations of Hybrid and Embedded Systems, Model-Integrated Computing, Operating Systems, Digital Systems Architecture, Solid State Effects and Devices, Principles of Cloud Computing, Network Security, Deep Learning, Distributed Systems Principles, Topics in Big Data, Special Topics – Side Channel Issues in Cybersecurity (Audited).

1st Author Research Publications

Robert Canady, Xingyu Zhou, Yogesh Barve, Daniel Balasubramanian, and Aniruddha Gokhale. Applying dddas principles for realizing optimized and robust deep learning models at the edge. In *Dynamic Data Driven Applications Systems*, Erik Blasch, Frederica Darema, and Alex Aved, editors, pages 325–339, Cham, 2024. Springer Nature Switzerland.

Robert Canady, Xingyu Zhou, Yogesh Barve, Daniel Balasubramanian, and Aniruddha Gokhale. "Applying DDDAS Principles for Realizing Optimized and Robust Deep Learning Models at the Edge." In *International Conference on Dynamic Data Driven Applications Systems*, pp. 325-339. 2022.

Canady, R., Zhou, X., Barve, Y., Balasubramanian, D. A., & Gokhale, A. (2022) "Adversarially Robust Edge-Based Object Detection for Assuredly Autonomous Systems," in the proceedings of *2022 IEEE International Conference on Assured Autonomy,* March 22-24, 2022.

Canady, R., Zhou, X., Barve, Y., Balasubramanian, D. A., & Gokhale, A. (2022) "Applying DDDAS Principles for Realizing Optimized and Robust Deep Learning Models at the Edge," accepted in *2022 InfoSymbiotics/Dynamic Data Driven Application Systems (DDDAS2022) Conference*, 2022.

Canady, R., Zhou, X., Barve, Y., Balasubramanian, D. A., & Gokhale, A. (2021). Deploying Adversarially Robust Computer Vision Deep Learning Models Across the Computing Spectrum. Presented at the *IBM IEEE CAS/EDS AI Compute Symposium*.

Robert Canady. (2019). Dynamic resource management algorithms for edge computing using hardware accelerators. In Proceedings *of the 20th International Middleware Conference Doctoral Symposium* (Middleware '19).

Robert Canady. (2019). Supporting Smart Applications via Dynamic Resource Management of Edge-based Field Programmable Gate Arrays. Proceedings *of the 5th IEEE International Conference on Smart Computing PhD Forum* (SMARTCOMP 2019).

Collaborative Research Publications

A. Raj, **R. E. Canady**, S. Das, A. Gokhale and S. Perarnau, "Reinforcement Learning-based Performance-aware Energy Management in 5G Base Stations," *2024 16th International Conference on COMmunication Systems & NETworkS (COMSNETS)*, Bengaluru, India, 2024, pp. 568-571.

Zhou, X., **Canady, R.**, Li, Y., Koutsoukos, X., & Gokhale, A. (2020, October). Overcoming Stealthy Adversarial Attacks on Power Grid Load Predictions Through Dynamic Data Repair. In *Dynamic Data Driven Applications Systems: Third International Conference, DDDAS 2020, Boston, MA, USA, October 2-4, 2020, Proceedings* (Vol. 12312, p. 102). Springer Nature. (LNCS Journal Chapter).

Zhou, X., **Canady, R.**, Li, Y., & Gokhale, A. (2020, November). Overcoming Adversarial Perturbations in Data-driven Prognostics Through Semantic Structural Context-driven Deep Learning. In *Annual Conference of the PHM Society* (Vol. 12, No. 1, pp. 11-11).

Zhou, X., **Canady, R.**, Li, Y., Bao, S., Barve, Y., Balasubramanian, D. A., & Gokhale, A. (2022). Guarding Against Universal Adversarial Perturbations in Data-driven Cloud/Edge Services. Accepted at the *10th IEEE International Conference on Cloud Engineering* (IC2E).

Zhou, X., **Canady, R.**, Bao, S., & Gokhale, A., "Cost-effective hardware accelerator recommendation for edge computing," in *3rd {USENIX} Workshop on Hot Topics in Edge Computing (HotEdge 20)*, 2020.

Kang, Z., **Canady, R.**, Dubey, A., Gokhale, A., Shekhar, S., and Sedlacek, M. (2020). A Study of Publish/Subscribe Middleware Under Different IoT Traffic Conditions. In *Proceedings of the International Workshop on Middleware and Applications for the Internet of Things* (M4IoT'20). Association for Computing Machinery, New York, NY, USA, 7–12.

Min, Z., **Canady**, **R.,** Ghosh, U., Gokhale, A., & Hakiri, A. (2020). Tools and Techniques for Privacy-aware, Edge-centric Distributed Deep Learning. In *Proceedings of the Workshop on Distributed Infrastructures for Deep Learning (*DIDL'20). Association for Computing Machinery, New York, NY, USA, 7–12.

Research Projects, Presentations, and Relevant Course Projects

Chameleon Cloud Users Meeting at TACC **February 2019**

Presented a PowerPoint describing the Cloud Computing class at Vanderbilt University, how we utilized the Chameleon Cloud platform for the class and our future research, and the advantages and disadvantages of using that platform. Listened to other speakers describe their use of Chameleon Cloud.

Past Miscellaneous Research

LSTM anomaly detection: Project done for Deep Learning class. The goal was to use an LSTM to predict anomalies in resource usage at the edge level using a tool called FECBench which was created by Yogesh Barve.

EACBench: Benchmarking work that compared various deep learning algorithms on FPGAs, GPUs, TPUs and CPUs. Then we used iFogSim (a fog/edge computing simulation tool) to simulate a real-life situation with many of these devices distributed across a network.

Vanderbilt Electrical Engineering and Computer Science Coursework Experiences

Hybrid and Embedded Systems: Completed a project that consisted of designing a collision avoidance system for an airplane using Simulink, the MATLAB-based graphical programming environment.

Model-Integrated Computing: Using the DSML, WebGME, deployed an FPGA program on a Zedboard that was connected to another laptop.

*Operating Systems***:** Learned fundamentals of operating systems, specifically Linux, through lectures and C-programming assignments. For the final project, we wrote a C program that simulated a bank account connected by five distributed ATMs that updated the account by using a distributed consensus algorithm.

Deep Learning: Learned the concepts behind Deep Learning by doing programming assignments using python and numpy without the help of Keras or Tensorflow. For my final project, I developed an LSTM network for time-series prediction of latency using data about various applications running with background noise.

Topics in Big Data: Gained knowledge of big data processing and analytics by studying databases, data modeling techniques, data processing and querying, data analytics and applications of machine learning in this area. Explored practical implementations of these areas by using Apache Spark, MySQL, and MapReduce through various programming assignments.

Principles of Cloud Computing: Obtained theoretical knowledge about cloud computing through lectures and readings. Gained practical experience with cloud computing by using Chameleon Cloud and AWS to run various experiments such as spawning VMs using Vagrant and Ansible to create a database server and webserver.

Distributed Systems Principles: Gained experience with different distributed systems technologies and theories through class lectures and programming assignments.

Work Experience

Physics and Mathematics Tutor, **Transylvania University,** Lexington, Kentucky **Sept 2015 - May 2017**

Helped University Physics I and II students advance in their learning by guiding them through various homework exercises and helping them conceptualize the different ideas presented to them in their class.

Gained a deeper understanding of the physics concepts I had previously learned by being able to explain them to my peers in a way that they could understand.

Teaching Assistant **August 2017 – December 2023**

Vanderbilt University, Nashville, Tennessee

Electromagnetics (August 2017 – December 2017)*:*

- Assisted the students of Electromagnetics to more thoroughly understand the material taught in the class through Office Hours, before test study sessions, creating and distributing step-by-step solutions to the homework, and teaching classes. Also, performed the tasks of grading homework and assisted in grading exams.

Digital Logic (January 2018 - May 2018)*:*

- Complemented the student's in-class learning with a lab where they could see the theory they learned in practice, a review session for tests, a study session, and office hours. Also, had the duties of teaching two separate, three hour lab sessions during the week, holding office hours, and grading exams.

Microelectronic Systems (January 2021 - May 2021)*:*

- Assisted students learn about active devices in the context of digital systems, with an emphasis on embedded systems integration. Characteristics and utilization of different digital integrated circuit families, common bus structures and protocols and real-world interfaces (comparators, A/D/A conversion)

Digital Systems (August 2021 - May 2022, August 2022 - May 2023, August 2023 - December 2023)*:*

- Complemented the student's in-class learning with a lab where they could see the theory they learned in practice. Also, had the duties of teaching two separate, three hour lab sessions during the week and holding two office hours.

Information Security Intern **May 2018 - August 2018**

Holzer Health System, Gallipolis, Ohio

Assisted the IT staff at Holzer in re-imaging all necessary laptops and desktops at the various locations in Southeast Ohio.

Performed a complete inventory of the networked devices to find unknown devices that could potentially store electronic patient health information.

Shadowed the server and network team to gain insights from what they were currently working on.

Gained experience with PuTTY, computer networking, powershell, windows 10, Lansweeper, CISCO SourceFire IPS, Solarwinds, Tenable, Nessus, and Office365.

Attended the HIMSS conference in March 2018 in Las Vegas, Nevada and also the InfoSec conference in Columbus, Ohio in June 2018.

Research Assistant **January 2024 – Present**

Vanderbilt University, Nashville, Tennessee

Conducted research sponsored by the NSA in the field of Adversarial Multimodal Federated Learning.

Read through and analyzed research papers to help develop my own ideas that could be useful to the NSA.

Research Assistant **August 2018 – May 2019, August 2019 – January 2020**

Vanderbilt University, Nashville, Tennessee

Conducted research sponsored by AFOSR in the field of DDDAS.

Read through and analyzed research papers to help develop my own ideas that could be useful to the AFOSR.

Research Assistant **Summer 2019**

Vanderbilt University, Nashville, Tennessee

Evaluated communication technologies such as RTI DDS Connext 6, OPC UA, and MQTT under a variety of different stress conditions on several different edge-centric hardware platforms including BeagleBone cluster, Raspberry Pis, and x86 devices.

Presented a technical report along with a presentation and any relevant source code at the end of the project to show what we found while working on the project.

Research Assistant **January 2021 - May 2021, August 2021 - January 2022**

Vanderbilt University, Nashville, Tennessee

Funded by the NSF Safe and Connected Communities (SCC) project to determine how to use robust machine learning to make safer neighborhoods.

Robust and Secure Machine Learning Intern **Summer 2020, Summer 2021, AY 2021-2022, Summer 2022**

ATR Center, Dayton, Ohio

Worked with the Air Force Research Lab to develop computer vision neural networks robust to adversarial machine learning attacks.

Volunteer **October 2021 - Present**

The Nashville Food Project, Nashville, TN

Assisted the meal preparation team turn bulk donations of food into nutritious meals to be distributed to those who experience food insecurity in the community.

Helped in the preparation and maintenance of an urban agriculture farm.

Contributed over 100 hours.

Campus Involvement

Golf Team, **Sept 2013-May 2017**

Obtained valuable leadership, organization, analytical, problem-solving, communication, and time-management skills.

Developed strategies to persevere through adverse situations during high-pressure situations.

2017 Heartland Collegiate Athletic Conference MVP, 2017 Srixon/Cleveland Golf All-America Scholar, 2017 Division III PING All-Region Team.

Men's Golf Representative, **Student Athlete Advisory Council (SAAC)***,* **Sept 2014-May 2016**

Helped plan and work events sponsored by SAAC to help bring awareness to various issues impacting student-athletes.

Additional Skills

Programming:	Python, C++, C, Matlab/Simulink, Javascript, Java
Deep Learning:	PyTorch, Tensorflow, Keras, Darknet
Edge Computing:	GPUs (Jetson Nano + TX2), TPUs (Coral Dev Board + USB), Ultra96 FPGA, Raspberry Pi
Distributed Systems:	MQTT, ZMQ, OPCUA, DDS, Vagrant, Ansible
Other Skills/Experience:	High Performance Computing, AWS, OpenStack, Linux, MacOS, Windows, MS Office.

Hobbies and Interests

In my spare time I enjoy cooking, darts, tennis, golf, skiing, and watching films, particularly horror. I also enjoy fermentation of vegetables and drinks. I am very passionate about food, equality, and the environment, so I regularly volunteer at a local non-profit farm to kitchen organization that is diverting food waste into nutritious meals for the food insecure. I did this by helping to prepare meals for a small industrial kitchen as well as helping out at a community/production garden where some of the produce was donated back to the kitchen.