

Justin Carpenter, Ph.D.

portfolio.justin-carpenter.com — scopus.com/pages/authors/57468514400 — linkedin.com/in/justincarpenter836
(208) 631-9540 — justin@justin-carpenter.com

SUMMARY

Ph.D. Machine Learning Researcher & Systems Engineer with 5+ years building production-grade GNNs, LLMs, and scalable ML infrastructure. Expertise in zero-shot graph learning (LLM-GMP, IEEE '25), temporal GNNs (VLDB '23), and optimized deployments of Higher-Order graph representation learning (2FWL-SIRGN, IEEE '24). The techniques have been proven by combining novel algorithms with real-world systems for research and engineering roles.

TECHNICAL SKILLS

Machine Learning: PyTorch, TensorFlow, DGL (Deep Graph Library), NetworkX, Scikit-learn, BERT

AI & LLM Ops: Ollama, HuggingFace, OpenAI, RAG, Quantization, Local Inference Optimization

Programming: Python, Java, C, C++, Rust, SQL, Jupyter, LaTeX

Infrastructure: Linux (Bash), Windows, MacOS, Docker, Kubernetes (K3s), AWS

Data & Graphs: Pandas, SciPy, Matplotlib, Structural Node Representation, Temporal Graph Analysis

EDUCATION

Doctor of Philosophy (Ph.D.) in Computing — Aug 2020 - Dec 2025

Boise State University — Boise, ID

- **Specialization:** Machine Learning & Graph Representation Learning.
- **Dissertation:** Scalable and Expressive Graph Representation Learning with Temporal, Structural, and Zero-Shot Capabilities.

Bachelor of Science (B.S.) in Computer Science — Aug 2016 - May 2020

Boise State University — Boise, ID

EXPERIENCE

Graduate Research Assistant — Dec 2020 - Dec 2025

Boise State University — Boise, ID

- Spearheaded research and development in the AI-based Security (AlBS) lab, publishing 4 papers in VLDB/IEEE by addressing current limitations, designing novel algorithms and conducting rigorous competitive analysis.
- Developed structural graph partitioning algorithms that improved processing time by up to 83%.
- Developed two efficient temporal and higher-order graph representation learning approaches for graph nodes that rivaled state-of-the-art methods.
- Developed a zero-shot learning method for graph nodes leveraging Ollama and HuggingFace to deploy and evaluate quantized LLMs.

Graduate Teaching Assistant — Dec 2020 - Dec 2025

Boise State University — Boise, ID

- **CS 535: Large Scale Data Analysis** – Instructed on algorithms and infrastructure for managing large-scale data (MapReduce, Hadoop, Spark); graded assignments and hosted tutoring sessions.
- **CS 534: Machine Learning** – Mentored on ML algorithms (GNNs, SVMs, Logistic Regression, Decision Trees); graded and tutored on debugging and concepts.
- **CS 321: Data Structures** – Taught design of data structures (hash tables, queues); graded and collaborated on tutoring.

Computer Science Lab Assistant — Jan 2020 - May 2020

Boise State University — Boise, ID

- Assisted students in CS 121 with debugging, development strategies, and project comprehension.
- Collaborated with professors and tutors to enhance learning during the transition to online classes.

PROJECTS

LLM-GMP: Large Language Model-Based Message Passing — Published 2025

Zero-Shot Learning on Graphs | Python, LLMs, Ollama

- Developed a novel zero-shot learning framework leveraging semantic reasoning of LLMs to perform message passing on graph structures without labeled training data.
- Deployed a wide range of quantized LLM models, prompt creations and optimizations, and rigorous testing and evaluation.

2FWL-SIRGN: Higher-Order Weisfeiler-Lehman Graph Representation Learning — Published 2024

Higher-Order Graph Representation Learning | Python

- Implemented 2FWL-SIRGN, an extension of SIR-GN that applies higher-order (2-dimensional) Folklore Weisfeiler-Lehman for richer structural node representations.
- Engineered a structural graph partitioning algorithm to distribute subgraph computations across machines, overcoming the quadratic computational bottleneck for large datasets.

Temporal SIR-GN: Dynamic Network Analysis — Published 2023

Temporal Structural Iterative Representation learning on graph nodes | Python

- Extended Structural Iterative Representation learning on graph nodes (SIR-GN) into the temporal dimension to detect evolving structural patterns in dynamic networks.
- Achieved state-of-the-art accuracy in node and link prediction tasks while requiring significantly lower computational resources than comparable deep GNN architectures.

Botnet Node Detection via Structural Learning — Published 2021

Cybersecurity Application | Python, Inferential SIR-GN

- Applied inferential structural node representation learning to cybersecurity, identifying malicious botnet nodes within high-volume internet traffic.
- Created a model that prevents overfitting, a common failure in GNNs, while operating at less than 50% of the computational cost of existing intrusion detection systems.

Manta Ray Identification System — Dec 2019 – Jun 2020

Computer Vision Project | Python, TensorFlow, PyTorch

- Developed a lightweight system to process aerial footage from drones or low aircraft to identify manta rays in water.
- Utilized transfer learning on a TensorFlow object detection model within a Python API for open-source researcher assistance.

PUBLICATIONS

Carpenter, J., Islam, M., Serra, E. (2025). "LLM-GMP: Large Language Model-Based Message Passing for Zero-Shot Learning on Graphs." *Proceedings of the IEEE International Conference on Big Data*.

Carpenter, J., Serra, E. (2024). "2FWL-SIRGN: A Scalable Structural 2-dimensional Folklore Weisfeiler Lehman Graph Representation Learning Approach Via Structural Graph Partitioning" *Proceedings of the IEEE International Conference on Big Data*.

Layne, J., Carpenter, J., Serra, E., Gullo, F. (2023). "Temporal SIR-GN: Efficient and Effective Structural Representation Learning for Temporal Graphs" *Proceedings of the VLDB Endowment*.

Carpenter, J., Layne, J., Serra, E., Cuzzocrea, A. (2021). "Detecting Botnet Nodes via Structural Node Representation Learning" *Proceedings of the IEEE International Conference on Big Data*.

Carpenter, J. (2025). "Scalable and Expressive Graph Representation Learning with Temporal, Structural, and Zero-Shot Capabilities." *Boise State University Theses and Dissertations*. 2446.