JUSTIN CARPENTER, PH.D.

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SUMMARY

Ph.D. Researcher and Systems Engineer with deep expertise in Graph Neural Networks (GNNs), Large Language Models (LLMs), scalable ML pipelines, and High-Performance Computing. Proven track record of bridging theoretical algorithm design and production-grade infrastructure, including zero-shot learning frameworks and GPU-optimized deployments.

TECHNICAL SKILLS

Machine Learning: PyTorch, TensorFlow, DGL (Deep Graph Library), NetworkX, Scikit-learn, Jupyter, BERT
AI & LLM Ops: Ollama, HuggingFace Transformers, RAG, Quantization, Local Inference Optimization
Languages: Python, C++, Java, C, SQL, LaTeX
Infrastructure: Docker, Kubernetes (K3s), Unraid/KVM, Linux (Bash), HPE Server Mgmt, GPU Passthrough
Data Analysis: Pandas, SciPy, Matplotlib, Structural Node Representation, Temporal Graph Analysis

PROJECTS

LLM-GMP: Large Language Model-Based Message Passing — Accepted IEEE Big Data 2025
Zero-Shot Learning on Graphs | Python, LLMs, Graph Representation
- Developed a novel zero-shot learning framework leveraging semantic reasoning of LLMs to perform message passing on graph structures without labeled training data.
- Deployed quantized Llama-3-70b models on a custom-built Linux KVM cluster, optimizing inference latency and reducing VRAM overhead by 40% via hardware-aware model serving.

2FWL-SIRGN: Scalable Structural Graph Partitioning — Published 2024
Graph Representation Learning | Python, Spark, Multi-Threading
- Implemented a scalable 2-dimensional Folklore Weisfeiler-Lehman (FWL) graph representation learning approach.
- Engineered a parallelized graph partitioning algorithm capable of processing massive datasets by distributing subgraph computations across Dockerized containers, overcoming the traditional $O(n^k)$ computational bottleneck.

Temporal SIR-GN: Dynamic Network Analysis — Published 2023
Temporal Graph Learning | Python, SIR-GN
- Extended Structural Iterative Representation (SIR) learning into the temporal dimension to detect evolving structural patterns in dynamic networks.
- Achieved state-of-the-art accuracy in 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, Structural Node Representation
- Applied 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 traffic analysis—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.

EXPERIENCE

Graduate Research Assistant — Dec 2020 – Dec 2025
AI-based Security (AIbS) Lab, Boise State University — Boise, ID
- Spearheaded the research lifecycle for 3 major publications, including competitive analysis, algorithm design, and large-scale testing experiments.
- Managed the lab's high-performance computing infrastructure, ensuring uptime for multi-user GPU compute nodes.
- Developed structural graph partitioning algorithms that improved processing time by up to 83%.

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 tutors to enhance learning during the transition to online classes.

EDUCATION

Boise State University   Boise, ID
Ph.D. in Computing, Focus: Machine Learning and Graph Representational Learning   *Dec 2025*
- Dissertation: Scalable and Expressive Graph Representation Learning with Temporal, Structural, and Zero-Shot Capabilities.

Boise State University   Boise, ID
B.S. in Computer Science   *May 2020*

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 (IEEE Big Data)*.

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

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 (IEEE Big Data)*.