Curriculum Vitae **Jincheng Zhou**

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EDUCATION

Purdue University

- Ph.D. in Computer Science, **GPA: 3.93/4.00** (in progress)
 - Advisor: Prof. Bruno Ribeiro 0
 - Related Coursework: Computation & Learn on Graphs, Deep Learning, Theoretical CS Toolkit 0 Los Angeles, CA

University of Southern California

- Master of Science in Computer Science, GPA: 3.68/4.00
 - Related Coursework: Applied Natural Language Processing, Affective Computing, Foundations of 0 Artificial Intelligence, Analysis of Algorithms

University of Southern California

- Bachelor of Science in Computer Science, GPA: 3.96/4.00
 - Graduated with *Computer Science Outstanding Student Award* (Top 10 students in CS Dept.) 0
 - Related Coursework: Introduction to Artificial Intelligence, Deep learning and its Applications, 0 Theory of Computing, Software Engineering
- Bachelor of Science in Mathematics, GPA: 3.96/4.00
 - Aug 17 May 21 Related Coursework: Mathematics of Machine Learning, Probability Theory, Mathematical 0 Statistics, Analysis, Advanced Topics in Linear Algebra, Geometry and Transformations, Number Theory, Applied Combinatorics, Abstract Algebra, Numerical Methods

RESEARCH INTERESTS

Graph Representation Learning, Knowledge Graph Reasoning, Causal Inference, Causal Discovery, Meta Learning, Large Language Models, Cognitive Architectures, Artificial General Intelligence

PUBLICATIONS

- [1] Zhou, Jincheng, Beatrice Bevilacqua, and Bruno Ribeiro. "An OOD Multi-Task Perspective for Link Prediction with New Relation Types and Nodes." Submitted to NeurIPS 2023 GLFrontiers Workshop (under review). https://arxiv.org/abs/2307.06046
- [2] Gao, Jianfei, Yangze Zhou, Jincheng Zhou and Bruno Ribeiro. "Double Equivariance for Inductive Link Prediction for Both New Nodes and New Relation Types." Submitted to International Conference on Learning Representations, 2024 (under review). https://arxiv.org/abs/2302.01313
- [3] Zhou, Jincheng, and Volkan Ustun. "PySigma: Towards Enhanced Grand Unification for the Sigma Cognitive Architecture." In International Conference on Artificial General Intelligence, pp. 355-366. Cham: Springer International Publishing, 2021. https://doi.org/10.1007/978-3-030-93758-4 36
- [4] Wang, Yunzhe, Nikolos Gurney, Jincheng Zhou, David V. Pynadath, and Volkan Ustun. "Route Optimization in Service of a Search and Rescue Artificial Social Intelligence Agent." In AAAI Fall Symposium, pp. 220-228. Cham: Springer Nature Switzerland, 2021. https://drive.google.com/file/d/1SvstZZz8axwi-rcZfaqiHPXcHvlJlGmH/view?usp=sharing

TALKS & PRESENTATIONS

PvSigma: Towards Enhanced Grand Unification for the Sigma Cognitive Architecture. Technical presentation at the 14th Conference of Artificial General Intelligence. Sunday, Oct 17, 2021. URL: https://youtu.be/evXLHTFTgxQ

SKILLS

- Programming languages: Python, C++, Julia, Java, JavaScript/TypeScript, HTML/CSS, SQL, SPARQL, Common Lisp, Haskell.
- Packages & Libraries: PyTorch, PyTorch Geometrics (PyG), Deep Graph Library (DGL), TensorFlow, • JAX, NumPy, Pandas, Scikit Learn.

Los Angeles, CA

Aug 21 - July 22

West Lafavette, IN

Aug 22 – May 27 (expected)

Aug 17 – May 21

FELLOWSHIP, AWARDS & HONORS

•	Ross Fellowship, Purdue University	April 22
	• Guaranteed four (4) years of Ph.D. support valued at approximately \$214,778.00.	
•	Computer Science Outstanding Student Award, USC Viterbi School of Engineering	May 21
	• Top 10 students in the CS Department.	
•	USC Viterbi Dean's List	Dec 19
•	USC Dornsife Dean's List Dec 19, Dec	ec 18, May 18
•	USC Academic Achievement Award Dec 19, Dec	ec 18, May 18
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RESEARCH EXPERIENCE & PROJECTS

Ph.D. Student at Purdue University

An OOD Multi-Task Perspective for Link Prediction with New Relation Types and Nodes Advisor: Prof. Bruno Ribeiro

- Identified a weakness in expressive power of the double equivariant graph representations as proposed in the paper "Double Equivariance for Inductive Link Prediction for Both New Nodes and New Relation *Types*," by proving that said methods are unable to model certain conflicting patterns in knowledge graphs.
- Developed a theoretical framework, dubbed Multi-Task Double Exchangeability, that explains said conflicting patterns in knowledge graphs.
- Proposed a novel graph neural network architecture, named MTDEA, that is expressive enough model multi-task double exchangeability in knowledge graph.
- Proposed a novel test-time adaptation regime for adapting the MTDEA model on the observable portion of a given test graph to learn the conflicting patterns in the test graph.
- Conducted comprehensive experiments showing the superiority of the MTDEA model in modeling conflicting patterns in knowledge graphs compared to baselines.

Ph.D. Student at Purdue University

Double Equivariance for Inductive Link Prediction for Both New Nodes and New Relation Types Advisor: Prof. Bruno Ribeiro

- Solved a novel task of zero-shot doubly inductive link prediction in knowledge graphs (a.k.a. knowledge graph completion) with completely unknown test-time entities and relations and without any semantic or ontological information (e.g. textual descriptions) of the entities and relations.
- Developed a unifying theoretical framework, dubbed Double Equivariant Graph Representations that underlie any methods capable of soving this novel doubly inductive link prediction task.
- Proposed a novel graph neural network architecture, named ISDEA, that implements the double equivariant graph representations and is capable of accurately performing the doubly inductive link prediction task with robust performance.
- Proposed an easy-to-implement and theoretically sound improved version of an existing graph neural network architecture, named DEq-InGram, that significantly boosts the performance compared to the original InGram.
- Conducted comprehensive experiments showing the superiority of the ISDEA and DEq-InGram model in accurately performing the doubly inductive link prediction task compared to a wide range of baselines.

Student Worker/Research Assistant at the USC Institute for Creative Technologies Jan 20 – Aug 22 PySigma: Towards Enhanced Grand Unification for the Sigma Cognitive Architecture Supervisor/Mentor: Prof. Paul Rosenbloom and Dr. Volkan Ustun

- Redesigned the entire computational layer (the graphical layer) of the Sigma Cognitive Architecture.
- Conducted a comprehensive literature review on message-passing inference algorithms for probabilistic • graphical models.
- Enabled probabilistic logical predicates to encode arbitrary probabilistic distributions and created new • message structures to represent such predicates.
- Conceived a generalized message-passing algorithm combining Variational Message Passing (VMP) and • Monte Carlo Message Passing (MCMP) for continuous approximate inference in lifted factor graphs.
- Analyzed the methematical correctness of the said message design and generalized algorithm. •
- Implemented the entire *PvSigma* architecture from the ground up in Python using PyTorch while strictly following software engineering best practices such as comprehensive unit testing and documentation.

Jan 23 – Sep 23

Jan 23 – Sep 23

Student Worker/Research Assistant at the USC Institute for Creative Technologies Route Optimization in Service of a Search and Rescue Artificial Social Intelligence Agent Supervisor/Mentor: Prof. Paul Rosenbloom and Dr. Volkan Ustun

- Investigated various Graph Transformer models for efficiently and approximately solving route optimization problems such as Travelling Salesman Problem (TSP) and Capacitated Vehicle Routing Problem (CVRP).
- Designed a Coorperative Mutli-Agent Reinforcement Learning system where agents with different roles • and capabilities use the said Graph Transformer models as the oracle to get approximately optimal paths and coorperate to solve a Search-and-Rescue task in a Minecraft environment.
- Constructed an efficient data preprocessing pipeline for the Message-bus of the Search and Rescue Testbed. •
- Streamlined the experimentation workflow by integrating the codebase with Data Version Control (DVC) for version-controlling experiments and *WandB* for real-time logging of the experiment statistics.
- **Undergrad Researcher** at the USC Cognitive Learning for Vision and Robotics lab Aug 19 – Nov 19 Generalizing Reinforcement Learning to Unseen Actions

Supervisor/Mentor: Prof. Joseph Lim

- Conceptualized and designed a variety of new tasks with vastly different properties for a novel RL • benchmark environment.
- Conducted large-scale experiments studying the capability of various RL algorithms to generalize to unseen • actions in the novel RL benchmark.
- Designed and built a dynamic webpage frontend for interactively showcasing the project.

Research Internship at the USC Institute for Creative Technologies Neural Learning of First-Order Probabilistic Logics in the Sigma Cognitive Architecture Supervisor/Mentor: Prof. Paul Rosenbloom and Dr. Volkan Ustun

- Conducted a comprehensive literature review on neural approaches to learning first-order probabilistic logic.
- Enhanced the model proposed by Neural Logic Machines (NLM) in principled ways and adapted the model in the Sigma Cognitive Architecture.
- Conducted experiments at various scales and analyzed the pros and cons of the Sigma implementation of the NLM model.

Project Leader, Course Project for CSCI 599: Deep Learning and Its Applications Learn and Exploit Causality for Curiosity-Driven Deep Reinforcement Learning Supervisor/Mentor: Prof. Joseph Lim

- Conducted a comprehensive literature review on curiosity / intrinsic motivation in reinforcement learning.
- Conceptualized and formalized the notion of causally inspired intrinsic motivation expressed by causal uncertainty.
- Developed a model-based reinforcement learning algorithm that learns a Structured Causal Model (SCM) • of its environment and uses the model's causal uncertainty to guide the agent's exploration in the environment.

Undergrad Researcher at the USC Institute for Creative Technologies Deep Reinforcement Learning in the Sigma Cognitive Architecture

Supervisor/Mentor: Prof. Paul Rosenbloom and Dr. Volkan Ustun

- Compared and analyzed the performance of state-of-the-art RL algorithms under OpenAI Gym game environments.
- Implemented selected RL algorithms using Sigma Cognitive Architecture in Lisp and evaluated their performance.
- Extended Sigma's architectural capabilities in reinforcement learning, constructed infrastructure for building and benchmarking Sigma's RL implementations, and evaluated the architectural benefits of Sigma for reinforcement learning.

Undergrad Researcher at the USC Institute for Creative Technologies

Social Simulation of Human Behaviors

Supervisor/Mentor: Prof. David Pynadath

- Analyzed pan-African socio-economic survey data from Afrobarometer
- Applied statistical analysis and data mining techniques to identify the correlations between people's actions and beliefs and uncover the underlying social dynamics within certain African communities

Jan 20 – Current

Jan 19 – May 19

May 19 – Aug 19

Jan 19 – May 19

Sep 18 – Dec 18

- Built *Partial Observable Markov Decision Process (POMDP)* agent models using *PsychSim* to simulate and reflect people's social behaviors and thought processes
- Devised a theoretical method to automate the construction of such a model on general public survey data

Other Selected Projects:

Project Leader, Computer Science Major Capstone Project LADA Open Discovery Toolkit LDD Genie

• Designed and implemented a full-stack open-sourced software to tag document boundaries and classify legal document types for the Los Angeles County District Attorney's Office

- Led the project team as the Person-of-Contact responsible for communicating with the stakeholders from the LADA Office and executing and maintaining an *Agile* software development pattern
- Built and tested a machine-learning model that automatically detects document boundaries and classifies document types, and integrated the model into the software to suggest solutions to user

TEACHING EXPERIENCE

- Course Producer(Undergrad TA) for CSCI 170: Discrete Methods in Computer Science Aug 18– Dec 18
- Course Producer(Undergrad TA) for CSCI 270: Introduction to Algorithms & Theory of Computing

Jan 19-May 19

 Course Producer(Undergrad TA) for CSCI 270: Introduction to Algorithms & Theory of Computing Aug 19–Dec 19

Feb 21 – May 21