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Caleb Schultz Kisby

Neuro-Symbolic AI Researcher

GitHub: [ais-climber](#)
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EDUCATION

Ph.D. Candidate, Computer Science (in progress)

Fall 2018 – Present

Indiana University

GPA: 3.75

Concentration: Neuro-Symbolic AI, Automated Reasoning

B.S. Computer Science and Mathematics

Spring 2018

University of South Carolina

GPA: 3.97

EXPERIENCE

Research Assistant

Spring 2022 – Present

Indiana University

Fall 2018 – Spring 2019

◦ See Projects below. Supported by a DoD Trusted AI grant for which I co-wrote the grant proposal.

Teaching Assistant

Summer 2019 – Fall 2021

Indiana University

◦ Planned and taught recitations for Theory of Computation, Honors Discrete Math, and Intro to Programming

PROJECTS

Argyle: Agda Library for Reasoning about Learning

[GitHub]

◦ Currently independently developing an Agda library for formally verifying what a neural network has learned, based on my own formal specification of unsupervised learning (see FLAIRS paper below).

à la Mode: Neural Network Model Checking & Building

[GitHub]

◦ Independently developed a suite for checking and building neural networks from symbolic constraints (using Tensorflow).
◦ Proved that the neuro-symbolic translation at the heart of the program is formally sound (see FLAIRS paper below).

Notakto Player

[GitHub][Report]

◦ Supplemented the [AlphaZero CNN](#) with light knowledge-based features to better play [Thane Plambeck's Notakto](#) (a game for which AlphaZero fails to learn a winning strategy — see the linked [Report](#)).
◦ Wrote testbed code (using Tensorflow) to compare the supplemented net against the original AlphaZero net.

An Efficient & Light Cardinality Reasoner

[Github]

◦ Proved completeness for a computationally light logic that reasons about cardinalities with intersection in polynomial time.
◦ Collaborated with co-authors on proof (see AAAI paper below); Independently implemented model-building in Python.

Sense-Able: Obstacle Sensor for Visually Impaired

[GitHub][Tutorial]

◦ Collaborated with a team to develop a proof-of-concept LIDAR sensor for our clients at [P. B. Mumola, Ph.D., LLC](#).
◦ Wrote core C++ code for object detection and the GUI (in Qt); Independently wrote a tutorial for the LIDAR SDK.

SKILLS

Formal Methods. Model-Checking and Building, First-Order & Modal Logics, Interactive Theorem Proving, Functional Programming

AI & ML. Deep Learning (CNNs, LSTMs), Tensorflow (Keras), Scikit-Learn, Knowledge Representation, Symbolic Reasoning

Languages. Python, Agda, C++, C, Java, Lisp (Racket), miniKanren, Lean, Prolog

Other Tools. Git, LaTeX, TexMacs, Jupyter Notebook (Google Colab), Visual Studio Code, Emacs, Linux

PUBLICATIONS

FLAIRS 2022 The Logic of Hebbian Learning

[pdf]

with Saúl A. Blanco and Lawrence Moss. Presented at FLAIRS 2022, Jensen Beach FL.
Nominated for Best Student Paper.

AAAI 2020 Logics for Sizes with Union or Intersection

[pdf]

with Saúl A. Blanco, Alex Kruckman, and Lawrence Moss. Presented at AAAI'20, New York NY

ICCBR 2019 CBR Confidence as a Basis for Confidence in Black Box Systems

[pdf]

with Lawrence Gates and David Leake. Presented at ICCBR 2019, Otzenhausen Germany.