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Caleb Schultz Kisby

Neuro-Symbolic AI Researcher

GitHub: [ais-climber](#)
LinkedIn: [\[Link\]](#)

EDUCATION

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

Fall 2018 – Present

Indiana University

GPA: 3.75

Concentration: Neuro-Symbolic AI

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

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

Teaching Assistant

Summer 2019 – Fall 2021

Indiana University

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

PROJECTS

à la Mode: Neural Network Model Checking & Building

[\[GitHub\]](#)

- Independently developed a suite for verifying and building neural networks via 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](#) (AlphaZero alone fails to learn a winning strategy for this game — see the linked [Report](#)).
- Prototyped 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.

COBB: Case-Based Confidence for Black Box Predictions

[\[GitHub\]](#)

- Co-developed a hybrid neuro-symbolic system that uses a case-based reasoner to assess confidence and explain a neural network's predictions (using Scikit-Learn). Larry Gates and I divided all work evenly. (See ICCBR paper below.)

Sense-Able: Obstacle Sensor for Visually Impaired

[\[GitHub\]](#)[\[Tutorial\]](#)

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

SKILLS

Machine Learning. Supervised & Reinforcement Learning, CNNs, Tensorflow (Keras), NLP (Word2Vec, NLTK)

Symbolic AI. Knowledge Representation & Reasoning, Model Building, First-Order & Modal Logics, Natural Language Semantics

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

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.