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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](#)).
- 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.

### 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 proof-of-concept LIDAR sensor for our clients at [P. B. Mumola, Ph.D., LLC](#).
- Wrote Qt front-end application & object detection code in C++; Independently wrote a tutorial for the LIDAR SDK.

## SKILLS

**Machine Learning.** Deep Neural Networks, Reinforcement Learning, Hebbian Learning, Tensorflow, NLP (Word2Vec, NLTK)

**Symbolic AI.** Knowledge Representation & Reasoning, Model Building, Case-Based Reasoning, Natural Language Semantics

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