Yu-Zhe Shi 师宇哲

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Education

Huazhong University of Science and Technology (pursuing B.S. degree on CS) Wuhan, China
ACM Honored Class on Computer Science, Supervised by Prof. Hai Jin. *Sept. 2018 –*

Research

Human-Level Abuctive Learning and Planning

Key Words: Neural-Symbolic Learning, Abductive Reasoning, Qualitative Simulation, Inverse Planning. *Oct. 2020 –*

- **Motivation:** A novice Minecraft player can explore the world well from only visual observation given very little guidance thanks to the rich background knowledge (or commonsense). Can a machine learner do the same?
- **Task:** I prepare several first-person video sequences recording a rational human player playing Minecraft and define some logic rules representing the human commonsense, e.g. Perspective Relationship.
- **Method:** The learner models the agent operations following the idea of Qualitative Simulation, which describes the motion not step-to-step but in a high-level state-to-state way, yielding greater representative power. It exploits a Transformer model to translate the video sequence to a sequence of motion state transition signals. Then the learner tries to inference subgoals of the player by abducting an interpretation from motion observations and background knowledge. Finally, the learner generates logic programs representing the strategies learned from human players.

Interpretative Neural Feature Primitives for Image Classification

Key Words: Explanability of Neural Networks, Abductive Reasoning, Visual Association. *Sept. 2020 –*

- **Motivation:** Human can recognize instances by executing association between different visual concepts using simple features such as shape, texture, color or symbol. I call these simple explanable features primitives. Can we train a neural network that detects such feature primmitives, and has compositional generalization ability over feature primitives?
- **Toy Data:** We construct a toy image dataset with objects in diverse shapes, textures, colors, and with different symbols on them, using C4D.
- **Method:** We train 4 CNN classifiers, one in each simple feature family. For a particular sample, we order the other samples by calculating their similarities to it. Experiments show that our method extremely reduces the open-world risk for novel instances and we can link them with known classes by applying association over some features. We couldn't go further due to the lack of computing resource.

Waiting for the Bus: A Human-Centered Computing Perspective

Key Words: Subjective Probability, Inverse Planning. *Aug. 2020 –*

- **Motivation:** How do long-term and short-term perspective affect human subjective probability of waiting for a bus? Can we design a intelligent bot that helps users feel better when waiting for some event?
- **Human Behavior Experiments:** We design a 2×6 experiment making participants waiting for a schoolbus in a virtual environment simulating the campus, within 6 scenes and 2 ways of prompts (in short-term and long-term respectively). We record the videos and interactions with the computer of 28 participants.
- **Method:** We apply micro-expression recognition models to the videos as groundtruth of emotion states of the participants and develop a bayesian model inferencing emotion states from human interactions with the computer via inverse planning. We aim to develop a bot that selects appropriate prompting strategy adaptively for different users according to their behavior on the interface, thus providing users with a better experience.

Abductive Novel Object Invention for Incremental Learning

Key Words: Neural-Symbolic Learning, Logic Abduction, Expectation Maximization. *Mar. 2020 –*

- **Motivation:** Can a machine learner detect instances belonging to classes that never been seen nor known before from raw data and label them autonomously with the help of background knowledge?
- **Task:** The learner starts with a CNN classifier that recognizes hand-written symbols `0, 1, 2, +, -, =` and background knowledge about successor relation. This leads a conceptual experiment over the hypothesis that the 4 features can serve as feature primitives.
- **Method:** I feed the learner with image sequences like `0+++=3` and it tries to estimate the distribution of novel objects by both the classification score and logical consistency of rules defined by a PCFG. Then the learner abducts an atomic predicate representing the relationship between the novel class and known classes, e.g. `new_digit(X):-succ(2,X)`. Ultimately, it labels the novel instances with the predicates and update the classifier.

Research on Visual Object Tracking

Key Words: Visual Object Tracking. *July 2019 – Feb. 2020*

- I worked with Prof. Yi-Ping Pheobe Chen at Queensland University and finished a research paper as co-author (Zikai Song, **Yu-Zhe Shi**, Shenyuan Gao, Yi-Ping Pheobe Chen, *Comprehensive Study on Visual Object Tracking under Explosion of Deep Learning: Survey and Experiments*). The paper is under review by *ACM CSUR*.
- Having learned the limitations of deep learning, I decided to pursue the intelligence which is more reliable, more explanable and in a higher level.

Awards

National Scholarship Ministry of Education, China

Top 2 % of all students *Oct. 2019*

Leadership

LEARN Lab LEARN Lab, China

President *Dec. 2019 –*

- LEARN Lab (Learners' Engineering and Research Network Lab) is a research team consisting of highly self-motivated undergraduate students, working on machine learning and cognitive psychology.

Microsoft Learn Student Ambassador Microsoft, U. S.

Beta Level *Aug. 2019 –*

- I held a series of impactive activities and talks at Microsoft Student Club, e.g. talk *Why LEARN Cognitive Science and Artificial Intelligence?* in June 2020.

Academic Skills

Programming: Python, Matlab, Prolog, C/C++, LaTex;
Mathematics: Calculus, Linear Algebra, Probability and Statistics, Discrete Mathematics, Complex Analysis, Numerical Analysis, Computational Theory, Convex Optimization;
Cognitive Psychology: Computational Representation Understanding of Mind;
Writing: Academic Writing in English.