

Muhan Li

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EDUCATION

Northwestern University
Master of Science in Computer Science

09/2020 - 12/2021
Cumulative GPA: 4.0/4.0

Sun Yat-sen University
Bachelor of Engineering in Computer Science and Technology

09/2016 - 06/2020
Cumulative GPA: 3.75/4.0

PUBLICATIONS

- **Muhan Li**, David Demeter, and Doug Downey. Augmenting language models with hierarchical knowledge graphs. (In progress as of July 2022)

EXPERIENCE

Augmenting language models with hierarchical knowledge graphs
Paper Supervised by Prof. Doug Downey

09/2021 - Present

- Raised the SDAR framework, a combination of neural hint generators and symbolic matchers which retrieve semistructured textual knowledge from a hierarchical knowledge graph and augment existing language models. We achieved 91.6% accuracy on the OpenBookQA dataset and only uses a model two magnitudes smaller than the current STOA ensemble (92% accuracy), and 84.2% accuracy on the ARC dataset with a model one magnitude smaller than the current STOA sparse model (84.5% accuracy). The used language models are commonly used pre-trained models with no structural modifications.
- Proposed and experimented a unified hierarchical knowledge structure by grounding free-form text knowledge that could be automatically extracted from web-scale sources such as OpenIE, onto concept atoms from ConceptNet to allow fast knowledge matching and eliminates the need to parse them into triples. This ensures expandability of current hand-crafted knowledge bases.
- Designed and tested a knowledge graph fine-tuning algorithm which adapts pre-computed graph embedding to specific tasks by learning the best alignment between given ground truth and query target, improving the recall ratio of target knowledge by a uniform 5% on the validation and test set of OpenBookQA.

On the Performance of A Baseline for Value-based Statistical Algorithms on Dynamic Iterated Prisoner's Dilemma (IPD) Networks

04/2021 - 07/2021

Paper Supervised by Prof. Uri Wilensky

- Proposed to use Advantage of Defection as a unified normalized representation for IPD payoff matrices with great difference in entnagry values, it is then used as the basis for decision making in IPD games.
- Designed a probabilistic algorithm (Random Table Sampling, RTS) with two action predictors and the Advantage of Defection function as a baseline for traditional deterministic strategies and more complex policies.
- Evaluated new RTS policy, traditional deterministic strategies and optimizable strategies in 3 game scenarios and 4 metrics including robustness, stability, initial viability and noise resistance. Simulated using NetLogo.
- Discovered that the RTS policy has comparable robustness, stability, and initial viability performance to tit-for-tat in lossless networks, and medium noise resistance ability when compared to tit-for-2-tats in noisy networks.

Machin: A Reinforcement Learning Framework

06/2020 - Present

- Developed a framework supporting single-agent RL, multi-agent RL, imitation & inverse RL, parallel RL algorithms and multiple common enhancements such as Prioritized Replay and Generalized Advantage Estimation.
- Abstracted the essential components of the training process into three parts: the model, the algorithm framework, and the environment.
- Implemented a distributed communication module to realize process grouping, resource exposure and discovery, synchronization.

- Wrote more than 40000 lines of Python code, 87% of which were covered with unit-tests, and employed Jenkins CI platform to ensure industrial grade robustness
- Deployed the framework on Github (<https://github.com/iffiX/machin>) and received 199 stars.

Partially Observable Multi-Agent Decentralized Reinforcement Learning Based on Dependence 01/2020 - 06/2020
Unmanned Systems Research Institute of Sun Yat-sen University Supervisor: Hui Cheng

- Developed a dependence weighting mechanism based on temporal convolution similar to the self-attention mechanism used in Natural Language Processing Literature.
- Used a fixed depth observation graph with the dependence weighting mechanism for agents to exchange information and obtained a compact graph embedding for decision making.
- Introduced a multiplication-based negotiation mechanism for finer control on collective actions of interdependent neighboring agents.

The Image Decomposition System based on Deep Reinforcement Learning 07/2019 - 11/2019

- Developed a differentiable brush stroke renderer based on extended disc B-splines and improved its performance using CUDA.
- Used ResNet as the basis of the critic and actor network, trained the painting network with DDPG (Deep Deterministic Policy Gradient) algorithm.
- Consulted relevant papers on style transfer, semantic inpainting and super resolution, and balanced the evaluation parameters by adopting the L2 distance, Texture Loss and Wasserstein Distance (used in WGAN) etc.

The Open Foundation Project for State Key Laboratory: A Research on the Telecommunication and Team Organization of Distributed Cluster Robots 09/2017 - 06/2018

- Developed a routing scheme based on the epidemic protocol for Ad Hoc networks.
- Built an efficient distributed P2P storage system for memory constrained robots.

EXTRA CURRICULAR ACTIVITIES

Participated in a UC Berkeley Digital Image Processing and Segmentation Project 07/2019 - 08/2019

- Realized a wide range of Pointwise operations, Spatial image enhancement techniques, Frequency Domain techniques, Image segmentation and Compression using Matlab.

Leader of the Image Processing Group, the International Aerial Robot Contest (IARC) 03/2017 - 09/2018

- Designed image systems of the UAV (in application of some machine-learning and parallel heterogeneous computing techniques like deep learning, CUDA, OpenCL, etc.)
- Implemented GPU acceleration modules for image segmentation and object detection.
- Participated in the designing of AI decision systems based on FSM (finite state machines).

HONORS & AWARDS

Best System Design (30%) in the International Aerial Robot Contest awarded by the Technical Committee on Guidance, Navigation and Control (TCGNC), Chinese Society of Aeronautics and Astronautics (CSAA) 08/2018

First Prize of System Control (10%) in the International Aerial Robot Contest awarded by the Technical Committee on Guidance, Navigation and Control (TCGNC), Chinese Society of Aeronautics and Astronautics (CSAA) 08/2017

OTHER INFORMATION

Computer Skills: C/C++ (7 years), Python (7 years), JavaScript (3 years), LISP (1 year); familiarity with Linux systems, kernel structure and Docker; expertise in High Performance Computing Programming, Distributed Systems Design and Databases.