Li Muhan

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EDUCATION

Northwestern University   09/2020 - 12/2021
Master of Science in **Computer Science**(Expected)   *Cumulative GPA:* **4.0/4.0**

Sun Yat-sen University   09/2016 - 06/2020
Bachelor of Engineering in **Computer Science and Technology**   *Cumulative GPA:* **3.75/4.0**

PUBLICATIONS

• **Muhan Li**, David Demeter, and Doug Downey. BERT with Context Information Encoding from Knowledge Graphs. (In progress as of July 2021)

• **Muhan Li**, Uri Wilensky, On The Performance of a Baseline for Value-Based Statistical Algorithms on Dynamic Iterated Prisoner's Dilemma Networks. (In progress as of July 2021)

EXPERIENCE

BERT with context information encoding from knowledge graphs   04/2021 - Present
Paper Supervised by Prof. Doug Downey

• Raised the CTX-BERT model, an optimized BERT model that could be combined with other language models (referred as OLM) to enrich their unstructured textual input with structured data from knowledge bases.

• Utilized the context comprehension ability of BERT model and trained the CTX-BERT model on a relation triple recovery task with partially masked entities and corresponding textual contexts as input.

• Proposed and experimented two relation encoding schemes using the traditional distance model and a deep neural model respectively. The relation encoding serves as an auxiliary task used to regularize the output encoding.

• Designed and tested three context encoding mixing methods for the extension of the vocabulary encoding of OLM with context encoding from CTX-BERT.

• Benchmarked and fine-tuned the model on Question Answering tasks, Common Sense Reasoning tasks and Rationale Evaluation tasks, demonstrating its effectiveness in improving the performance of OLM by xx%

On the Performance of A Baseline for Value-based Statistical Algorithms on Dynamic Iterated Prisoner's Dilemma (IPD) Networks   04/2021 - Present
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 (5 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.