Songtao Wang

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EDUCATION

•**Harbin Institute of Technology, China** *Sep,2018-Jul,2022*

Bachelor Degree in Engineering, Automation GPA: 3.74/4

•**National University of Singapore** *Aug,2022-Jan,2024*

Ms.c in Computer Engineering CAP: 4.5/5

RESEARCH INTEREST

My research interest span a wide range of areas in theoretical Machine Learning including Bayesian Inference, and intersection of intersection of machine learning, natural language processing, reinforcement learning and large language model. Specifically, I'm interested in exploring the possibility of large language model applied as multi-agent combined with reinforcement learning and optimized through Bayesian inference. Currently, I'm working on combining LORA with VAE to make LLM absorb info of latent variables which is derived from VAE training and embedded in LORA form.

PUBLICATION

•**Towards Communicative Medical Coaching via Latent Chain-of-thought**

(It will be finished in few days, and I'm the second author) Nov, 2023

- **Description**: Firstly, we introduced the benchmark dataset and metrics on communicative medical coaching, enabling the assessment of LLM coaching efficacy in a simulated patient-doctor-coach environment supported by human annotation, forging a novel intersection among education, medical and AI. Secondly, we proposed a new probabilistic framework latent chain-of-thought by approximating the distribution over the feedback space of coaching correction through carefully designed prompts, through which we set up rules in the form of prompts representing the related latent variables to make feedback distribution close to the spectrum of potential coaching corrections. Language model would follow the probabilistic framework by itself to generate appropriate responses without multiple sampling. We demonstrated its effectiveness by comparing with other prompting methods including ICL, COT, TOT and lora finetuning.

- **Contribution**: I played a pivotal role in creating the simulated patient-doctor-coach environment for LLM communication, generating the benchmark dataset, and conducting comprehensive experiments on various prompting methods. My significant contribution also includes integrating latent variables into the chain-of-thought by creating the latent variables environment which is a mixture of Bernoulli-distribution and Categorical-distribution in form of multiple prompts which finally result in Categorical-distribution outcomes from LLM.

•**Incomplete multi-view clustering with multiple imputation and ensemble clustering**

*Guoqing Chao, **Songtao Wang**, Shiming Yang, Chunshan Li, Dianhui Chu, Applied Intelligence (IF=5.086), 2022.* Jan, 2022

- **Description**: We proposed a new multi-view clustering algorithm that could handle missing values in the machine learning with multiple imputation and weighted ensemble clustering method based on Bayesian estimation which has been proved to reach state-of-the-art performance.

- **Contribution**: I managed to perform multiple imputation to handle incomplete datasets to make it available to implement clustering algorithms. Furthermore, given that many complete datasets acquired from last step with much of uncertainty, I implemented ensemble clustering trying to gather them all. And I designed a weighted algorithm based on Bayesian estimation to combine all the results from ensemble clustering whose weights are based on the accuracy on its branch of algorithm. Finally, it will contribute to performing last step hierarchical clustering.

THESIS

•**NLP based algorithms for evaluating student portfolios**

Master thesis Apr, 2023

- **Description**: Developed an evaluation system for NUS's Pioneer House students using machine learning algorithms and hierarchical clustering, with an emphasis on unsupervised learning approaches such as VAE and HDBSCAN.

- **Contribution**:My work included critical feature analysis using correlation, PCA, SVM, and more. I developed an LSTM-based framework for predicting student enrollment probabilities, integrating feature importance into the recommendation process. Most importantly, I mainly focused on unsupervised learning. Considering that the portfolio is complicated high-dimension data, I utilize VAE to extract latent variable provided for HDBSCAN which was demonstrated to have a better performance.

•**Decision making simulation of autonomous driving based on deep reinforcement learning**

Bachelor Thesis Aug, 2022

- **Description**: This is my bachelor graduation thesis. It was designed to implement to deep reinforcement learning algorithm on simulating decision making procedures of racing cars in TORCS system.

- **Contribution**: I was responsible for programming the entire network, implementing the DDPG algorithm which is one of the extension of Actor-Critic framework for critical decision-making regarding steering and acceleration, complemented by a self-designed adapted Q-function.

Work Experience

•**National University of Singapore, School of Computing, Sound Music Computing Lab**

Research Assistant Apr, 2023-Present

- During this period, I started to get familiar with large language model(LLM) and the beneath model GPT. I was committed to the program Towards Communicative Medical Coaching via Latent Chain-of-thought.

Selected Award

–**China Undergraduate Mathematical Contest in Modeling**

Third-class Price China, 2021

–**Mathematics competition of Chinese College Students**

First-class Price China, 2019

–**Chinese high school Olympiad Mathematical Competition**

First-class Price China, 2016

Related Modules

Pattern Recognition: I learned the basis of several machine learning algorithms including Bayesian predictive distribution, PCA, LDA, LR, SVM and I'm required to programmed them from scratch. Also, I managed to perform CNN for a facial recognition task.

Machine Learning: In this module, I learned the mathematical principle about machine learning and reinforcement learning. I was also required to finish the DQN, DDQN from scratch and its application on game

Deep Learning: I learned principle and application of RNN, LSTM, Transformer, GPT and so on. It also showed me the most popular deep learning generation algorithms including VAE, GAN, stable Diffusion and NeRF. Thanks to the module, I got acquaintance about the mathematical formulas about them. During this period, we accomplished the semantic *segmentation tasks with LinkNet*, and the *Style Transfer tasks with CycleGAN*.

Additional Information

Natural Languages: Chinese(native), English, GRE:320

Technical Skill: Python, C/C++, R, matlab

Tools and Framework: Pytorch, Huggingface, ROS

Interest: Go/Weiqi(4th grade), electronic piano(8th grade), basketball, football