Xinyi Ni

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Education

University of California, Davis — Davis, CA, USA
Ph.D. Electrical and Computer Engineering — *Sept. 2019 - Present*

Zhejiang University — Zhejiang, China
B.Eng. Information Engineering — *Sept. 2015 - Jun. 2019*

Research Interests

My research interests lie in risk-sensitive reinforcement learning, including algorithm efficiency, sample complexity and robustness. In particular, I have developed risk-sensitive RL algorithms based on new risk measures. On the other hand, I have also explored risk-sensitive RL under different setups, including the reward-free framework and with human feedback.

Research Experience

Research Assistant — Sept. 2019 - Present
with Prof. Lifeng Lai — *UC Davis, CA*

Risk-Sensitive RL with Human Feedback | *Paper Submitted to NeurIPS 2024*

- Developed a novel framework that solves risk-sensitive RL with human feedback rather than reward functions.
- Proposed a CVaR-RLHF algorithm to solve the CVaR RL with utility-based feedback.
- Demonstrated the optimality convergence and the regret analysis; Validated practicality through experiments.

Risk-Sensitive Reward-Free RL with CVaR| *Paper Accepted to ICML 2024*

- Designed a framework that explored environments efficiently without reward information.
- Proposed CVaR-RF-UCRL algorithm for efficiently reward-free exploration and then developed CVaR-RF-Planning algorithm to solve CVaR RL with any given reward function solely based on former exploration data.
- Demonstrated the PAC of this framework, Analyzed sample complexity, and Validated through experiments.

Policy Gradient for ϕ-Divergence Risk Measure| *Paper Submitted to NeurIPS 2024*

- Developed a comprehensive ϕ-divergence risk measure encompassing various objectives in risk-sensitive RL.
- Proposed a novel policy gradient algorithm tailored for these risk measures with infinite state & action space.
- Conducted near-optimal convergence analysis through stochastic approximation; Validated through simulations.

Robust Risk-Sensitive RL with CVaR| *Paper Submitted to ITW 2024, IEEE*

- Built a connection between robust RL and risk-sensitive RL, which enhanced the understanding of robustness and safety; Proposed robust CVaR algorithms under various predetermined model uncertainties.
- Designed a new risk measure NCVaR, as a variant of CVaR and developed NCVaR-VI to enhanced CVaR's robustness under decision-dependent uncertainties.
- Provided near-optimal convergence and error bound analysis, Validated through simulations.

Risk-Sensitive RL via EVaR Optimization| *Papers Accepted to ACSSC 2022 and Allerton 2022, IEEE*

- Applied a novel risk measure EVaR to better capture decision-makers' risk preferences based on KL divergence.
- Proposed EVaR-VI and EVaR-VI-DISC algorithms to solve EVaR RL within tabular setup (finite state & action space); Developed a trajectory-based policy gradient method under infinite state & action space.
- Demonstrated the optimality convergences and provided error bounds; validated by simulation.

Student Researcher — Sept. 2018 - Jun. 2019
with Prof. Jiangtao Huangfu — *ZJU, China*

Clinical Diagnosis of HPV based on Deep Learning | *Paper Awarded the Best Graduation Thesis*

Collaborated with Shanghai First Maternity and Infant Hospital

- Detected the blur degree and applied blind deconvolution for image restoration; Combined histogram equalization and the Laplace algorithm for image enhancement; Utilized Otsu's method to partition the target area; Applied data augmentation and zero-mean normalization.

- Employed SE-ResNet50 for classification, achieving a 15.3% improvement in the Youden index.

Driver Assistance with Traffic Signs Recognition Based on ML | *Project Awarded a Patent in China*

- Developed an assistance system capable of capturing traffic sign images and classifying for real-time response.
- Detected the ROI and enhanced the image quality through image processing methods.
- Utilized a pre-trained CNN and fine-tuning for classification.

Work Experience

Incoming Research Scientist Intern Jun. 2024 - Sept. 2024
Xbox Gaming AI @ Microsoft *Redmood, WA*

Project Experience

Autonomous Driving with Distributed RL | *Azure ML, Keras, DQN, Python* Sept. 2023 - Feb. 2024
Student Mentor and Project Leader Davis, CA

- Developed a platform combining Azure ML with N-series GPUs and AirSim for landscape simulation.
- Applied ROI detection, data cleaning and data augmentation to the dataset provided by Microsoft; Designed the reward function and decision maker's risk-preference as additional features.
- Employed & Modified a Deep Q-Network (from Google DeepMind) with a three-layer convolution architecture; Validated the practicality of the risk-sensitive autonomous driving system through simulations.

Deep Risk-Sensitive RL in Video Games | *Linux, TensorFlow, DQN, LSTM* May. 2021 - Dec. 2021
Student Mentor and Project Leader Davis, CA

- Constructed an learning platform based on OpenAI in Linux and a replay buffer to accelerate learning process.
- Integrated & Modified deep RL networks, including Deep Q-learning Network (DQN), Double DQN (DDQN), and Deep Recurrent Q-learning Network (DRQN with LSTM) within the context of risk-sensitive RL; Resulted in an 11.6% increase in game scores.

Publications

[1] **Xinyi Ni**, Guanlin Liu and Lifeng Lai,"Risk-Sensitive Reward-Free Reinforcement Learning with CVaR." *International Conference on Machine Learning (ICML)*. 2024. [Paper]

[2] **Xinyi Ni** and Lifeng Lai. "Policy Gradient Based Entropic-VaR Optimization in Risk-Sensitive Reinforcement Learning." *2022 58th Annual Allerton Conference on Communication, Control, and Computing (Allerton)*. IEEE, 2022. [Paper]

[3] **Xinyi Ni** and Lifeng Lai. "Risk-sensitive reinforcement learning via Entropic-VaR optimization." 2022 56th *Asilomar Conference on Signals, Systems, and Computers*. IEEE, 2022. [Paper]

[4] **Xinyi Ni** and Lifeng Lai. "EVaR Optimization for Risk-Sensitive Reinforcement Learning." University of California, Davis. 2021. [Paper]

Academic Activity

Worksho: 2024 UC Davis ECExpo; 2023 UC Davis ECExpo.
Reviewer:AAAI, IEEE Transactions on Mobile Computing

Coursework

Courses: Machine Learning, Reinforcement Learning, Deep Learning, Mathematics and Statistics, Optimization, Digital Image Processing, Data Structures & Algorithms, Time Series, Signal Processing.
Honors: Dean's Distinguish Scholarship, Academic Excellence Student Honor (x3).

Skills

Language: Python, MATLAB, C/C++, Java, R, Latex, SQL.
Tools: TensorFlow, Keras, Caffe, PyTorch, GPT-4, Azure ML, AWS, GCP.