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

University of California, Davis — Davis, CA, USA
Research Assistant, Advisor: Lifeng Lai — *Sept. 2019 - Present*

Risk-Sensitive Reward-Free RL with CVaR

- **Method:** Proposed an algorithm to explore environments efficiently without reward information; developed algorithms that solve CVaR RL with any given reward function solely based on exploration data.
- **Analysis:** Demonstrated the approach is PAC, analyzed sample complexity, and validated through experiments.

Policy Gradient for ϕ-Divergence Risk Measure

- **Method:** Developed a comprehensive ϕ-divergence risk measure encompassing a wide range of objectives in risk-sensitive RL; introduced a novel policy gradient algorithm tailored for these risk measures.
- **Analysis:** Conducted near-optimal convergence analysis and experimentally validated using Python.

Robust Risk-Sensitive RL with CVaR

- **Method:** Built the equivalence between robust RL and risk-sensitive RL; proposed robust CVaR algorithms under various predetermined model uncertainties; introduced a new risk measure NCVaR, as a variant of CVaR and developed NCVaR-VI to enhanced CVaR's robustness under decision-dependent uncertainties.
- **Analysis:** Provided near-optimal convergence and error bound analysis, confirmed through Python simulations.

Policy Gradient Method for EVaR RL

- **Method:** Solved EVaR RL with infinite state space and action spapce by proposing a trajectory-based policy gradient method for EVaR.
- **Analysis:** Demonstrated the near-optimality convergence and error bounds; validated by simulations conducted for optimal stopping problem and vesting problem.

Risk-Sensitive RL via EVaR Optimization

- **Method:** Applied a novel risk measure EVaR to better capture decision-makers' risk preferences and proposed EVaR Value Iteration to solve risk-sensitive RL with EVaR.
- **Analysis:** Demonstrated the optimality convergence and error bounds; validated by simulation through Python.

Project Experience

Autonomous Driving with Distributed RL | *Azure ML, Keras, DQN, Python* — Sept. 2023 - Feb. 2024

- **Method:** Developed a simulation platform on Azure ML with N-series GPUs.
- **Implement:** Employed a Deep Q-Network (DQN) with a three-layer convolution architecture and modified the Q-function according to risk-sensitive criterion; demonstrated its practicality in autonomous driving system.

Deep Risk-Sensitive RL in Video Games | *Linux, TensorFlow, DQN, LSTM* — May. 2021 - Dec. 2021

- **Platform:** Constructed an learning environment based on OpenAI in Linux and wrote a replay buffer.
- **Implement:** Integrated deep RL networks: Deep Q-learning Network (DQN) and Deep Recurrent Q-learning Network (with LSTM) with risk-sensitive RL, resulting in an 11.6% increase in game scores.

Clinical Diagnosis of HPV based on Deep Learning | *Caffe, CNN, Python* Sept. 2018 - Jun. 2019

- **Data Preprocessing:** 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.
- **Implement:** Employed SE-ResNet50 for classification, achieving a 15.3% improvement in the Youden index.

Publications

[1] **Xinyi Ni**, Guanlin Liu and Lifeng Lai,"Risk-Sensitive Reward-Free Reinforcement Learning with CVaR." *2024 41st 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." 2021. [Paper]

Skills and Honors

Language: Python, MATLAB, C/C++, Java, R, Latex, SQL.

Tools: TensorFlow, Keras, Caffe, PyTorch, GPT-4, Azure ML, AWS, GCP.

Honors: Dean's Distinguish Scholarship, Academic Excellence Student Honor (x3).