

DIEQIAO FENG

PhD Candidate @ Cornell University

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RESEARCH STATEMENT

My research interests lie in Combinatorial Search, Logic, and Planning. In particular, I am interested in machine learning for hard combinatorial problems, including long-horizon reinforcement learning, curriculum learning, and theorem proving.

EDUCATION:

Cornell University, Ithaca, NY, USA *2017.8 - Present*

- PhD Candidate, Department of Computer Science, Advisor: Bart Selman and Carla P. Gomes
- GPA: 4.0/4.0, Coursework: Machine Learning, Logic, Model Theory, NLP with Deep Learning, Reinforcement Learning, Probabilistic Graphical Models.

Tsinghua University, Beijing, China *2012.8 - 2016.7*

- Institute for Interdisciplinary Information Science (Yao Class), Bachelor in Computer Science and Technology
- 1st Place in National Olympiad in Informatics (top 0.01%), received waiver for the National College Entrance Exam to enter THU

UC Berkeley, Berkeley, CA, USA *2015.6 - 2015.10*

- Research assistant in Center for Computational Biology, supervised by Prof. Nir Yosef

Chinese University of Hong Kong, Hong Kong, China *2015.1 - 2015.2*

- Exchange student in the Institute of Theoretical Computer Science and Communications

Awards

- Gold medal in 28th National Olympiad in Informatics (NOI) *Top 1 in China, 2011.8*
- Current Topcoder Algorithm Competition Rating: 2298 *Highest world rank: 43*
- Current Codeforces Algorithm Competition Rating: 2520 *Highest world rank: 23*
- Gold medal in ACM International Collegiate Programming Contest (ACM-ICPC) *Top 3 in Tianjin Region, 2012.10*

PUBLICATIONS AND MANUSCRIPTS

- [1] **Dieqiao Feng**, Carla P. Gomes, Bart Selman, [Left Heavy Tails and the Effectiveness of the Policy and Value Networks in DNN-based best-first search for Sokoban Planning](#), *NeurIPS*, 2022.
- [2] **Dieqiao Feng**, Carla P. Gomes, Bart Selman, [A Novel Automated Curriculum Strategy to Solve Hard Sokoban Planning Instances](#), , *NeurIPS*, 2020.
- [3] **Dieqiao Feng**, Carla P. Gomes, Bart Selman, [Solving Hard AI Planning Instances Using Curriculum-Driven Deep Reinforcement Learning](#), *IJCAI*, 2020.
- [4] **Dieqiao Feng**, Carla P. Gomes, Bart Selman, [Graph Value Iteration](#), *preprint*, 2022.
- [5] Yiwei Bai, **Dieqiao Feng**, Carla P. Gomes, [Zero Training Overhead Portfolios for Learning to Solve Combinatorial Problems and More Sustainable Computing](#), *preprint*, 2022.
- [6] Shuchang Zhou, Taihong Xiao, Yi Yang, **Dieqiao Feng**, Qinyao He, Weiran He. [GeneGAN: Learning Object Transfiguration and Attribute Subspace from Unpaired Data](#), *BMVC*, 2017.
- [7] He Wen, Shuchang Zhou, Zhe Liang, Yuxiang Zhang, **Dieqiao Feng**, Xinyu Zhou, Cong Yao. [Training Bit Fully Convolutional Network for Fast Semantic Segmentation](#), *preprint*, 2016.

EXPERIENCES

Cornell University, Ithaca, NY, USA *2019.8 - Present*

Combinatorial Search Laboratory, Department of Computer Science

Research Assistant, Advisors: **Prof. Bart Selman**, **Prof. Carla P. Gomes**

Mastering the puzzle of Sokoban with deep neural networks and best-first search

- My PhD thesis is on achieving superhuman performance on Sokoban, which is a canonical single-agent PSPACE-complete problem. My mission is to build learning frameworks that can solve hard instances that are beyond the reach of specialized solvers and find shorter solutions that have never been reached by human experts, with the ability to generalize to other domains. I have been approaching this problem from three aspects: 1) Creating sub-instances to augment the dataset; 2) Curriculum learning with multi-armed bandit on instances with varying difficulties. 3) Proposing fully differentiable best-first search.
- Developed state-of-the-art frameworks that set up thousands of *sole records* on the largest Sokoban community [letslogic rankings](#).
- Analyzed the left-handed heavy-tailed behavior of randomized neural network augmented search. This is the first series of works that extensively study the opposite spectrum of traditional right-handed heavy tails [1].
- Proposed fully differentiable best-first search, which is an end-to-end RL framework that gets rid of manually designed A*-like evaluation functions and domain-dependent quantities to predict (under review).
- Proposed the sub-instance creation strategy. Combined with curriculum learning, the RL framework, for the first time, solved a bunch of Sokoban instances that are beyond the reach of traditional domain-specialized solvers [2] [3].

Cornell University, Ithaca, NY, USA

2017.8 - 2019.7

Department of Mathematics

Research Assistant, Advisors: **Prof. Richard A. Shore**, **Prof. Robert L. Constable**

- *I spent the first two years of PhD studying and doing research in mathematical logic, model theory, and automated theorem proving.*
- Wrote an efficient **unification algorithm** of higher-order logic for the HOL Light library.
- Developed a reinforcement learning project for NBG set theory (finitely axiomatizable set theory) and proved the infinitude of primes from basic axioms without extra human knowledge and heuristics.

MIT-IBM Watson AI Lab, Cambridge, MA, USA

2021.7 - 2022.1

AI in Finance Research

Research Intern, Manager: **Dr. Yada Zhu**

Time Series Financial Forecasting with News Data

- Applied VQ-VAE to discretize time series financial data. Extracted vector quantized features to interpret the potential cause of stock Return and Volume.
- Combined news information into the framework to boost the performance of predicting future Return. Increased the accuracy of binary classification of future Return by 30%.

Cornell University, Ithaca, NY, USA

2022.6 - Present

Institute for Computational Sustainability, Department of Computer Science

Research Assistant, Advisors: **Prof. Carla P. Gomes**

Mass Spectrometry Prediction

- Developed a trajectory sampling method for predicting mass spectrometry of metabolite (small molecules).
- Proposed flow network to detect the core sub-graph of Deterministic Finite Automata (DFA), which reduces the size of DFA by 98%.

Megvii Inc., Beijing, China

2015.10 - 2016.9

Research Intern, Manager: **Dr. Jian Sun**, **Dr. Shuchang Zhou**

- *I worked on Computer Vision and Binarized Neural Networks during my undergraduate, which gives me a solid engineering background in deep learning.*

GeneGAN: Learning Object Transfiguration and Attribute Subspace from Unpaired Data

- Proposed a model that can learn object transfiguration from two unpaired sets of images [6].
- The model can perform fine-grained control of generated images, like swapping the glasses in two images by swapping the projected components in the “eyeglasses” subspace, to create novel images of people wearing eyeglasses.

Training Bit Fully Convolutional Network for Fast Semantic Segmentation

- Proposed a method to train a fully convolutional neural network that has low bit-width weights and activations [7].
- Our method with 1-bit weights and 2-bit activations, which runs 7.8x faster on CPU or requires less than 1% resources on FPGA, can achieve comparable performance as the 32-bit counterpart.

UC Berkeley, Berkeley, CA, USA

2015.7 - 2015.9

Center for Computational Biology, Department of Electrical Engineering & Computer Sciences

Research Assistant, Advisor: **Prof. Nir Yosef**

Data Mining in Bioinformatics

- *Prior to combinatorics, I worked on Computational Biology and Statistical Machine Learning, which gives me an interdisciplinary background.*
- Obtained knowledge of statistical analysis methods in bioinformatics, and conducted significance tests on multiple check experiments.
- Applied SVM method to discriminate smokers and non-smokers by observational data collected from buccal and nasal cells.
- Wrote a web application based on Flask to provide multiple analytical tools for data from National Center for Biotechnology Information.

TECHNICAL STRENGTHS

Deep Learning Software Stacks:

PyTorch, PyTorch C++ API, CUDA programming

Programming Languages:

Proficient with C/C++, Python, R, Java

Additional Skills:

Graduate-level understanding of first-order logic, set theory, model theory, proof theory

last updated: 2022/11/02