

# Fangrui Huang

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## EDUCATION

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### Boston University

Sept 2019 - June 2023

Bachelor of Arts and Science, Mathematics and Computer Science Double Major

- Overall GPA: 3.95/4.00, Major GPA: 3.99/4.00
- Dean's list for all academic years

## RESEARCH EXPERIENCE

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### Machine Learning Genomic Research

June 2021 - Now

Boston University, Research assistant, Advisor: **Prof. Ashok Cutkosky**

- Recent studies suggest that large-scale transformer models can achieve impressive prediction accuracy on human genomics data. However, huge cost of intensive computation impedes its development and large datasets don't exist for most other organisms. In this project, I try to improve the computation and data efficiency of transformer models on genomics prediction.
- I propose layer pruning to remove the model redundancy for accelerated training and introduce pre-training to address the data scarceness by leveraging prior knowledge from data-rich domains. Empirically, I highly reduced the computation cost from 64\*3 TPU days (from Google) to 5 GPU days and the proposed pretraining method increases accuracy for 28.7% on average across 5 species and saves 50%-97% training time.
- To achieve this, I modify the state-of-the-art Enformer by reducing the number of self-attention and linear layers based on our empirical observation that most of layers in Enformer are redundant and provide marginal accuracy gain. In addition, I investigate the transfer ability of transformer models pretrained on human genomic datasets to a variety of niche species.
- I build DNA datasets from scratch for six species and benchmark several DNA prediction models (including conventional Transformer, Performer, and CNN with FFT) in terms of accuracy and efficiency. Codes and data are released to benefit the ML community.
- **A first-author paper is accepted and selected as oral in Machine Learning in Computational Biology Conference (MLCB 2022).**

### Frequency Analysis for Computer and Human vision

May 2022 - Now

Boston University, Research assistant, Advisor: **Prof. Arash Yazdanbakhsh and Prof. Haluk Ogmen**

- In order to understand human visual system and inspire the design of next-generation computer vision algorithms, I compare how human visual system and state-of-the-art computer vision models (e.g. convolutional neural network) respond to images with different spatial frequencies and contrast levels.
- I build a synthetic dataset based sinusoidal grating with 5 spatial frequencies, 4 contrast levels and 6 angles. Then I train an AlexNet model on this dataset to do angle prediction and study the differences of prediction performance under various frequencies and contrast levels.
- I quantitatively compare performance of human visual system and AlexNet model under different frequencies and contrast levels. I find that CNN specializes on higher frequency components (20-50 cycle per degree spatial frequency) while human specialize in lower ones (6-8 cycle per degree spatial frequency). This ongoing project will further investigate the reason behind why this inconsistent focus between human and computer vision models happen.

### Ball Game on Bose AR Glasses

Nov 2019

BostonHacks Hackthon Participant

- AR glasses provide people an opportunity to do immersive sport games anywhere and anytime. In this project, I design a AR ball game that control the movement of a ball by moving Bose AR glasses.
- I use Unity to build 2 separate versions of virtual game environments and make player's viewpoint align with the ball movement. In addition, I also design and implement the logic of game in the Unity environment.
- Won BU Spark! Innovative prize and was selected to give a presentation at the closing ceremony.

### AI Teaching Experience

2021 - 2022

1) AI4ALL Summer Camp Coordinator; 2) BU ML course grader; 3) Machine Intelligence Club eboard

- I designed and delivered a 3-week AI4ALL summer camp with four AI lectures. I guided students to complete a fine-grain plant image classification project using Keras and Tensorflow. I also invited guest speakers in AI field.
- I graded homework and exams of a graduate-level machine learning (CS542) course at BU.
- I organized weekly machine intelligence club workshop (~20 people) to introduce and discuss AI topics.

## AWARDS & HONORS

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2019 **BostonHacks Spark! Innovative Prize**

2021 **Undergraduate Research Opportunity Award(\$1350)**

2022 **Undergraduate Research Opportunity Award(\$2850) ; Undergraduate Research Spotlight Presentation**