Yuanzhe Liu

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Education

Rensselaer Polytechnic Institute — **Troy, USA**
*Ph.D. in **Computer Science*** — *2023 – now*
Advisor: Prof. Ziniu Hu

New York University — **New York, USA**
*M.S. in **Computer Science*** — *2021 – 2023*

Oberlin College and Conservatory — **Oberlin, USA**
*B.A. in **Computer Science**, **Piano Performance** and **Mathematics*** — *2016 – 2021*
Piano Advisor: Prof. Peter Takács

Research Interests

(Controllable and Interactive) Generative Models (autoregressive, diffusion and others), especially for creative art and **music**, with the goal of facilitating artists and composers with AI models.
In the past, I did research on approximation theory and algorithmic game theory.

Selected Hornors and Awards

2023: NeurIPS 2023 Co-organizer of Social Activity "AI + music". Presented a guest lecture on "Symbolic Music Generator with Rule-Guided Diffusion models" at "AI + music".

2023: SIGKDD 2023 Student Volunteer

2019: Presented my work on “harmonic measure distribution functions on cantor set” at MAA (Mathematical Association of America) Annual Meeting

2018: Perform at Several **Piano Ensemble Recitals** at Oberlin Conservatory

2018: Third Prize of Ohio Wesleyan Programming Contest

2017: Final Round for Annual Scholarship Competition in Akron, organized by Tuesday Musicale

2016-2021: Oberlin College Scholarship

Publications

1. **Symbolic Music Generation with Non-Differentiable Rule-Guided Diffusion Models**
   - Yujia Huang, Yuanzhe Liu, Adishree Ghatare, Ziniu Hu, Qinsheng Zhang, Chandramouli Sastry, Siddharth Gururani, Sageev Oore, Yisong Yue
   - Under Review.
2. **Automated Detection and Segmentation of Internal Carotid Artery Calcifications on CBCT Images Using Deep Neural Networks**
   - C. Qiang, A.V. Keenan, Y. Liu, Y. Kou, S. Khurana
   - 2024 IADR/AADOCR/CADR Abstract Presentation
3. **Algorithmic Delegation**
   - Ali Khodabakhsh, Yuanzhe Liu, Emmanouil Pountourakis, Samuel Taggart, Yichi Zhang
   - algorithmic contract theory workshops at both STOC and EC

Work and Research Experience

Rule-Guided Music Generation — **Caltech**
Visiting Student Researcher — *Jun. 2023 – Present*

- *Advisor*: Sageev Oore, Ziniu Hu and Yisong Yue
- Working on 'Symbolic Music Generation (e.g., piano rolls) with Non-differentiable Rule-Guided Diffusion Models'.
- Implement a *Transformer-based Latent Diffusion Model* for piano-roll music generation, further extending for long-music generation using *DiffCollage*.
- We study how to use music rules (e.g., note density, chord progression) to **control diffusion process** as a plug-and-play framework. I implement those APIs for key and chord prediction using Music21, and support Yujia in investigating derivative free conditional sampling methods. I also implement classifier-guidance baselines, and construct a survey for human evaluation.
- **The work is currently under review for publication.**

Classification and Detection for Medical Images **NYU**
Research Assistant *Feb. 2023 – Present*

- *Advisor*: Sonam Khurana
- Implement Swin Transformer backbone to detect Internal Carotid Artery Calcification. For detection, further use Mask R-CNN and Faster R-CNN with Feature Pyramid Network to detect and segment images. Attain a recall rate of 72 percent.
- Pretrained Swin Transformer and ResNet-50 backbone on ImageNet using Self-Supervised Algorithm (MoBY, DINO). Obtained more than 40 percent of Average Precision on COCO 2017 test dataset using Mask R-CNN as the detection algorithm and mmdetection as the framework.
- Implement Pretrained U-Net in brain MRI to classify Internal Carotid Artery Calcification. Attain an accuracy rate of 90 percent.
- **This work is accepted at 2024 IADR/AADOCR/CADR General Session for Abstract Presentation.**

Theoretical Algorithmic Delegation **Oberlin College, TCS**
TCS Research Assistant *Jul. – Sep. 2018, Jun. – Sep. 2019*

- *Advisor*: Sam Taggart
- **Project 1 on Algorithmic Game Theory**: Analyze the welfare and revenue of Bayes-Nash equilibrium in first-price auctions with agents. Wrote a python program to computer the equilibrium by applying dynamic programming
- **Project 2 on Algorithmic Delegation**: Extend the proof of the existence of the low bound under several constraints. Proved the APX hardness result of this particular delegation problem under certain conditions. Attempted to disprove the 2-approximation of the threshold policy by invoking examples that would break the 2-approximation.
- **These works are presented on algorithmic contract theory workshops at both STOC and EC.**

Brownian Motion and Cantor Set **Oberlin College, Math**
Mathematics Research Assistant *Jan. – Feb. 2018*

- *Advisor*: Kevin Gerstle
- Study of harmonic measure distribution functions (H-Functions) with focus on domains with fractal boundary shapes through MATLAB simulation. Found H-Functions on Cantor Set by simulating Brown Motion with teleportation algorithm.
- **This work is presented at the MAA Ohio Spring Section Meeting in April 2018**.

Teaching Experience

- **Teaching Assistant for RPI CSCI 2500: Computer Organization, 2023 Fall**.
  - Hold a 46-student on-campus lab (2 hours per week), review students' work, and address their queries regarding lab materials. During TA office hours, explain many details to many attended students.

Revelant Courses

- **Computer Science:** Algorithm, Deep Learning System, Natural Language Processing, Machine Learning, Operating System, Programming Language
- **Mathematics:** Linear Algebra, Group Theory, Number Theory, Analysis, Fourier Series, Probability
- **Piano Performance:** Piano Private Lesson, Degree Recitals, Keyboard Skills, Form and Analysis, Rhythmic Theory, Aural Skills, Music in the Classic Era, Intro to Electroacoustic Music