YIFAN CAI

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EDUCATION

Shanghaitech University **Shanghai, China**
Bachelor of Science *in Computer Science,* ***GPA:*** *3.63/ 4.0* *Sept. 2021-Jul. 2025*

University of Wisconsin-Madison **Madison, WI**
Exchange Program, ***GPA:*** *3.75/ 4.0* *Sept. 2024-Dec. 2024*

University of Pennsylvania **Philadelphia, PA**
Master's in Systems Engineering *Sept. 2025-*

PUBLICATIONS

Cai, Y. (2024). Core technologies in recommender systems: Investigating and analyzing standard implementations. In Proceedings of the 2024 2nd International Conference on Computer, Machine Learning and Artificial Intelligence (CMLAI 2024). Highlights in Science, Engineering and Technology.

Yu, J., Wang, J., Shi, Y., & **Yifan, C.** (2024). Guidance with spherical Gaussian constraint for conditional diffusion. In Proceedings of the International Conference on Machine Learning (ICML 2024).

Cai, Y. (2025). *Structure-Based Drug Design via Diffusion Models Guided by Non-Differentiable Metrics*[Undergraduate Thesis]. Retrieved from https://github.com/caiyf03/Diffusion-model-based-drug-design-guided-by-non-differentiable-metrics.

RESEARCH EXPERIENCE

Individual Project: Core Technologies In Recommender Systems: Investigating And Analyzing Standard Implementations
Researcher *Sept. 2023- Jan. 2024*

- Identified significant inaccuracies in movie rating predictions using classic models like UCB and Thompson Sampling during a course project on recommender systems
- Aimed to enhance the accuracy and personalization of recommendation algorithms by investigating their evolution, especially in the context of reinforcement learning and big data
- Conducted extensive literature reviews and empirical data analysis, explored advancements in the field, and examined the different design and application of algorithms in response to different recommendation needs and characteristics in various industries
- Provided a comprehensive perspective on the technological, ethical, and practical dimensions of recommender systems, contributing to the understanding and future direction of the field

Group Project: Guidance with Spherical Gaussian Constraint for Conditional Diffusion
Researcher *Jun. 2023-May. 2024*

- Attended weekly research group meetings, contributed to paper discussions, reviewed and shared relevant literature to offer insights and direction for the research framework
- Wrote code for the research paper, selected and evaluated various datasets, analyzed experimental results from different approaches, and regularly reported progress
- Contributed to code development by understanding and implementing key algorithms from papers like DDIM, DPS and writing evaluation metric algorithms
- Collaborated on writing the paper, and responsible for parameter tuning and sample selection based on experimental results

SELECTED COURSE PROJECTS

Hearts Game AI Development Group Project **Shanghai, China**
Team Leader, instructed by Prof. Tu from Shanghaitech University *Nov. 2023-Jan. 2024*

The project aimed to develop a competitive AI for the classic game Hearts by implementing and integrating advanced algorithms. https://github.com/caiyf03/Heart_Game_AI-ShanghaiTech_course_project/tree/master

- Led a project team, overseeing the entire project workflow and coordinating team efforts and conducting a paper
- Applied advanced AI algorithms, including Monte Carlo, e-greedy, Q-learning, and deep Q-learning, to develop high-performance AIs for the Hearts game
- Implemented the complete Hearts game with a graphical user interface, supporting both human-AI and AI-AI gameplay

modes

- Innovatively integrated multiple AI algorithms and designed reward functions to enhance game situation awareness, resulting in a 5x improvement over random algorithms and a 3x improvement over traditional greedy algorithms

Application of Image Recognition Models in Real-time Object Detection for Counter-Strike2 **Shanghai, China**

Team Leader, instructed by Prof. Chen from Shanghaitech University *Nov. 2023-Jan.2024*

The project aimed to apply classic image recognition models, such as YOLOv7, SSD, and Faster R-CNN, for the detection of characters and items in the game Counter-Strike 2.

https://github.com/caiyf03/The-Application-and-Comparison-of-Object-Detection-Algorithm-in-Counter-Strike-2/tree/main

- Applied convolutional neural network (CNN) techniques to implement and optimize three classic image recognition models for real-time object detection in the game
- Created the first VOC-format dataset for CS2, facilitating the detection and annotation of game characters and in-game items
- Combined three models using K-means, voting, and confidence metrics to improve prediction accuracy and score item confidence
- Implemented in-game with real-time screen capture, target distance calculation, and auto-aiming based on confidence and distance, achieving above-average hit rates

Application of Finite Element Methods in Solving PDE-Constrained Optimization for Heat Conduction Problems **Shanghai, China**

Team Leader, instructed by Prof. Liao from Shanghaitech University *May.2024-June.2024*

The project addressed challenges such as temperature distribution fitting and internal heat source prediction.

https://github.com/caiyf03/APPLICATION-OF-FEM-IN-SOLVING-PDE-CONSTRAINED-OPTIMIZATION-FOR-HEAT-CONDUCTION-PROBLEM

- Focused on implementing the Simultaneous Analysis and Design (SAND) method for solving specific types of PDE-constrained optimization problems, particularly those applicable to thermodynamics issues like heat conduction in conductors.
- All code developed for this project is original, created by our team without borrowing from or referencing existing implementations. This demonstrates a capacity for independent problem-solving and tool development .

More course projects, such as Pac-Man, Mahjong, Sokoban, Aircraft Battle, microcontroller development, mobile app development, network attack simulation, and CPU chip design, e.t.c. **Shanghai, China**

Overseas Artificial Intelligence Research-based Project Online Seminar **Oversea**

Student and Researcher, instructed by Prof. Osman Yagan from Carnegie Mellon University *Sept.2023-Nov. 2023*

- Learned about classical and modern multi-armed bandit algorithms (e.g., UCB and Thompson Sampling) and analyzed their effectiveness in various fields, such as ad placement and rating prediction, through case studies
- Gained hands-on experience in implementing different algorithms and evaluating their performance, including regret analysis and parameter optimization. Reinforced theoretical knowledge and practical skills through hands-on projects and final presentations
- Collaborated on enhancing a movie recommendation system by analyzing user characteristics and developing AI models for better predictions. Systematically consolidated the knowledge to publish a research paper.
- Received high recognition and praise from professor, along with a recommendation letter for graduate school application.

EXTRACURRICULAR ACTIVITIES

ShanghaiTech University Volunteer Association **Shanghai, China**

Head of the Activities Department *Sept. 2021- Feb. 2024*

- Coordinated and organized all volunteer activities at both the school and district levels
- Organized volunteers for large-scale public service events, including the Shanghai Marathon and guidance services at the Shanghai Science and Technology Museum
- Recognized as the Outstanding Student Organization of the Year

ShanghaiTech University Student Association **Shanghai, China**

Member, Student Welfare Department *Sept. 2021-Jul.2023*

- Addressed and resolved daily issues faced by students, acting as a liaison between students and the university's residential colleges, dormitories, and dining services

- Organized and coordinated university-wide entertainment events, enhancing campus life and student engagement

Industrial Practice: Field Study at Mandi Medical Devices and Ruijin Hospital's Proton Therapy Center, *Head of the News Team* — **Shanghai, China** — *Jul. 2023*

- Led the research team in field studies at Mandi Medical Devices and Ruijin Hospital's Proton Therapy Center, exploring industrial applications of computer vision and machine learning
- Managed team coordination, data collection, and synthesis of information, resulting in a comprehensive and coherent report

Social Practice: Yan'an Field Study — **Yan'an, China**

Head of the News Team — *Aug. 2022*

- Led a team in investigating the development of local tourism in Yan'an, conducting interviews with government agencies and cultural heritage bearers, managing daily tasks, and writing news reports
- Conducted on-site assessments to analyze the impact of the pandemic on Yan'an and assisted the local government in recovery efforts