Yifan Cai

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▪*LinkedIn:https://www.linkedin.com/in/yifancai03/* ▪*Git:https://github.com/caiyf03* ▪*Portfolio: caiyf03.github.io*

EDUCATION

University of Pennsylvania — **Philadelphia, PA**

Master's in Systems Engineering (Expected in May 2027), ***GPA:*** *3.9/ 4.0* — *Sept. 2025-Now*

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*

TECHNICAL SKILLS

Languages: Python (Proficient), MATLAB, C/C++, JAVA

ML/DL Frameworks: PyTorch, TensorFlow, OpenCV

Areas: Deep Learning, Reinforcement Learning, Computer Vision, Scientific Machine Learning

Tools: Git, Linux, LaTeX

SELECTED PROJECTS

PERoKF: Physics-Enhanced Super-Resolution of Kolmogorov Flow (Python, PyTorch) — **Upenn, America**

https://github.com/caiyf03/PERoKF — *Nov.2025-Dec.2025*

- Developed a super-resolution pipeline reconstructing 512×512 turbulent flow fields from 128×128 inputs, implementing and benchmarking CNN, UNet, FNO, and Diffusion models
- Designed a pseudo-spectral Navier–Stokes physics-consistency loss, reducing physical violations by ~40%
- Self-built 14,400+ high-definition sample data and reproducible training/evaluation scripts to validate model performance and generalization

PDE-Constrained Optimization System for Heat Conduction (Matlab) — **Shanghaitech, China**

https://github.com/caiyf03/PDE-Constrained-Heat-Optimization — *May.2024-June.2024*

- Implemented a SAND-based PDE-constrained optimization framework for heat conduction control
- Developed custom numerical solvers and end-to-end optimization pipelines from scratch
- Conducted simulation-driven validation and constraint-based performance evaluation
- Led a 3-member team, overseeing architecture design, integration, and system testing

Real-time Object Detection System for Counter-Strike 2 (Python, OpenCV) — **Shanghaitech ,China**

https://github.com/caiyf03/The-Application-and-Comparison-of-Object-Detection-Algorithm-in-Counter-Strike-2 — *Nov. 2023-Jan.2024*

- Engineered a real-time end-to-end pipeline (screen capture, auto-aim, distance detection) achieving <50ms per-frame latency.
- Implemented and optimized YOLOv7, SSD, and Faster R-CNN on a custom dataset of 500+ in-game images, balancing speed and accuracy
- Led a 3-person team through Agile development, integrating modular components and ensuring system robustness

Hearts Game AI System (Python, PyTorch) — **Shanghaitech,China**

https://github.com/caiyf03/Heart_Game_AI — *Nov. 2023-Jan. 2024*

- Built a complete card-game system with GUI supporting human–AI and AI–AI gameplay
- Implemented multiple decision-making algorithms for AI gamer including Monte Carlo, Q-learning, and Deep Q-learning
- Designed reward functions and evaluation pipelines, achieving ~5× performance improvement over random agents

PUBLICATIONS

Yu, J., Wang, J., Shi, Y., & Cai, Y. (2024). Guidance with Spherical Gaussian Constraint for Conditional Diffusion. Proceedings of the 41st International Conference on Machine Learning (ICML)

Cai, Y. (2024). Core Technologies in Recommender Systems: A Comparative Analysis of Standard Implementations. Proceedings of the 2nd International Conference on Computer, Machine Learning and Artificial Intelligence

UNDERGRADUATE THESIS

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