Shanshan Mao

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Education

University of Birmingham, UK *Mar 2021 – Present*
PhD in Computer Science, School of Computer Science

- Research focuses on hierarchy emergence in multi-agent systems via self-organisation.

University of Birmingham, UK *Sept 2019 – Sept 2020*
MSc in Advanced Computer Science, School of Computer Science

- Awarded Distinction (UK grading standard).
- Selected modules: Machine Learning, Neural Computation, Nature-Inspired Search, Intelligent Data Analysis.

Henan University, China *Sept 2014 – Jun 2018*
BSc in Computer Science and Technology

- Final grade: 80.5/100;
- Selected modules: JAVA, C++, Data Structure, Operating Systems, Networks, Databases.

Research Experience

Emergence of Hierarchy in Multi-Agent Systems *PhD Research, Mar 2021 – Present*
University of Birmingham, UK

- Investigated how centrally coordinated actions can emerge from purely local interactions in Multi-Agent Systems.
- Designed and implemented a real-time Python-based simulation framework of speaker–listener dynamics in distributed environments.
- Studied the spontaneous emergence and collapse of social hierarchies through endorsement networks, deception mechanisms, and cooperation models.
- Applied Trophic Incoherence as a structural metric and evaluated hierarchy stability under mutation, inequality, and bounded rationality.
- Implemented adaptive learning and experience-weighted update rules for agent decision-making under uncertainty.

Heuristic Optimization on the Constrained Traveling Salesman Problem *Nov 2019 – Jun 2020*
Mini Project and Master Thesis, University of Birmingham

- Conducted an in-depth study on the Travelling Salesman Problem (TSP) with time and cost constraints.
- Explored and compared heuristic algorithms including Genetic Algorithm (GA), Tabu Search, and Simulated Annealing.

- Proposed enhancements to GA for constrained environments, and applied models to benchmark datasets (e.g., ATT48).
- Extended the mini-project into a full thesis, demonstrating algorithmic performance through empirical evaluation and parameter tuning.

PCA-Based Life Expectancy Data Analysis *Feb 2020 – Mar 2020*

- Applied PCA and LDA to analyse and visualise health-related datasets.

Teaching Experience

Teaching Assistant (PGTA), University of Birmingham *Sept 2022 – Present*

- Conducted tutorials and labs in undergraduate modules (Data Structures, Databases, Programming for Data Science, Evolutionary Computation, AI/ML).
- Delivered lab sessions, exercise lectures, and in-class support for core undergraduate modules (e.g., Data Structures).
- Graded assignments and exams, monitored assessments, and offered help sessions for large student cohorts.
- Completed formal training certified by HEFi (PGTA Programme), covering:
  - Small group teaching (labs and seminars)
  - Teaching with digital tools
  - Giving a lecture
  - Teaching international students

Teaching Assistant, University of Birmingham Summer School *Jul 2025*

- Assisted in delivering the *Machine Learning for Mathematics* programme, providing lab support and guidance on coding exercises.
- Taught practical use of machine learning and deep learning frameworks (scikit-learn, PyTorch, TensorFlow).

Other Work Experience

User Interface Developer (Project) *2018*

- Independently developed a user interface in Python to connect third-party testing hardware with dSPACE HIL systems via an existing API.
- Translated customer requirements into core UI functionalities, enabling smooth interaction between end-users and back-end simulation tools.
- Strengthened practical experience in Python GUI development and system-level integration within real-time testing environments.

Front-End Developer and Tester – Henan University Project *2017*

- Developed and tested the front-end components of the Zhenjiang Commerce Official Website using jQuery, HTML, and CSS.
- Ensured responsive design and browser compatibility for access to public services.
- Worked with a small development team in an agile environment to meet web digitization standards.

Entrepreneurial Experience

Doctoral Innovation Programme – AI Companion Robotics *China, Sept 2023 – Jun 2024*
Participant & Technical Lead

- Selected for a national PhD entrepreneurship programme.
- Designed a sample multimodal AI companion robot with voice, vision, and emotion-aware capabilities.
- Integrated speech processing (ASR, TTS), gesture sensing, and adaptive dialogue flow for elderly care and education.
- Explored real-time multimodal fusion for socially engaging human-machine interaction.

Skills

Languages: Python, C++, MATLAB
Frameworks: PyTorch, scikit-learn, PyGame
Tools: Git, VSCode, Jupyter, LaTeX, Pycharm
Statistics & Data Analysis: Hypothesis Testing, Regression Analysis, p-value Computation, t-tests, Statistical Modeling, Data Visualization(Matplotlib, Seaborn)
Others: Agent-Based Modeling, Dynamic Multi-Agent System Simulation

Awards

Sustainable Future in the City: Student Competition *Oct 2019*

- Won first place for designing and presenting a speech-based solution themed on e-ticketing for green transport.

Publications

Mao, S., Tino, P. From Cooperation to Hierarchy: A Study of Dynamics of Hierarchy Emergence in a Multi-Agent System. Accepted at EvoStar 2026.

Works in Progress

Nash Equilibrium and Deception Mechanisms in Multi-Agent Systems: A Game-Theoretic Approach Experimental stage, planned submission to (ALife 2026).