ANANYA GANDHI

Pune, India

📞 +91 9405639871 | ✉ ananya.gandhi.183@gmail.com | 🌐 ananya183.github.io | 🔗 ananya183 | ⭘ ananya183

EDUCATION

Indian Institute of Science Education and Research (IISER) - Bhopal　　　　　**2020 − 2025**
BS-MS in Electrical Engineering and Computer Science　　　　　*CPI: 7.56/10*

- Major: Electrical Engineering and Computer Science (EECS)
- Minor: Data Science and Engineering (DSE)

MS Thesis: Posing Flocking as a MARL Problem 🔗　　　*Advisor: Prof. Sujit P. B.*
Formulated decentralised flocking as a Multi-Agent Reinforcement Learning (MARL) problem　　　*Aug 2024 – May 2025*
by modelling it as a Partially Observable Markov Game. Designed hybrid reward functions
balancing cohesion, alignment, survival, and exploration objectives. Developed and trained UAV
swarm agents using Proximal Policy Optimization (PPO) and Soft Actor-Critic (SAC) algorithms
within a Unity-based simulator. Demonstrated emergence of stable flocking behaviour under
partial observability and dynamic obstacle-rich environments, with PPO + curriculum learning
showing superior performance.
Final-Year *Report*
Mid-Year *Report* & *Slides*

BS Thesis: Moving Depot (MOD): An Efficient Depot Motion Strategy for Multi-Robot Foraging 🔗　*Advisor: Prof. Sujit P. B.*
Developed a novel moving depot strategy (MOD) for enhancing resource collection efficiency in　*Jan 2024 – Apr 2024*
multi-robot foraging systems. The strategy dynamically relocates the depot based on foraging
patch quality and avoids obstacles using a potential field-based method. Conducted agent-based
simulations comparing MOD with stationary depot strategies (SDS) and multiple-place foraging
algorithms (MPFA), demonstrating up to 50% performance improvements in dynamic environ-
ments.
This work led to the acceptance of an *Extended Abstract* and a *Poster Presentation* at the *ANTS
2024 International Conference on Swarm Intelligence, Konstanz, Germany.*

Relevant Coursework: Multi-Agent Reinforcement Learning, Artificial Intelligence, Network Science, Control Systems, Data Science
in Machine Learning, Introduction to Quantum Computer Science, Computer Vision

Mathematical Courses: Applied Optimization, Multivariable Calculus, Probability and Statistics, Real Analysis

TIMELINE OF EDUCATION & WORK

Aug, 2008 - July, 2018:	Primary & Secondary Education at Abhinava Vidyalaya Eng. Med. School (Maharashtra State Board)
Aug, 2018 - July, 2020:	Higher Secondary Education in Science stream at Dr. Kalmadi Shamrao Junior College (12th Boards)
July, 2020 - Dec 28, 2020:	Without activity *(COVID Lockdown)*; independent study
Dec 28, 2020 - June 30, 2025:	BS-MS in EECS at the Indian Institute of Science Education and Research (IISER), Bhopal
Aug, 2022 - June 2025:	Multi-rObot autONomy (MOON) Lab, IISER Bhopal
July 10 - July 14, 2023:	Summer School at the Indian Institute of Science (IISc), Bangalore
Nov 22 - Nov 25, 2024:	IEEE HUMANOIDS 2024 Conference at Nancy, France
Dec 02 - Dec 07, 2024:	Winter CS Theory Program at the Indian Institute of Technology (IIT), Delhi
July 21, 2025 - Aug 08, 2025:	Konstanz School of Collective Behaviour (KSCB) at CASCB, Universität Konstanz

HONOURS AND AWARDS

Kanako Miura Travel Award | *IEEE-RAS International Conference on Humanoid Robots 2024*　　　**Nov 2024**
Awarded by the IEEE Robotics and Automation Society (RAS) Technical Committee on Humanoid Robotics.　　*Nancy, France*

PUBLICATIONS & PRESENTATIONS

P Ingle, A Gandhi, PB Sujit *"Moving Depot (MOD): An Efficient Depot Motion Strategy for Multi-Robot Foraging"*. *Poster
Presentation, ANTS 2024 International Conference on Swarm Intelligence*, Konstanz, Germany. (Extended Abstract)

A Gandhi *"Adaptive Swarm Strategies and Multi-Agent Reinforcement Learning for Optimization"*. *Lightning Talk, Women in
Engineering Luncheon, IEEE-RAS Humanoids 2024 Conference on Humanoid Robotics*, Nancy, France. (Kanako Miura Travel Award)

A Gandhi, P.B. Sujit *"Multi-Drone Reinforcement Learning for Swarm Formation and Navigation"*. *Poster Presentation, EECS
Research Symposium 2025, Indian Institute of Science Education and Research (IISER) Bhopal.*

P Ingle, A Gandhi, P.B. Sujit *"Moving Depot (MOD): A Strategy for Efficient Multi-Robot Foraging"*. *Poster Presentation, EECS
Research Symposium 2025, Indian Institute of Science Education and Research (IISER) Bhopal.*

A Gandhi, Peter Dayan *"Modelling Theory of Mind in Buyer-Seller Interactions"*. *Project Presentation, CASCB Summer School,
Konstanz School of Collective Behaviour.*

COMPETITIONS

INSEF Regional Fair, IISER Pune | *Chemistry Research Project*   **Nov 2017**
- Out of 2,000 participants, one of the only 21 students to make it to the final round.
- Received the **Special Mentions Award** for the project **"Element Flame Colours: A Trend in the Periodic Table?"**.
- Conducted experiments, presented findings on flame colors of elements and periodic trends, recognized among top projects at the regional fair organized by **IISER Pune**, **CSIR-NCL**, and **SSI**.

Infosys Spark: Catch Them Young (CTY) Program | *Summer Workshop, IT Concepts and Applications*   **July 2016**
- Out of the top-performing 3000+ students of the state, selected as one of 40 students for the Summer Workshop
- Completed a **two-week summer workshop** at **Infosys Pune**, focused on Information Technology fundamentals, programming, and software development.

RESEARCH EXPERIENCE

Lab Member, Multi-rObot autONomy (MOON) Lab 🔗   **Prof. Sujit P. B.**

Indian Institute of Science Education and Research (IISER Bhopal)   *Aug 2022 – Present*

Moving Depot (MOD): Multi-Robot Foraging Strategy
- Developed and published a novel depot motion strategy for multi-robot foraging, accepted at ANTS 2024 International Conference on Swarm Intelligence in Konstanz, Germany
- Presented research findings as an Extended Abstract, focusing on swarm robotics and swarm optimization techniques

Emergent Flocking via Multi-Agent Reinforcement Learning
- Designed and trained decentralized drone swarms using MARL (PPO, SAC) to achieve flocking behaviors under partial observability
- Implemented curriculum learning in Unity to enable stable, scalable swarm formation with dynamic obstacle handling

CS Theory Winter Residency Program Student, Topics in Computational Social Choice 🔗   **Prof. Rohit Vaish**

Department of Computer Science and Engineering, Indian Institute of Technology (IIT Delhi)   *Dec 2024*
- Explored the mathematical foundations of *Social Choice* or *collective decision-making problems* that involve making a group decision based on the preferences of individuals
- Used tools and techniques from theoretical computer science, economic theory, and artificial intelligence to design and analyze algorithms for collective decision-making problems centered around economic issues such as fairness, efficiency, and incentives and how they interact with computation

Summer School Student, Dynamic Resource Allocation in Networks 🔗   **Prof. Alexandre Reiffers-Masson**

Centre for Networked Intelligence (CNI), Indian Institute of Science (IISc Bangalore)   *July 2023*
- Explored mathematical and ML techniques for *NP-Hard Dynamic Resource Allocation Problems in Communication Networks*
- Implemented heuristics including LP-based and Whittle index policies for real-world network issues
- Applied the theory of Weakly-Coupled MDP and Restless Multi-Armed Bandit Problems to solve finite horizon optimization challenges

Summer Research Intern, Multi-Robot Foraging and Danger Communication Algorithm 🔗   **Prof. Sujit P. B.**

Multi-rObot autONomy (MOON) Lab, IISER Bhopal   *Aug 2022 – Present*
- Designed an innovative Swarm Algorithm for Danger-based Signal communication system, validated through comprehensive Monte-Carlo Simulations

COURSE PROJECTS

Collaborative Multi-Car Racing using Multi-Agent Reinforcement Learning 🔗 | *Python, PettingZoo, Stable-Baselines3* **2024**
- Trained autonomous agents to race cooperatively in teams using MADQN in a grid-based track environment

Feature Selection for Few-Shot Mixed-Type Building Classification 🔗 | *Python, PyTorch, Genetic Algorithms*   **2024**
- Applied genetic algorithms and contrastive learning techniques to classify mixed-type buildings from Street-View images.
- Achieved superior accuracy compared to ResNet-50 with DINOv2, demonstrating the effectiveness of the proposed approach.
- Explored the potential of few-shot learning in reducing the need for large labeled datasets in urban scene understanding.

Network Analysis of the Indian Stock Market 🔗 | *Python, NetworkX, Pandas*   **2024**
- Conducted comprehensive analysis of stock market networks using various centrality measures.
- Identified Federal Bank and ITC as highly influential stocks based on daily closing prices and network topology.
- Developed visualizations and metrics to represent complex financial relationships and market dynamics.

Quantum HHL Simulation Project 🔗 | *Python, Xanadu PennyLane, Wolfram Mathematica*   **2023**
- Implemented the Harrow-Hassidim-Lloyd (HHL) algorithm to solve a 2D non-Hermitian linear system by transforming it into a Hermitian form.
- Designed and simulated quantum circuits using the PennyLane framework, achieving normalised solutions with minor deviations and analysing challenges like approximation errors in controlled rotations.

Butterfly/Moth Image Classification Project (100 Species) 🔗 | *Python, PyTorch*   **2022**
- Leveraged ResNet50 pre-trained model for the classification of 100 species of butterflies and moths.
- Achieved a validation accuracy of 77.8% and test accuracy of 79.4% using transfer learning techniques.

TECHNICAL SKILLS

Programming Languages: Python, C++, MATLAB, C# (Unity)
Frameworks & Libraries: TensorFlow, PyTorch, Scikit-learn, Pandas, NumPy, PettingZoo
Tools & Technologies: Git, LaTeX, Shapr3D, Linux, Wolfram Mathematica, Xanadu-PennyLane, VR Systems

LEADERSHIP AND EXTRACURRICULAR ACTIVITIES

'Arbitrage': the Quantitative Finance Club of IISER Bhopal   **Founding Date – Jan 2025**
Founder and Coordinator (2024)   *IISER Bhopal*

- Established the first quantitative finance-focused club across all IISERs.
- Developed and implemented educational programs to foster financial literacy and quantitative skills among peers.
- Organized workshops, seminars, and competitions to engage students in practical applications of finance and data science.

IISERB Book Club   **Aug 2022 – May 2025**
Coordinator (2022-2023), Advisor (2023-2025)   *IISER Bhopal*

- Revitalized the club post-pandemic, leading recruitment and management of the core committee.
- Expanded the club's reach and impact, gaining recognition from the Education Minister of Madhya Pradesh State.
- Organized regular literary events, author talks, and reading sessions to foster a vibrant intellectual community.

ACHIEVEMENTS

Maharashtra State Board Junior College Topper | *Computer Sciences*   **2019**

- Achieved **97.5%** in Computer Science in Kalmadi Shamrao Junior College, Pune.
- Maintained consistent academic excellence with **92%** in 10th grade boards and **87%** in 12th grade boards.

Foundation Level Course Completed | *BSc in Programming and Data Science, IIT Madras*   **2021**

ADDITIONAL INFORMATION

Research Interests: Collaborative Intelligence in Robotics, Drone Swarming, Efficient Depot Strategies, Multi-robot Systems, Multi-agent Reinforcement Learning, Decentralized Autonomous Systems
Languages: English (Fluent), Hindi (Fluent), Marathi (Native), Spanish (Beginner), French (Beginner)
Hobbies: Literature, Travel, Hiking, Letter Writing & Philately, Chess, Basketball
Workshops: Workshop on Energy Conversion and Storage, 3D Design and Printing Workshop, IPR Workshop