CSC 36000 Modern Distributed Computing NextGen with AI Agents: Project Topics

1. Adaptive Resource Allocation Strategies (e.g. Load Balancing) for Distributed Large Language Models in Edge AI Networks

- D-LLM: A Token Adaptive Computing Resource Allocation Strategy for Large Language Models (NeurIPS 2024) neurips

- Learning with Adaptive Resource Allocation (ICML 2024) pmlr

Team Members: Shale Lucas, Omar Stevens

2. Standardized Benchmarking of Multi-Agent Distributed Machine Learning in Augmented Reality

- BenchMARL: Benchmarking Multi-Agent Reinforcement Learning (NeurIPS 2024) neurips
- Simulating autonomous agents in augmented reality sciencedirect

Team Members: Parthkumar Joshi, Klea Meta

3. Resilient Data Routing Algorithms for NextGen Multi-Agent Connected Autonomous Vehicle Networks

- Autonomous Agents for Collaborative Task Under Information Asymmetry (NeurIPS 2024) neurips
- Fault-Tolerant Consensus of Multi-Agent System With Distributed Adaptive Protocol (IEEE Transactions on Cybernetics, 2015) nih

Team Members: Marcley Colin, Mustafa Ahmet Must Donmez

4. Leveraging Distributed AI in NextGen Networks for Real-Time Autonomous Risk Management

- Risk Management for Distributed Arbitrage Systems: Integrating Artificial Intelligence (ICAIFI 2025) arxiv
- AI re-shaping financial modeling (Nature 2025) nature

Team Members: Erik Brobyn, Arnav Deepaware

5. Real-time State Synchronization Solutions for Decentralized AI Agents Over Slow Networks

- Decentralized Training of Foundation Models in Heterogeneous Environments (NeurIPS 2022) neurips
- Fine-tuning Language Models Over Slow Networks Using Activation Compression with Guarantees (NeurIPS 2022) neurips

Team Members: Brandon Bedoya, Haoliang Zhang

6. Fault-Tolerant Consensus Algorithms for Multi-Agent Networks Facing Random Attacks and Sensor Failures in Multimodal Models (e.g. Vision Language Models)

- Fault-Tolerant Consensus of Multi-Agent Systems Subject to Multiple Faults and Random Attacks (2024) hull
- Fault-Tolerant Consensus of Multi-Agent System With Distributed Adaptive Protocol (IEEE Transactions on Cybernetics, 2015) nih

Team Members: Gaurav Gupta, Joshua Kenneth Jimenez

7. Distributed Multi-Agent Augmented Reality Environments Using Game-Theoretic Theory of Mind for Strategic Interaction

- Distributed Computing Meets Game Theory: Robust Mechanisms for Rational Secret Sharing and Multiparty Computation (PODC 2006) cornell
- Dynamics at the Boundary of Game Theory and Distributed Computing (ACM EC 2017) columbia

Team Members: Alhassana Diallo, Sadia Nawaz

8. Multi-Agent MIMO Strategies for Robust Communication in Distributed Wireless Networks

- Multi-Agent Coordination via Multi-Level Communication (NeurIPS 2024) neurips
- Machine Learning Helps Robot Swarms Coordinate (Caltech, 2020) caltech

Team Members: Minning Liu, Emmanuelle Padilla

9. Interpretable Multi-Agent Coordination Algorithms for Heterogenous (Urban/Suburban/Rural) Autonomous Mobility Networks

- Language Grounded Multi-agent Reinforcement Learning with Zero-shot Ad-hoc Teamwork (NeurIPS 2024) neurips
- Autonomous Agents for Collaborative Task Under Information Asymmetry (NeurIPS 2025) neurips

Team Members: Rivaldo Lumelino, Alexandr Voronovich

10. Power Management and Energy-Efficient Protocols for Distributed AI Agents on Resource-Constrained Devices

- Distributed Task Offloading and Resource Allocation for Latency Sensitive Mobile Edge Computing (arxiv, 2024) arxiv

- Learning with Adaptive Resource Allocation (ICML 2024) pmlr

Team Members: Mehedi Hasan, Aidan Adonis Pena

11. Distributed Vision-Language Model (VLM) Framework for Optimizing Building Engineering (e.g. HVACs, Regulations, Energy Efficiency Monitoring)

- Distributed VLMs: Efficient Vision-Language Processing through Cloud-Edge Collaboration (2025) columbia
- Opportunities of applying Large Language Models in building energy sector sciencedirect

Team Members: Christopher Luis Barbosa Jr, Sean Jenkins

ADDITIONAL PROJECT IDEAS WHICH ARE NOT TAKEN BY ANY STUDENT TEAM YET

12. Efficient and Interpretable Communication Protocols in Deep Multi-Agent Reinforcement Learning and Control Systems

- Learning to Communicate with Deep Multi-Agent Reinforcement Learning (NeurIPS 2016) neurips
- Language Grounded Multi-agent Reinforcement Learning with Zero-shot Ad-hoc Teamwork (NeurIPS 2024) neurips

13. Secure and Private Cooperation Protocols for Large Swarm Robotic Missions

- Secure and Secret Cooperation in Robotic Swarms (MIT, 2023) mit
- Machine Learning Helps Robot Swarms Coordinate (Caltech, 2020) caltech

14. Semantic Web Integration for Communication and Knowledge Sharing in Autonomous Multi-Agent Systems

- From Semantic Web and MAS to Agentic AI (arxiv, 2024) arxiv

- Multi-Agent Coordination via Multi-Level Communication (NeurIPS 2024) neurips

15. Dynamic Task Offloading and Optimization Frameworks for Edge-Aware Multi-Agent Distributed Job Scheduling (e.g. Phones/AR/Connected Autonomous Vehicles)

- Dynamic Task Offloading Edge-Aware Optimization Framework for AI-Driven UAV Networks (Nature Scientific Reports 2024) nature

- Distributed Task Offloading and Resource Allocation for Latency Sensitive Mobile Edge Computing (arxiv, 2024) arxiv

16. Smart Arbitration and Decision-Making Protocols for Decentralized Agentic Systems in Heterogeneous Environments

- Multi-Agent Coordination via Multi-Level Communication (NeurIPS 2024) neurips
- Decentralized Safe and Scalable Multi-Agent Control under Limited Actuation (ICRA 2025) arxiv

17. Multi-Agent Planning Under Unreliable and Bandwidth-Limited Network Conditions

- Decentralized Training of Foundation Models in Heterogeneous Environments (NeurIPS 2022) neurips
- Fine-tuning Language Models Over Slow Networks Using Activation Compression with Guarantees (NeurIPS 2022) neurips

18. AI Agents for Distributed Chip Design

- MACO: A Multi-Agent LLM-Based Hardware/Software Co-Design Framework for CGRAs (Arxiv 2025) arxiv
- MAHL: Multi-Agent LLM-Guided Hierarchical Chiplet Design with Adaptive Debugging arxiv

19. AI Agents for Distributed Discovery of Materials and Chemicals for Downstream Tasks like Drug Discovery

- Foundation models for materials discovery – current state and future directions nature
- Empowering biomedical discovery with AI agents arxiv