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**SEMINARS**

**15 DEC 2025**

**13:00-14:00**



**ISB 210**



**Vahideh Hayyolalam**

## **Optimizing Federated Learning: Metaheuristic-Driven Approaches for Efficient and Reliable Distributed AI**

**SHORT BIO:** Vahideh Hayyolalam is a PhD researcher in Computer Science and Engineering at Koç University. Her work focuses on federated learning, distributed systems, and optimization. She holds a master's degree in Computer Science and Engineering, as well as a bachelor's degree in Mathematics. She has published in leading conferences and journals, including IEEE ICDCS, IEEE IoT, JNCA, and FGCS, among others. Her work continues to advance scalable, efficient, reliable, and adaptive distributed AI systems through.

**ABSTRACT:** Federated Learning (FL) enables decentralized model training while preserving data privacy; however, practical deployments face significant challenges, including communication bottlenecks, client heterogeneity, and slow convergence. In this talk, I will present an overview of FL fundamentals and recent advancements in optimization-driven and metaheuristic-enhanced FL. I will focus on our latest contributions, including FedBWO and MetaFed, which leverage the Black Widow Optimization (BWO) algorithm to enhance global accuracy, accelerate convergence, and reduce communication cost. These methods demonstrate how nature-inspired optimization algorithms can address real-world constraints in distributed learning. I will conclude by discussing open research directions and how metaheuristic-guided FL can pave the way for scalable, efficient, and adaptive intelligent systems.