

# Graph Mining & Learning

— NETWORK SCIENCE & REPRESENTATION LEARNING



## THE CORE PARADIGM

**How can machines map complex, relational network topologies into representations for advanced analytics?**

Relational data is everywhere. This advanced course bridges classic network science with modern Deep Representation Learning, mapping out how to process, extract, and predict complex structural connections.

## COURSE PILLARS

01



### Network Analytics

Dive into graph structural properties, centrality measures, network motifs, and community detection algorithms.

02



### Graph Neural Nets

Harness powerful deep representation frameworks including GNNs, GATs, generative structures, and graph embeddings.

03



### Modern Frontiers

Explore dynamic systems, recommender frameworks, Knowledge Graphs, and integration with Large Language Models.

## 🎯 Key Learning Outcomes

- **Deep Graph Architectures**  
Master node embedding techniques, GCNs, and GATs.
- **Generative Graph Modeling**  
Understand deep graph matching similarity algorithms and generative graph network models.
- **Knowledge Reasoning**  
Build relational reasoning networks using Knowledge Graph systems and entities.
- **Integration with Modern AI**  
Unpack advanced alignment techniques that integrate GNNs directly with LLMs.
- **In-class Paper Presentations**

## 🗺️ Course Roadmap

- **Graph Fundamentals**  
Structural analysis, centrality, and community detection frameworks.
- **Deep Representation Learning**  
From node embeddings to GNN/GATs, augmentations, and generative Models.
- **Structuring Knowledge**  
Graph recommenders, Knowledge Graphs (KG), and dynamic/heterogeneous network settings.
- **Advanced Apps**  
Social network analysis, counterfactual KG inference, and integration to LLMs.
- **Final Project and Presentations**

"Look beyond nodes; discover the architecture of intelligence with graphs."

GRAPH X KNOWLEDGE REASONING X REPRESENTATION LEARNING