Course Orientation

Neural Network

Graph Machine Learning

Hongik University

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About the Instructor

GN

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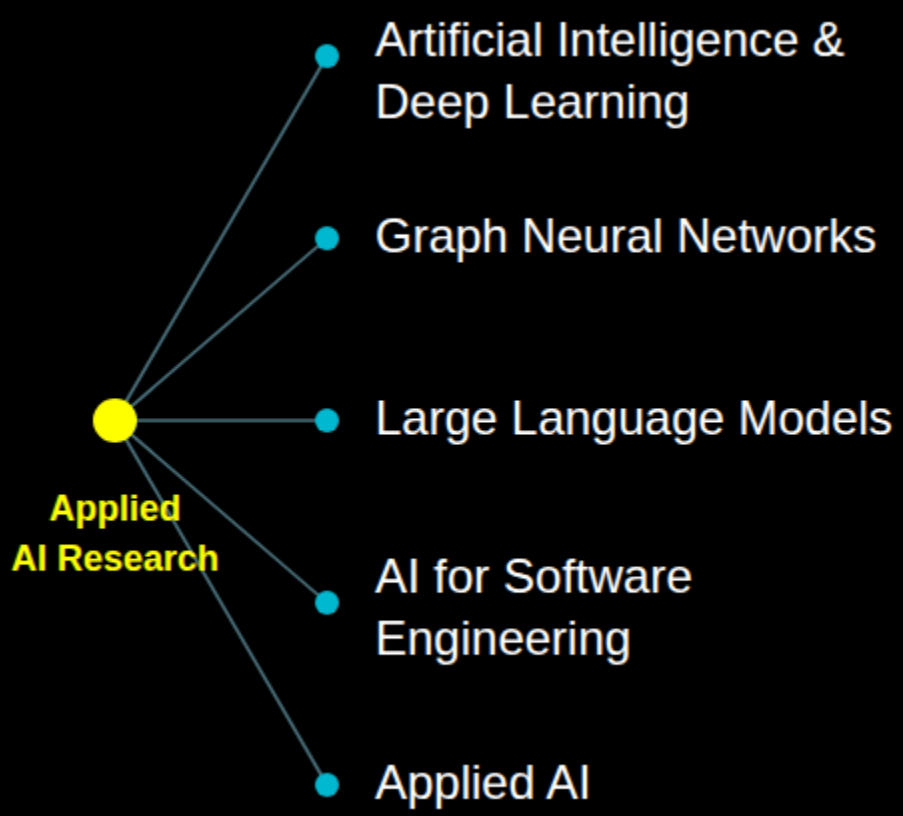
RESEARCH LAB

DeepShark Lab

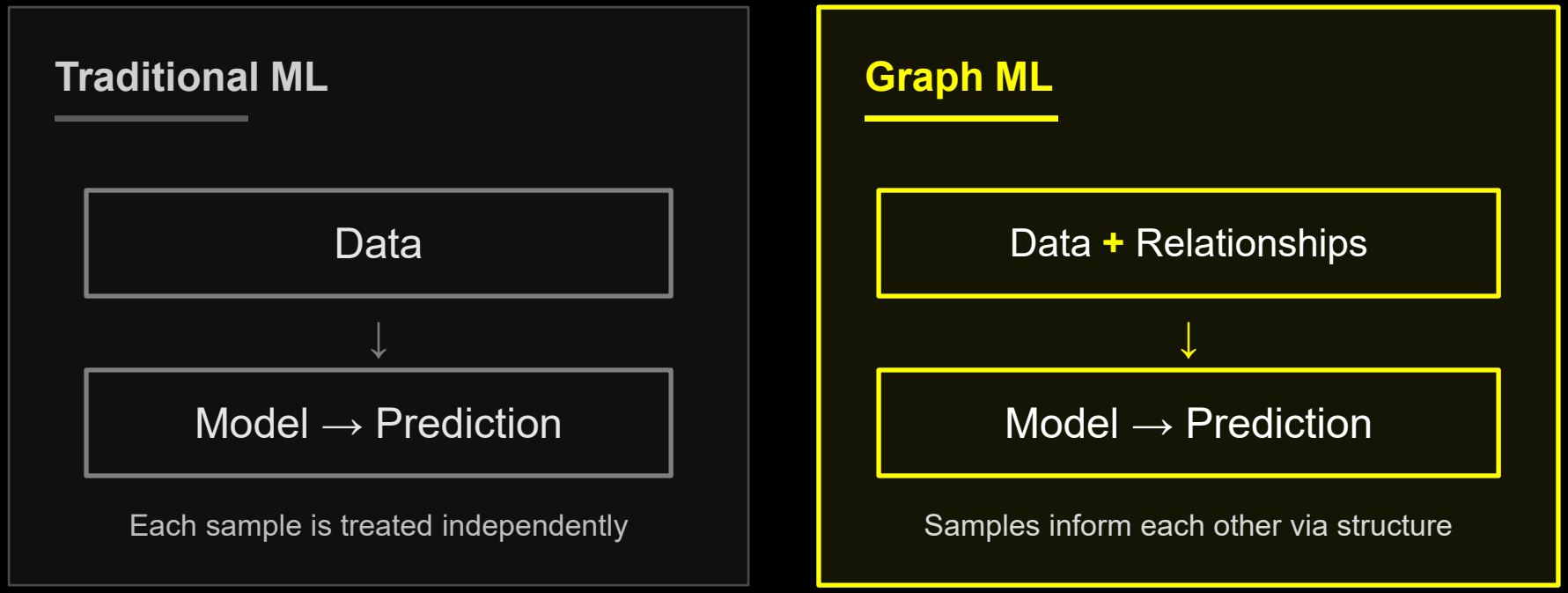
RESEARCH INTERESTS



What Is This Course About?

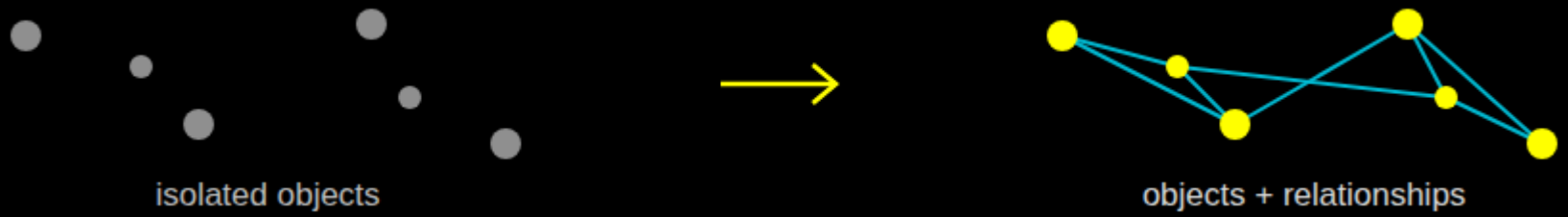
Learning from data is important.

Learning from relationships is equally important.



This course studies machine learning where relationships and structure matter.

Why Learn Graph Machine Learning?



01
Real-world entities are often **connected**

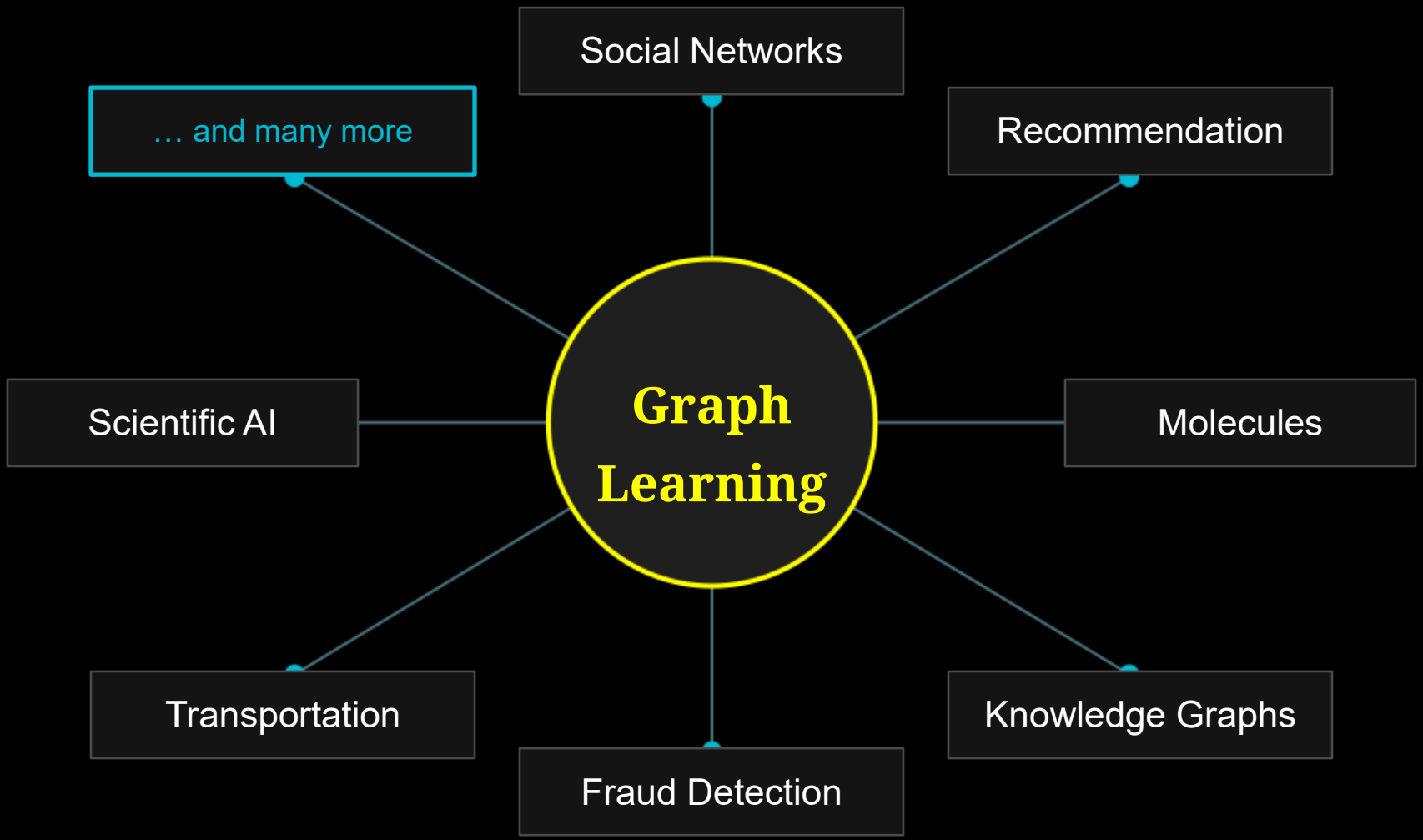
02
Relationships carry **critical information**

03
Many AI problems are naturally **relational**

04
Graph learning combines **features + structure**

AI is not only about objects.
It is also about relationships between objects.

Graphs Are Everywhere



What Will We Learn?

1 **FOUNDATION**
Weeks 2 – 4

- Graph Representation
- Node Embedding

↓

2 **GRAPH NEURAL NETWORKS**
Weeks 5 – 9

- GCN
- Message Passing
- Graph-Level Learning

↓

3 **ADVANCED GRAPH LEARNING**
Weeks 10 – 12

- Scalable GNNs
- Advanced GNNs
- Self-Supervised Learning

↓

4 **FRONTIERS** Weeks 13 – 14 — Graph Transformers · Foundation Models

Course Schedule

FIRST HALF

Weeks 1 – 7 · Foundations and core GNN models

Week 1	Course Orientation
Week 2	Introduction to Graphs
Week 3	Graph Representation
Week 4	Node Embedding
Week 5	Permutation Invariance & Equivariance
Week 6	Graph Convolutional Networks (GCN)
Week 7	Message Passing Neural Networks

Week 8 **MID-TERM EXAM** Covers Weeks 1 – 7

Course Schedule

SECOND HALF

Weeks 9 – 14 · Scaling up, frontiers, and research

Week 9	Graph-Level Representation Learning
Week 10	Graph Sampling and Scalable GNNs
Week 11	Advanced Graph Neural Networks
Week 12	Self-Supervised Learning on Graphs
Week 13	Graph Transformers & Graph Foundation Models
Week 14	Applications and Recent Research Trends

Week 15 **FINAL EXAM** Full-semester coverage

Learning Outcomes

By the End of This Course, You Will Be Able To:

UNDERSTAND

Fundamental concepts of **graph learning**

EXPLAIN

Major **GNN architectures**

DESIGN

Graph learning solutions for new problems

IMPLEMENT

Build and evaluate **modern GNNs**

ANALYZE

Critically analyze **research papers**

APPLY

Graph learning to **real-world problems**

COMPETENCY PROGRESSION

Understand → **Design** → **Implement** → **Analyze** → **Apply**

How We Will Learn

Every topic passes through the same four-stage pipeline.

01 **Learn the Concept**
Lecture
Why does this idea exist?

↓

02 **Understand the Model**
Mathematics & Architecture
How exactly does it work?

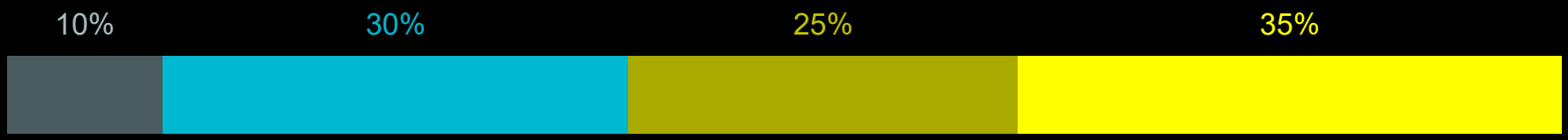
↓

03 **Implement It**
Programming Assignments
Can I build it myself?

↓

04 **Think Like a Researcher**
Paper Reading & Discussion
What is still unsolved?

Assessment & Grading



10%

Attendance

Presence in every lecture

30%

Assignments

· Programming
· Paper Reading
· Presentation

25%

Mid-Term

Week 8 — Weeks 1 to 7

35%

Final Exam

Week 15 — full semester

COURSE POLICY

· Active participation in class discussions is expected.
· Missing **five or more classes** without valid reasons results in an **F grade**.

What You Need Before Starting

Recommended background — not a barrier, just a head start.

01

Programming

- Python
- PyTorch basics

02

Mathematics

- Linear Algebra
- Probability
- Basic Calculus

03

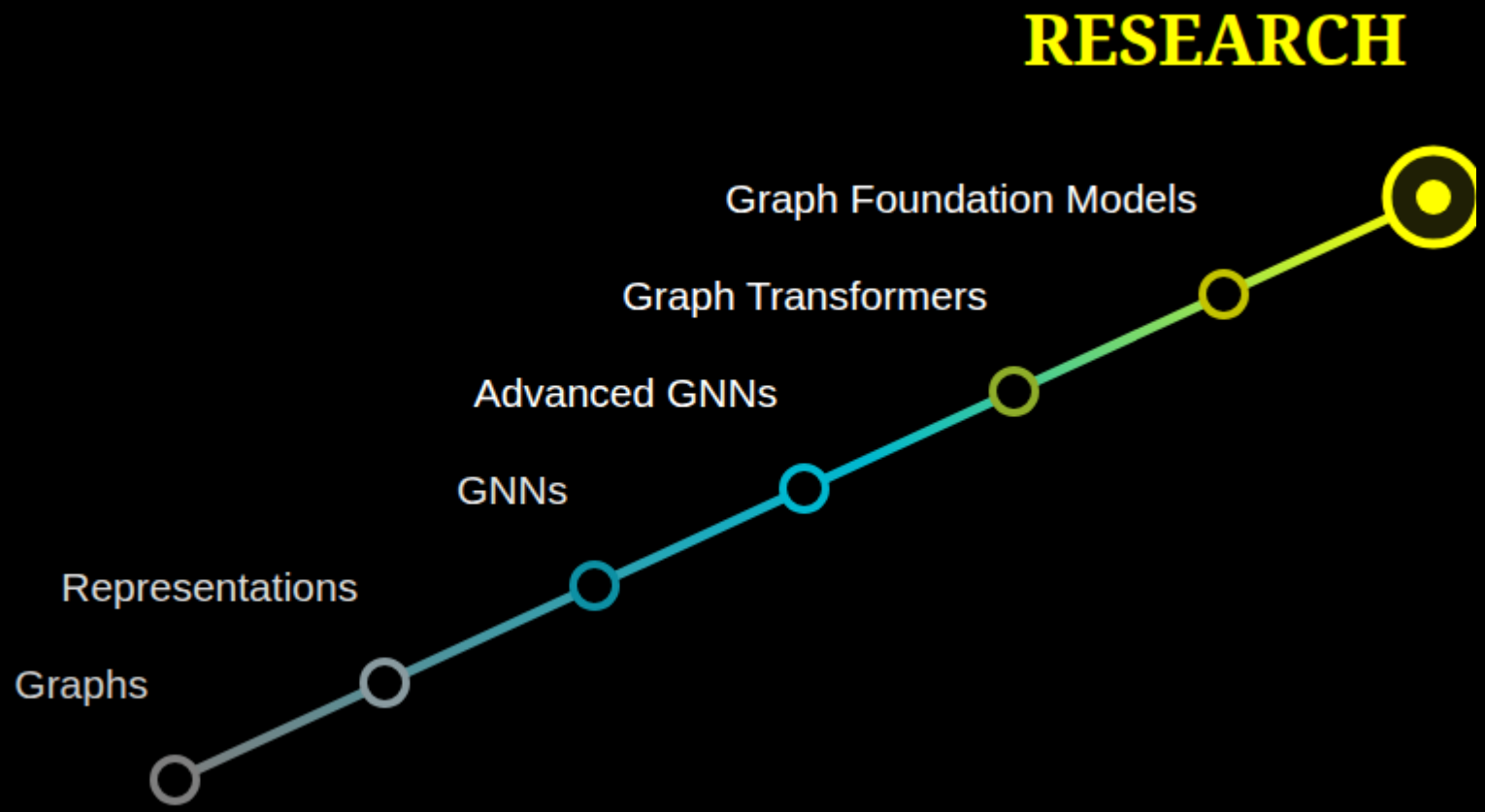
Machine Learning

- Neural Networks
- Gradient Descent
- Representation Learning

Don't worry! No prior knowledge of GNNs is required.

We will build everything from the ground up, starting next week.

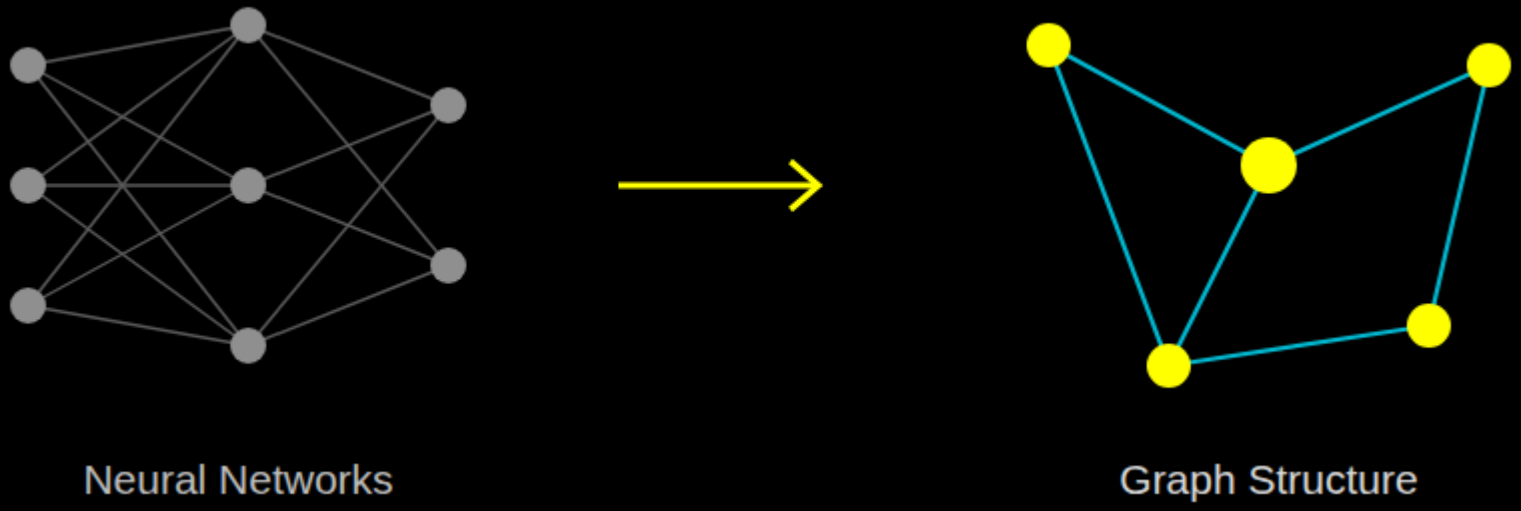
The Journey Ahead



This course aims beyond learning existing models —
toward exploring graph-learning research.

Next: Introduction to Graphs

WEEK 02 · COMING UP



Before learning Graph Neural Networks,
we first need to understand graphs.

See you next week. — Questions are always welcome.