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A Tutorial on Hypergraph Neural Networks: An In-Depth and Step-by-Step Guide

Part 6. Discussions



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Part 6. Discussions

Part 1.
Introduction

Part 2.
Inputs

Part 3.
Message
Passing

Part 4.
Training
Strategies

Part 5.
Applications

Part 6.
Discussions



The slides are available at <https://sites.google.com/view/hnn-tutorial>

Presenter



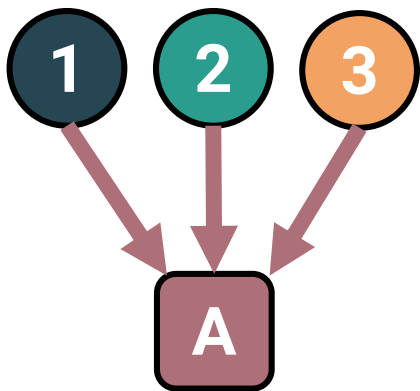
Yue Gao.

Associate Professor @

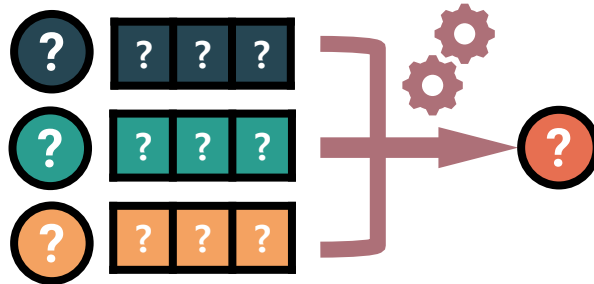
Tsinghua University

Tutorial Summary

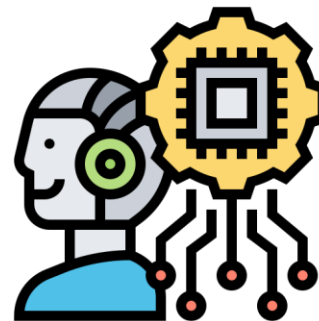
- We provided tutorial on HNNs,
 - with a focus on how they address higher-order interactions (HOIs),
 - covering the following topics:



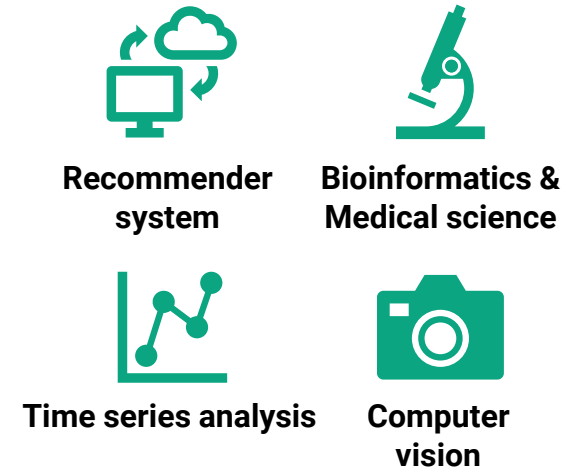
Input



Message Passing



Training Strategies



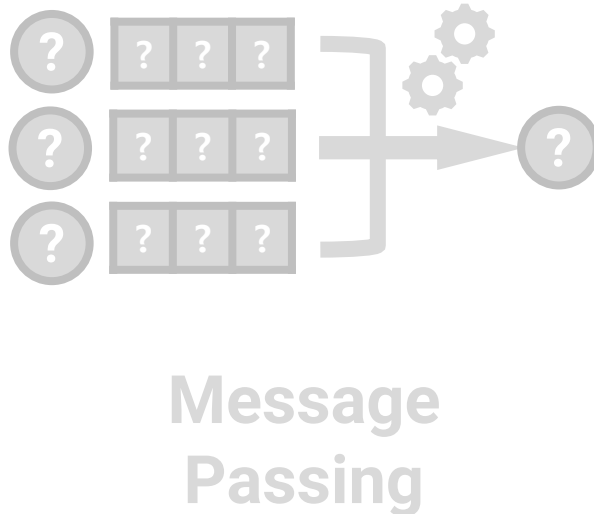
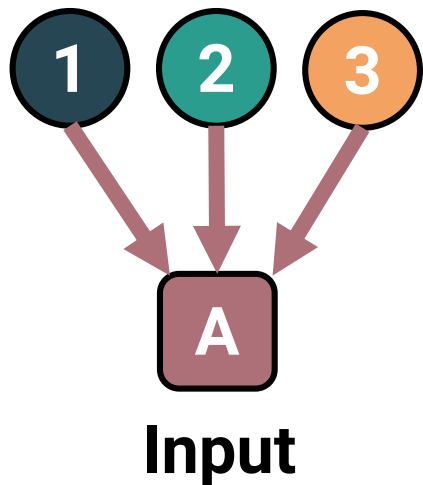
Recommender system Bioinformatics & Medical science

Time series analysis Computer vision

Applications

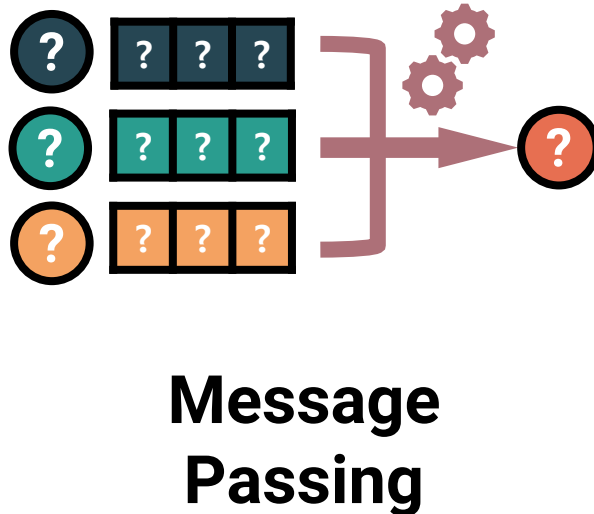
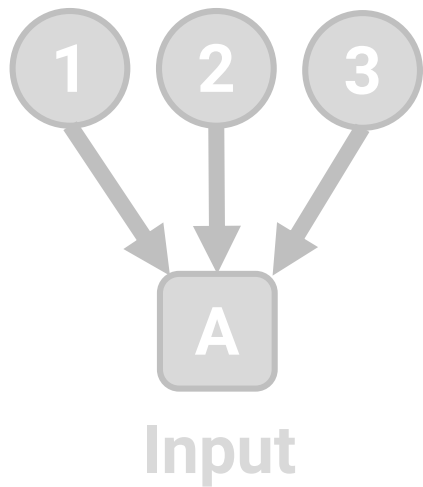
Tutorial Summary

- For HNN's input, we discussed
 - Q1) How are **hypergraph structures** expressed?
 - Q2) What **input feature vectors** are typically used?



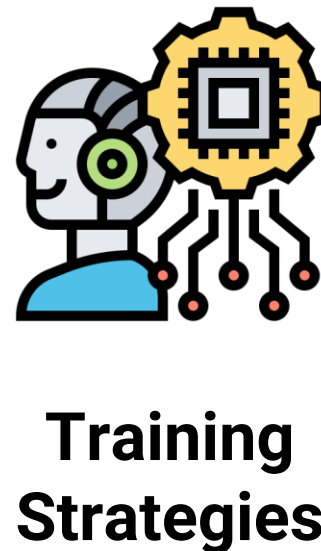
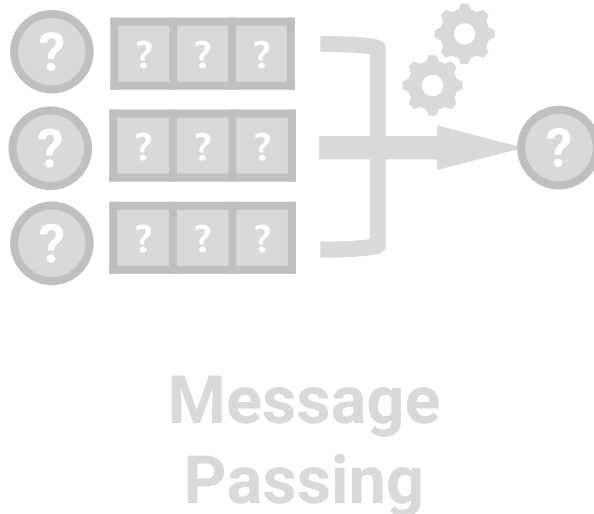
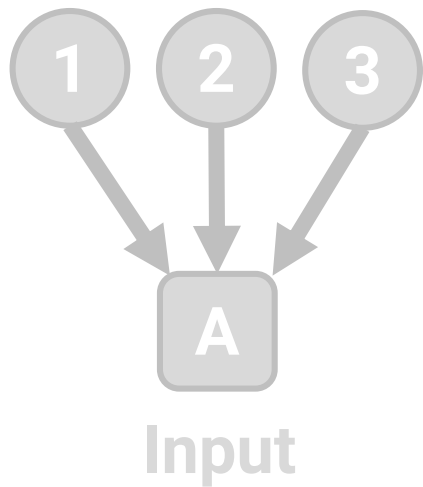
Tutorial Summary (cont.)

- For HNN's message passing, we discussed
 - Q1) **Whose** messages to aggregate
 - Q2) **What** messages to aggregate
 - Q3) **How** to aggregate messages



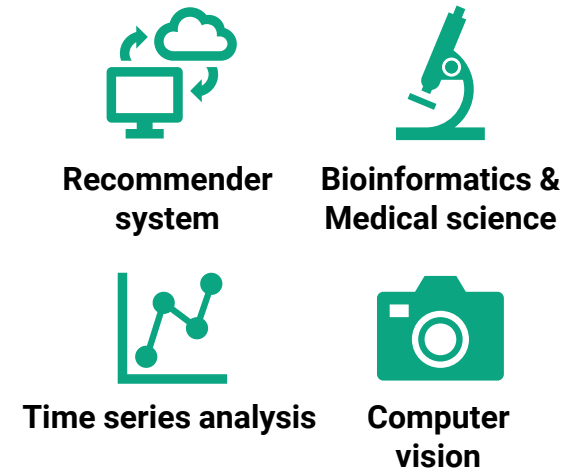
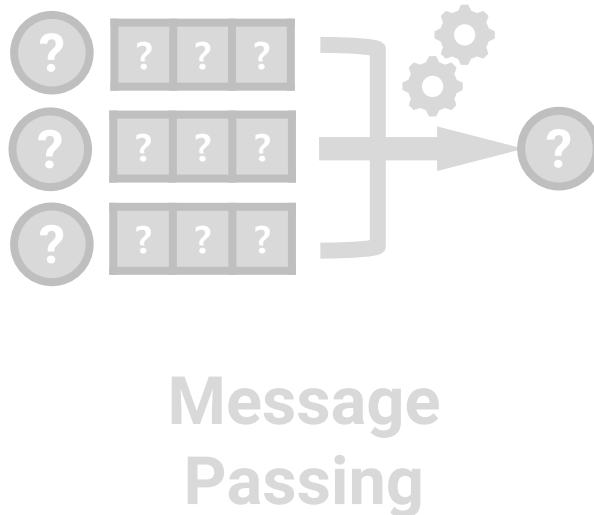
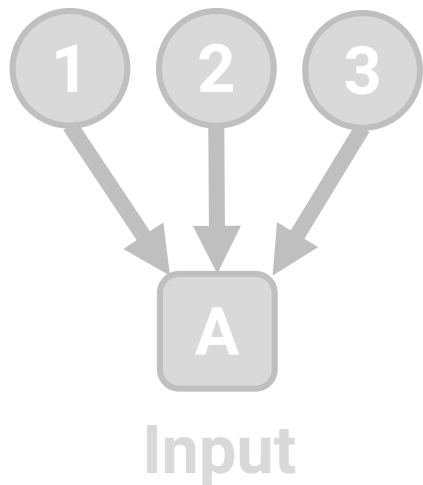
Tutorial Summary (cont.)

- For HNN's training strategies, we discussed
 - Q1) How to conduct **task-agnostic training**?
 - Q2) How to conduct **task-targeted training**?



Tutorial Summary (cont.)

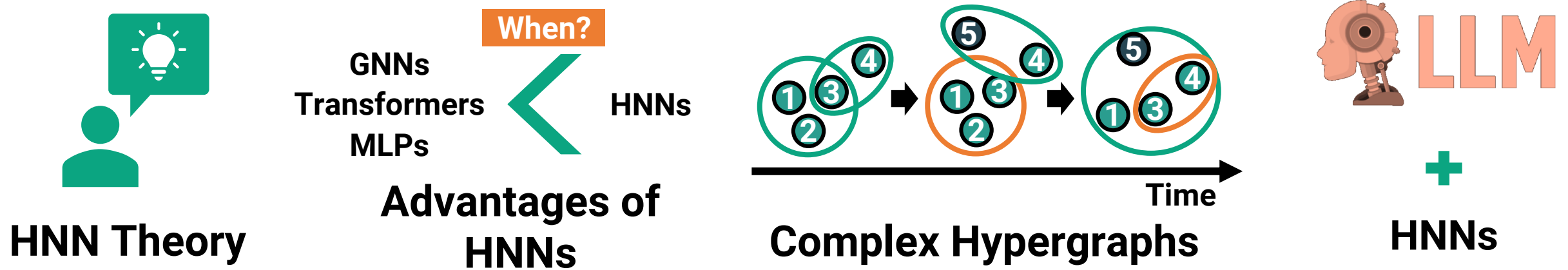
- For HNN's applications in 4 domains, we discussed
 - Q1) How to **express the raw data** as hypergraphs?
 - Q2) How to **formulate the learning task** for HNN?



Applications

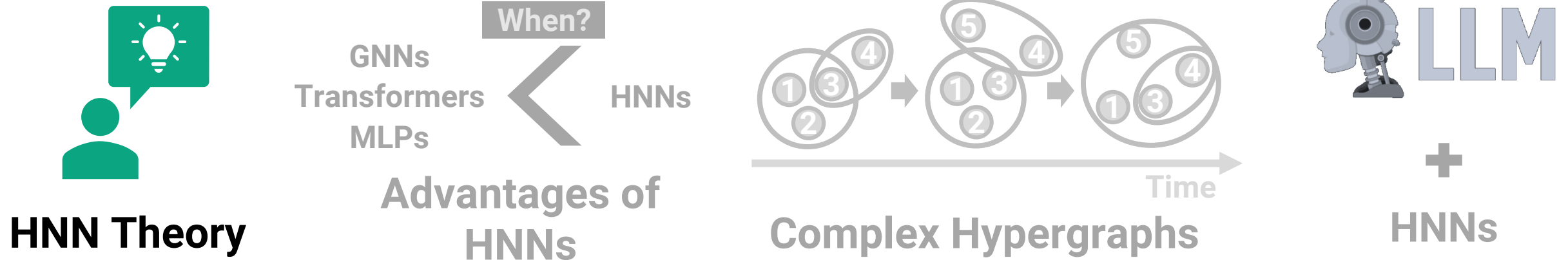
Future Directions

- We close with potential future research directions.
 - Q1) What are **theoretical foundation** of HNNs in hypergraph learning?
 - Q2) When is using HNNs especially **advantageous**?
 - Q3) How should HNNs encode more **complex hypergraphs**?
 - Q4) How to utilize **Large Language Models(LLMs)** to empower HNNs?



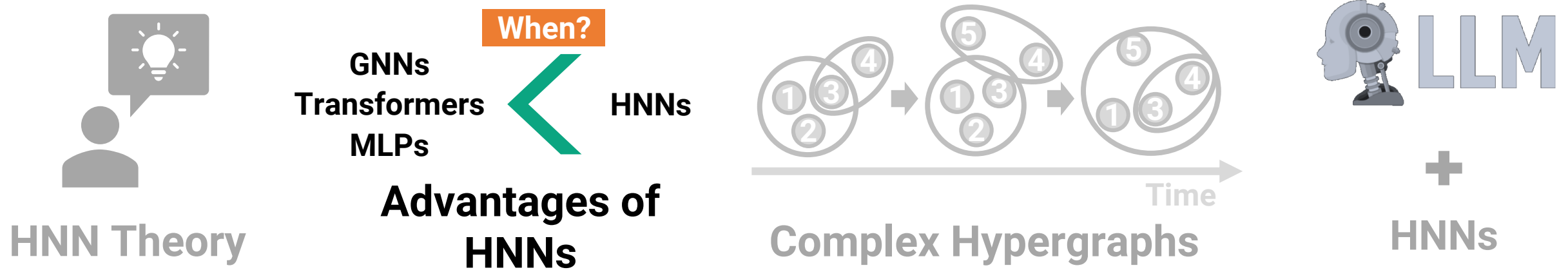
Future Directions (cont.)

- Q1) What are **theoretical foundation** of HNNs in hypergraph learning?
 - Generalizing GNN theories to HNNs can be non-trivial (e.g., isomorphism recognition).
 - Theoretical foundation for HNNs would be a significant contribution.



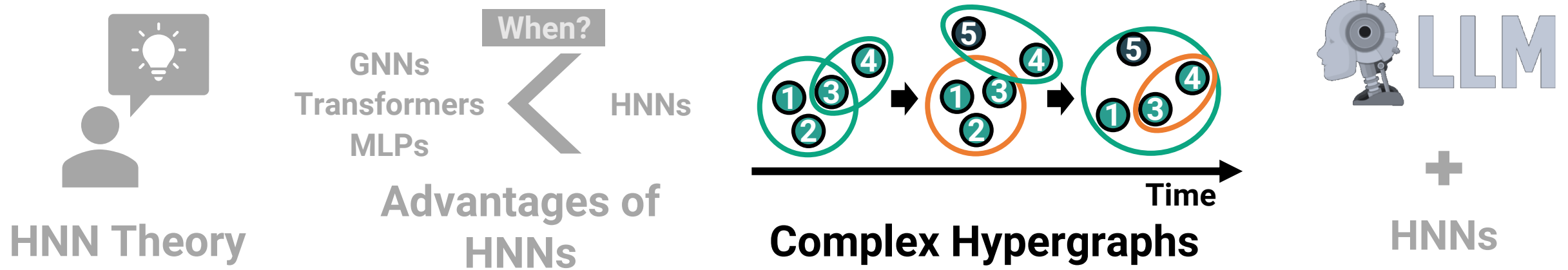
Future Directions (cont.)

- Q2) When is using HNNs especially **advantageous**?
 - For hypergraphs, one could also use MLPs, GNNs, or transformers.
 - What confers HNNs advantages over the alternatives is unclear.
 - Finding the relevant factors can lead to enhanced HNN algorithms.



Future Directions (cont.)

- Q3) How should HNNs encode more **complex hypergraphs**?
 - Networks of higher-order interactions often have complex properties (e.g., temporal, directional, heterogenous).
 - Research on HNNs for complex hypergraphs is at its infancy.






Future Directions (cont.)

- Q4) How to utilize **Large Language Models(LLMs)** to empower HNNs?
 - Integrating LLMs to enhance feature representations (e.g., contextual understanding, high-order structure tokenize).
 - Leveraging LLMs for enhanced learning and inference.



Tutorial Materials

- <https://sites.google.com/view/hnn-tutorial>
 - Slides 
 - Survey Paper 
 - References 
 - Resources 