

## **Final Project Deliverable 1: LoRA or Fine Tuning of LLM or Diffusion model**

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### **Knowledge Graph Question Answering System for GW Courses**

We plan to build an intelligent question-answering system over a custom knowledge graph of GW courses initially focusing on SEAS, including prerequisites, topics, professors, and degree requirements.

Courses naturally form a graph structure where nodes represent courses, professors, and topics, connected by relationships like "prerequisite," "taught\_by," and "covers\_topic." Through this project, we aim to explore Graph Attention Networks for multi-hop reasoning, LoRA fine-tuning for domain adaptation, knowledge graph construction and querying, and hybrid architectures combining structured retrieval with language generation. We also plan to touch on evals and QA for the fine tuned LLM.

The system will combine graph-based retrieval with LLM-based answer generation. Example queries that we plan to answer might be something like "Which courses should I take to prepare for computer vision research if I've completed CSCI 6212?", "Which professors teach courses that are prerequisites for both Computer Vision and Natural Language Processing?", etc where it goes through multiple hop reasoning too.

### **Resources that we have identified that might be helpful for us:**

1. **"GraftNet: Answering Complex Questions with Knowledge Graphs"** - [Enhancing Complex Question Answering over Knowledge Graphs through Evidence Pattern Retrieval](#) Demonstrates how to combine GNNs with language models for question answering over knowledge graphs. Directly applicable to our hybrid retrieval + generation architecture.
2. **"Graph Attention Networks"**- [\[1710.10903\] Graph Attention Networks](#) Introduces attention mechanisms for GNNs, enabling the model to learn which graph relationships are most relevant for a given query. Essential for multi-hop reasoning in our knowledge graph.
3. **"LoRA: Low-Rank Adaptation of Large Language Models"** - [\[2106.09685\] LoRA: Low-Rank Adaptation of Large Language Models](#) Provides the fine-tuning technique for adapting pre-trained language models to our domain-specific vocabulary and question types without full retraining.
4. **PyTorch Geometric (PyG)** - <https://pytorch-geometric.readthedocs.io/>: Leading library for Graph Neural Networks including Graph Attention Networks.