DGL 2025 Coursework 1

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Abstract

Instructions: This is a structured report template for your DGL 2025 coursework. Please insert your written answers, discussions, and figures in the designated sections. **Do not include any code** in this report. All code should remain in your Jupyter notebooks.

Note: We have **kept the structure the same as the Coursework Description PDF** to maintain consistency across your notebooks and this report template. Please keep your headings and subheadings aligned with those in the provided instructions. However, if a section primarily relates to code implementation, you may keep your answers concise (e.g., reference your notebook or provide brief clarifications).

1 Graph Classification

1.1 Graph-Level Aggregation and Training

1.1.a Graph-Level GCN

INSERT YOUR ANSWER HERE

1.1.b Graph-Level Training

INSERT YOUR ANSWER HERE

1.1.c Training vs. Evaluation F1

INSERT YOUR ANSWER HERE

1.2 Analyzing the Dataset

1.2.a Plotting

INSERT YOUR ANSWER HERE

1.2.b Discussion

INSERT YOUR ANSWER HERE

1.3 Overcoming Dataset Challenges

1.3.a Adapting the GCN

INSERT YOUR ANSWER HERE

1.3.b Improving the Model

INSERT YOUR ANSWER HERE

1.3.c Evaluating the Best Model

1.3.d Final Analysis and Explanation

INSERT YOUR ANSWER HERE

2 Node Classification in a Heterogeneous Graph

2.1 Dataset

2.1.a Problem Challenge

INSERT YOUR ANSWER HERE

2.1.b Real-World Analogy

INSERT YOUR ANSWER HERE

2.1.c Interpretation of the Dataset: Plotting the Graph

INSERT YOUR ANSWER HERE

2.1.d Interpretation of the Dataset: Plotting the Node Feature Distributions

INSERT YOUR ANSWER HERE

2.1.e Interpretation of the Dataset: Discussion

INSERT YOUR ANSWER HERE

2.2 Naive Solution: Padding

2.2.a Limitations of Naive Solution

INSERT YOUR ANSWER HERE

2.3 Node-Type Aware GCN

2.3.a Implementation

INSERT YOUR ANSWER HERE

2.3.b Discussion

INSERT YOUR ANSWER HERE

2.4 Exploring Attention

2.4.a Implementation

INSERT YOUR ANSWER HERE

2.4.b Discussion

INSERT YOUR ANSWER HERE

2.5 Overall Discussion

INSERT YOUR ANSWER HERE

3 Investigating Topology in Node-Based Classification Using GNNs

3.1 Analyzing the Graphs

3.1.a Topological and Geometric Measures

INSERT YOUR ANSWER HERE

3.1.b Visualizing and Comparing Topological and Geometric Measures of Two Graphs

INSERT YOUR ANSWER HERE

3.1.c Visualizing the Graphs

INSERT YOUR ANSWER HERE

3.1.d Visualizing Node Feature Distributions

INSERT YOUR ANSWER HERE

3.2 Evaluating GCN Performance on Different Graph Structures

3.2.a Implementation of Layered GCN

INSERT YOUR ANSWER HERE

3.2.b Plotting of t-SNE Embeddings

INSERT YOUR ANSWER HERE

3.2.c Training the Model on Merged Graphs $G_1 \cup G_2$

INSERT YOUR ANSWER HERE

3.2.d Joined vs. Independent Training

INSERT YOUR ANSWER HERE

3.3 Topological Changes to Improve Training

3.3.a Plot the Ricci Curvature for Each Edge

INSERT YOUR ANSWER HERE

3.3.b Investigate Extreme Case Topologies

INSERT YOUR ANSWER HERE

3.3.c Improving Graph Topology for Better Learning

INSERT YOUR ANSWER HERE

4 References