Deep Learning – Lab 06

**1. NetworkX Random Graph Analysis**

**Graph Density Calculation:**

The graph density decreased by increasing the number of nodes from 20 to 200; this indicates that fewer edges exist compared to the maximum possible in the grown graph.

**Degree Distribution Observation:**

The degree distribution histogram developed much more variation as N increased, which further spread the distribution.

**2. Learning Method Comparisons**

**Supervised vs. Self-supervised vs. Semi-supervised Learning:**

* **Supervised learning** Fully Labeled Data.
* **Self-supervised learning** Labels generated by data for pretext tasks.
* **Semi-supervised learning** Mix of labelled and unlabelled data.

**Transductive vs. Inductive Learning:**

* **Transductive learning** The entire graph is used for training and specific to the test set.
* **Inductive learning**, The model generalizes to unseen data.

**3. Karate Club GCN (Graph Convolutional Networks)**

**Experiment 1 - Increasing Epochs:**

* Increasing epochs from 50 to 500 improved validation accuracy slightly, with diminishing returns after 300 epochs.

**Experiment 2 - Self-loops in GCNConv:**

Removing self-loops decreased accuracy, suggesting they aid performance.

**Experiment 3 - Increasing GCNConv Layers:**

More layers initially improved accuracy, but performance degraded after 5 layers due to potential overfitting.

**Experiment 4 - Hyperparameter Tuning:**

Hyperparameter Tuning:

Smaller out channels led to faster training but lower accuracy. Optimal value found at 16 for both in channels and out channels.

**Experiment 5 - Adding Skip Connections:**

Improved validation accuracy and stabilized learning, helping with deeper layers.

**4. Comparison of GNN Models**

**Message Passing GNN, GCN, GAT, and GraphSAGE:**

* **Message Passing GNN:** Iteratively passes node features to neighbors.
* **GCN:** Uses convolutional layers for neighbor aggregation.
* **GAT:** Uses attention mechanisms for neighbor weighting.
* **GraphSAGE:** Samples and aggregates fixed neighbors, scalable to large graphs.