Week 1: Graph Theory, Traversals & Social Simulation

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Report: -

1.) Network Generation & Group Analysis

a.) Graph Generation Logic:

- Used 150 students, 3 classes
- Popularity bias and intra-class boost in connection probability
- Clustering via friend-of-friend links

b.) Friend Group Analysis:

- DFS traversal done
- Calculated Number of components
- Smallest and largest group sizes found with components
- Usually one large group formed and very few small

2.) Pathfinding & Bridge Analysis

c.) Shortest Paths:

- Dijkstra and A* applied to five random student pairs
- A* slightly faster within same class due to heuristic

d.) Bridge Nodes (Bonus):

- Nodes whose removal increases the number of groups
- Indicates students having cross class ties

e.) Reflections:

- Realistic social structures emerge from simple biases
- Central students tend to form more bridges
- Clustering enhances connectivity

Final Reflection: -

Our graph models a student friendship network of 150 nodes, where edges represent friendships weighted by random interaction strength. Students are grouped into 3 classes, and friend connections are more likely within the same class and for more popular students. We also incorporated clustering by introducing connections between friends-of-friends.

Friendship groups were analyzed using DFS. Most students formed a large, connected component, while a few smaller isolated groups also emerged. The largest group typically spanned over half the graph, showing strong intra-network cohesion.

Shortest path algorithms, Dijkstra and A*, provided insight into how easily students could connect across the network. A* leveraged class similarity to prioritize intra-class paths, often producing slightly more efficient results.

Bridge node detection revealed key individuals whose removal fragmented the network, indicating social influencers or connectors. These nodes often had cross-class ties and spanned multiple clusters, suggesting a central role in maintaining network cohesion