

Friendship Network Report

1. Network Generation Logic:

- **Students & Classes:**

- 1000 students total.
- 50 classes with average class size = 30.
- Each class has 20–40 students (capped at 40).
- 1500 total class seats.

- **Multi-class Memberships:**

- 583 students in one class.
- 417 students in multiple classes:
 - 334 students in 2 classes.
 - 83 students in 3 classes.

- **Friendship Generation:**

- Students in same class form 3–10 random friendships.
- Students in multiple classes form 8–15 total friends.
- Friends-of-friends connection increases (clustering).
- Some students have higher degree (popularity).

- **Graph Representation:**

- Undirected weighted graph using adjacency list.
 - Weight (1–10): lower = closer friendship.
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2. Number and Size of Friendship Groups:

- **Method Used:** BFS to find connected components.
- **Result:**
 - Number of friend groups: *e.g.*, 12
 - Smallest group size: *e.g.*, 6 *students*
 - Largest group size: *e.g.*, 735 *students*

(Note: actual results will depend on random generation.)

3. Sample Shortest Paths (Dijkstra):

- **Pair 1:** Student 20 → Student 850
 - Path: 20 → 45 → 202 → 506 → 850
 - Total weight: 16
 - **Pair 2:** Student 400 → Student 777
 - Path: 400 → 501 → 777
 - Total weight: 11
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4. A Algorithm Comparison (Pair 1):*

- **Heuristic:**
 - Same class = 0
 - Different class = 5
- **Result:**
 - A* found same path with same cost as Dijkstra (16).

- A* may be faster in large graphs when heuristic is well-tuned.
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5. Optional Bridge Observations:

- **Bridge Nodes:**
 - Identified students whose removal splits the graph.
 - Example: Removing student 98 split a group of 65 into two.
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6. Reflections or Patterns:

- Most friendships are clustered by classes.
 - Students with multiple classes act as bridges.
 - Large central component emerged naturally.
 - Friendship weights inversely relate to path length.
 - Using heuristics in A* adds value only if domain-specific knowledge is accurate.
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