Network of Friendships

By: Tanner Davis, Johnny Dao, and Nhu Vo
Course: Discrete Structures II – COMP-SCI 291-0002

Supervisor:
Professor Gharibi Wajeb

Date:
Fall 2025

Contents of Project:

Link to Presentation: *Discrete-II-Project.pptx*

Introduction & Objectives

The Network of Friendships project models a small group of friends as weighted, undirected graphs to connect ideas of graph theory to a real-world context.

Main Objectives:

- Represent a weight graph in a social-relation setting (a network of friendships).
- Compute and interpret basic graph statistics such as average friendship strength, highest and lowest edge weights, and overall graph weight.
- Identify structural properties of the network, including hubs, shared neighbors, and strong vs. weak ties.
- Relate this small example to larger real-world networks such as social media graphs, campus networks, and workplace networks.

Data Collection

Subjects: *Tanner, Johnny, Nhu*

Each of us listed 10 friends and rated the strength of each friendship on a scale from 1 to 10, where:

- 1 = very weak / barely know each other
- 10 = extremely close friendship

Example (Tanner's Friends List):

- Johnny - 10
- Nhu - 8
- Jacob - 9
- Kayden - 8
- Jordan - 9
- Juice - 7
- Francis - 7
- Adeeba - 8
- Alex - 9
- Prof. Gharibi - 10

Similar 10-friend lists were created for Johnny and Nhu.
This gave us 30 rated friendships in total.

- Shared friends (people who appear in more than one list).
- Friends in common to all three members:
    - Adeeba, Juice, Jordan, and Prof. Gharibi.

Data Collection

We constructed a graph *G = (V, E)* as follows:

- Vertices (nodes): every unique person who appears in any of the three lists.
    - Includes the main members and all their friends
- Edges: an undirected edge between two vertices if there is a friendship listed between them.
- Weights: the 1-10 rating assigned to that friendship.

Friendship graph:

- Tanner, Johnny, and Nhu are highlighted as main focus members (hubs).
- Friends such as Adeeba, Juice, Jordan, and Prof. Gharibi connect to multiple hubs, showing up as shared neighbors.

- Several other friends connect to only one hub, appearing as “leaf” nodes with degree 1.

Data Collection

Per-Person Friendship Statistics
For each of the three members, we calculated:
- Average friendship strength
- Highest and lowest friendship strengths in their list

Data:
- Tanner
  - Sum of weights = 85
  - Average strength = 8.5
  - Highest = 10
  - Lowest 7
- Johnny
  - Sum of weights = 85
  - Average strength = 8.4
  - Highest = 10
  - Lowest = 7
- Nhu
  - Sum of weights = 74
  - Average strength = 7.4
  - Highest = 10
  - Lowest = 6

Global Graph Statistics
- Graph total weight
  - *W(G) = Tanner’s Sum of Weights + Johnny’s Sum of Weights + Nhu’s Sum of Weights*
    - *W(G) = 85 + 85 + 74 = 244*
- Number of weighted friendships: 30 (3 people with 10 friends each)
- Graph average weight (average friendship strength over all edges)
- Most popular person by total friendship weight
  - Tanner (85)
  - Johnny (85)
  - Nhu (74)

Analysis of the Network

When looking at the weighted friendship graph we created, we can see how each of us fits into the overall structure of our friend group.

1. **We act as the hubs of the network**
   Each of us – Tanner, Johnny, and Nhu – has 10 friendship edges connected to our node. That makes us the three main hubs. Many paths between other people pass through at least one of us, so we play a big role in holding the network together.

2. **Our shared friends form the core of the group**
   A few people show up in all three of our friend lists: Adeeba, Juice, Jordan, and Prof. Gharibi. These friends are directly connected to each of us, so they sit near the "center" of the graph. They help link our three circles of friends and prevent the network from splitting into separate parts.

3. **Our friendships are generally strong**
   From the statistics we calculated:
   - Tanner's average friendship strength is about 8.5
   - Johnny's average is about 8.4
   - Nhu's average is about 7.4

4. **Strong vs. weak ties in our network**
   When we ignore the weaker edges (those with weights 6–7) and only keep edges with weights 8–10, the graph still remains mostly connected. That means our group has a strong backbone of close friendships. The weaker ties add extra paths, but the network doesn't depend entirely on them.

5. **How important our nodes are for connectivity**
   If we remove our three nodes (Tanner, Johnny, and Nhu) from the graph, many of the remaining nodes either become isolated or end up in very small components. This shows that we are not only well-connected individually but also structurally important: we act as the main bridges that keep our whole friendship network connected.

Real-World Implementation

Working on this project helped us see how a small friendship graph like ours relates to larger, real-world networks.

1. **Social networks**
   We can imagine each user on platforms like Instagram or X as a node. An edge connects two users who interact, and the weight of that edge could represent:
   - how many messages they exchange per week
   - how often they like or comment on each other's posts
   - how frequently they tag or reply to each other

   Just like we used weights to measure friendship strength, social networks can use weights to decide which posts to show higher in a feed, which accounts to recommend, and which groups of users form tight communities.

2. **Campus networks**
   On a university campus, we can treat each student or each club as a node:
   - For students, edge weights might count how many classes they share, how many clubs they're in together, or how often they attend the same events.
   - For clubs, edge weights could represent how many joint events they run or how many members they share.

   The same kind of analysis we did—finding hubs, shared neighbors, and strong vs. weak ties—could help a campus identify isolated students, highly connected communities, or clubs that act as bridges between different groups.

3. **Workplace networks**
   In a company, employees or teams can be modeled as nodes. Edges represent collaboration, and weights could measure:
   - emails exchanged
   - hours spent in meetings together
   - number of shared projects

   Using a weighted graph, an organization could see who the key communicators are, where communication silos exist, and which people are overloaded because so many workflows depend on them—similar to how our friendship graph shows how much the group depends on us as hubs.

Conclusion

In this project, we:

- Collected real friendship data by each listing 10 friends and rating our friendship strengths from 1–10.
- Turn those lists into a weighted, undirected graph where nodes represent people and edge weights represent friendship strengths.
- Computed statistics like average, highest, and lowest friendship strength for each of us, as well as the total graph weight (244) and the overall average weight (≈ 8.13).
- Identified important features of our network:
    - We (Tanner, Johnny, and Nhu) act as the main hubs,
    - Our friends Adeeba, Juice, Jordan, and especially Prof. Gharibi play central roles as shared neighbors,
    - Most of the connections in our group are relatively strong.

By looking at our own friendships through the lens of graph theory, we got a concrete feel for concepts like degree, weighted degree, hubs, shared neighbors, strong vs. weak ties, and connectivity. Even though our network is small, the same ideas apply to much larger systems such as social media platforms, campus communities, and workplaces.

Overall, creating this "Network of Friendships" helped us see how graph theory can take something personal and familiar—our friend group—and turn it into a structured model that we can analyze, quantify, and connect to real-world applications.

Source

Graph Creator: https://csacademy.com/app/graph_editor/
Prof. Gharibi Wajeb