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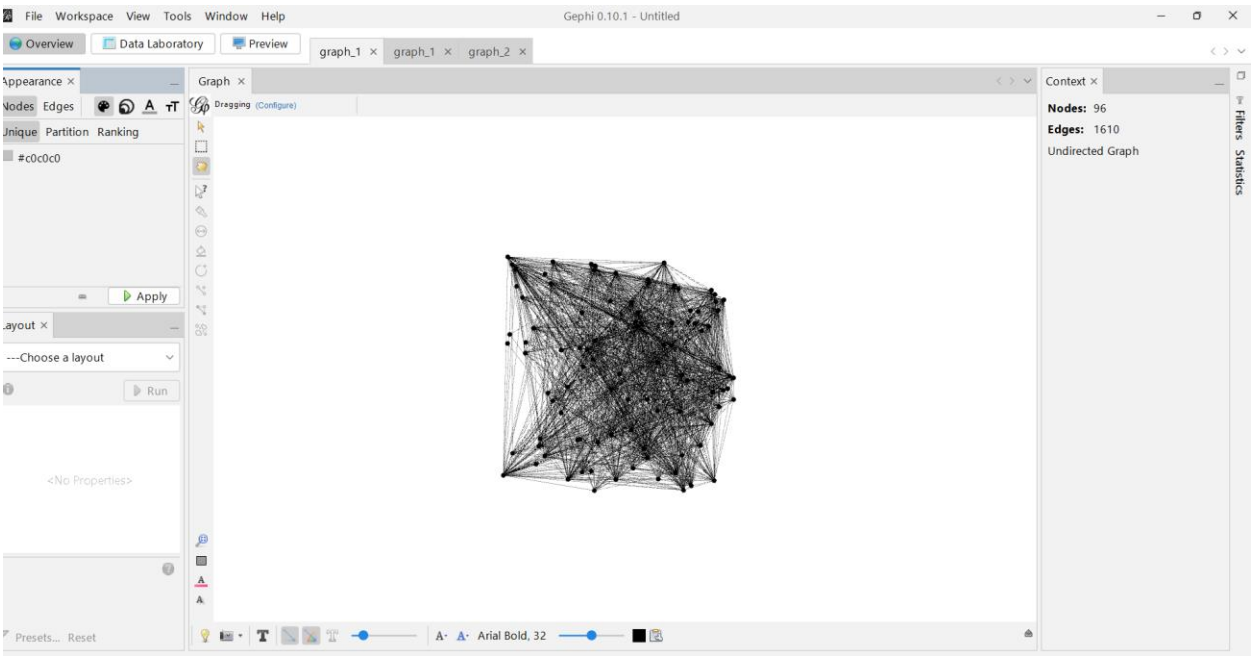
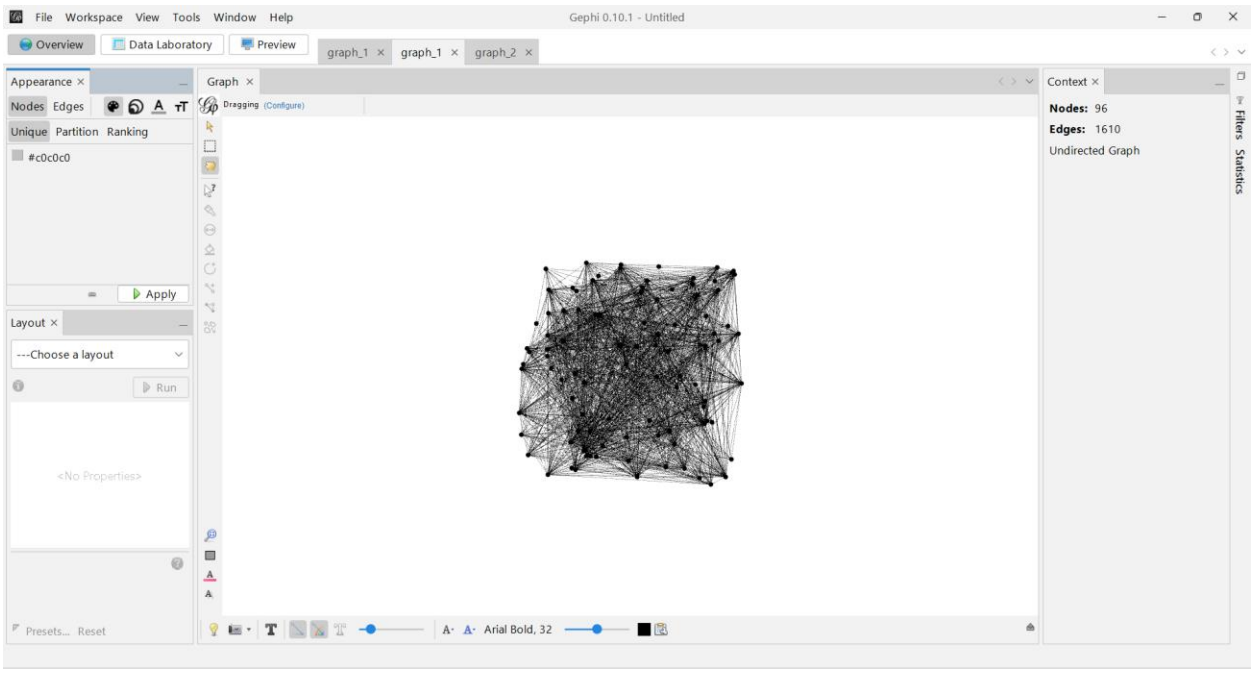
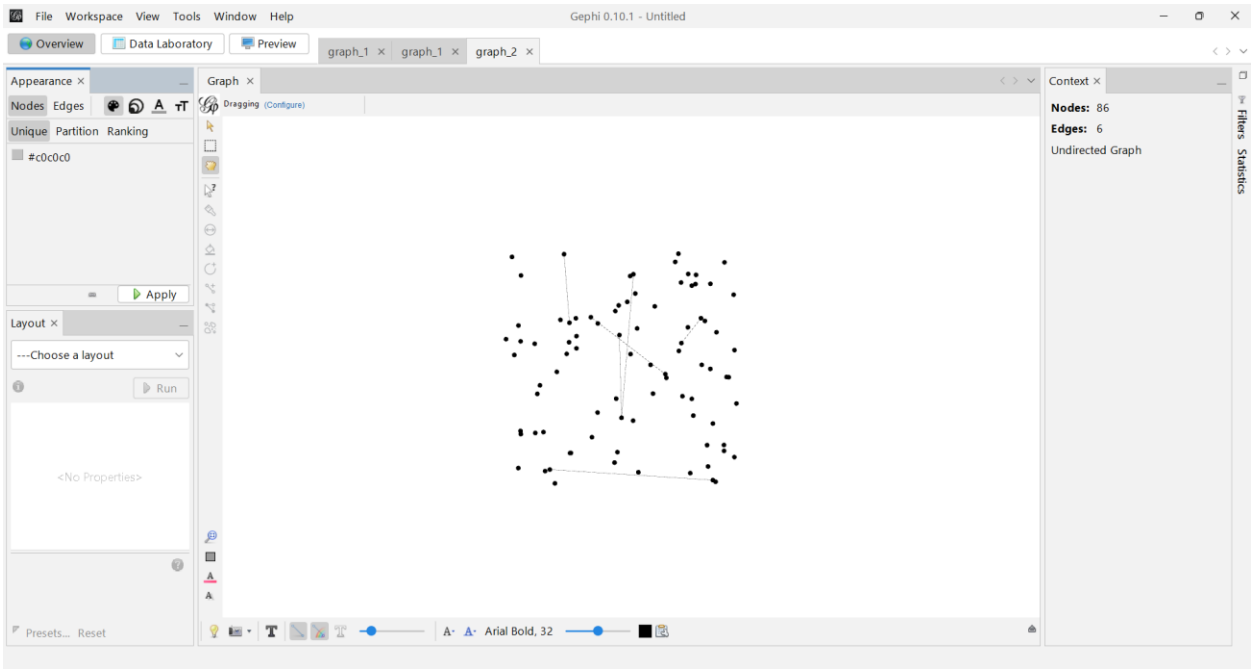
**2205027**

# Assignment Social Networking






This report analyzes and compares two Twitter subgraphs extracted from the WICO dataset :

- **Graph 1 :** A dense, highly connected subgraph ( From 5G Conspiracy Folder).

- **Graph 2 :** A sparse, weakly connected subgraph ( From Non-Conspiracy Folder).

| Metric | Graph 1 | Graph 2 |
|---|---|---|
| **Number of nodes** | 96 | 86 |
| **Number of edges** | 1610 | 6 |
| **Average degree** | 33.54 | 0.14 |
| **Graph density** | 0.35307 | 0.00164 |
| **Average clustering coefficient** | 0.69945 | 0.0 |
| **Modularity (Q)** | 0.06779 | 0.77778 |
| **Number of communities** | 7 | 80 |
| **Connected components** | 4 | 80 |
| **Largest connected component size** | 93 | 3 |

**Number of Nodes and Edges :**

- **Nodes :** represent users.
- **Edges :** represent interactions

**Interpretation :**

- **Graph 1 :** High number of edges relative to nodes – users interact heavily with one another.
- **Graph 2 :** Very low number of edges – almost no interaction between users.

**Average Degree :**

**Average degree =** how many connections each node has no average.

- **Graph 1 :** 33.54
  Users are highly active and interconnected.
- **Graph 2 :** 0.14
  Users barely connect with each other.

Conspiracy clusters form tightly interconnected echo chambers, while benign communities appear sparse.

**Graph Density :**

**Density =** measures how close the graph is to being fully connected.

- **Graph 1 :** 0.35307 **( Very high ).**
- **Graph 2 :** 0.00164 **( Near zero).**

Graph 1 behaves like a tightly packed cluster where information can spread extremely fast.

Graph 2 is nearly empty – information hardly moves.

**Average Clustering Coefficient :**

Measures how strongly nodes form local groups or " triangles".

- **Graph 1 :** 0.69945 **( Very high ).**
  Strong presence of cliques, typical of echo chambers.
- **Graph 2 :** 0.0
  No clustering; users not forming groups.

  **Modularity (Q) and Number of Communities :**
  Modularity identifies clusters/communities in the network.
  - **Graph 1 : Q =** 0.06779 **, Communities =** 7
    Weak community separation – most users belong to one giant cluster with subgroups.
  - **Graph 2 : Q =** 0.77778 **, Communities =** 80
    Very high modularity – network is highly fragmented into isolated nodes or tiny pairs.

  **Connected Components :**

A connected component = a set of nodes all reachable from one another.

- **Graph 1 :** 4 components; **largest =** 93 nodes.
  Almost the entire network is one connected structure.
- **Graph 2 :** 80 components; **largest =** only 3 nodes.
  Extremely fragmented network.

## Graph Level Analysis :

### 1- Analysis of Graph 1

Graph 1 displays all the characteristic features of a misinformation/coordination cluster :

- **Dense Connectivity :** enables rapid message amplification.
- **High clustering coefficient (~0.70)** indicates tightly knit groups reinforcing shared narratives (echo chambers).
- **Low modularity (Q ≈ 0.06)** shows that communities are not well separated — the group behaves as one unified entity.
- **Very large connected component (93/96 nodes)** means nearly all accounts are directly or indirectly connected.
- **Influential nodes are visible** through high betweenness and closeness centrality, acting as misinformation bridges.

This is a highly cohesive network optimized for fast rumor propagation, typical in misinformation campaigns or conspiracy movements.

### 2- Analysis of Graph 2 :

Graph 2 behaves like a normal, uncoordinated Twitter user set :

- **Only 6 edges among 86 nodes** → almost no social structure.
- **Density near 0** → users do not interact heavily.
- **Zero clustering** → no groups or closed loops.
- **High modularity (Q ≈ 0.78)** → nodes form many small disconnected pieces.
- **80 connected components** → the network is highly fragmented.

This is a typical benign social graph with organic, non-coordinated user behavior.

## Misinformation vs. Normal Behavior :

| Feature | Graph 1 (Conspiracy Graph) | Graph 2 (Normal Graph) |
|---|---|---|
| **Structure** | Cohesive | Fragmented |
| **Connectivity** | Extremely high | Extremely low |
| **Clustering** | Strong echo chambers | No clustering |
| **Communities** | Few, large | Many tiny or single-node |
| **Spread Potential** | Very high | Very low |
| **Security Risk** | High (organized amplification) | Low |

**Security Focused Interpretation :**

- **Graph 1 : High-Risk (Misinformation) :**
  - Dense structure amplifies messages quickly.
  - Echo chambers increase belief reinforcement.
  - Low modularity suggests coordination by a unified group.
  - Large connected component enables viral propagation.
  - Central nodes act as "super-spreaders" that can be targeted for mitigation.
- **Graph 2 : Low-Risk (Benign) :**
  - Sparse interactions prevent coordinated amplification.
  - No echo chambers → no mass reinforcement loops.
  - Fragmentation inhibits message spreading.