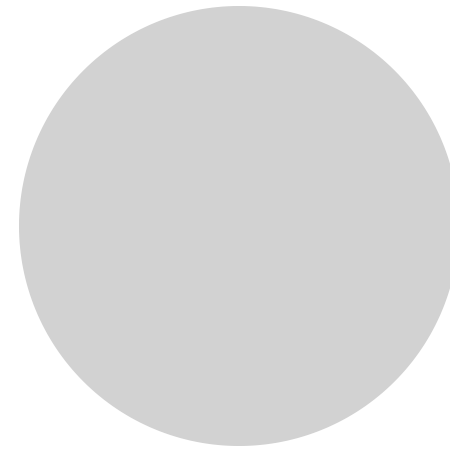


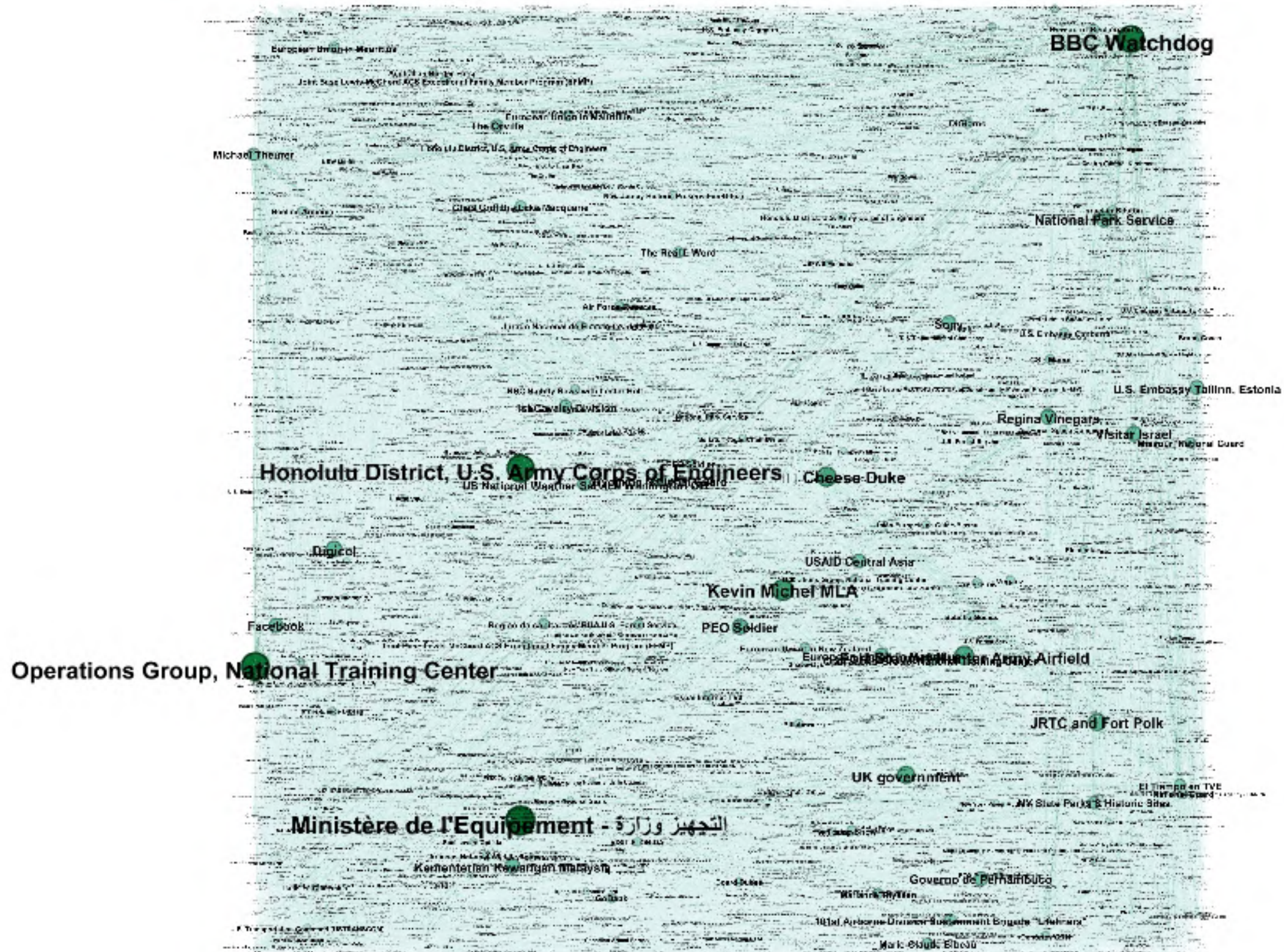
SOCIAL NETWORK ANALYSIS

FACEBOOK PAGES

Agenda

1. Network description
2. Visualization
3. Degree and density
4. Facebook network model
5. Random network model
6. Hubs
7. Centrality
8. Transitivity
9. Bridges
10. Assortativity
11. Community

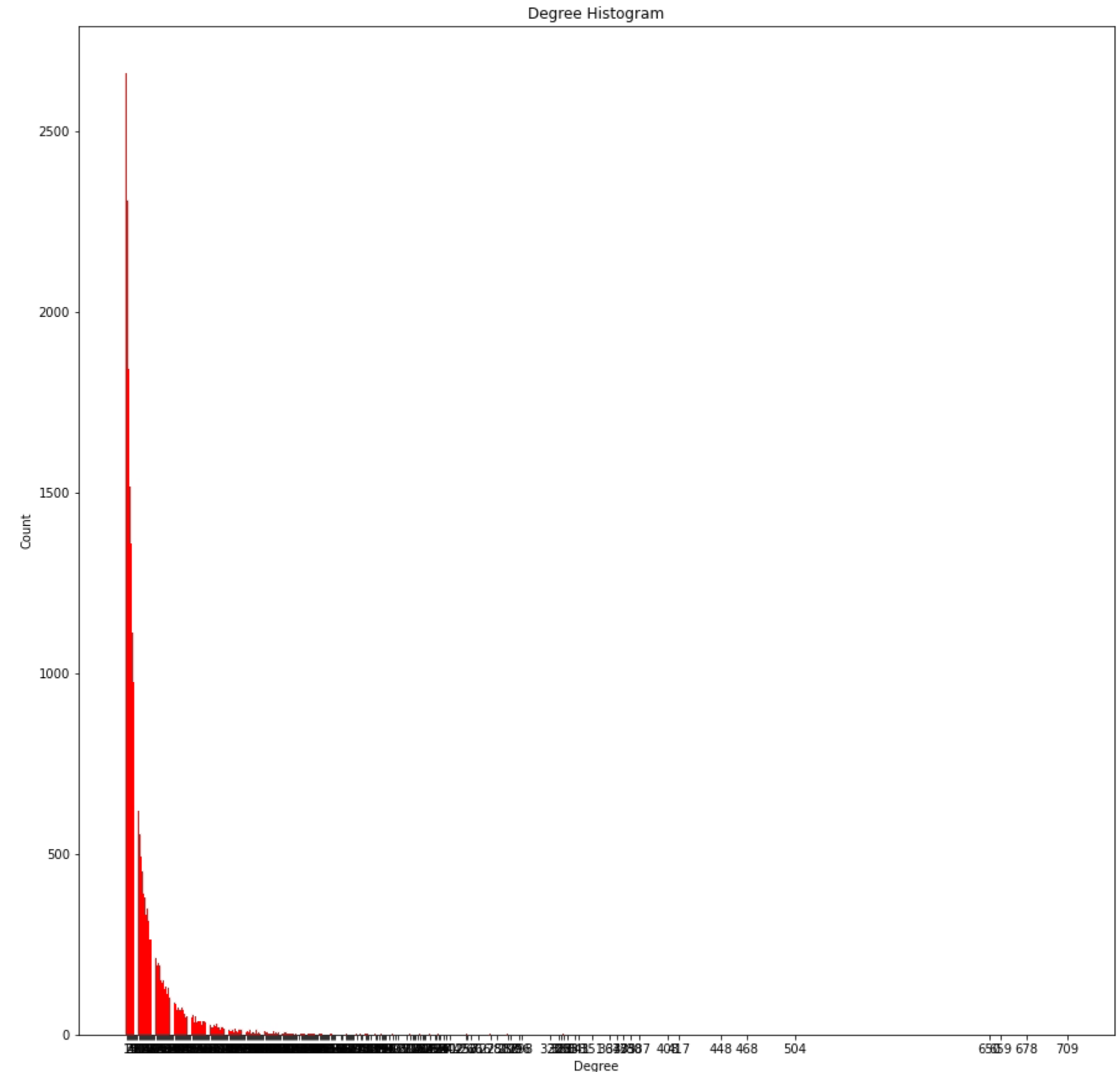




- Official Facebook pages of 4 categories: politicians, government organizations, television shows and companies
- Time of extraction: 2017
- Network order: $N = 22470$
- Network size: $L = 171002$
- Links: mutual likes
- Undirected
- Unweighted
- Labeled
- Connected components: 1 (centralized)

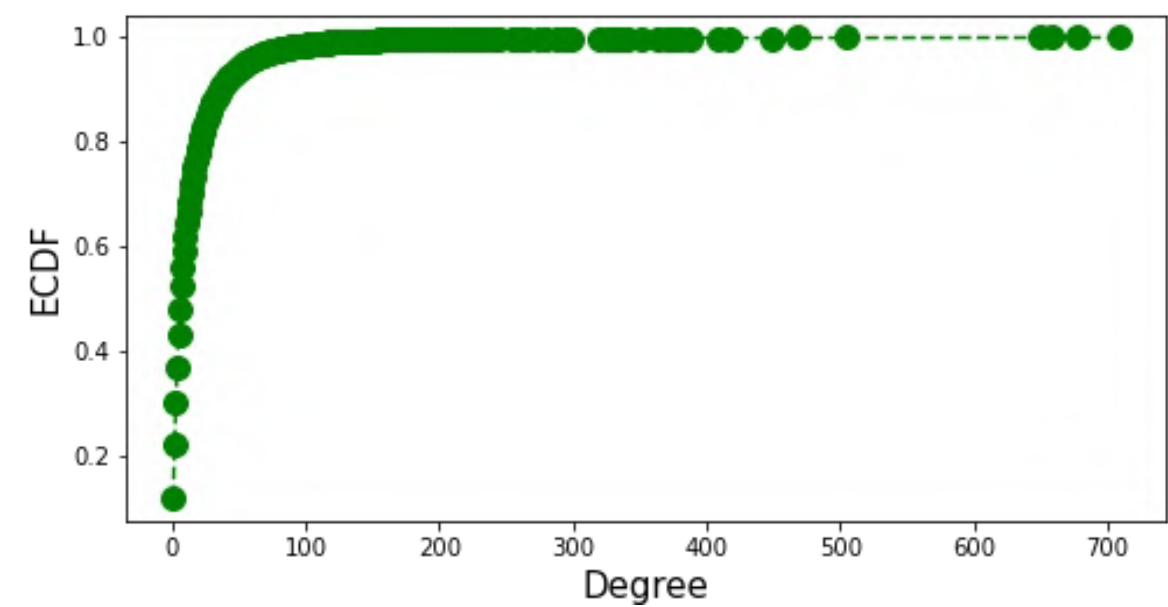
Graph Degree statistics and density:

- Median degree: 7.0
- Avg degree: 15.22 (> median cause of hubs)
- Standard deviation: 26.4 (high)
- Maximum degree: 709
- Minimum degree: 1 (no isolated components)
- Density: 0.00068 (low fraction of links)
- Degree assortativity: 0.085 (correlation between nodes of similar degree)

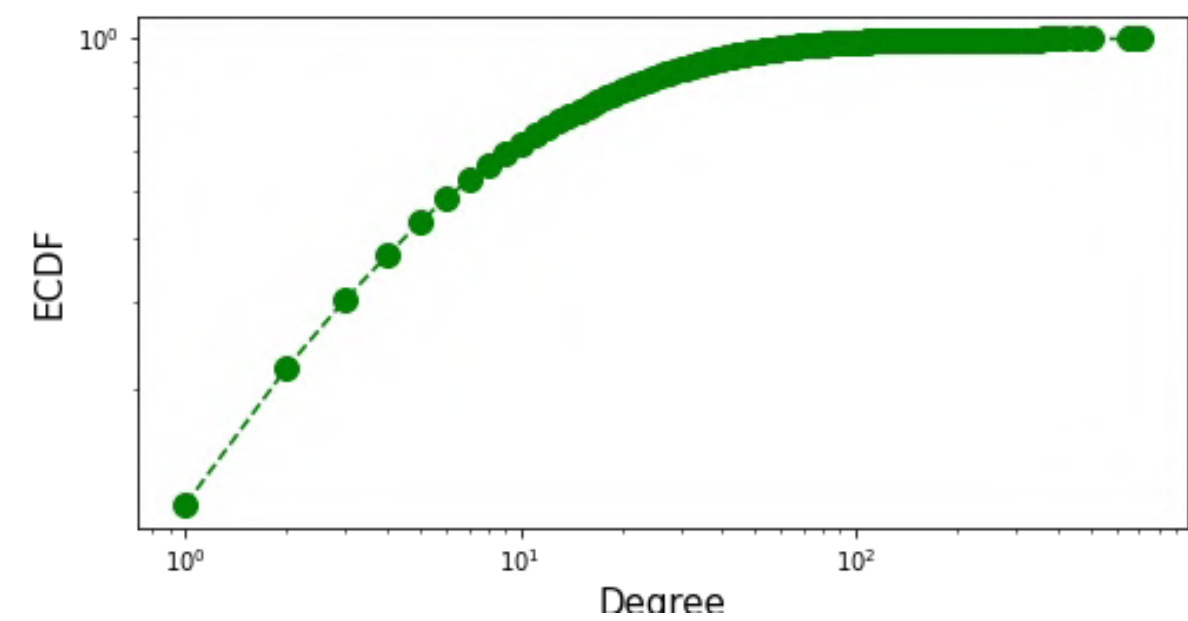


FACEBOOK NETWORK MODEL

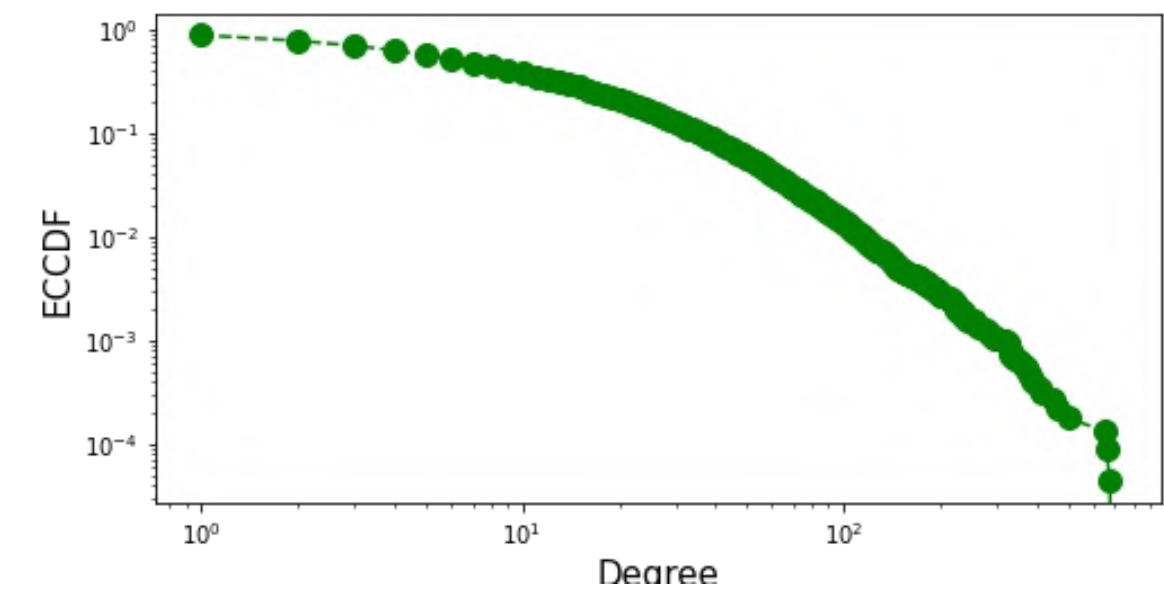
TAKE A LOOK AT THE DEGREE DISTRIBUTION



EMPIRICAL CUMULATIVE DISTRIBUTION FUNCTION

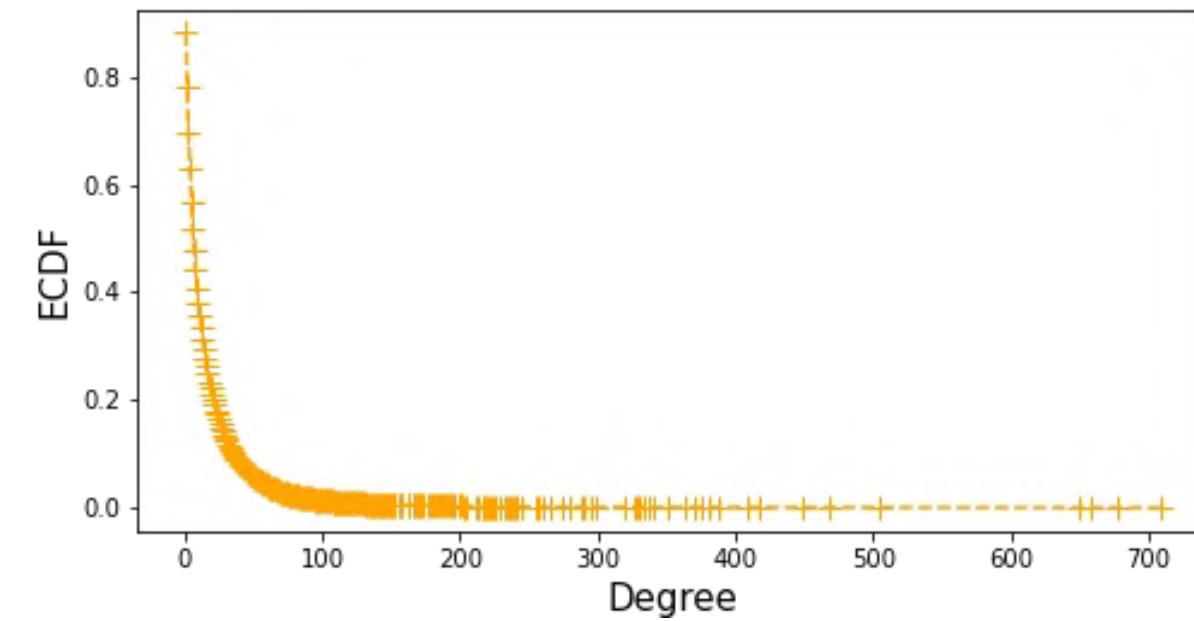
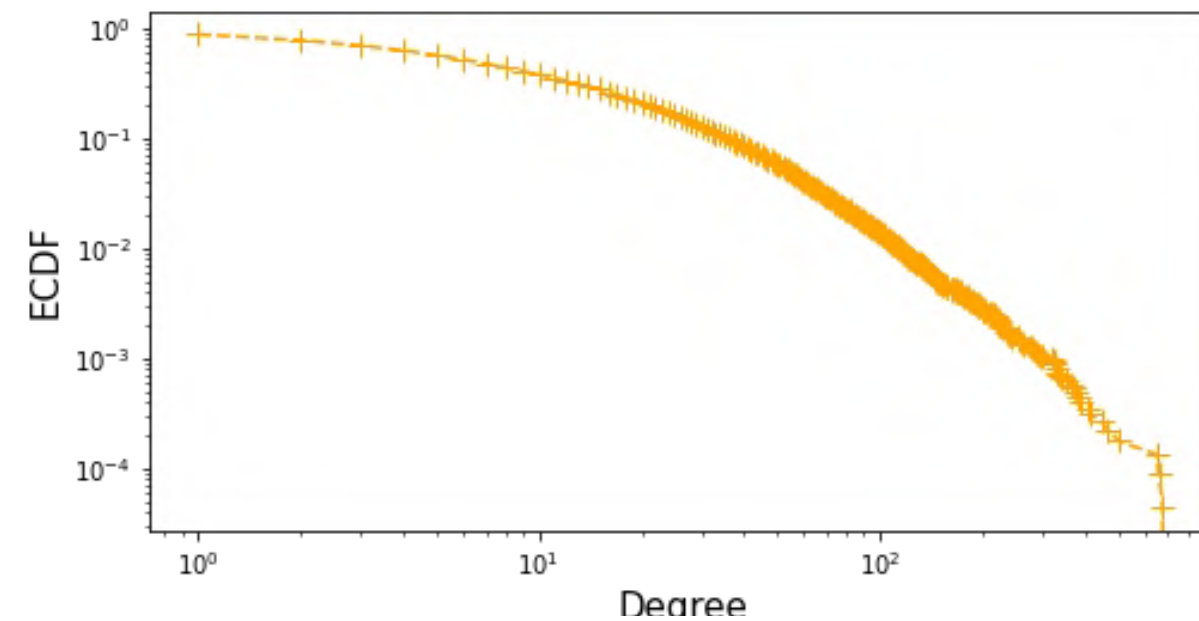
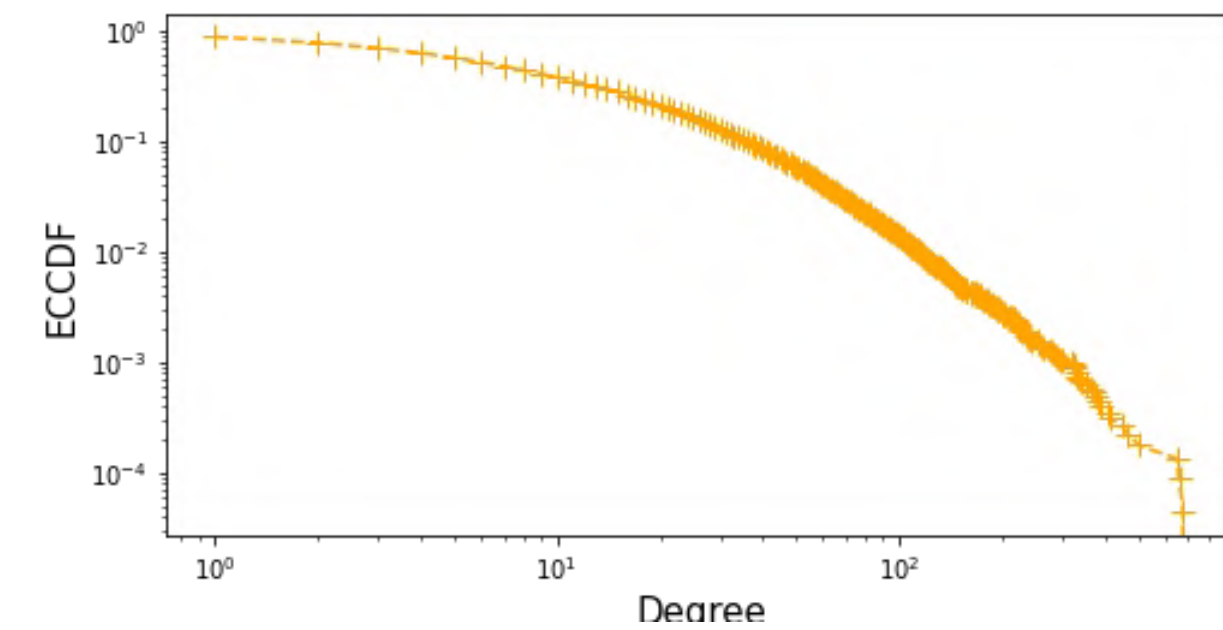


EMPIRICAL CUMULATIVE DISTRIBUTION FUNCTION
LOG-LOG SCALE



EMPIRICAL COMPLEMENTARY CUMULATIVE
DISTRIBUTION FUNCTION

RANDOM NETWORK MODEL

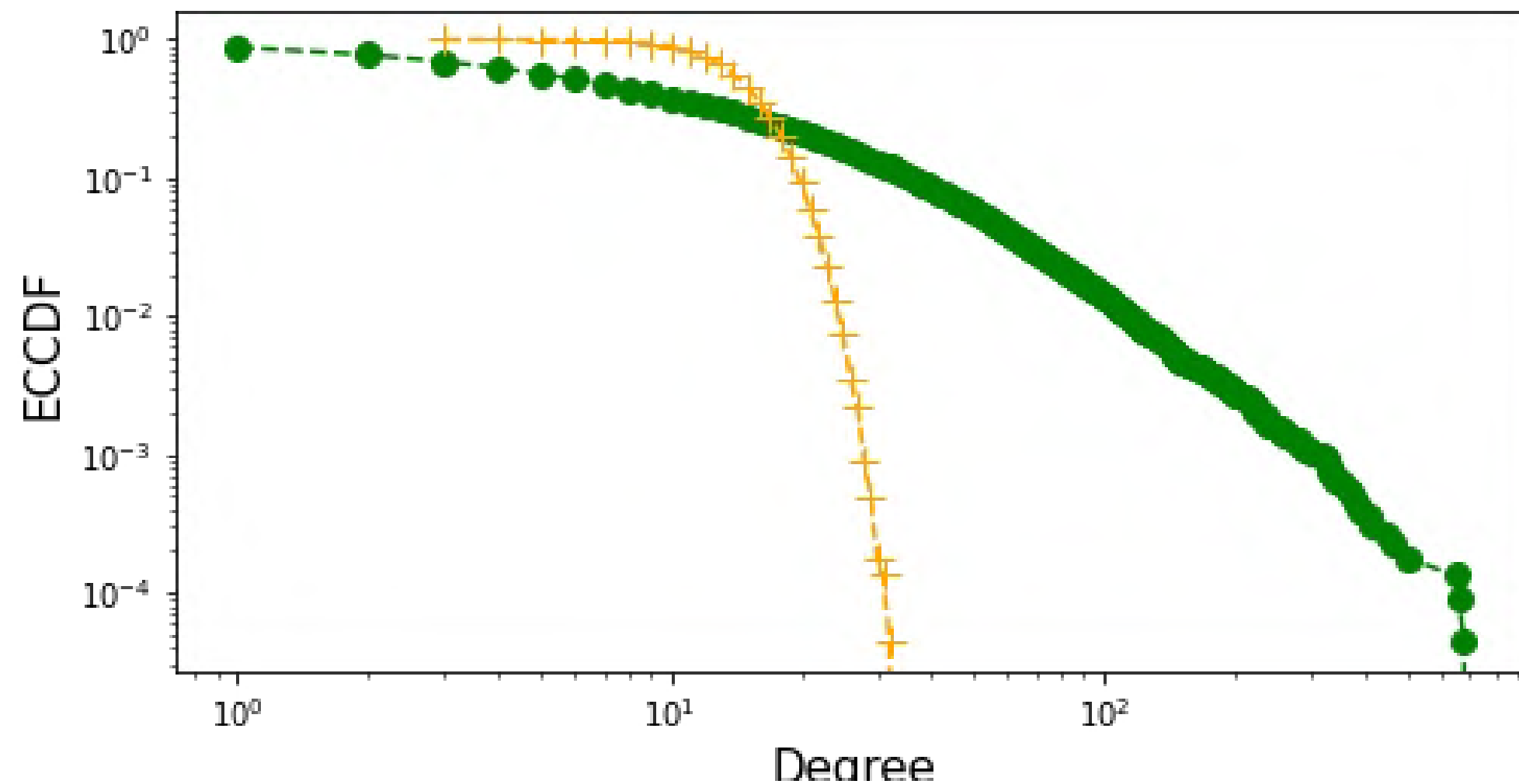
EMPIRICAL CUMULATIVE DISTRIBUTION
FUNCTIONEMPIRICAL CUMULATIVE DISTRIBUTION FUNCTION
LOG-LOG SCALEEMPIRICAL COMPLEMENTARY CUMULATIVE
DISTRIBUTION FUNCTION

Number of nodes: 22470
Number of links: 171060

Random Graph Degree statistics:

- Standard deviation: 3.9
- Mean: 15.2
- Median: 15.0
- Minimum: 2
- Maximum: 32
- $P = D =$ Facebook net density

COMPARISON



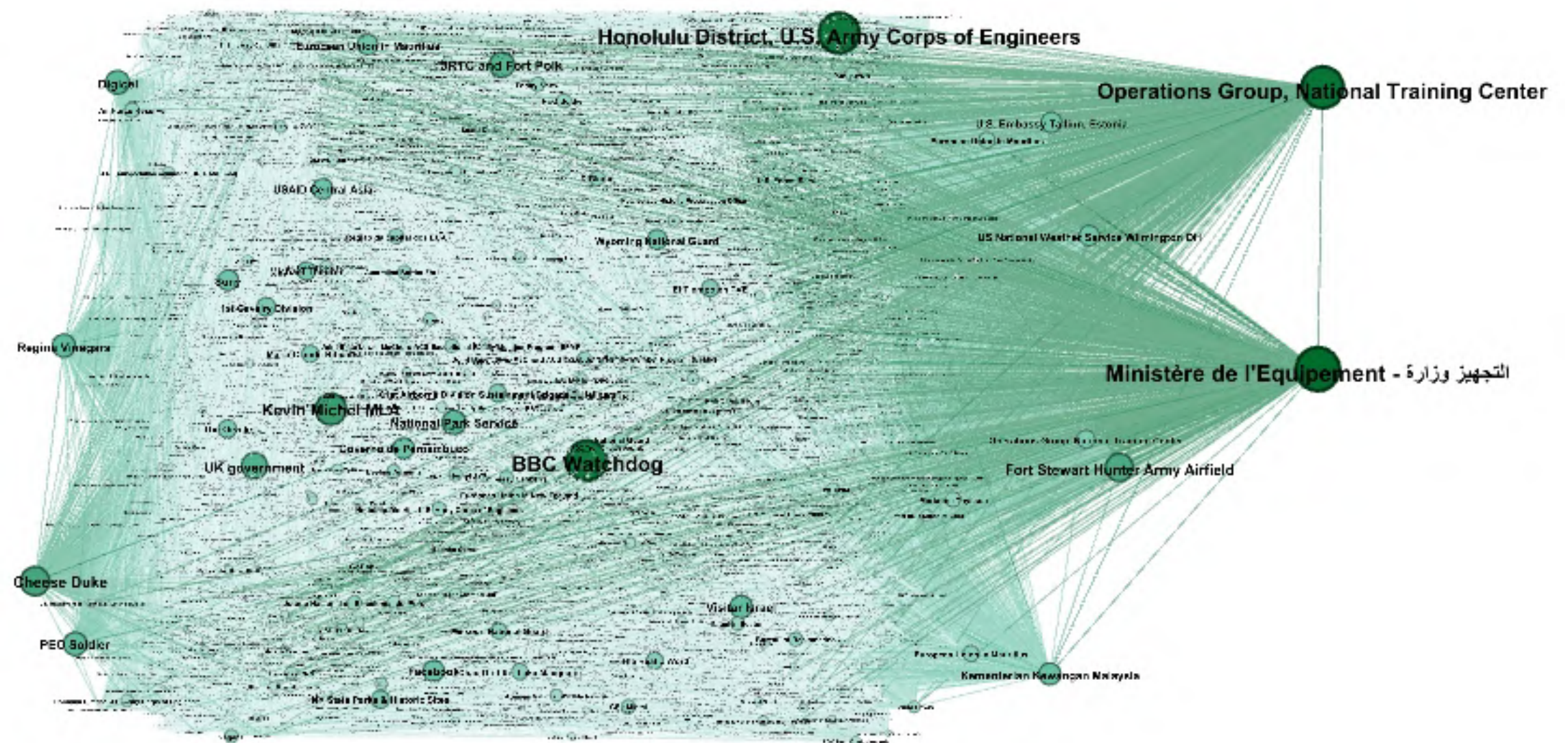
- **Random** graph degree distribution is Poisson distribution
- **Facebook** pages graph degree distribution follows Power Law (Heavy Tail distribution)
- **Heavy Tail** indicates presence of hubs and the scale-free property of the network: indicating the presence of nodes with a much higher degree than most other nodes.

HUBS

percentile_99 = 114.31

Nodes that have a degree higher than
114.31 will be considered as hub:
225 Hubs

No isolated nodes (confirmed by
minimum degree = 1) in the network.



CENTRALITY

Name	Score	Page Name
Degree	0.25088	Honolulu District U.S.
Betweenness	0.35594	Ministère de l'Équipement
Closeness	0.35794	Ministère de l'Équipement
Eigenvector	0,26199	Honolulu District U.S.

Centrality Measures

Transitivity

Global clustering coefficient: 0,232

Average local clustering coefficient: 0,3597

(nodes tend to form clusters in the neighborhood)

Triangles

Computing the number of triangles: each triangle is counted three times, once at each node.

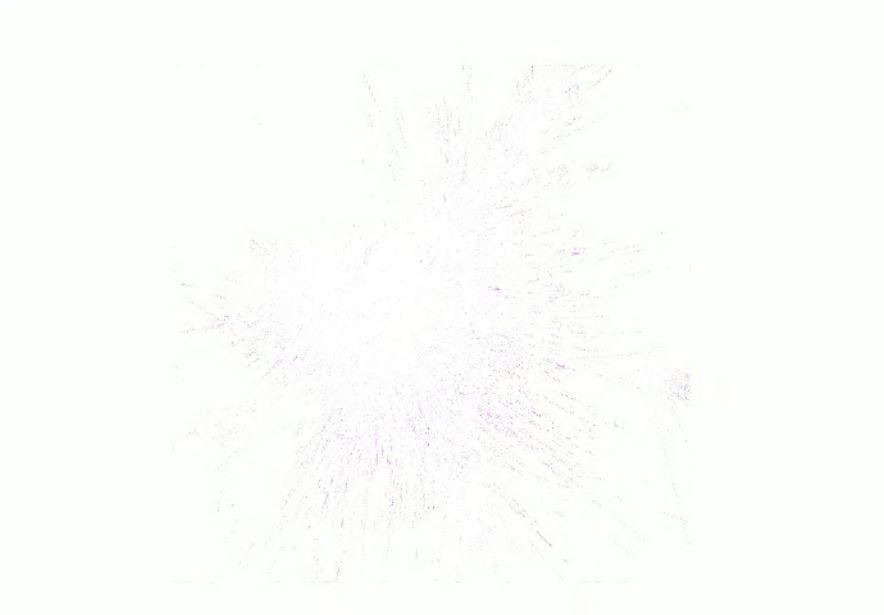
Transitivity value is high, and it shows a high fraction of closed triangles in the network.

Triangles statistics:

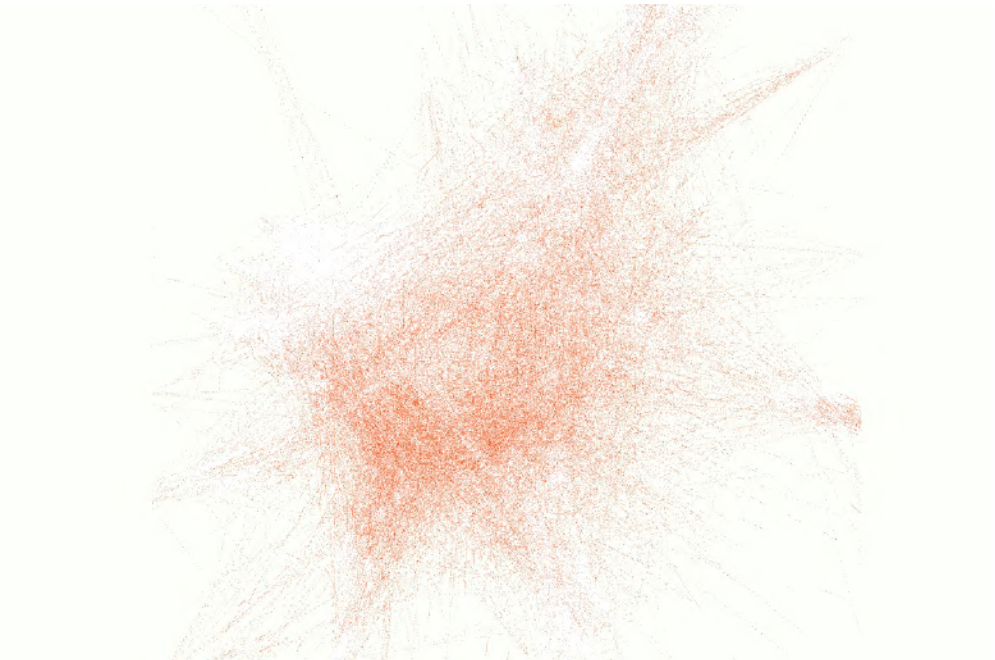
- Number of triangles (counted for each node): 2384859
- Number of triangles (unique value): 794953
- Mean number of triangles: 106.13
- Maximum number of triangles: 16219
- Minimum number of triangles 0

BRIDGES

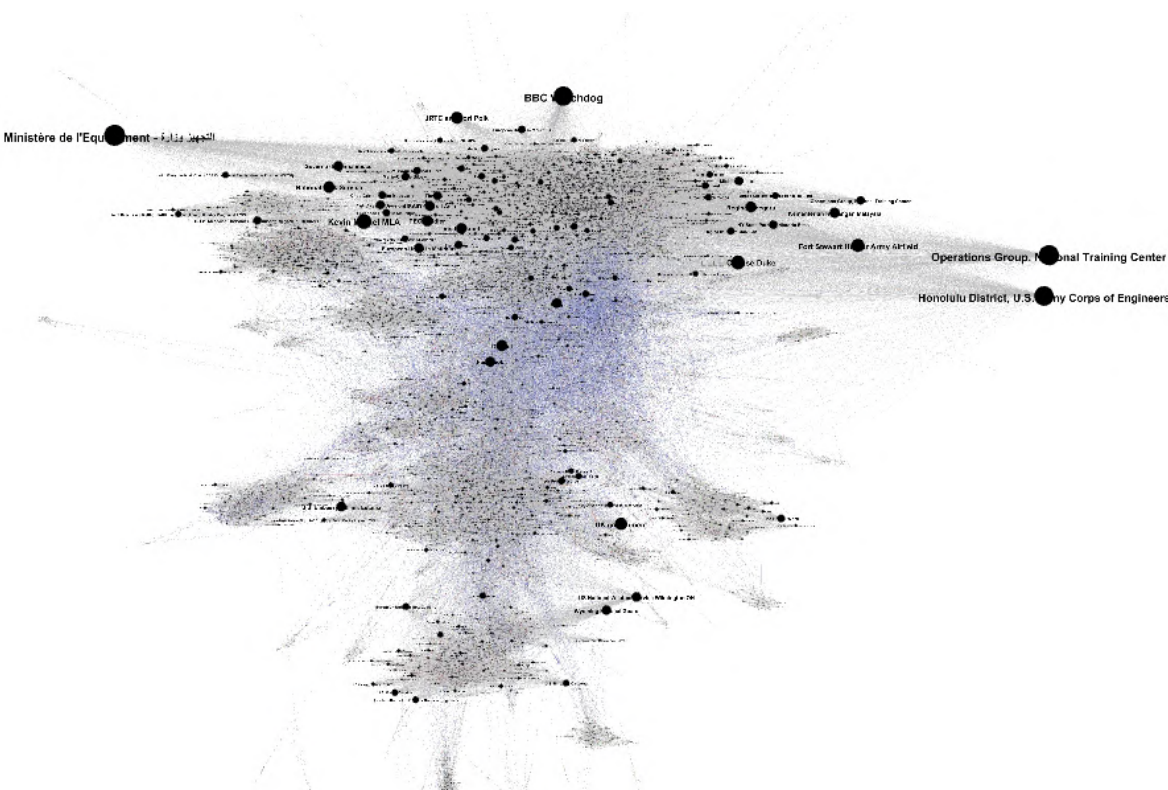
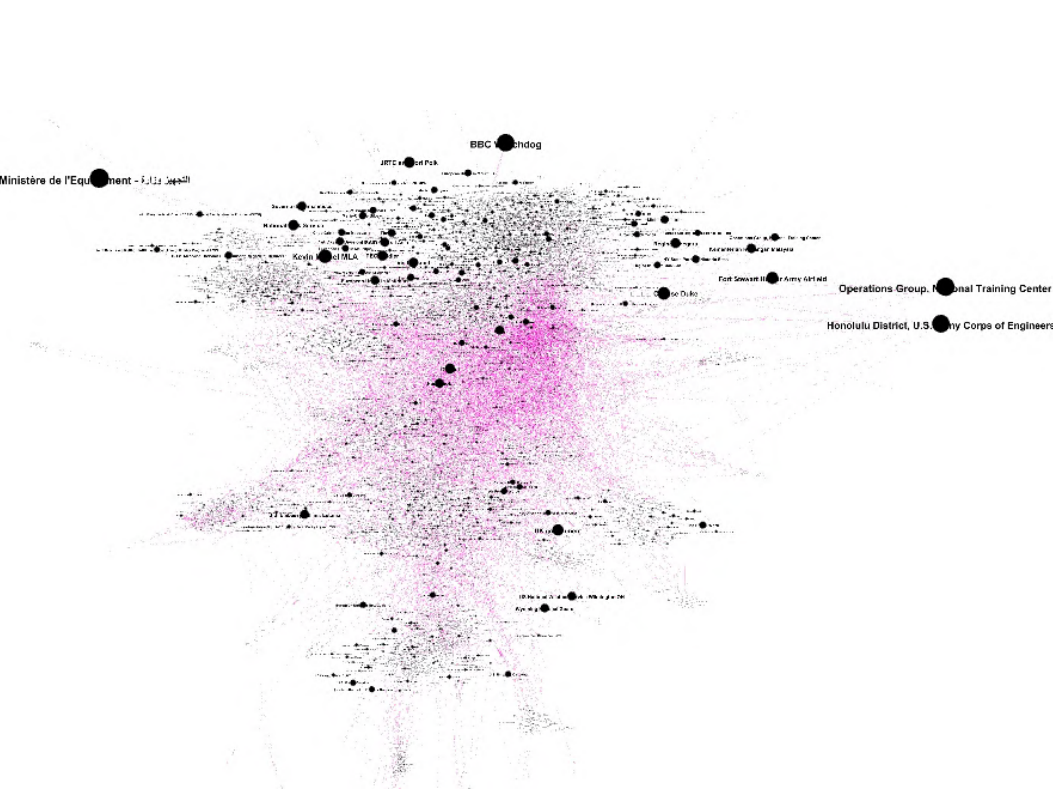
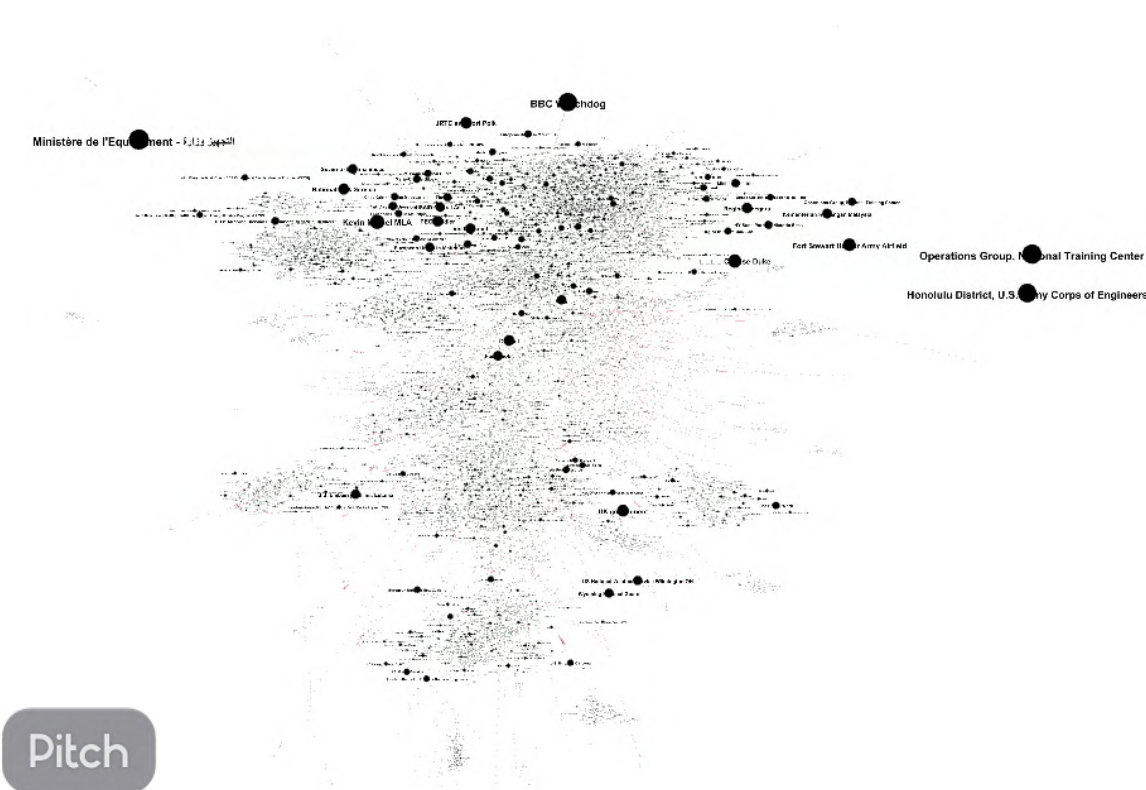
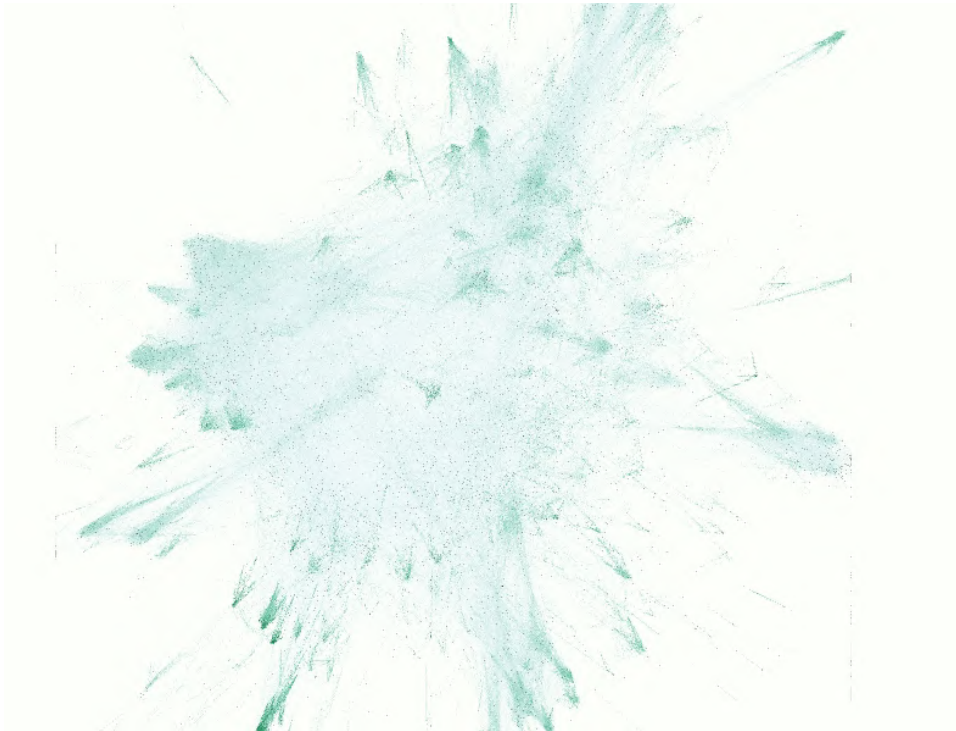
Bridges



Local bridges



Almost local bridges



Network Similarity

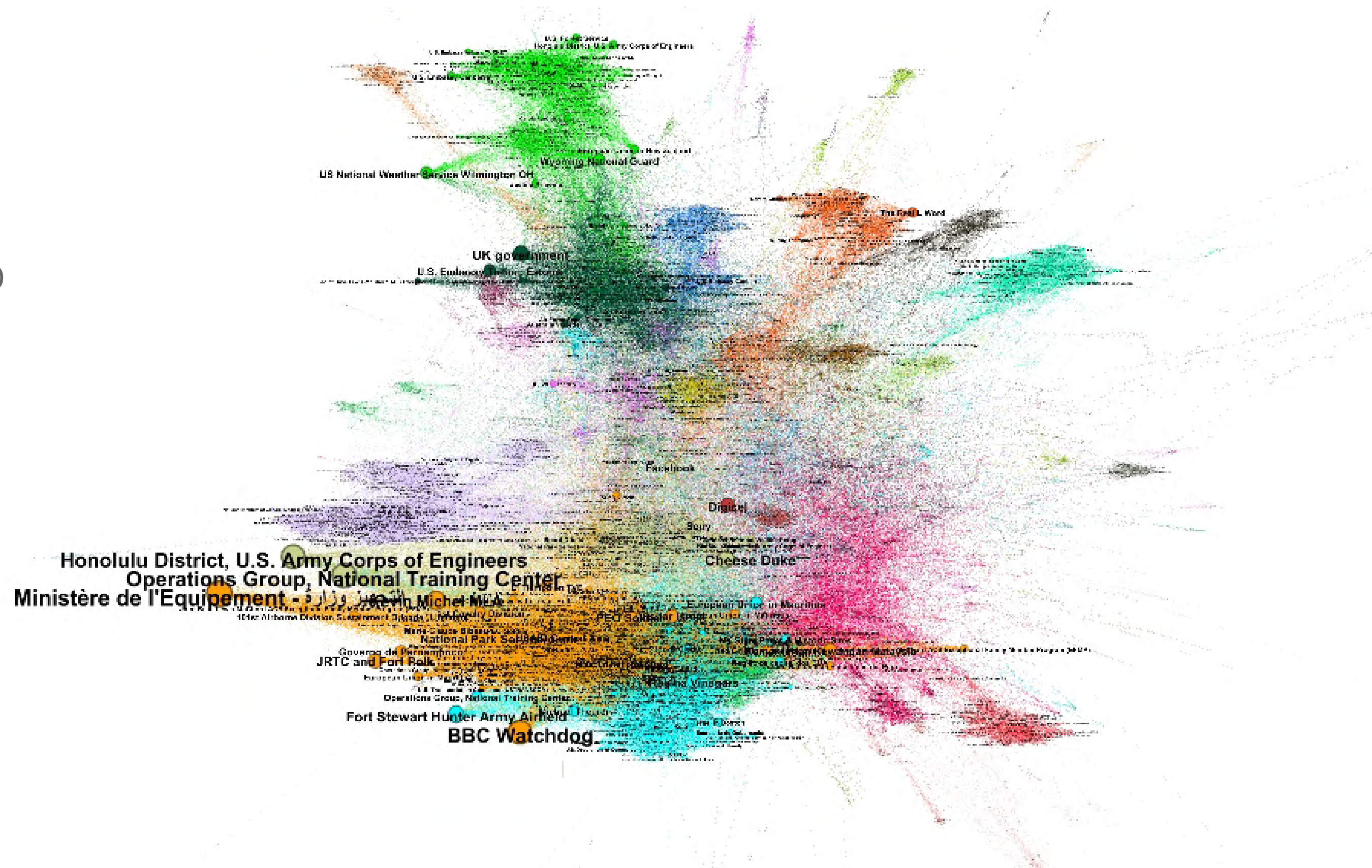
THE PAGE CATEGORY AFFECT THE
PROBABILITY OF SIMILARITY
BETWEEN TWO NODES

ATTRIBUTE ASSORTATIVITY

- **Attribute:** page category
- **Nodes:** Facebook pages
- **Results:** 0.0008

COMMUNITY DETECTION

- Method: Louvain method
- Number of communities: 60
- Coverage: 0.88
- Modularity: 0.81



References

- Graph collected through Facebook Graph API in November 2017
- **Dataset:** B. Rozemberczki, C. Allen and R. Sarkar. Multi-scale Attributed Node Embedding, 2019.
- https://mathinsight.org/scale_free_network