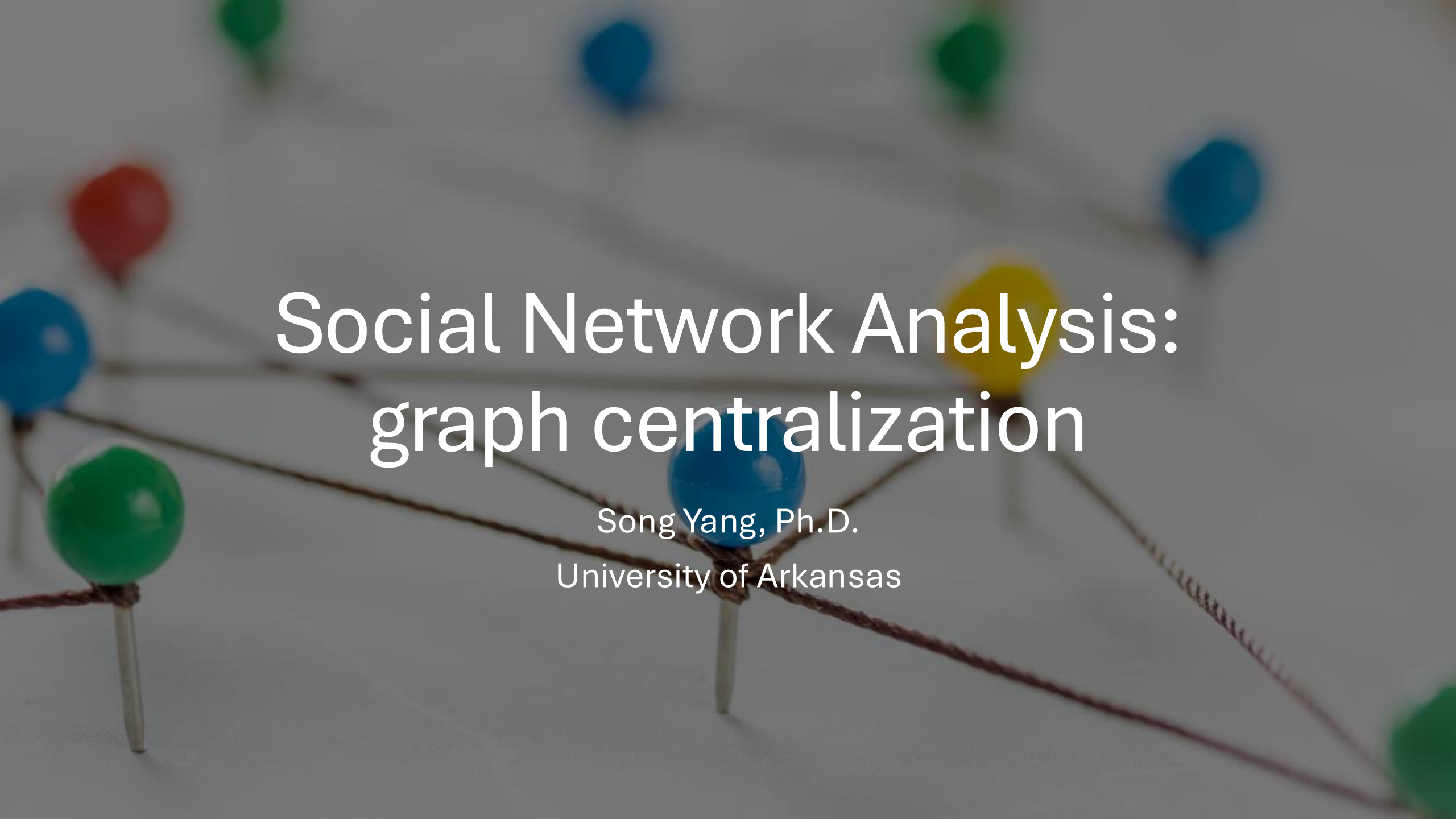

Social Network Analysis: graph centralization

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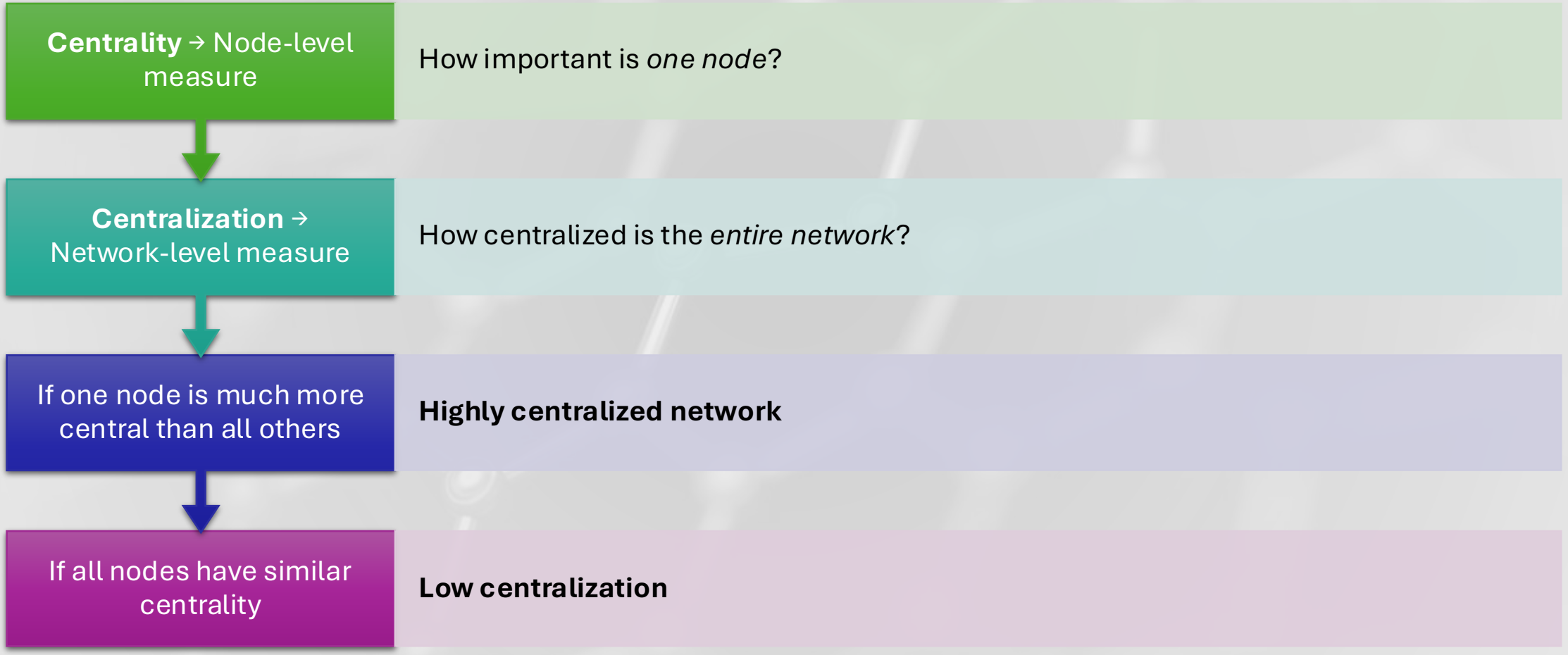
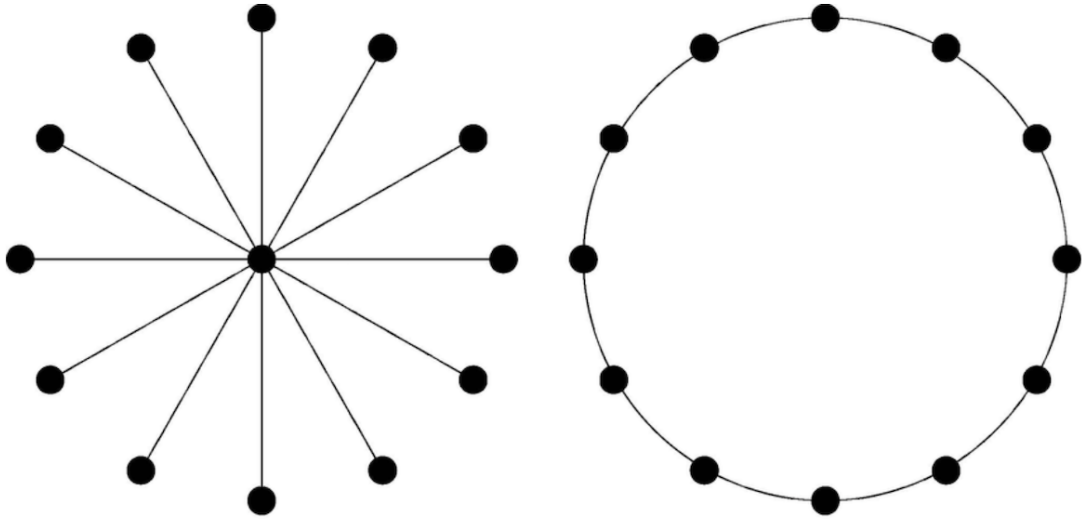
University of Arkansas

Centralization ≠ Centrality



Two extremes

- Star network → Highly centralized
- Circle network → Low centralization



Why Centralization Matters?

- Power concentration
- Vulnerability of a network
- Information flow control
- Organizational hierarchy
- Resilience to node removal
- Example:
  - Highly centralized network → Removing central node can collapse system.

Degree Centralization

- Based on degree centrality
- Measures:
  - How unequal is the distribution of node degrees?
- Formula (conceptually):
  - $C_D = \frac{\sum(max(d) - d_i)}{maximum\ possible\ sum}$
- Where:
  - d_i =degree of node i
  - max(d) = highest degree in network

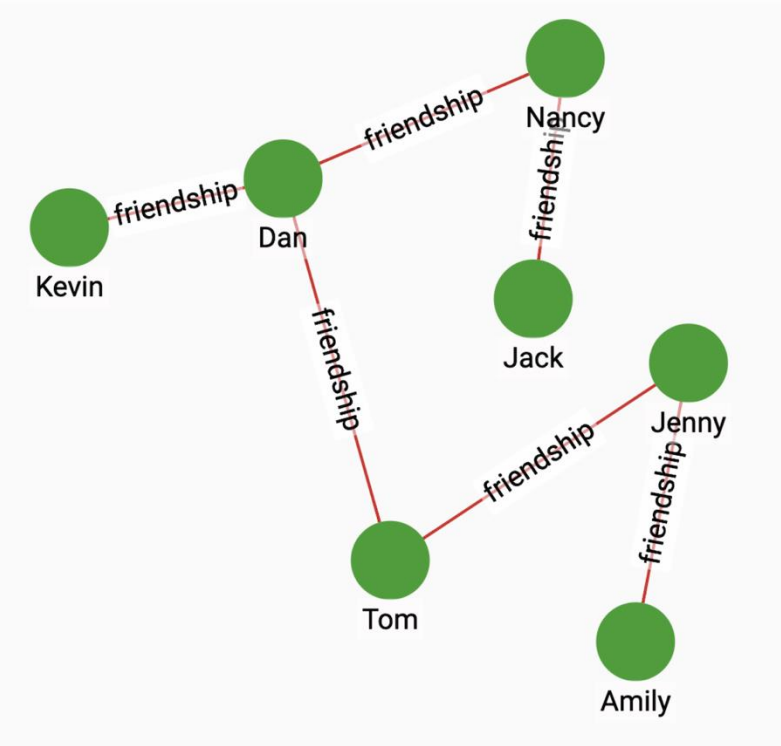
Computing degree centralization

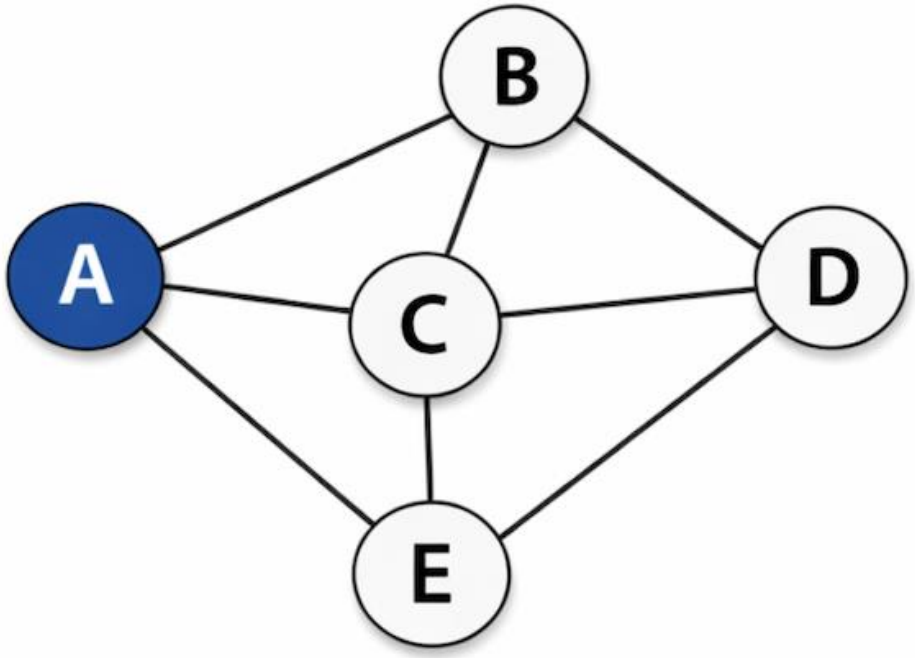
- For an **undirected graph**, the normalized degree centralization is:
  - $C_D = \frac{\sum_{i=1}^{n}(d_{max} - d_i)}{(n-1)(n-2)}$
- Where:
  - d_i =degree of node i
  - d_{max} =maximum degree in the network
  - n= number of nodes
  - $(n-1)(n-2)$ =maximum possible denominator (occurs in a star network)

Interpreting degree centralization

- Range:
  - 0 → perfectly equal
  - 1 → star network (maximum centralization)

exercise


Nancy
friendship
friendship
Kevin
Dan
friendship
friendship
Jack
Jenny
friendship
friendship
Tom
Amily


B
A
C
D
E

Applications

- Organizational hierarchy analysis
- Social media influencer detection
- Disease spread networks
- Criminal network analysis