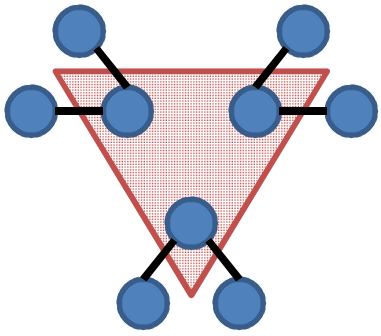# Lecture 4:
Roles and groups in networks
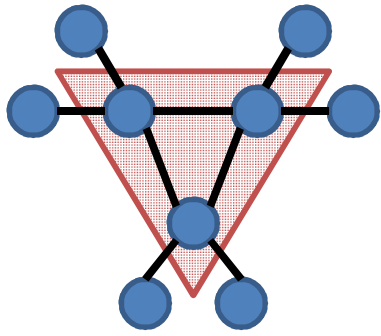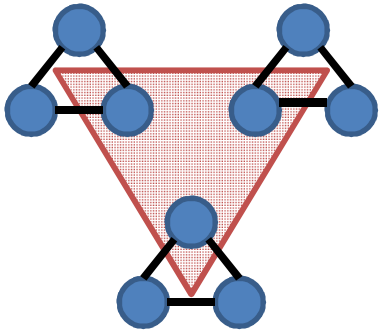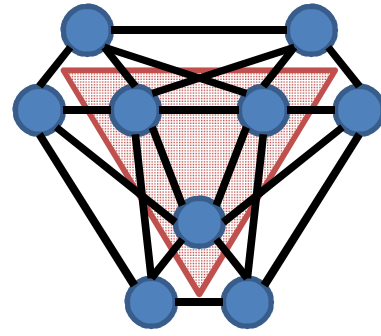
Noshir Contractor

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Brokerage & closure

	Low closure	**High closure**
High brokerage	Divisive group with diverse contacts	Cohesive group with diverse contacts
Low brokerage	Divisive group with homogenous contacts	Cohesive group with homogenous contacts

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Different brokerage roles

- Coordinating
  - Insider brokering within group

- Consulting
  - Outsider brokering within group

- Gatekeeping
  - Insider brokering outsiders' access to insiders

- Representing
  - Insider brokering insiders' access to outsiders

- Liaising
  - One party brokering a second party's access to a third party
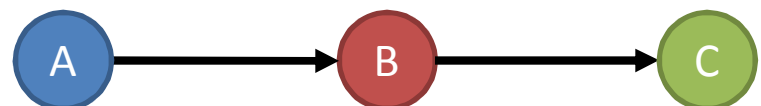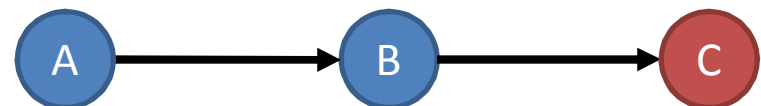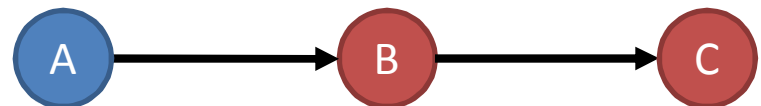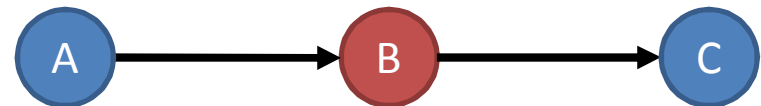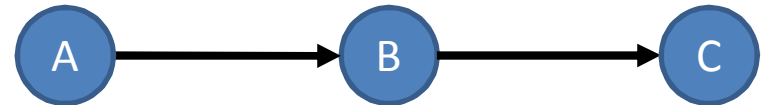
Structural balance

- Unbalanced triangles are sources of stress & dissonance
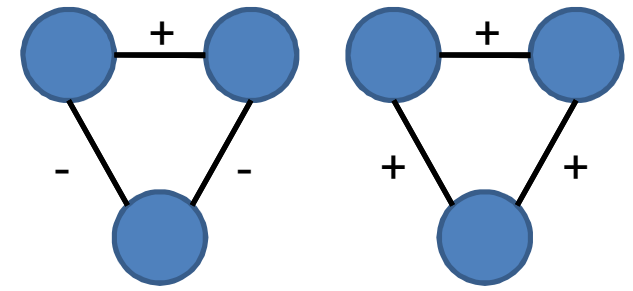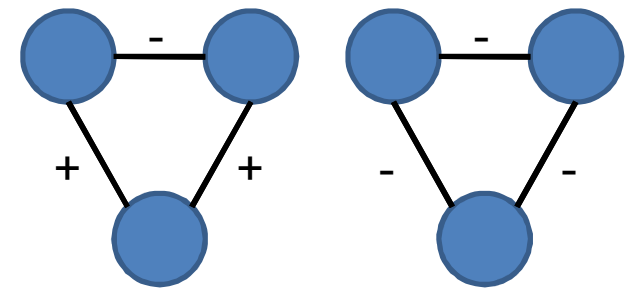
- **Cartwright-Harary Theorem**: If a graph is balanced, then either

  - All pairs of nodes are friends

  - There exist groups that are friendly within the group but members of groups are antagonistic to other groups

Balanced

Unbalanced

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Strong, Weak, & Simmelian ties

- **Granovetter's strong ties**:
  - Time spent interacting
  - Emotional intensity of interaction
  - Mutual confiding
  - Degree of reciprocal services
- **Krackhardt's strong ties**:
  - Trust
  - Frequent interaction
  - Affection
  - Relationship history

- **Simmelian ties**:
  - Addition of a third person fundamentally changes interaction dynamics
  - **Dyads**: more individuality, withdrawal as bargaining power, but conflicts escalate
  - **Triads**: reliance on norms, withdrawal diminishes power, conflicts moderated
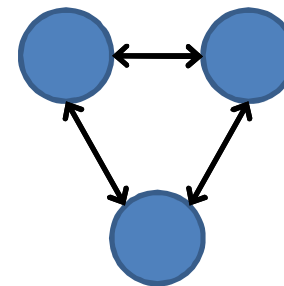
Subgroups

- Bottom-up approaches
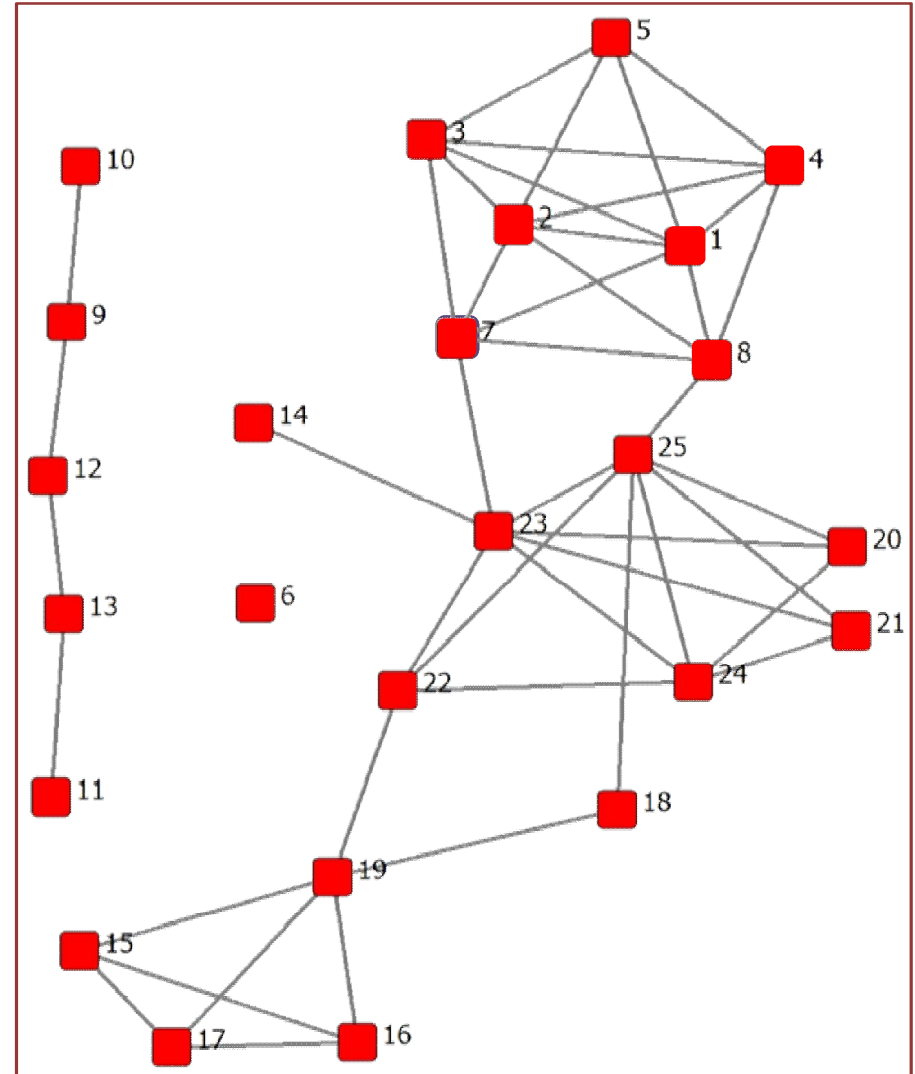 - Cliques, clans, plexes, & cores

- Top-down approaches
  - Weak & strong components, blocks & cutpoints, lambda sets & bridges

Cliques

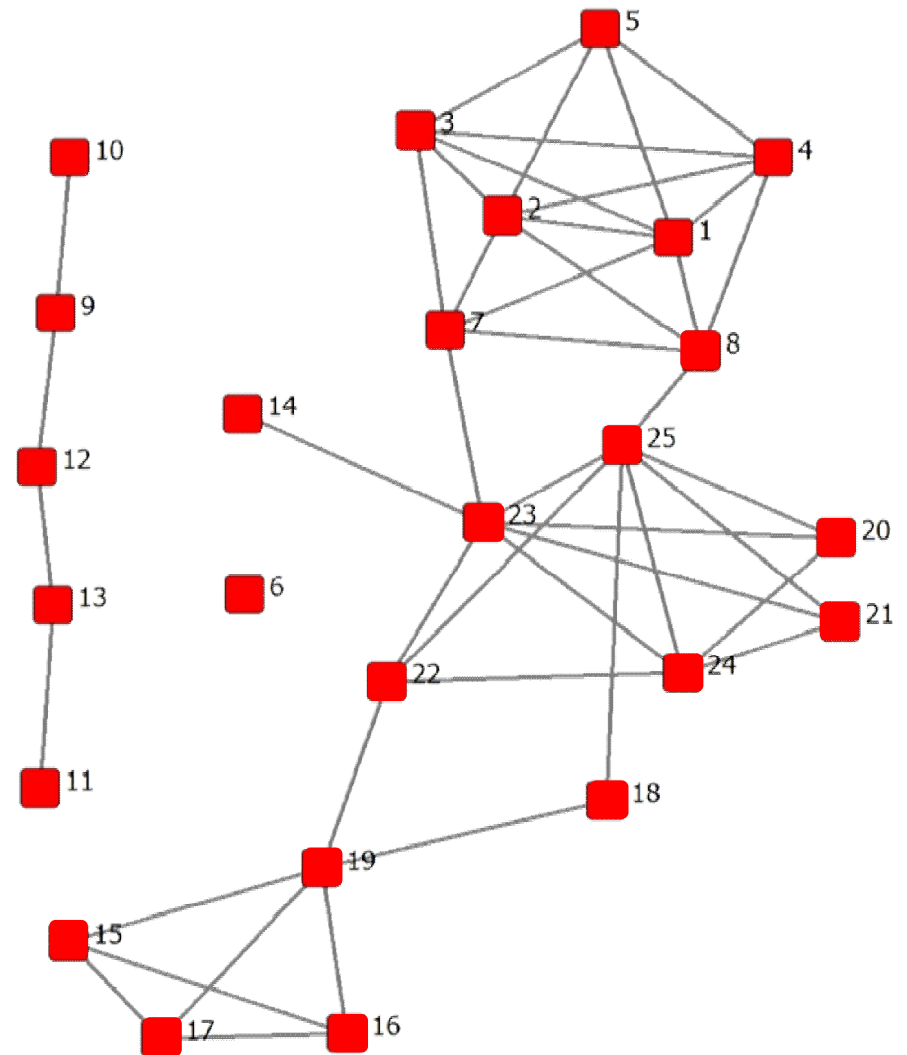- Largest subset of actors that are directly and completely connected to the rest of the set

- "Maximal complete sub-graph"

- 8 is a member of what cliques?

N-Cliques

- Largest subset of actors that are completely-connected with rest of the set **within N steps**

- N is typically 2

- "Long & stringy"

- Possible for N-clique members to be connected by non-members ☹

- 18 is a member of what 2-cliques?

N-Clans

- Path between any two members of an N-clique must occur via members of the N-clique

- Ties to the "clique" by having ties to some member of the clique and are no farther than N steps from all members of the clique

- 14 is a member of what 2-clans?

K-plexes

- Node is a member of a "clique" of size N if it has direct ties to N-K members of that "clique"

- Creates large numbers of small groups

- Group members must have ties to most other group members, no intermediaries

- N=4, K=2?

K-cores

- Maximal group of actors all connected to K other members of the group

- Connection rather than immersion, closure, or clustering

- If an actor has some threshold of ties to a group, they may feel tied to the group even if they don't know all members

- What sets are 4-cores?
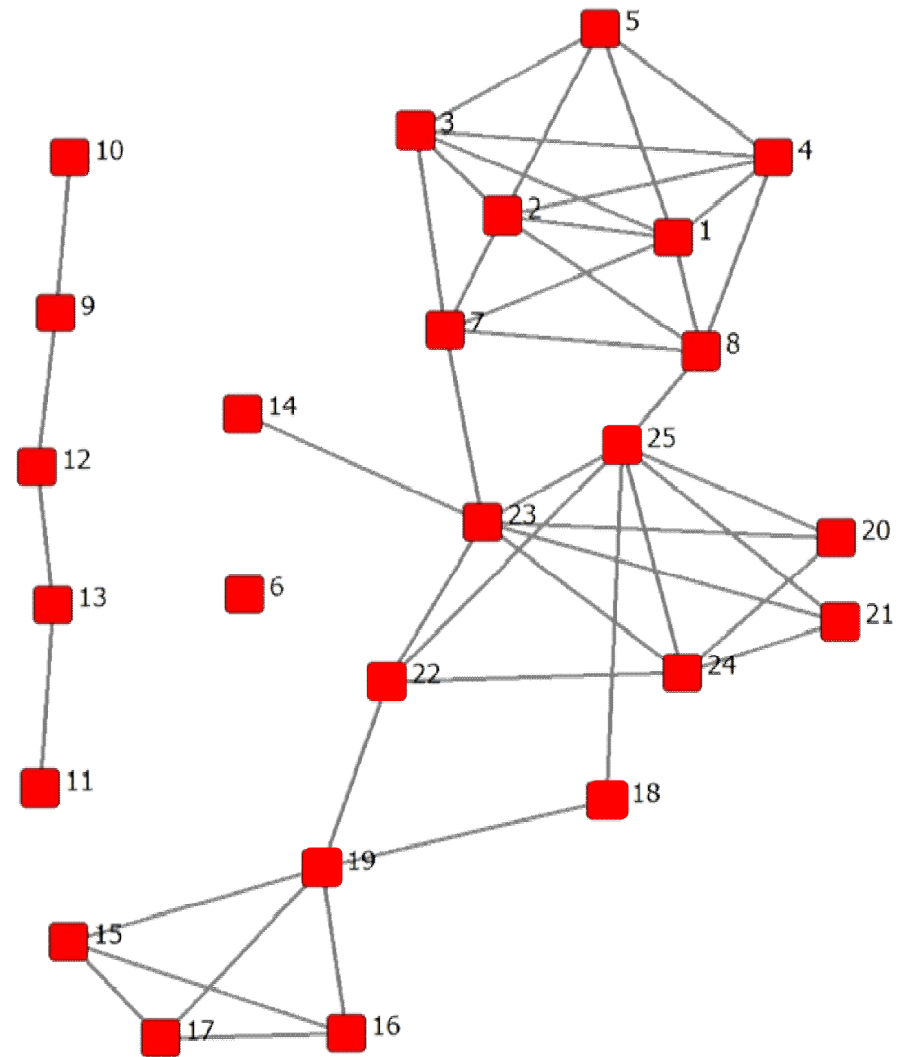
Strong & weak components

- Weak component
  - Set of connected nodes, regardless of direction of connections

- Strong component
  - A directed path must exist between two nodes for them to be in the same component
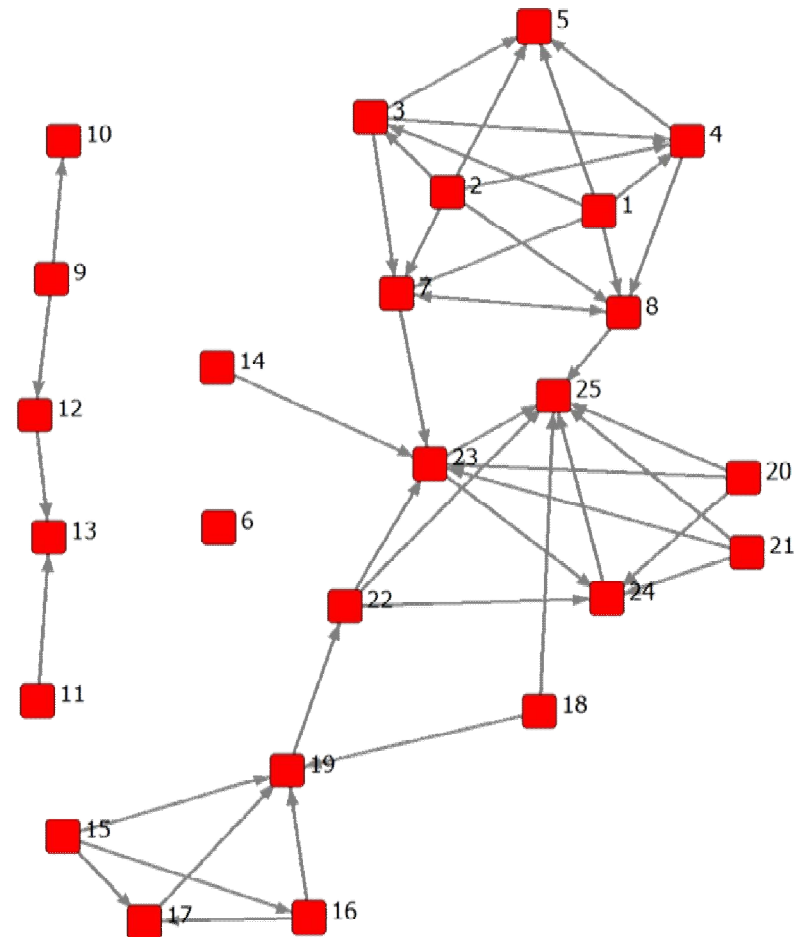
Cutpoints & bridges

- Cutpoint
  - Removing a node creates a new component
  - Resulting divisions are blocks

- Bridges
  - Removing a link creates a new component

- Lambda sets
  - Importance of relationships based on flux through link
  - "Betweenness centrality" for a link
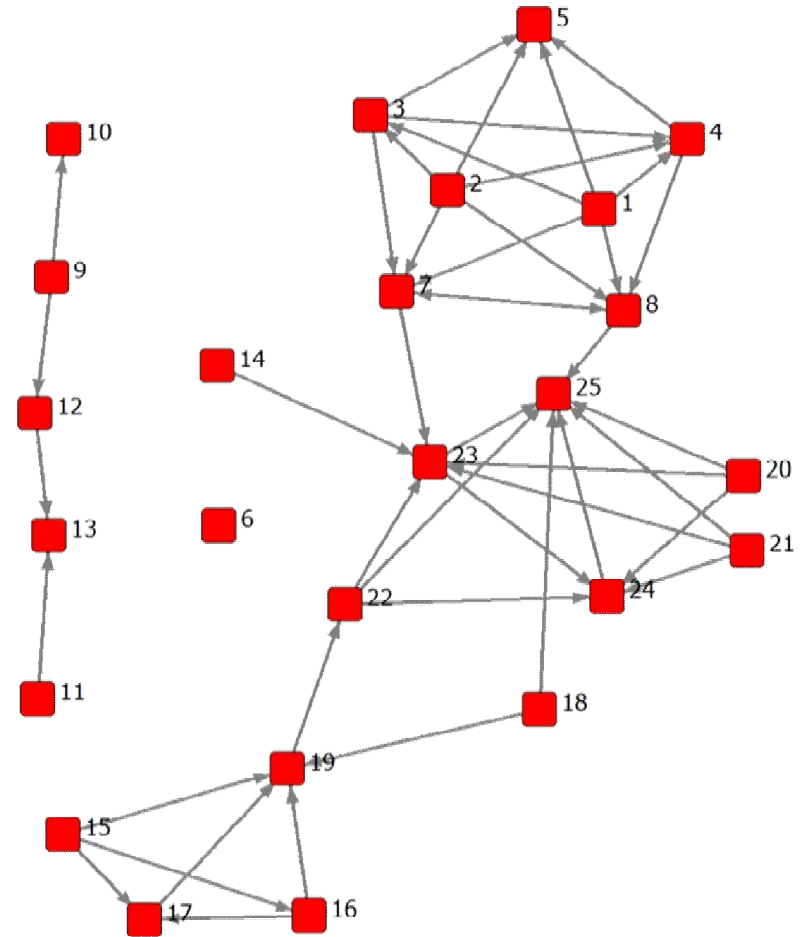
Equivalence

- **Structural equivalence**
  - Sets of actors having exactly the same set of relations as another actor (brothers)
  - {A}, {B}, {C}, {D}, **{E,F}**, {G}, **{H,I}**

- **Automorphic equivalence**
  - Sets of actors having the same patterns of ties and are completely substitutable (cousins)
  - {A}, **{B,D}**, {C}, **{E,F,H,I}**, {G}

- **Regular equivalence**
  - Sets of actors having similar relationships types with other sets (fathers)
  - {A}, **{B,C,D}**, **{E,F,G,H,I}**