Social Networks

Lecture #5

Strong Triadic Closure

Strong Ties → Frequent/Regular Contacts
Weak Ties → Occasional Contacts
          → Rare Contacts

Marc Granovetter [American Sociologist –
Currently at Stanford Univ]

"Weak ties enable reaching populations
and audiences with much higher
efficiency than what is achievable
or accessible via strong ties."

STRENGTH OF WEAK TIES (1973)

Why?

Ref. "Getting a Job." PhD Diss, Granovetter, M.,
Dept. of Social Relation, Harvard Univ.

Experiment

Location: Newton, MA
Subjects: 282 professionals, technical
         & managerial workers.
Result: \( N = 54 \) - \# individuals (out of 282) who found jobs through personal contacts.

- Strong ties (16.6%)
- Weak ties (88.4%)
- Occasional contacts (55.6%)
- Rare contacts (27.8%)

In a social network, let \( f_1 \) and \( f_2 \) be two close friends of yours.

- They are connected by strong ties to you.
- Then, it is likely that \( f_1 \) and \( f_2 \) are at least acquaintances and are connected to each other by weak ties.

\[
\Pr \left[ (v, w) \in E \mid (u, v) \in E_s \land (u, w) \in E_s \right] > \Pr \left[ (v, w) \in E \right]
\]
Augmented Graph

Def: Consider an "augmented" undirected graph

\[ G = (V, E, E_5) \]

in which \( E_5 \subseteq E \subseteq V \times V \)

\( E \): The edges/ties.

\( E_5 \): The strong ties \( \Rightarrow E \setminus E_5 \): The weak ties.

\( \Rightarrow (u, v) \in E \Rightarrow u \text{ and } v \text{ are friends} \)

(acquaintances + close friends)

\( (u, v) \in E_5 \Rightarrow u \text{ and } v \text{ are close friends.} \)

The Strong Triadic Closure Property (STC)

If \( (u, v) \in E_5 \) and \( (u, w) \in E_5 \)

then \( (v, w) \in E \) a.s.

\[ \Pr [(v, w) \in E | (u, v) \in E_5 \land (u, w) \in E_5] \]

\[ \rightarrow \Pr [(v, w) \in E] \]

Probability Raising in Social Network

Homophily vs Social Influence.
(I) \[ \Pr \left[ (u, \omega) \in E \land (u, v) \in E_s \mid (u, \omega) \in E_s \right] \Rightarrow \Pr \left[ v \in E \land (u, v) \in E_s \mid (u, \omega) \in E \setminus E_s \right] \]

\[ \Pr \left[ v \in E \land (u, v) \in E_s \right] \]

Corollary of STC

(II) Consider a new relation \( R \)

\[ \xi (u, v) \in R^2 = \text{event } u \text{ obtained a job through a "recommend" } v. \]

\( u \) recommend \( u \) to \( v; \)
\( v \) verified \( u \) independently;
\( v \) determined whether \( u \) is a suitable candidate.

Strong Recommendation \( \Rightarrow (v, w) \in E_s \)
Weak Verification \( \Rightarrow (u, w) \notin E \)
\[
\Pr[(u,v) \in R \mid (u,v) \in E_s] \\
\approx \Pr \left[ (u,w) \in E \land (v,w) \in E_s \mid (u,v) \in E_s \right] \\
\leq \Pr \left[ (u,w) \in E \land (v,w) \in E_5 \mid (u,v) \in E \setminus E_s \right] \\
= \Pr \left[ (u,v) \in R \mid (u,v) \in E \setminus E_5 \right]
\]

\text{u: Applicant} \quad \text{r: Recommender} \\
\text{w: verifier.}

\text{Strong Ties} \\
(u,v) \in E_5 \land (v,w) \in E_s \\
\Rightarrow (u,w) \in E

w knows about u and can use information in addition to what's provided in v's recommendation.

\text{Weak Ties} \\
(u,v) \in E \setminus E_5 \land (v,w) \in E_s \\
\Rightarrow (u,w) \not\in E

w will go by v's recommendation only.