SOCIAL NETWORKS

FEBRUARY 24 2015

LECTURE #3

STRONG TRIADIC CLOSURE.

- 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 they (f_1 and f_2) belong to a k-clan (for small k) with high prob.
  - ⇒ Then, it is likely that f_1 and f_2 are acquaintances and are connected to each other by weak ties.

[At least your social network may recommend that f_1 and f_2 explore connecting with each other.]

$$\Pr\left[(v,w) \in E \mid (u,v) \in E_s \wedge (u,w) \in E_s \right] > \Pr\left[(v,w) \in E \right].$$

NOTE BOOK

TRIADIC CLOSURE PROPERTIES

- If f_1 and f_2 have a large subgroup of common friends (which include you)
  ⇒ Then it is ~~possible~~ probable that they are acquaintances.
  ⇒ The probability montonically increases with the size of the set of mutual friends.

- In a connected social network, we expect to see lots of K_3's (Cliques of size 3).

Empirical Results.

"Strength of Weak Ties" (1973)

Mark 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."

WHY?

NOTE BOOK

◇ Granovetter's PhD dissertation:
(Dept of Social Relation, Harvard Univ.)

"Getting a Job"

Experiment:

Location: Newton, MA.

Subjects: 282 professinal, technical & managerial workers.

Result: N = 54 = # individuals (out of 282) who found jobs through personal contacts.

- Strong Ties (16.6%)
- Weak Ties (83.4%)
  - Occasional Contacts (55.6%)
  - Rare Contacts (27.8%)

AUGMENTED GRAPH

Def^n: Consider an "augmented" graph (undir.)

$$G = (V, E, E_s)$$

in which

$$E_s \subseteq E \subseteq V \times V.$$

E: The edges/ties.
E_s: The strong ties.
$\Big\}$ $E \setminus E_s$ = The weak ties.

$\Rightarrow$ $(u,v) \in E \Rightarrow u$ and v are friends
(acquaintances + close friends)

$(u,v) \in E_s \Rightarrow u$ and v are close friends.

The strong triadic closure property

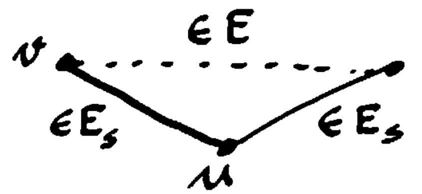
if $(u,v) \in E_s$ and $(u,w) \in E_s$
then $(v,w) \in E$ a.s.

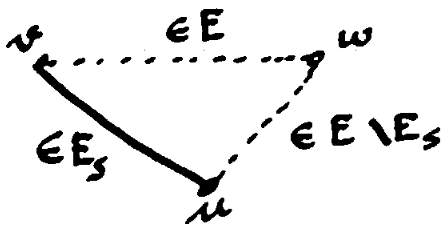
$\Leftrightarrow$ $\Pr[(v,w) \in E \mid (u,v) \in E_s \wedge (u,w) \in E_s]$
$> \Pr[(v,w) \in E]$

$\Rightarrow$ Probability Raising in Social Network.
(Influence vs Social Influence)

(I) $\Pr\left[(v,w) \in E \;\wedge\; \cancel{\Pr}\; (u,v) \in E_s \,\middle|\, (u,w) \in E_s \right]$

$$> \Pr\left[(v,w) \in E \;\wedge\; (u,v) \in E_s \,\middle|\, (u,w) \in E \setminus E_s \right]$$

$\Pr$ []

$>$ $\Pr$ []

(II) Consider a new relation R

$\{(u, v) \in R\}$: Event u obtained a job through a "recommender" v.

[v recommended u to w;
w verified u independently;
w determined whether u is a suitable candidate.]

NOTE BOOK

$$\Pr[(u,v) \in R \mid (u,v) \in E_s]$$
$$\approx \Pr[(u,w) \notin E \wedge (v,w) \in E_s \mid (u,v) \in E_s]$$
$$< \Pr[(u,w) \notin E \wedge (v,w) \in E_s \mid (u,v) \in E \setminus E_s]$$
$$= \Pr[(u,v) \in R \mid (u,v) \in E \setminus E_s]$$

u = Applicant ; v = Recommender
w = Verifier (Employer)

Strong Ties:

$$(u,v) \in E_s \wedge (v,w) \in E_s$$
$$\Rightarrow (u,w) \in E$$

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

Weak Ties:

$$(u,v) \in E \setminus E_s \wedge (v,w) \in E_s$$
$$\Rightarrow (u,w) \notin E$$

w will go by v's recommendation only.

NOTE BOOK