Implicit Affinity Networks (IAN)

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Outline

- **Introduction**
- **Related Work**
- **Implicit Affinity Network (IAN)**
  - Building
  - Filtering
  - Social Capital
- **Implementation**
- **Experimental Results**
- **Conclusion and Future Work**

Introduction

- Individuals are complex and dynamic
  - Complex
    - No two individuals are exactly the same
  - Dynamic
    - Due to changing circumstances of life (e.g., marriage, retirement), geographical location, age, social interactions, hobbies, friends, family, etc.

Motivation

- Homophily
  - “Similarity begets friendship” - Plato
  - “Birds of a feather flock together”
- Belonging
  - Claimed by psychologists, such as Maslow, to be a basic need of humans
- Small World Phenomenon
  - People tend to be connected to each other by short chains of social acquaintances

Thesis Statement

- Although they clearly exist, affinities among individuals are not all easily identified. Yet, they offer unique opportunities to discover new social networks, strengthen ties among individuals, and provide recommendations.
- We propose the idea of Implicit Affinity Networks (IAN) to build, visualize, and track affinities among groups of individuals. IANs are simple, interactive graphical representations that users may navigate to uncover interesting patterns.
- This thesis describes a system supporting the construction of IANs and evaluates it in the context of online communities and family history.

Related Work

- Match-making “communities”
  - Examples
    - Match.com, LDSSingles.com, etc.
  - Static set of attributes to match on
- Circle of Friends communities
  - Examples
    - LinkedIn.com, Facebook.com, MySpace.com, etc.
  - Dynamic friends (explicitly linked)
  - Static set of attributes
  - Community evolution limited

More Related Work

- Network Modeling
- Social Network Analysis Methods
- Social Influence / Viral Marketing
- Social Capital
- Social Bookmarking by Tagging
- Collaboration and Communities
- Blogging / Web 2.0
- Targeted Advertising

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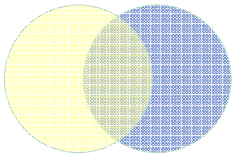
Implicit Affinity

Let a community be comprised of an

- *Arbitrary number* of individuals $\{1, \ldots, n\}$
- With an *arbitrary number* of attributes for each individual $\{1, \ldots, m_i\}$
- Having an *arbitrary number* of values for each attribute $\{1,\ldots,p_{ij}\}$

- We define an *affinity* between two individuals as the overlapping of attribute-values for any common attribute



Affinity Scoring

$$score_{A_j}(I_X, I_Y) = \frac{|\ V_j^X \bigcap V_j^Y\ |}{|\ V_j^X \bigcup V_j^Y\ |}$$

combined user weight

$$scorew_{A_j}(I_X, I_Y) = score_{A_j}(I_X, I_Y) \cdot \Delta_{A_j}^{X,Y} \cdot w_{A_j}$$

community weight

$$overall\_score(I_X, I_Y) = \frac{1}{|\ A^X \bigcap A^Y\ |} \sum_{A_j \in A^X \bigcap A^Y} scorew_{A_j}(I_X, I_Y)$$

Combined User Weight

- Specified by each user ($\delta_{A_j}^X$)

Combined User Weight

$$\Delta_{A_j}^{X,Y} = \frac{\delta_{A_j}^X + \delta_{A_j}^Y}{2}$$

- Somewhat obtrusive, however, they allow the IANs to be tailored to the user's indicated interests (e.g., identifying clusters of individuals along well-defined characteristics)

$$scorew_{A_j}(I_X, I_Y) = score_{A_j}(I_X, I_Y) \cdot \Delta_{A_j}^{X,Y} \cdot w_{A_j}$$

Community Weights

- Dynamically learned for each attribute favoring *frequently* used attributes

$$w_{A_j} = \frac{|\{I_i \in I : V_j^i \neq \varnothing\}|}{|I|}$$

- Change as the community evolves

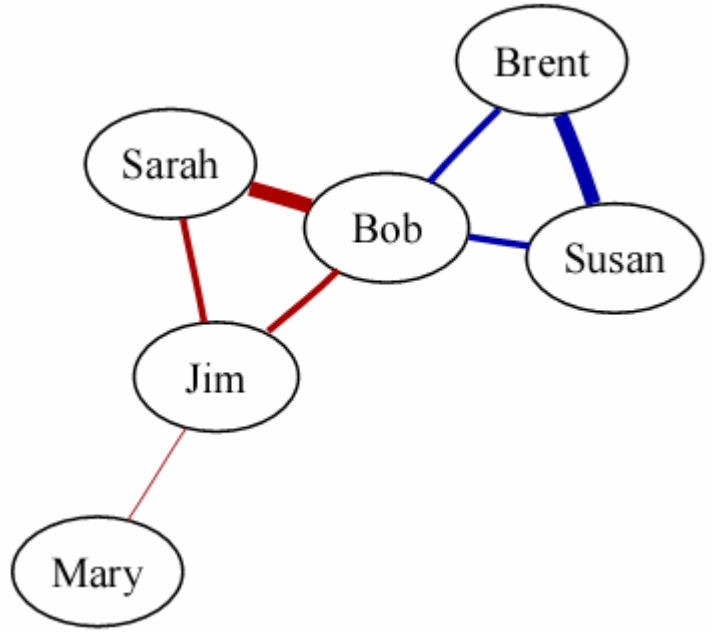
$$scorew_{A_j}(I_X, I_Y) = score_{A_j}(I_X, I_Y) \cdot \Delta_{A_j}^{X,Y} \cdot w_{A_j}$$

Affinity Network Building

Sample of Individuals and their Attributes

Individual	Attributes
Jim	A: $\{a_1, a_2, a_3\}$
Sarah	A: $\{a_1, a_2\}$
Mary	A: $\{a_3\}$
Bob	A: $\{a_1, a_2\}$ B: $\{b_1, b_2\}$
Susan	B: $\{b_1, b_2, b_3\}$
Brent	B: $\{b_1, b_2, b_3\}$

Sarah										
1	0	Bob								
$\frac{2}{3}$	0	$\frac{2}{3}$	0	Jim						
0	0	0	0	$\frac{1}{3}$	0	Mary				
0	0	$\frac{2}{3}$	$\frac{2}{3}$	0	0	0	0	Susan		
0	0	$\frac{2}{3}$	$\frac{2}{3}$	0	0	0	0	0	1	Brent
A	B	A	B	A	B	A	B	A	B	

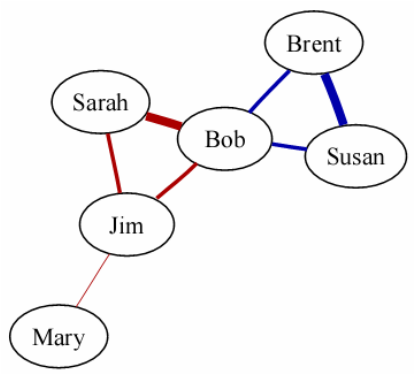


IAN

Affinity Network Filtering

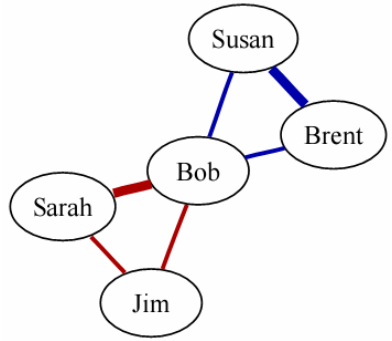
- Affinity Strength Threshold
- N-Affinities (strongest)
- User-Centralized *n*-Clique

Full Network



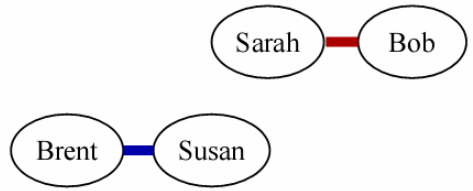
2-clique from Sarah

Threshold=0.5



2-clique from Susan

2-Affinities (strongest)



Affinity Network Social Capital

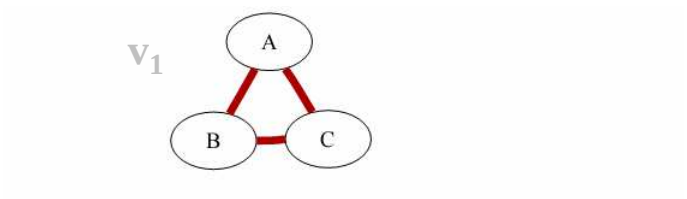
- Social Capital: The advantage available through connections between individuals within a particular network

- Bonding and Bridging Metrics

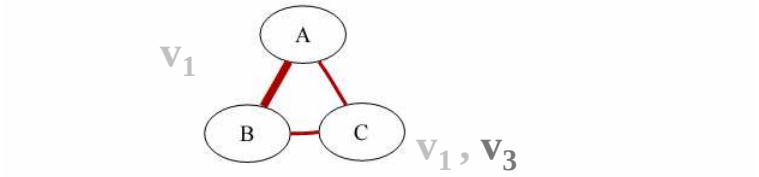
$$bonding\_strength = \frac{\sum_{I_X \in I} \sum_{I_Y \in I} overall\_score(I_X, I_Y)}{\mid I \mid \cdot \frac{(\mid I \mid -1)}{2}}$$

$$bridging\_strength = 1 - bonding\_strength$$

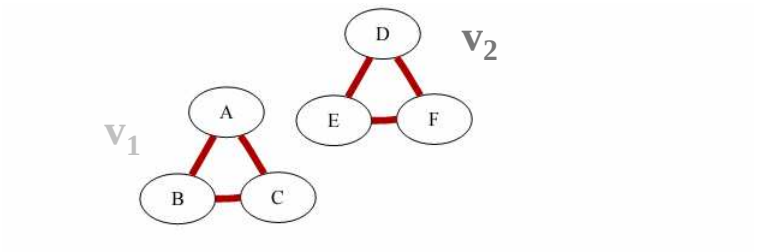
IAN Social Capital Evolution



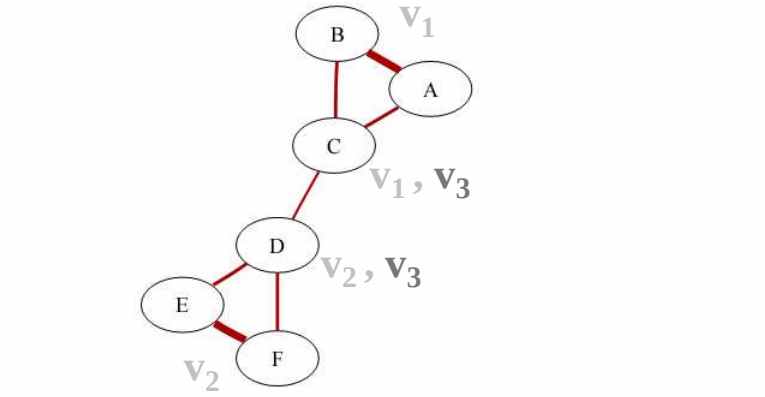
Bonding Strength: 1.00, Bridging Strength: 0.00 (t=1)



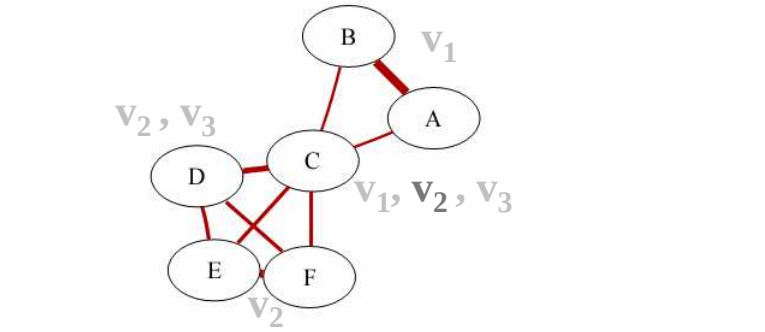
Bonding Strength: 0.67 ⇓ - Bridging Strength: 0.33 ⇑ (t=2)



Bonding Strength: 0.60 ⇓ - Bridging Strength: 0.40 ⇑ (t=3)

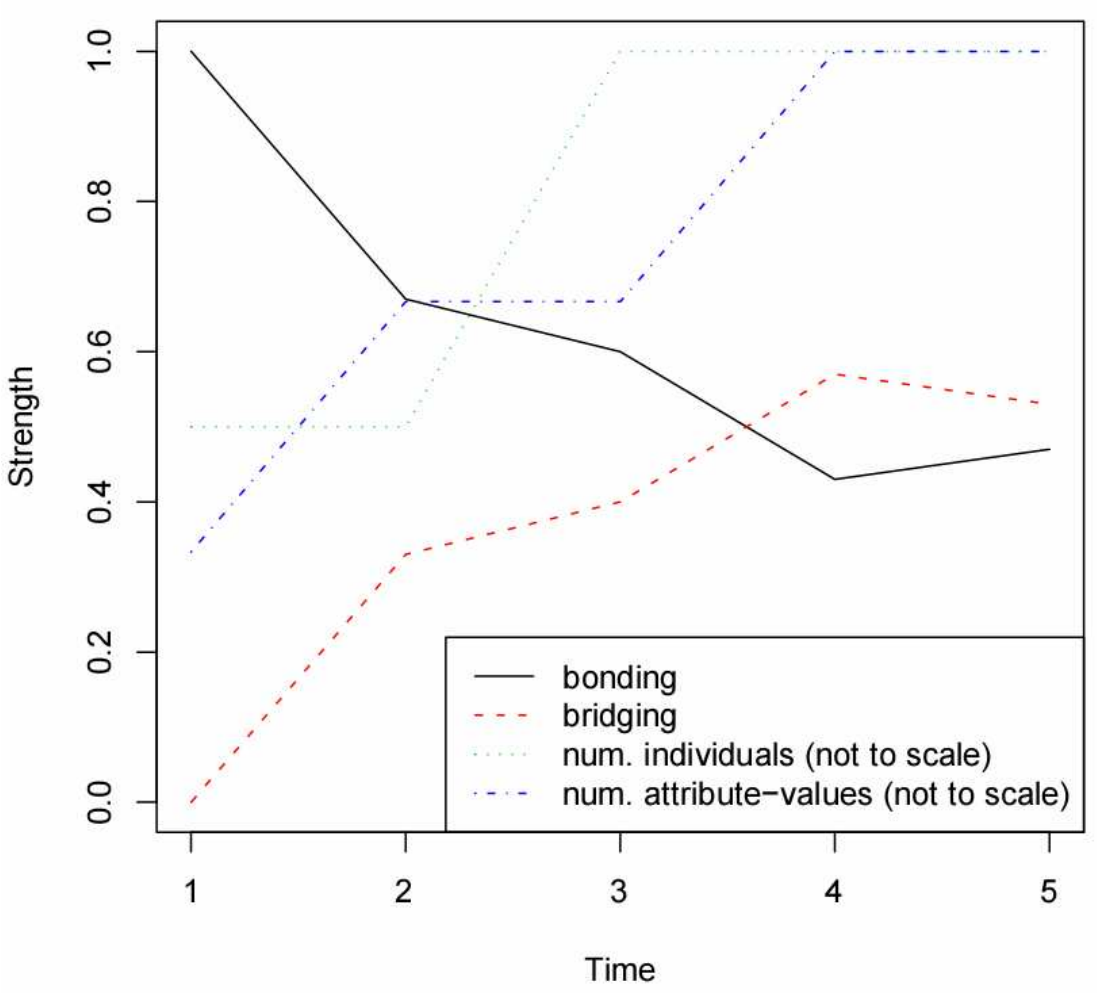


Bonding Strength: 0.43 ⇓ - Bridging Strength: 0.57 ⇑ (t=4)



Bonding Strength: 0.47 ⇑ - Bridging Strength: 0.53 ⇓ (t=5)

Network Strength Evolution



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IAN Community

- Online Community
  - Driven by members rather than managers
  - Members can describe themselves however they wish
  - Any change that a member makes affects all other members to some degree
- Online at:
  - http://dml.cs.byu.edu/IAN

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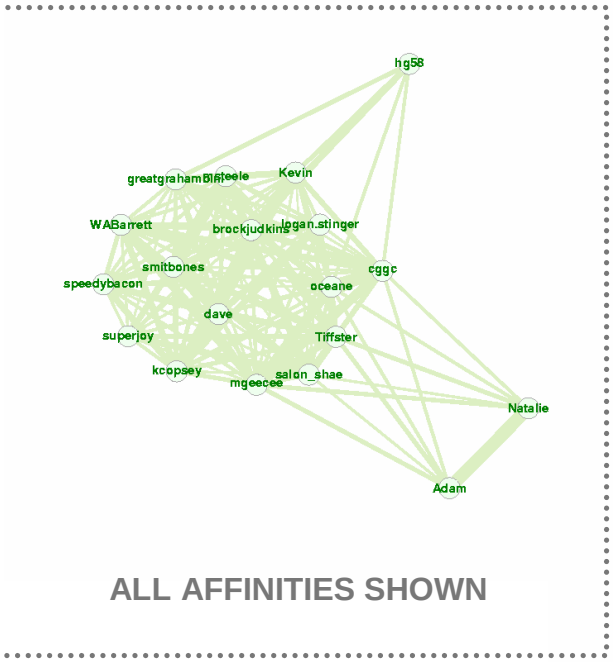
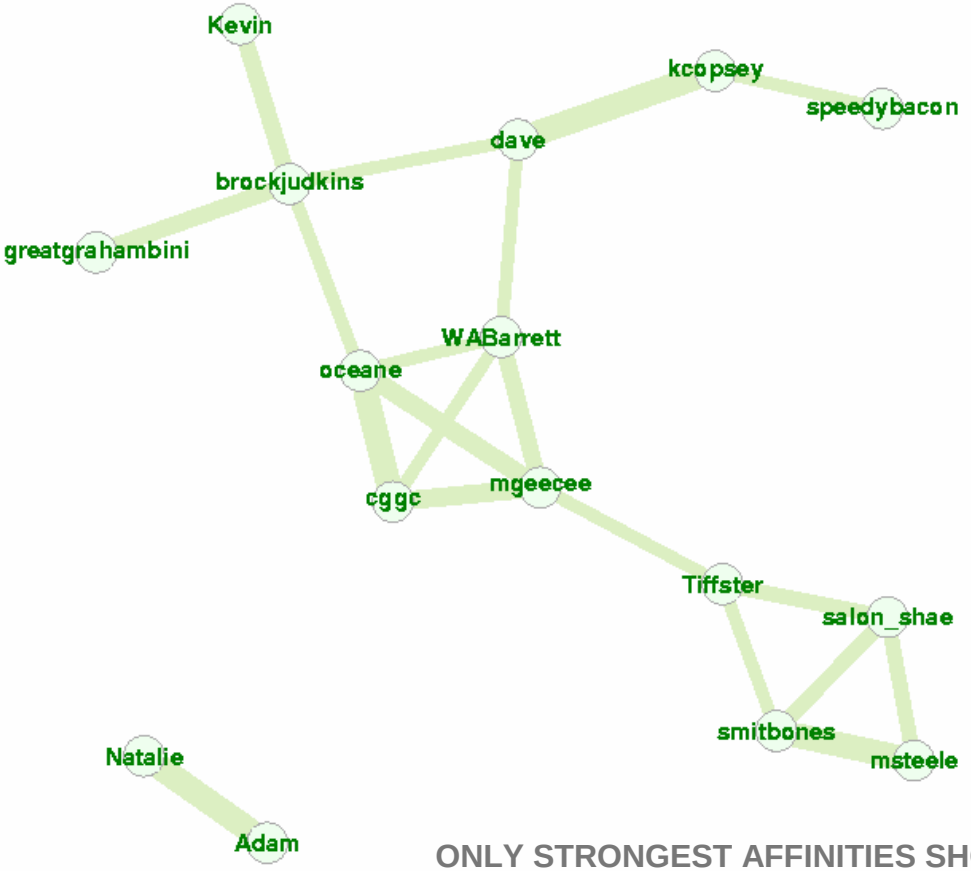
IAN Experiment

- 221 days
  - Since May 10
- 69 users participated in the experiment
- During first 183 days, on average,
  - a user was active for 39 days
  - a user visited every 8 days
  - a user added 2.38 attribute-values to their profiles per visit
  - a user had 93 attribute-values across 21 attributes

Languages Spoken



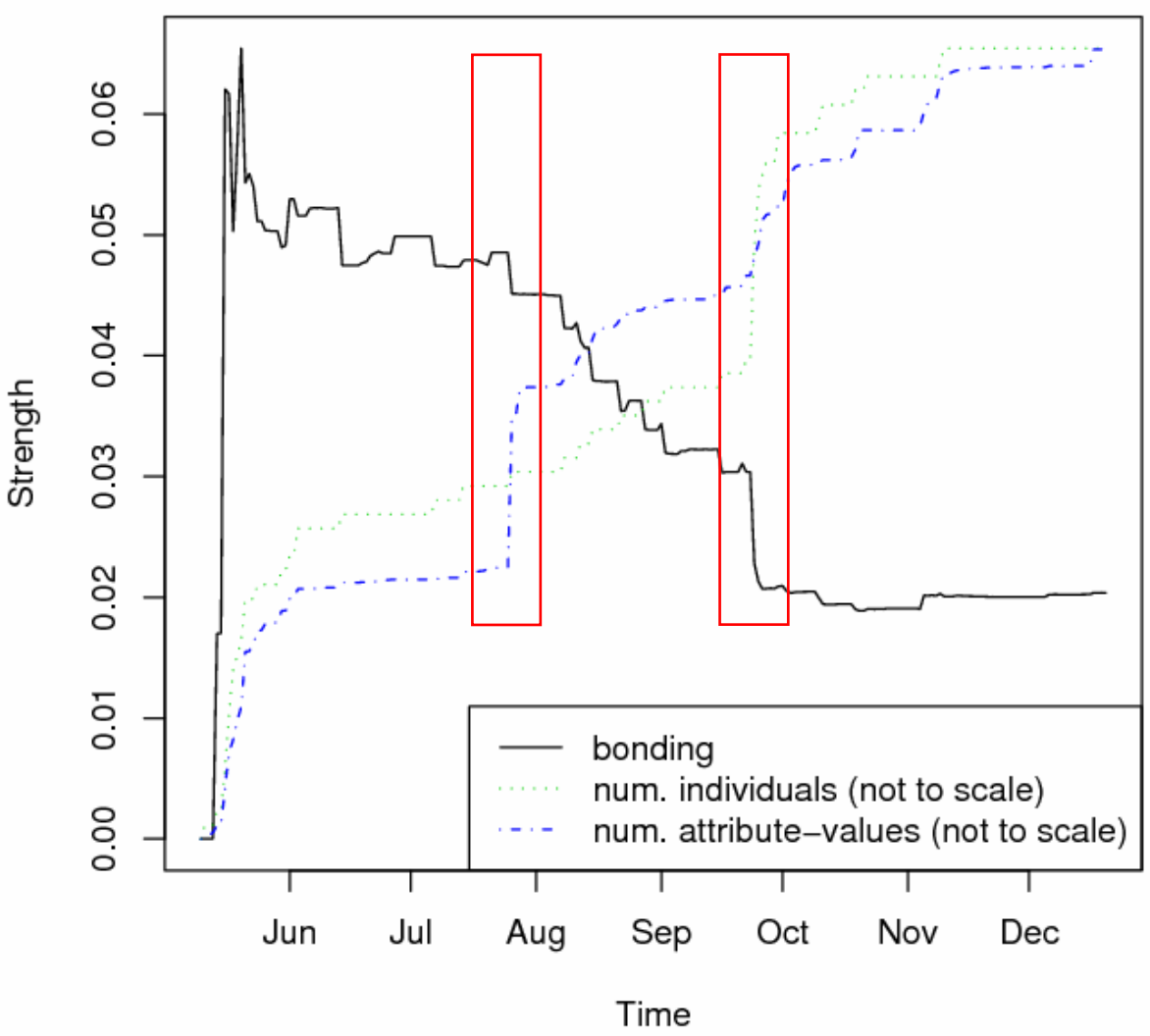
ALL AFFINITIES SHOWN



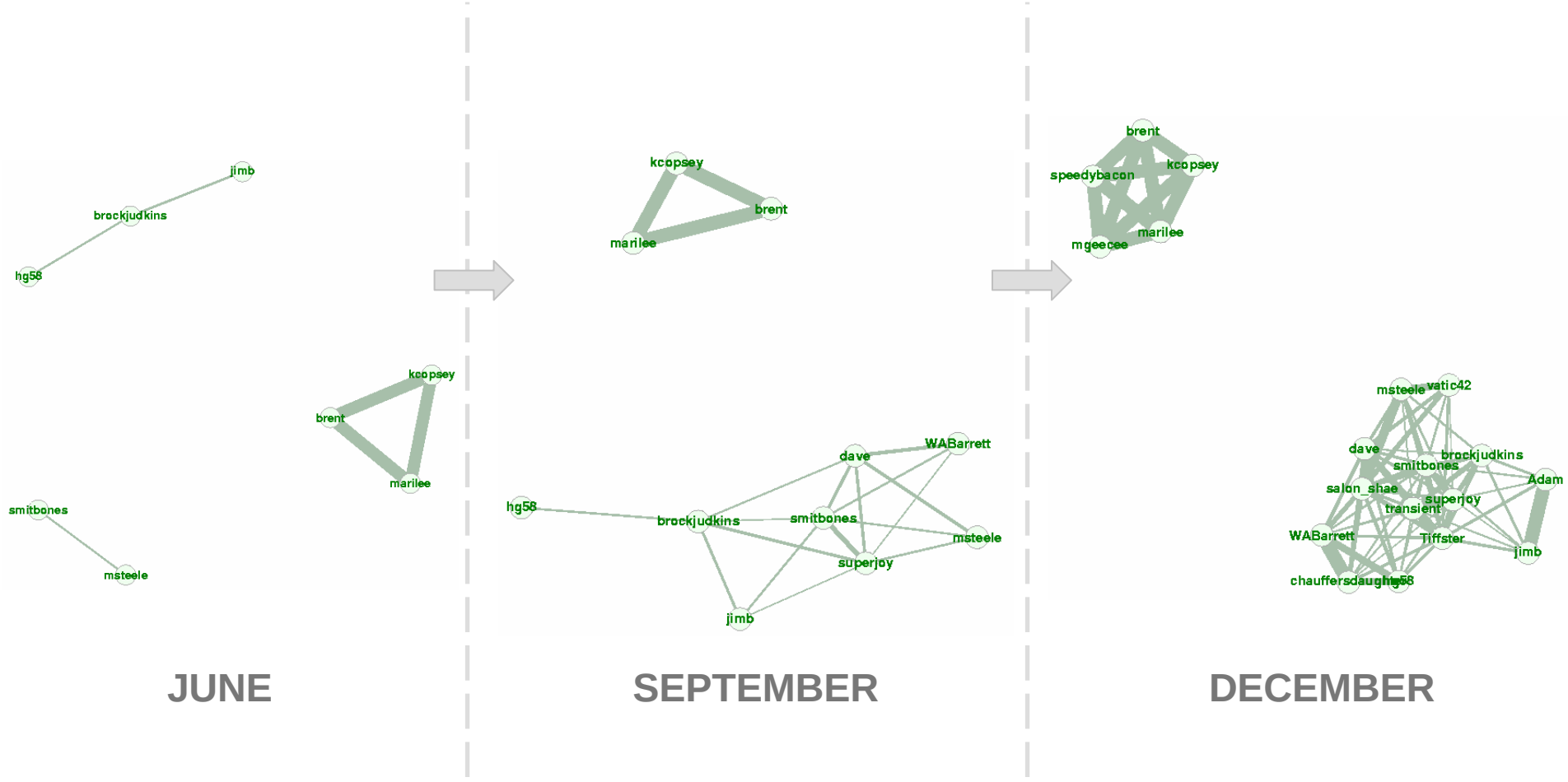
ONLY STRONGEST AFFINITIES SHOWN

(IAN Snapshots taken: December 7, 2006)

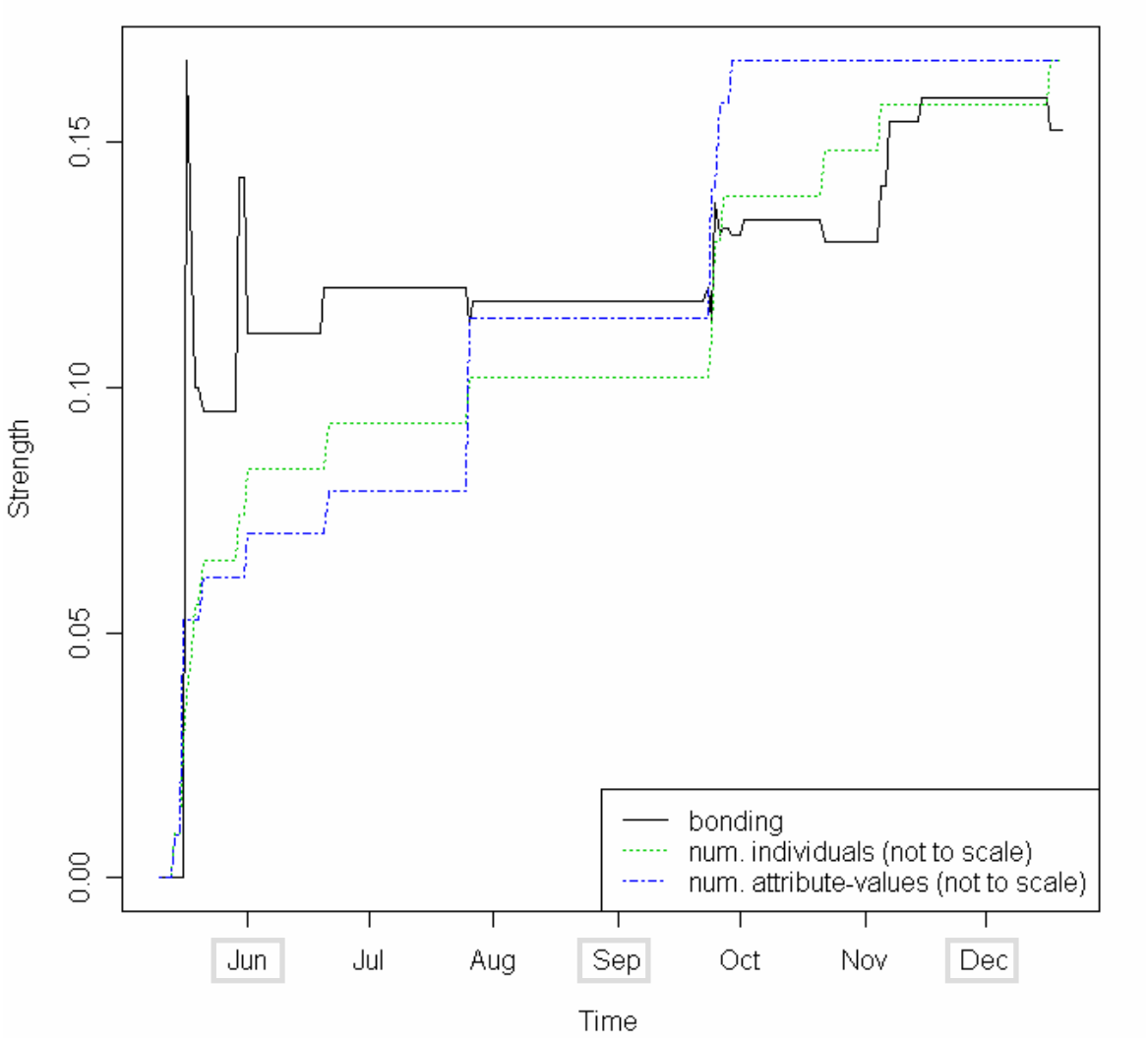
IAN Community Evolution



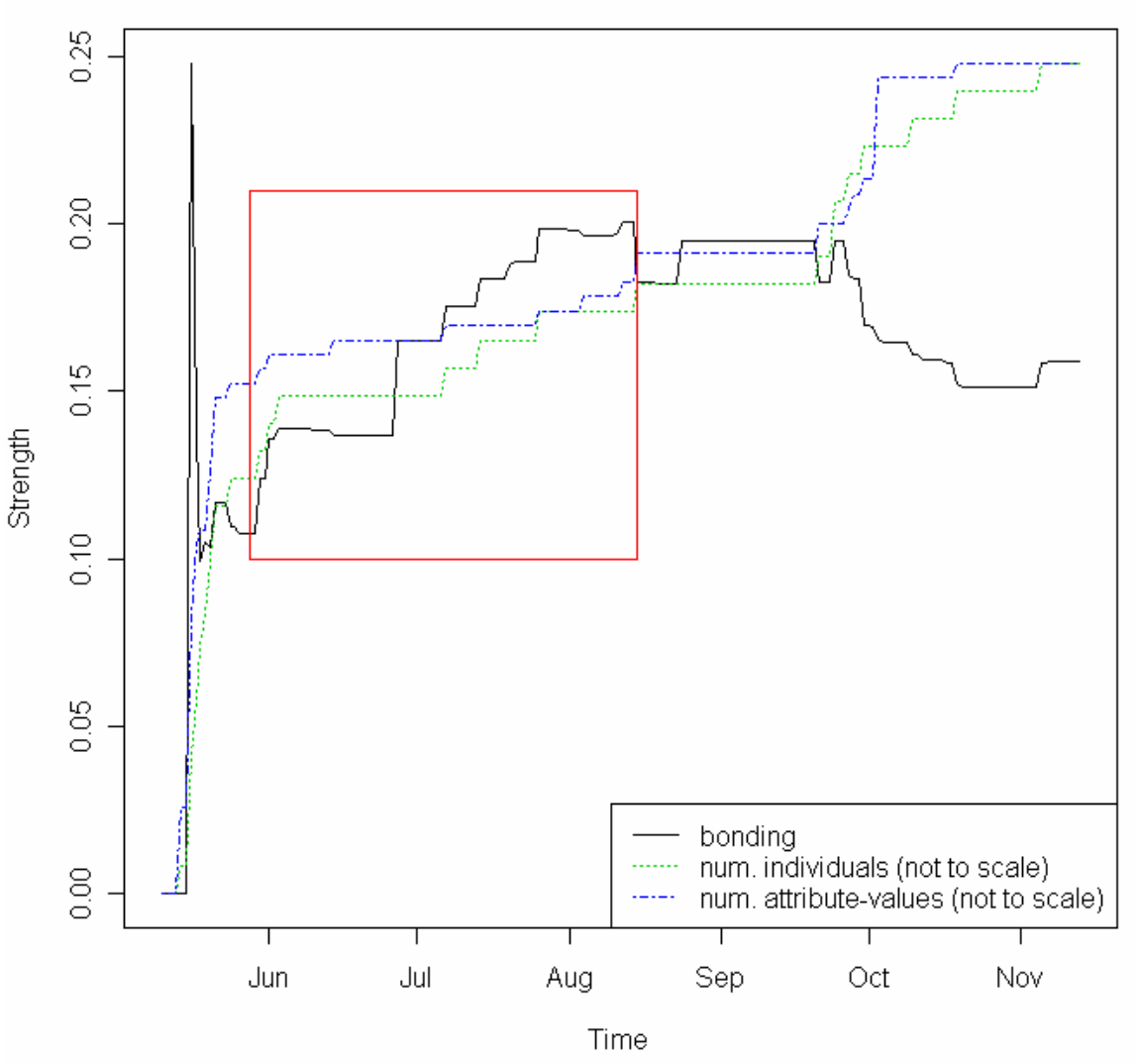
Musical Talents Evolution



Musical Talents Evolution



Food Evolution



Qualitative Assessment – Survey Snippets

Q: What did you find most interesting about IAN?

- It was great to see the different things I have in common with the community
- It was interesting to see who was most related to me, and why
- It is cool that I can add my own interests

Q: What did you find most uninteresting about IAN?

- It was sometimes arduous to sort through attributes that I cared about
- Not knowing who some of the people in the community were made the affinities less interesting

Qualitative Assessment – Survey Snippets

Q: What new discoveries did the affinity networks help to highlight?

- It was interesting to find that I actually had stronger affinities with different people than I would have expected
- I am part of a musically talentless group
- There is good, solid, English ancestral origin
- I'm surprised by the handedness affinity network. I would have thought it would have a hard split, but hasn't (most people in that sub-community are right-handed)

Q: What, if any, thoughts or suggestions do you have?

- It would be interesting to do a study with businesses to see if grouping people based on their attribute affinities correlates to productivity in the workplace
- I misspelled a word and did not see a way I could fix it
- The graphical depiction of the network was interesting to see, but I didn't understand the way the spatial relationships were plotted.
- I think this concept could be used as a social tool for networking and friendship building

Qualitative Assessment - Survey

Please choose one answer to complete the following sentence:

IAN _____

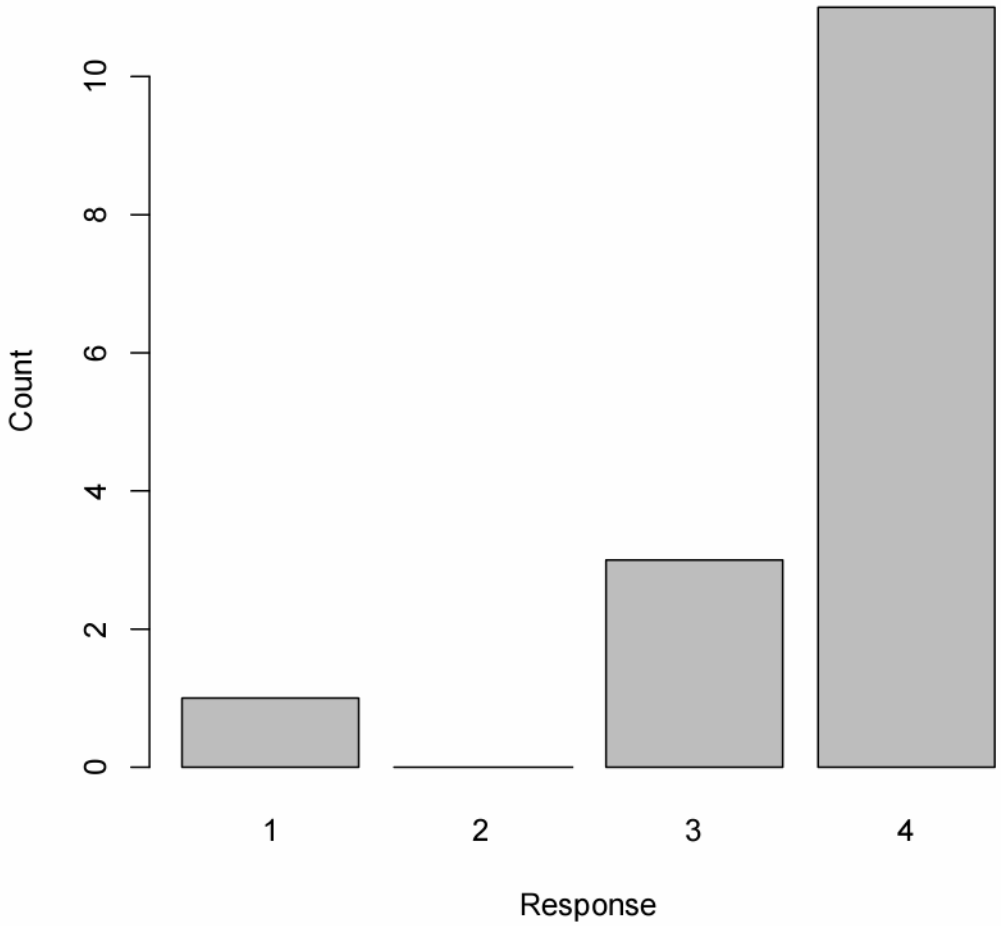
[ ] 1. did nothing for me

[ ] 2. showed me things I already knew

[ ] 3. highlighted things I suspected but was unsure about

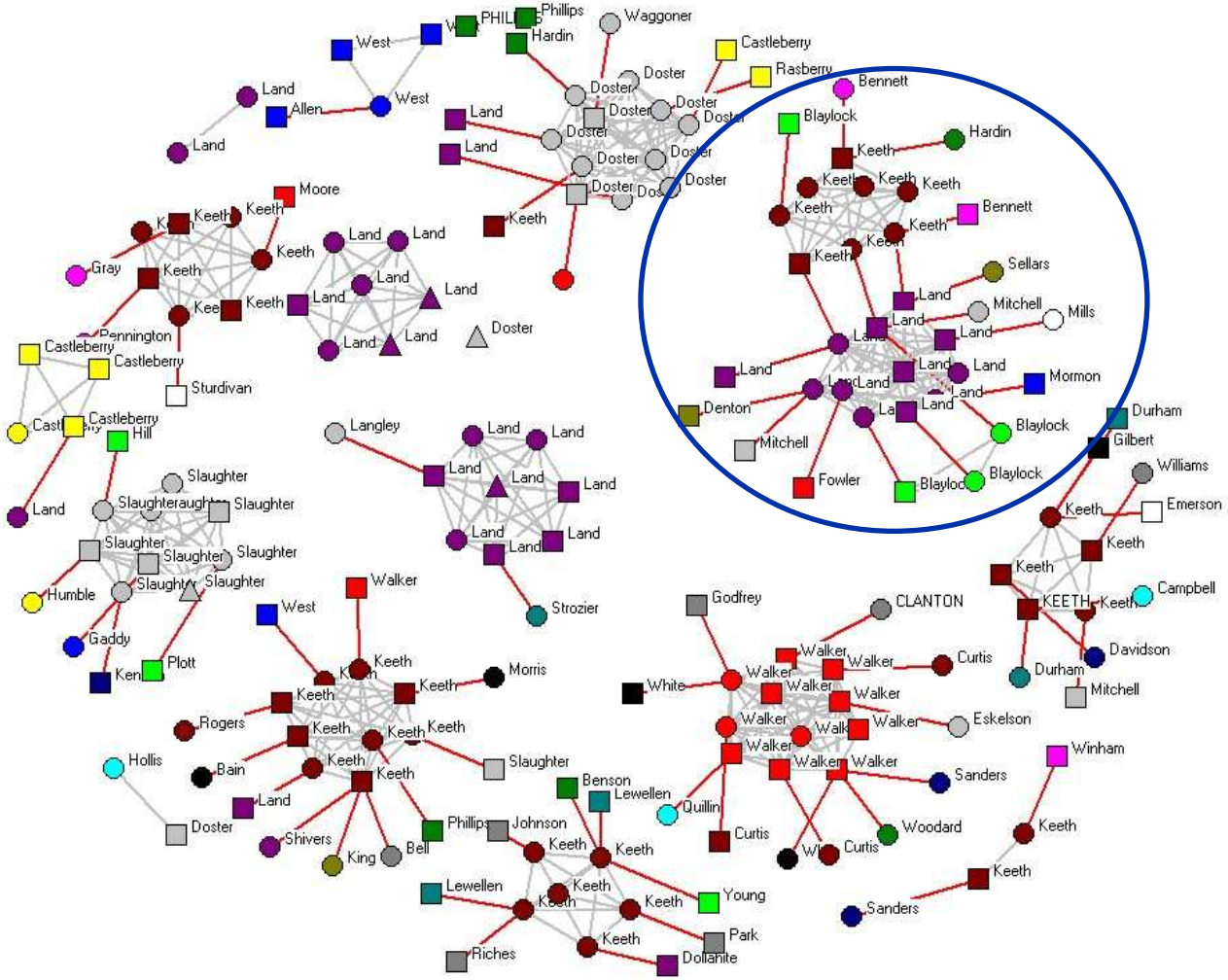
[ ] 4. helped me discover new things

~23% responded (15 of 65)



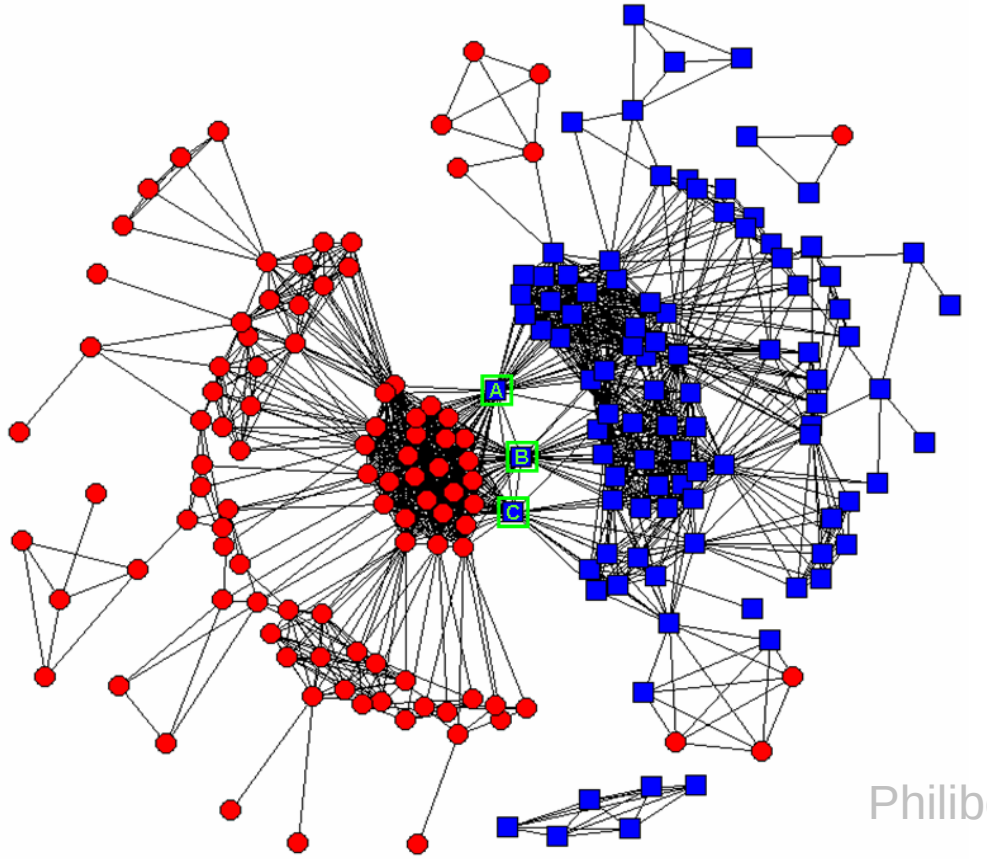
GIAN

Spouse-Sibling IAN



GIAN

Gender Naming Patterns



A Joseph Marie
B Francois Marie
C Jean Marie

Philibert

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Conclusion and Future Work

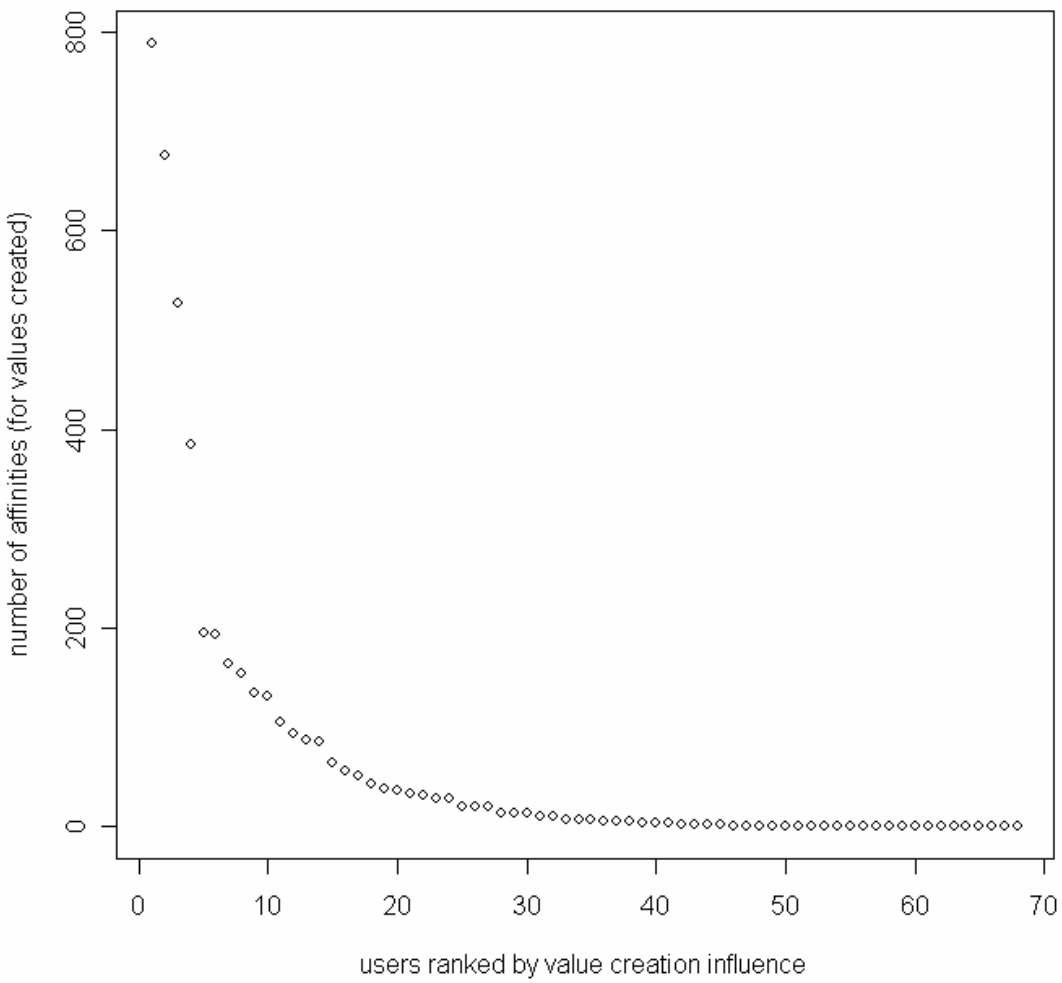
- Conclusion
  - We presented an inventive methodology of creating and using IANs for discovery
  - IANs can be used to better understand how complex entities are interconnected and how they evolve
  - We have begun to show how network strength metrics of bonding and bridging can be used to measure social capital and track community evolution
- Future Work
  - Apply IANs to more domains
    - Medical patient communities
    - Search communities
  - Extend IAN interactivity
  - Reproduce existing / create new communities

Questions?

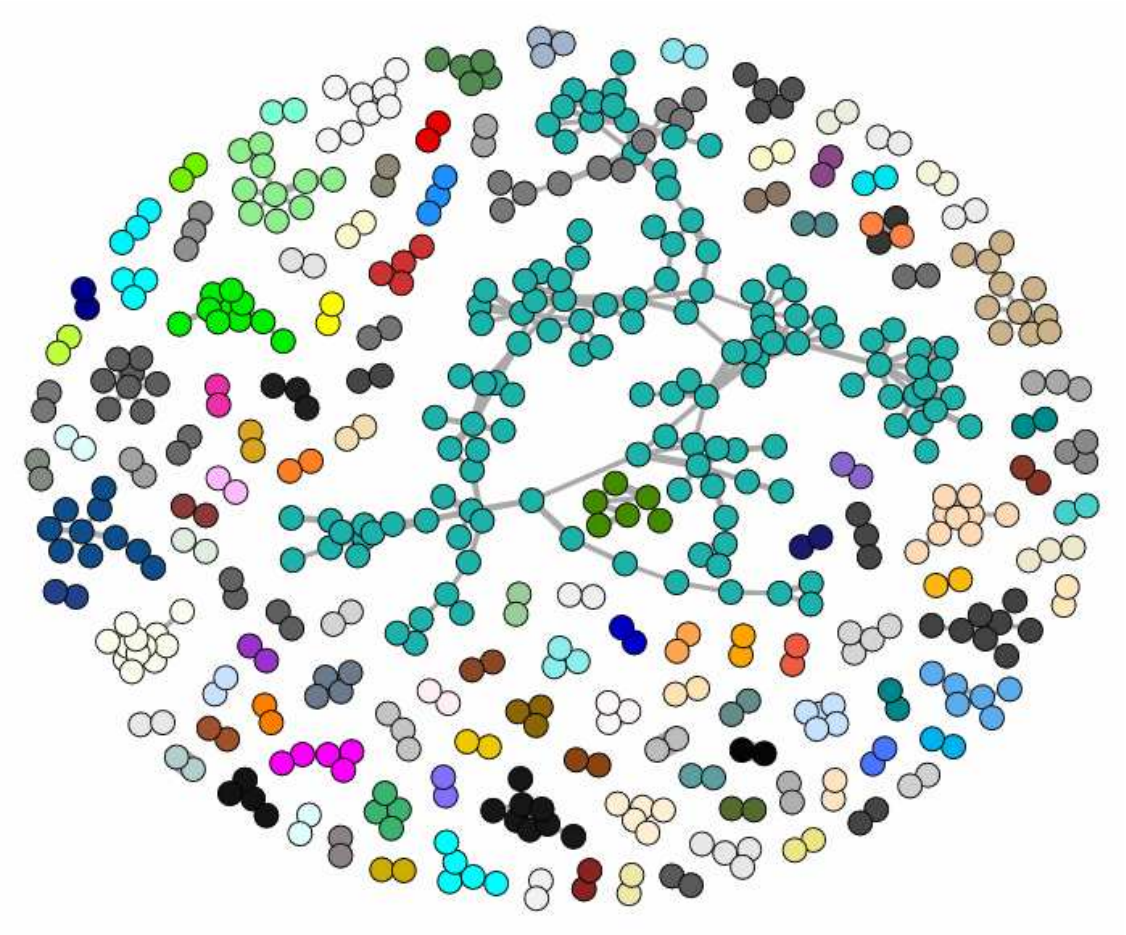
Extra Slides

- Influencers
- Search Phrase Community
- Research Interests
- Connecting Attributes
- IAN Snapshots
- GIAN Examples
- Jon Kleinberg Quote

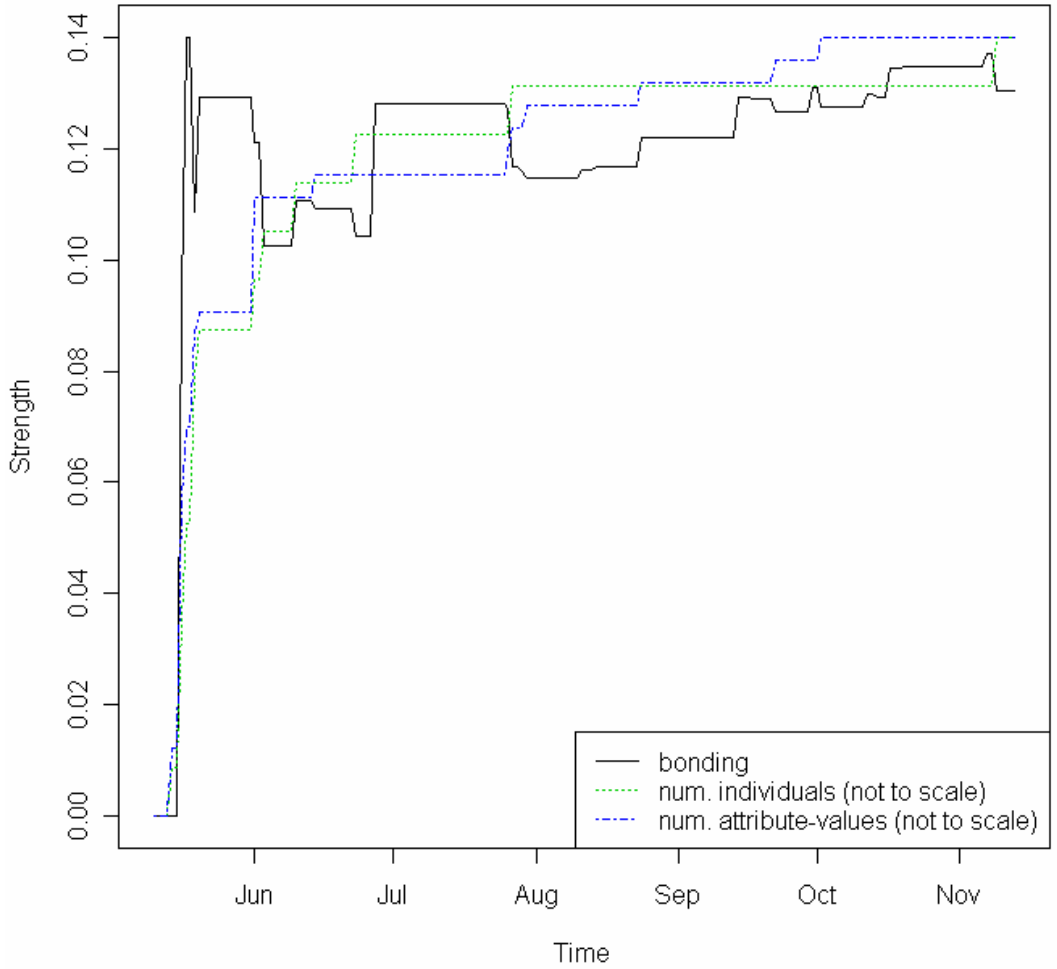
Influencers



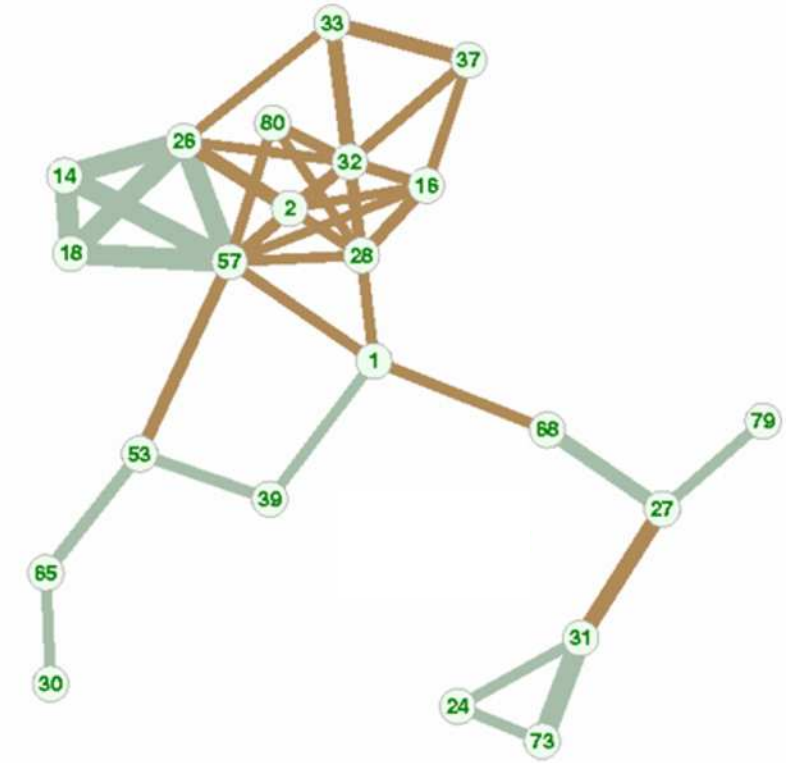
Search Phrase Community

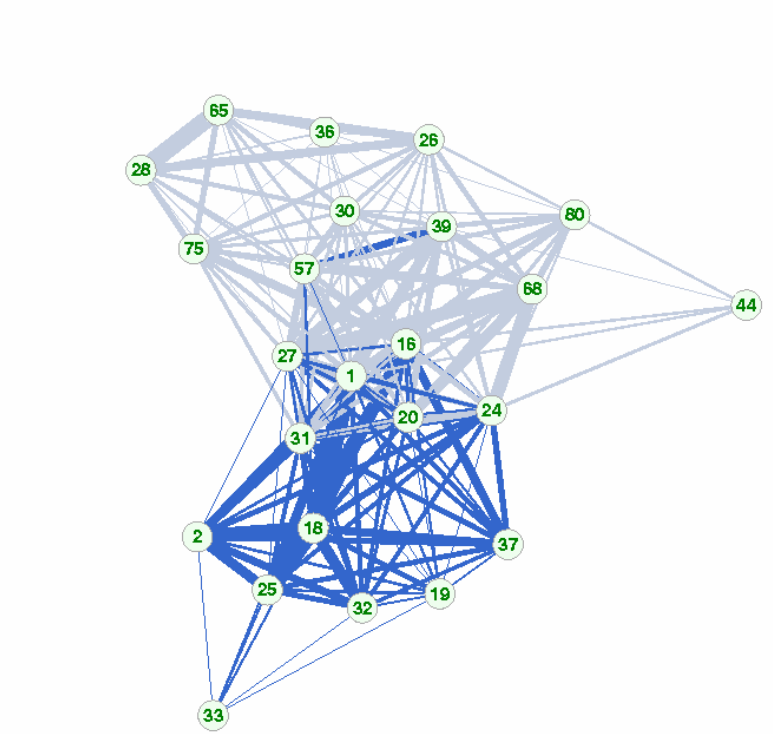


Research Interests Evolution

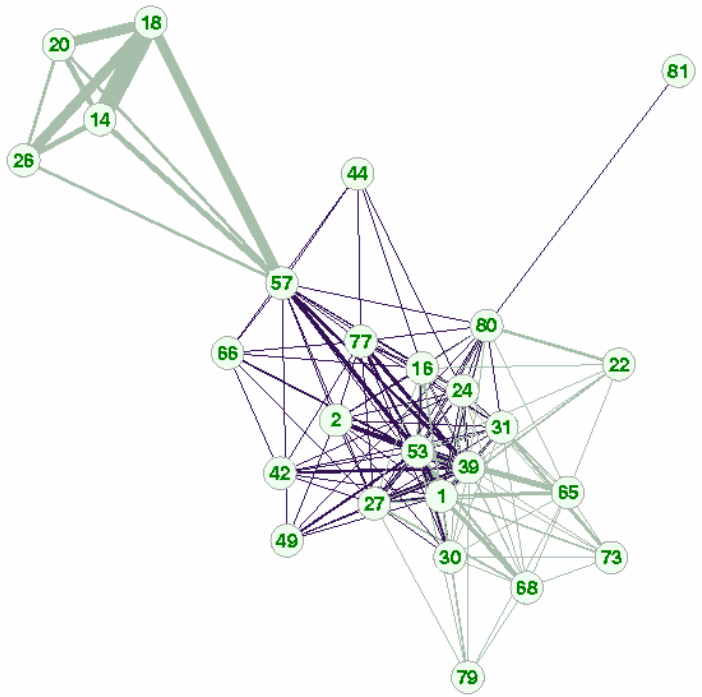


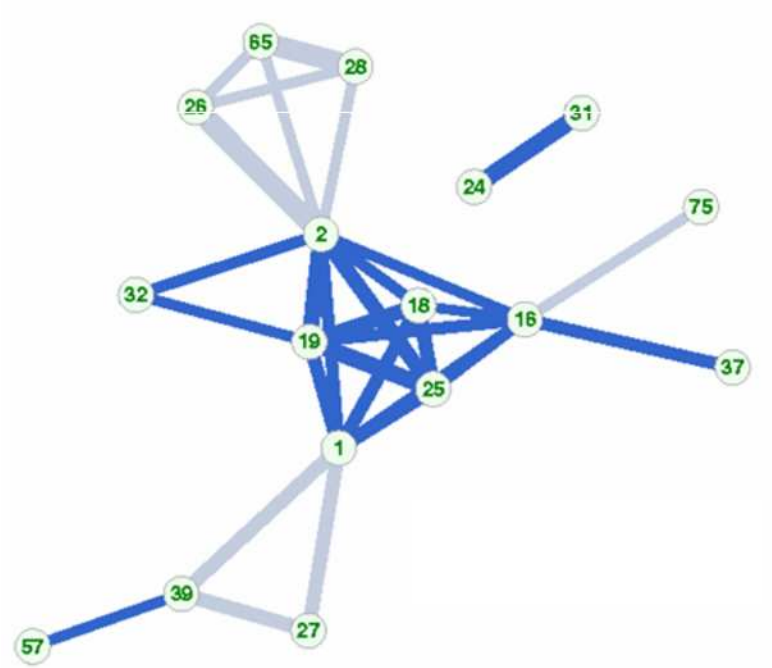
Connecting Through Attributes



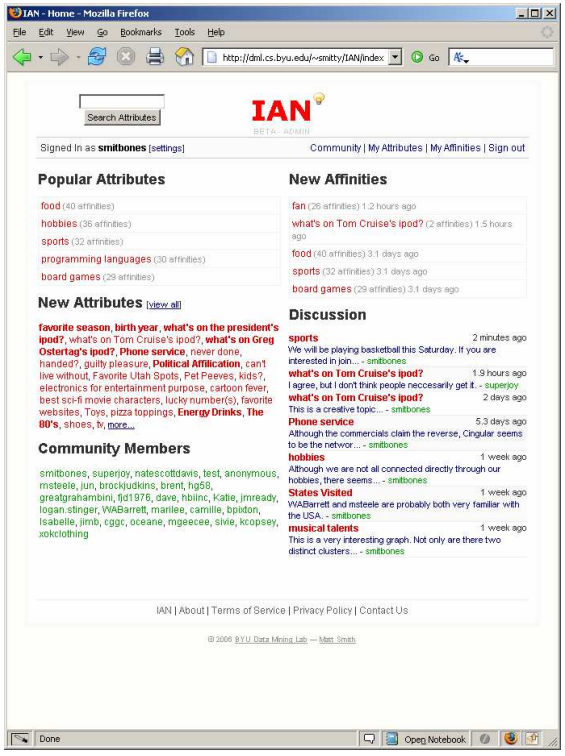


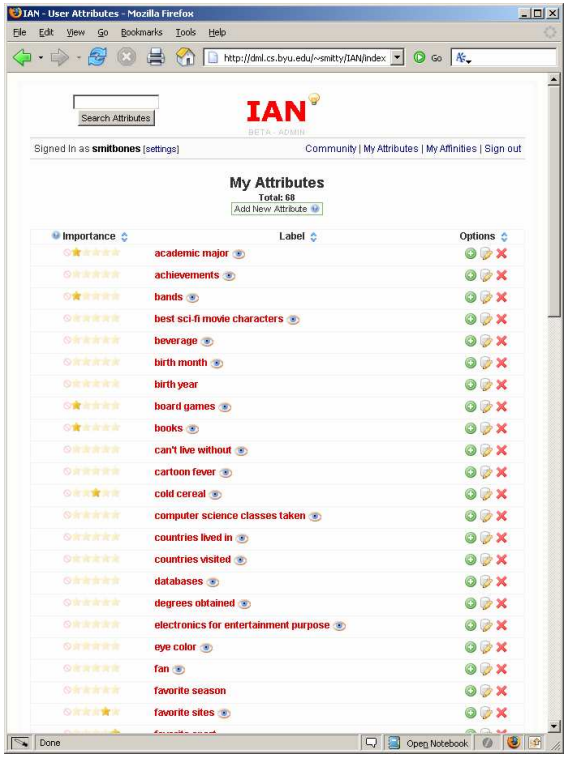
Connecting Through Attributes

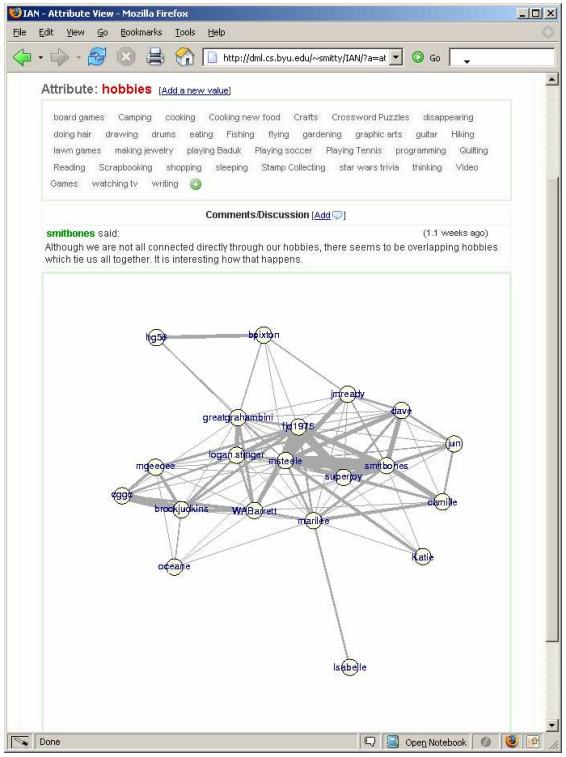




IAN Screenshots

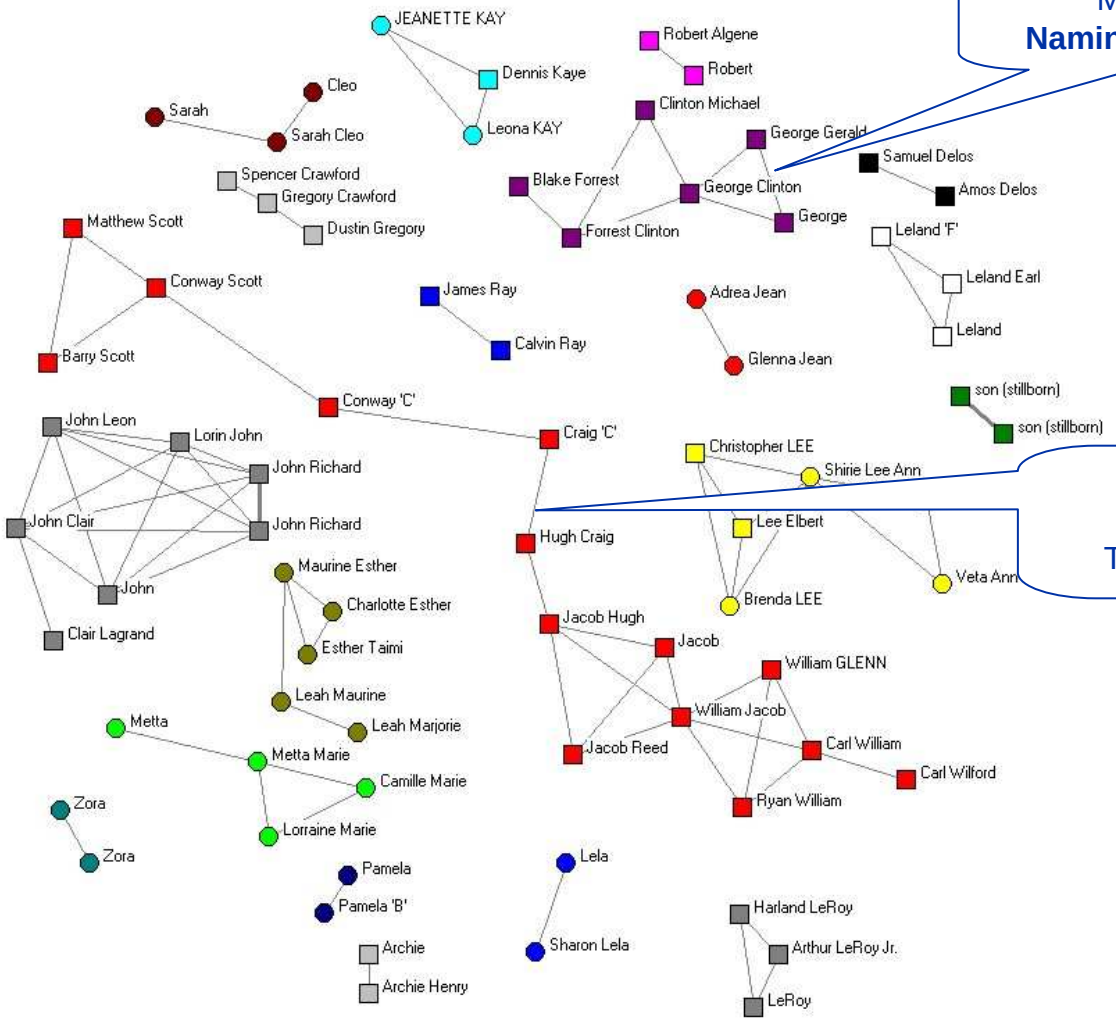






Given Name IAN

(One or more affinities --- Isolates removed)



More neat
Naming Patterns…

Interesting
Naming Pattern
Through generations

Jon Kleinberg

- In a recent article in the New York Times, renowned computer scientist Jon Kleinberg had this to say about social networking research:
  - ``We're really witnessing a revolution in measurement...This is the introduction of computing and algorithmic processes into the social sciences in a big way, and we're just at the beginning''
- We are encouraged by this trend. IANs offer a way to build and analyze social networks in a way that may be useful to sociologists.