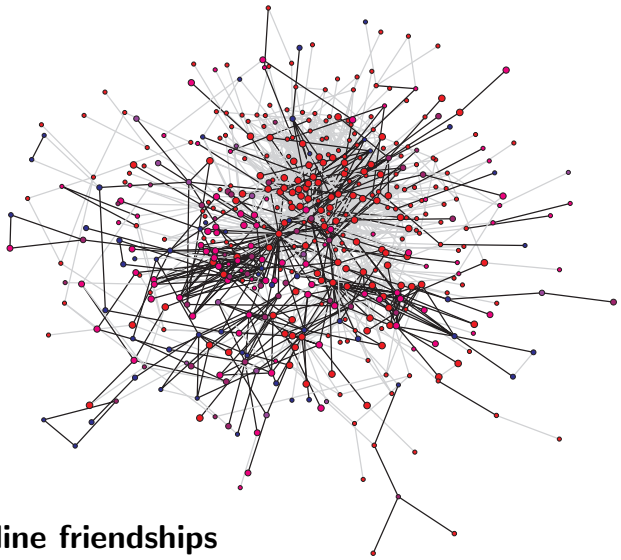
Global Information Networks

Jon Kleinberg

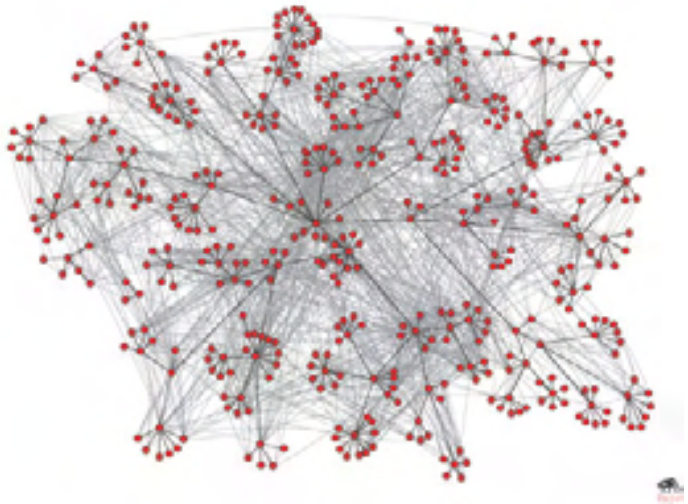
Cornell University

Crandall-Backstrom-Huttenlocher-Kleinberg (2009)

The Social Transformation of Computing



On-line friendships
(Backstrom-Huttenlocher-Kleinberg-Lan 2006)



Corporate e-mail communication
(Adamic and Adar, 2005)

Technological networks intertwined with social ones.

Profound transformation in:

- **how knowledge is produced and shared;**
- **how people interact and communicate;**
- **the scope of computer science as a discipline.**

Two Central Issues for the Foundations of Computing

(1) How do we design in this space?
Combine social models with core ideas from computing.

- **Complex networks: design, analysis, models.**
- **Algorithmic game theory: designing with incentives.**
- **Social media: reputation, recommendation, contagion**

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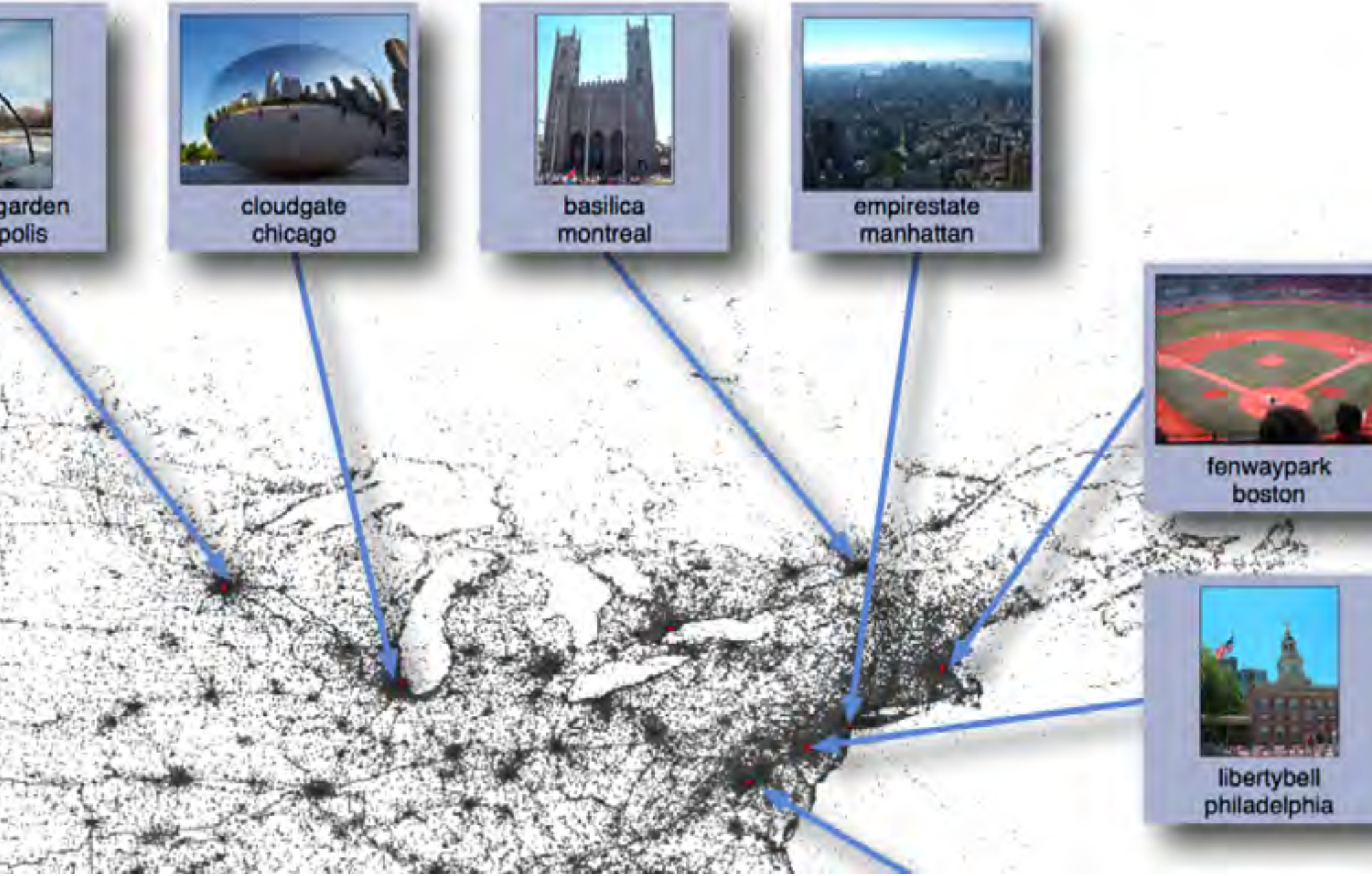
(2) Science advances the invisible becomes visible.

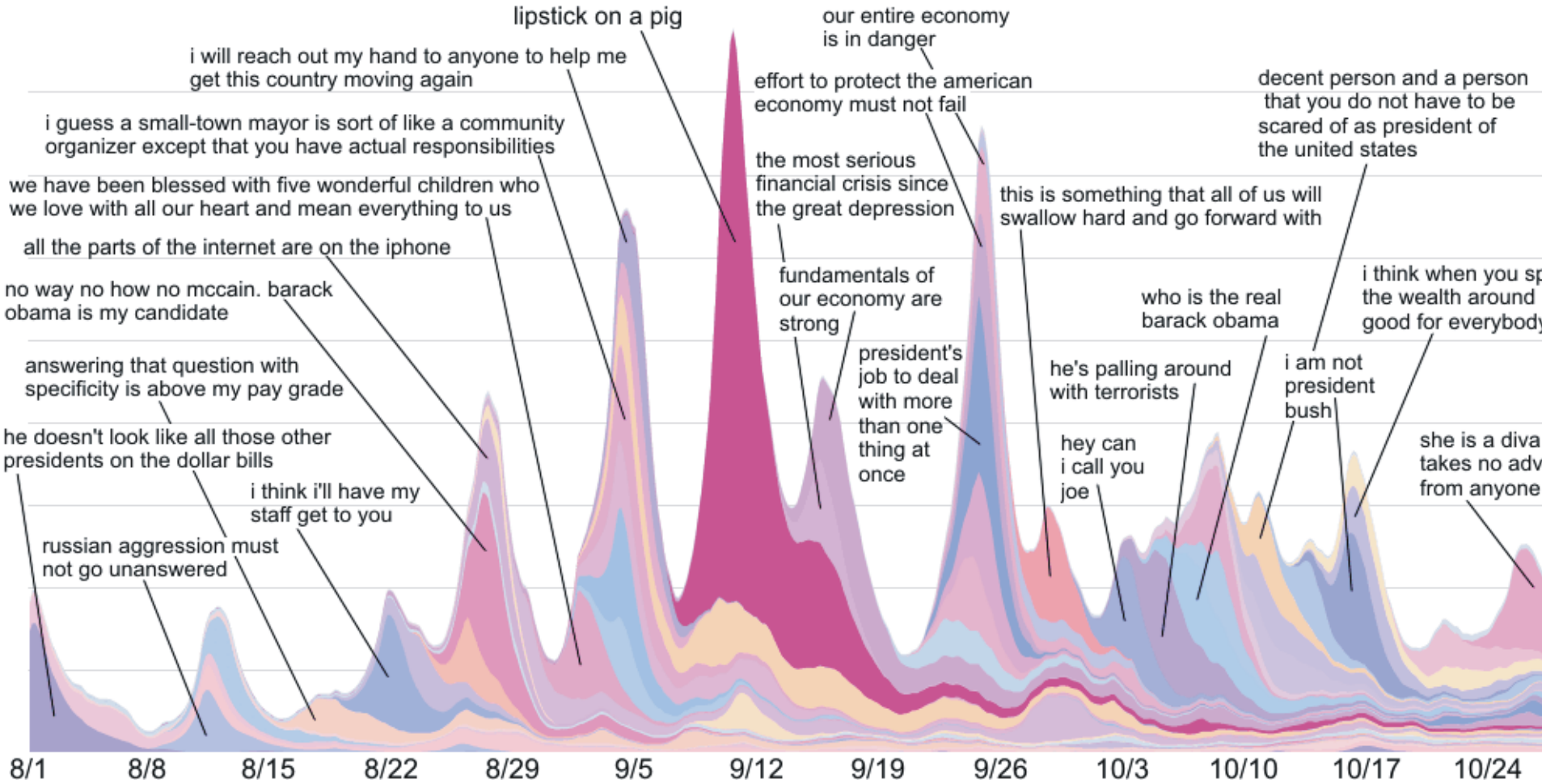
- **Can we recognize fundamental patterns of human behavior from raw digital traces?**
- **Can new computational models address long-standing social-science questions?**

North American Tourist Sites, from Raw Flickr Data

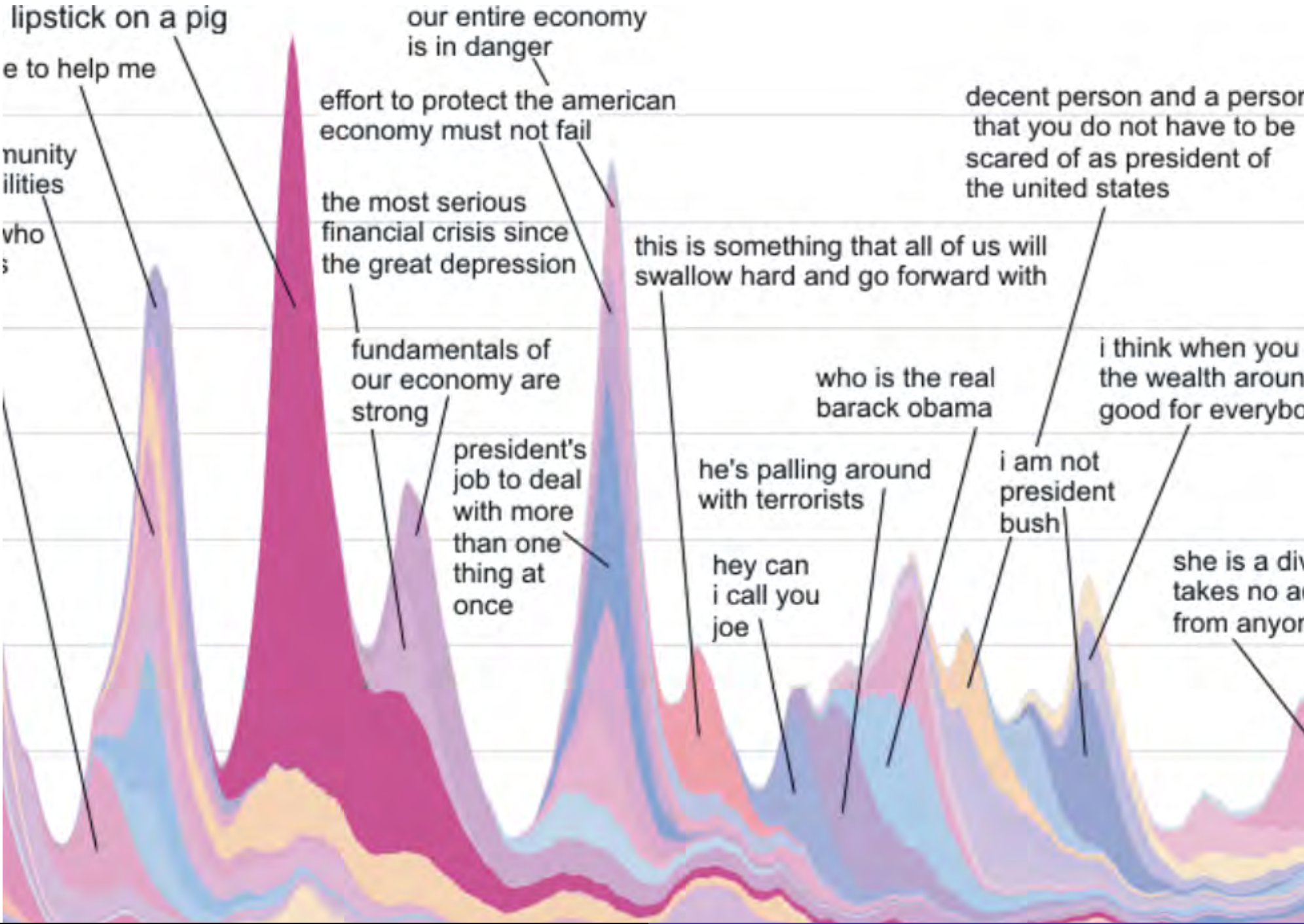
Crandall-Backstrom-Huttenlocher-Kleinberg (2009)


garden
polis
cloudgate
chicago
basilica
montreal
empirestate
manhattan
fenwaypark
boston
libertybell
philadelphia

The 24-Hour News Cycle, from Raw Blog/News Data



Leskovec-Backstrom-Kleinberg (2009)


lipstick on a pig
e to help me
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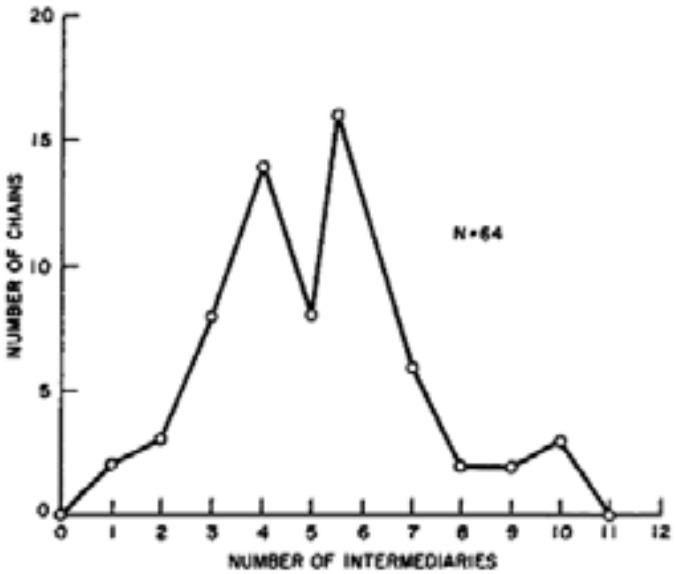
ilities
who
our entire economy
is in danger
effort to protect the american
economy must not fail
the most serious
financial crisis since
the great depression
fundamentals of
our economy are
strong
president's
job to deal
with more
than one
thing at
once
this is something that all of us will
swallow hard and go forward with
hey can
i call you
joe
who is the real
barack obama
he's palling around
with terrorists
decent person and a person
that you do not have to be
scared of as president of
the united states
i am not
president
bush
i think when you
the wealth aroun
good for everybo
she is a div
takes no a
from anyon

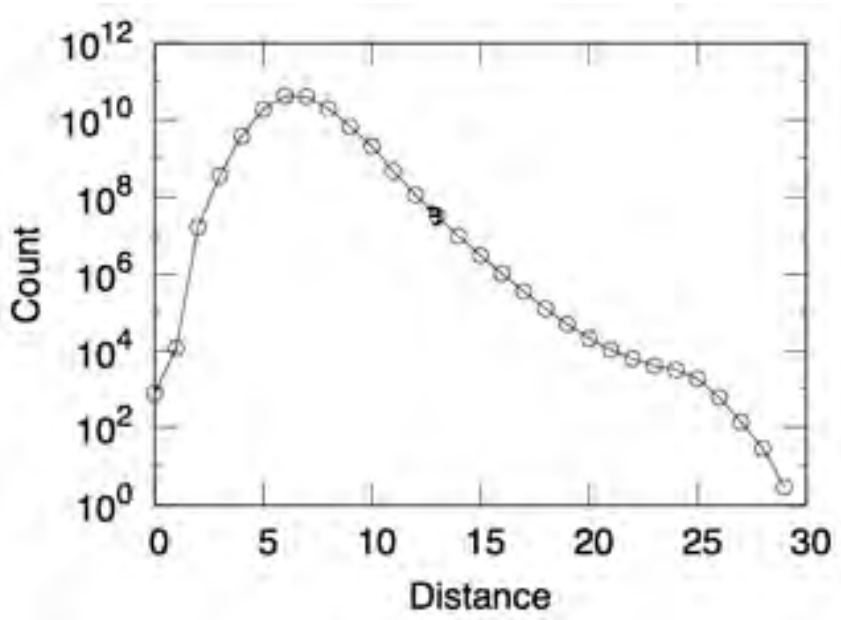
The Research Strategy in Action: Six Degrees

Milgram's small-world experiment (1967)

Choose a target in Boston, starters in Nebraska.
A letter begins at each starter, must be passed between personal acquaintances until target is reached.
Six steps on average $\longrightarrow$ six degrees of separation.

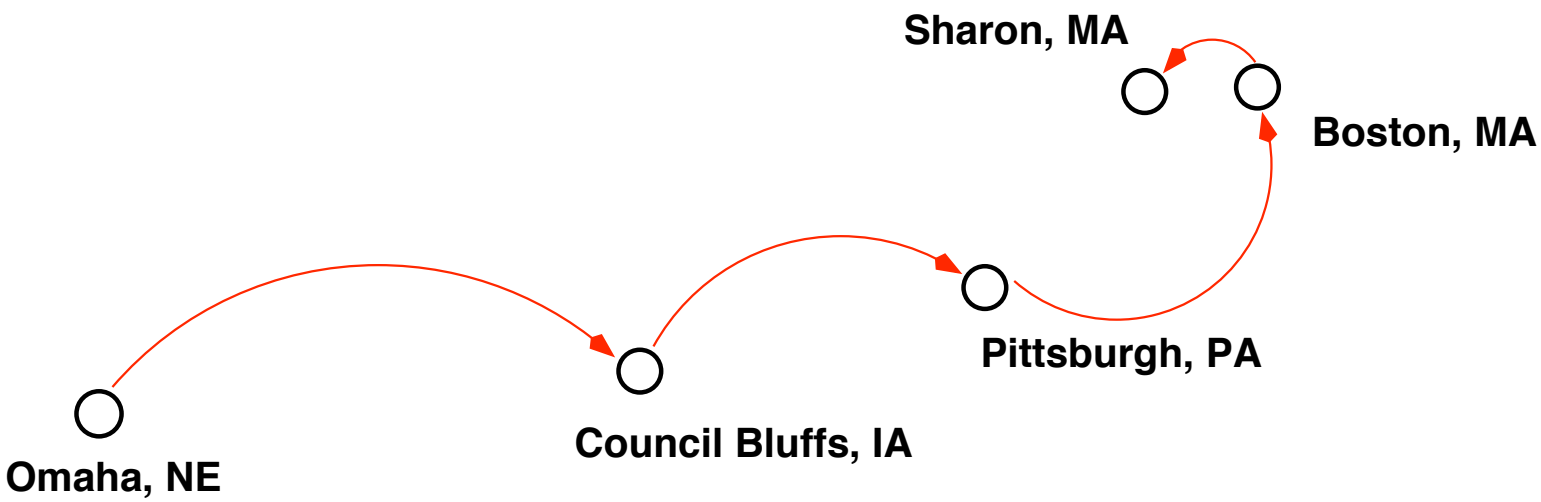


Milgram experiment (Travers-Milgram 1969)



Microsoft IM (Leskovec-Horvitz 2008)

How do people find their way through social networks?



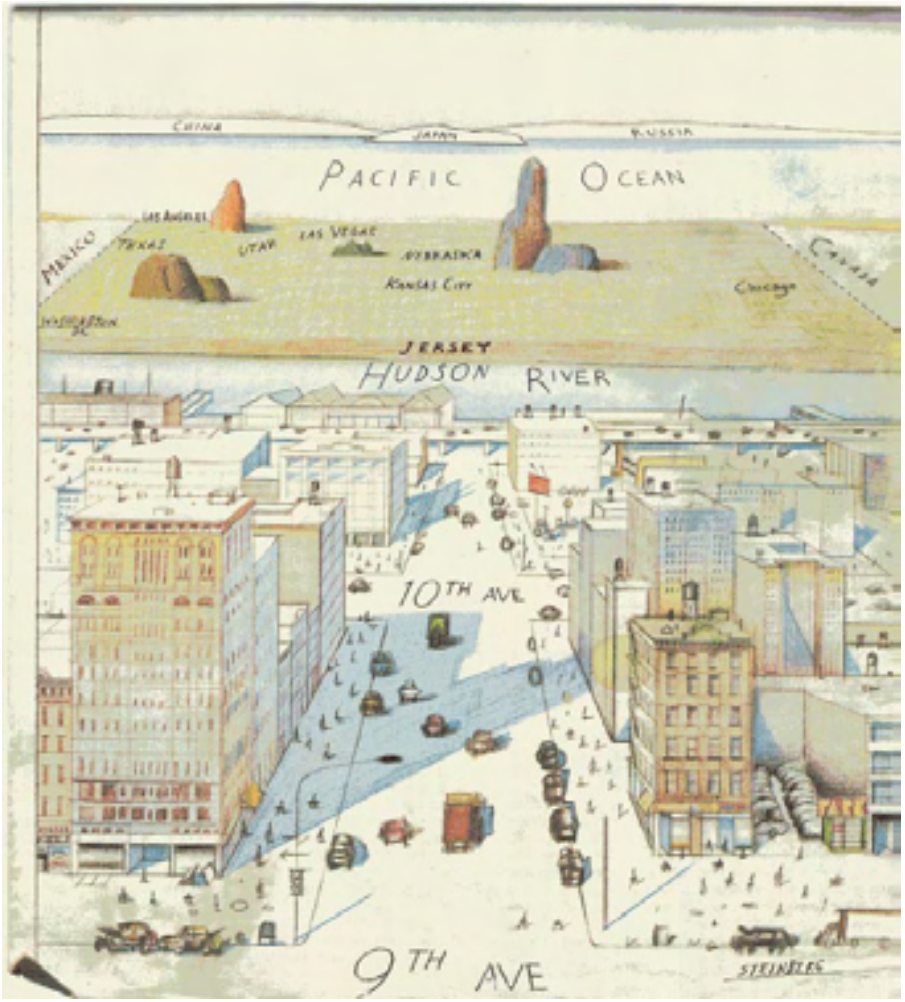
Why should pairs of strangers be able to find short chains of acquaintances linking them together?

Computational thinking as a way to pose scientific questions: A question of how people could find the chains.

What's the Right Balance of Links?

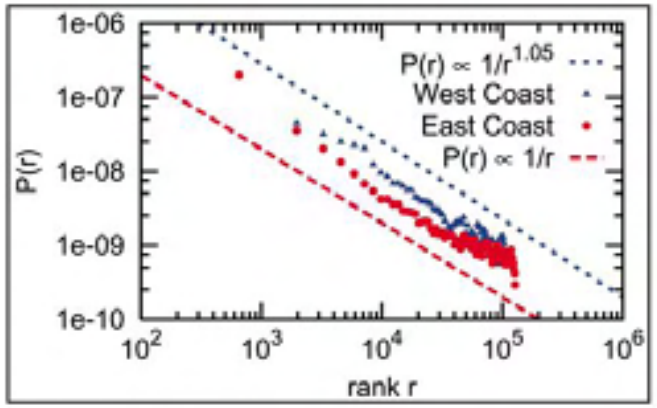
Key issue: balance of links across (physical/social) distance.

- **Need links at every "distance scale."**
- **Friends balanced across distances**
  1-10,
  10-100,
  100-1000,
  1000-10000, ...
- **Think of how USPS delivers mail; here the network organizes itself.**



Saul Steinberg, 29 March 1976

Testing the Theory on Social-Networking Data



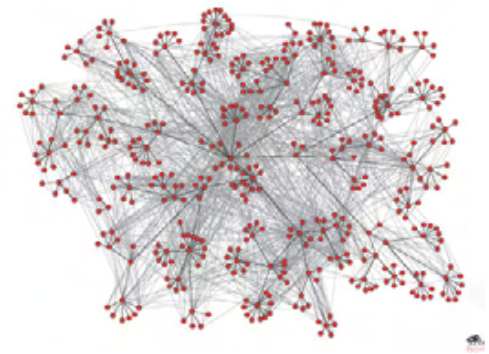
Liben-Nowell and colleagues: LiveJournal social network.

- **Roughly a million members w/Zip codes and friend links.**
- **Punchline: LiveJournal friendships closely approximate optimal spread of friendship links for search.**

Reflections

Computational ideas play two crucial roles

- **Designing systems in this new space.**
- **Modeling the social processes.**



Corporate e-mail
(Adamic and Adar, 2005)

Hard scientific questions and fundamental societal problems.

- **Why do social processes produce the outcomes they do?**
- **How do our on-line worlds affect these processes?**
- **Stockpiling of massive data: looming privacy risks; plus, software that knows your behavior better than you do.**
- **Can all this help us understand ourselves and each other any better?**