

# Model Thinking

Scott E Page

Function

Emergent

Six Degrees

# Six Degrees (1)

Stanley Milgram asked  
296 people from  
Nebraska to get a  
letter to a stockbroker  
outside Boston.  
Could only send the  
letter to someone  
they knew on a first  
name basis

# Six Degrees (2)

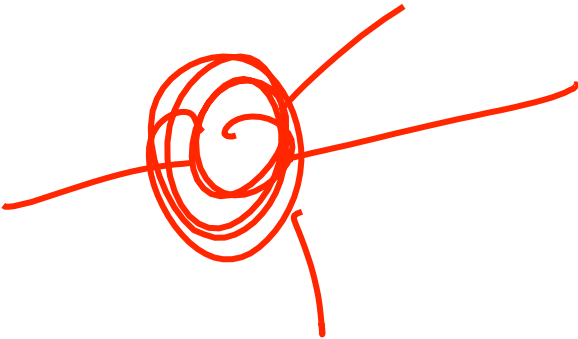
Duncan Watts did an email experiment with 48,000 senders and 19 targets in 57 countries. The average number of connections was six.

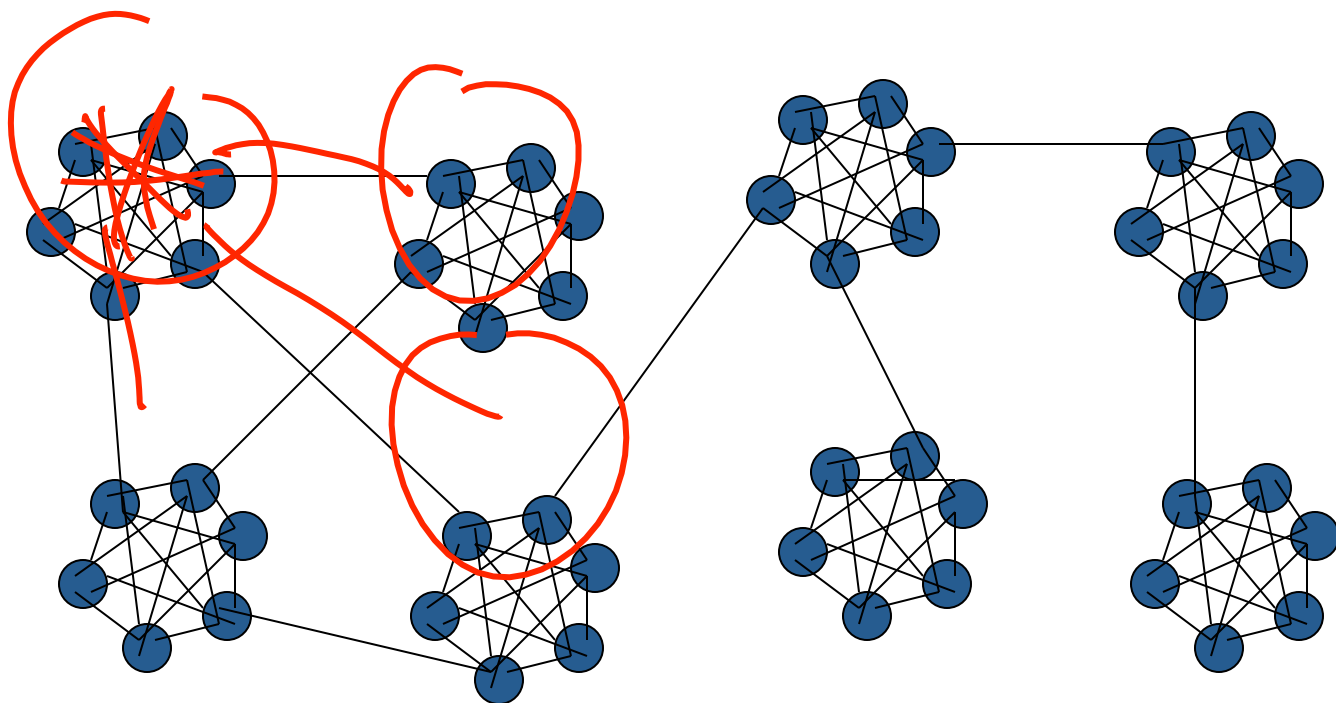
# Random Clique Network

Each person has

$C$  clique friends

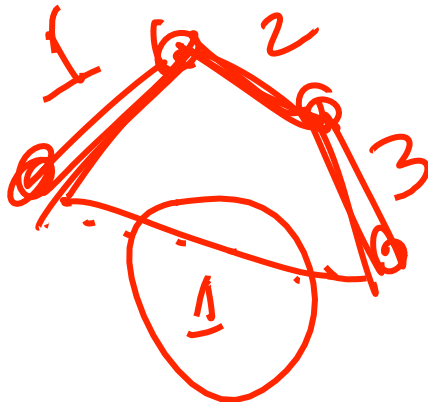
$R$  random friends.



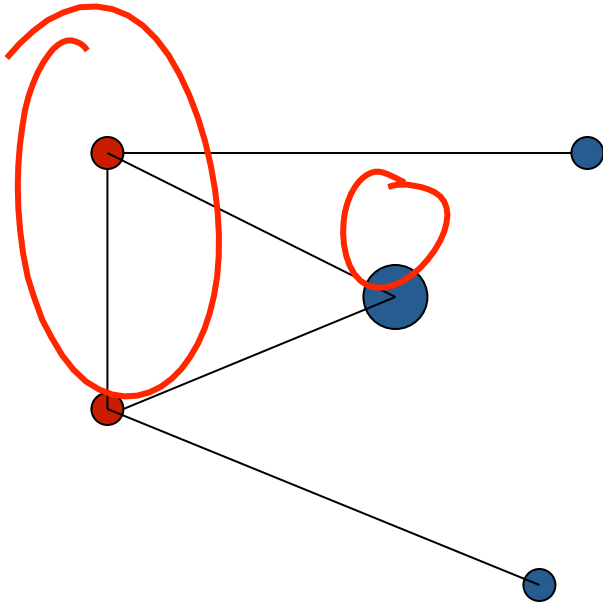


# K - Neighbor

All nodes that are of path length  $K$  to a node but not of any shorter path length

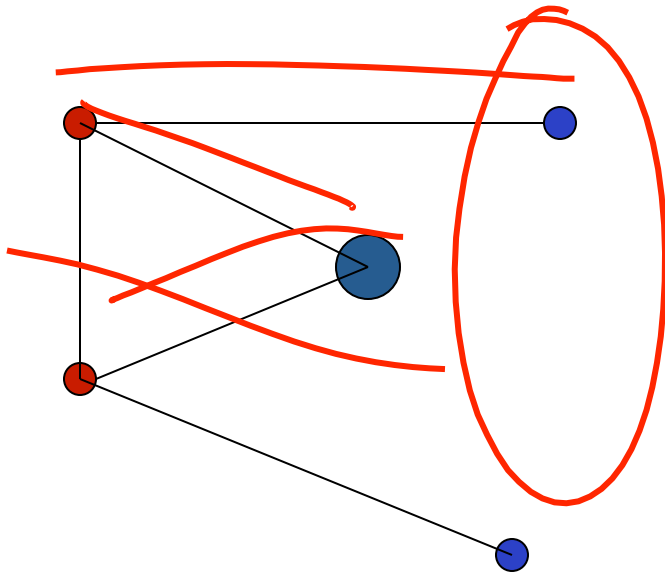


# 1 - Neighbors



- 1-neighbor

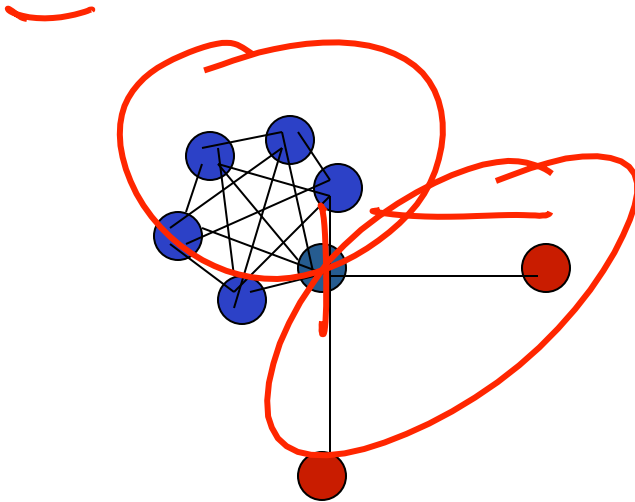
## 2 - Neighbors



- 2-neighbor

# 1-Neighbors

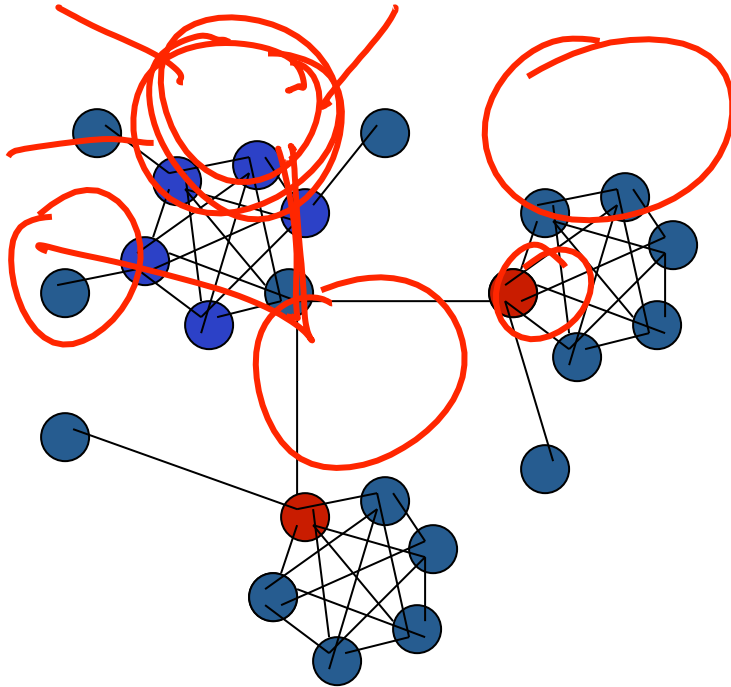
R + C



# 2- Neighbors

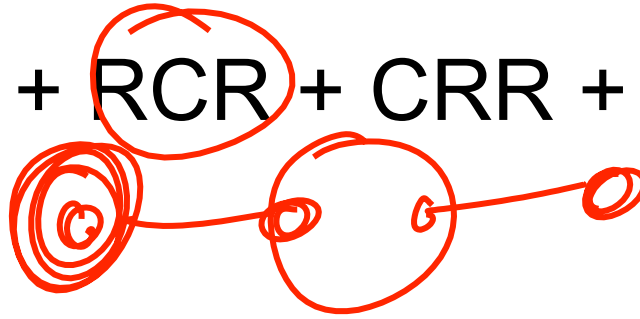
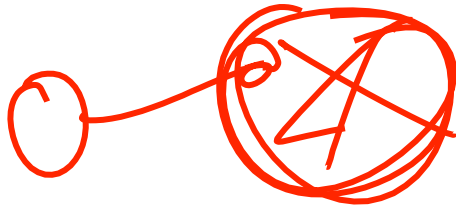
$$\underline{CR} + \underline{RR} + \underline{RC} \quad \text{+ ~~CC~~}$$

$$CC = C$$



## 3 - Neighbors

RRR + RRC + **R**CR + CRR + CRC


$$\text{RCC} = \text{RC}, \text{CCR} = \text{CR} \text{ and } \text{CCC} = \text{C}.$$


$$C = 140 \quad R = 10$$

$$1 \quad 150$$

$$2 \quad CR \quad RC \quad RR \quad 1400 \quad 1400 \quad 100 = 2900$$

$$3 \quad RRR \quad RRC \quad RCR \quad CRR \quad CRC$$

$$1000 \quad 14,000 \quad 14,000 \quad 14,000$$

$$229,000$$

$$\begin{array}{r} 1400 \\ 140 \\ \hline 140000 \\ 56000 \\ \hline 196,000 \end{array}$$

People get jobs, find  
friends, partners, etc...  
through weak ties.

Granovetter (1973) “The Strength of Weak Ties”

Roommate's brother's  
friend

Mother's coworker's  
daughter

High school friend's  
college roommate's  
dad.

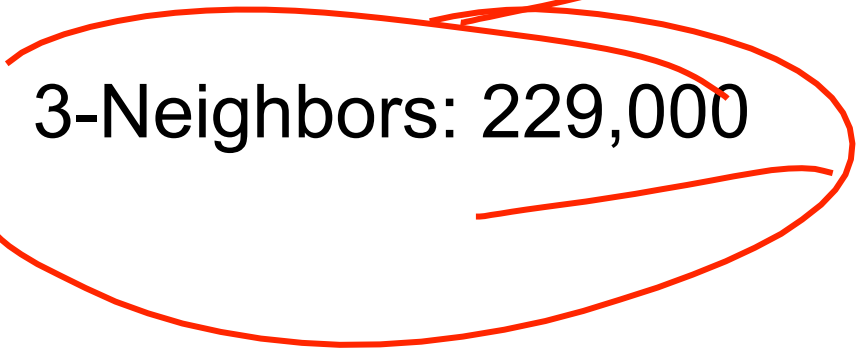
1-Neighbors: 150



2-Neighbors: 1900



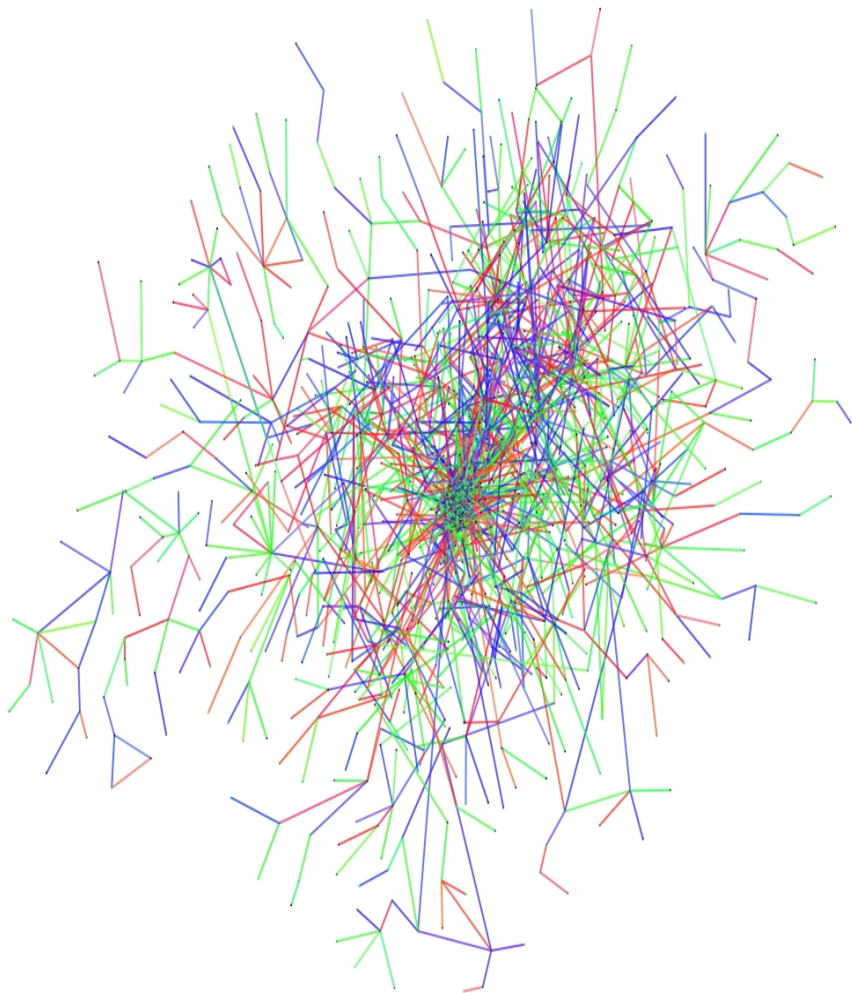
3-Neighbors: 229,000



Emergence

# **Emergent**

**Phenomenon:** A functionality that emerges at the micro level that does not hold at the micro level. Often the functionality was not intended.



ucsd.edu

few

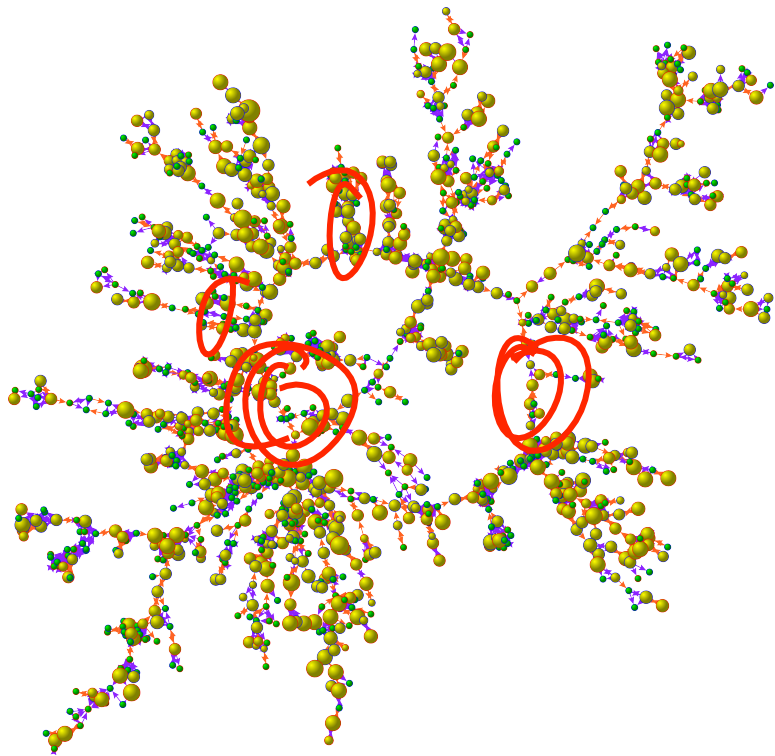


wikicommons

**Logic:** how it forms

**Structure:** measures

**Function:** what it does



Graph: James Fowler UCSD

# Model Thinking

Scott E Page