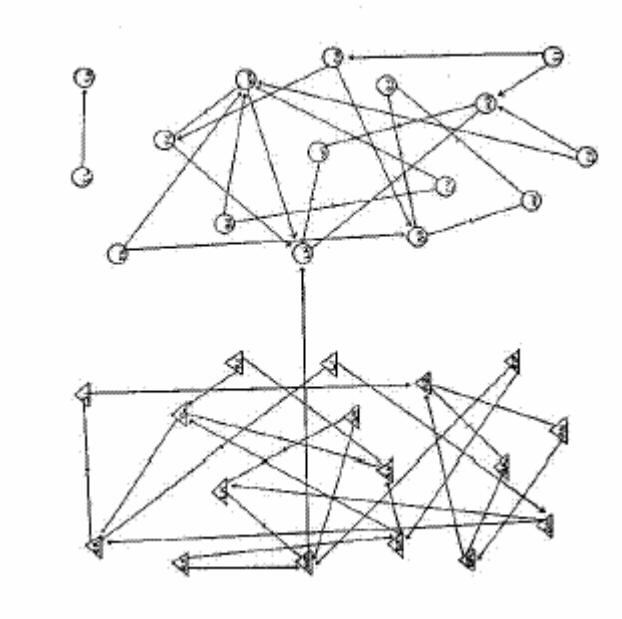
Social Networks Visualization

Who's the popular kid?



Sociologists are looking for:

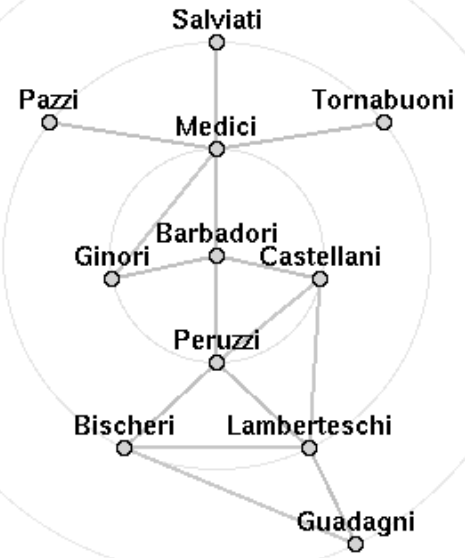
- Social Groups - collections of *actors* closely linked to one another

- Social Positions – sets of *actors* who are linked to the social system in similar ways

(note: "actors" = nodes)

Visualizations are a helpful tool when exploring social relationships in

- business practices
- social groups
- tribal cultures
- animal species
- crime families



Social Networks Visualization

Overview

Visualizing Social Networks (Linton C. Freeman)

Graph Layout

Visualizing Social Groups (Linton C. Freeman)

- *Multidimensional Scaling*
- *Factor Analysis (SVD)*

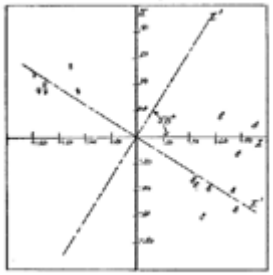
Your social network – an application

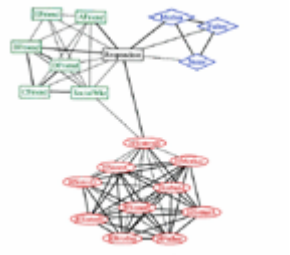
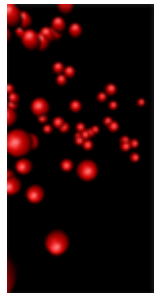
Social Network Fragments (Danah Boyd)

- *Spring Models*

Five Phases

- 1930's Hand drawn images
- 1950's Using computational procedures
- 1970's Machine drawn images
- 1980's Screen-oriented graphics
- 1990's The era of web browsers

1930's Hand Drawn Images

Jacob L. Moreno's foundational work

(1) Draw graphs

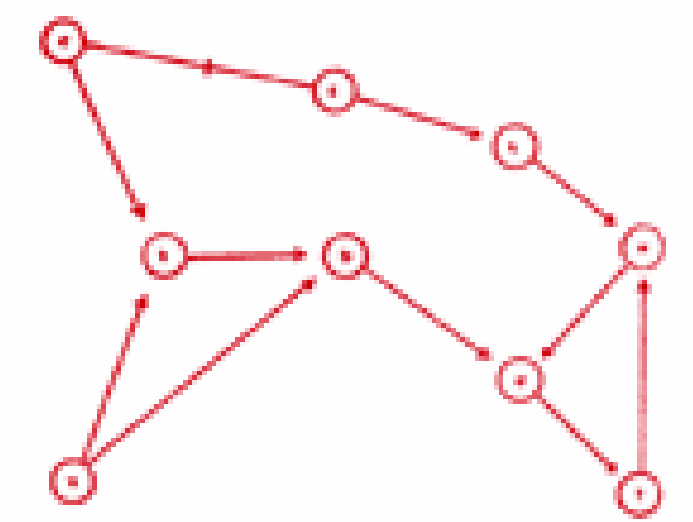
- nodes represent actors, lines represent relations between actors

1930's Hand Drawn Images

Jacob L. Moreno's foundational work

(1) Draw graphs

(2) Draw directed graphs



Moreno (1932)

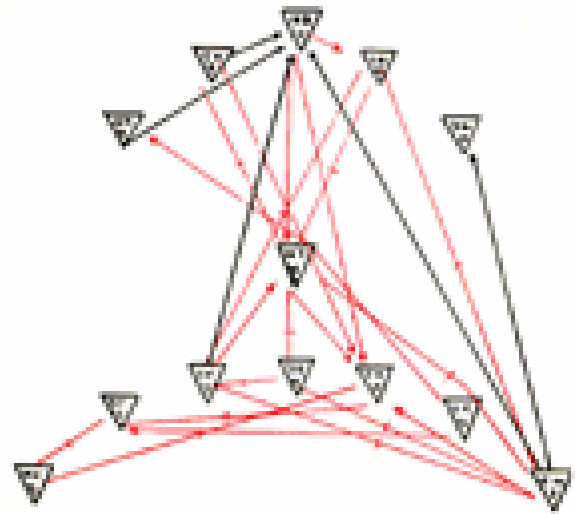
1930's Hand Drawn Images

Jacob L. Moreno's foundational work

(1) Draw graphs

(2) Draw directed graphs

(3) Use colours to draw "multigraphs"



Moreno (1932)

1930's Hand Drawn Images

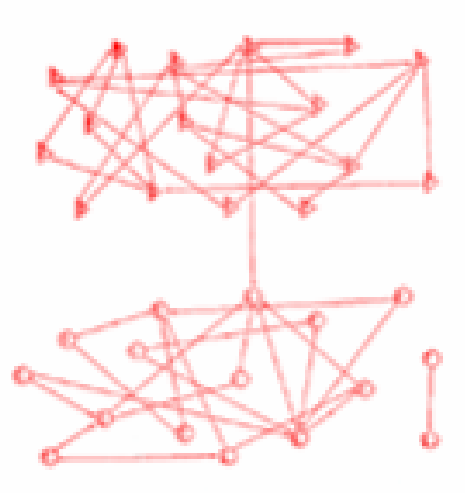
Jacob L. Moreno's foundational work

(1) Draw graphs

(2) Draw directed graphs

(3) Use colours

(4) Vary shapes of nodes



Moreno (1932)

1930's Hand Drawn Images

Jacob L. Moreno's foundational work

(1) Draw graphs

(2) Draw directed graphs

(3) Use colours

(4) Vary shapes of nodes

(5) Use location of nodes to stress different features of the data

1950's Computational Methods

The burning question:

How do we lay out the points?

Solutions:

Factor analysis

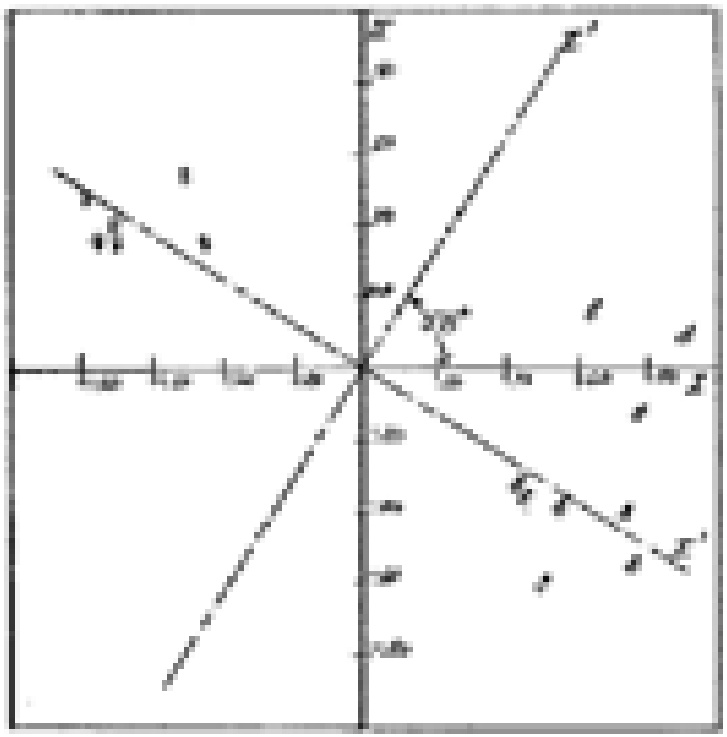
Multidimensional scaling

1950's Computational Methods

Factor analysis

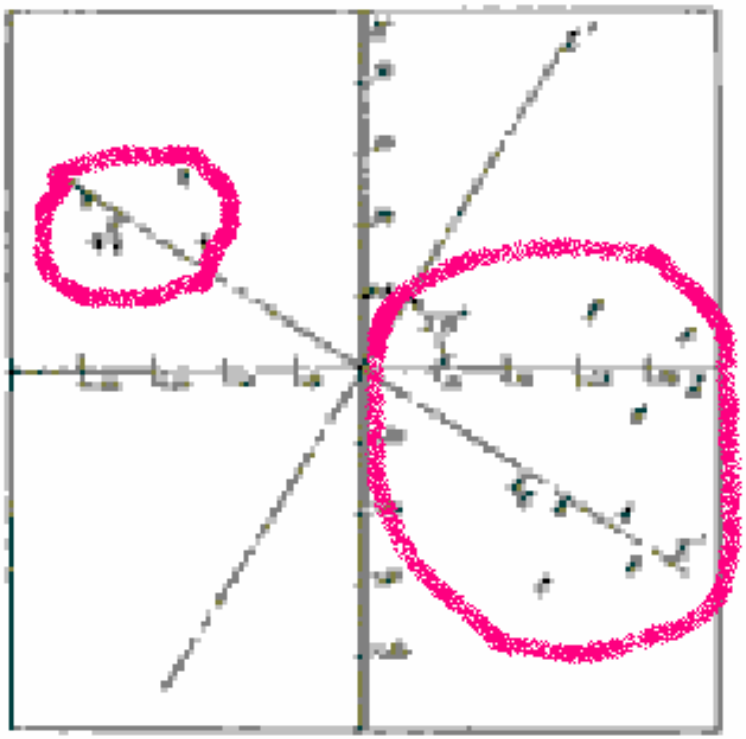
Reduce the number of points by mapping similar points into "factors". Each successive factor represents less and less of the variability of the data.

1950's Computational Methods



Bock & Husain (1952) Clusters of 9th grade school children

1950's Computational Methods



Bock & Husain (1952) Clusters of 9th grade school children

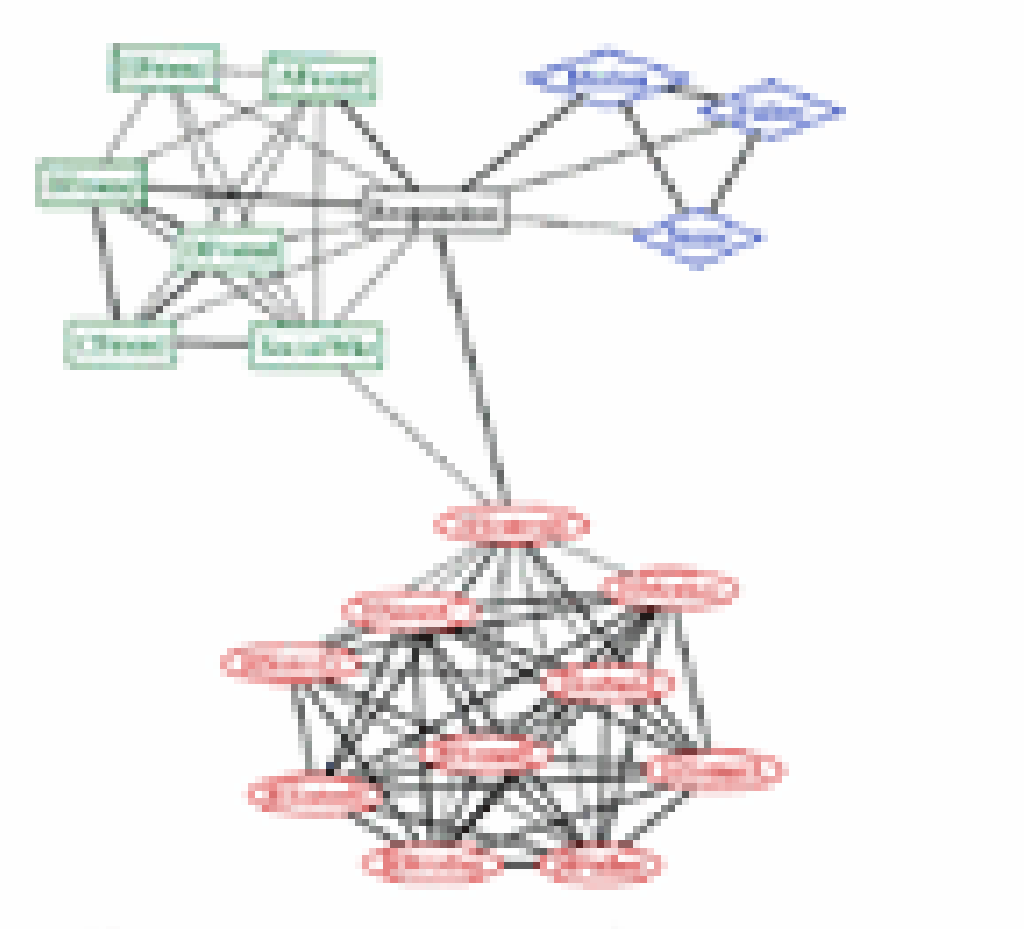
1950's Computational Methods

Multidimensional Scaling (MDS)

Arrange points in 2D or 3D in such a way that distances between pairs of points on the display correspond to distances between individuals in the data

1980's Screen oriented graphics

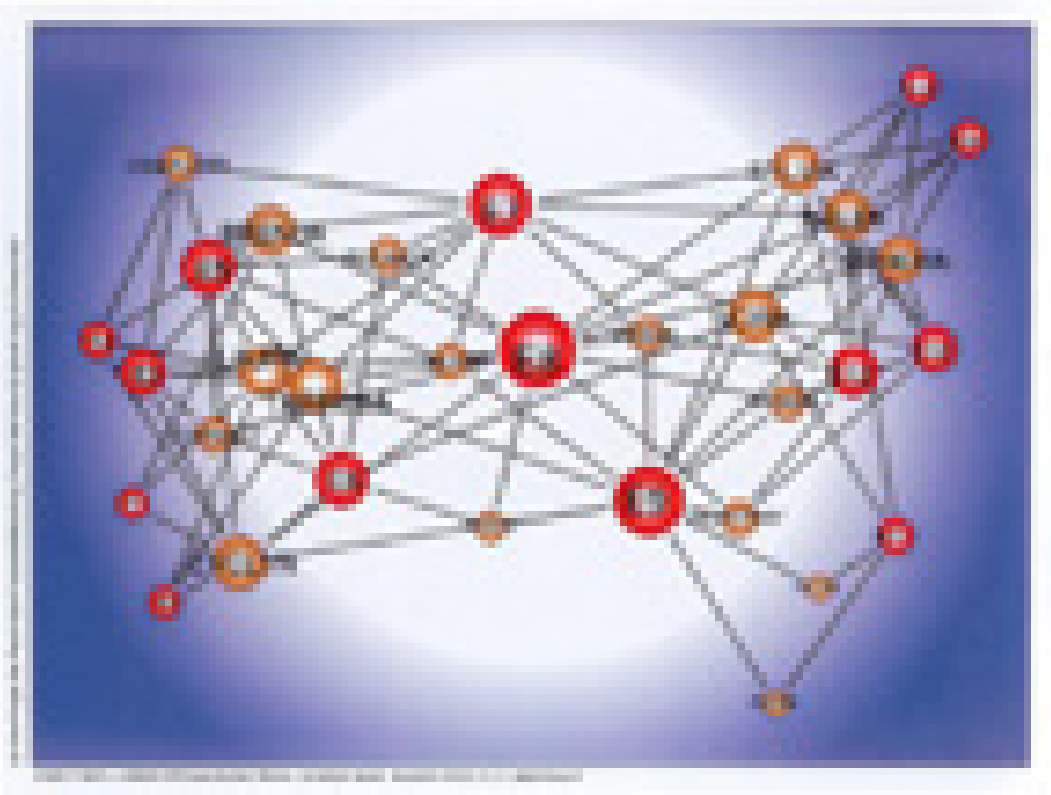
- **Krackplot**



Krackplot image of Social Support Network of a Homeless Woman

1980's Screen oriented graphics

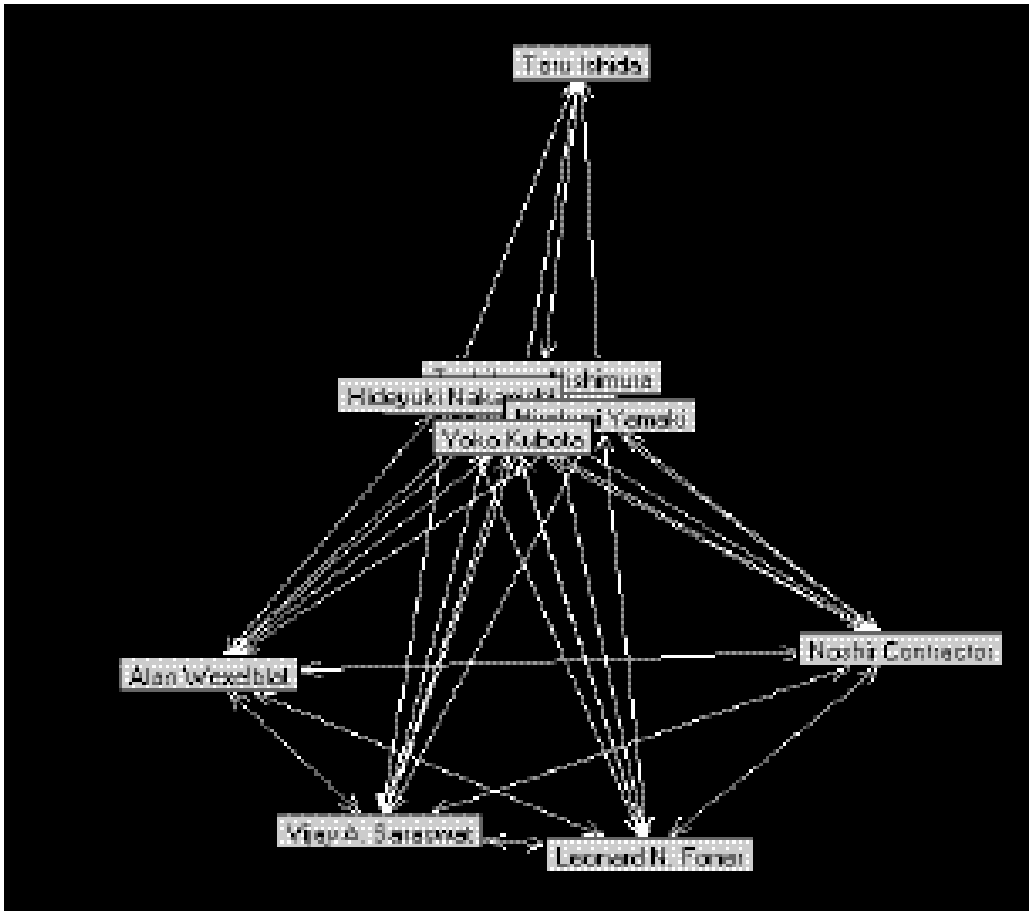
- Krackpot
- **NetVis**



Two-mode data on Women's Attendance at Social Events

1990's The era of web browsers

- Java Programs



1990’s The era of web browsers

- Java Programs
- Virtual Reality Modeling Language (VRML)

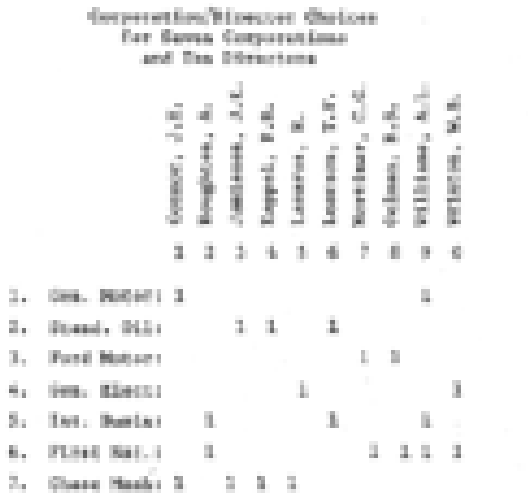
Visualizing Social Networks by Linton C. Freeman

Strong Points:

- **A comprehensive overview**
- **Many examples of visualizations with real data**

Weak Points:

- **Short description of each system**
- **Figures!!!**



Visualizing Social Networks by Linton C. Freeman

Strong Points:

- **A comprehensive overview**
- **Many examples of visualizations with real data**

Weak Points:

- **Short description of each system**
- **Figures!!!**
- **Examples arranged chronologically, not by contribution**
- **No evaluation**

Social Networks Visualization

Overview

Visualizing Social Networks (Linton C. Freeman)

Graph Layout

Visualizing Social Groups (Linton C. Freeman)

- *Multidimensional Scaling*
- *Factor Analysis (SVD)*

Your social network – an application

Social Network Fragments (Danah Boyd)

- *Spring Embedder*

Visualizing Social Groups

We want to

(1) uncover social groups

(2) investigate roles/positions in the groups

Social connections are either

(1) Binary – individuals are either linked or not linked

(2) Qualitative – individuals are relatively more or relatively less strongly linked

Binary Connections

	I1	W1	W2	W3	W4	W5	W6	W7	W8	W9	S1	S4
I1	0	1	1	1	1	0	0	0	0	0	0	0
W1	1	0	1	1	1	1	0	0	0	0	1	0
W2	1	1	0	1	1	0	0	0	0	0	1	0
W3	1	1	1	0	1	1	0	0	0	0	1	0
W4	1	1	1	1	0	1	0	0	0	0	1	0
W5	0	1	0	1	1	0	0	1	0	0	1	0
W6	0	0	0	0	0	0	0	1	1	1	0	0
W7	0	0	0	0	0	1	1	0	1	1	0	1
W8	0	0	0	0	0	0	1	1	0	1	0	1
W9	0	0	0	0	0	0	1	1	1	0	0	1
S1	0	1	1	1	1	1	0	0	0	0	0	0
S4	0	0	0	0	0	0	0	1	1	1	0	0

Table 1. Game Playing at Western Electric
om Roethlisberger and Dixon [23]).

Laying out the Nodes

Two methods

- Multidimensional Scaling (MDS)
- Factor Analysis (SVD)

Multidimensional Scaling (MDS)

Need proximity data; relative distance between two points.

Arrange points in 2D or 3D so that distances between pairs of points on the display correspond to distances between individuals in the data

Spring Model to lay them out so that the ideal distance between nodes is their proximity. Nodes are laid out in random then “let go”.

Multidimensional Scaling (MDS)

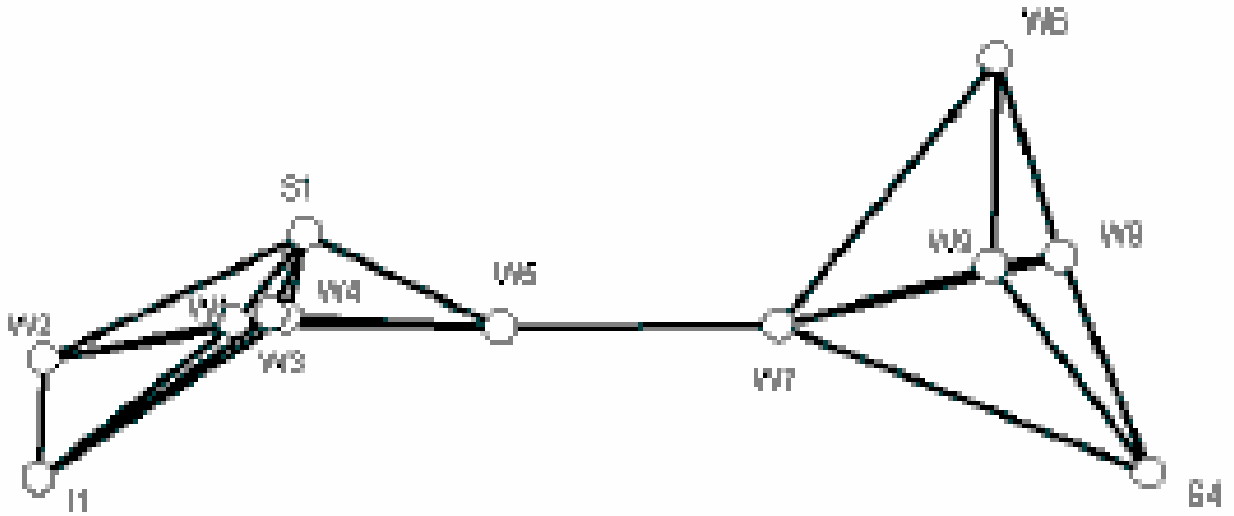
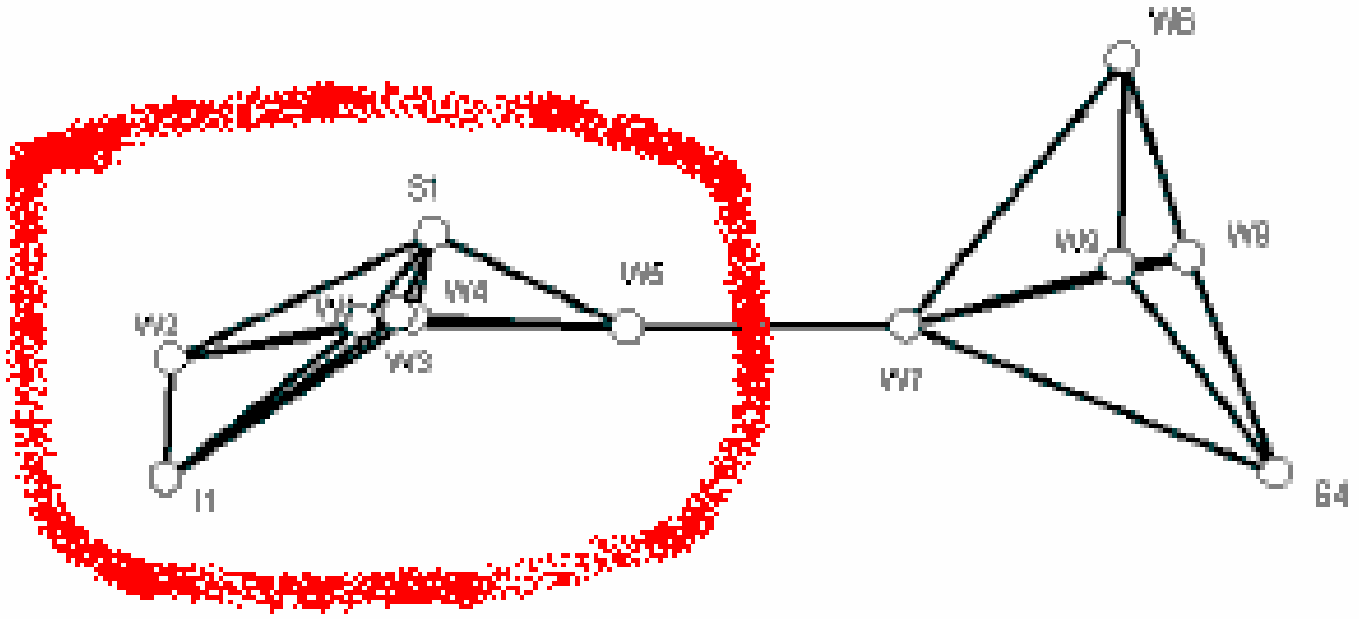


Figure 3. MDS of Game Playing at Western Electric (Graph Theoretic Distances).

Multidimensional Scaling (MDS)



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Multidimensional Scaling (MDS)

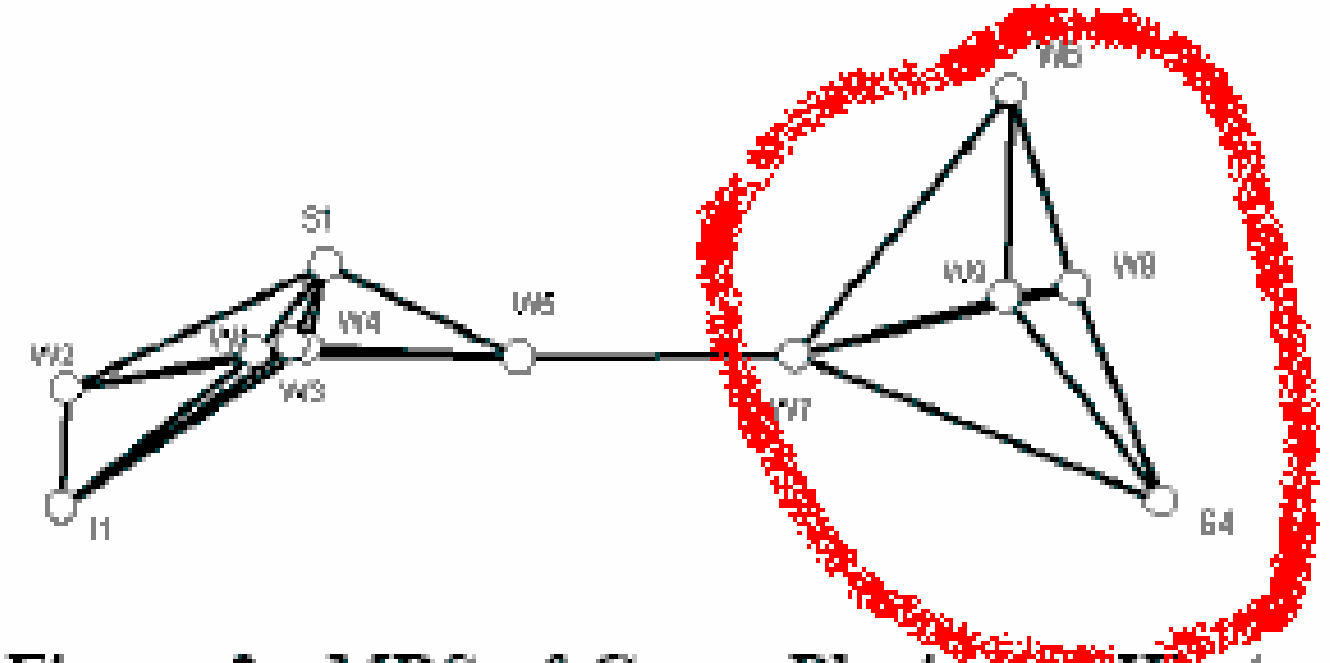


Figure 3. MDS of Game Playing at Western Electric (Graph Theoretic Distances).

Principal Components Analysis

Another way to assign a location to the points

Maps each node in the matrix of associations to a new vector (factor). Some nodes will have been collapsed to a single point

Each new vector contains less and less of the variance of the original data.

Principal Components Analysis

Figure 3. SVD of Game Playing at Western Electric.

Evaluation

How do we decide which method is better?

Two criteria:

(1) Groups as specified in ethnographic reports

(2) Groups based on formal specification of group properties

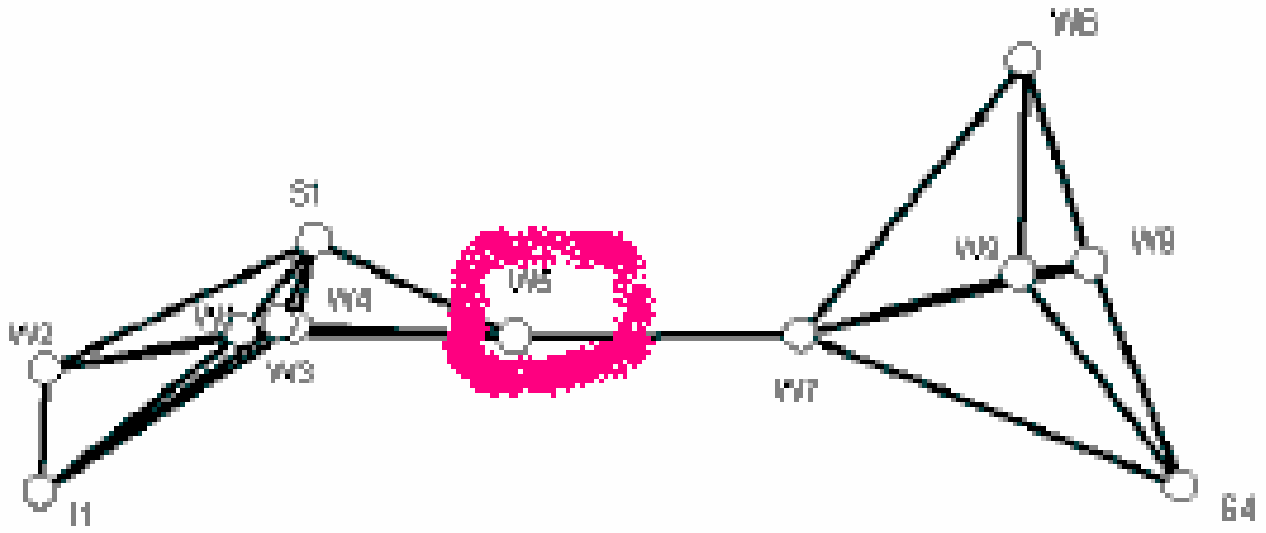
Ethnographic report

Observer reports:

- Workers are divided into two groups (W1, W2, W3, W4, S1, I1)

  (W6, W7, W8, W9, S4)
- **W5 was an outsider to both groups**

MDS



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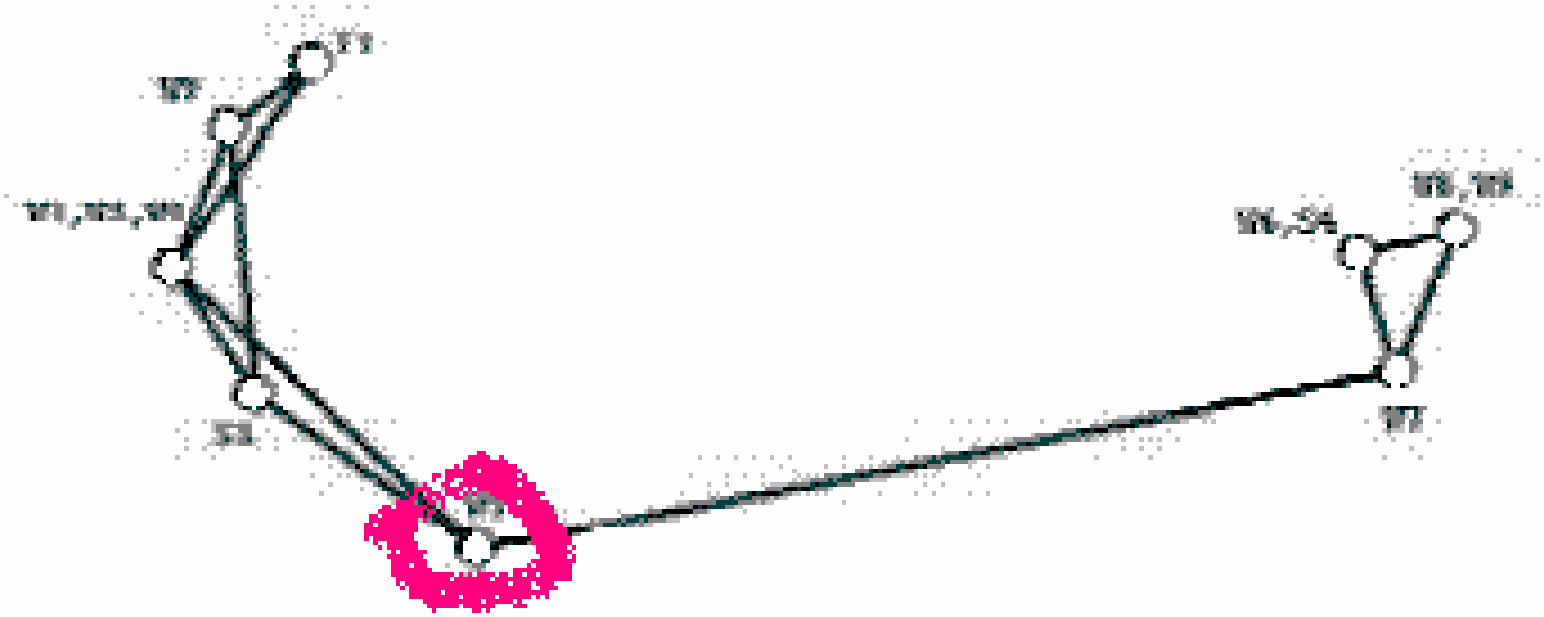
SVD



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Ethnographic report

Observer reports:

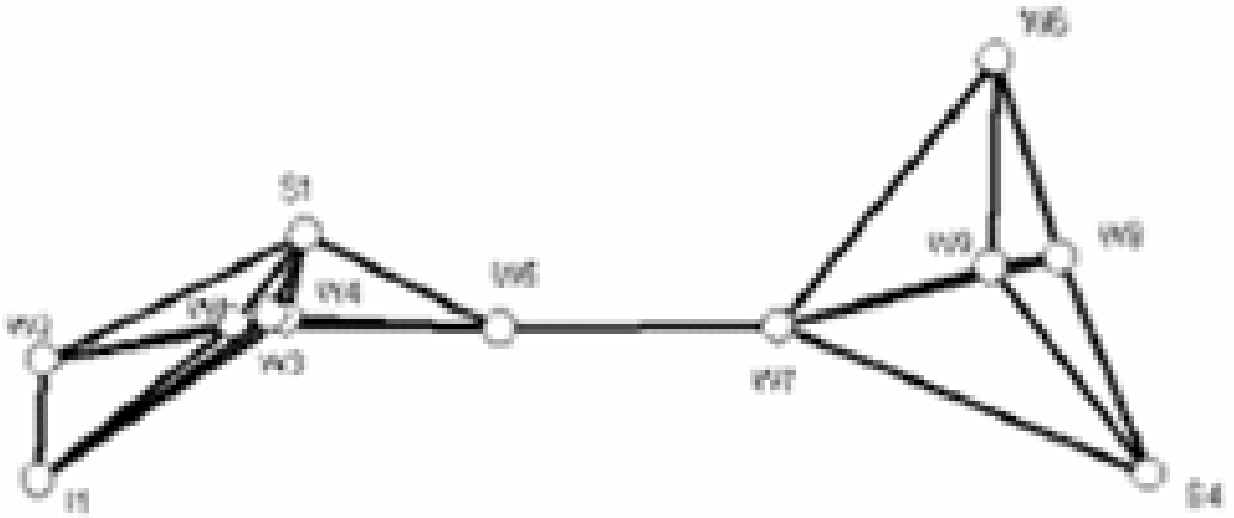
- Workers are divided into two groups (W1, W2, W3, W4, S1, I1)

  (W6, W7, W8, W9, S4)
- W5 was an outsider to both groups
- **Groups had core and peripheral members**

  W3 “leader”, W2 “marginal”

  W6 “not entirely accepted”, S4 “socially inferior”

MDS



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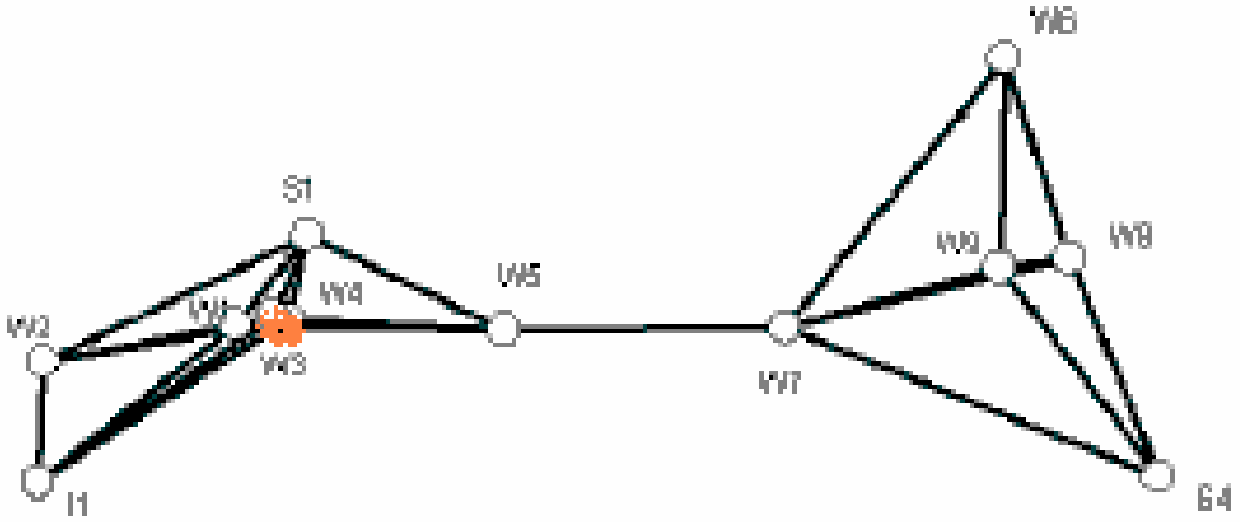

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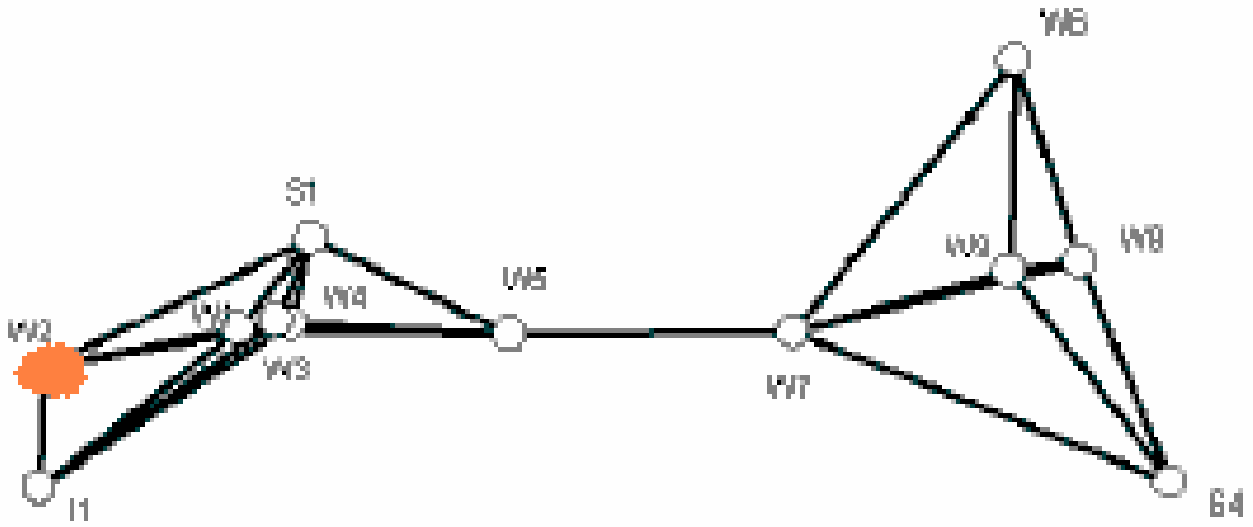
MDS



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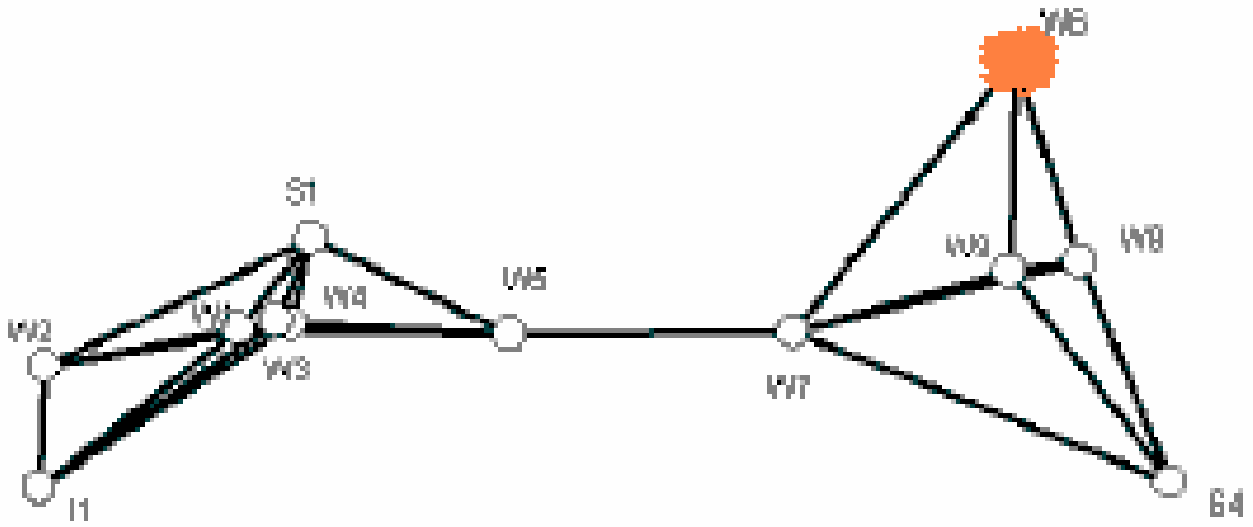
MDS



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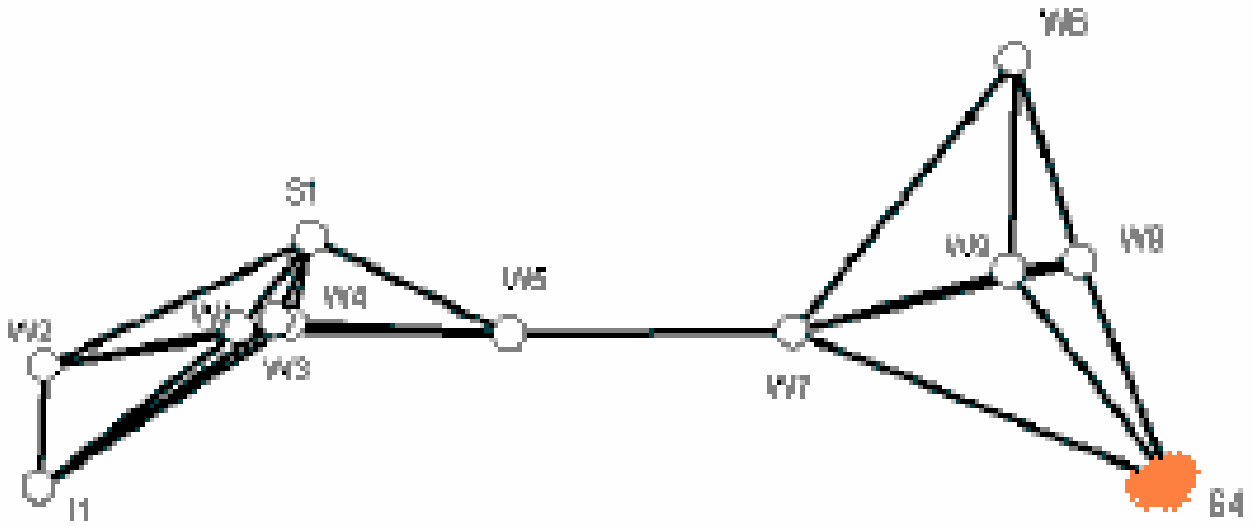

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SVD

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SVD

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SVD

Figure 3. SVD of Game Playing at Western Electric.

Evaluation

(1) Groups as specified in ethnographic reports

- *Both do well, MDS captures more subtle detail*

(2) Groups based on formal specification of group properties

Evaluation

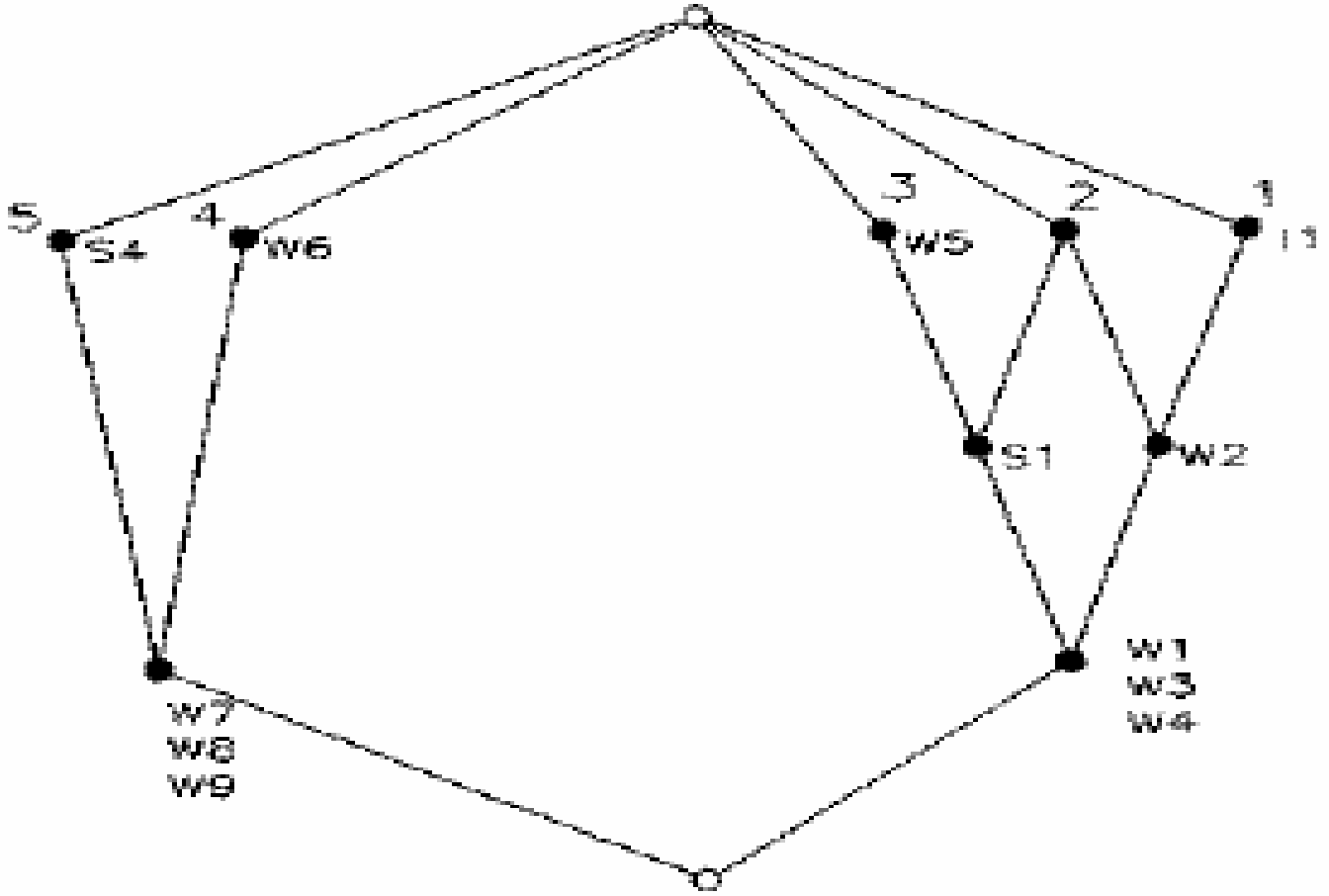


Figure 4. Galois Lattice of the Western Electric Cliques.

Qualitative Connections

	a	b	c	d	e	f	g	h	i	j	k	l	m
a	12	12	8	7	7	4	7	4	0	0	0	0	0
b	12	12	8	7	7	4	7	4	0	0	0	0	0
c	8	8	24	23	18	3	5	3	0	0	0	0	0
d	7	7	23	26	19	2	4	2	0	0	0	0	0
e	7	7	18	19	20	3	5	3	0	0	0	0	0
f	4	4	3	2	3	21	20	21	0	0	0	0	0
g	7	7	5	4	5	20	23	20	0	0	0	0	0
h	4	4	3	2	3	21	20	21	0	0	0	0	0
i	0	0	0	0	0	0	0	0	31	26	0	0	0
j	0	0	0	0	0	0	0	0	26	28	0	0	0
k	0	0	0	0	0	0	0	0	0	0	35	31	24
l	0	0	0	0	0	0	0	0	0	0	31	31	22
m	0	0	0	0	0	0	0	0	0	0	24	22	25

Table 2. Male Dolphins Observed Swimming Together (from Connor, Smolker and Richards, [2]).

MDS

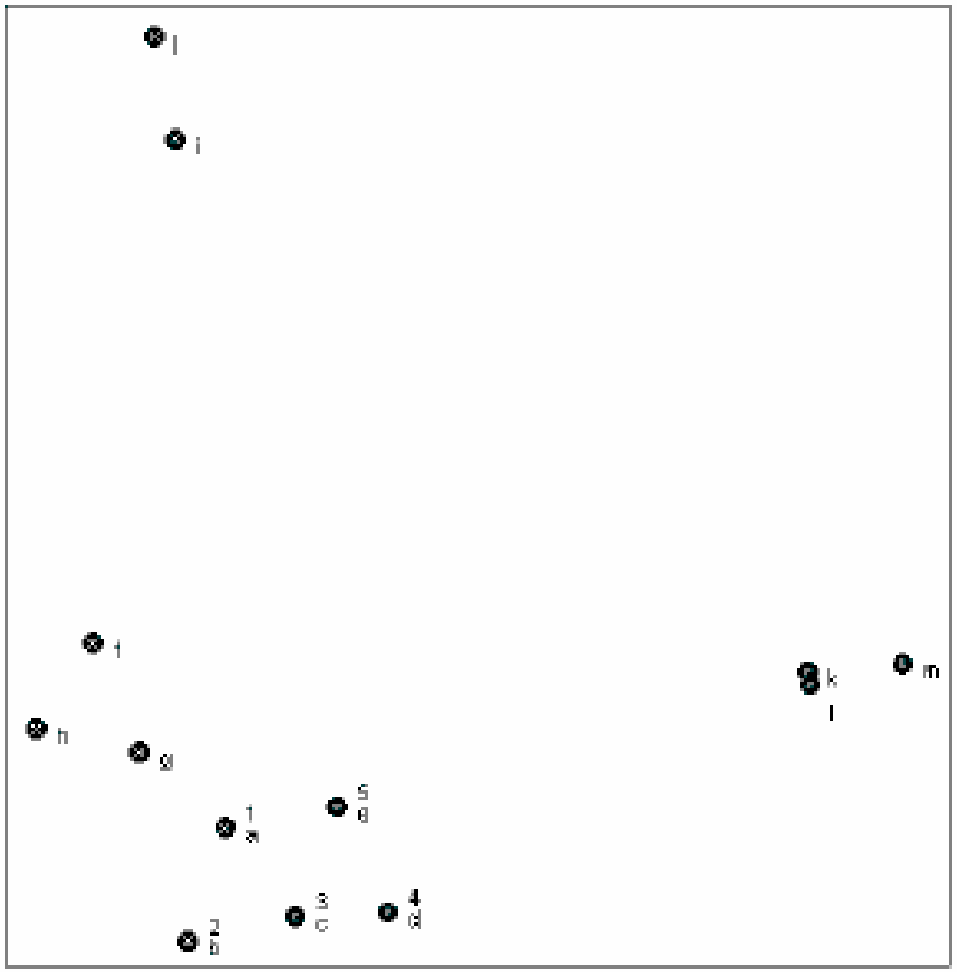


Figure 5. Two Dimensional MDS Representation of the Association among Dolphins.

SVD

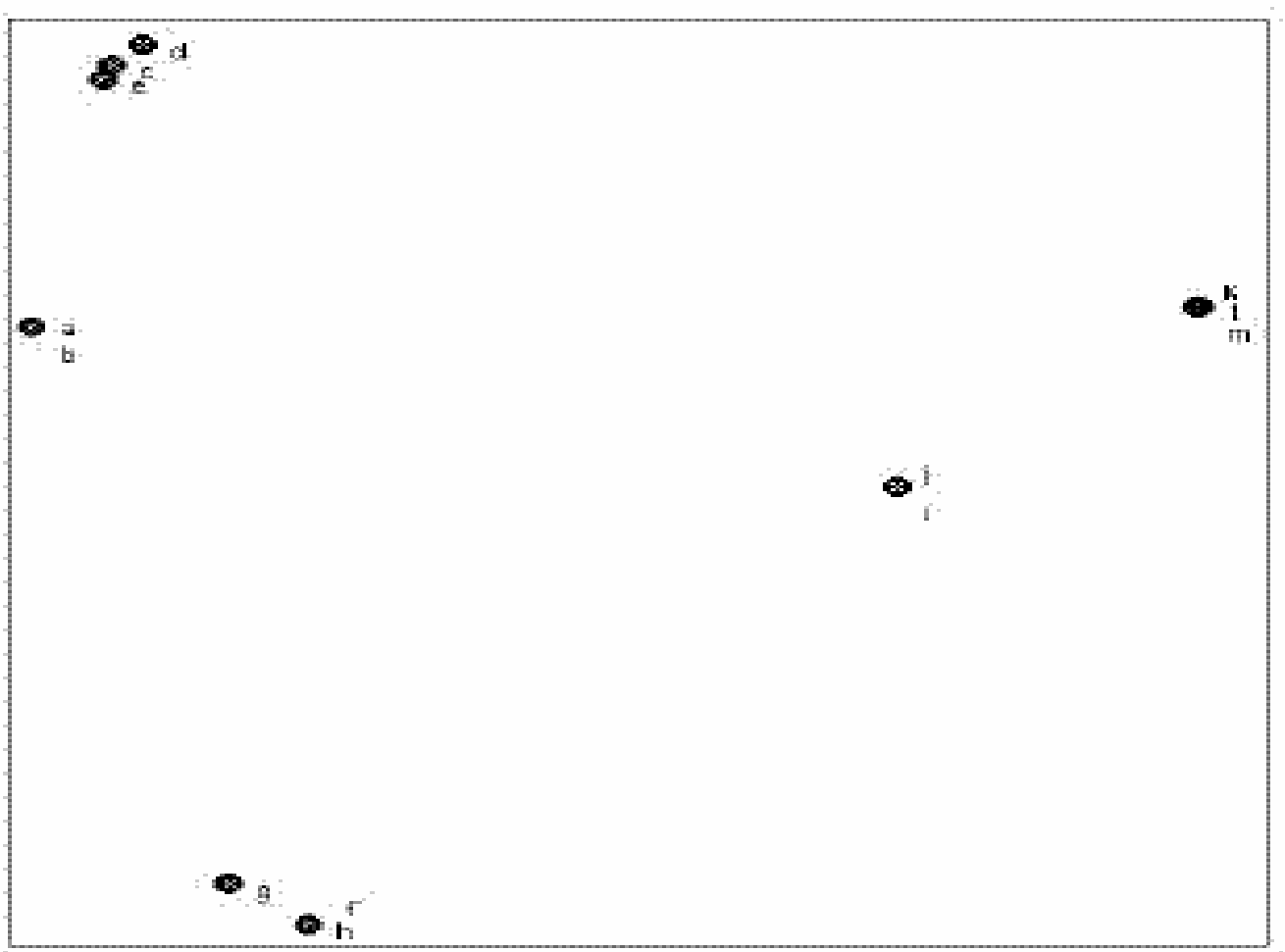


Figure 6. Two Dimensional SVD Representation of the Association among Dolphins.

Evaluation

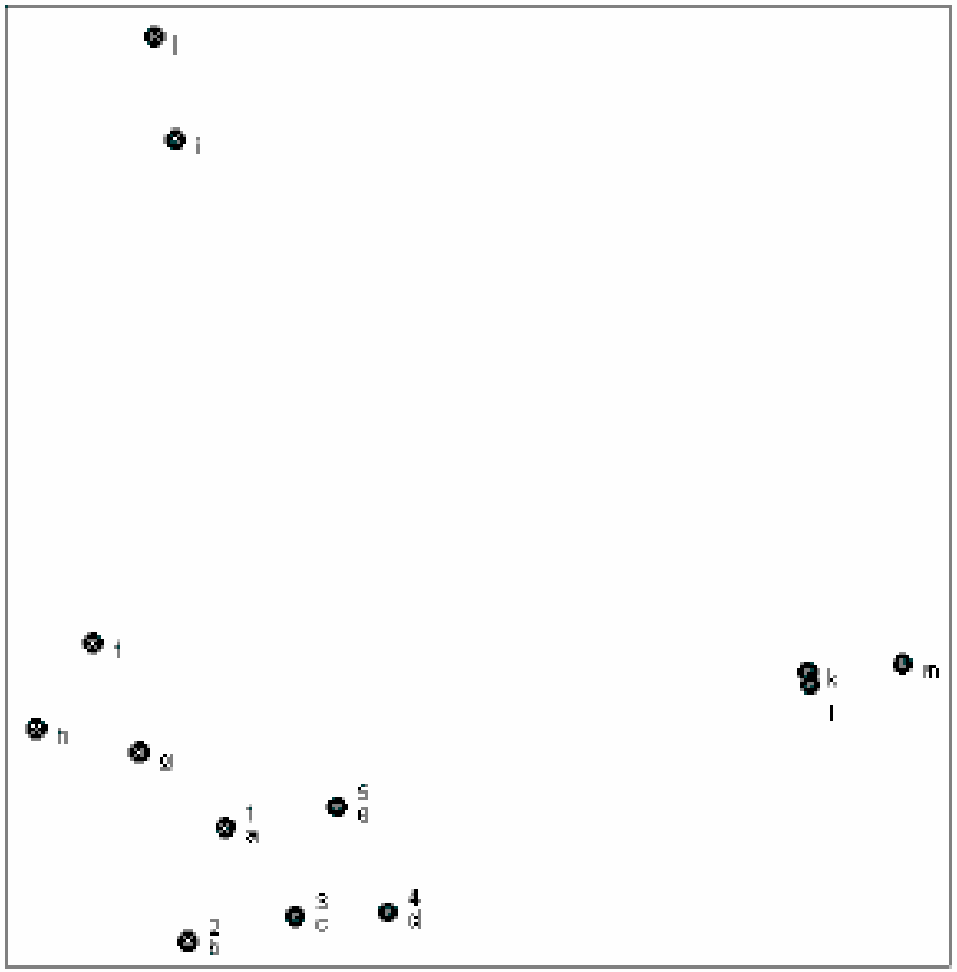
A is a member of a group A,B,C,… if A interacts more often with B,C,… than with others, and B interacts more with A,C,… than with others, and …

A simple genetic algorithm on the dolphin data shows that there are 3 groups:

{a,b,c,d,e,f,g,h}, {i,j}, {k,l,m}

The first can be divided into {a,b}, {c,d,e}, {f,g,h} which overlap a bit

MDS



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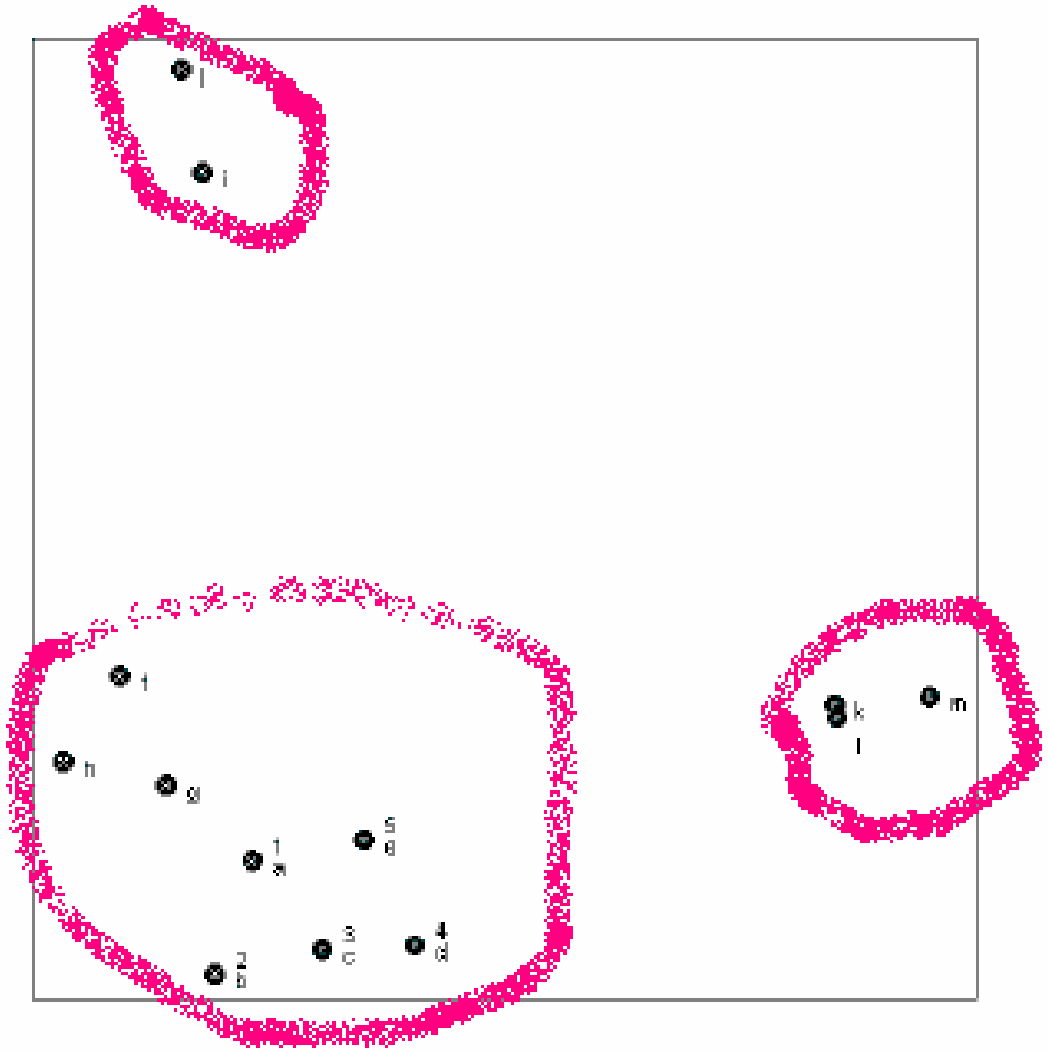

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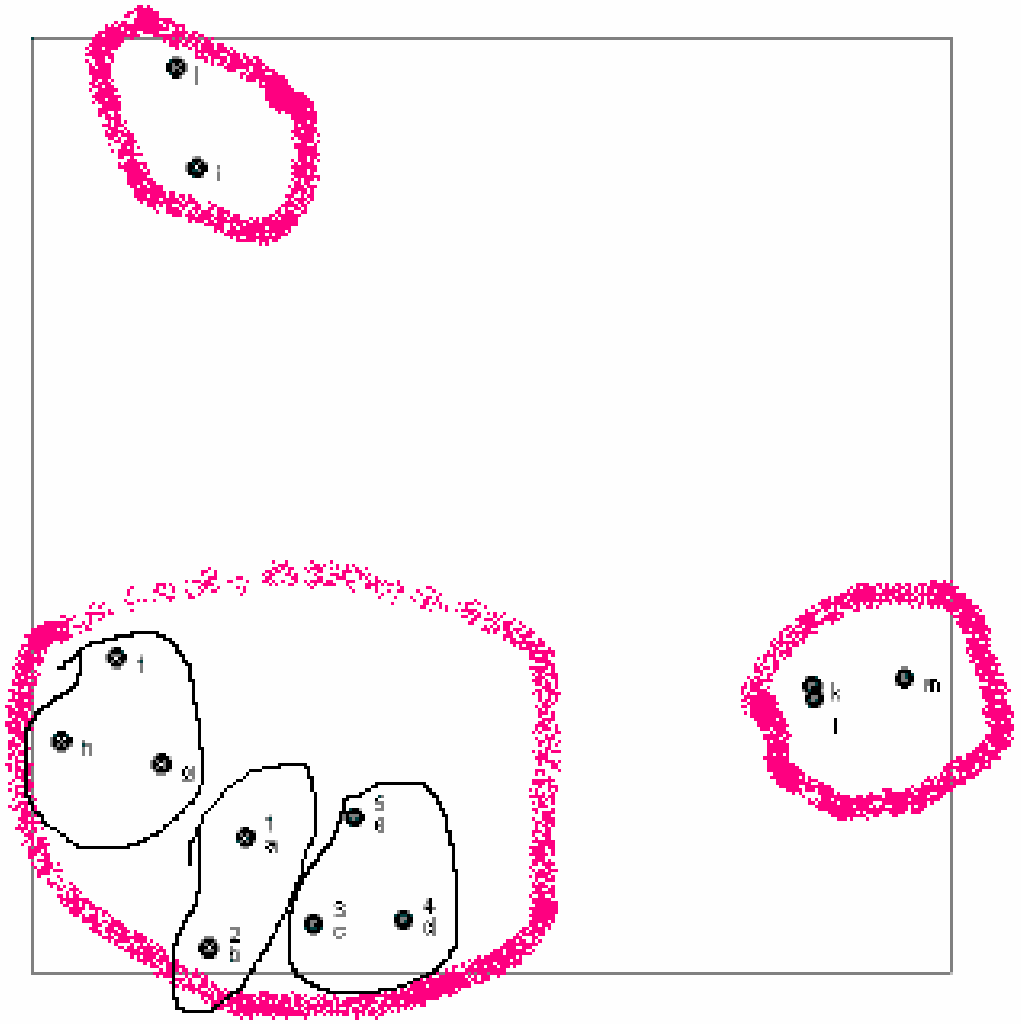

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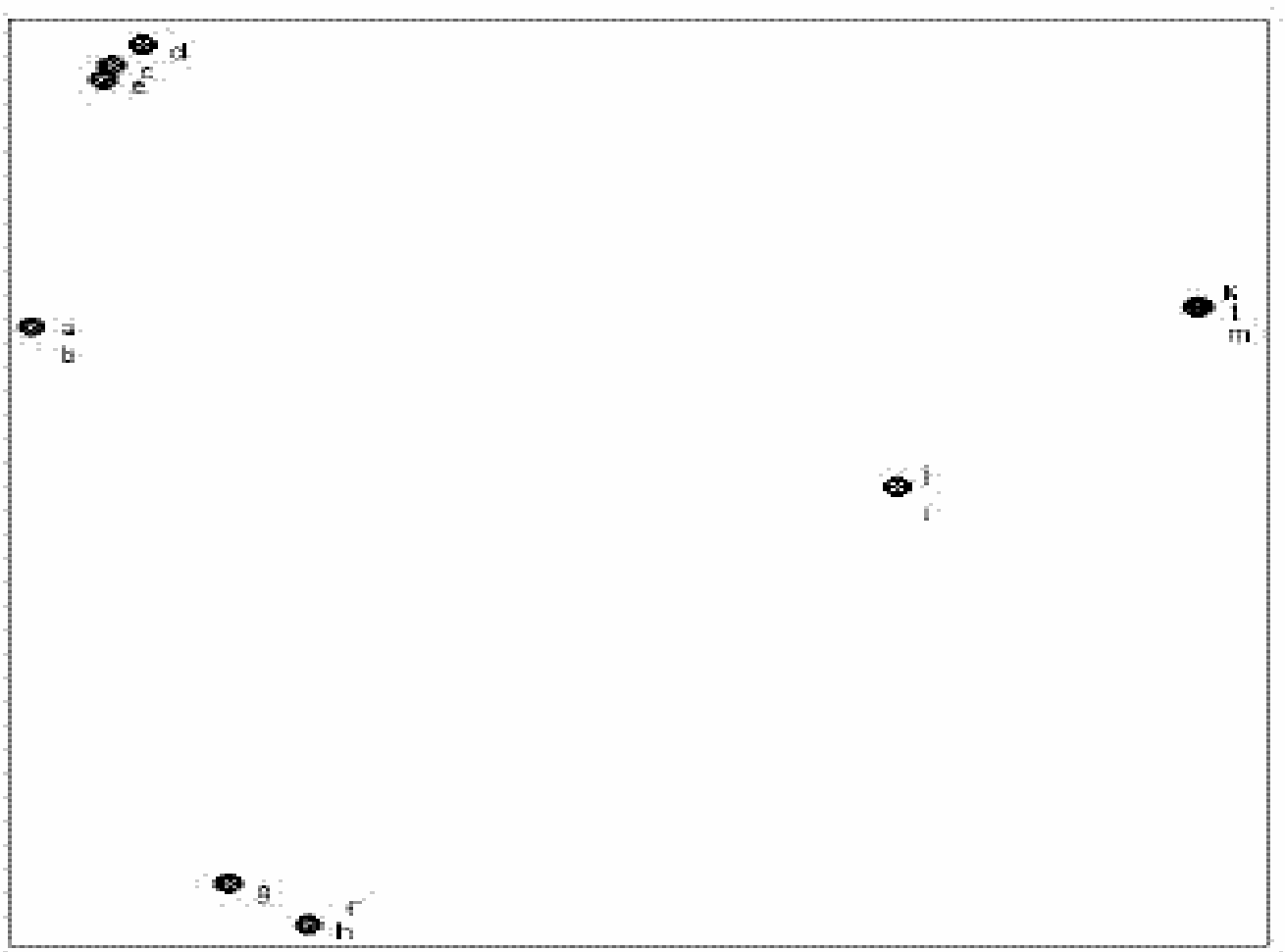

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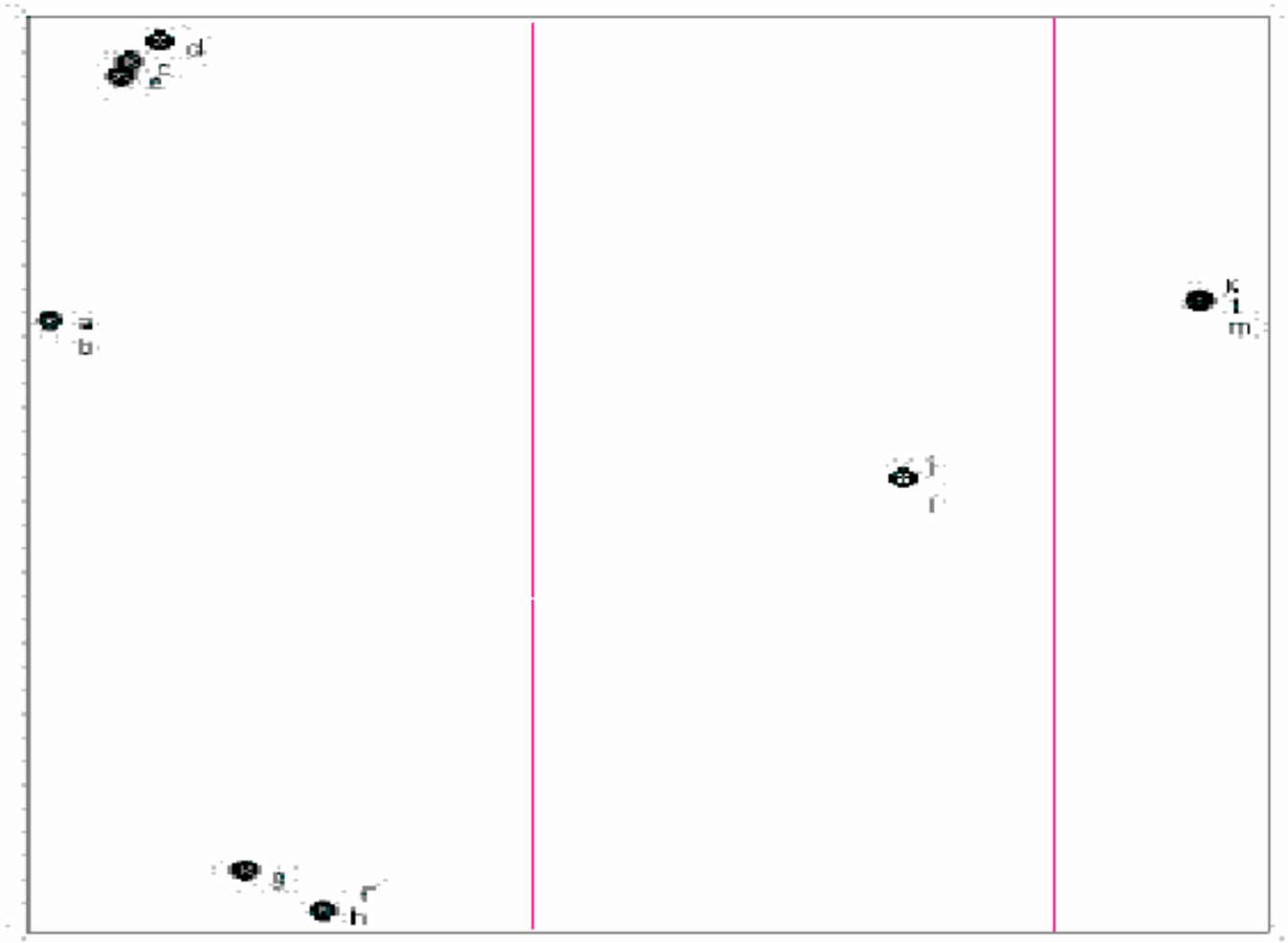

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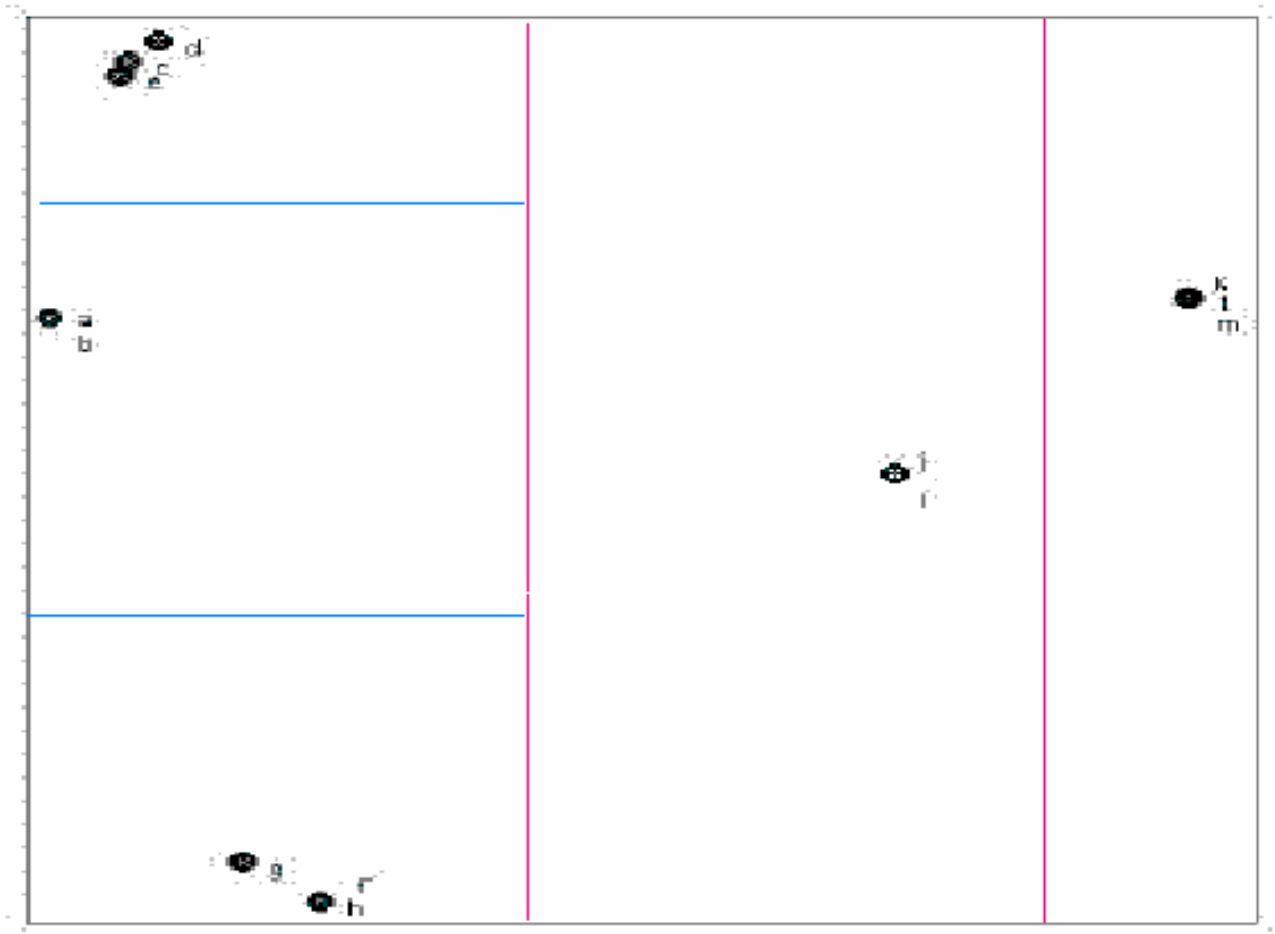


Figure 6. Two Dimensional SVD Representation of the Association among Dolphins.

Visualizing Social Networks by Linton C. Freeman

Strong Points:

- **Concrete examples using real data sets**
- **Criteria given for evaluation of each**

Weak Points:

- **No guidelines given**
- **Gloss over the details of MDS and SVD. How are the computations performed?**

Social Networks Visualization

Overview

Visualizing Social Networks (Linton C. Freeman)

Graph Layout

Visualizing Social Groups (Linton C. Freeman)

- *Multidimensional Scaling*
- *Factor Analysis (SVD)*

Your social network – an application

Social Network Fragments (Danah Boyd)

- *Spring Embedder*

Your Social Network

Context

We all have a social network of connections which we use to obtain emotional, economical and functional support. The connections vary in strength.

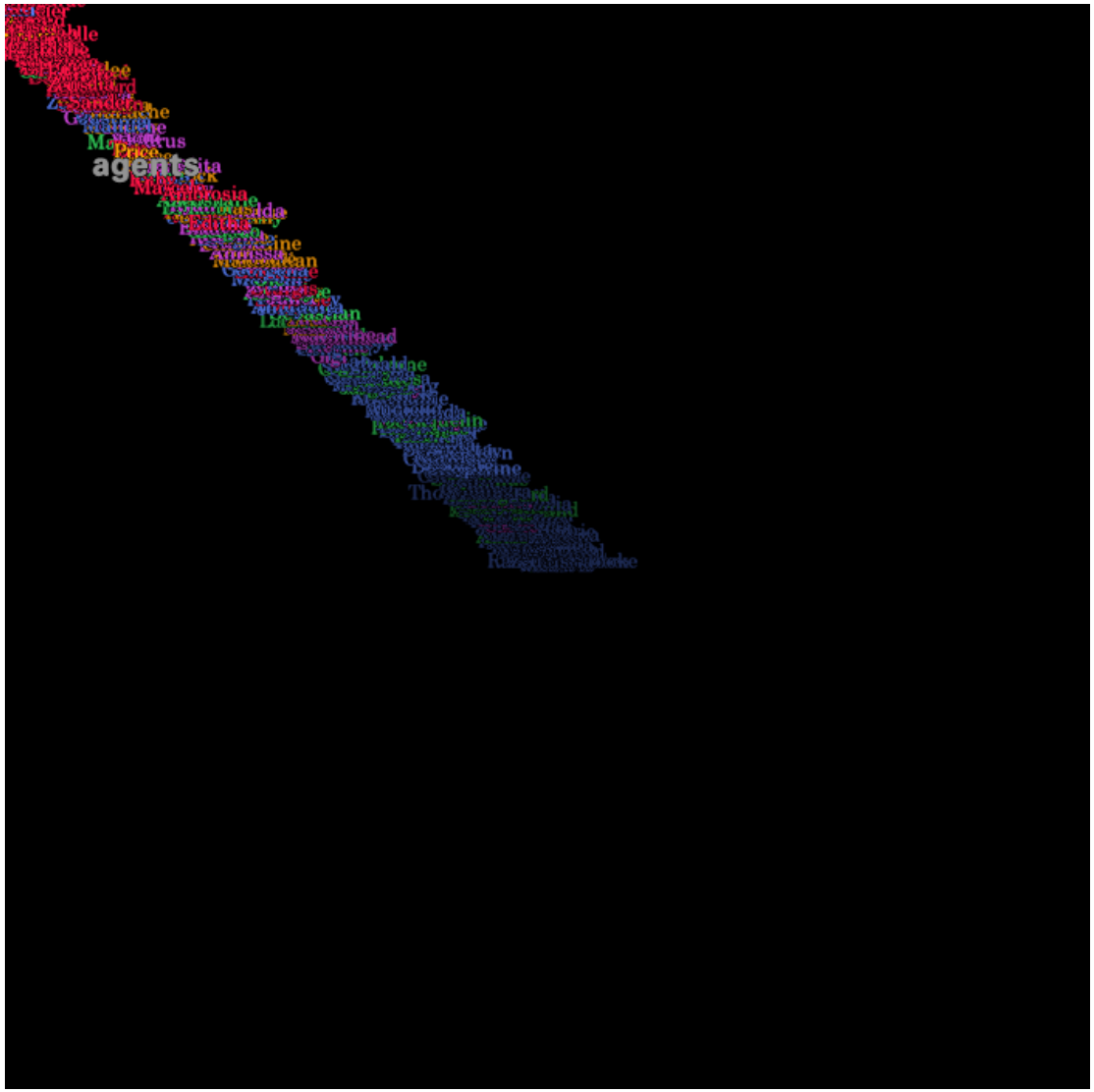
The same concepts can be applied in the digital world. People manage and control their social networks using digital tools.

Your Social Network

Goal

Create a system that reveals the structure of an individual's social network so that they can consider the impact of the network on their identity.

Visual Who (Judith Donath)



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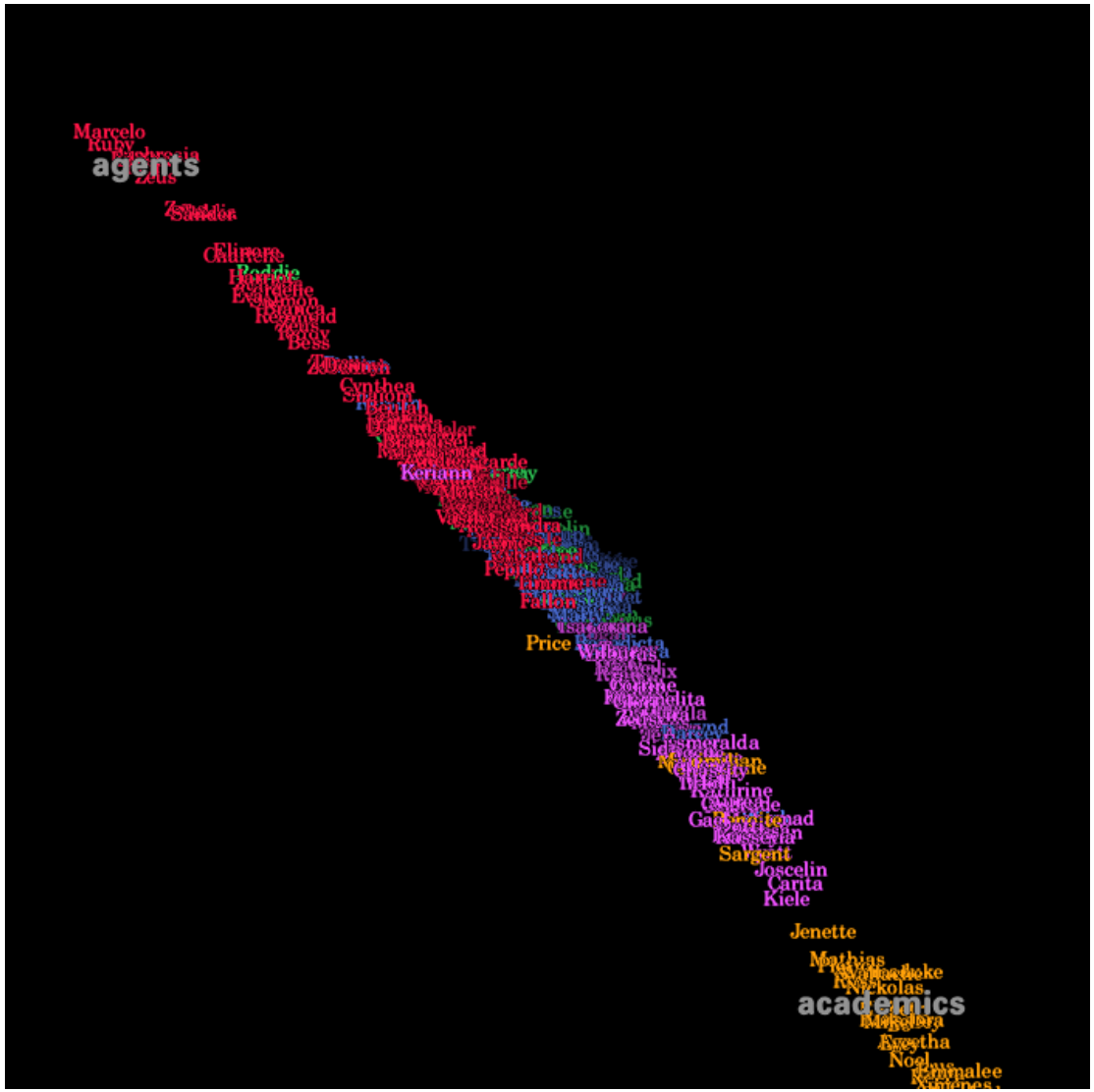

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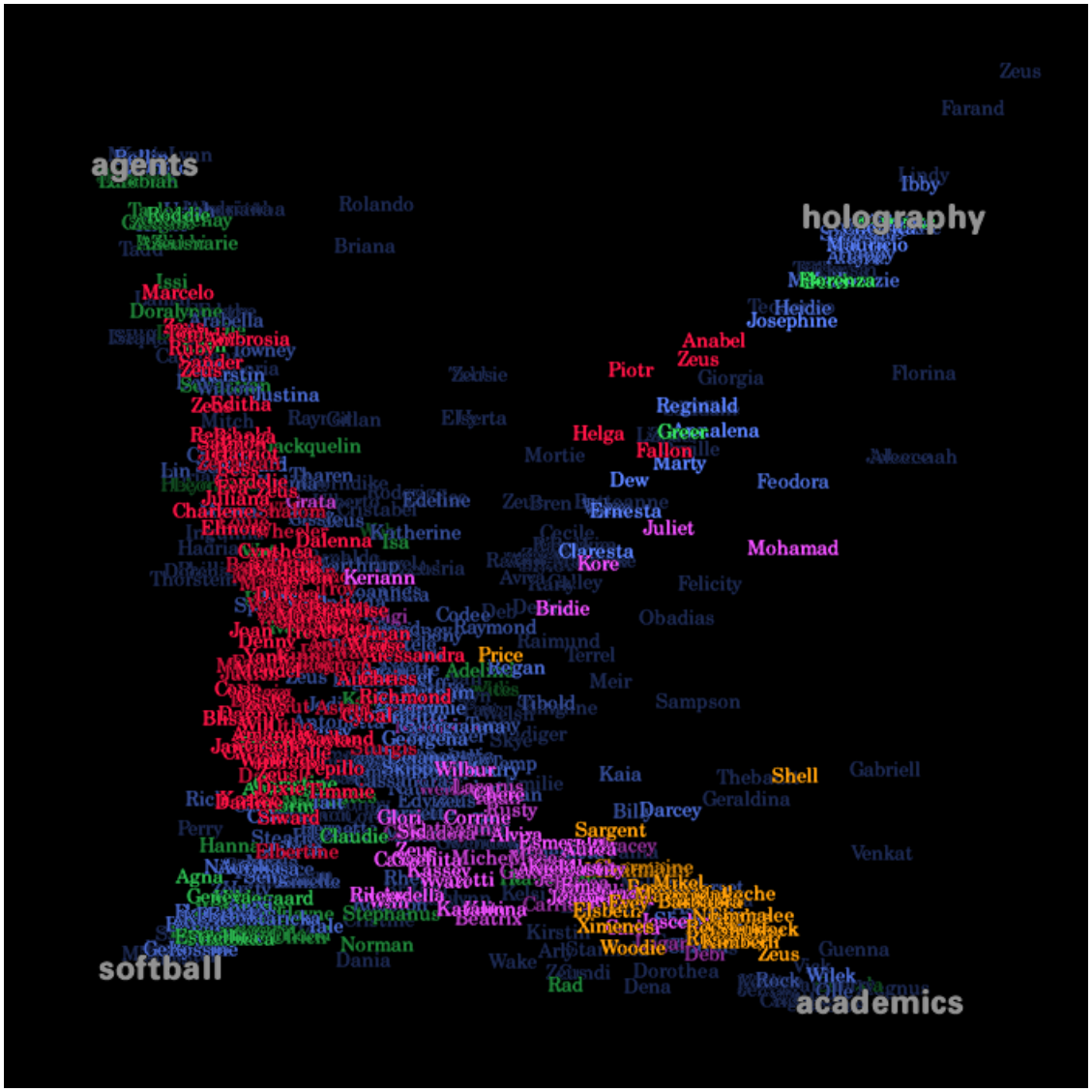


Your Social Network

Proposed solution

Spring system

- nodes start off in random positions
- all nodes repel one another
- there is an attraction force between nodes with a tie, relative to the strength of the tie

Use people as nodes and email messages to determine the ties between people

Determining Ties

Example

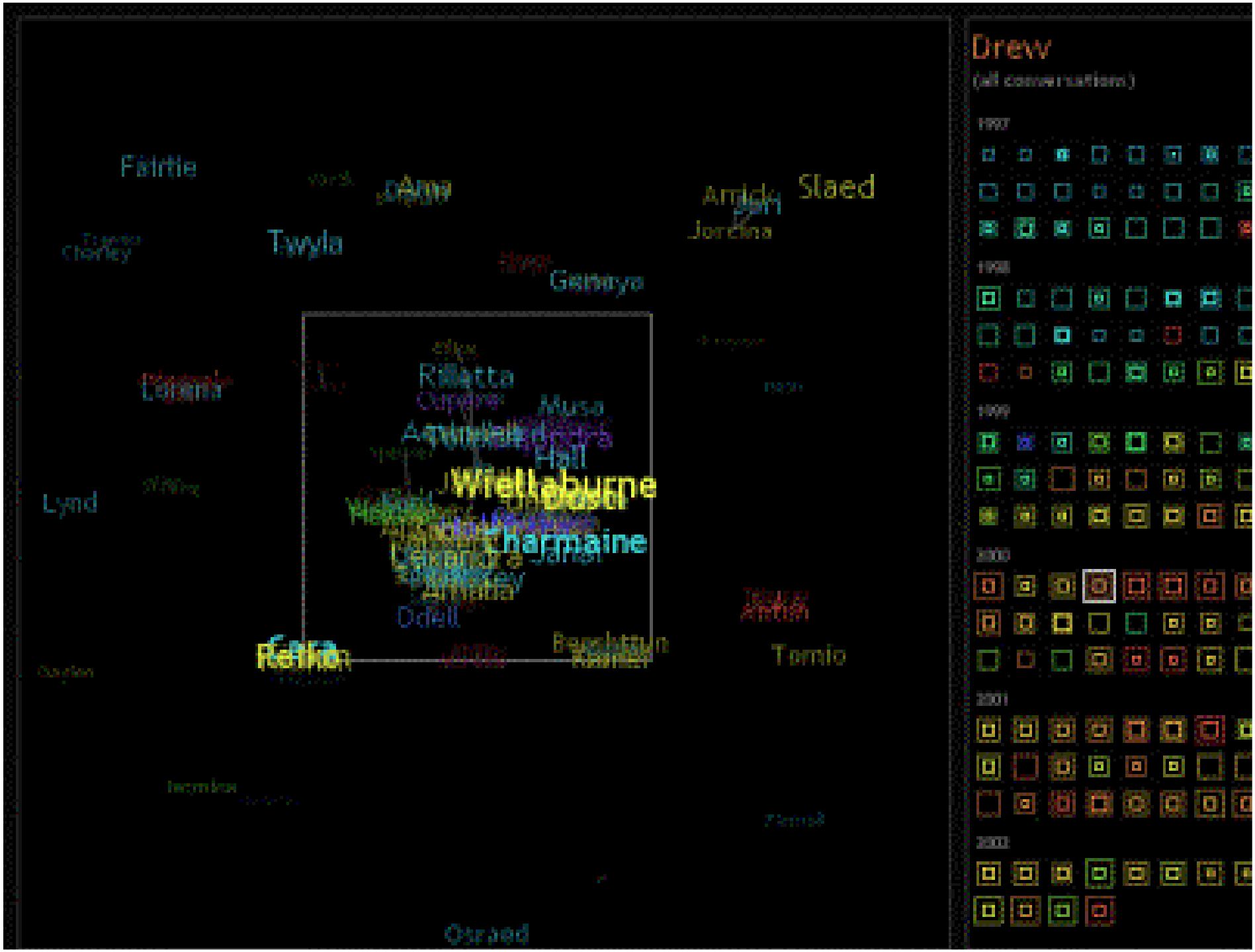
From: Drew
To: Mike, Taylor
BCC: Morgan, Kerry

Ties

Drew knows Mike
Mike is aware of Drew
Mike is loosely aware of Taylor
Drew knows & trusts Morgan

Coloring

Mike: College
Morgan: Family
All others: Work (because Drew is writing from work address)


Fairlie
Twyla
Slaed
Gennyo
Rillatta
Musa
Hall
Wiellaburne
Charmaine
Odell
Lynd
Tornio
Osraed
Drew
(all conversations)
1997
1998
1999
2000
2001
2002

Evaluation

Are the clusters meaningful?

Ask Drew

- colours
- groups

Weaknesses?

Evaluation

Weak points

- Unrelated individuals can appear close
- Longer names stand out more
- The colouring scheme must be carefully chosen
- Ties are only as good as the rules used to make them

IS THIS REALLY USEFUL TO SOMEONE?

Evaluation

Strong points

- Used real data
- Implementation fully described
- Evaluation attempted (although criteria for success not clearly explained)

Take-away messages

(1) Social groups and positions in groups can be visualized by considering the strength of connections between individuals (proximity data)

(2) Multidimensional scaling and Factor Analysis (aka. component analysis, SVD) are two ways displaying proximity data

(3) Spring systems layout nodes using repulsion and attraction forces which depend on proximity data

References

Visualizing Social Groups, Linton C. Freeman, American Statistical Association, 1999 Proceedings of the Section on Statistical Graphics, 2000, 47-54.

Visualizing Social Networks, Linton C. Freeman, Journal of Social Structure, 1, 2000, (1).

Social Network Fragments, Dana Boyd, MIT Master's Thesis: Faceted Id/entity: Managing Representation in a Digital World, Chapter 7.

Visual Who, Judith Donath, Proceedings of ACM Multimedia '95, Nov 5-9, San Francisco, CA.