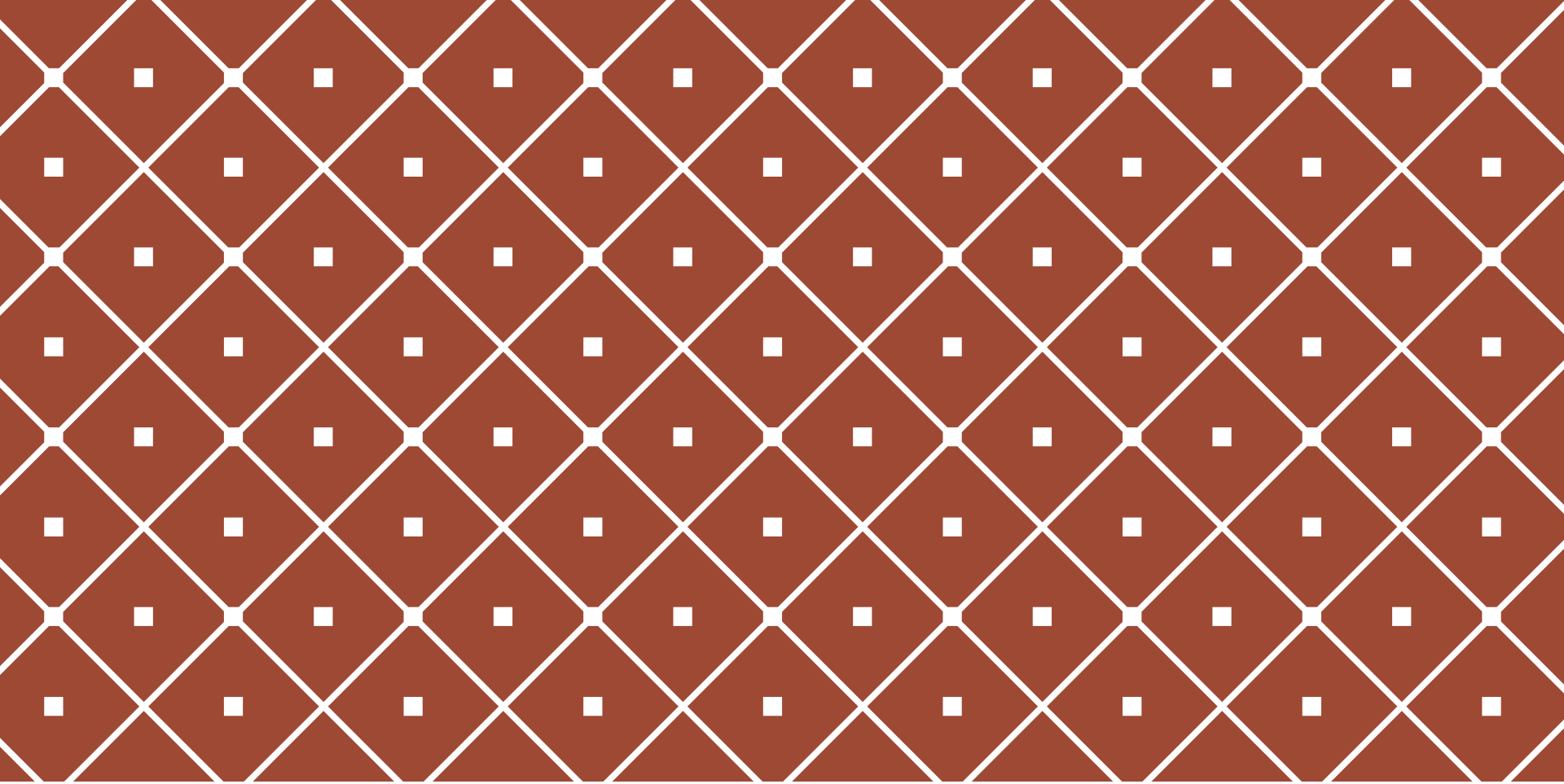


DIGITAL SCHOLARSHIP
NETWORKS & VISUALIZATIONS

Presentation
9:00-10:15

SCHEDULE

9:00-10:15

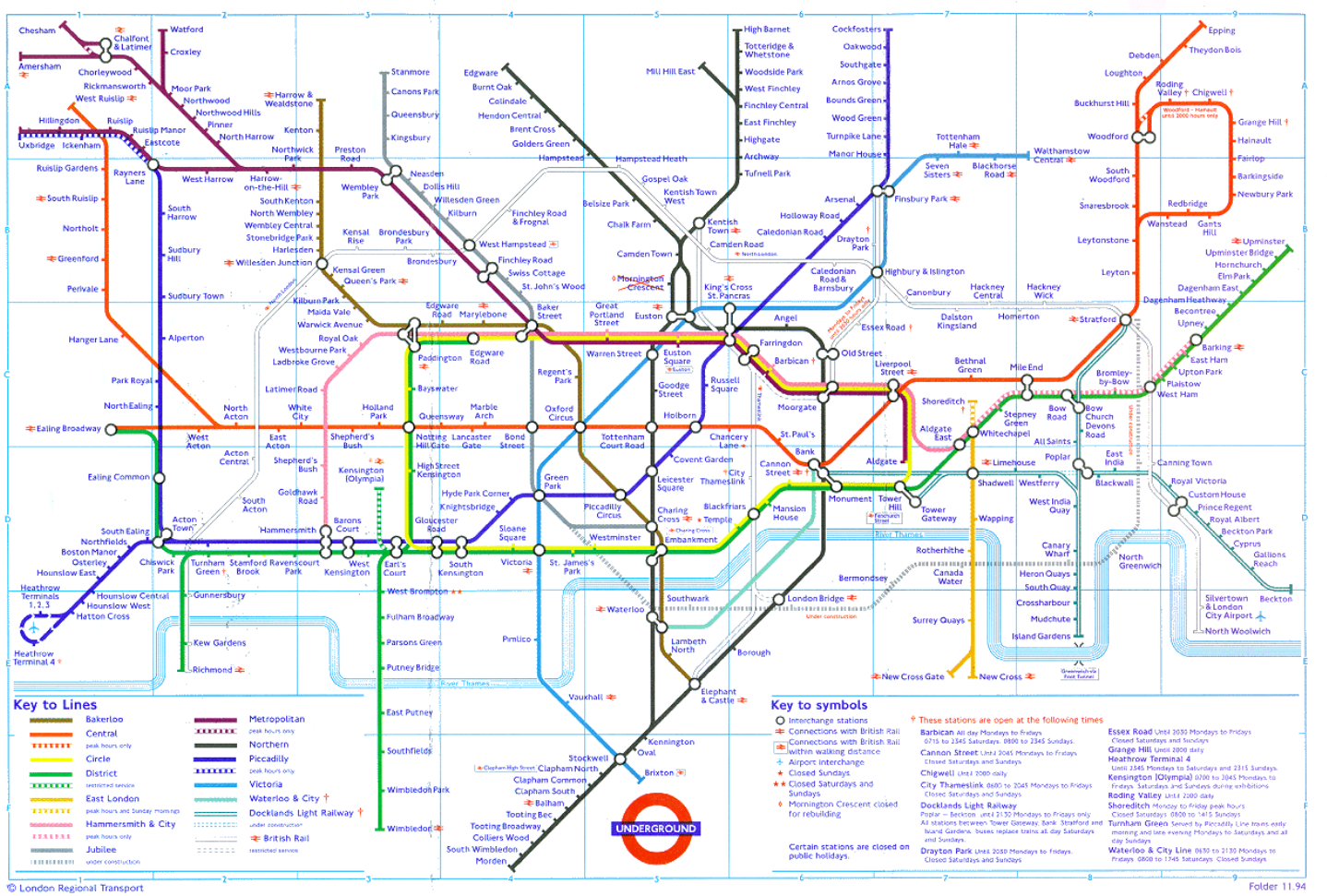
- Presentation: Research with Networks & Visualizations

14:45-16:30

- Workshop: Building Networks & Visualizations

NETWORKS EVERYWHERE

09:00-09:15	The Ubiquity of Networks
09:15-09:30	Basic Concepts
09:30-10:00	Information Visualization
10:00-10:15	Q&A



LONDON UNDERGROUND

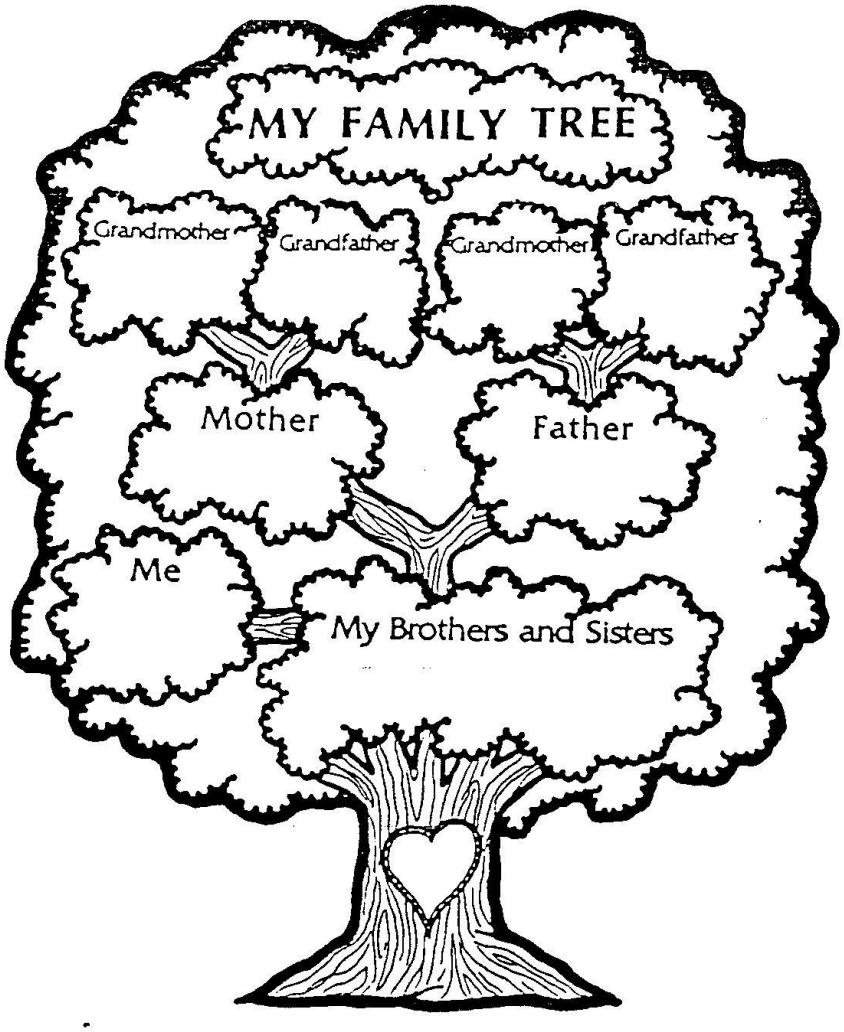
A network of stations.

FACEBOOK FRIENDS

A network of friends.

UNITED STATES RIVERS

A network of water.

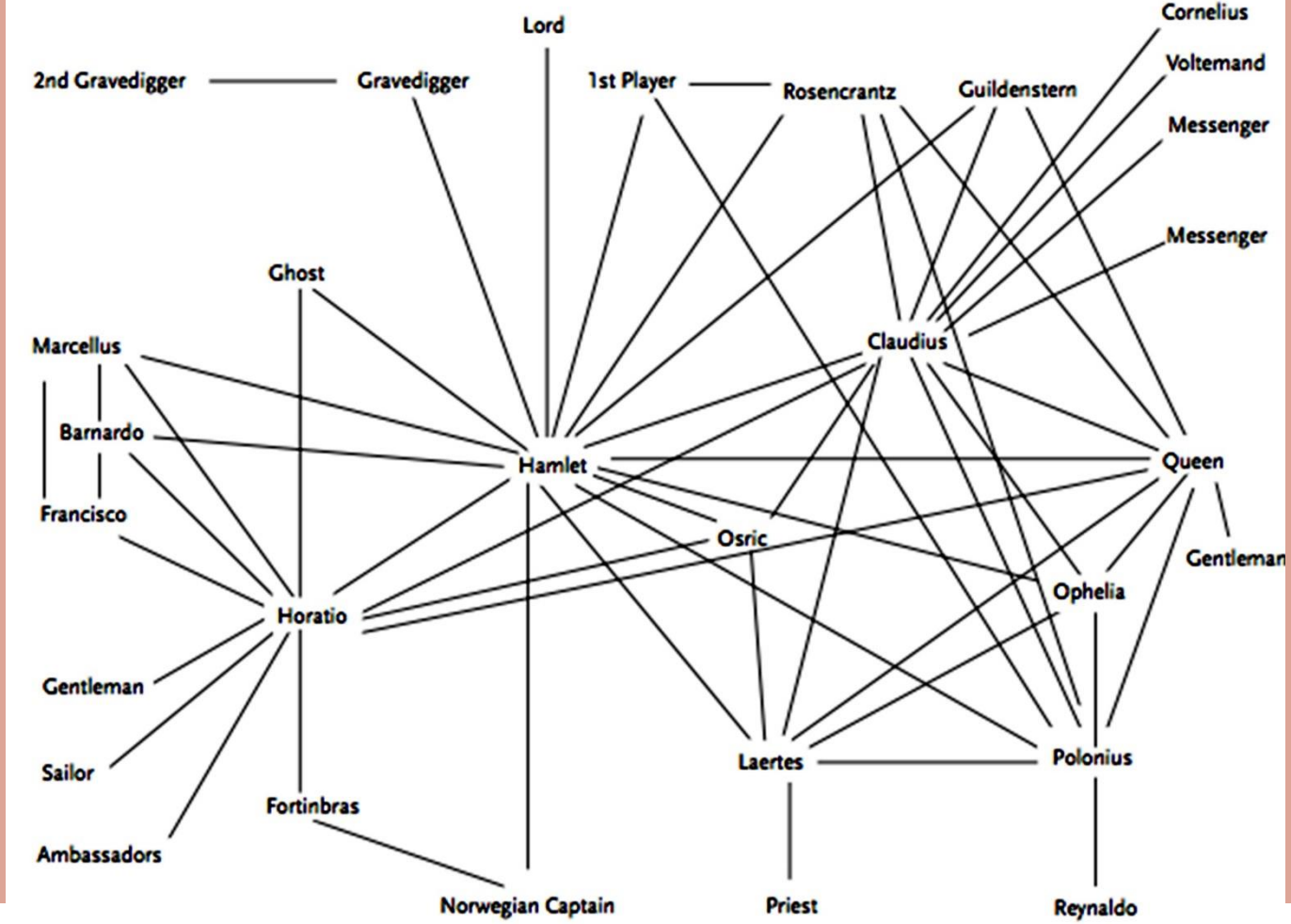


FAMILY TREE

A network of relations.

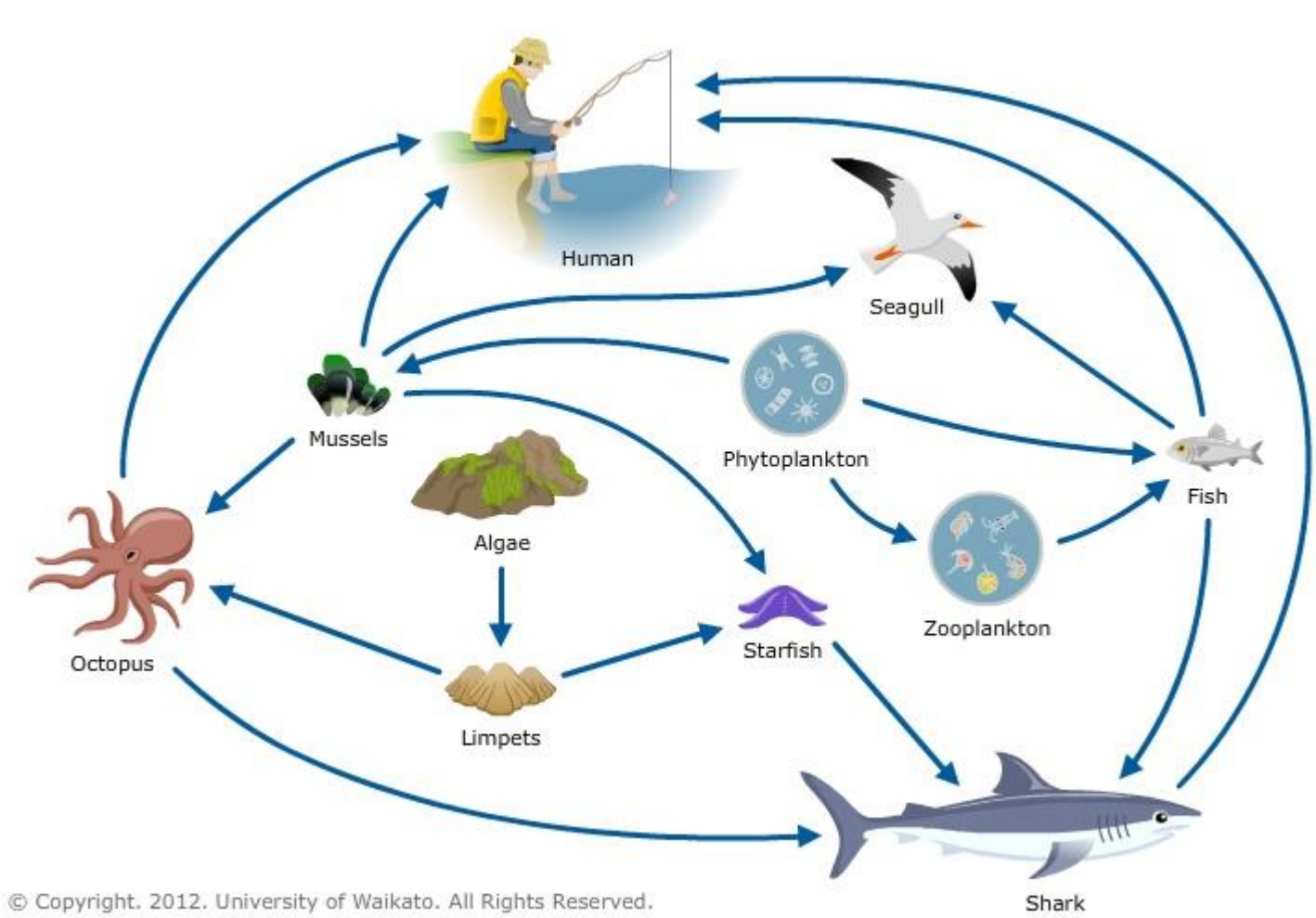
TELEGRAPH CABLES

A 1901 network of submarine communication.



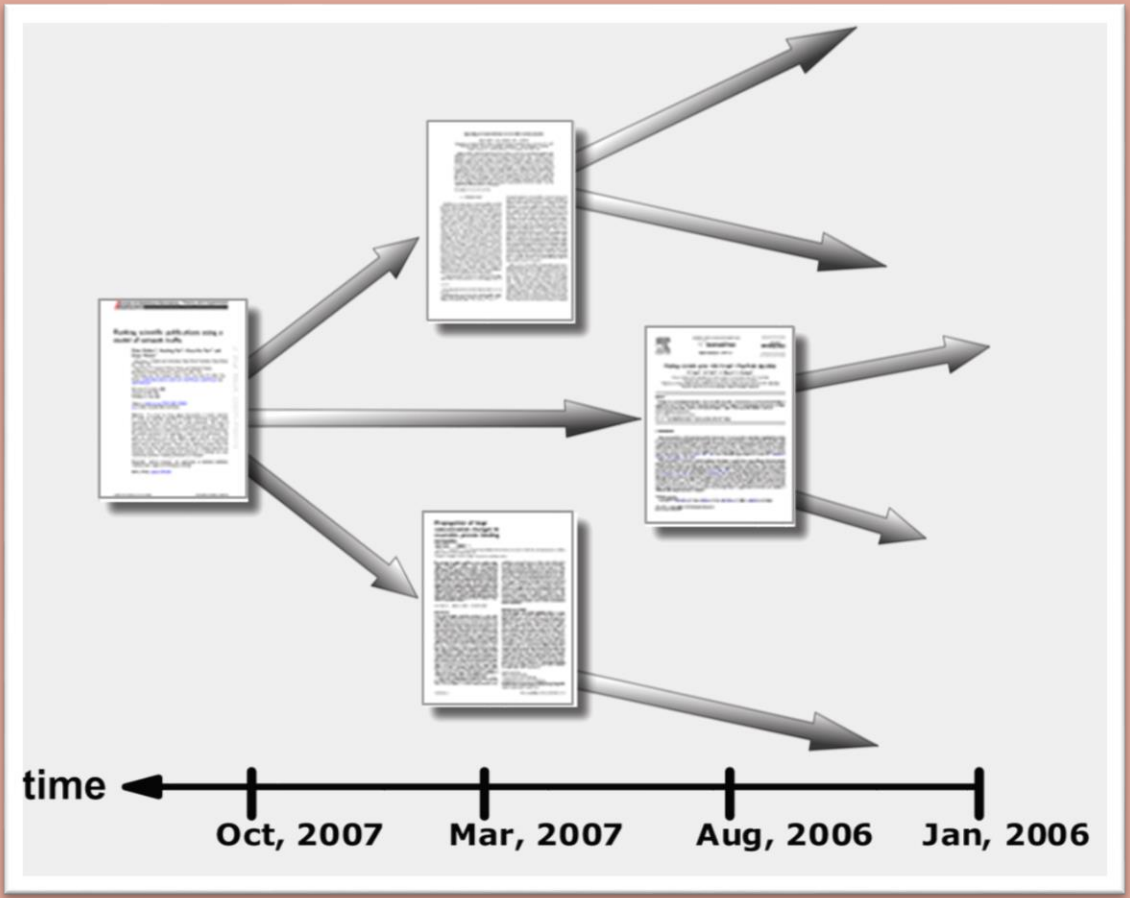
HAMLET

A network of stage time.



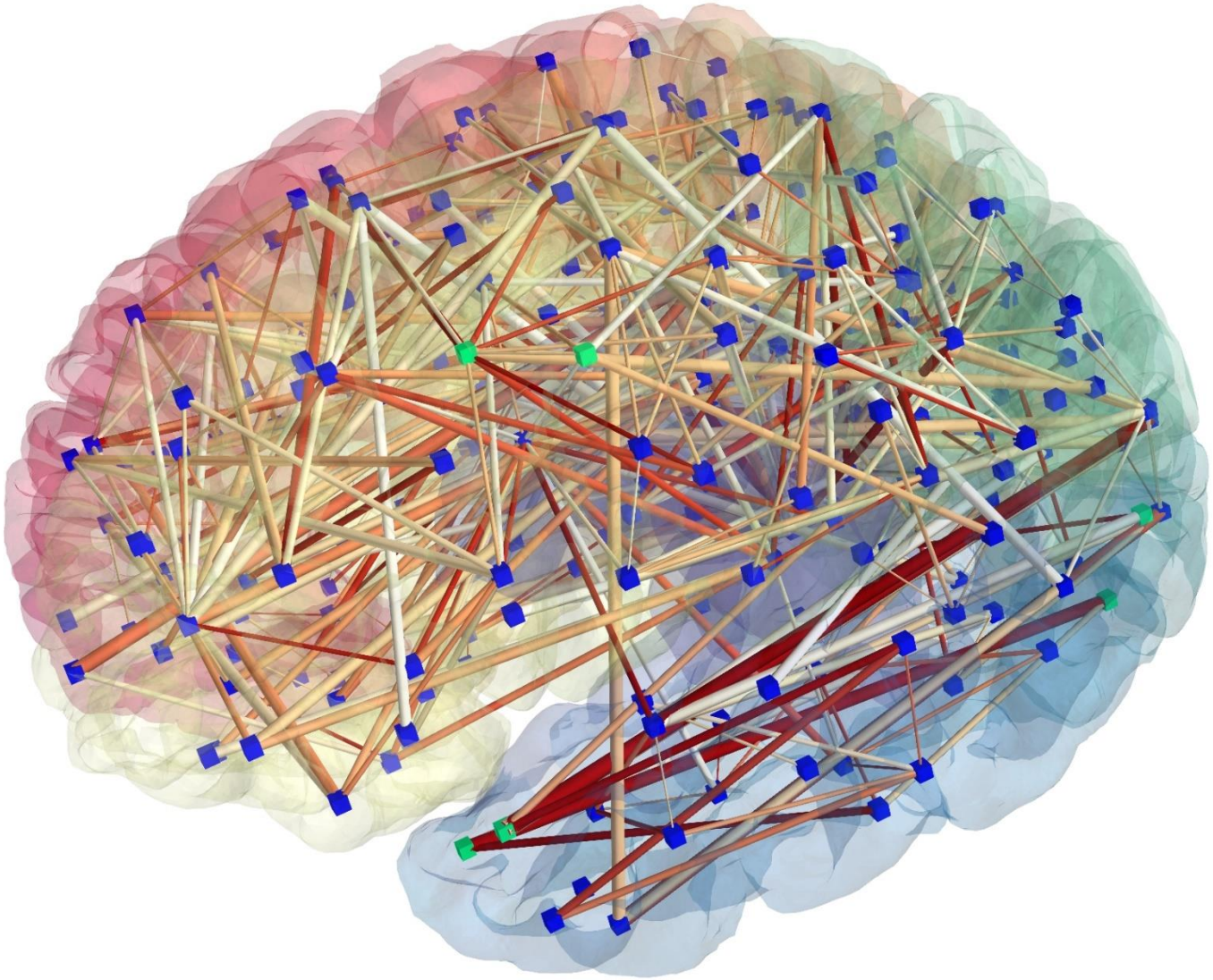
FOOD WEB

A network of eating.



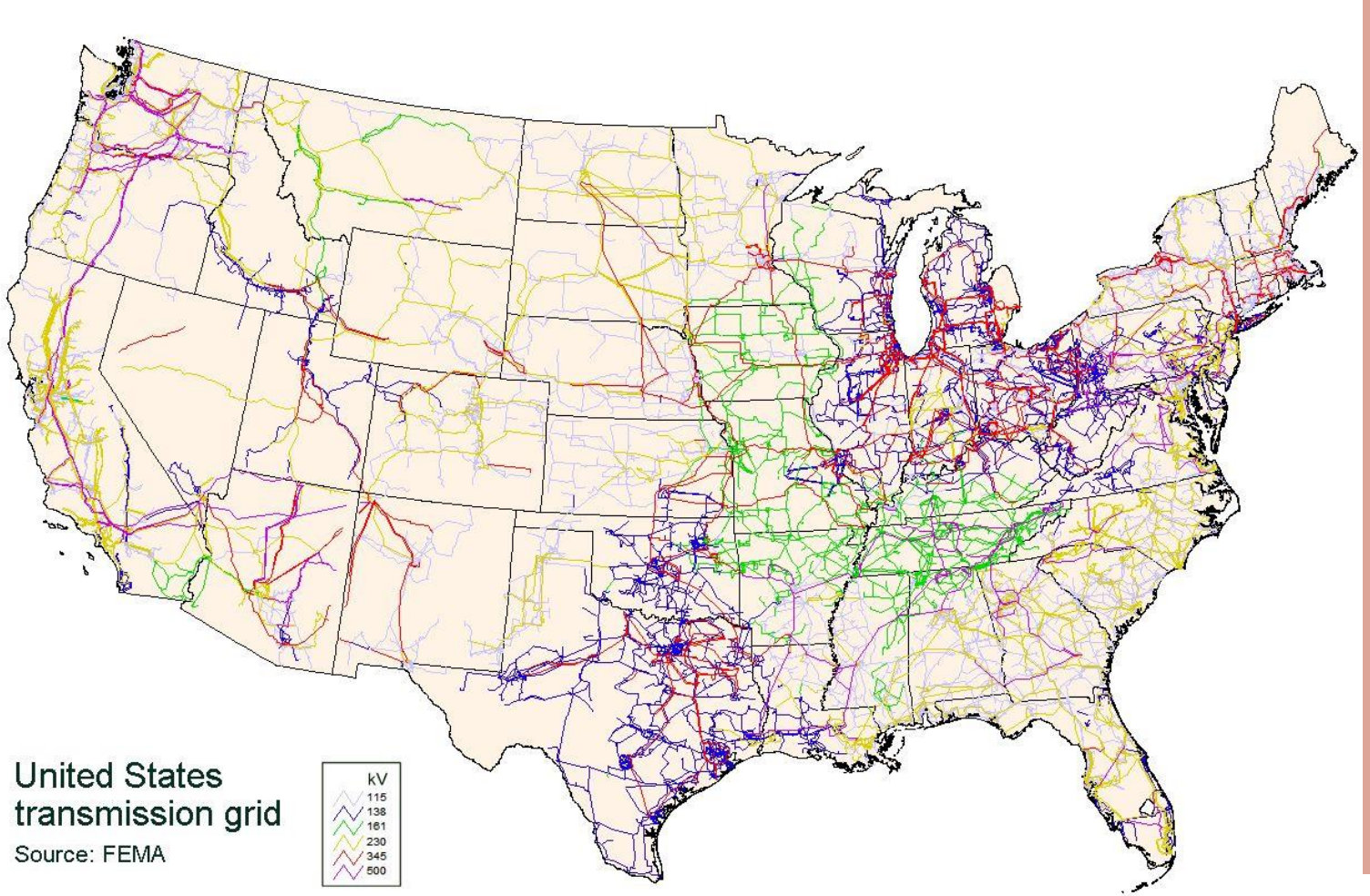
CITED ARTICLES

A network of text.



YOUR BRAIN

A network of neurons.



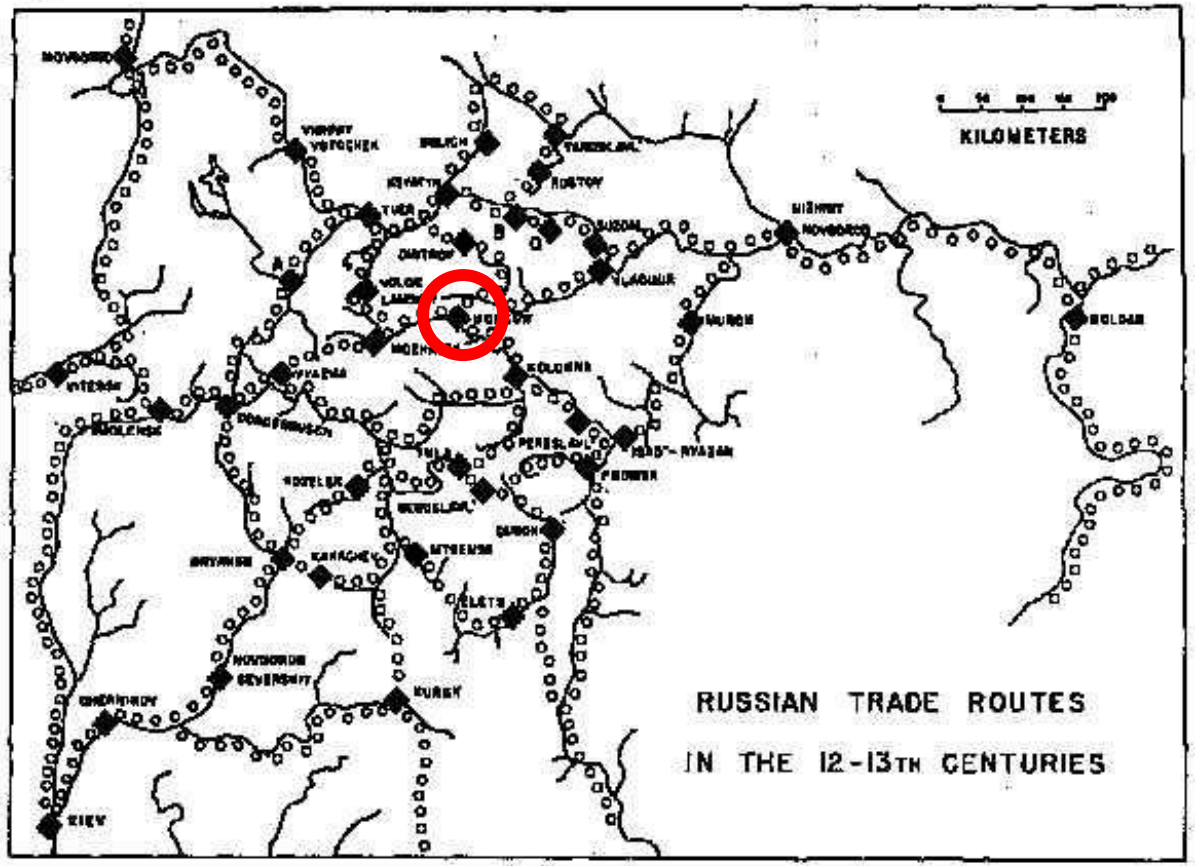
ELECTRICAL GRID

A network of power.

ELECTRICAL GRID

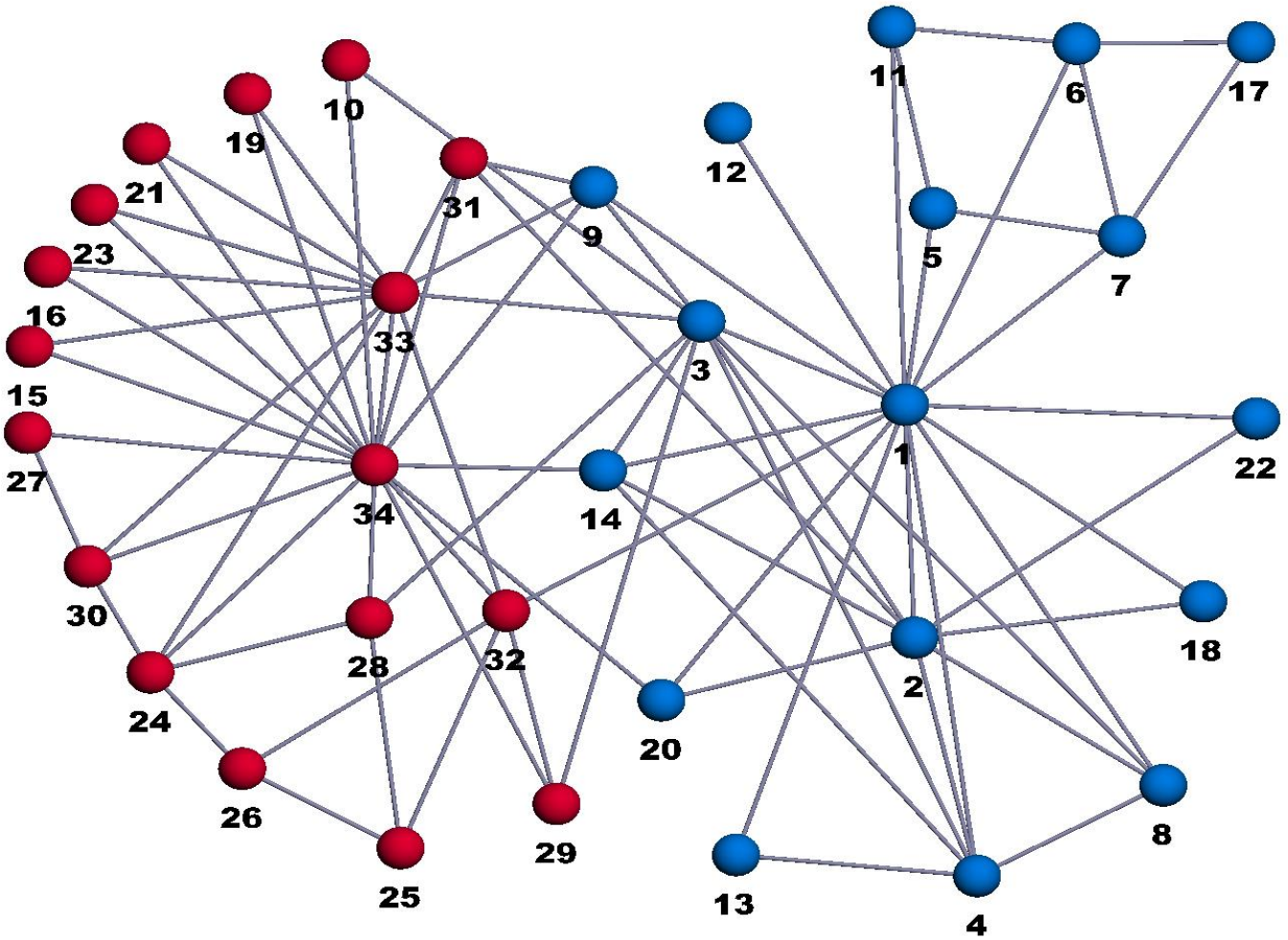
A network of power.

Figure 1. *Russian trade routes in the 12th - 13th centuries.*



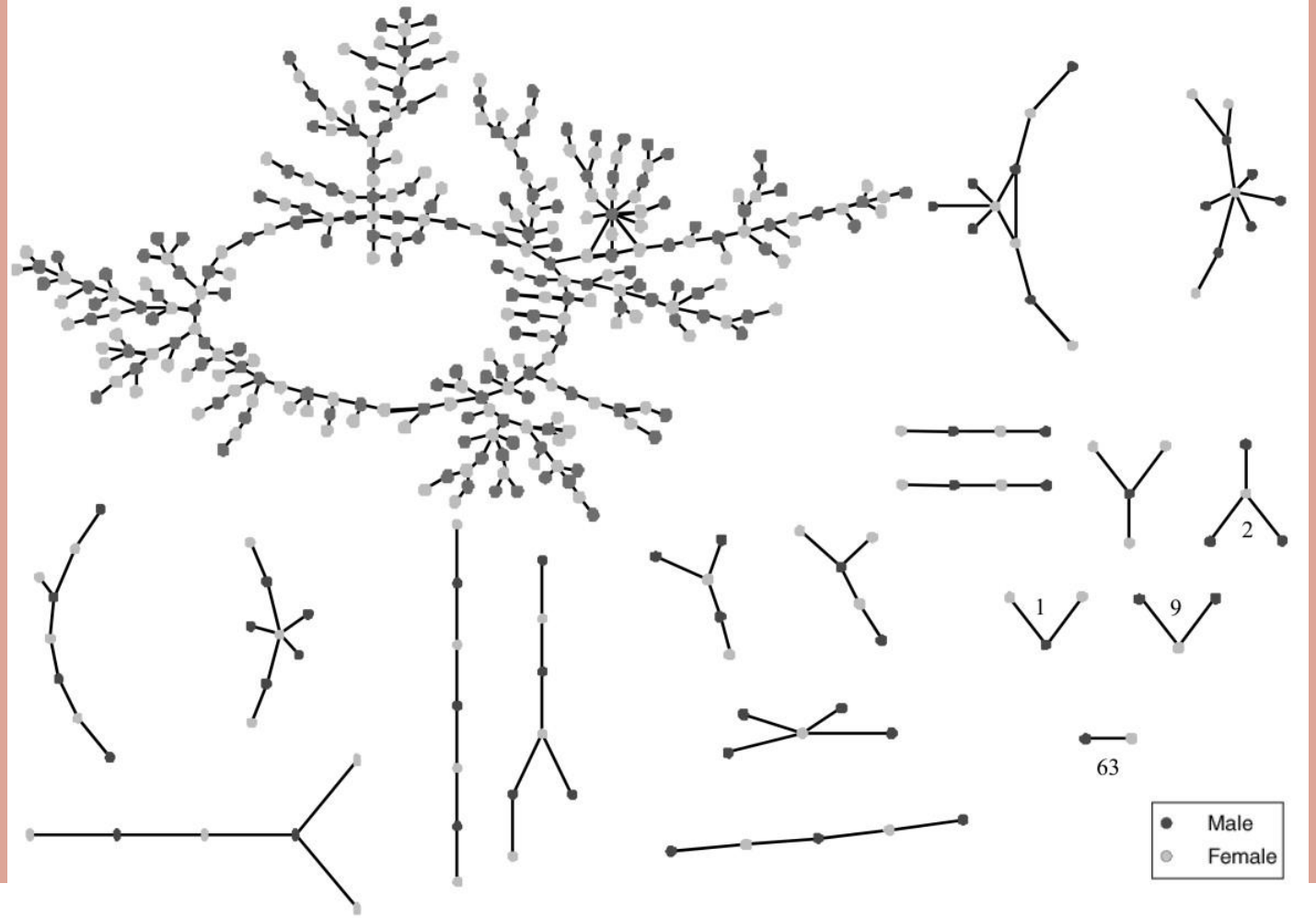
RUSSIAN RIVER NETWORKS

Moscow in between.



ZACHARY'S KARATE CLUB

Friendship and the start of a new Karate club.



JEFFERSON HIGH

How safe is having a single partner? How fast can disease spread?

BUILDING BLOCKS

09:00-09:15	The Ubiquity of Networks
09:15-09:30	Basic Concepts
09:30-10:00	Information Visualization
10:00-10:15	Q&A

WHAT IS A NETWORK?

entities

- people
- organizations
- concepts
- objects
- documents
- etc.

connected to each other by

relationships

- "is friends with"
- "shares a board member with"
- "is similar to"
- "is a type of"
- "contains a reference to"
- etc.

WHAT IS A NETWORK?

entities

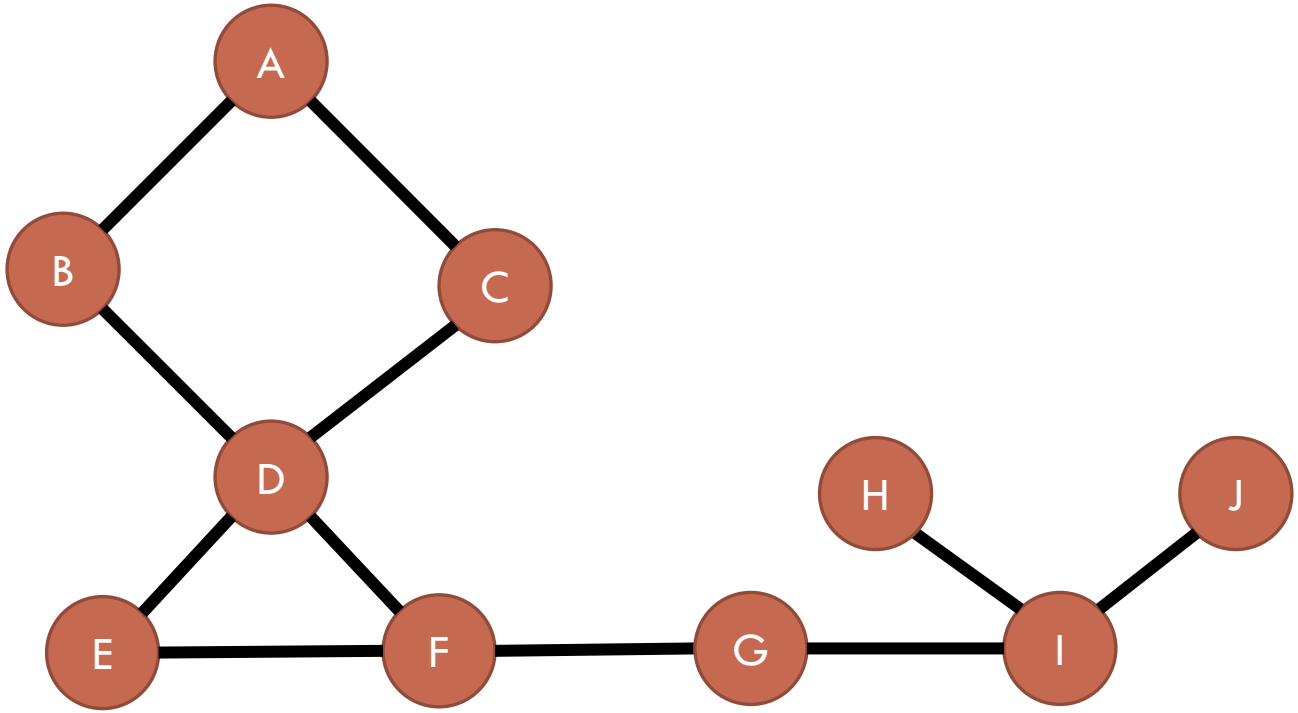
- nodes
- actors
- agents
- vertices
- points
- etc.

connected to each other by

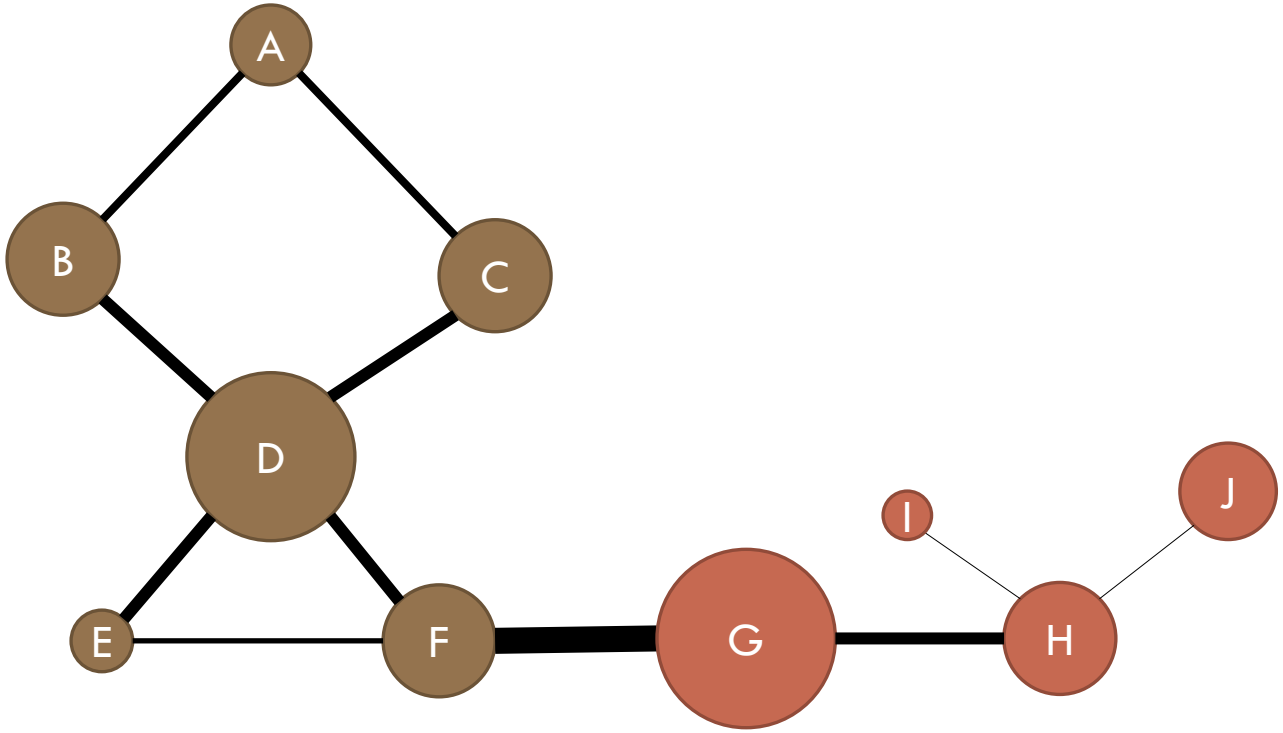
relationships

- edges
- arcs
- links
- ties
- relations
- etc.

NODES AND EDGES

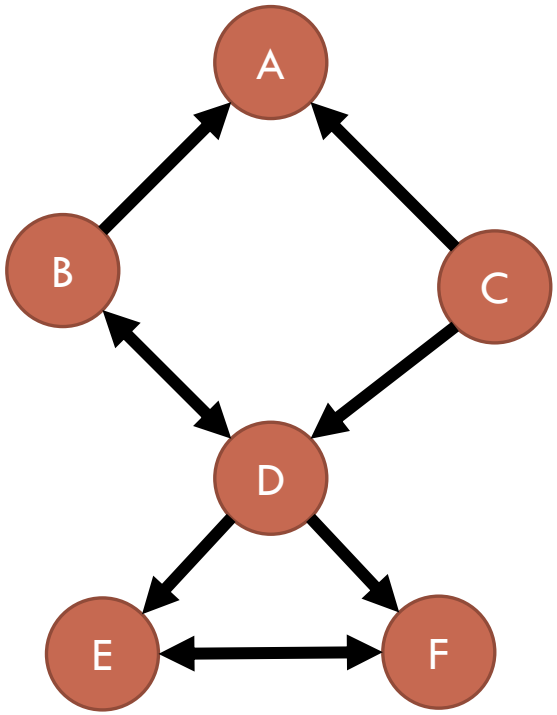


ATTRIBUTES

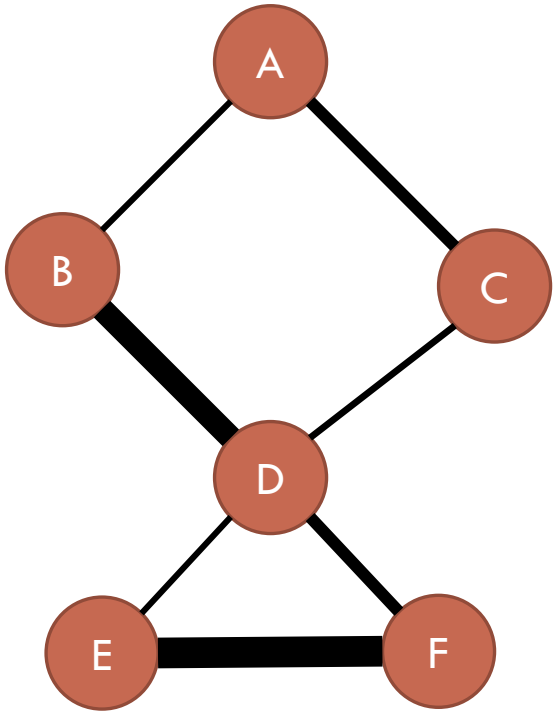


EDGE ATTRIBUTES

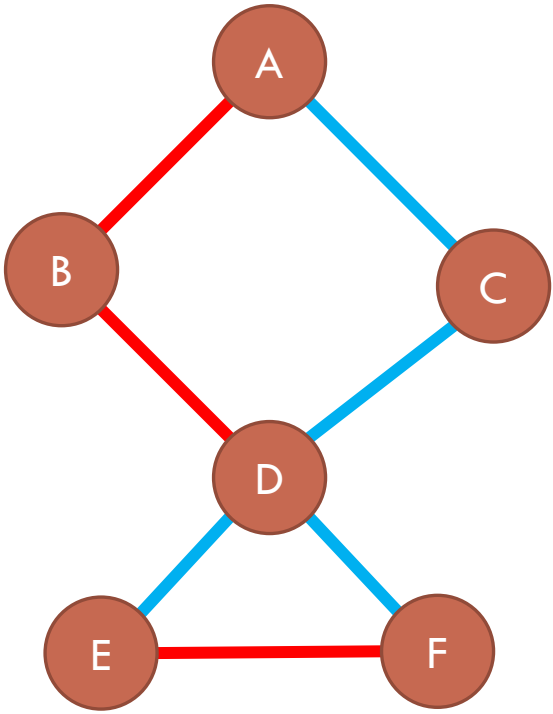
Directed & Undirected



Weighted & Unweighted

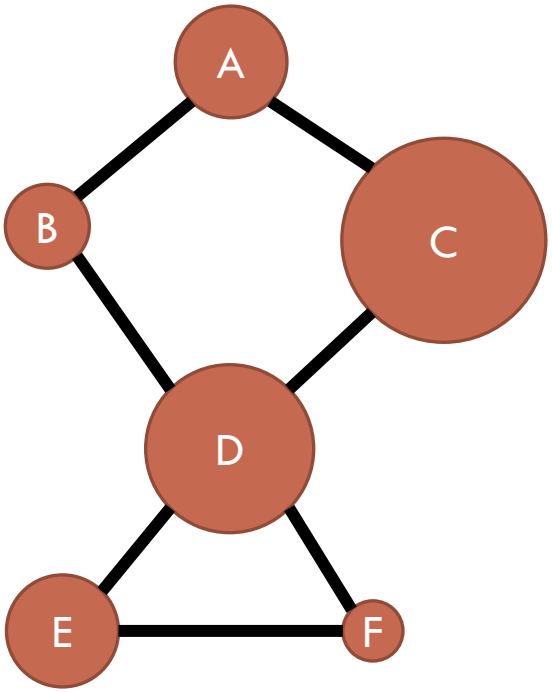


Types



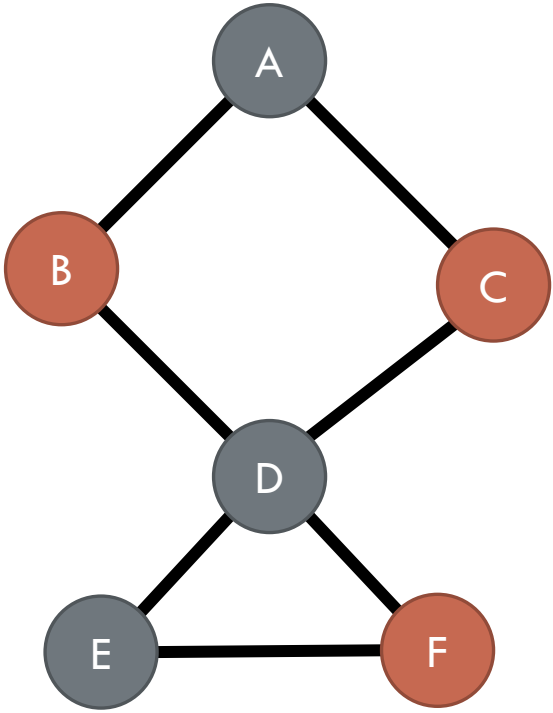
NODE ATTRIBUTES

Numerical



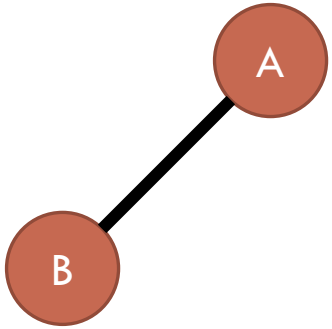
- Gender
- Location
- Start/End Time
- Age
- Title
- Salary
- Electrical Output
- GDP
- Genre
- Full Text

Categorical

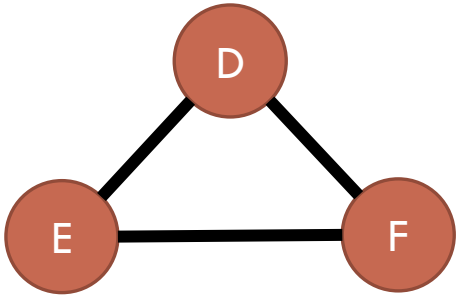


DYADS AND TRIADS

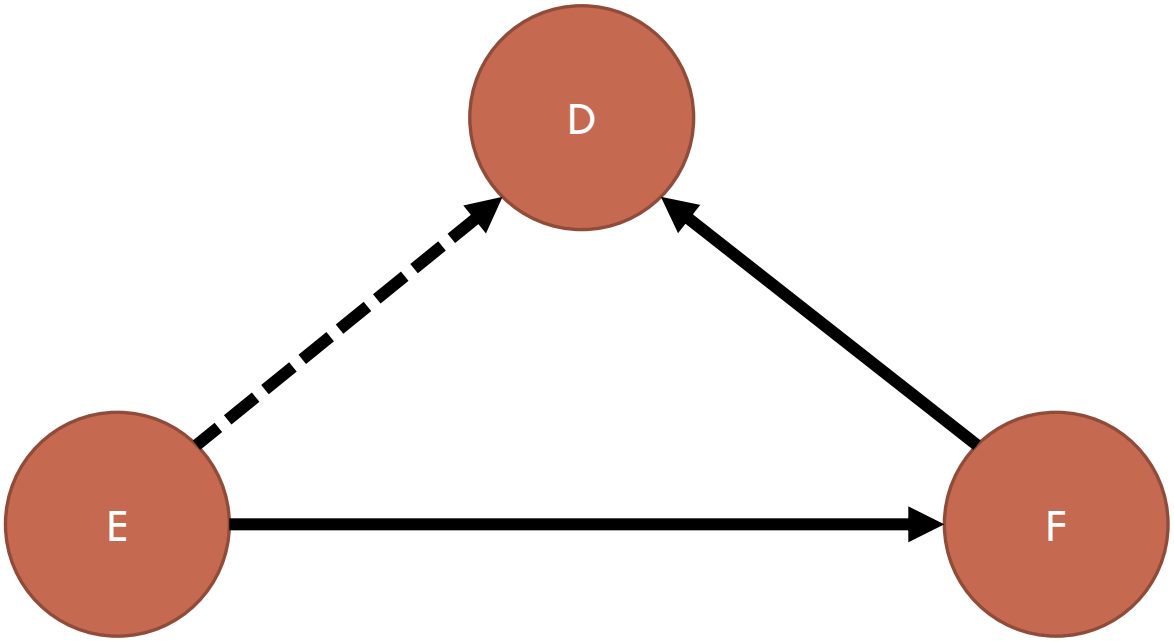
Dyad



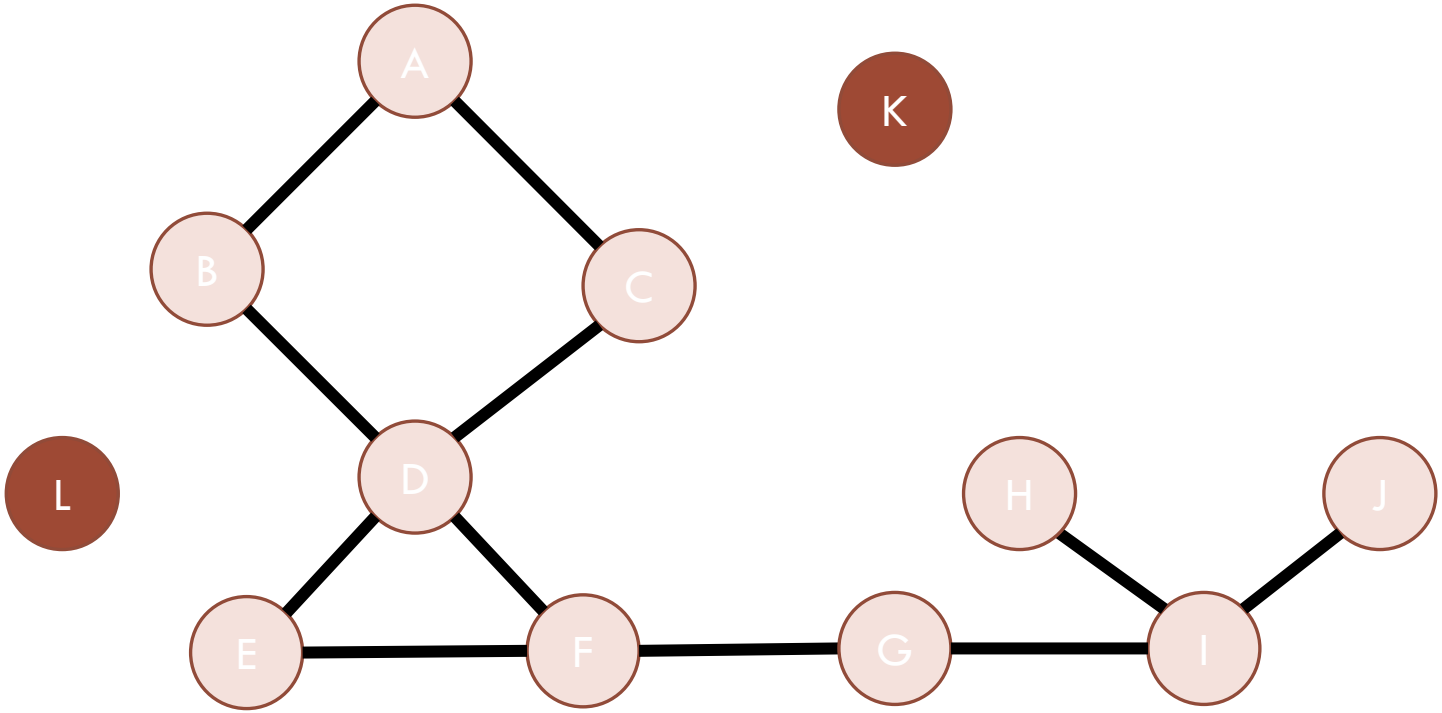
Triad



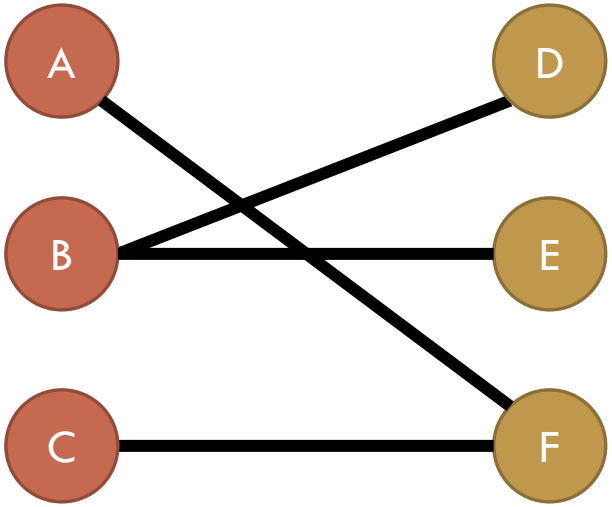
TRANSITIVITY



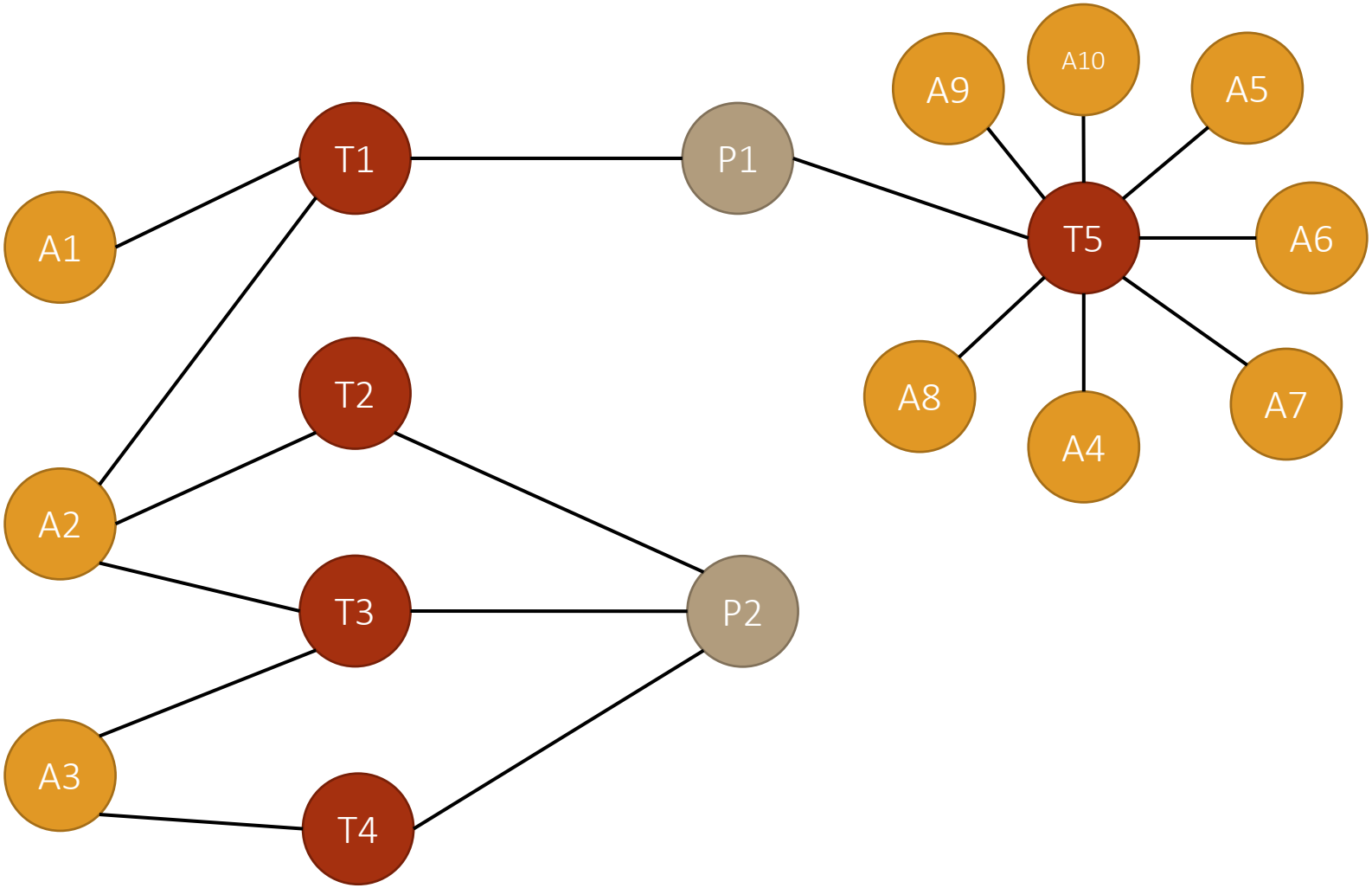
ISOLATES



BIPARTITE NETWORKS

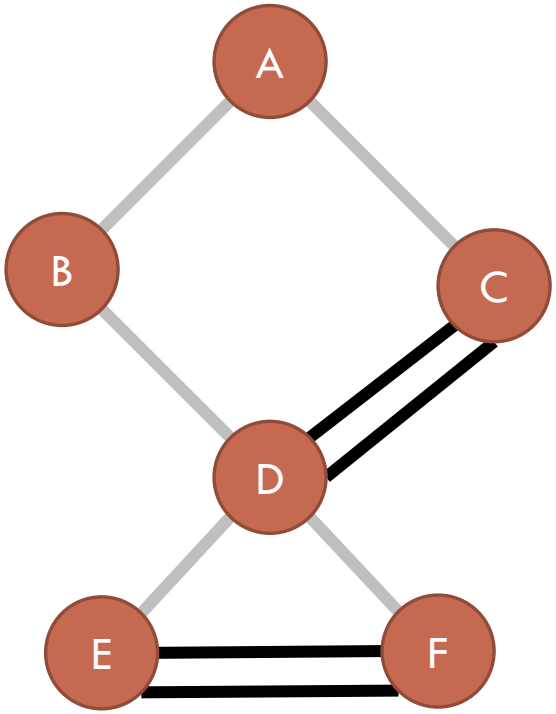


K-PARTITE NETWORKS

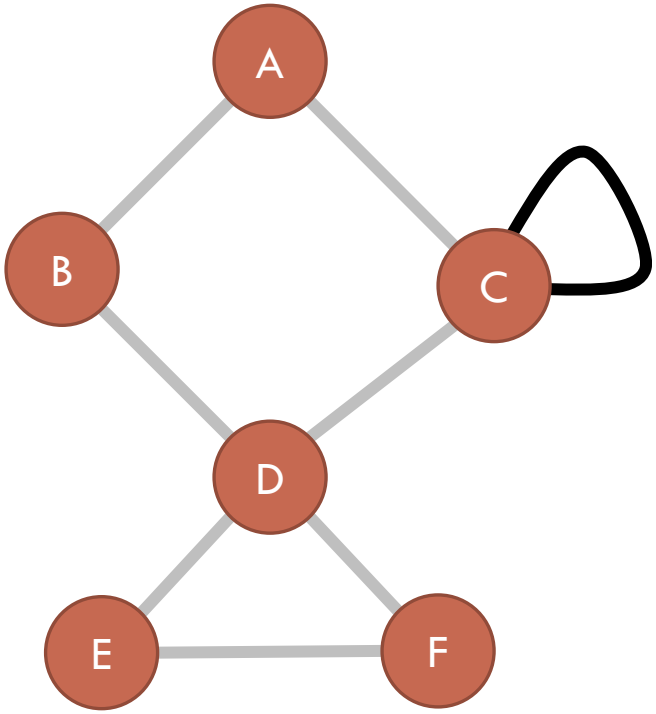


PARALLEL EDGES & SELF-LOOPS

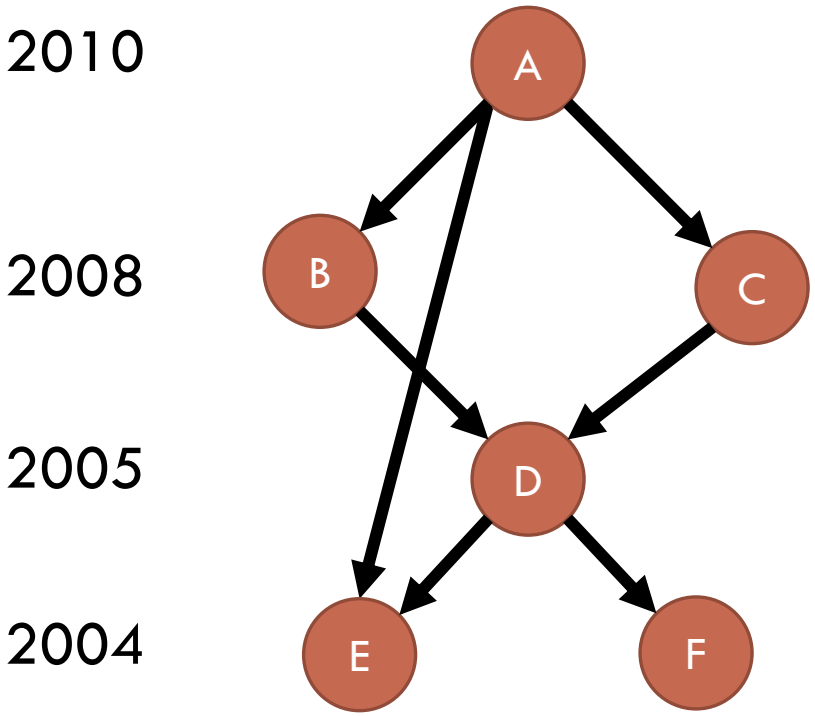
Parallel Edges



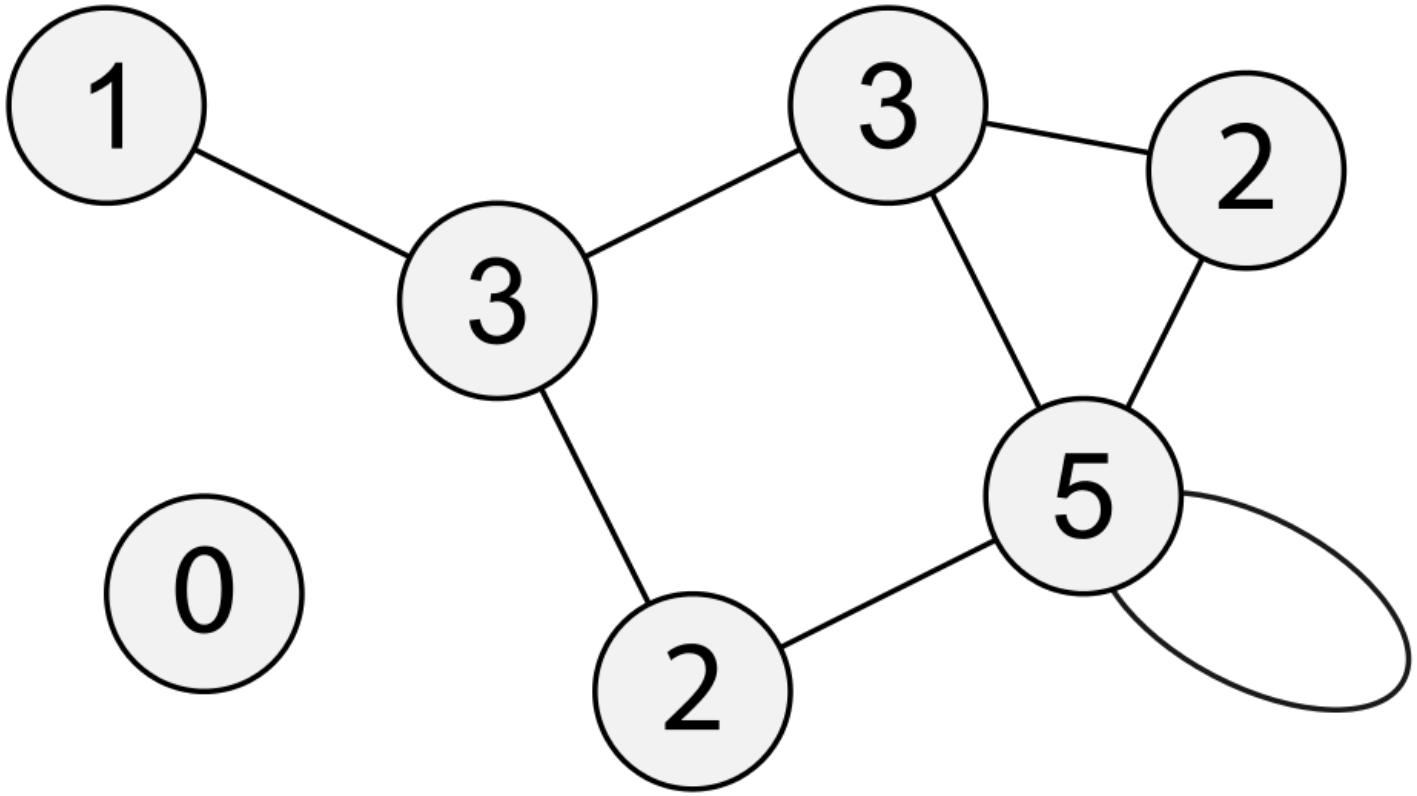
Self-Loops



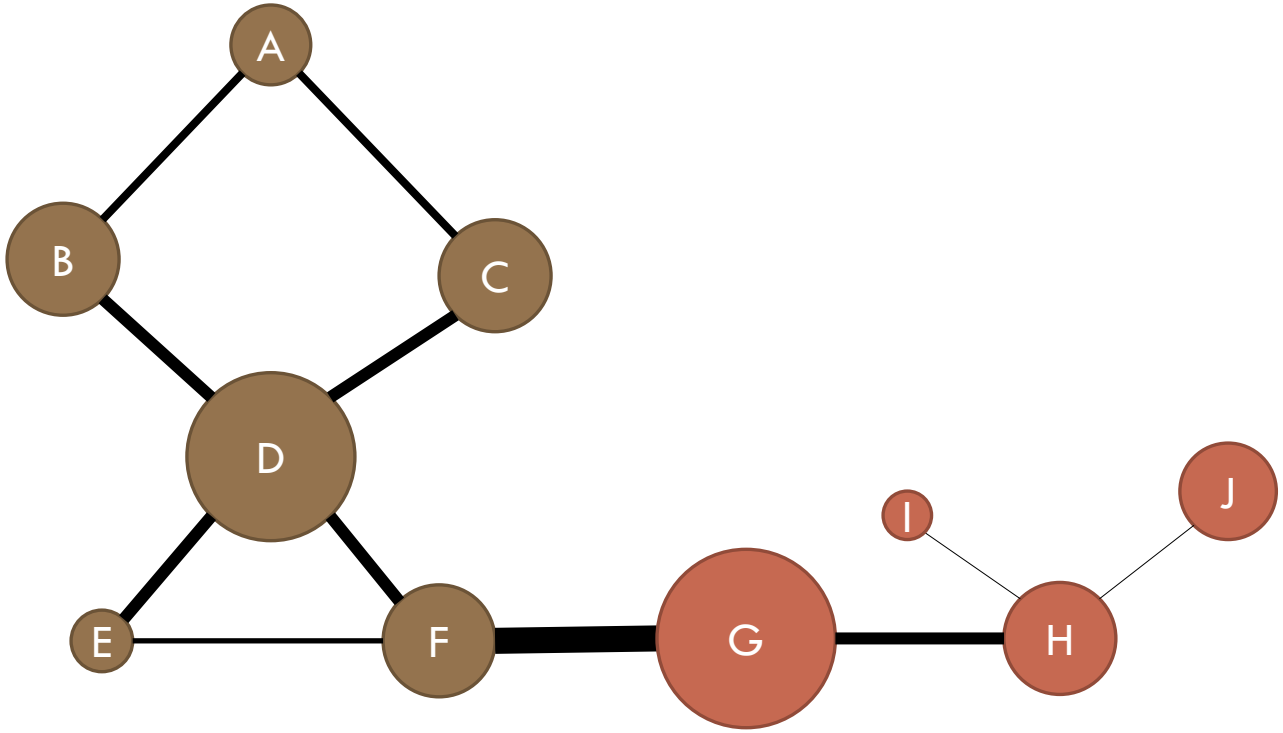
DIRECTED ACYCLIC GRAPHS



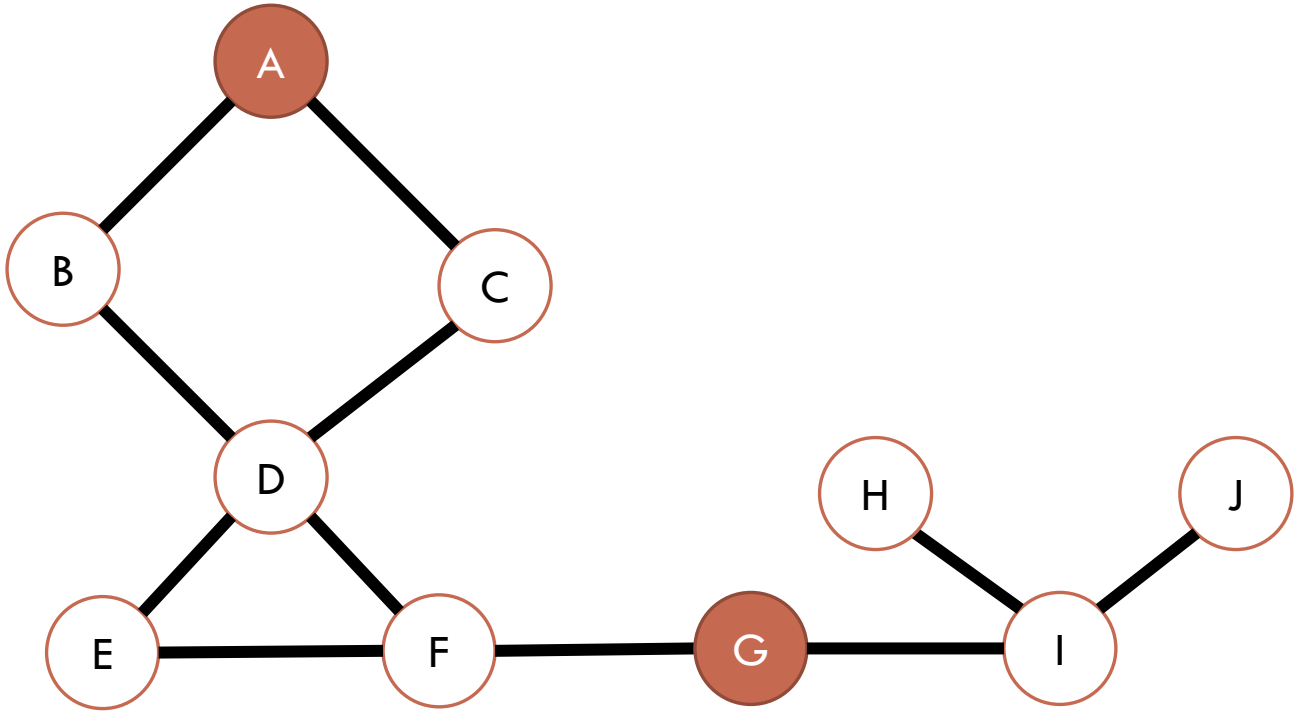
DEGREE CENTRALITY



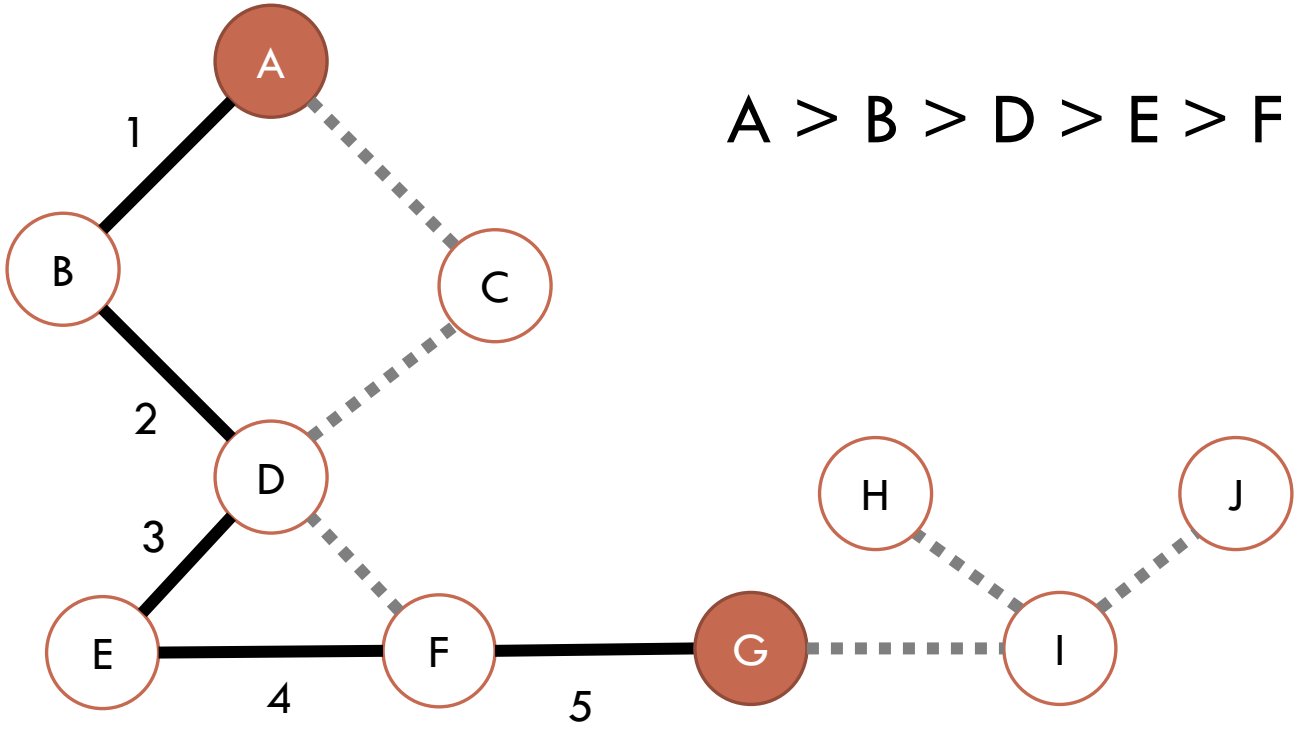
WEIGHTED DEGREE



NETWORK PATH

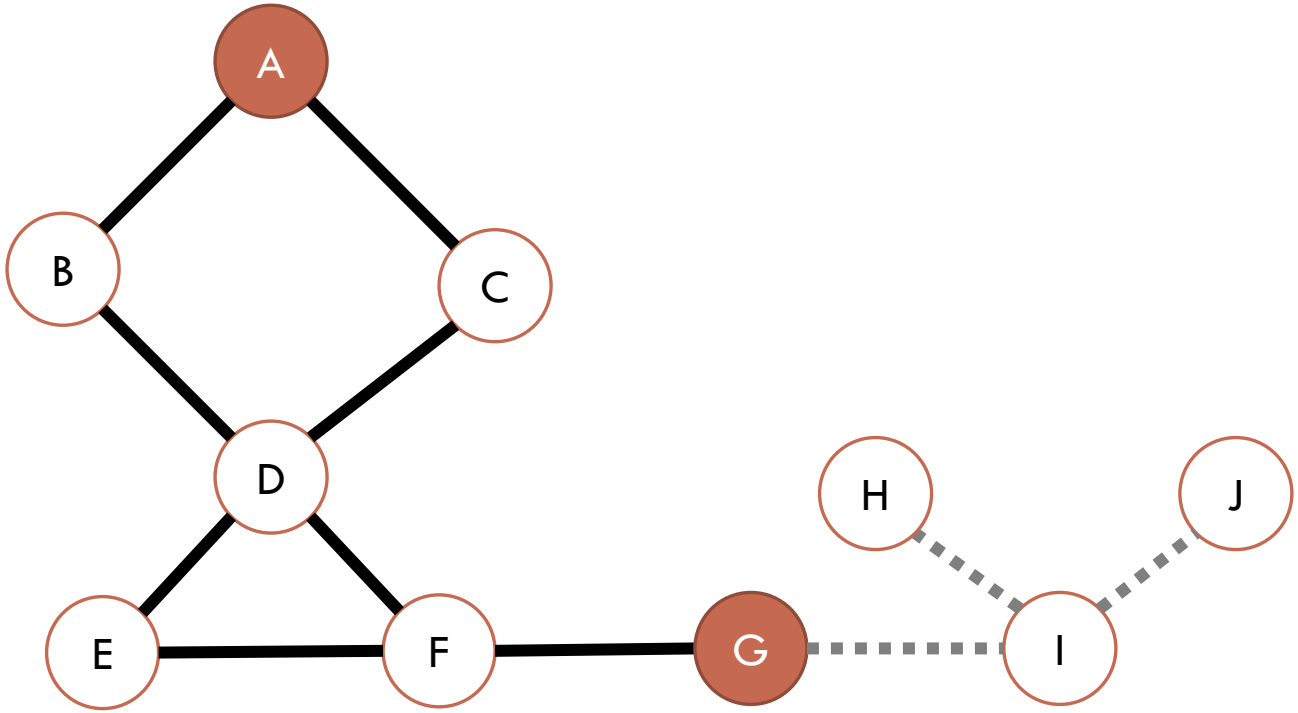


NETWORK PATH

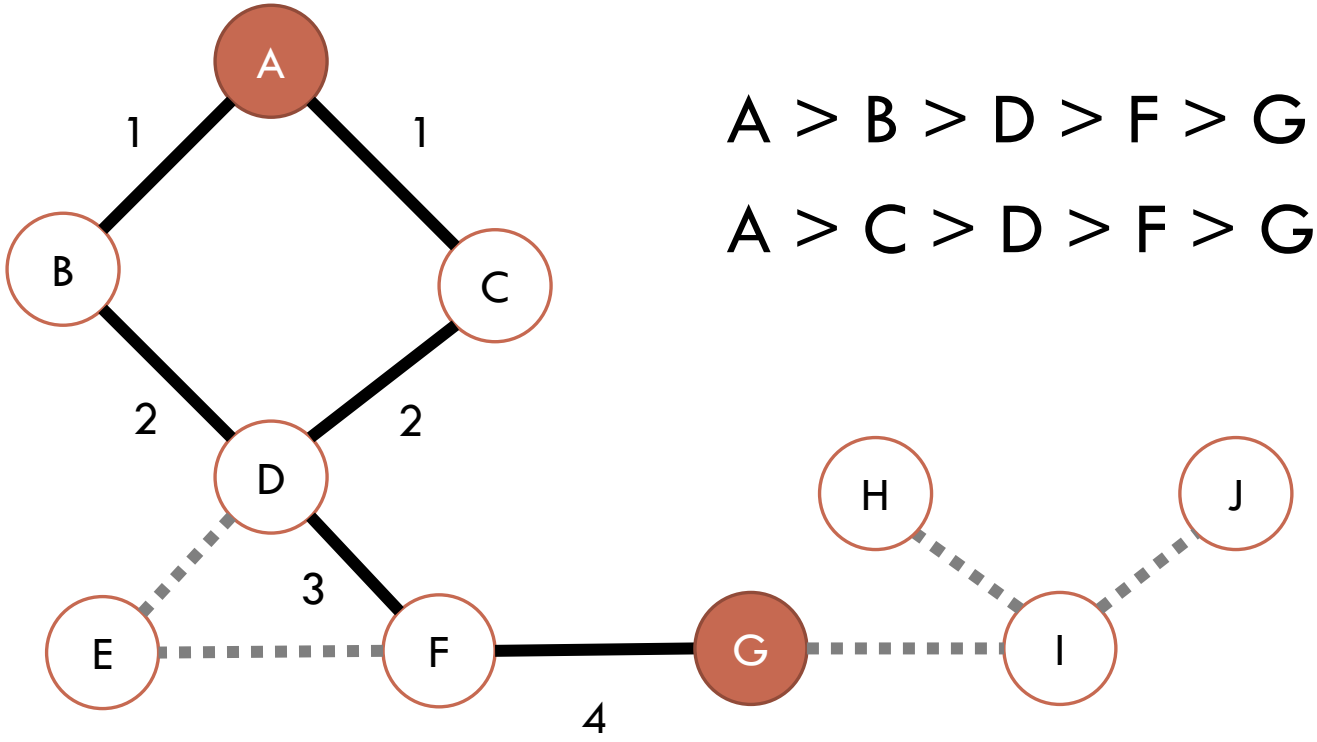


A > B > D > E > F > G

NETWORK PATHS



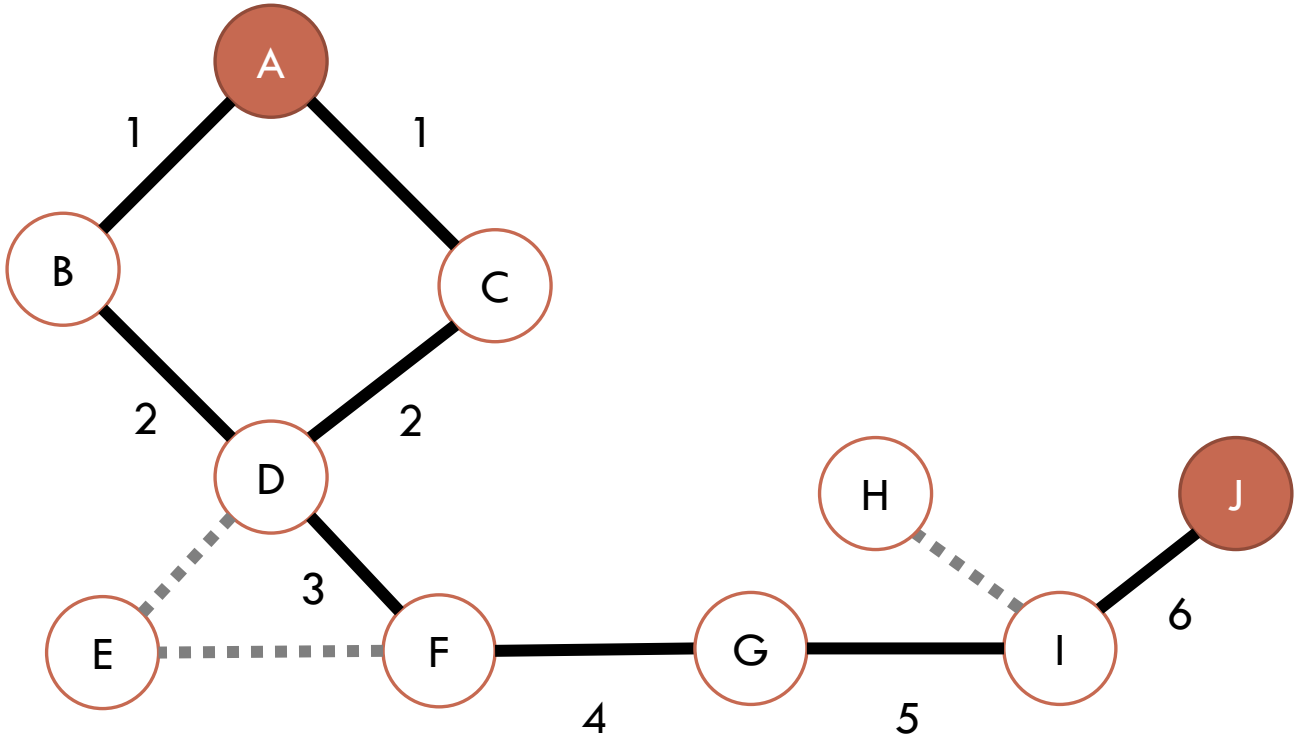
SHORTEST PATH



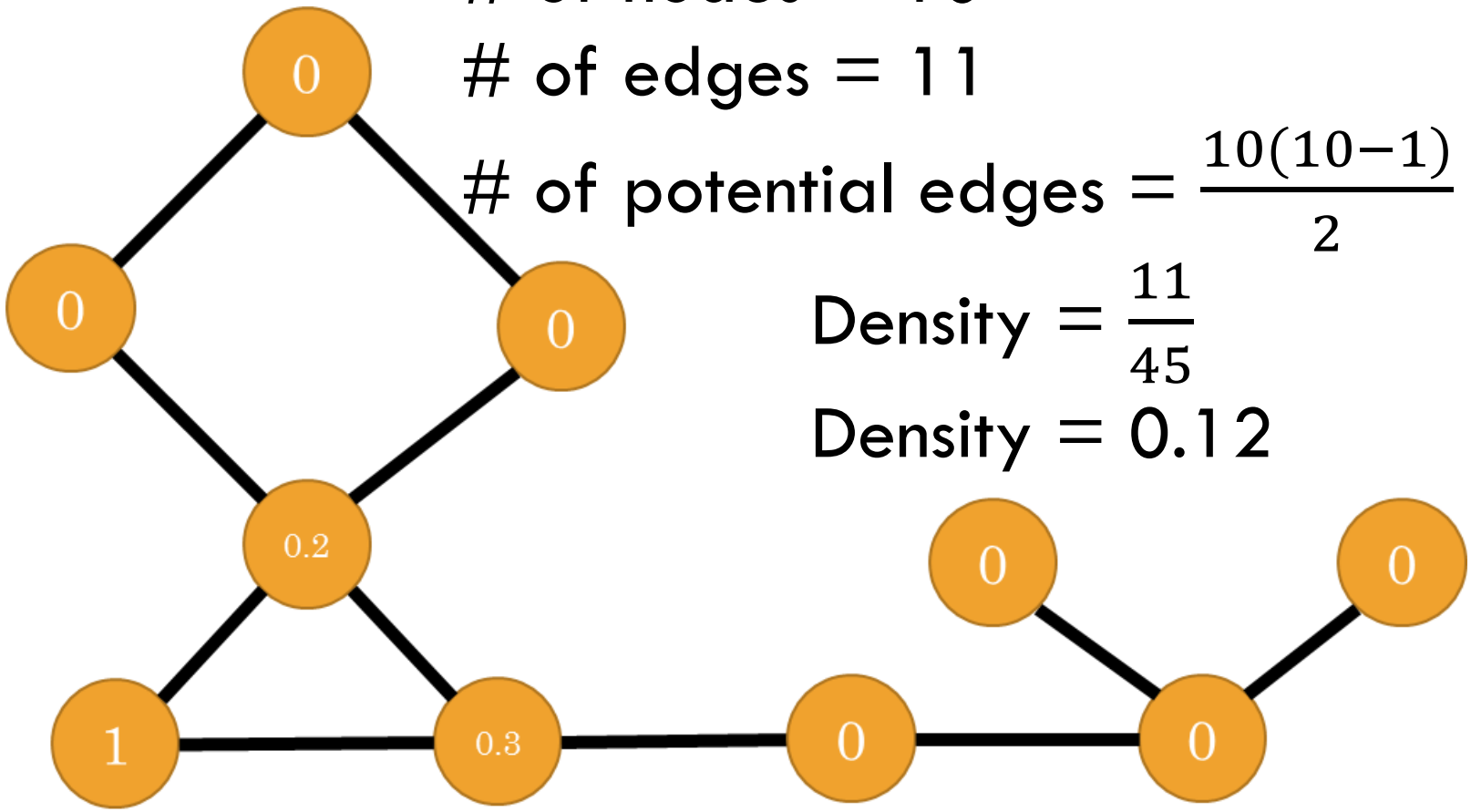
A > B > D > F > G

A > C > D > F > G

NETWORK DIAMETER



DENSITY



# of nodes = 10

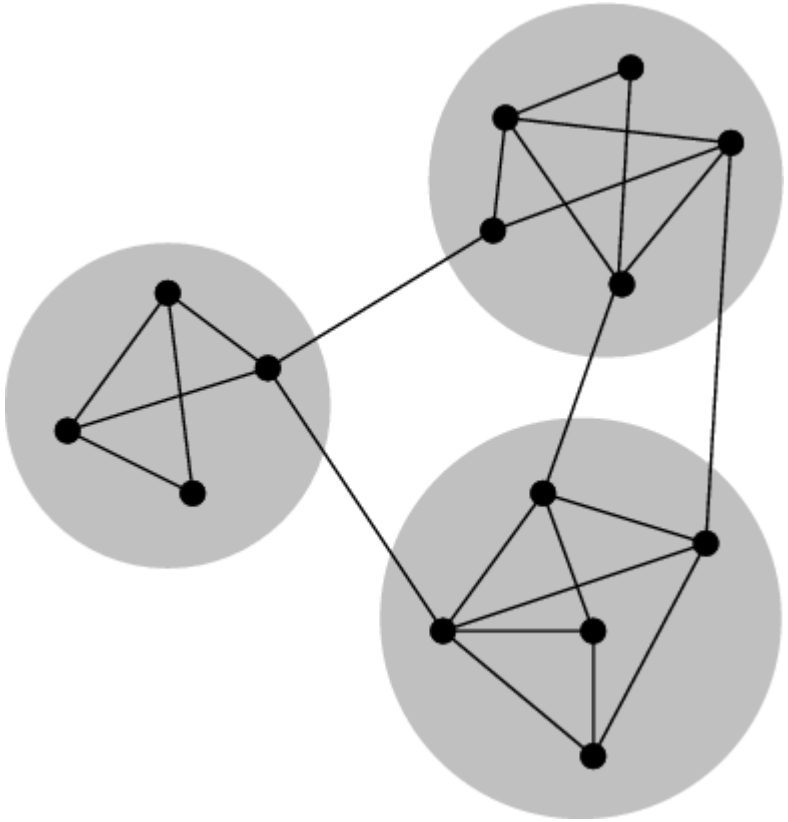
# of edges = 11

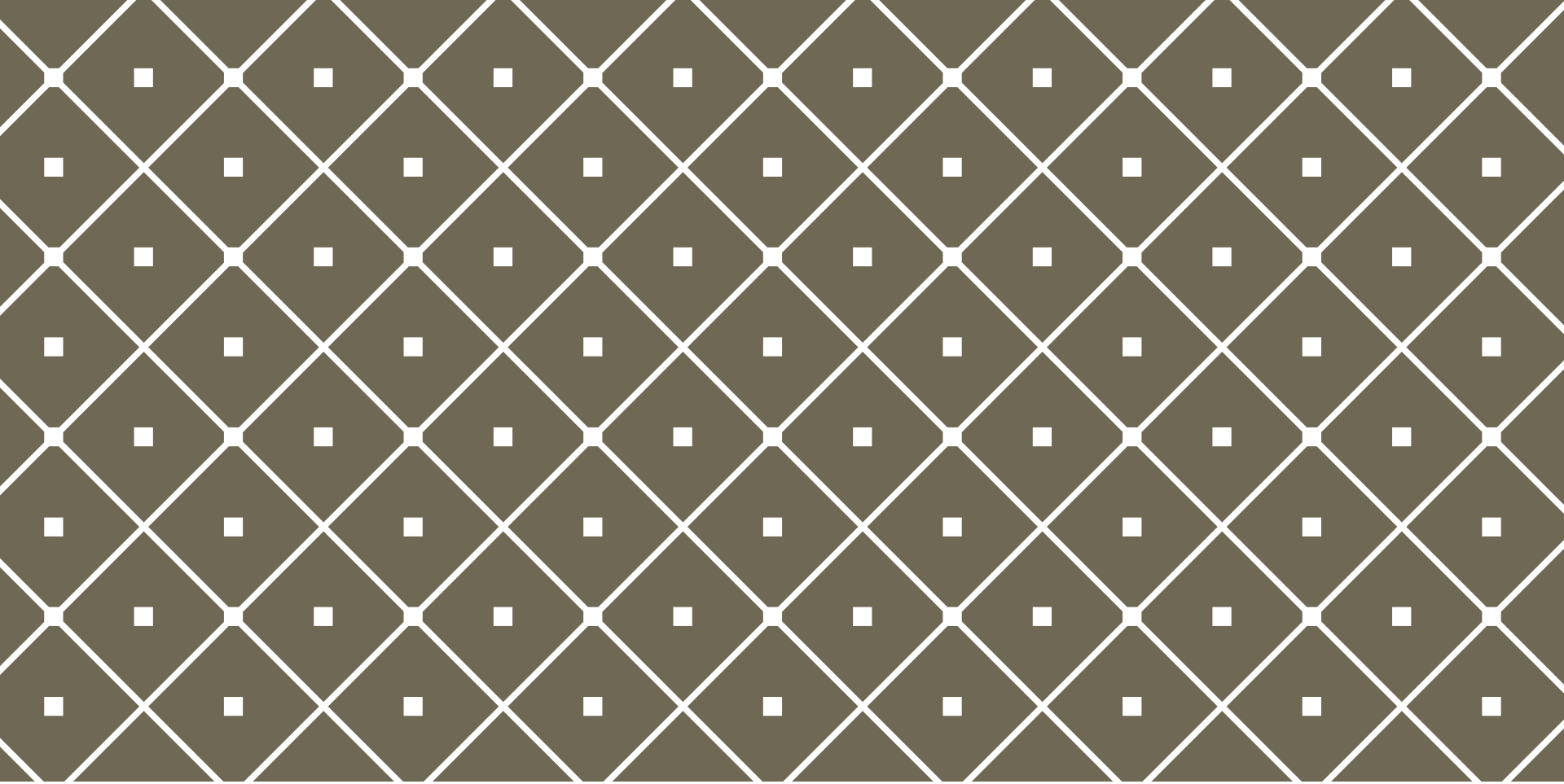
$$\text{\# of potential edges} = \frac{10(10-1)}{2} = 45$$

$$\text{Density} = \frac{11}{45}$$

$$\text{Density} = 0.12$$

MODULARITY & LOUVAIN METHOD



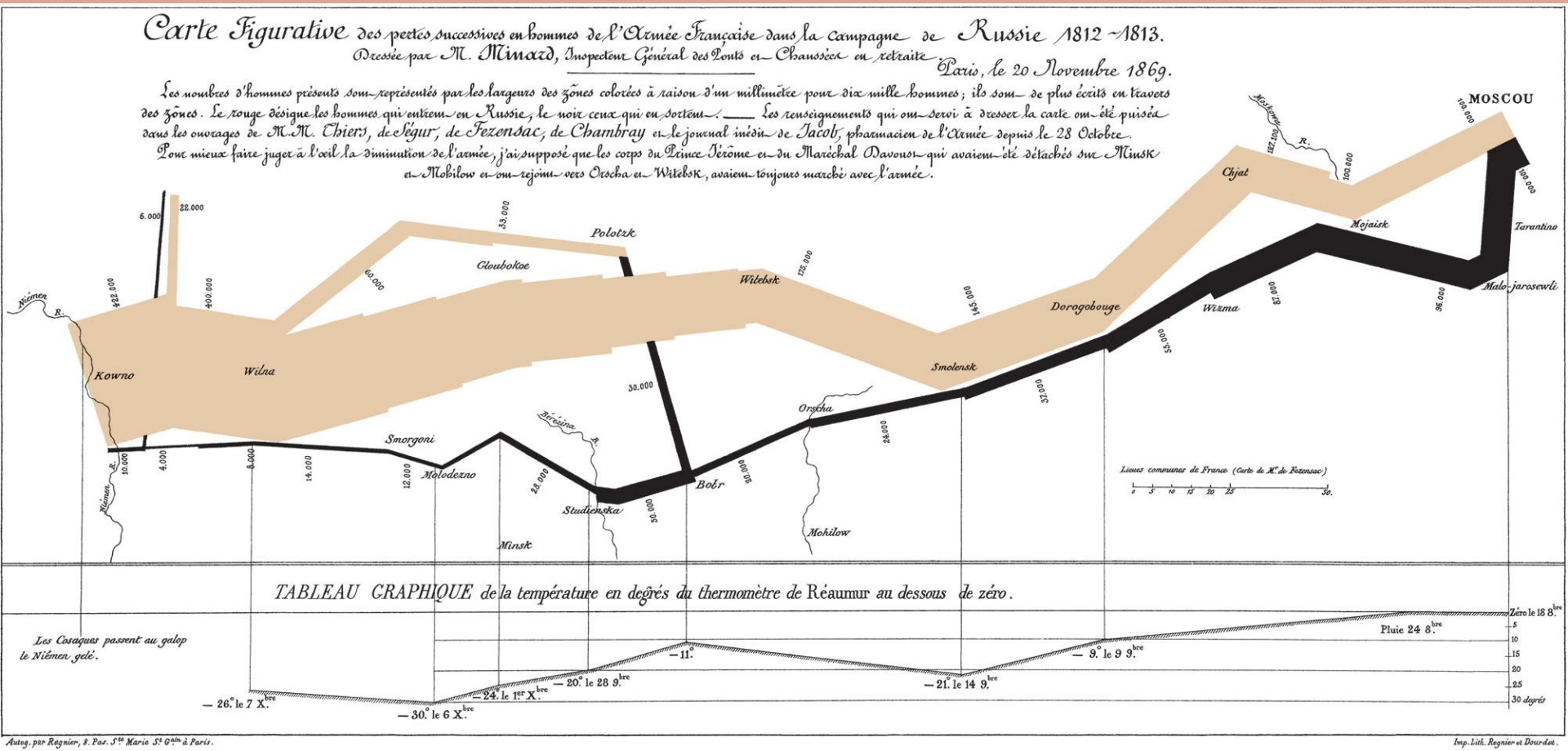


BREAK

Breathe.

VISUALIZATION

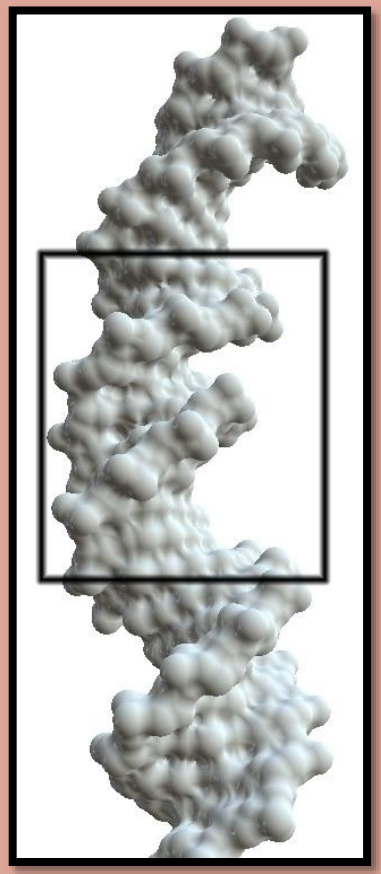
09:00-09:15	The Ubiquity of Networks
09:15-09:30	Basic Concepts
09:30-10:00	Information Visualization
10:00-10:15	Q&A

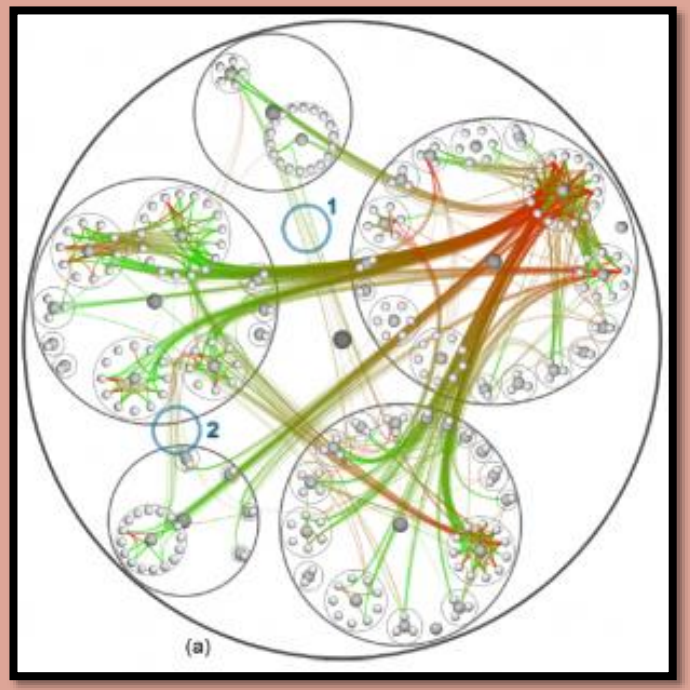


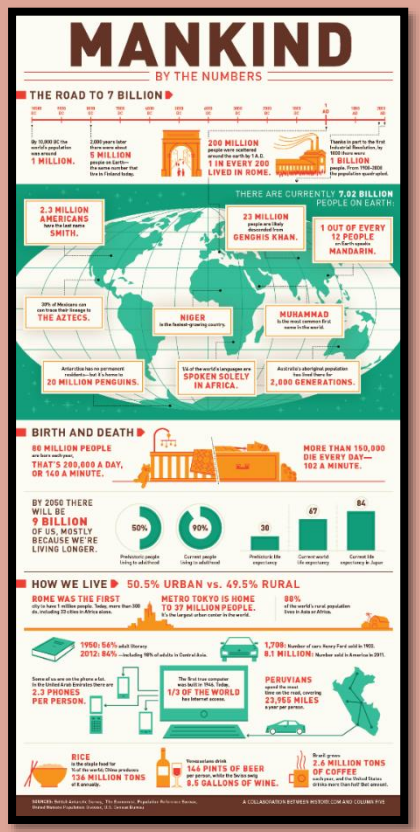
WHAT IS INFORMATION VISUALIZATION?

Charles Minard

Edward Tufte

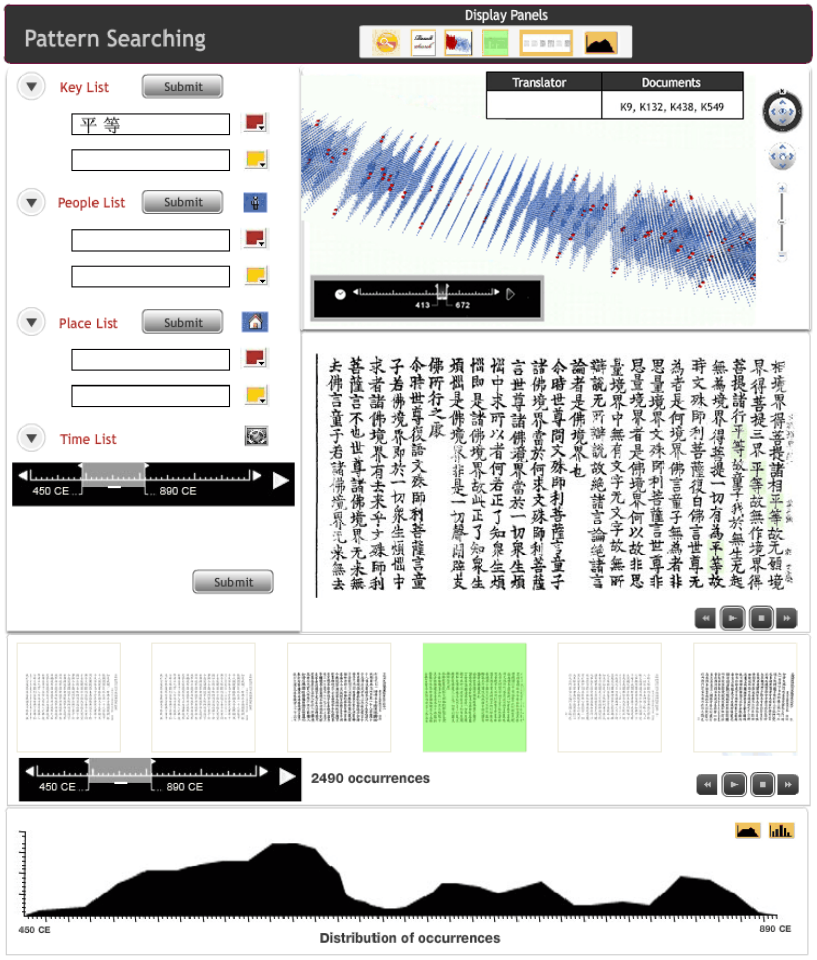


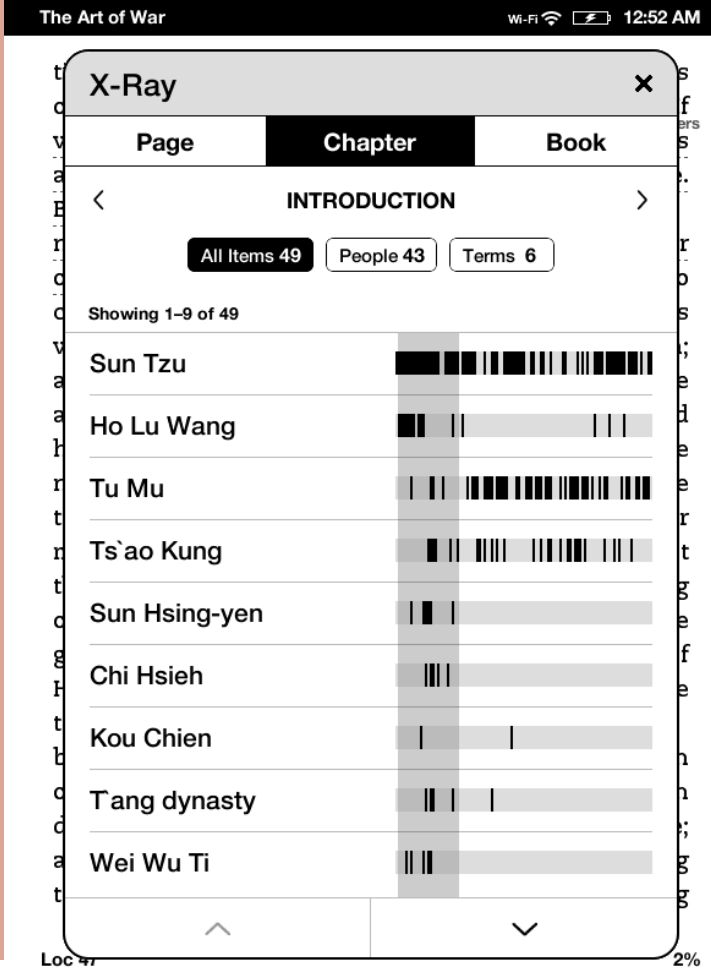




SCIENTIFIC VISUALIZATION VS. INFORMATION VISUALIZATION VS. INFOGRAPHIC.

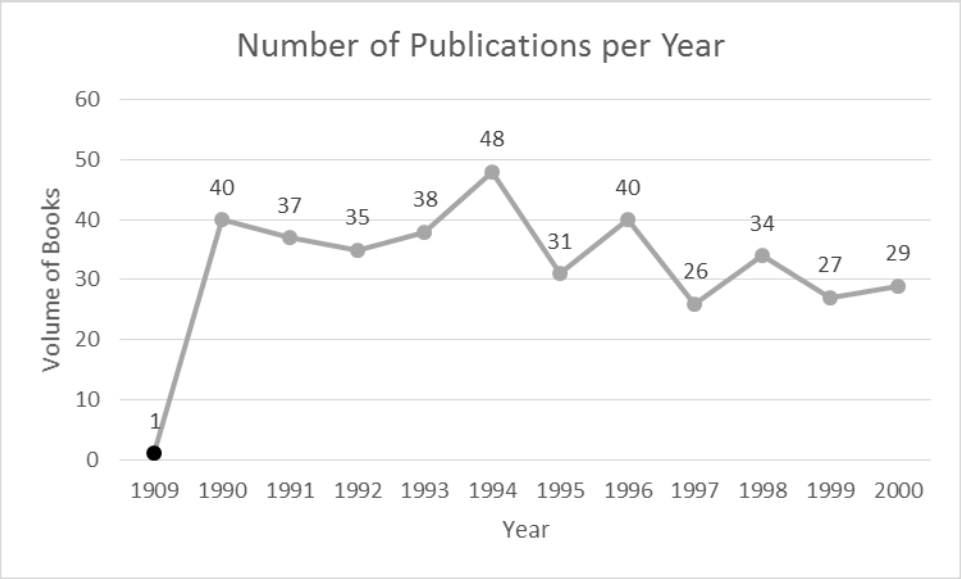
What's in a name?





WHY VISUALIZE?

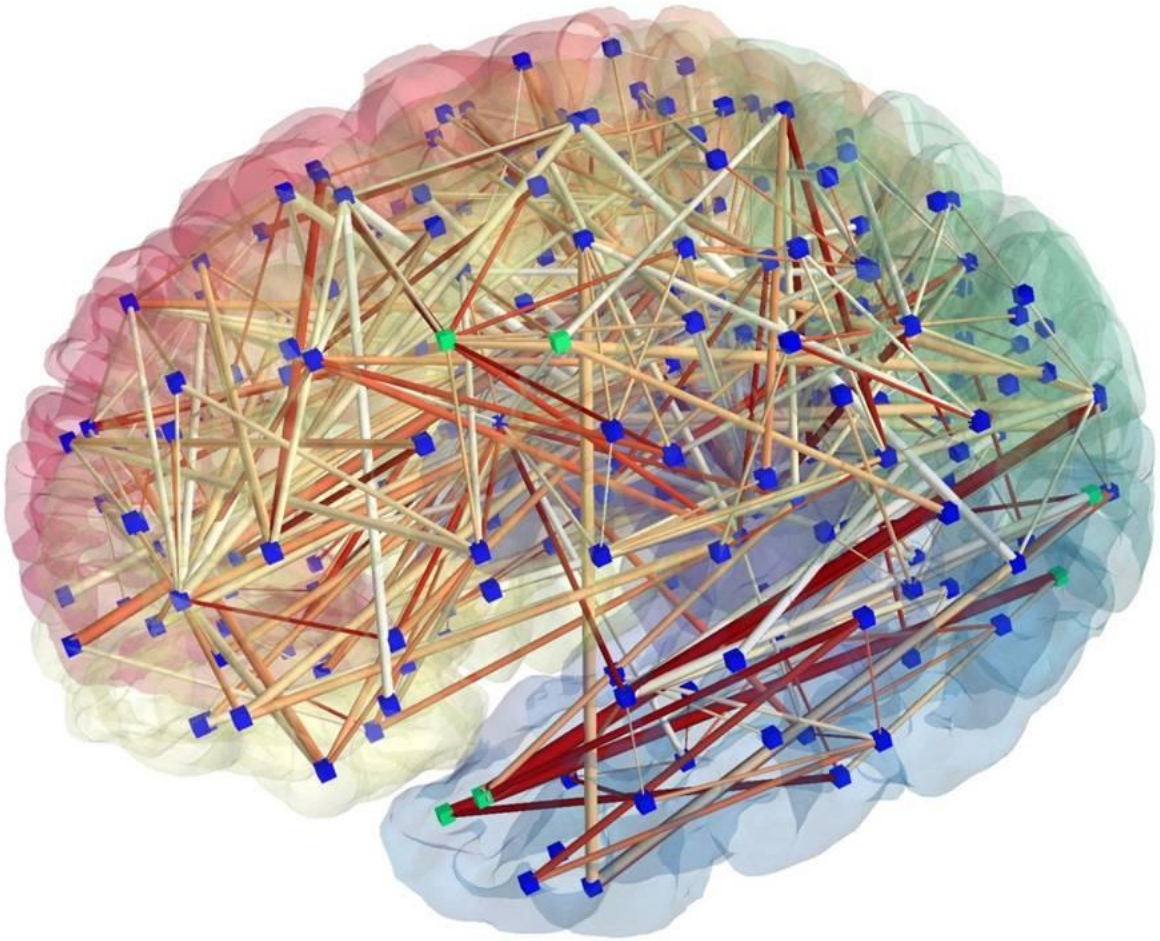
Good ideas?



Name	Department	Salary
Anon 13	Chemistry	$248,045
Anon 7	Economics	$213,467
Anon 17	Economics	$172,500
Anon 6	Chemistry	$154,487
Anon 15	Chemistry	$145,723
Anon 4	Economics	$133,541
Anon 12	Chemistry	$128,953
Anon 16	English	$122,885
Anon 19	English	$117,203
Anon 14	Economics	$115,341
Anon 20	English	$110,136
Anon 21	Chemistry	$107,000
Anon 8	English	$105,038
Anon 18	English	$104,916
Anon 2	English	$74,206

WHY VISUALIZE?

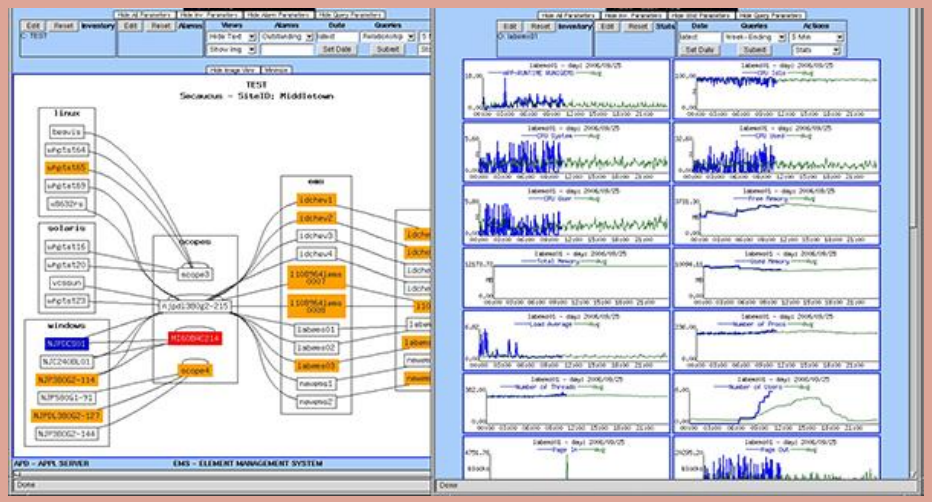
More good ideas?



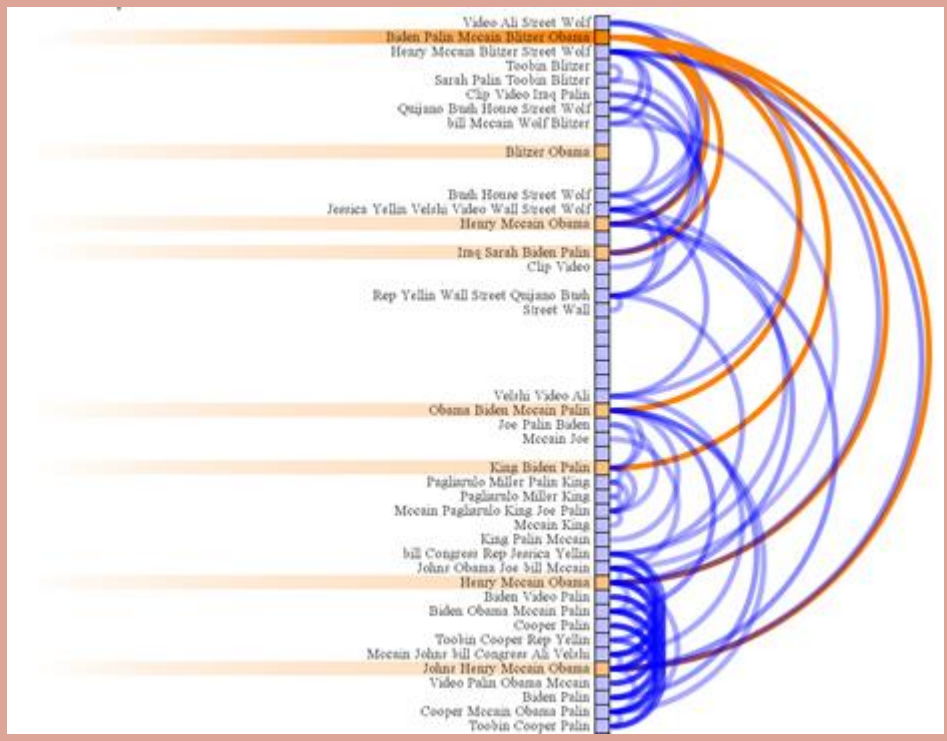
WHY VISUALIZE?

Even more good ideas?

Exploratory

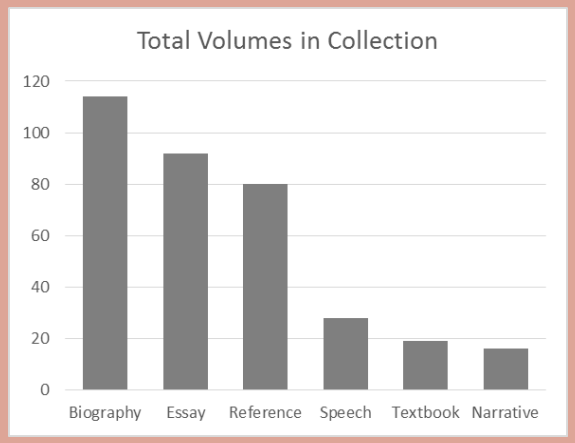


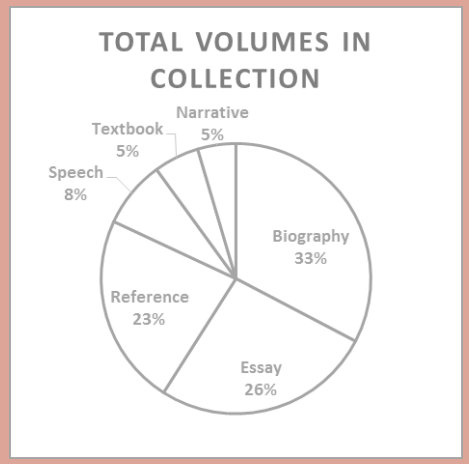
Explanatory

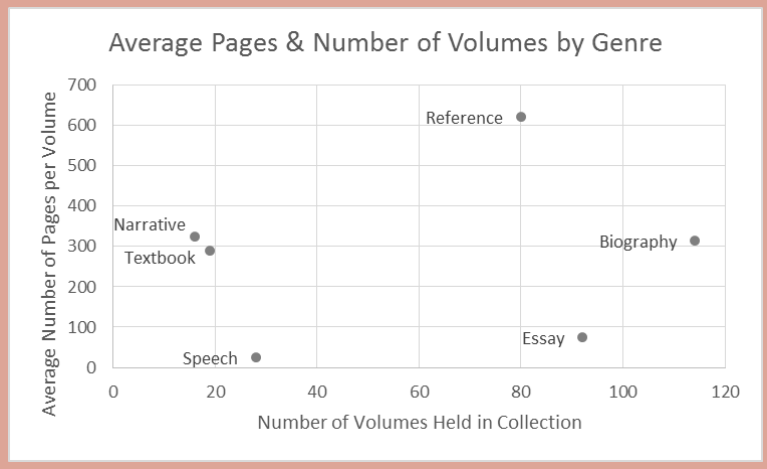


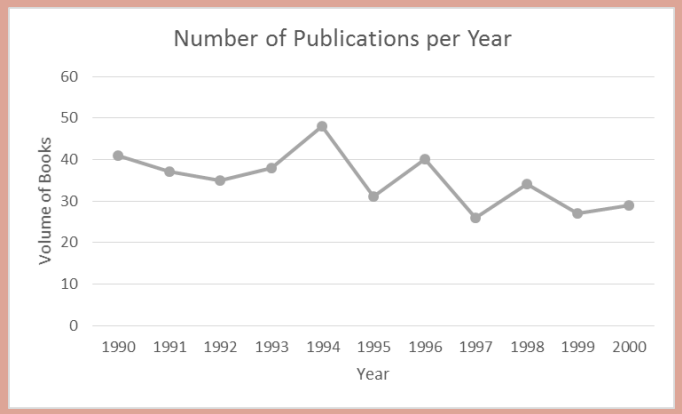
TYPES OF VISUALIZATIONS

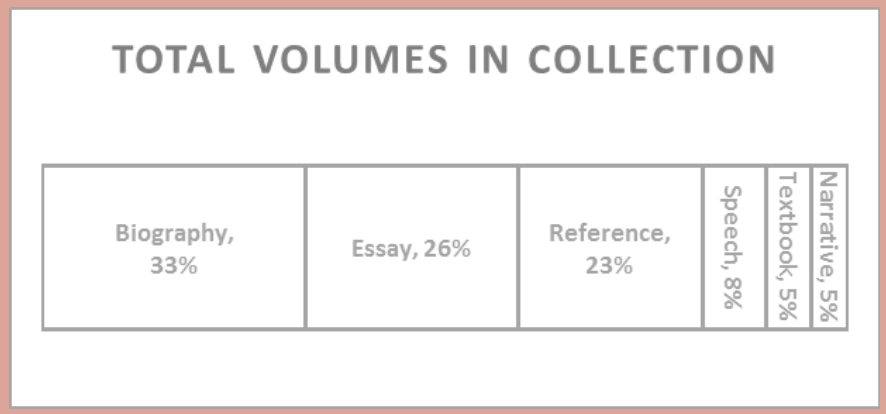
Exploratory
Explanatory





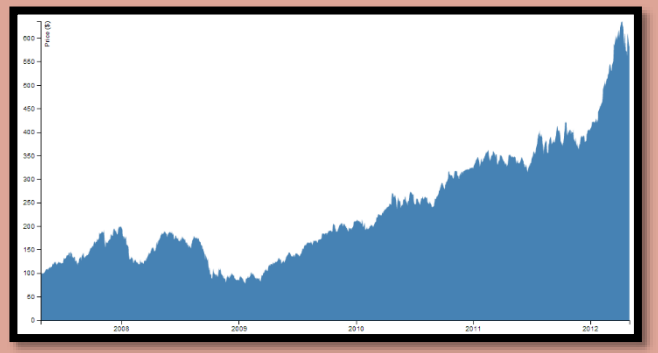


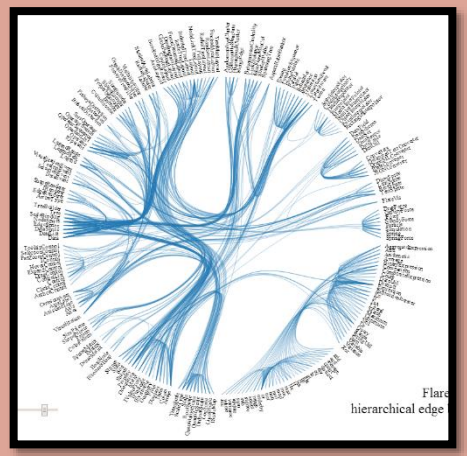


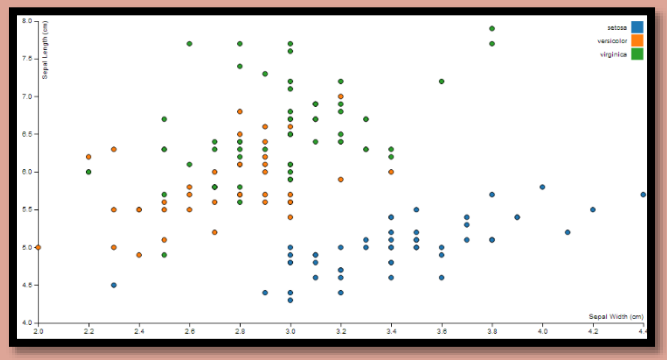


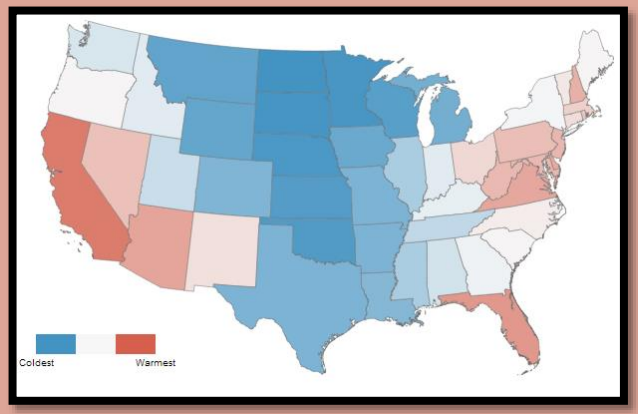
TYPES OF VISUALIZATIONS

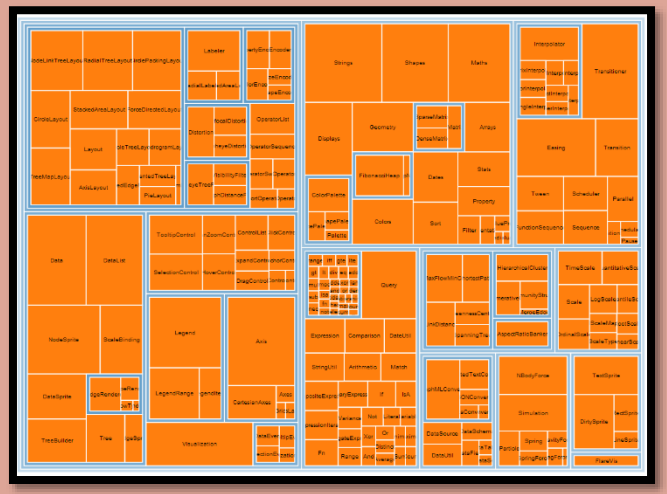
"Excel" charts.









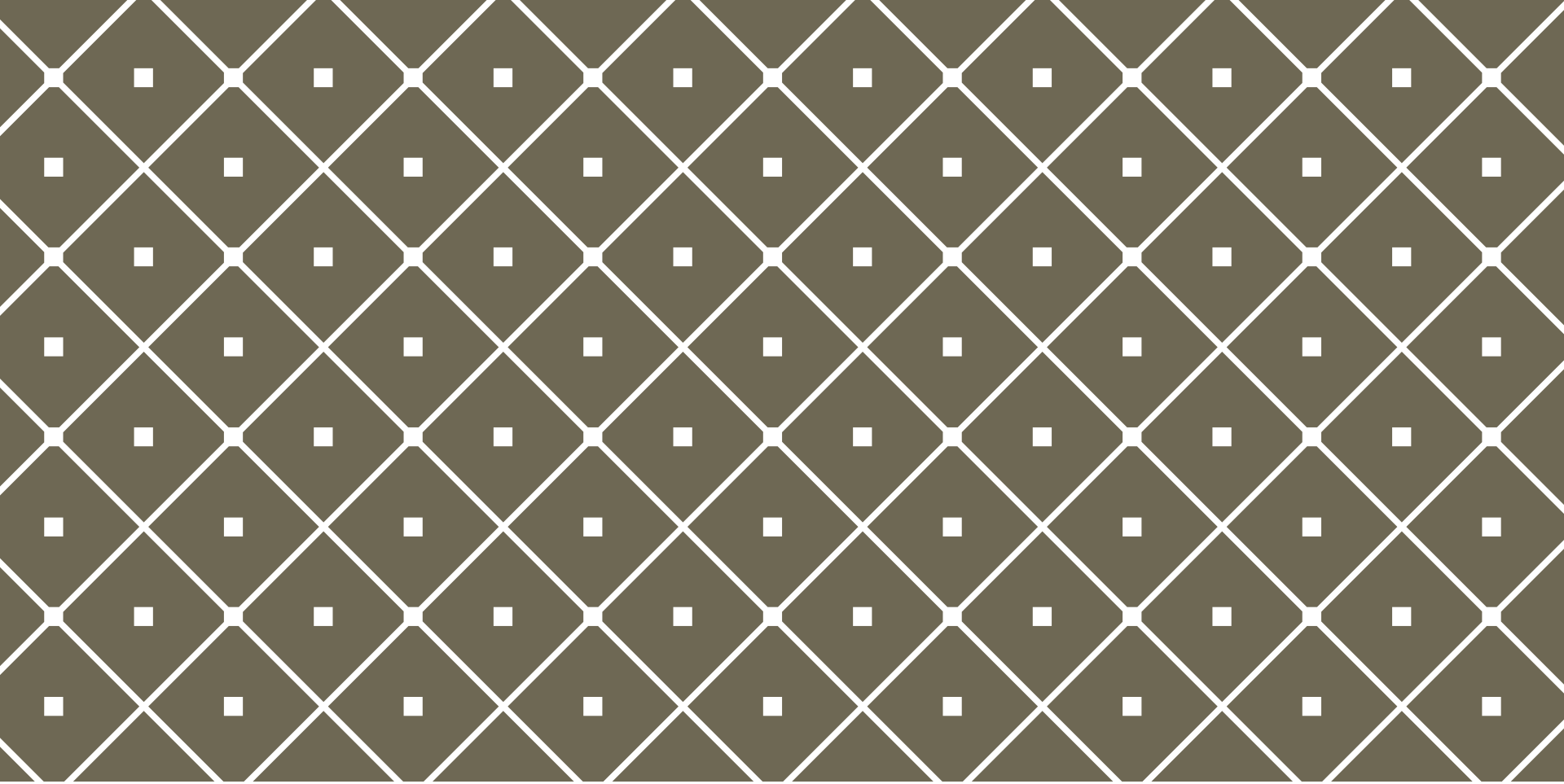


VARIETIES OF VISUALIZATIONS

Moving outward.

STATIC, INTERACTIVE, AND DYNAMIC VISUALIZATIONS

What's best and when.



EFFECTIVE VISUALIZATION

Visual Encoding

SCALES OF MEASURE

Nominal

United States

Canada

France

Turkey

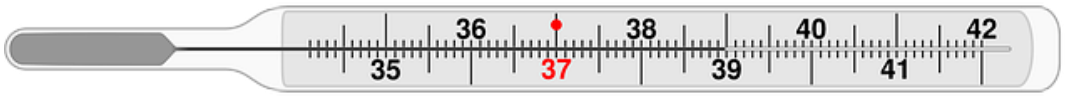
Mexico

China

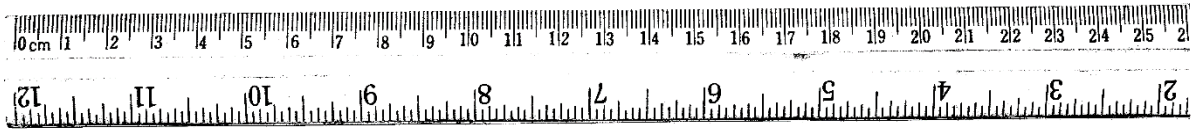
Ethiopia

Ordinal

Interval



Ratio

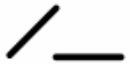


Graphic Variable Types vs. Data Scale Types

Position: x, y; possibly z		**Quantitative**
Form:		
• Size		**Quantitative**
• Shape		Qualitative
• Orientation (Rotation)		Qualitative
Color:		
• Value (Lightness)		**Quantitative**
• Hue (Tint)		Qualitative
• Saturation (Intensity)		**Quantitative**
Texture:		
• Pattern, Rotation, Coarseness, Size, Density Gradient		**Quantitative**
Optics:		
• Crispness, Transparency, Shading		Qualitative

VISUAL ENCODING

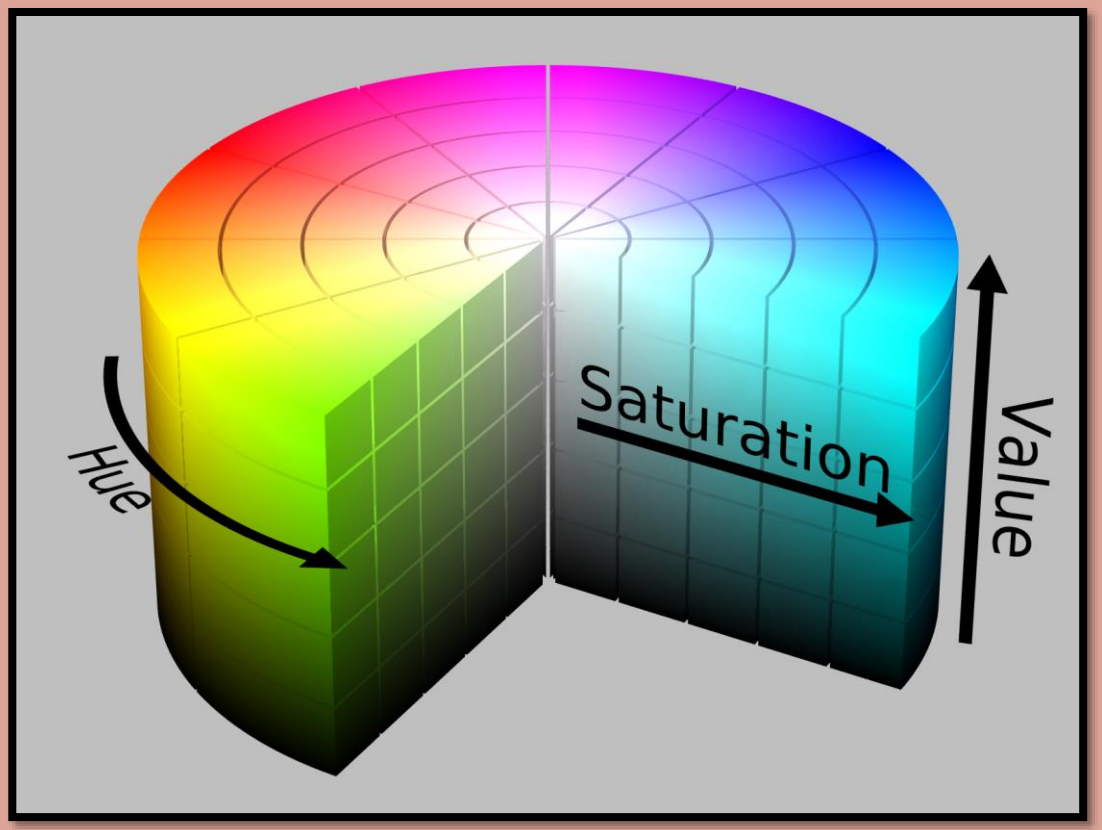
Matching scale to sight.

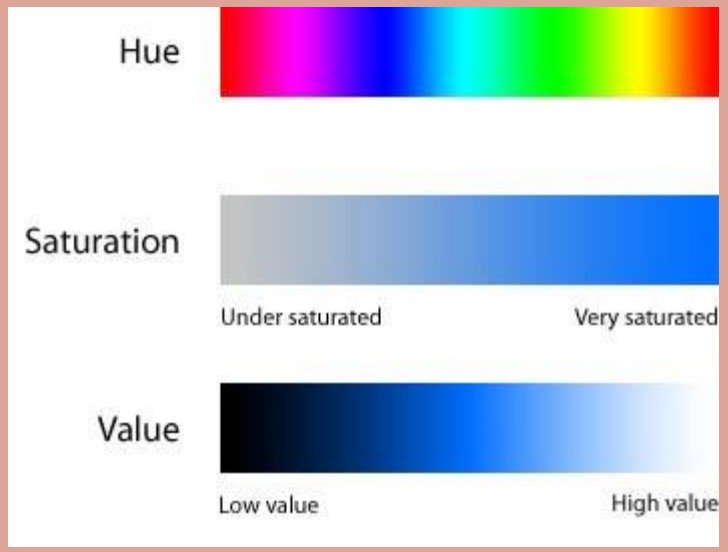
Example	Encoding	Ordered	Useful values	Quantitative	Ordinal	Categorical	Relational
	position, placement	**yes**	**infinite**	Good	Good	Good	Good
1, 2, 3; A, B, C	text labels	**optional** (alphabetical or numbered)	**infinite**	Good	Good	Good	Good
	length	**yes**	**many**	Good	Good		
	size, area	**yes**	**many**	Good	Good		
	angle	**yes**	medium/few	Good	Good		
	pattern density	**yes**	few	Good	Good		
	weight, boldness	**yes**	few		Good		
	saturation, brightness	**yes**	few		Good		
	color	no	few (< 20)			Good	
	shape, icon	no	medium			Good	
	pattern texture	no	medium			Good	
	enclosure, connection	no	**infinite**			Good	Good
	line pattern	no	few				Good
	line endings	no	few				Good
	line weight	**yes**	few		Good		

Noah Iliinsky • ComplexDiagrams.com/properties • 2012-06

VISUAL ENCODING

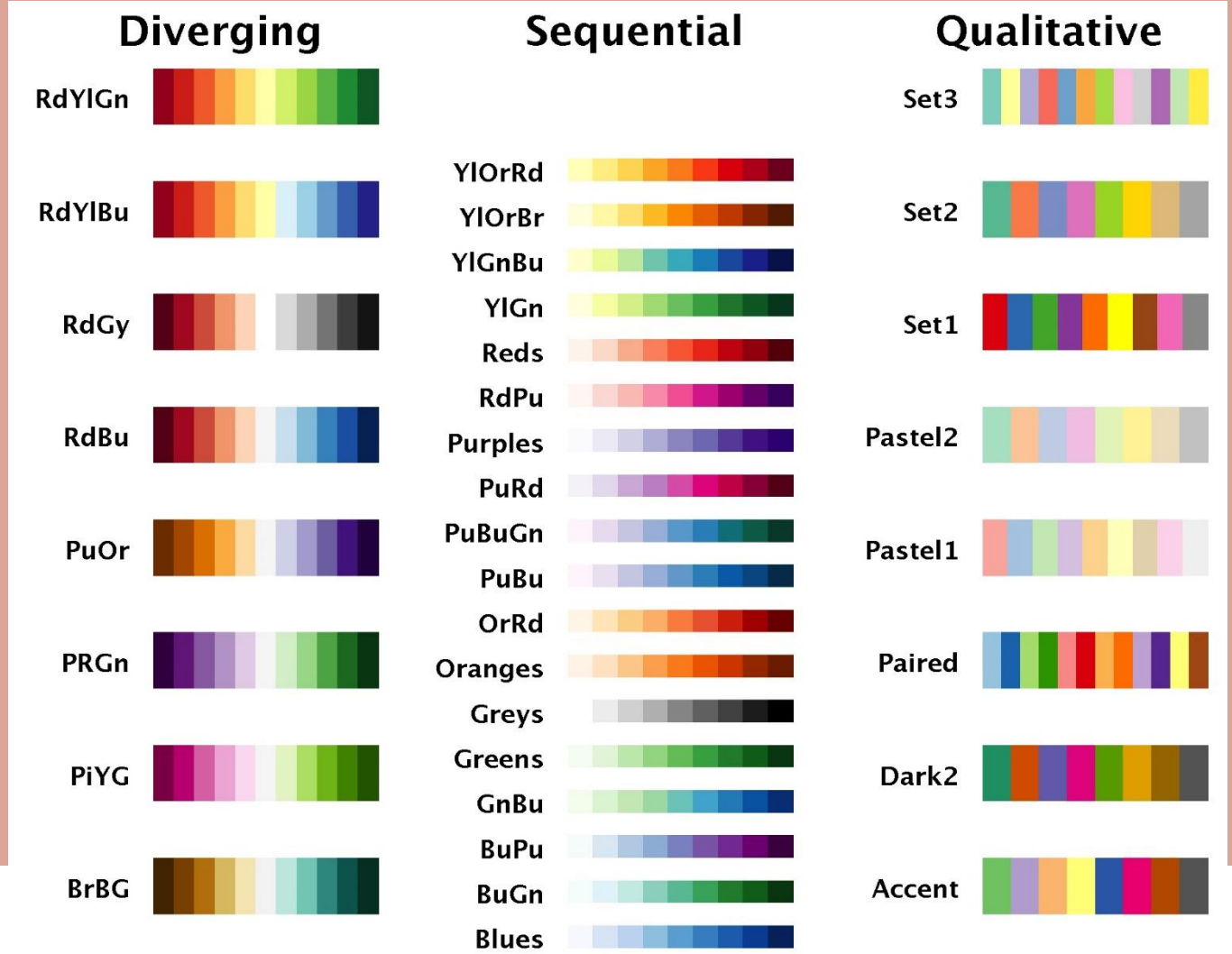
Everything you need to know in one handy chart.





COLOR CHOICE

What works where?



COLOR CHOICE

What works where?

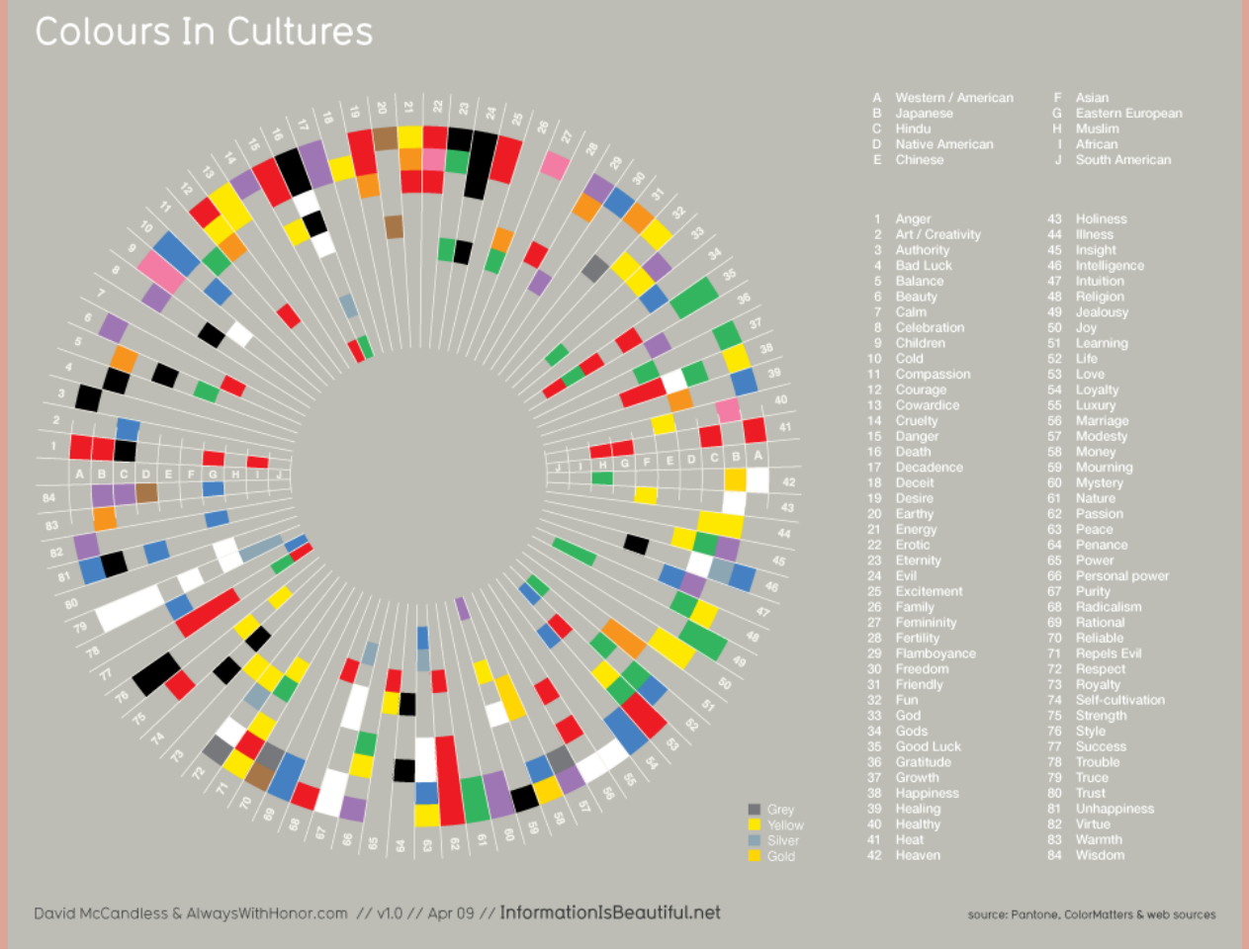
	Normal Vision	L-cone defect	M-cone defect	S-cone defect
Men	91.4%	2.45%	6.1%	0.011%
Women	99.6%	0.04%	0.36%	0.04%
Overall	95.5%	1.25%	3.24%	0.025%

COLOR BLINDNESS

Designing for everyone

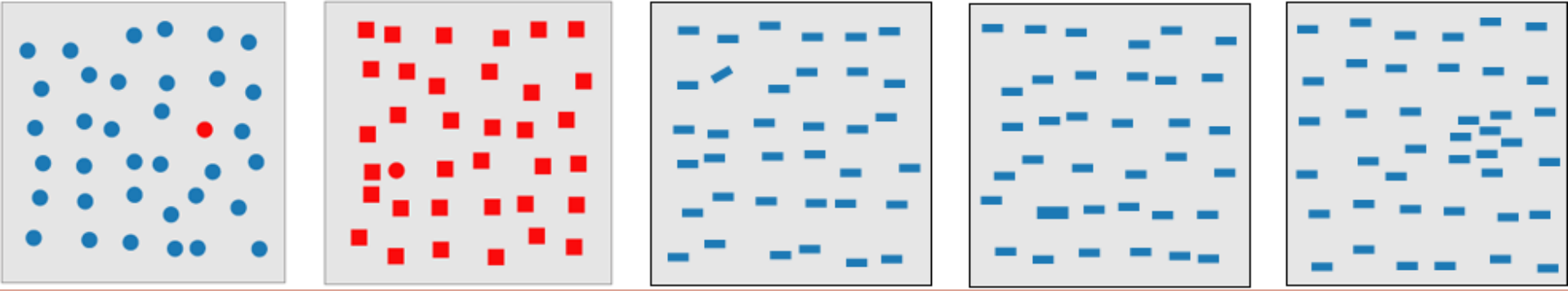
GENDERED COLORS

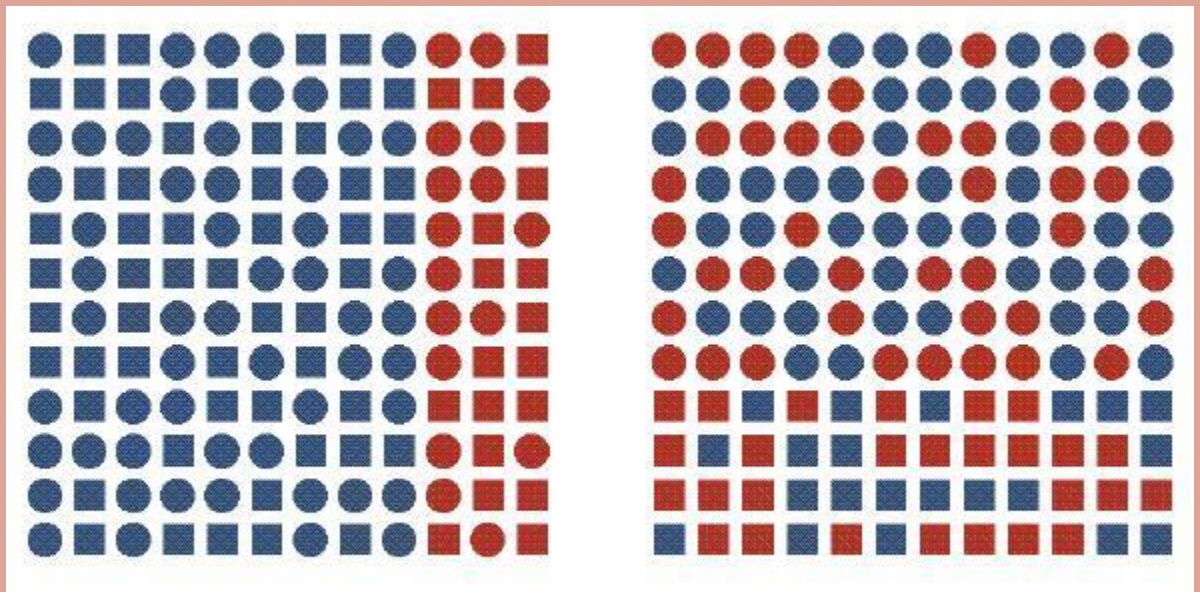
Designing for everyone



CULTURAL COLORS

Designing for everyone

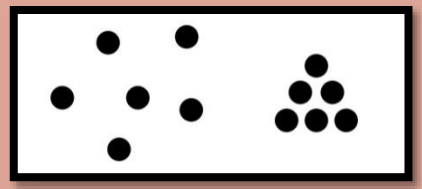


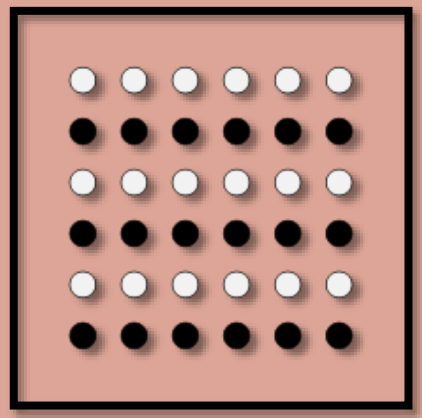


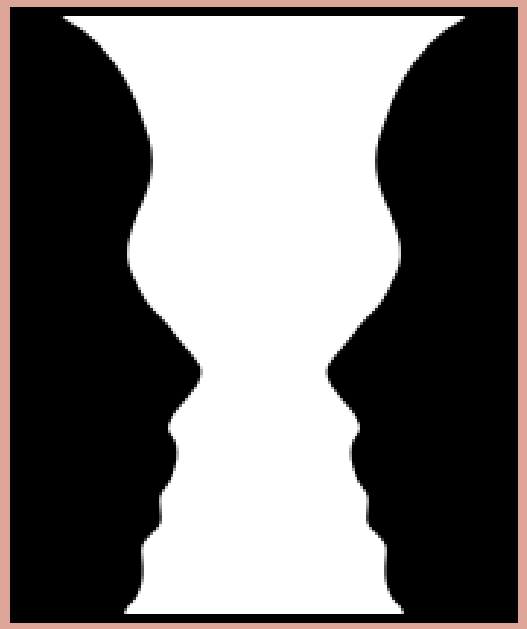
(a) (b)

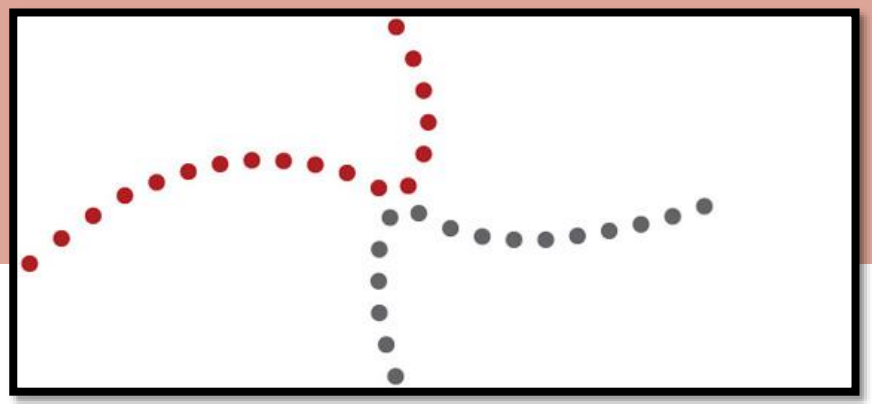
PREATTENTIVE PROCESSING

Designing for effectiveness







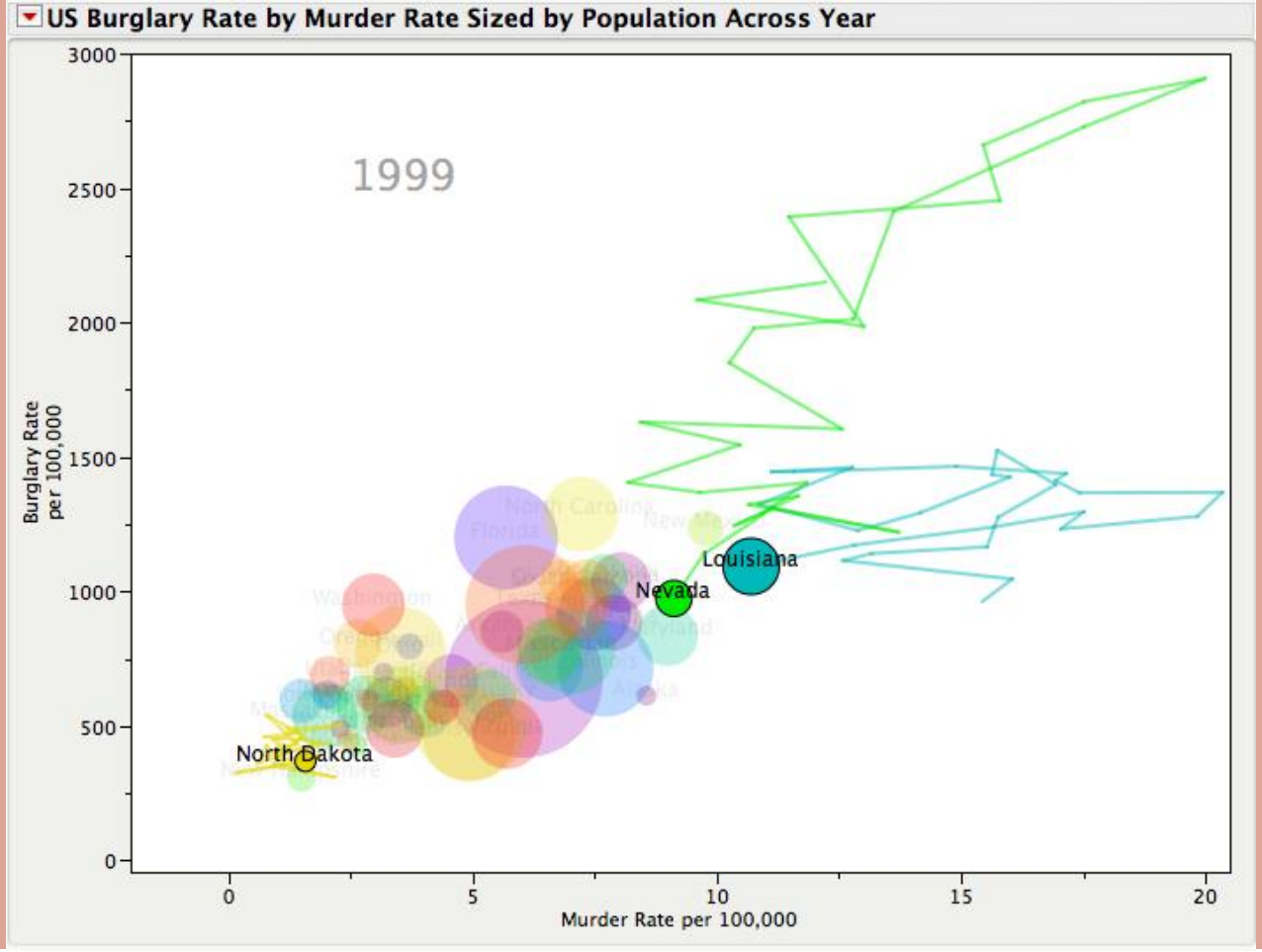


GESTALT PRINCIPLES

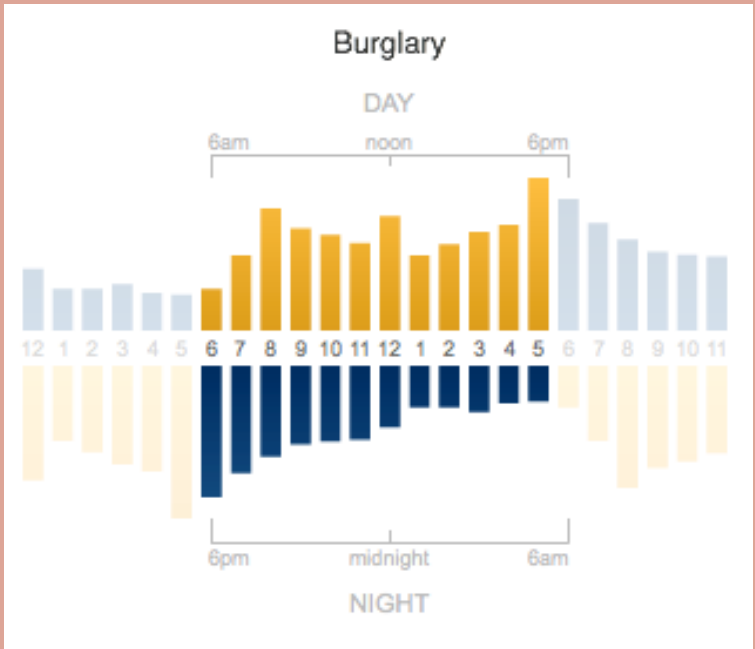
Perception is important

VISUALIZATION PRINCIPLES

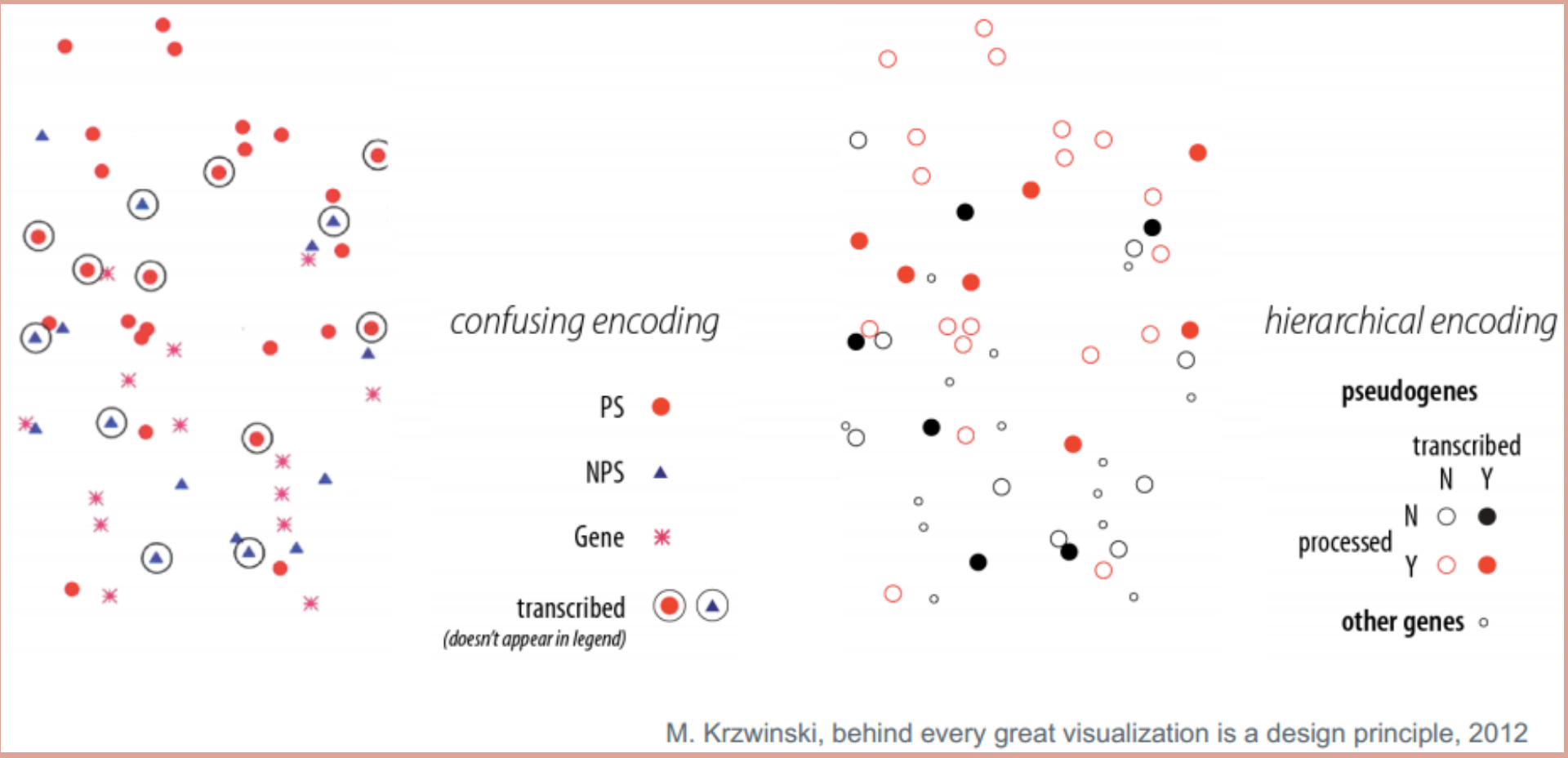
- Content focus
- Comparison rather than mere description
- Integrity
- High resolution
- Utilization of classic designs and concepts



ANIMATED VS. STATIC

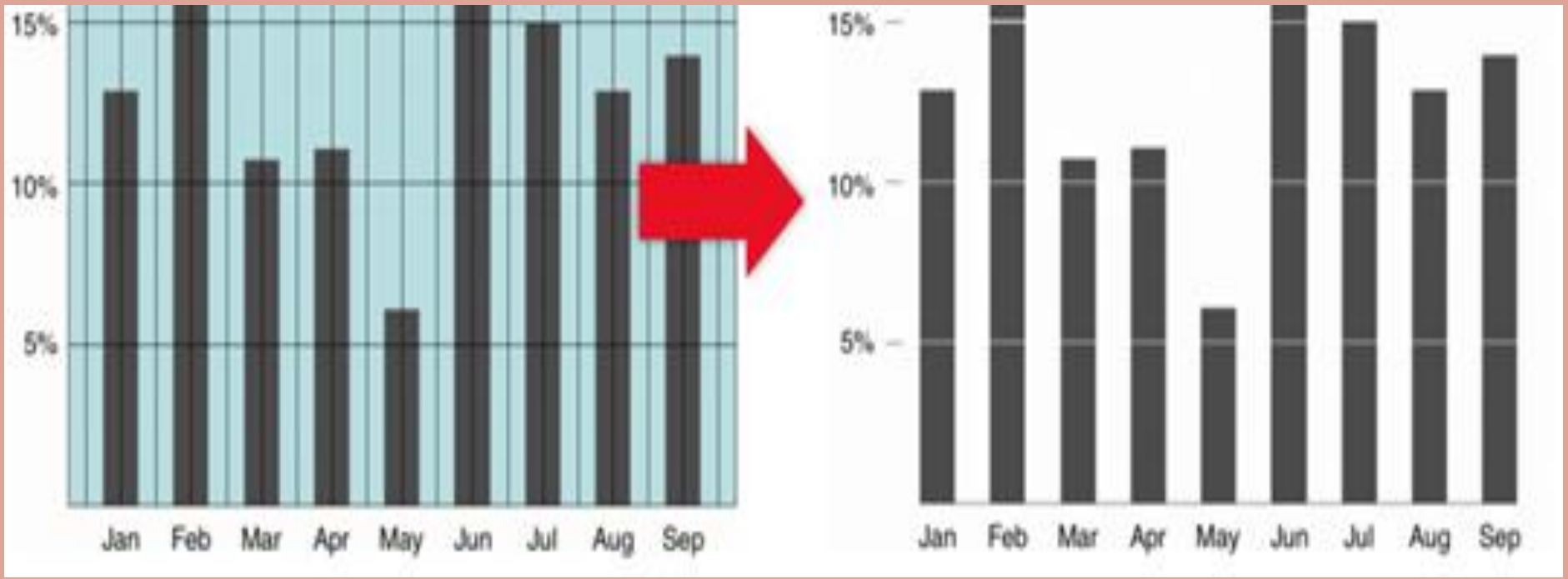


SMALL MULTIPLES



M. Krzwinski, behind every great visualization is a design principle, 2012

CONSISTENCY



DATA:INK RATIO

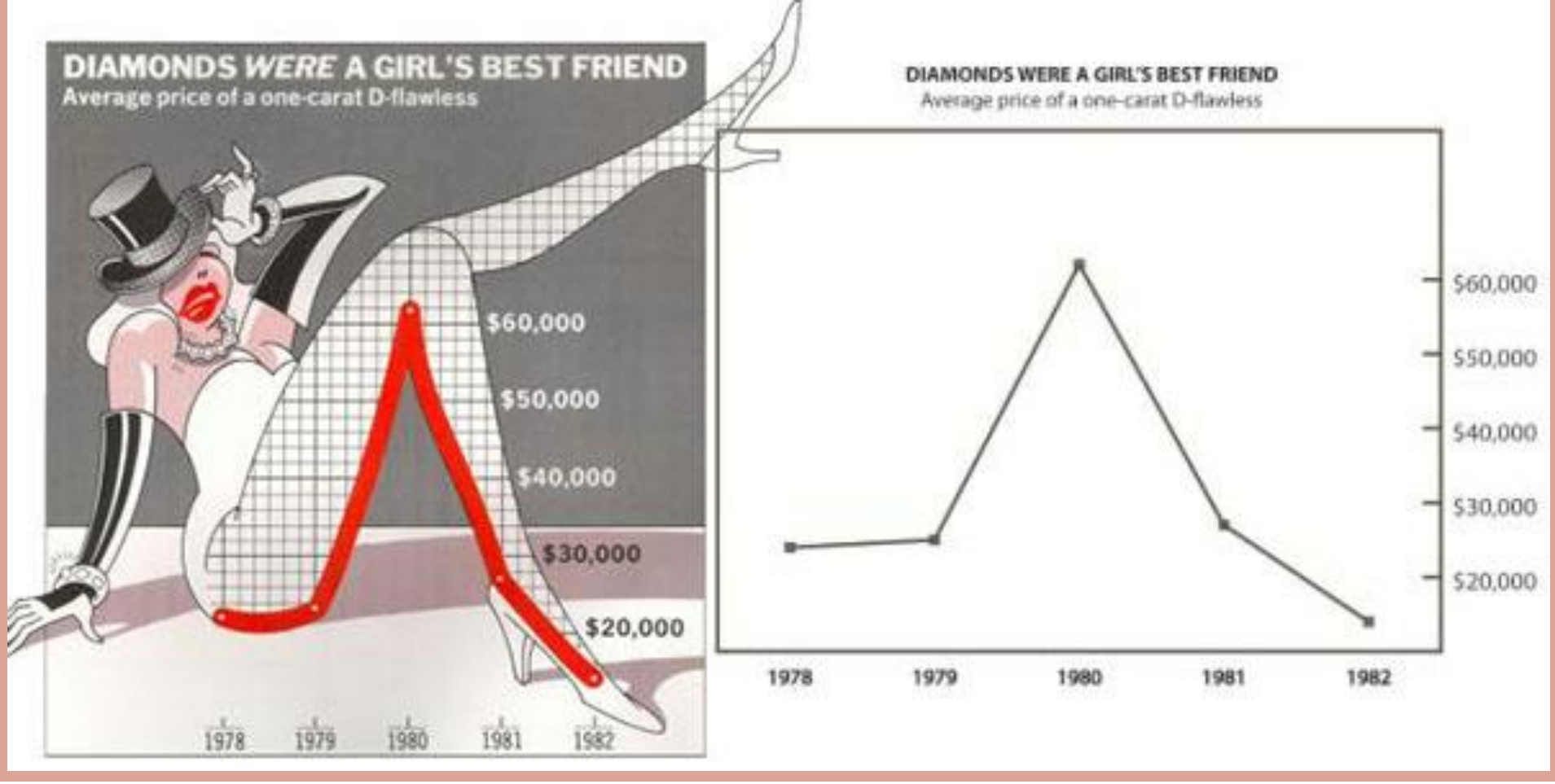
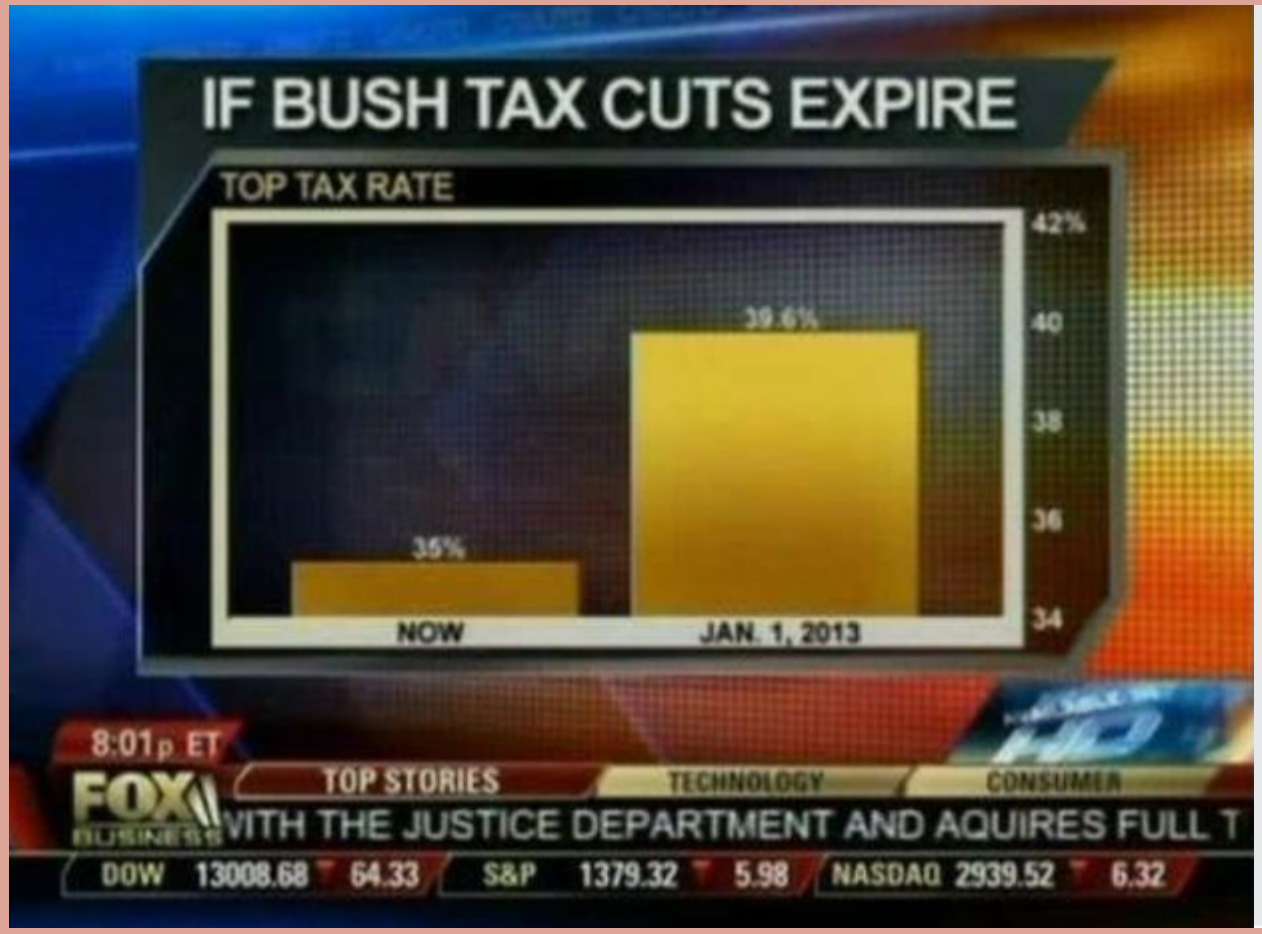
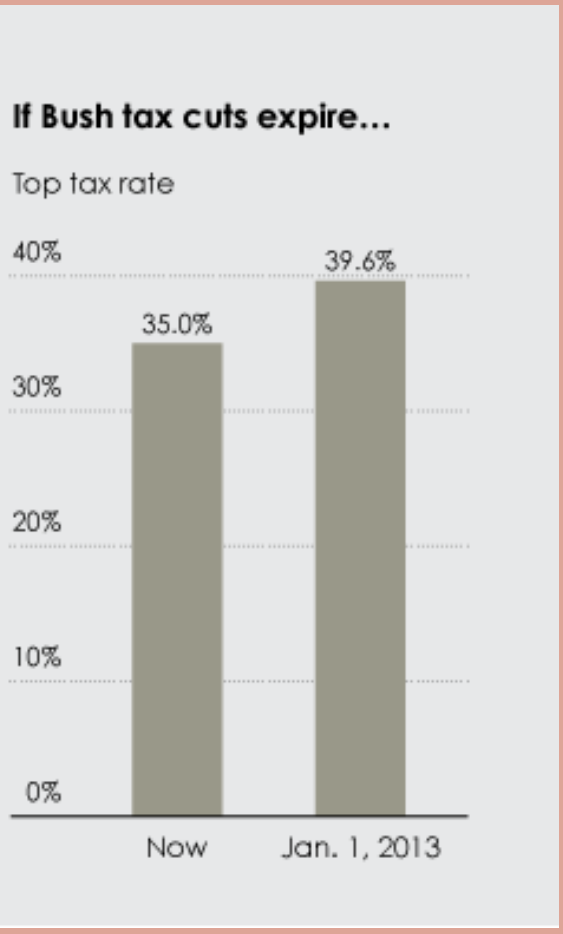
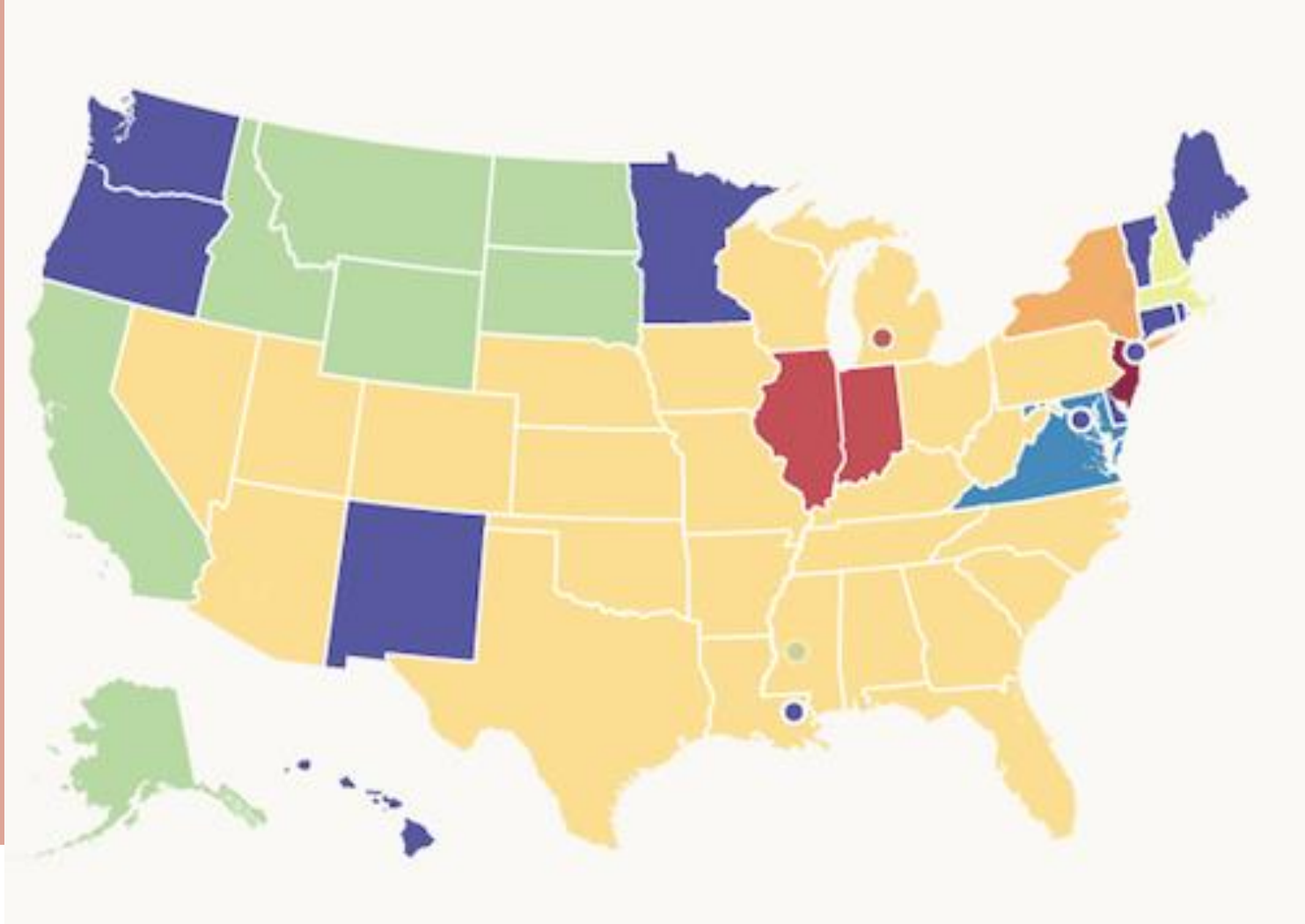

DIAMONDS *WERE* A GIRL'S BEST FRIEND
Average price of a one-carat D-flawless
$60,000
$50,000
$40,000
$30,000
$20,000
1978
1979
1980
1981
1982
DIAMONDS WERE A GIRL'S BEST FRIEND
Average price of a one-carat D-flawless
$60,000
$50,000
$40,000
$30,000
$20,000
1978
1979
1980
1981
1982

CHART JUNK

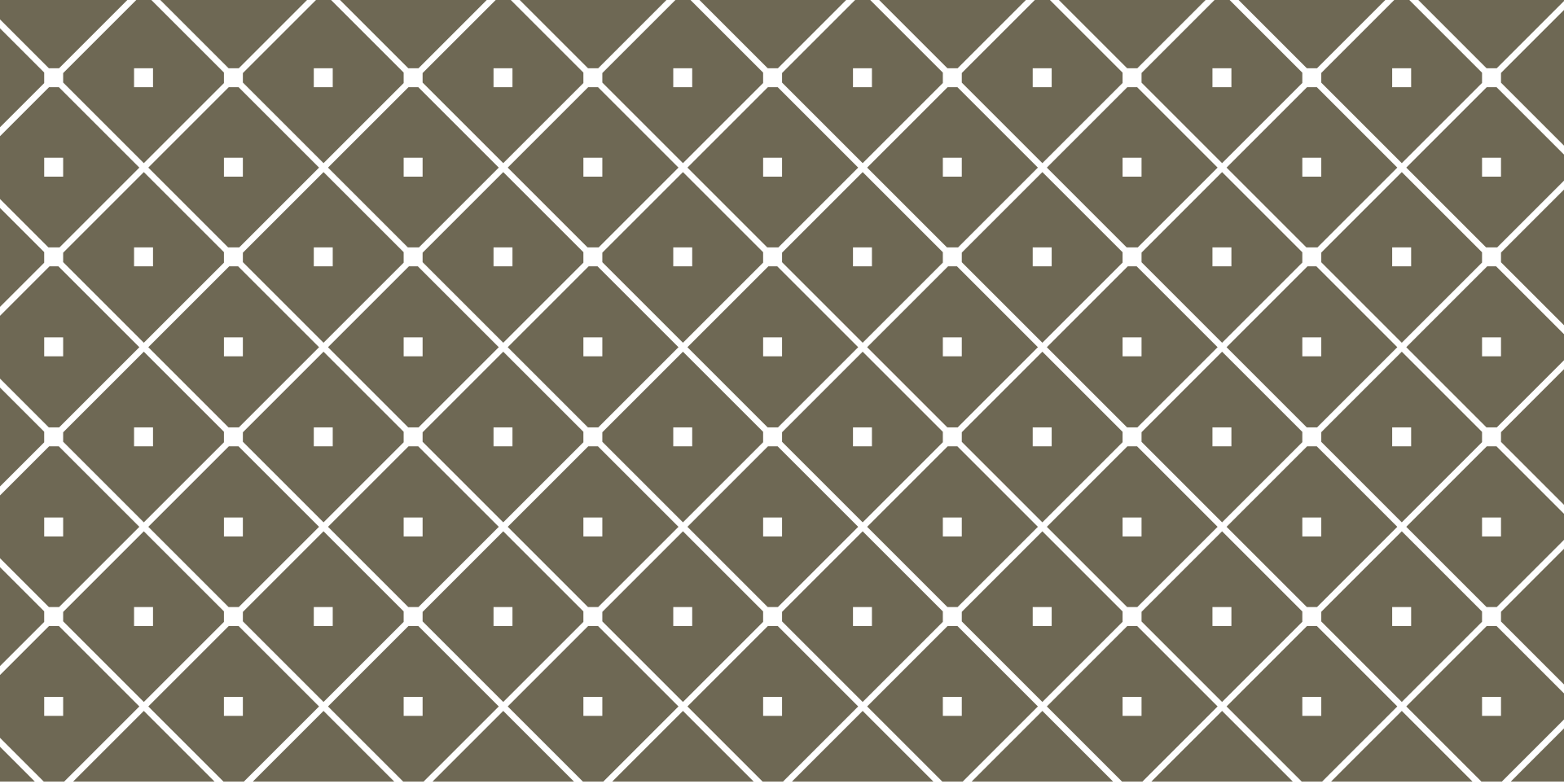




FULL NUMERICAL AXIS



INCLUDE LEGENDS

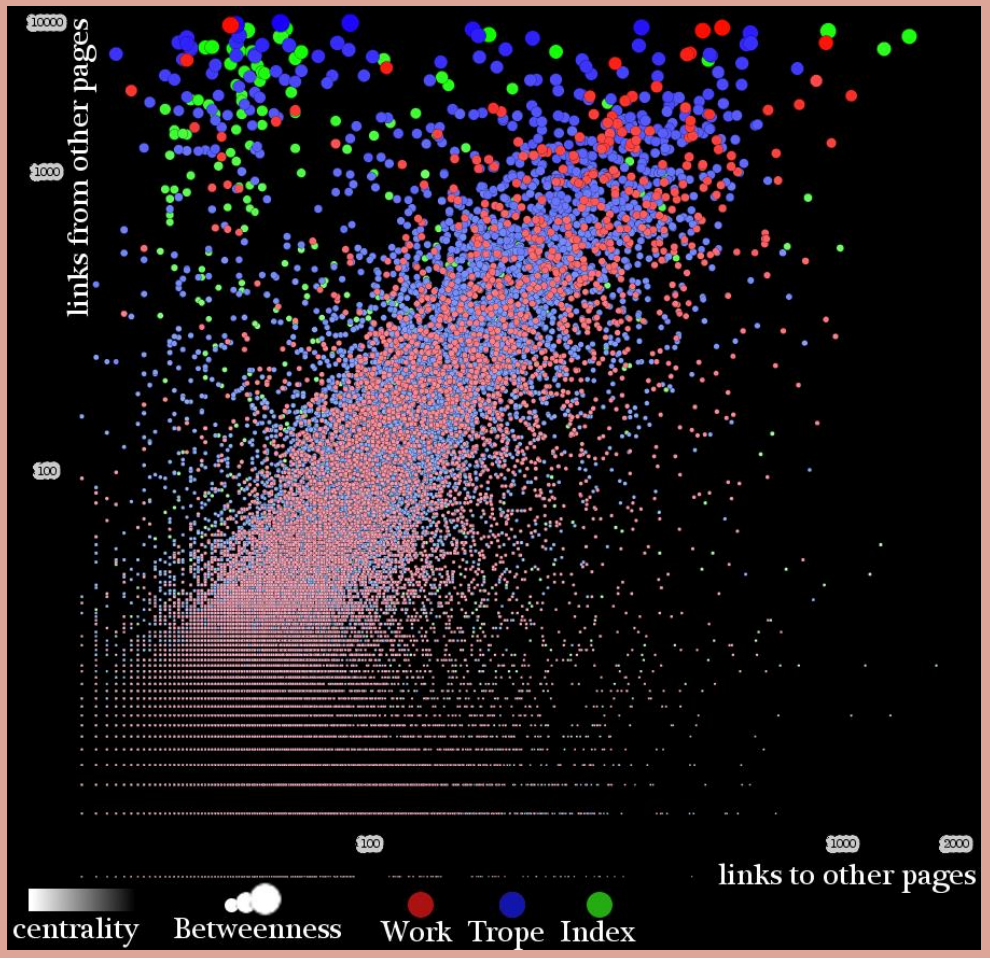


NETWORK VISUALIZATION

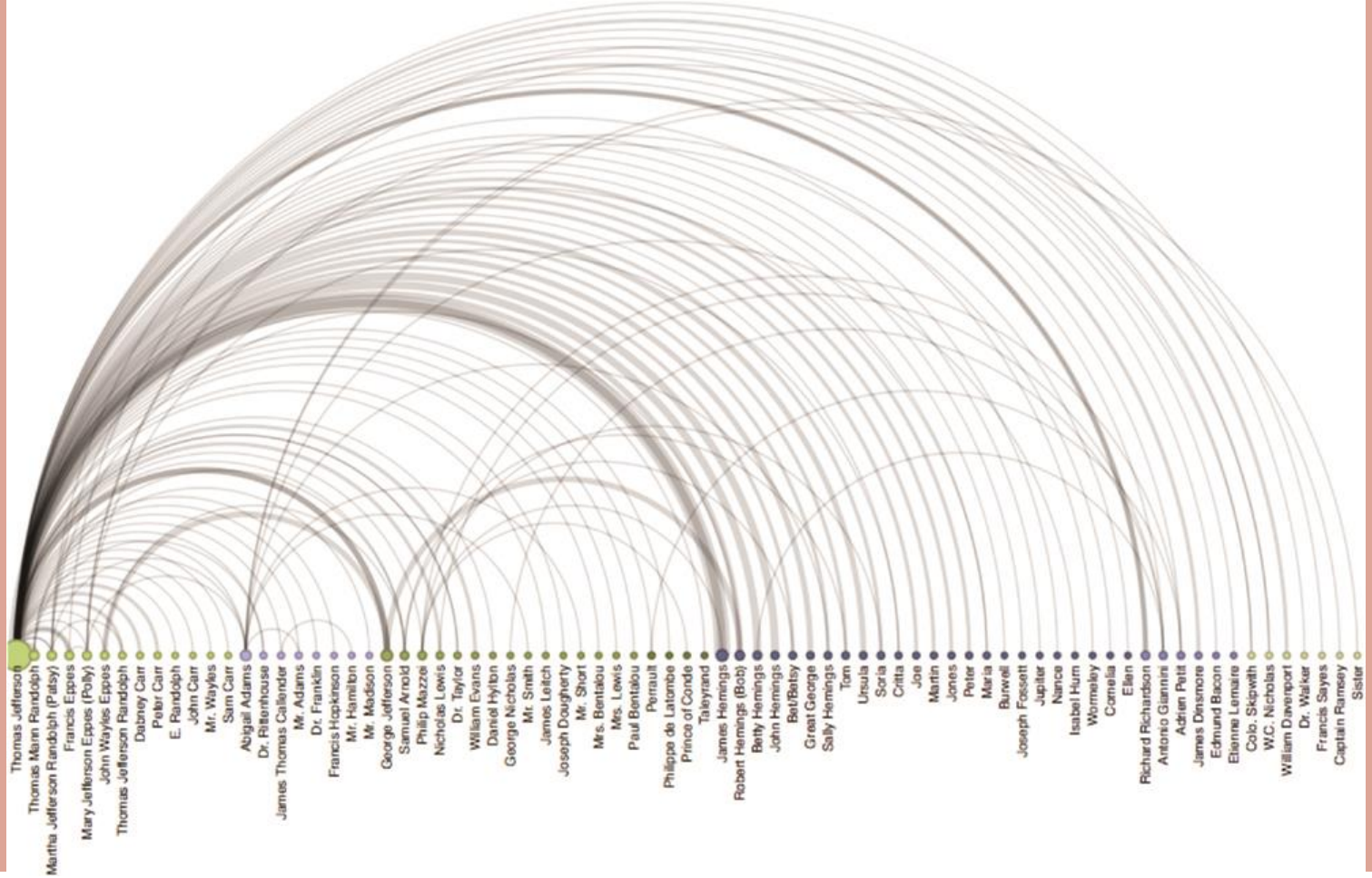
Some examples

MATRIX LAYOUTS

Surprisingly simple.

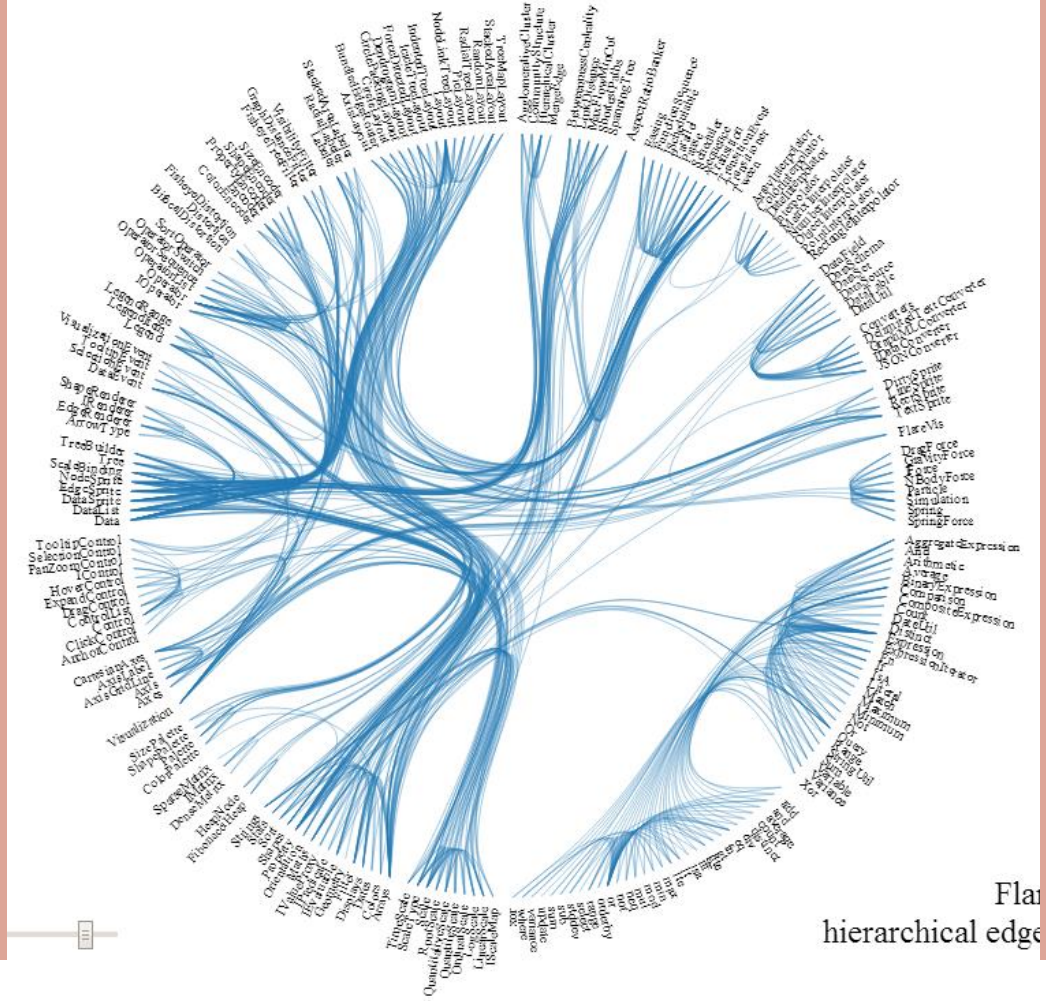


CARTESIAN COORDINATES



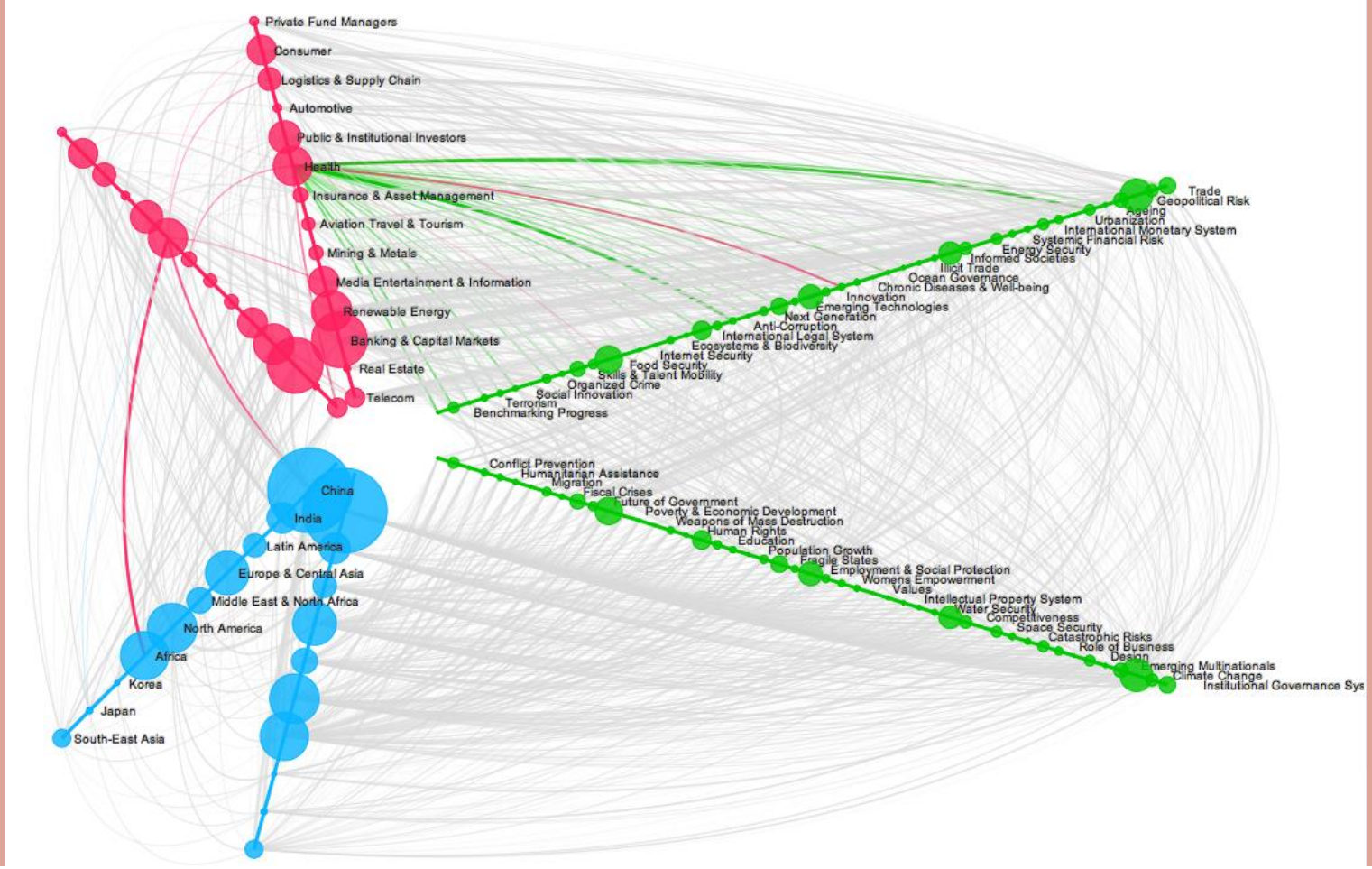
ARC DIAGRAMS

Nodes in order.



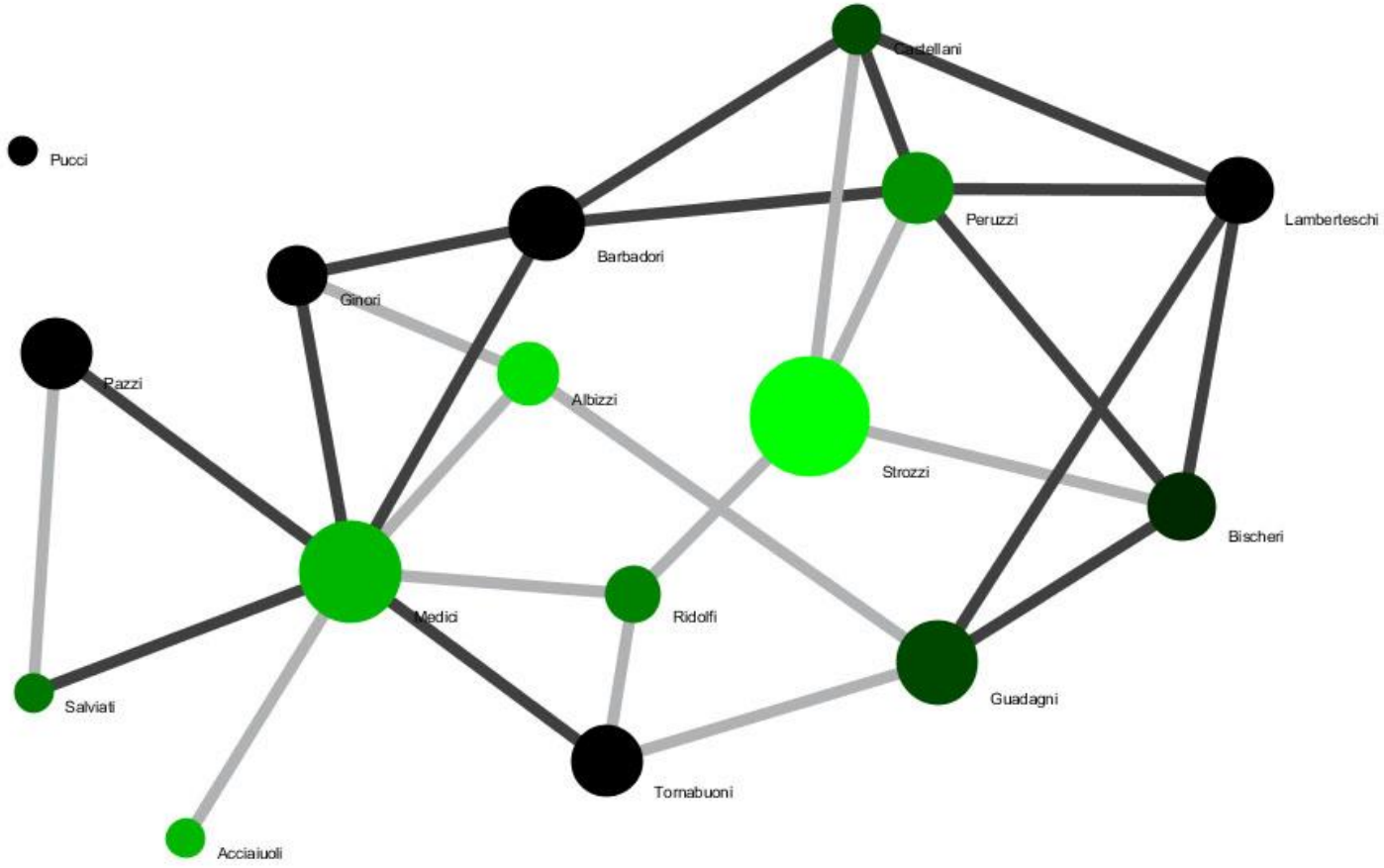
CIRCULAR LAYOUT

Arc curved in on itself.



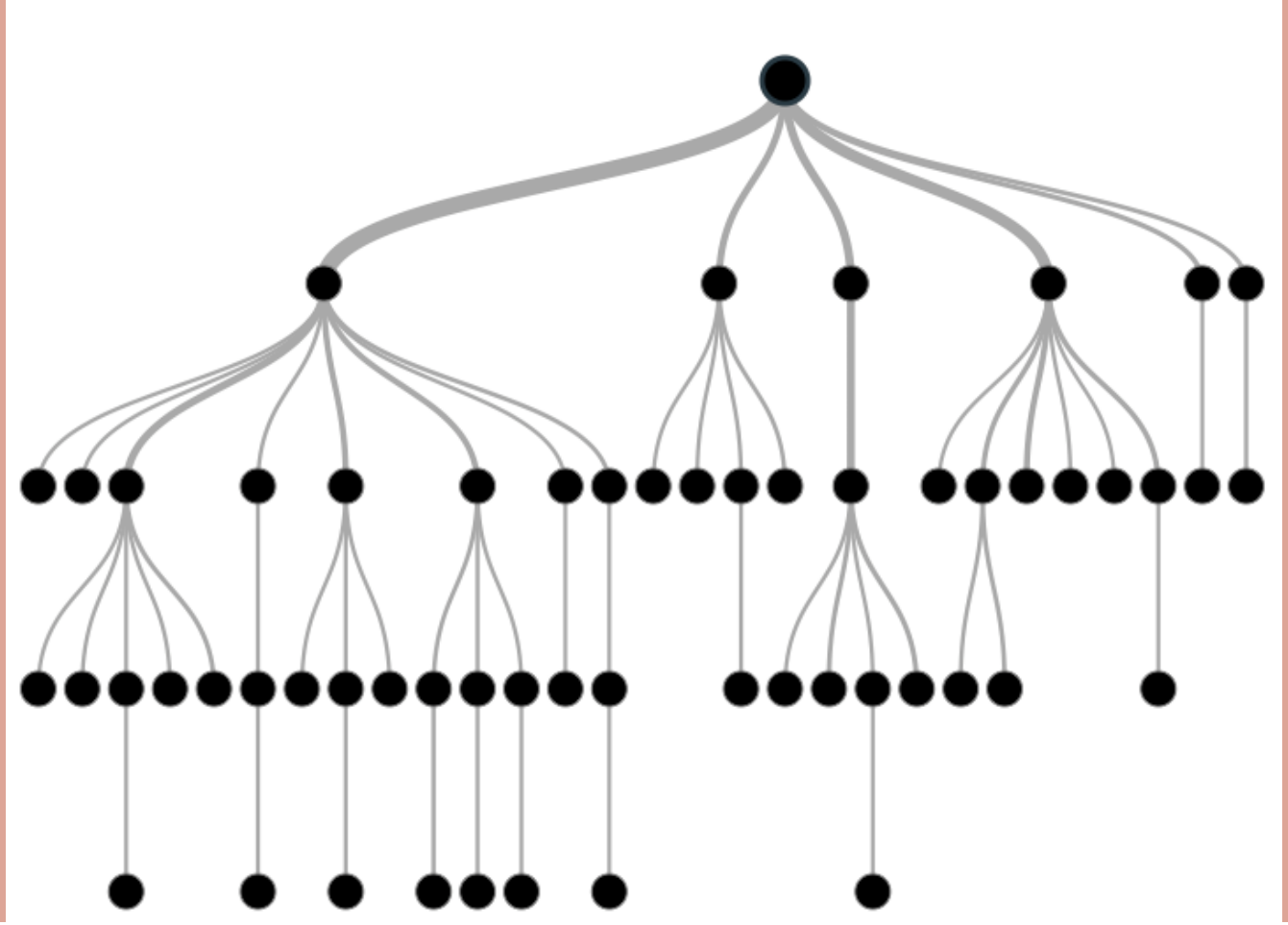
HIVE PLOTS

Cartesian + *n*.



FORCE-DIRECTED LAYOUTS

Retraining how you read.

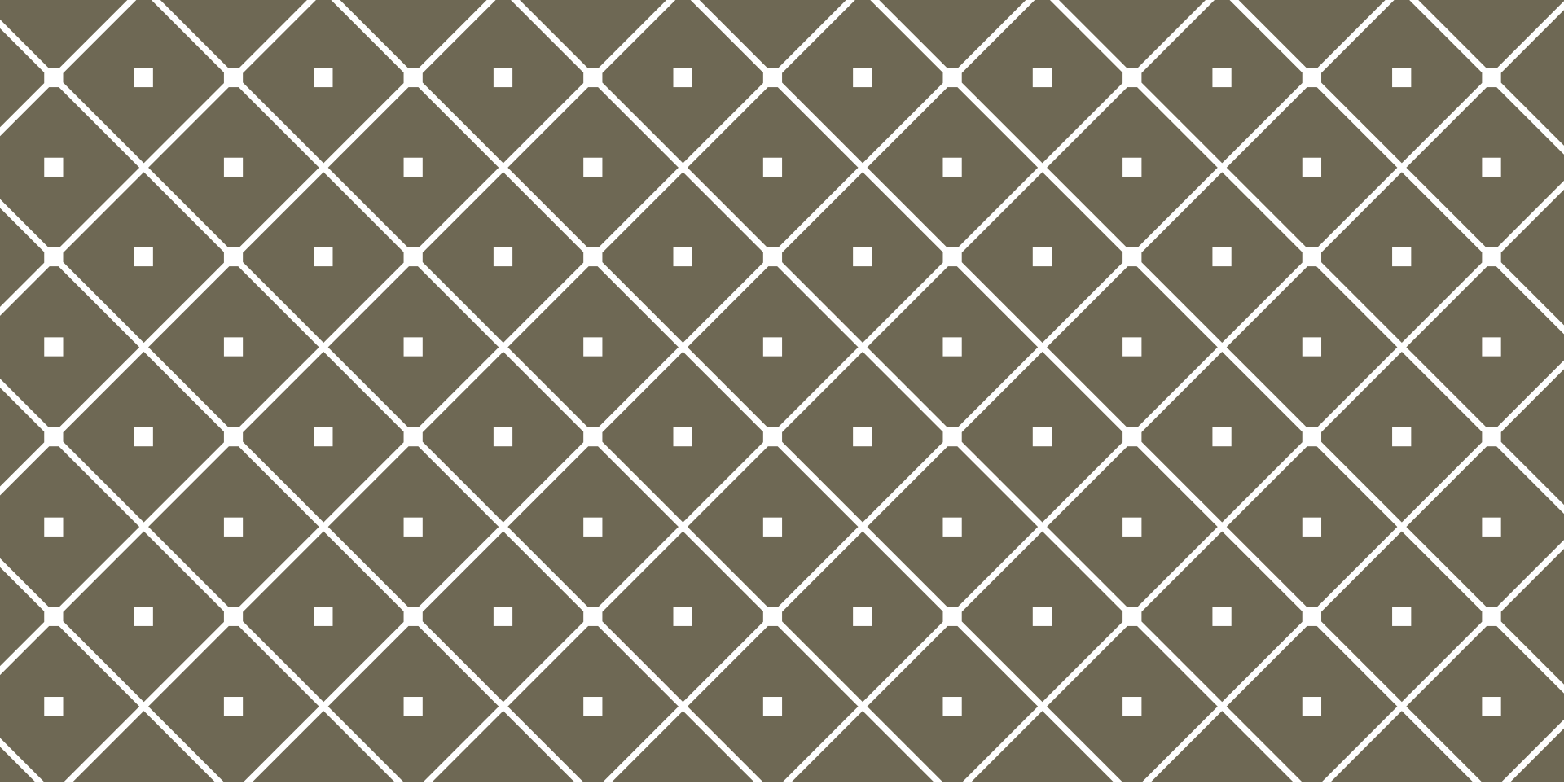


TREES

A special kind of network.

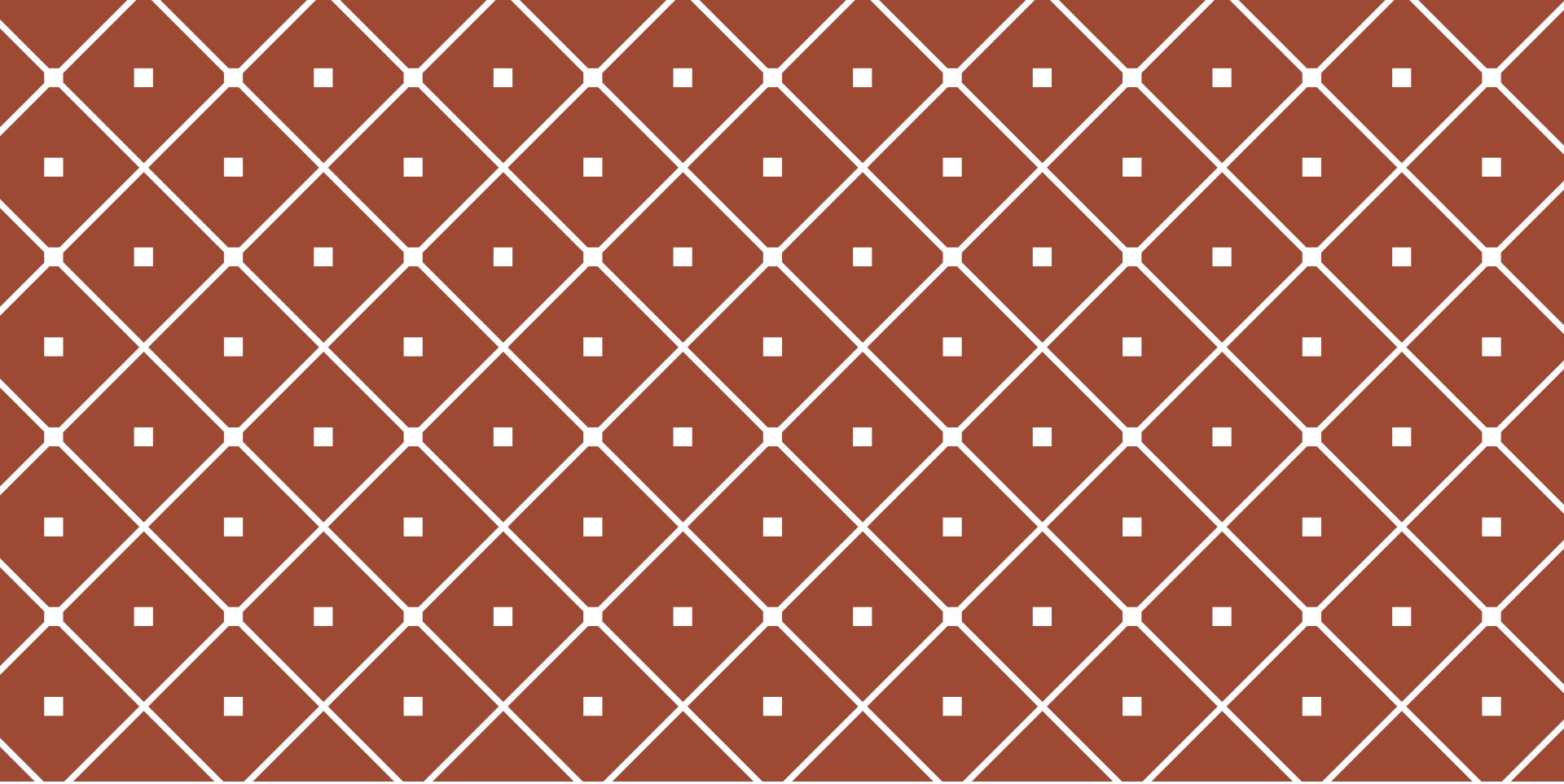
VISUALIZATION

09:00-09:15	The Ubiquity of Networks
09:15-09:30	Basic Concepts
09:30-10:00	Information Visualization
10:00-10:15	Q&A



THANK YOU / Q&A

Scott B. Weingart
@scott_bot



DIGITAL SCHOLARSHIP
NETWORKS & VISUALIZATIONS

Workshop
14:45-16:30

SCHEDULE

9:00-10:15

- Presentation: Research with Networks & Visualizations

14:45-16:30

- Workshop: Building Networks & Visualizations

NETWORK DATA

14:45-15:05	Network Data
15:05-15:20	NodeXL Introduction
15:20-15:50	Creating A Network
15:50-16:00	Combining The Network
16:00-16:30	Network Analysis & Visualization

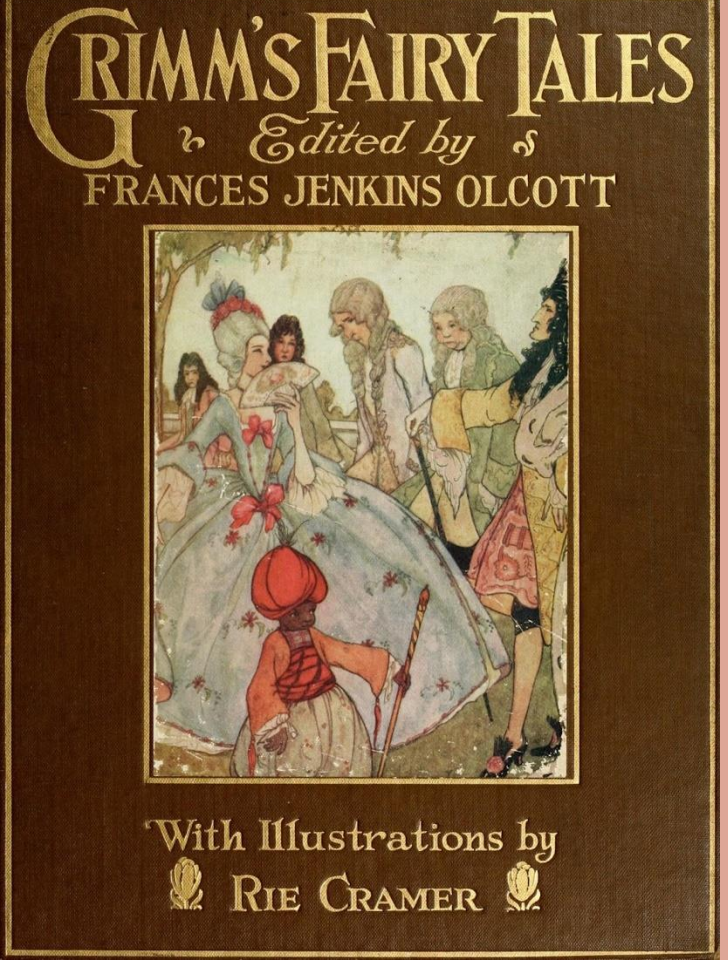
DATA VS. CAPTA

Data (n.)

- Neuter past participle of *dare* (Latin)
- “that which is given“

Capta (n.)

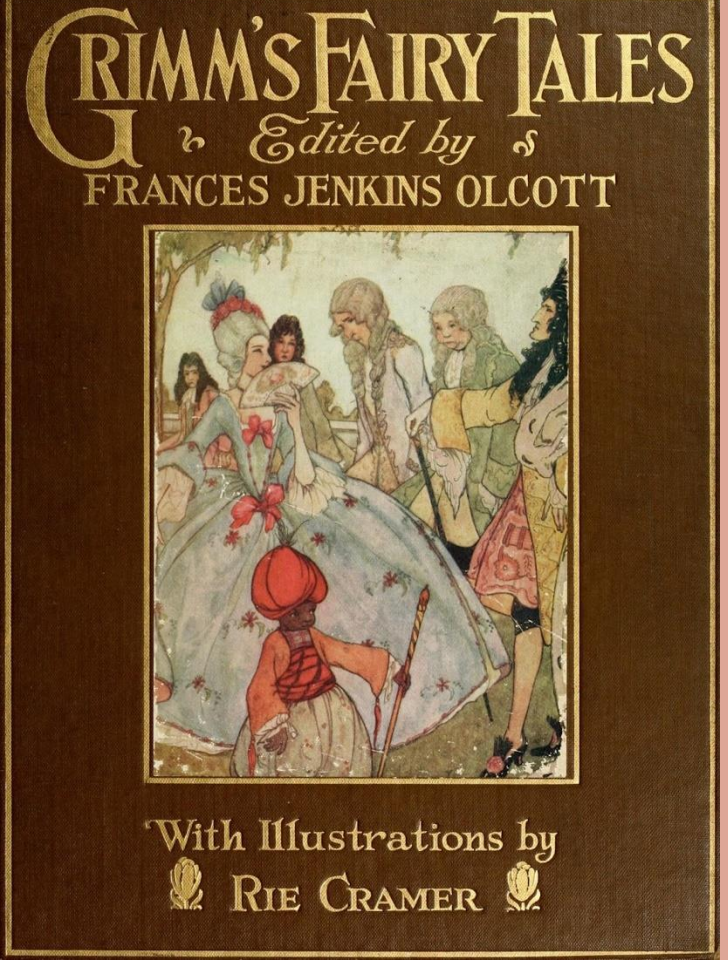
- Neuter past participle of *capere* (Latin)
- “that which is taken”



1. Tale ID
2. Noun
3. Adjective
4. Text
5. Page number
6. Gender (m/f)
7. + / - value
8. Young/old
9. High/low
10. Move (1-5)
11. Quoted speech (y/n)
12. Grotesque (y/n)
13. Violence (y/n)
14. Nudity (y/n)
15. Skin tone
16. Transform to
17. Transform From
18. Tale
19. Collection
20. Author
21. Teller
22. Collector
23. Year Collected
24. Year of Writing/Collecting
25. Year of Publication
26. Tale Type
27. Region
28. Original Language
29. Gender of Teller/Writer
30. Gender of Collector
31. Gender of Editor
32. Gender of Protagonist

CHOOSING VARIABLES

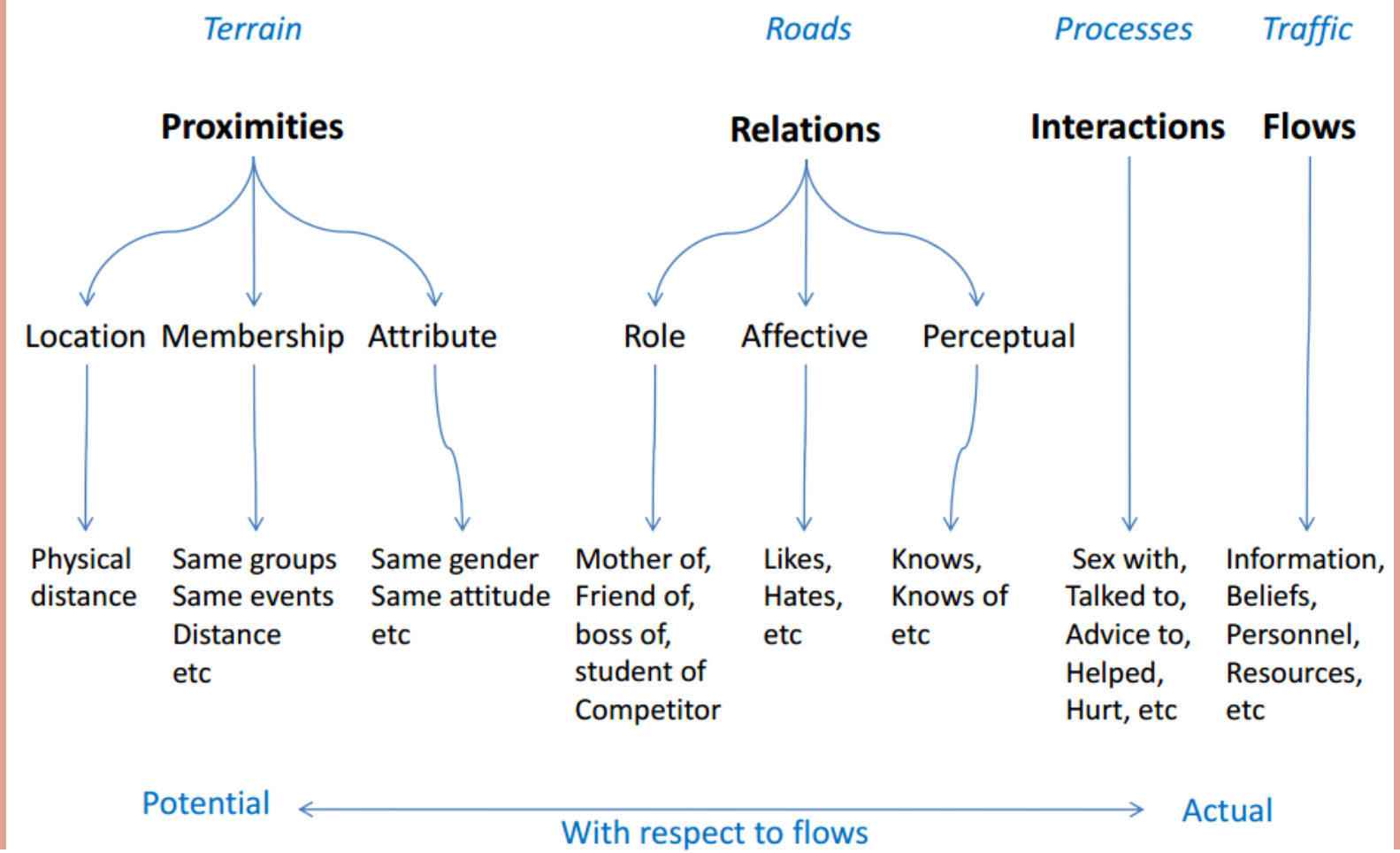
The subjective process of variable choice, and the importance of planning ahead.



- 11,000 lines
- 3 months of work, 9-5
- Numerical, qualitative, objective, & subjective variables
- Went back and added several variables
- Didn't use some variables

CHOOSING VARIABLES

The subjective process of variable choice, and the importance of planning ahead.



NETWORK DATA

Which type of network will be drawn?

NETWORK DATA

entities

- people
- organizations
- concepts
- objects
- documents
- etc.

connected to each other by

relationships

- "is friends with"
- "shares a board member with"
- "is similar to"
- "is a type of"
- "contains a reference to"
- etc.

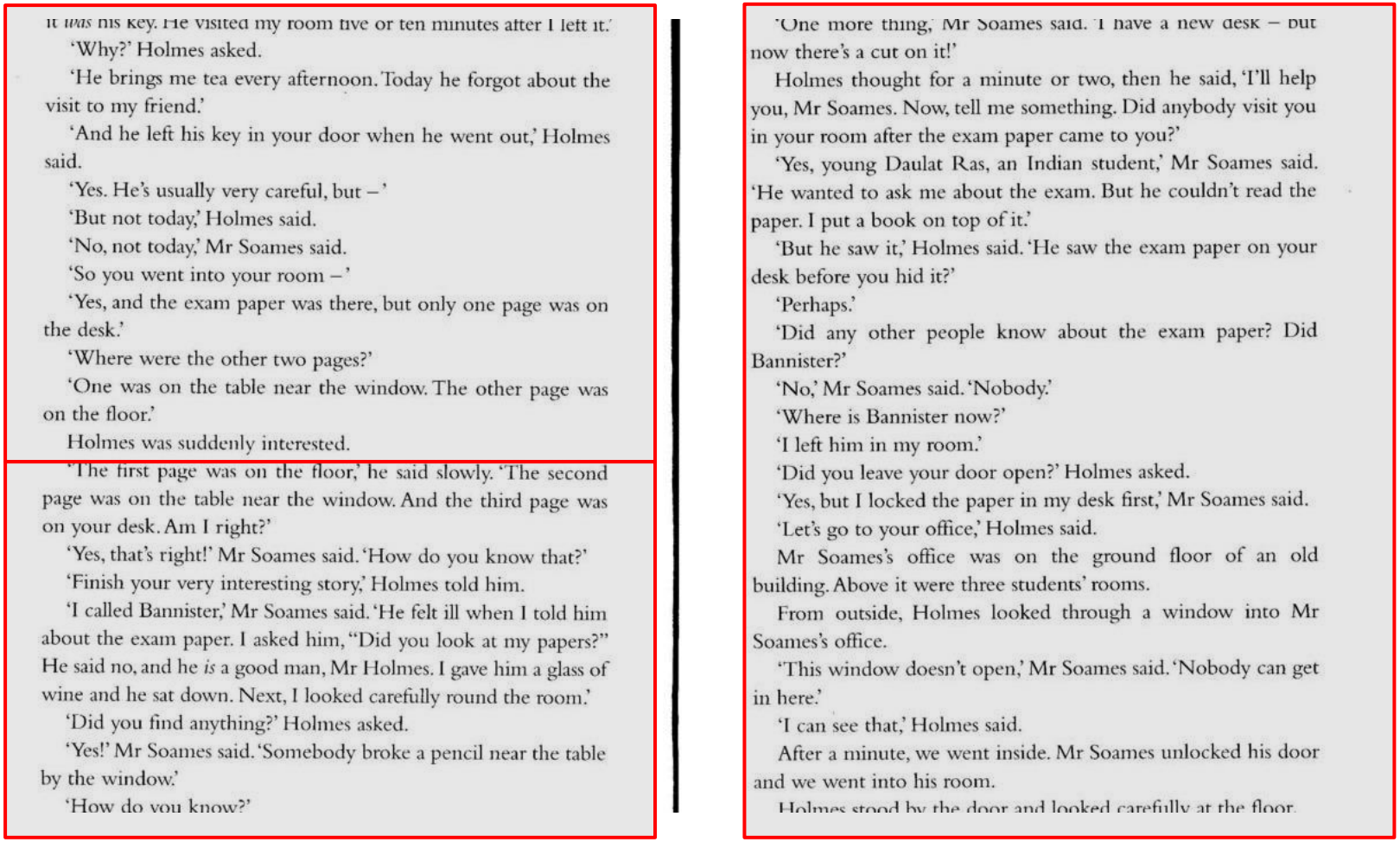
GENERATING DATA

Picking what's important

GENERATING DATA

Picking what's important

CHARACTER INTERACTIONS



it *was* his key. He visited my room five or ten minutes after I left it.'

'Why?' Holmes asked.

'He brings me tea every afternoon. Today he forgot about the visit to my friend.'

'And he left his key in your door when he went out,' Holmes said.

'Yes. He's usually very careful, but –'

'But not today,' Holmes said.

'No, not today,' Mr Soames said.

'So you went into your room –'

'Yes, and the exam paper was there, but only one page was on the desk.'

'Where were the other two pages?'

'One was on the table near the window. The other page was on the floor.'

Holmes was suddenly interested.

'The first page was on the floor,' he said slowly. 'The second page was on the table near the window. And the third page was on your desk. Am I right?'

'Yes, that's right!' Mr Soames said. 'How do you know that?'

'Finish your very interesting story,' Holmes told him.

'I called Bannister,' Mr Soames said. 'He felt ill when I told him about the exam paper. I asked him, "Did you look at my papers?" He said no, and he *is* a good man, Mr Holmes. I gave him a glass of wine and he sat down. Next, I looked carefully round the room.'

'Did you find anything?' Holmes asked.

'Yes!' Mr Soames said. 'Somebody broke a pencil near the table by the window.'

'How do you know?'

'One more thing,' Mr Soames said. 'I have a new desk – but now there's a cut on it!'

Holmes thought for a minute or two, then he said, 'I'll help you, Mr Soames. Now, tell me something. Did anybody visit you in your room after the exam paper came to you?'

'Yes, young Daulat Ras, an Indian student,' Mr Soames said. 'He wanted to ask me about the exam. But he couldn't read the paper. I put a book on top of it.'

'But he saw it,' Holmes said. 'He saw the exam paper on your desk before you hid it?'

'Perhaps.'

'Did any other people know about the exam paper? Did Bannister?'

'No,' Mr Soames said. 'Nobody.'

'Where is Bannister now?'

'I left him in my room.'

'Did you leave your door open?' Holmes asked.

'Yes, but I locked the paper in my desk first,' Mr Soames said.

'Let's go to your office,' Holmes said.

Mr Soames's office was on the ground floor of an old building. Above it were three students' rooms.

From outside, Holmes looked through a window into Mr Soames's office.

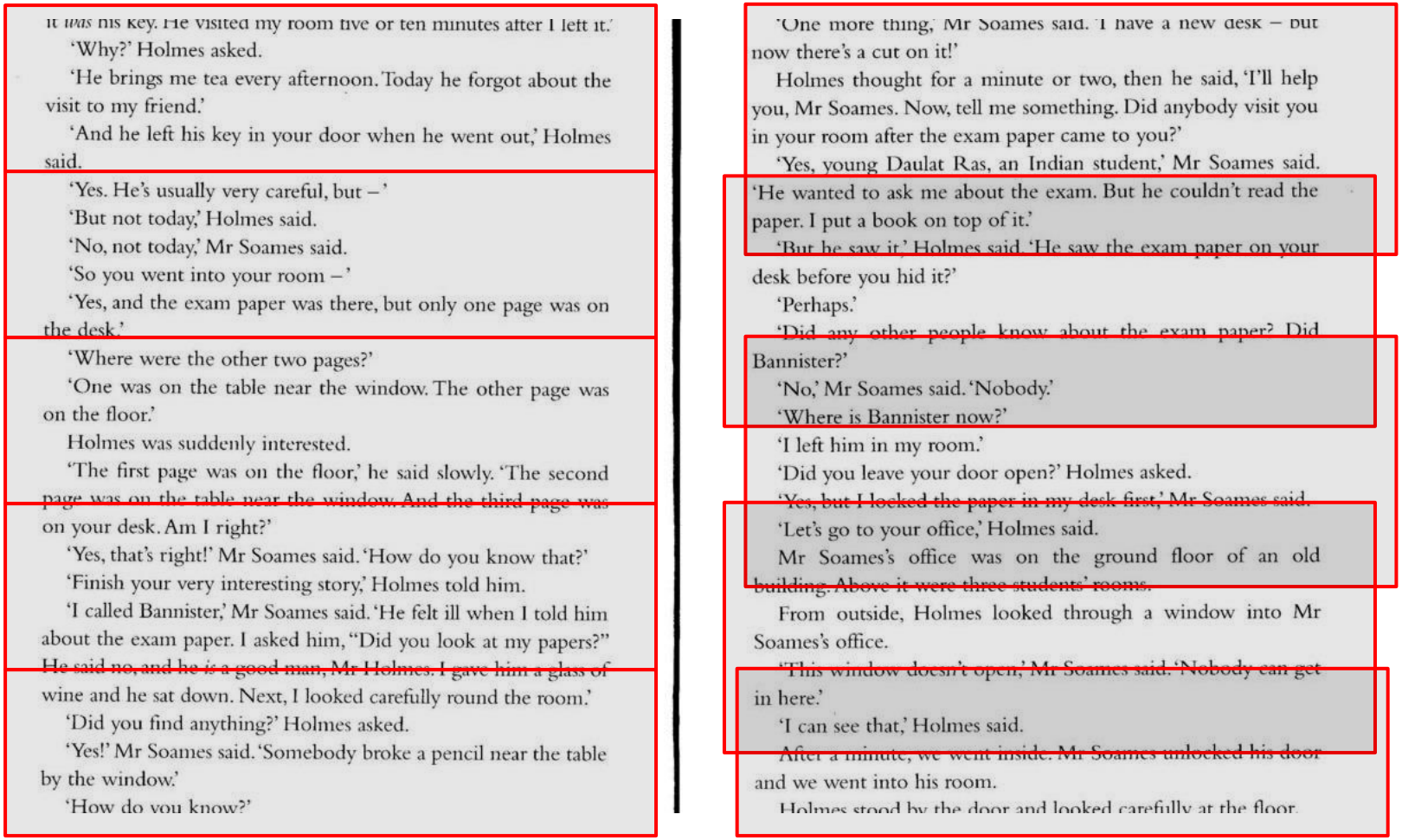
'This window doesn't open,' Mr Soames said. 'Nobody can get in here.'

'I can see that,' Holmes said.

After a minute, we went inside. Mr Soames unlocked his door and we went into his room.

Holmes stood by the door and looked carefully at the floor.

CHARACTER INTERACTIONS



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'One was on the table near the window. The other page was on the floor.'

Holmes was suddenly interested.

'The first page was on the floor,' he said slowly. 'The second page was on the table near the window. And the third page was on your desk. Am I right?'

'Yes, that's right!' Mr Soames said. 'How do you know that?'

'Finish your very interesting story,' Holmes told him.

'I called Bannister,' Mr Soames said. 'He felt ill when I told him about the exam paper. I asked him, "Did you look at my papers?" He said no, and he *is* a good man, Mr Holmes. I gave him a glass of wine and he sat down. Next, I looked carefully round the room.'

'Did you find anything?' Holmes asked.

'Yes!' Mr Soames said. 'Somebody broke a pencil near the table by the window.'

'How do you know?'

'One more thing,' Mr Soames said. 'I have a new desk – but now there's a cut on it!'

Holmes thought for a minute or two, then he said, 'I'll help you, Mr Soames. Now, tell me something. Did anybody visit you in your room after the exam paper came to you?'

'Yes, young Daulat Ras, an Indian student,' Mr Soames said. 'He wanted to ask me about the exam. But he couldn't read the paper. I put a book on top of it.'

'But he saw it,' Holmes said. 'He saw the exam paper on your desk before you hid it?'

'Perhaps.'

'Did any other people know about the exam paper? Did Bannister?'

'No,' Mr Soames said. 'Nobody.'

'Where is Bannister now?'

'I left him in my room.'

'Did you leave your door open?' Holmes asked.

'Yes, but I locked the paper in my desk first,' Mr Soames said.

'Let's go to your office,' Holmes said.

Mr Soames's office was on the ground floor of an old building. Above it were three students' rooms.

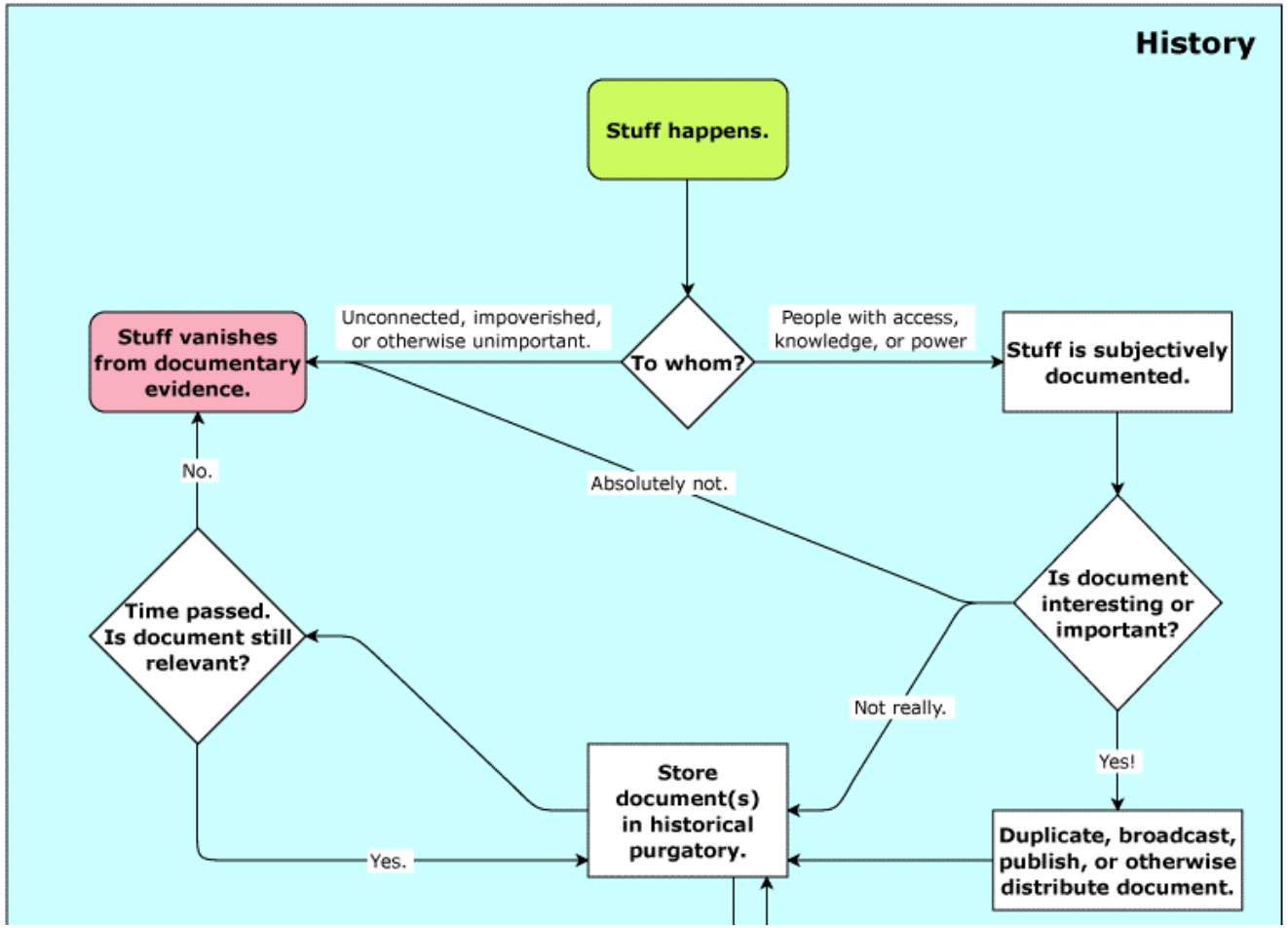
From outside, Holmes looked through a window into Mr Soames's office.

'This window doesn't open,' Mr Soames said. 'Nobody can get in here.'

'I can see that,' Holmes said.

After a minute, we went inside. Mr Soames unlocked his door and we went into his room.

Holmes stood by the door and looked carefully at the floor.



HISTORICAL BIAS

What don't networks show?

SAMPLING VS. ENTIRE NETWORK

- Snowball Sampling
- Random Nets
- Biases of Sampling Techniques
  - Snowball – Power law degree distributions
  - Random Nodes – Low density

DATA IN LETTERS (EDGES)

- Sender
- Recipient
- Date
- Language
- Full Text
- Sender Location
- Recipient Location

DATA IN LETTERS (NODES)

- Unique ID
- Birthdate
- Location in DNB/DBPedia/Etc
- Birth Location
- Death Location
- Position
- Religion

DATA IN SHAKESPEARE

- If characters appear in a scene together.
- If characters interact with one another.
- If characters are on the same page.
- If characters are on stage at the same time.

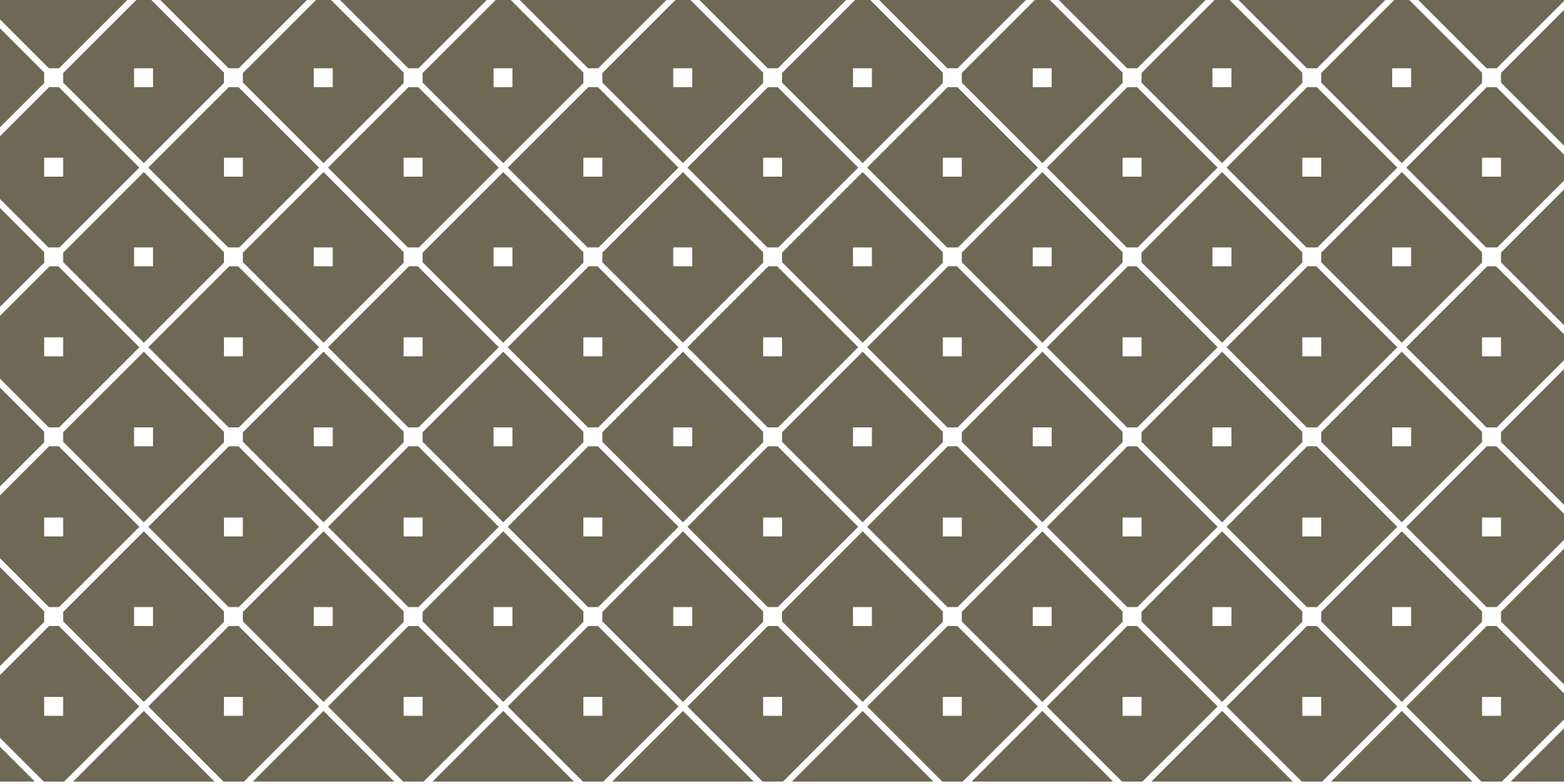
DATA IN DIARIES

- What sort of relationship?
  - Friendship
  - Business Transactions
  - Traveling Together
  - Dining Together
  - Symmetric or Assymetric?

  - Marten Düring's Holocaust Networks

DATA IN WIKIPEDIA

- Page-to-Page Links
- Category-to-Page Links
- Category co-occurrence
- Word co-occurrence
- Co-occurrence of pages by editors
- Co-occurrence of editors by pages

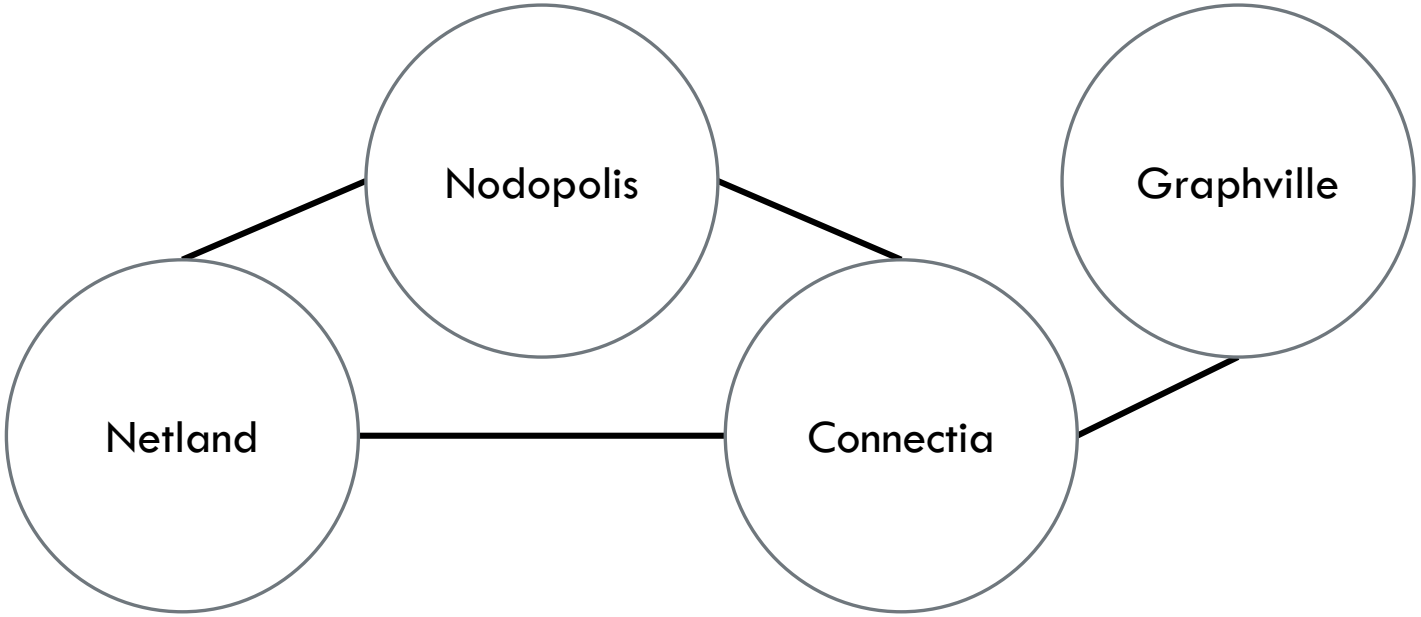


DATA TYPES

What a network looks like.

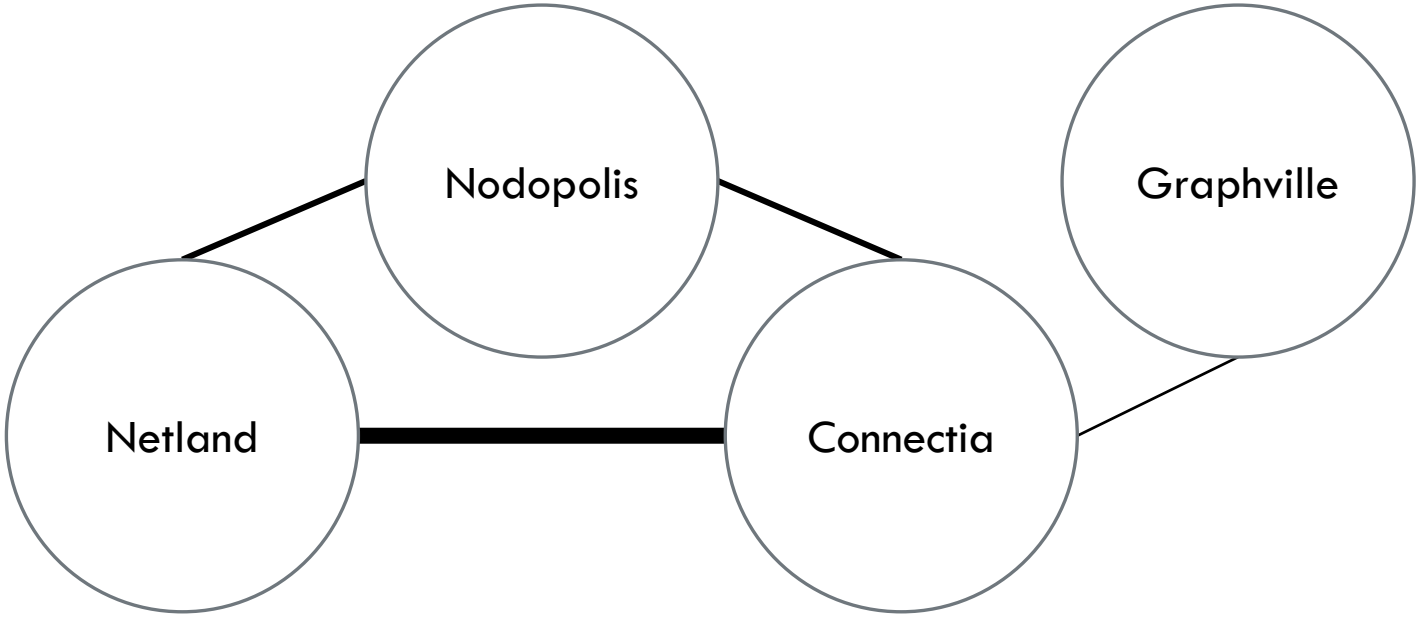
THE MATRIX

	Netland	Connectia	Graphville	Nodopolis
Netland	x	1	0	1
Connectia		x	1	1
Graphville			x	0
Nodopolis				x



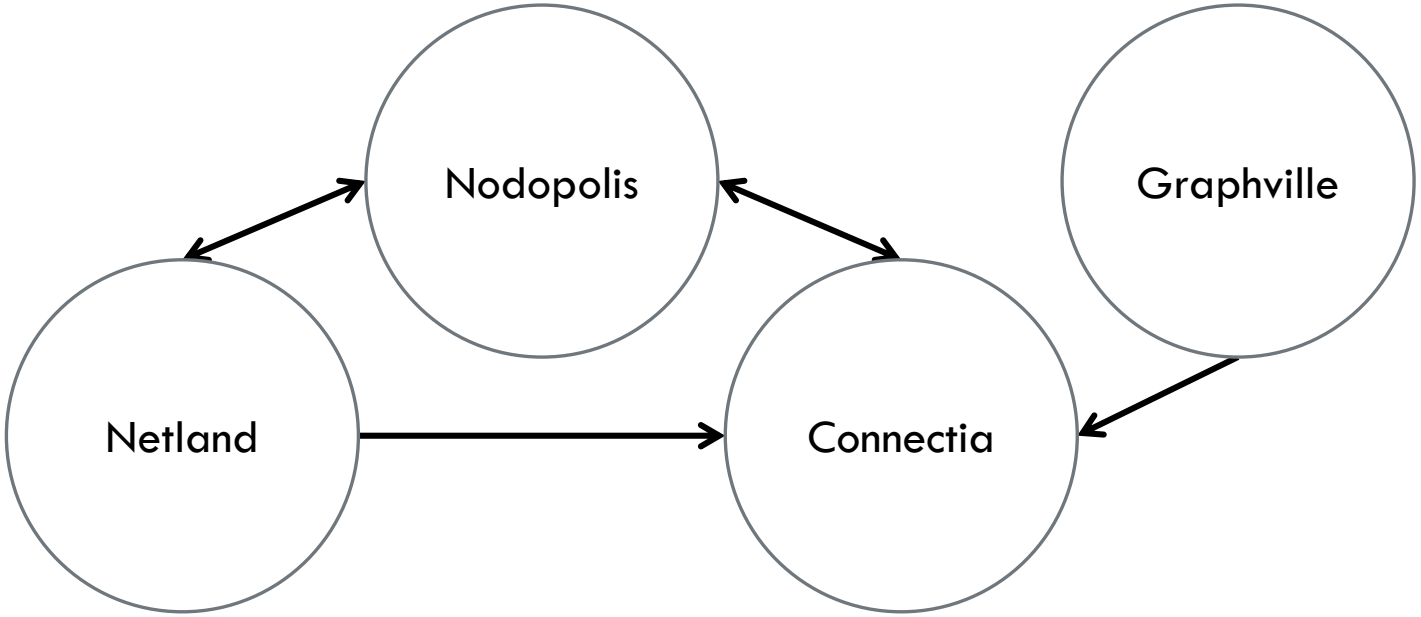
WEIGHTED MATRIX

	Netland	Connectia	Graphville	Nodopolis
Netland	x	$10m	0	$4m
Connectia		x	$2m	$4m
Graphville			x	0
Nodopolis				x

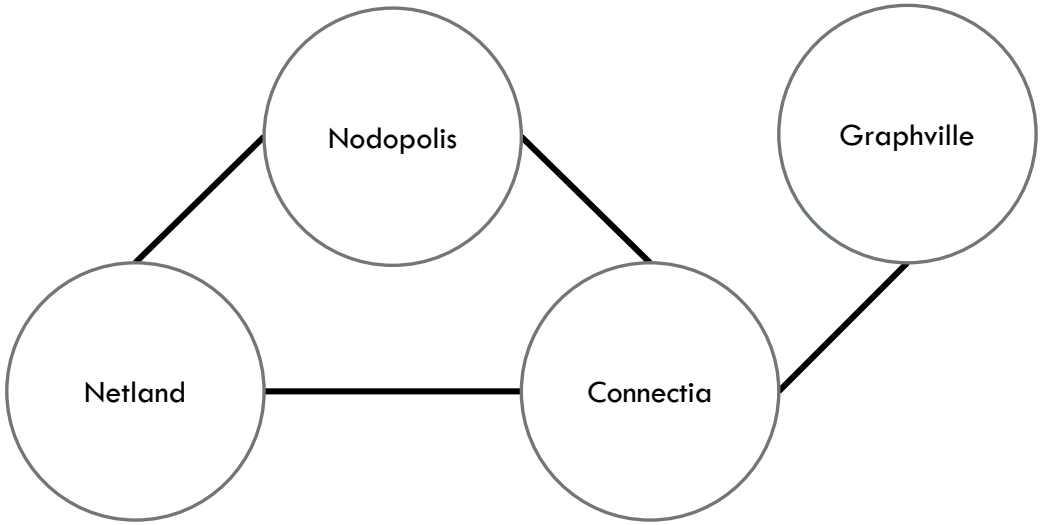


DIRECTED MATRIX

	Netland	Connectia	Graphville	Nodopolis
Netland	x	1	0	1
Connectia	0	x	0	1
Graphville	0	1	x	0
Nodopolis	1	1	0	x

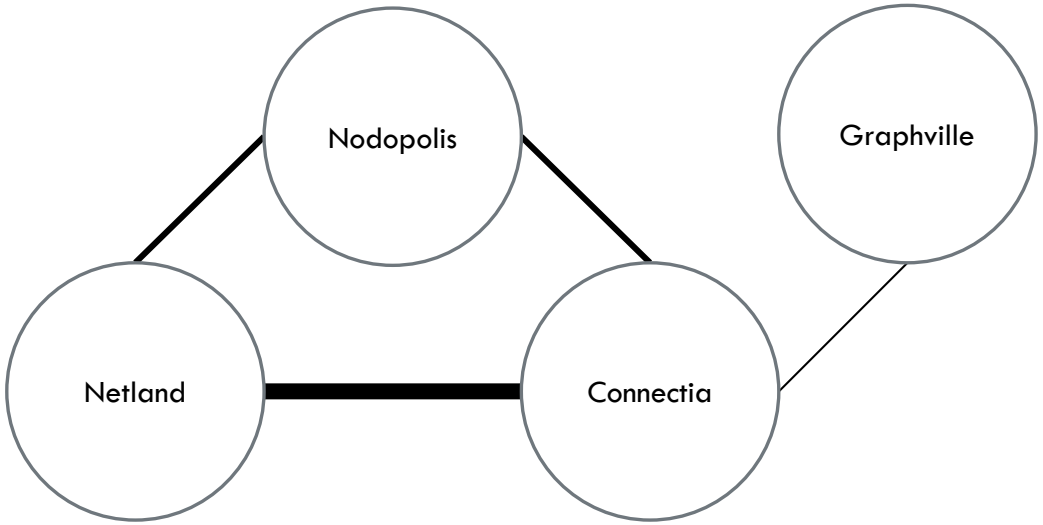


ADJACENCY LIST



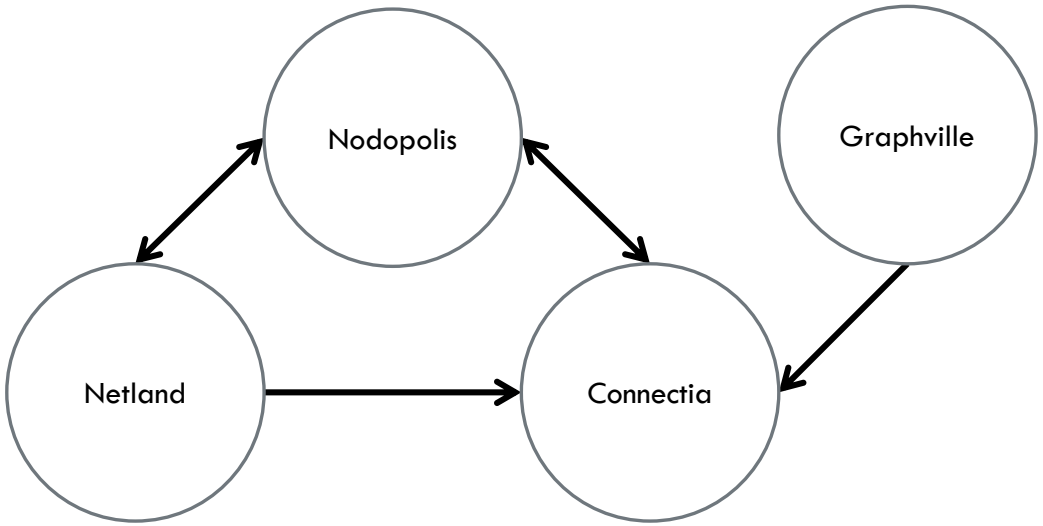
Node 1	Node 2
Netland	Connectia
Netland	Nodopolis
Connectia	Graphville
Connectia	Nodopolis

WEIGHTED ADJACENCY LIST



Node 1	Node 2	Weight
Netland	Connectia	$10m
Netland	Nodopolis	$4m
Connectia	Graphville	$2m
Connectia	Nodopolis	$4m

DIRECTED ADJACENCY LIST



Source	Target
Netland	Nodopolis
Nodopolis	Netland
Netland	Connectia
Nodopolis	Connectia
Connectia	Nodopolis
Graphville	Connectia

NODE & EDGE LISTS

Nodes	
ID	**Label**
1	Graphville
2	Nodopolis
3	Connectia
4	Netland

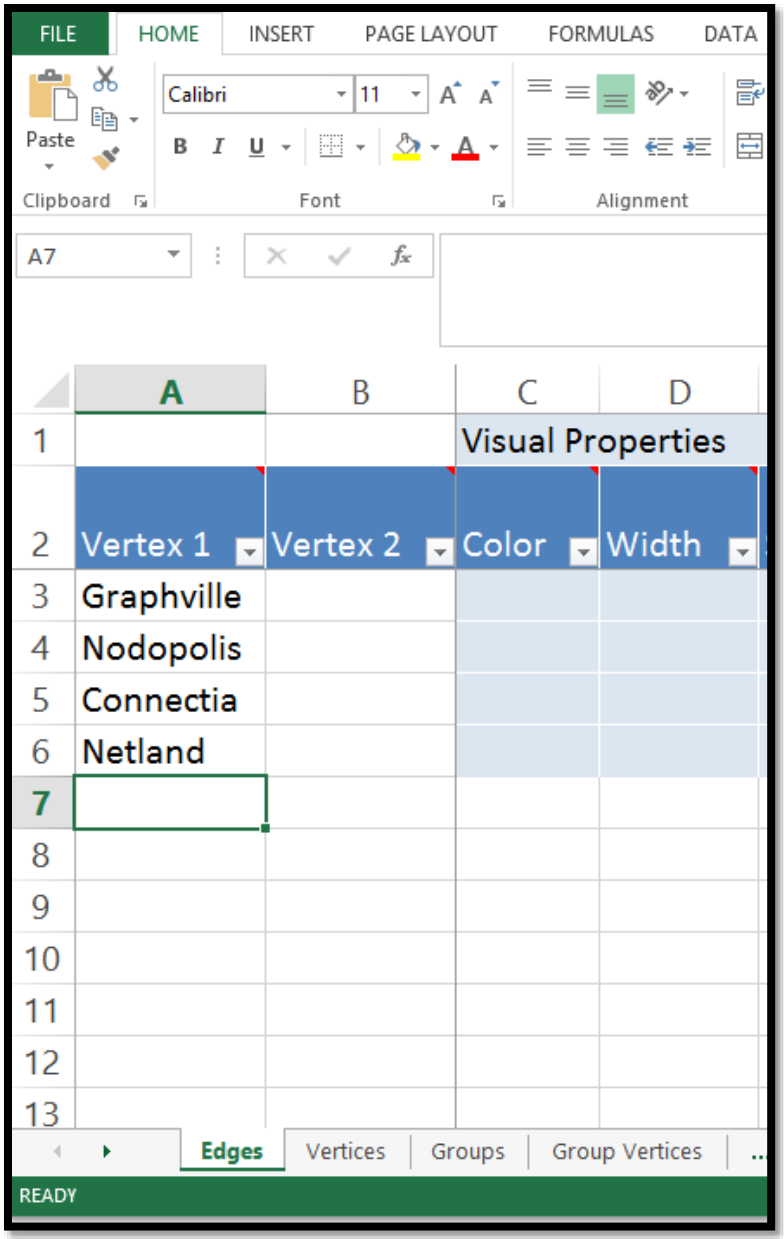
Edges	
4	3
4	2
3	1
3	2

NODE & EDGE LISTS

Nodes			
ID	**Label**	**Population**	**Country**
1	Graphville	700,000	USA
2	Nodopolis	250,000	Canada
3	Connectia	1,000,000	Canada
4	Netland	300,000	USA

Edges		
Source	**Target**	**Weight**
4	3	$6mil
4	2	$1mil
3	1	$1mil
3	2	$3mil
3	4	$4mil
1	3	$1mil
2	4	$3mil
2	3	$1mil

NODEXL


FILE
HOME
INSERT
PAGE LAYOUT
FORMULAS
DATA
Paste
Calibri
11
Clipboard
Font
Alignment
A7
A
B
C
D
1
Visual Properties
2
Vertex 1
Vertex 2
Color
Width
3
Graphville
4
Nodopolis
5
Connectia
6
Netland
7
8
9
10
11
12
13
Edges
Vertices
Groups
Group Vertices
READY

NODEXL INTRODUCTION

14:45-15:05	Network Data
15:05-15:20	NodeXL Introduction
15:20-15:50	Creating A Network
15:50-16:00	Combining The Network
16:00-16:30	Network Analysis & Visualization

NODEXL

-Create a basic network

-Basic visualization with different layouts

-Add and display labels

-Automate (with graph metrics)

-Go through each tab

-Directed vs. Undirected

-Custom columns

CREATING A NETWORK

14:45-15:05	Network Data
15:05-15:20	NodeXL Introduction
15:20-15:50	Creating A Network
15:50-16:00	Combining The Network
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CREATING A NETWORK

-Create a Digital Scholarship at UF network
    -People? Institutions? Disciplines? Email?
    -Directed or Undirected?
    -Temporal?
    -Weighted?
    -What's in and what's out?
    -Does not need to be complete.

-At 15:50, groups present their incomplete networks and explain/defend data decisions.

COMBINING THE NETWORK

14:45-15:05	Network Data
15:05-15:20	NodeXL Introduction
15:20-15:50	Creating A Network
15:50-16:00	Combining The Network
16:00-16:30	Network Analysis & Visualization

COMBINING THE NETWORK

-If there are ways to combine any data sets, how do we do so?

-If not, evaluate the various datasets and decide on one to analyze.

ANALYSIS & VISUALIZATION

14:45-15:05	Network Data
15:05-15:20	NodeXL Introduction
15:20-15:50	Creating A Network
15:50-16:00	Combining The Network
16:00-16:30	Network Analysis & Visualization

ANALYSIS & VISUALIZATION

-Automate > Graph Metrics

-Graph Metrics > Centralities / Clustering

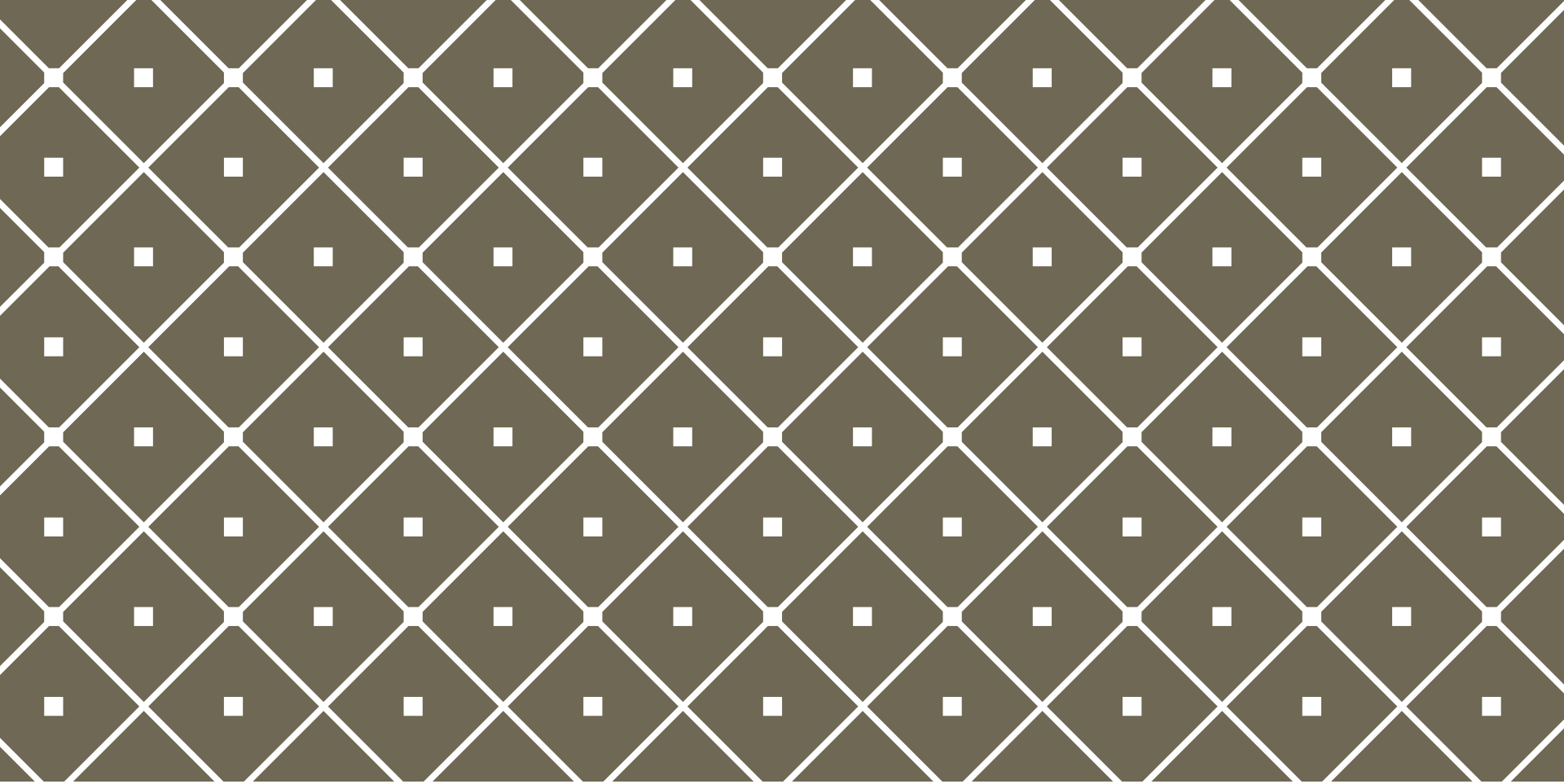
-Group by Cluster

-Autofill Columns

-Sorting

-Graph Options

-Layout Options Dropdown (boxes)



THANK YOU / Q&A

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