

CS49000-VIZ - Fall 2020

Introduction to Data Visualization

Data Abstraction & Data Types

Lecture 6

September 10, 2020

What?

Datasets

Attributes

→ Data Types

→ Items → Attributes → Links → Positions → Grids

→ Attribute Types

→ Categorical



→ Ordered

→ Ordinal



→ Quantitative

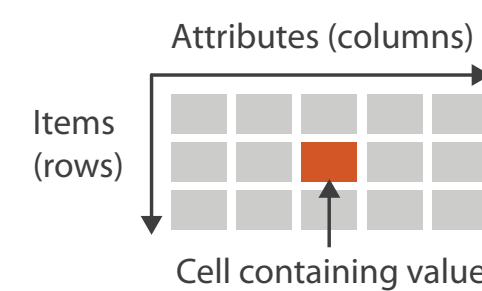


→ Data and Dataset Types

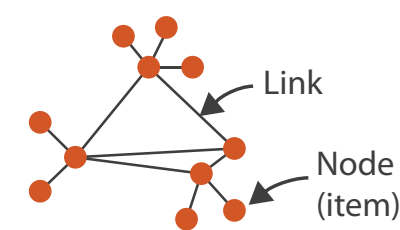
Tables	Networks & Trees	Fields	Geometry	Clusters, Sets, Lists
Items	Items (nodes)	Grids	Items	Items
Attributes	Links	Positions	Positions	
	Attributes	Attributes		

→ Dataset Types

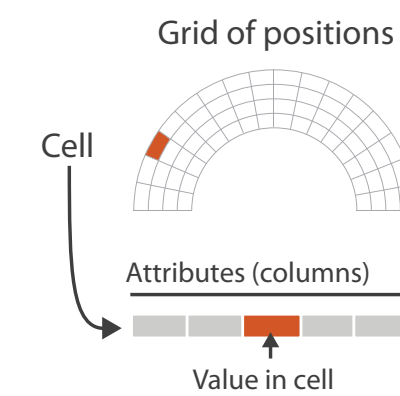
→ Tables



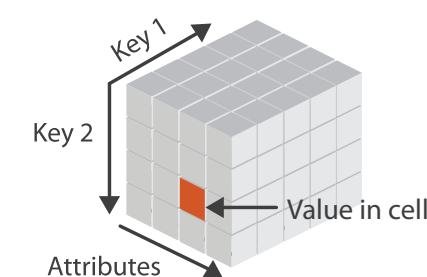
→ Networks



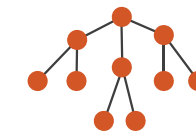
→ Fields (Continuous)



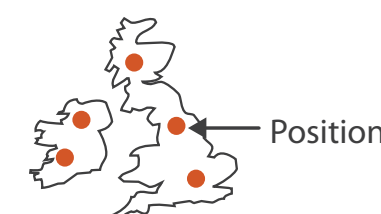
→ Multidimensional Table



→ Trees



→ Geometry (Spatial)



→ Ordering Direction

→ Sequential



→ Diverging



→ Cyclic



What?

Why?

How?

[VAD Fig 2.1]

Goal

- Translate problem specific data into abstract data type
- Consider visualization strategies available for this data type

Data Semantics

2, Basil, 7, S, Pear

Data Semantics

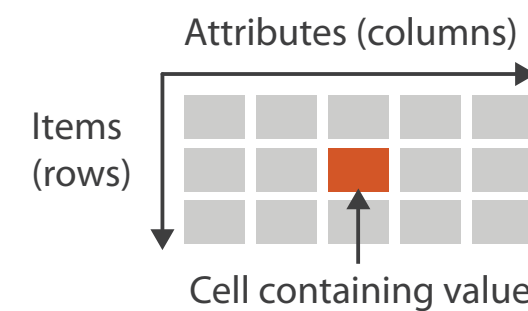
ID	Name	Age	Shirt Size	Favorite Fruit
1	Amy	8	S	Apple
2	Basil	7	S	Pear
3	Clara	9	M	Durian
4	Desmond	13	L	Elderberry
5	Ernest	12	L	Peach
6	Fanny	10	S	Lychee
7	George	9	M	Orange
8	Hector	8	L	Loquat
9	Ida	10	M	Pear
10	Amy	12	M	Orange

Structure

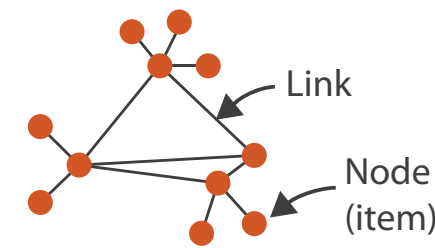
- **Structured data:** known data types, semantics

→ Dataset Types

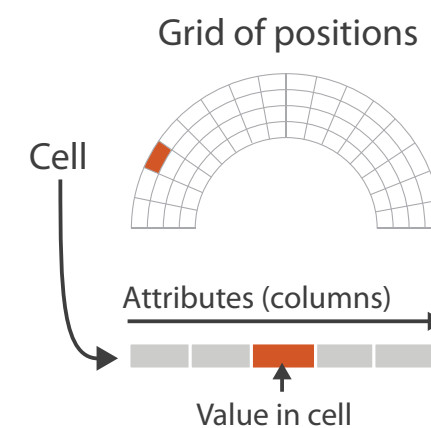
→ Tables



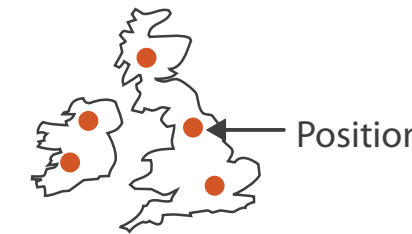
→ Networks



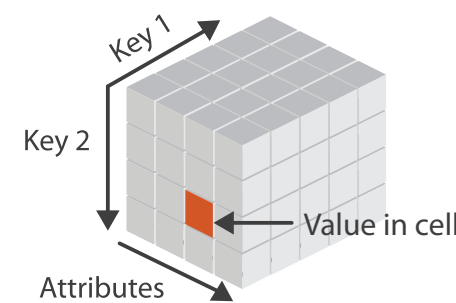
→ Fields (Continuous)



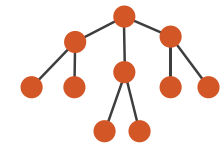
→ Geometry (Spatial)



→ Multidimensional Table



→ Trees



- **Unstructured data:** no predefined data model, text-heavy, interspersed with facts (dates, times, locations), video, image: **convert to structured**

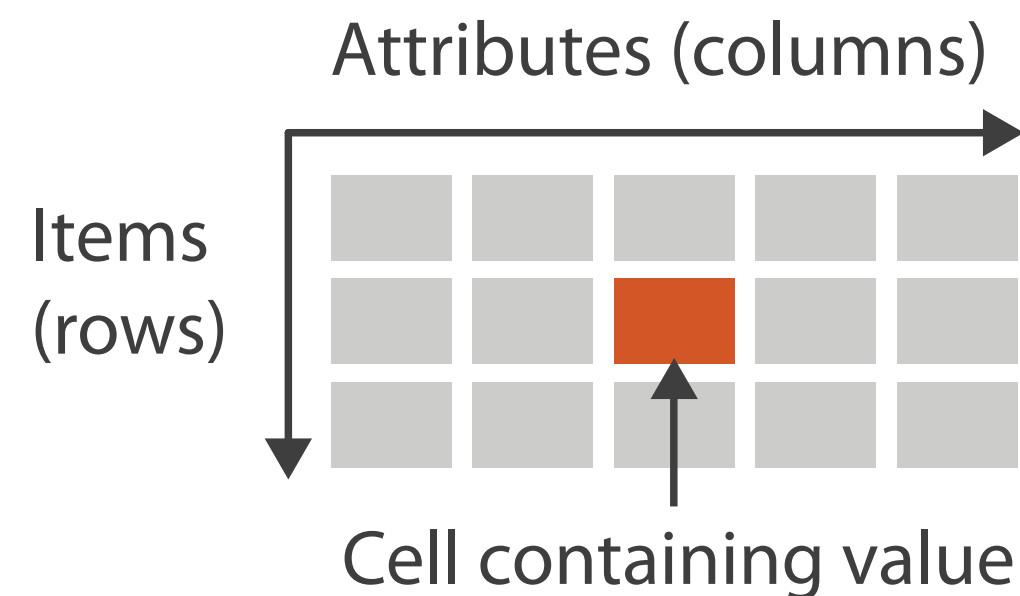
Structure

- **Unstructured data:**
 - No predefined data model, text-heavy, interspersed with facts (dates, times, locations), video, image:
- **Convert to structured**
 - Natural language processing (NLP), text mining (sentiment, keywords, concepts, categories)

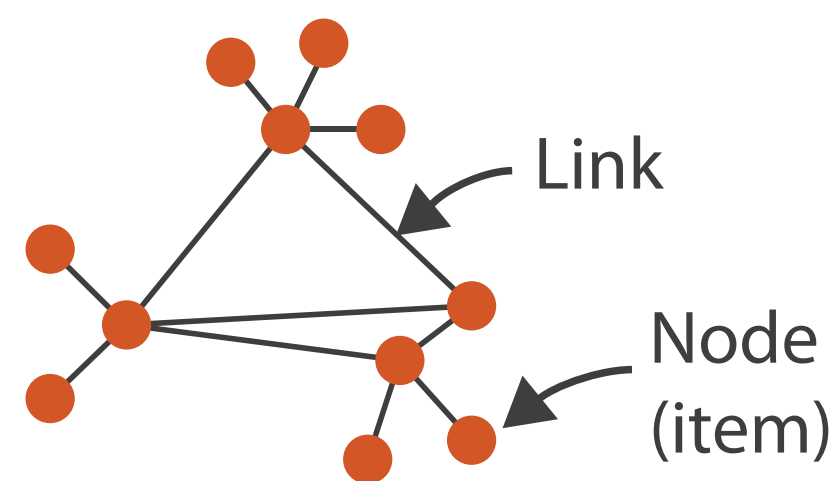
Dataset types

→ Dataset Types

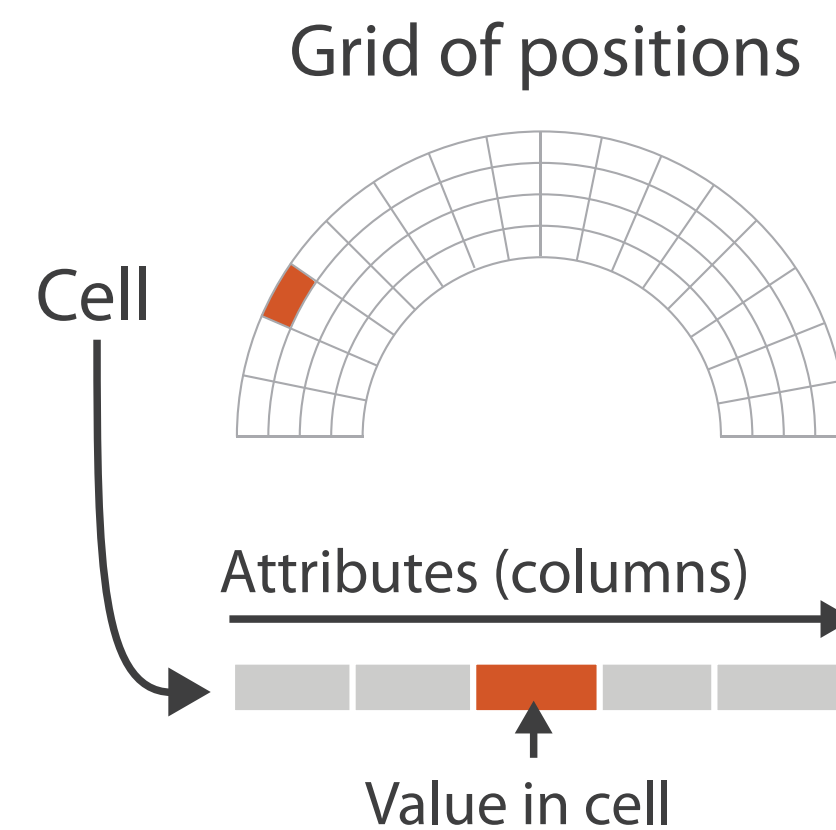
→ Tables



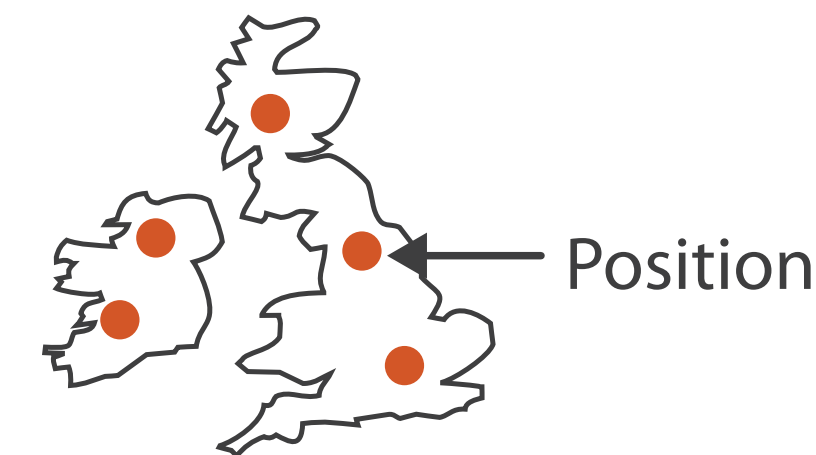
→ Networks



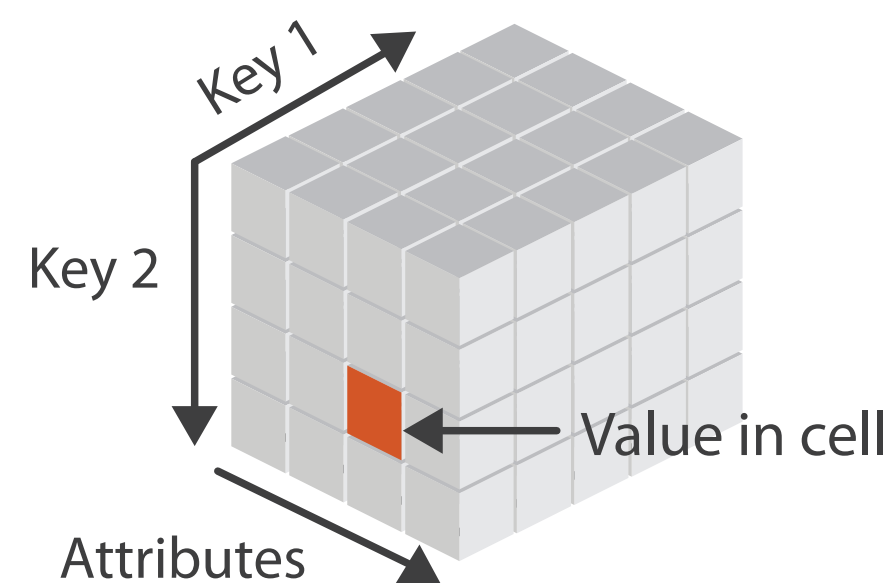
→ Fields (Continuous)



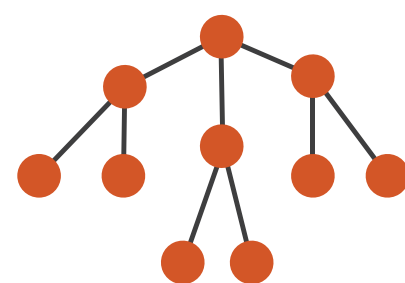
→ Geometry (Spatial)



→ Multidimensional Table



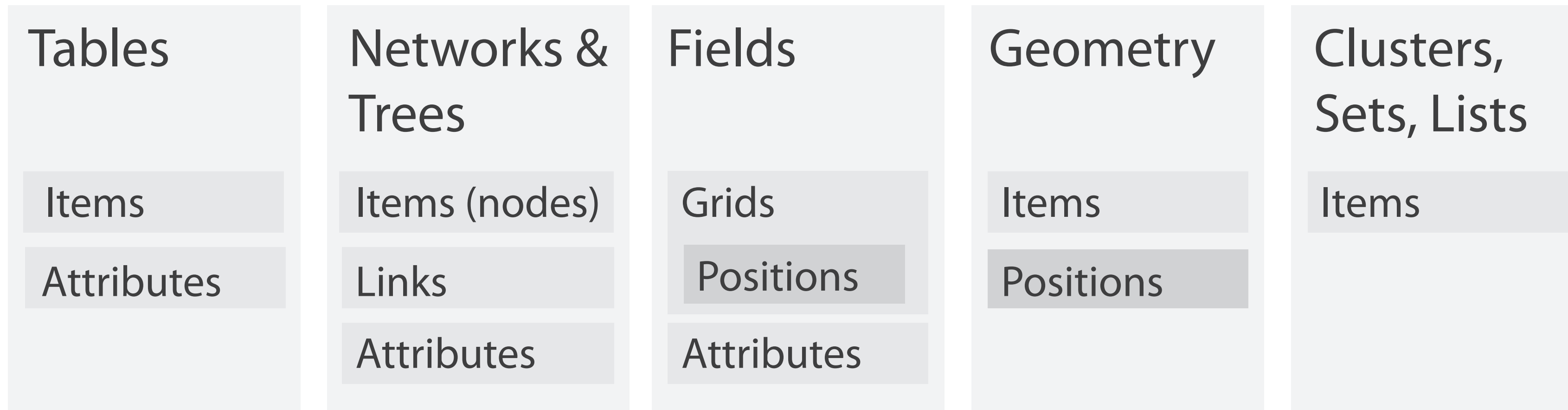
→ Trees



The stuff to visualize

Dataset and data types

→ Data and Dataset Types



→ Data Types

→ Items → Attributes → Links → Positions → Grids

→ Dataset Availability

→ Static → Dynamic



Tables

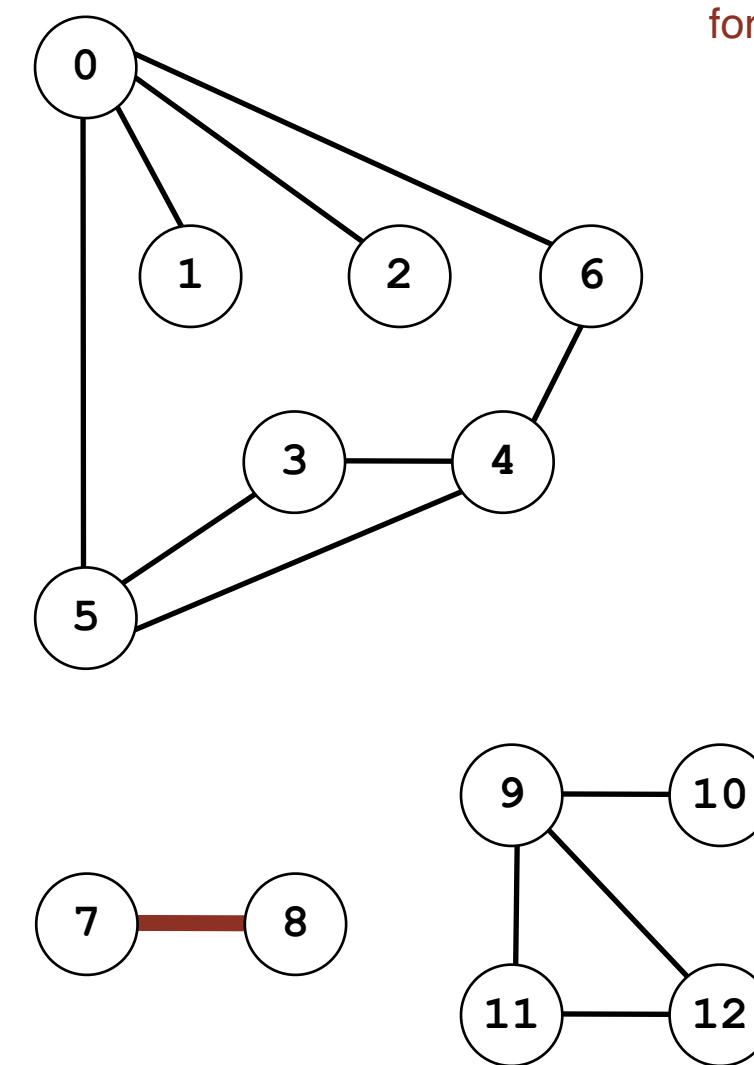
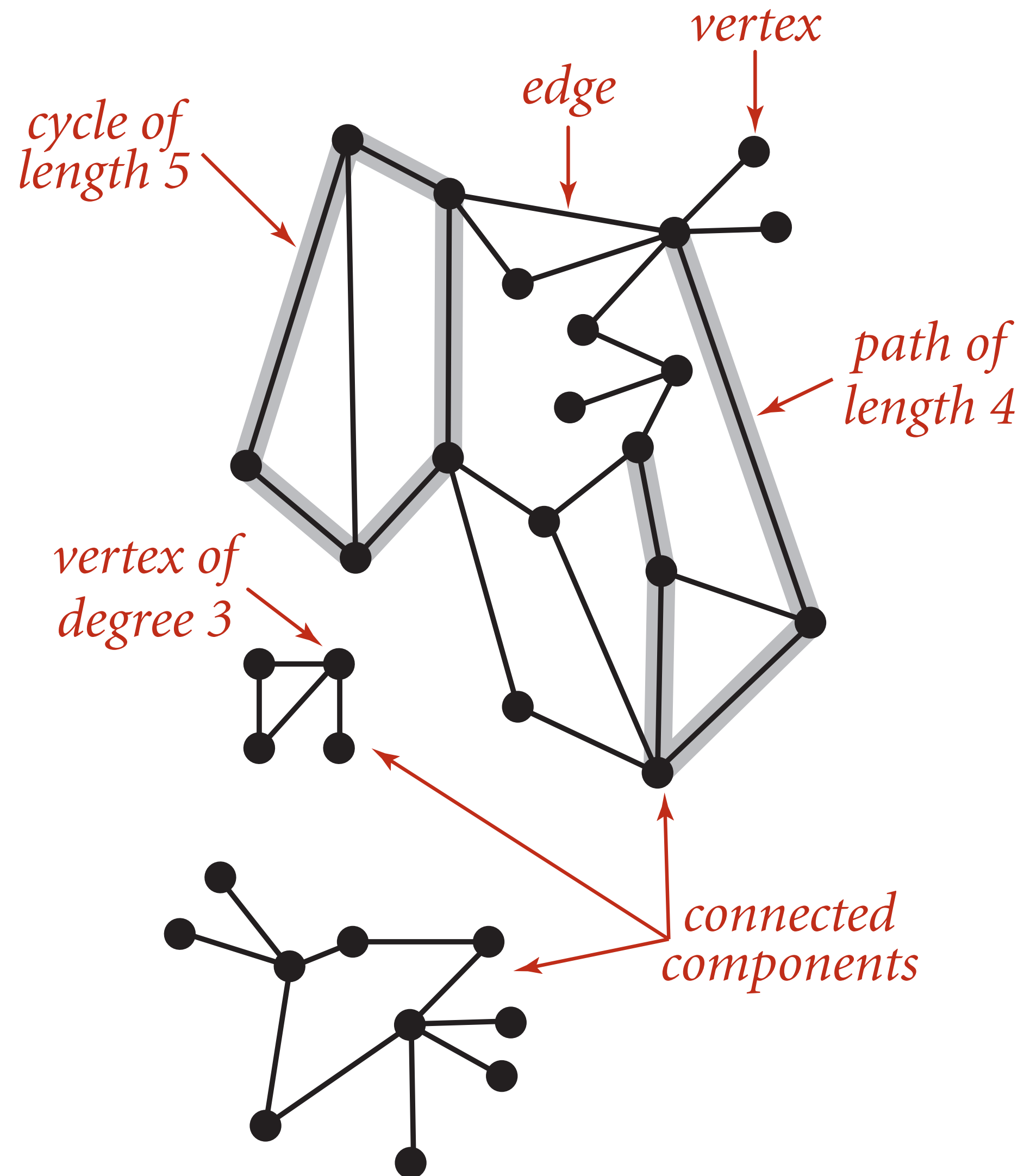
A	B	C	S	T	U
Order ID	Order Date	Order Priority	Product Container	Product Base Margin	Ship Date
3	10/14/06	5-Low	Large Box	0.8	10/21/06
6	2/21/08	4-Not Specified	Small Pack	0.55	2/22/08
32	7/16/07	2-High	Small Pack	0.79	7/17/07
32	7/16/07	2-High	Jumbo Box		7/17/07
32	7/16/07	2-High	Medium Box		7/18/07
32	7/16/07	2-High	Medium Box		7/18/07
35	10/23/07	4-Not Specified	Wrap Bag	0.52	10/24/07
35	10/23/07	4-Not Specified	Small Box	0.58	10/25/07
36	11/3/07	1-Urgent	Small Box	0.55	11/3/07
65	3/18/07	1-Urgent	Small Pack	0.49	3/19/07
66	1/20/05	5-Low	Wrap Bag	0.56	1/20/05
69		4-Not Specified	Small Pack	0.44	6/6/05
69		4-Not Specified	Wrap Bag	0.6	6/6/05
70	12/18/06	5-Low	Small Box	0.59	12/23/06
70	12/18/06	5-Low	Wrap Bag	0.82	12/23/06
96	4/17/05	2-High	Small Box	0.55	4/19/05
97	1/29/06	3-Medium	Small Box	0.38	1/30/06
129	11/19/08	5-Low	Small Box	0.37	11/28/08
130	5/8/08	2-High	Small Box	0.37	5/9/08
130	5/8/08	2-High	Medium Box	0.38	5/10/08
130	5/8/08	2-High	Small Box	0.6	5/11/08
132	6/11/06	3-Medium	Medium Box	0.6	6/12/06
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134	5/1/08	4-Not Specified	Large Box	0.82	5/3/08
135	10/21/07	4-Not Specified	Small Pack	0.64	10/23/07
166	9/12/07	2-High	Small Box	0.55	9/14/07
193	8/8/06	1-Urgent	Medium Box	0.57	8/10/06
194	4/5/08	3-Medium	Wrap Bag	0.42	4/7/08

attribute

item

cell

Networks (Graphs)



two entries
for each edge

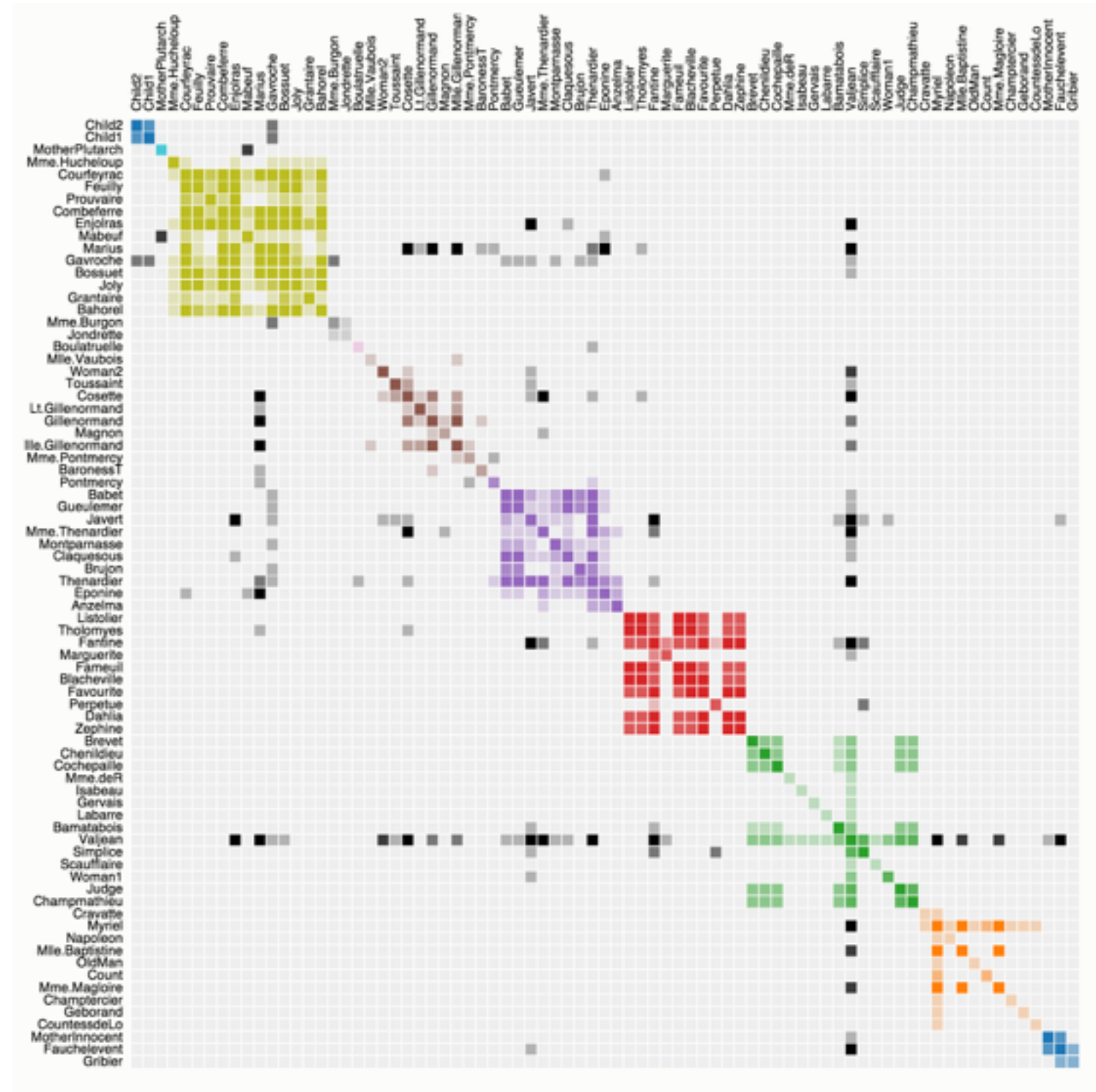
	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	1	1	0	0	1	1	0	0	0	0	0	0
1	1	0	0	0	0	0	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	1	1	0	0	0	0	0	0	0
4	0	0	0	1	0	1	1	0	0	0	0	0	0
5	1	0	0	1	1	0	0	0	0	0	0	0	0
6	1	0	0	0	1	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	1	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	1	1	1	0
10	0	0	0	0	0	0	0	0	0	1	0	0	0
11	0	0	0	0	0	0	0	0	0	1	0	0	1
12	0	0	0	0	0	0	0	0	0	1	0	1	0

Connectivity matrix

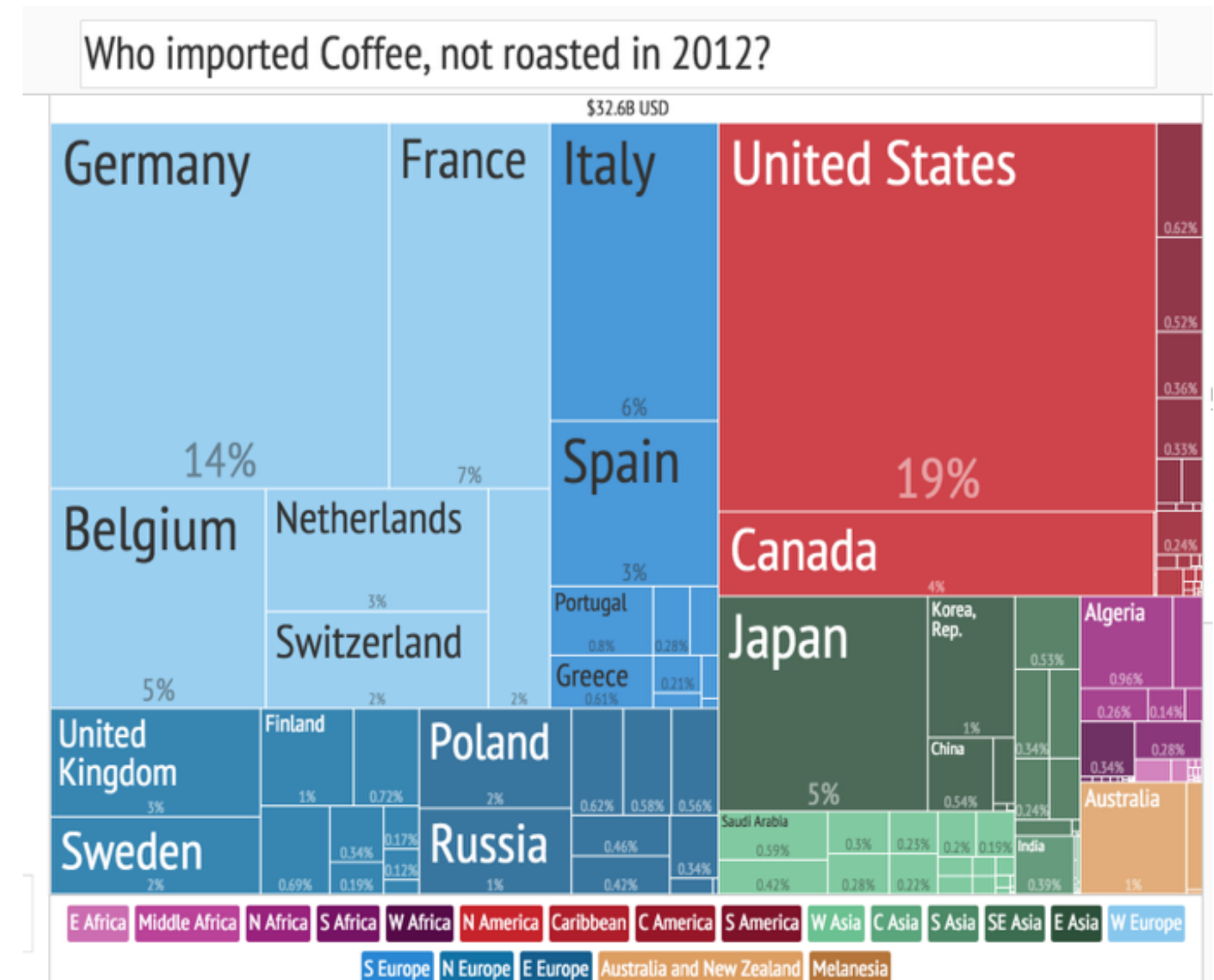
Network Visualizations



Node-Link Diagram



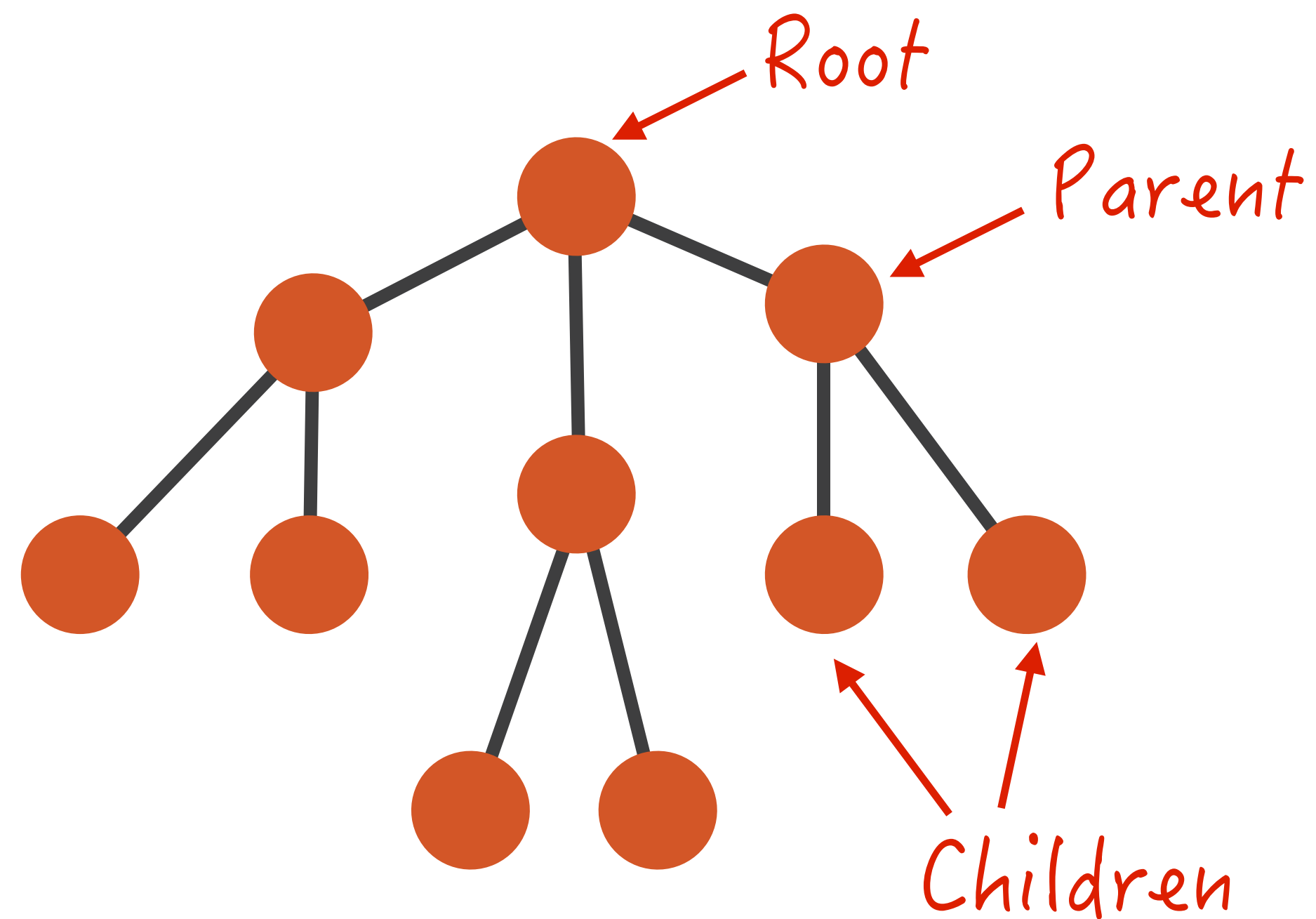
Matrix



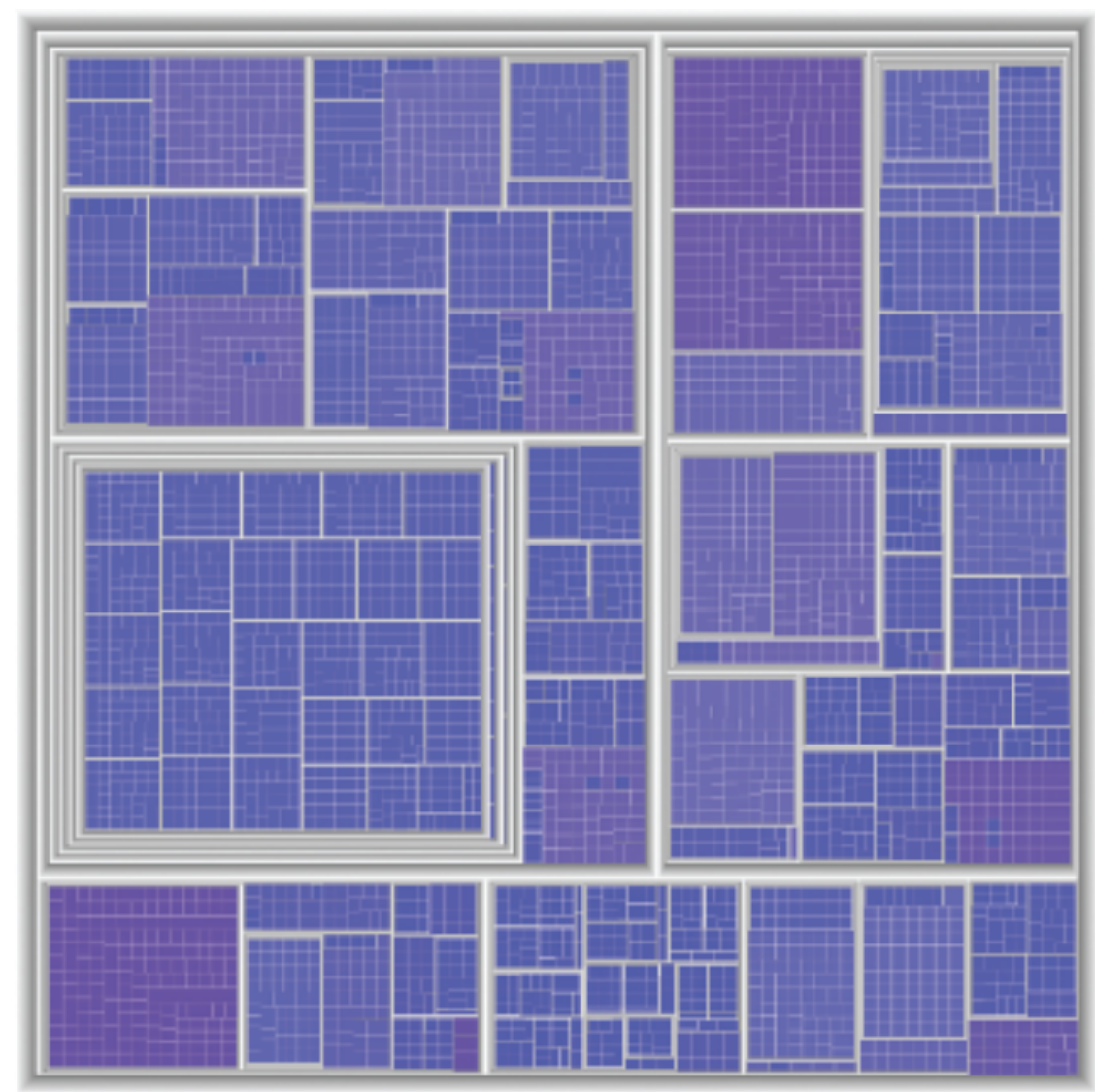
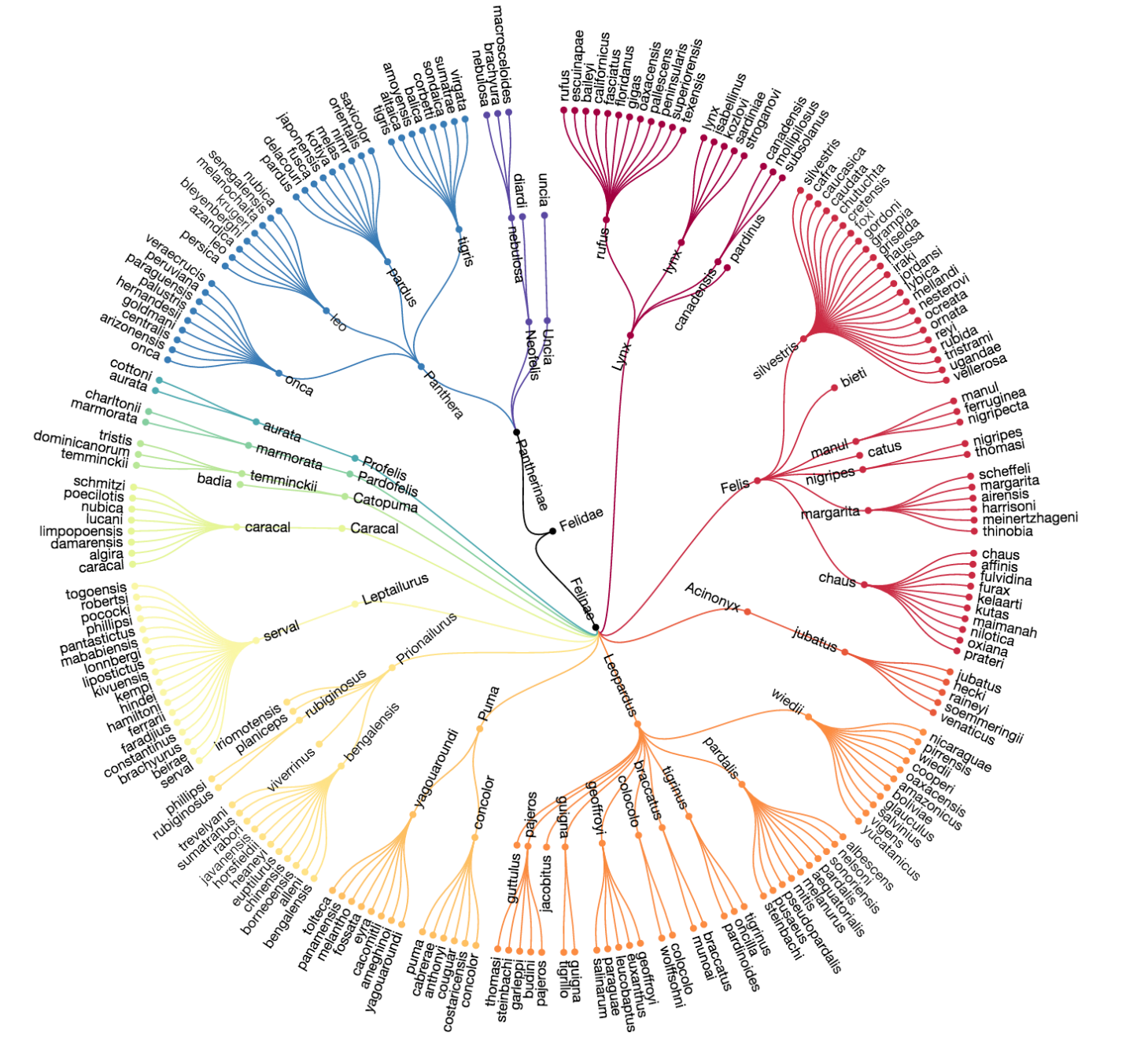
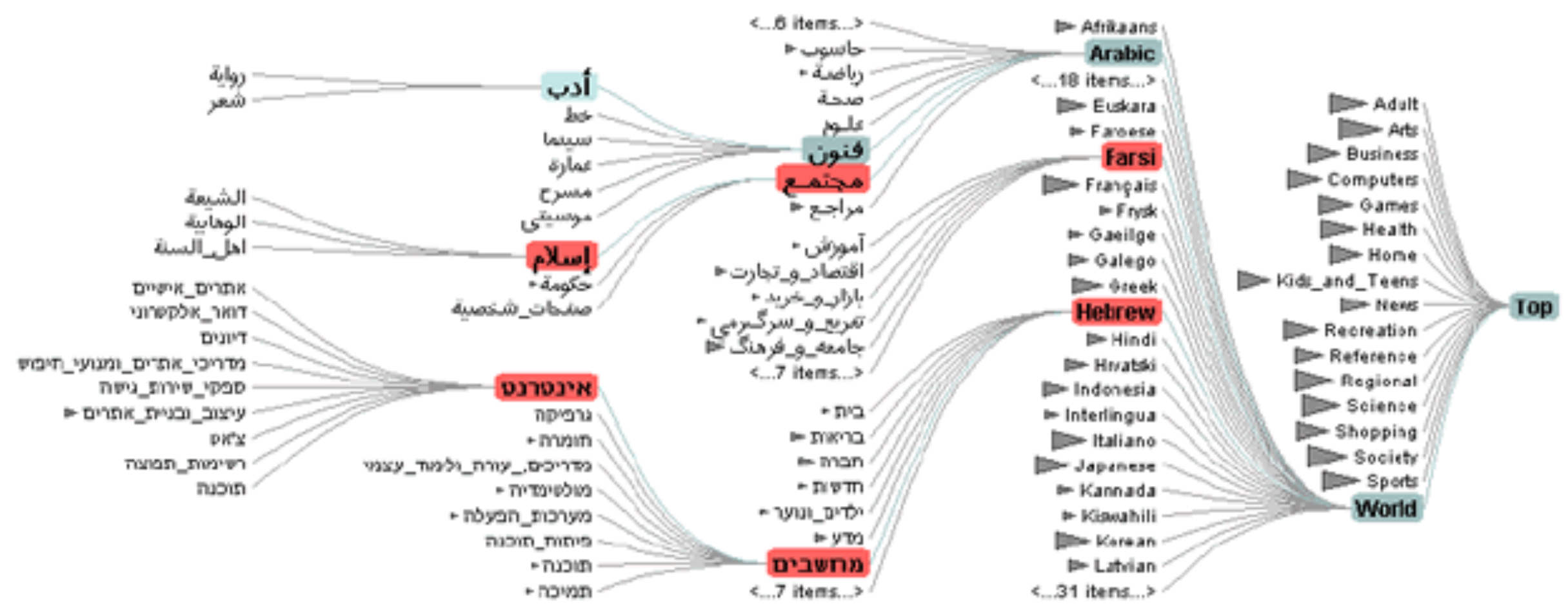
Treemap (Implicit Tree Visualization)

Trees

Trees are acyclic graphs



Tree Visualizations



Attributes Types

→ Categorical
no implicit ordering



Examples: Fruits, movie genres, file types, countries...

Attributes Types

→ Ordered

→ *Ordinal*



Attributes Types

→ Ordered

→ *Ordinal*



→ *Quantitative*

meaningful magnitude,
can do arithmetic



Attributes Types

Ordering direction

→ Sequential



ex: Mountain elevation

→ Diverging



ex: temperature variation (+/-)

→ Cyclic



ex: time of day

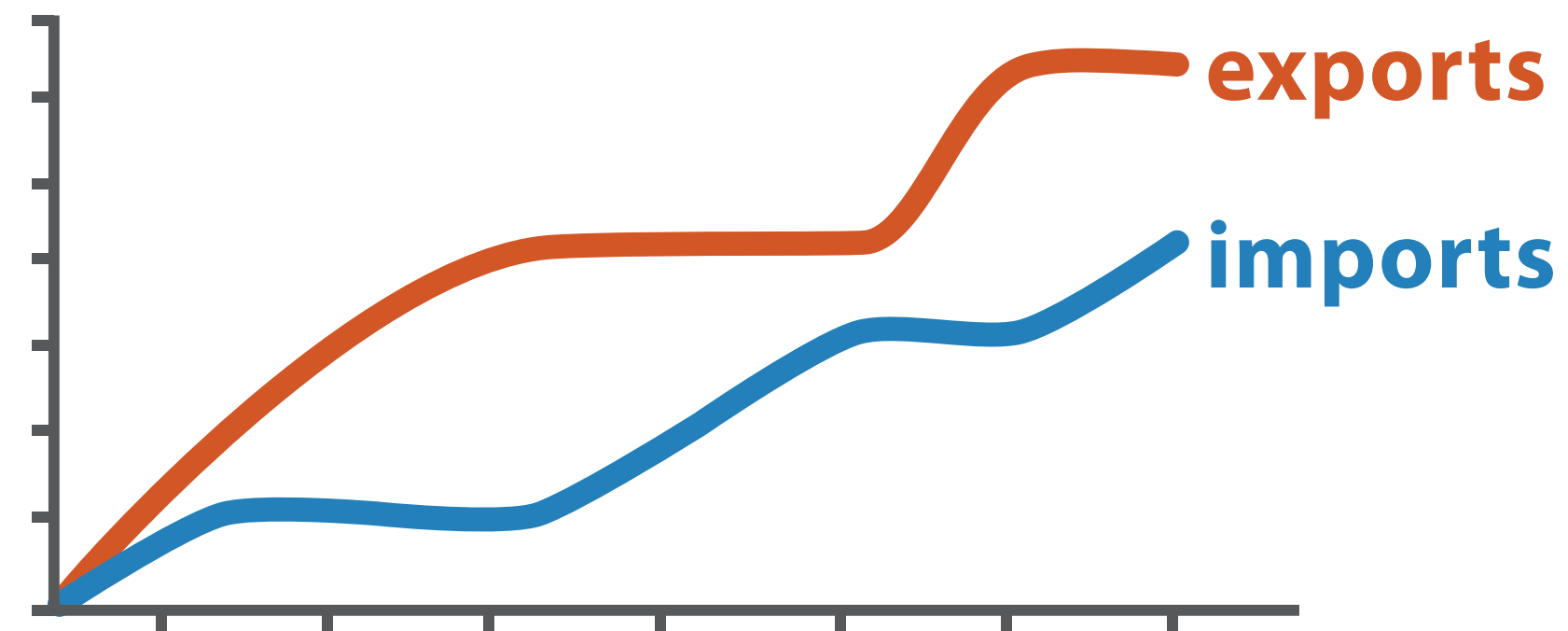
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32	7/16/07	2-High	Jumbo Box	0.72	7/17/07
32	7/16/07	2-High	Medium Box	0.6	7/18/07
32	7/16/07	2-High	Medium Box	0.65	7/18/07
35	10/23/07	4-Not Specified	Wrap Bag	0.52	10/24/07
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quantitative
ordinal
categorical

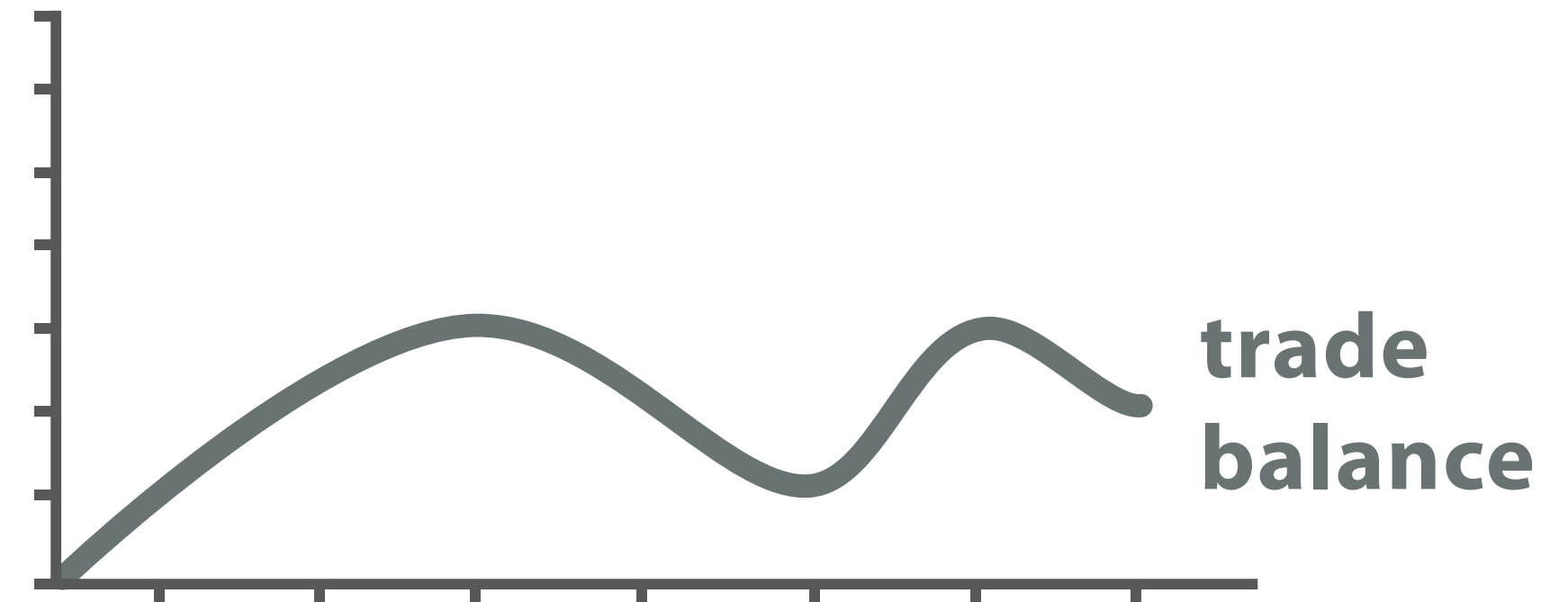
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quantitative
ordinal
categorical

Derived Data



Original Data



$$\text{trade balance} = \text{exports} - \text{imports}$$

Derived Data

Data vs Conceptual Model

- Data model: mathematical abstraction
- Set with operations, *eg.* floats with $*/-+$
- Conceptual model: mental construction - includes semantics, supports reasoning
- Conceptual model motivates derived data

Examples

- from data model . . .
 - 32.52, 54.06, -17.35, . . . (floats)
- using conceptual model . . .
 - temperature
- to data type.
 - continuous to 2 significant figures (Q)
 - hot, warm, cold (O)
 - above freezing, below freezing (C)

Next Lecture: **Task Abstraction**

- Read chapter 3 of VAD book:
sections 3.1-3.5

Next Lecture: **Task Abstraction**



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