

# Information Visualization Lecture 9

## Welcome to **COURSEVOYAGER**

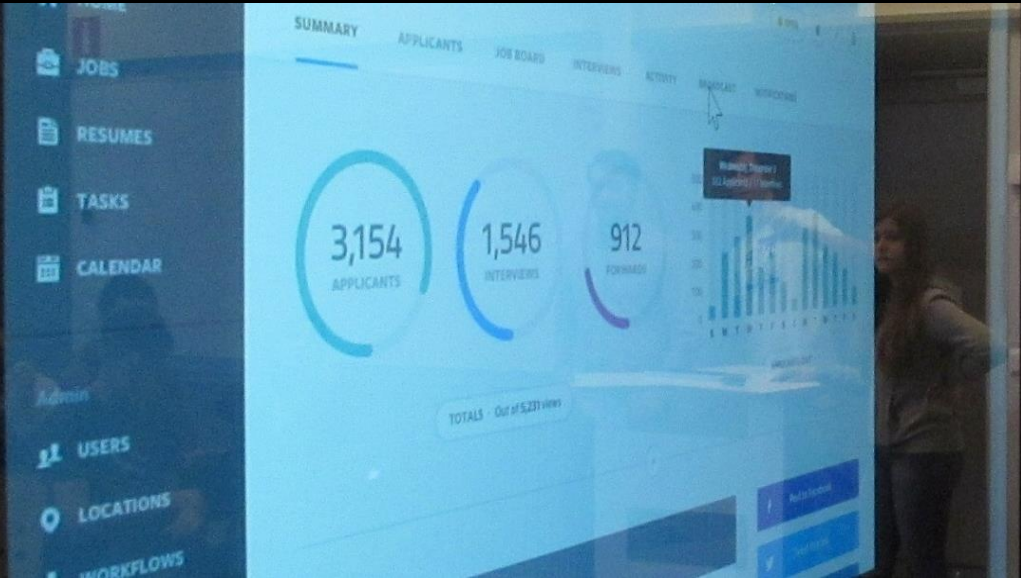
Course Voyager gives an easy way of exploring the different programmes at KTH and what type of courses they consist of to help new and current students

IVIS15 CourseVoyager C-Award for Business Opportunity ([link to project](#), [link to video](#)).



Mario Romero 2016/02/19

# Proposal Course Voyager: Link to [PDF](#)



**Tomas, Erica, Annika, Rickard, Jim:** your proposal is extremely practical and if done well, it may be extremely useful. You may have a market for a startup for it, as Shapter demonstrated. To have a quality project in the time you have, you must focus on a handful of tasks only. Be mindful of the visualization pipeline and mantra. How do you get good raw data what transformations do you need to apply to it? How do you map it to coherent visual structures and what view transformations do you provide to support effective overview, zooming, filtering and details on demand? Use the 4K screen whenever possible.

# Hello World Demo Course Voyager



**Tomas, Erica, Annika, Rickard, Jim:** You continue on a clear path from a concrete proposal that most see a real utility to. Your Hello World demo demonstrated many of the challenges you are faced with and the accomplishments you have already garnered. Clean your data, focus on a few goals, and mind the basics: pipeline, mantra, brushing, focus and context. [References](#)



[Link](#) to working project.

2016-02-19

IVIS16 L9

4

# Prelude Videos

- Deb Roy, birth of a word (19:45) - [link](#)
- Trend and Variation (1:04)- [link](#)
- Global Wealth Inequality (3:50) - [link](#)
- CourseVoyager – IVIS15 project (2:06) – [link](#)

# IVIS16 Schedule

					<b>DUE:</b>
<b>9.</b>	<b>Friday</b>	<b>19.2</b>	<b>08:30</b>	<b>Lecture 9</b>	<b>Reading 4</b>
10.	Tuesday	23.2	13:15	Lecture 10	Reading 5
11.	Friday	26.2	<b>08:30</b>	Lectures 11, 12 (labs)	Project 3, Hello World!
13.	Tuesday	01.3	13:15	Lecture 13	Reading 6
14.	Friday	11.3	<b>08:15</b>	Lecture 14	Reading 7
15.	Friday	18.3	<b>08:30</b>	Final Demo (exam)	Project 4 Final Demo
16.	Thursday	14.4		C-Awards	

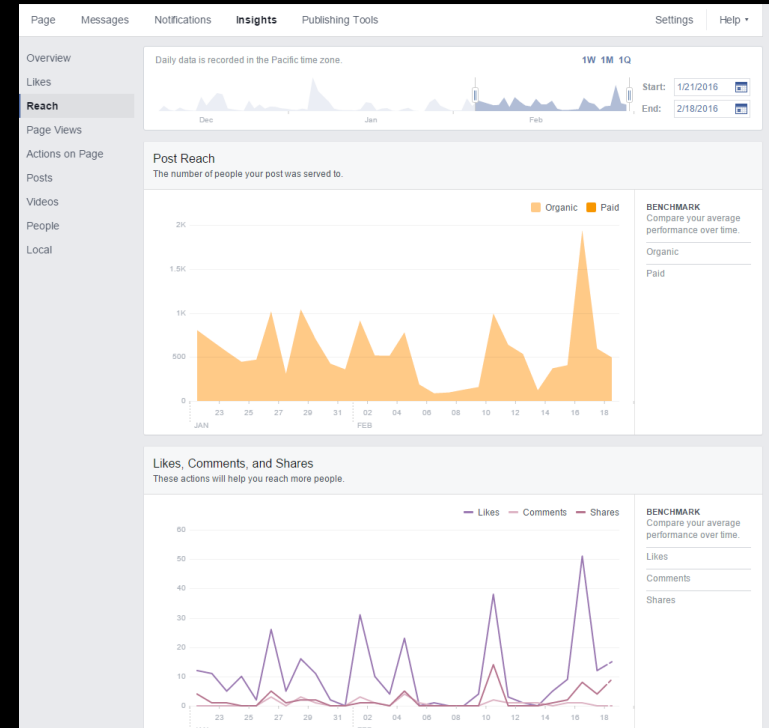
# Outline

1. Project 3 questions
2. Project 4 Hello World! questions
3. Green Hackathon Reporting
4. Data, Data Transformations, Data Tables
5. Parallel Coordinates
6. Test Reading 4 (10 minutes!)

# Questions P3?



The image shows a Facebook page for 'Visualization Studio VIC'. The cover photo features a group of people celebrating, holding signs that say '10 000 KR'. The page header includes the KTH logo (KTH VETENSKAP OCH KONST) and the text 'Visualization Studio VIC Technical Institute - Educational Research'. Below the header, there are navigation tabs for 'Timeline', 'About', 'Photos', 'Reviews', and 'More'. The main content area shows a post from 'Visualization Studio VIC' shared on Feb 13, 2016, with the text: 'Last year at KTH. Swedish pop singer Robyn held a science and technology festival for girls ages 11 to 18. Here's why she and KTH are hosting Tekla again on April 9. #Teklafestival'. Below the text is a video thumbnail showing Robyn and a man sitting together. The left sidebar contains engagement statistics: 1,107 likes, 267 people have been here, 'Closed now - 9:00AM - 5:00PM', '4.9 of 5 stars - 12 reviews', and an 'ABOUT' section with a map and contact information.



The image shows the Facebook Insights dashboard for the page. The top navigation bar includes 'Page', 'Messages', 'Notifications', 'Insights', and 'Publishing Tools'. The 'Insights' section is active, showing 'Daily data is recorded in the Pacific time zone' for the period '1W 1M 1Q'. The 'Reach' section displays a line chart of reach over time, with a 'Start' date of 1/21/2016 and an 'End' date of 2/18/2016. The 'Post Reach' section shows a bar chart comparing 'Organic' and 'Paid' reach over time, with a 'BENCHMARK' section for comparison. The 'Likes, Comments, and Shares' section displays a line chart showing the volume of these actions over time, with a 'BENCHMARK' section for comparison.



# Questions P4 Hello World?

## **Green Hackathon Reporting**

Turn in on March 1

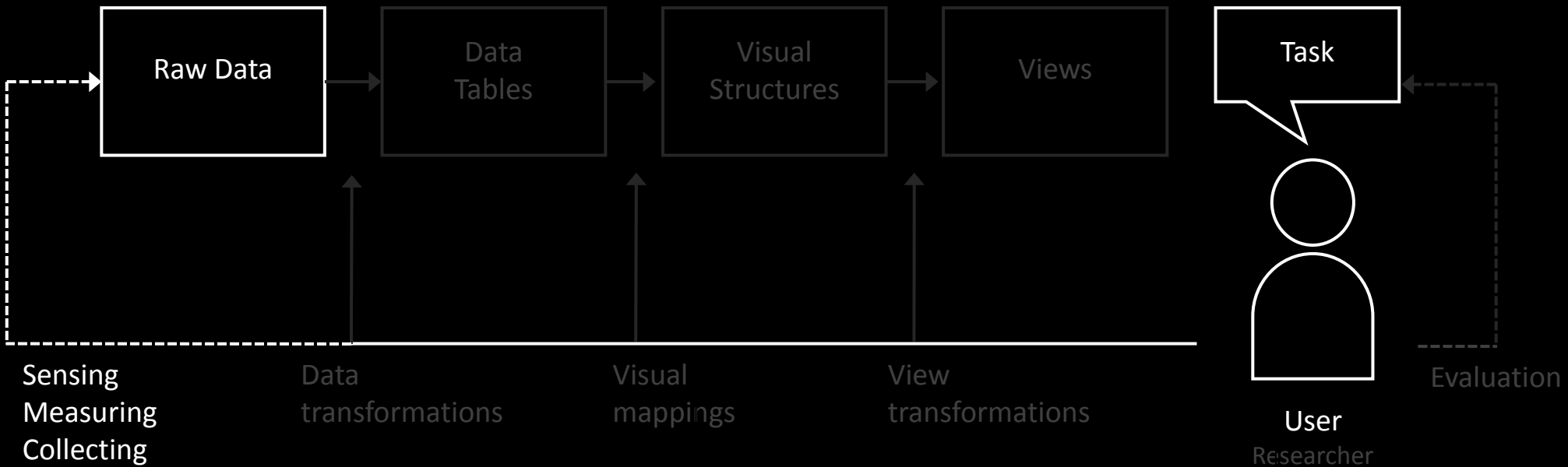
Grade: P/F x 15%

1. In groups
2. Name of group
3. Individual Names
4. Individual Contribution
5. Video of final presentation
6. Photos of process

# Answer the following questions about P2 and P4

1. Who is the user?
2. What are the tasks?
3. What is the data?
4. What are the data transformations?
5. What are the visual mappings?
6. What are the visual structures?
7. What are the view transformations?
8. What are the views?
9. How does the demo support the tasks?
10. How can it be improved?

# Raw Data



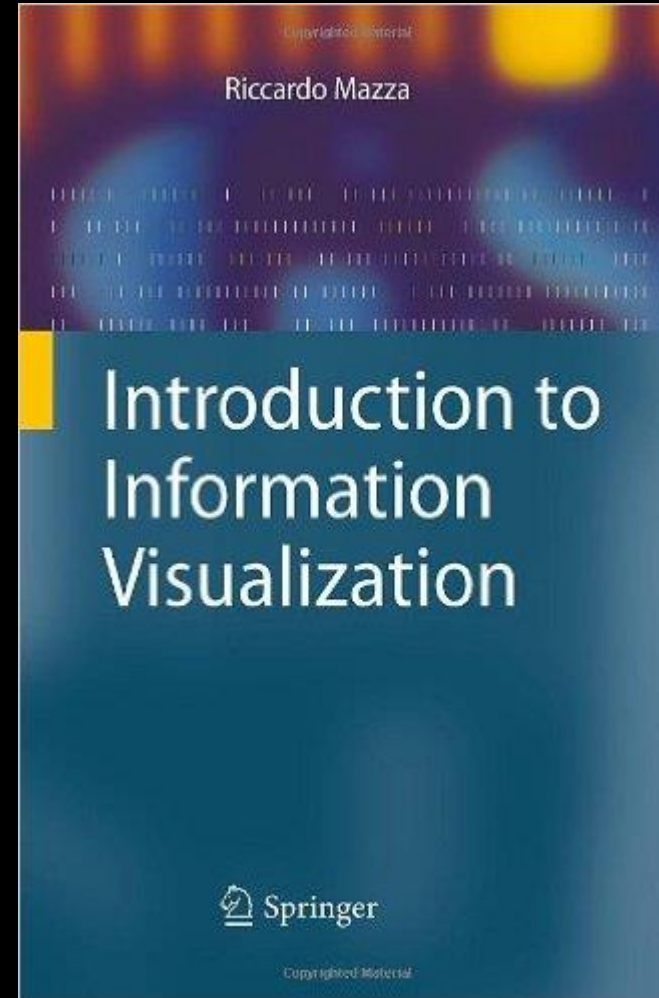


Bob Amar and John Stasko:  
Scholar, LinkedIn



Riccardo Mazza

[Scholar](#), [LinkedIn](#), [home](#)

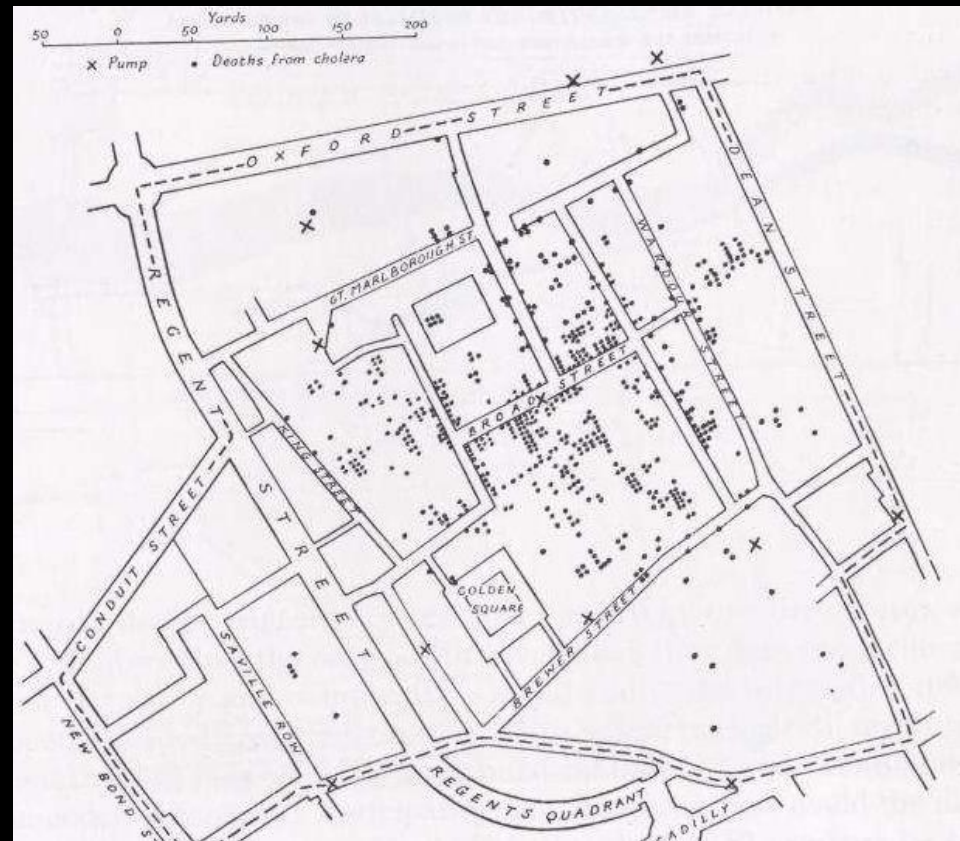


# John Snow's 1845 Map of Soho District, London

What is the raw data?

What are the datatypes?

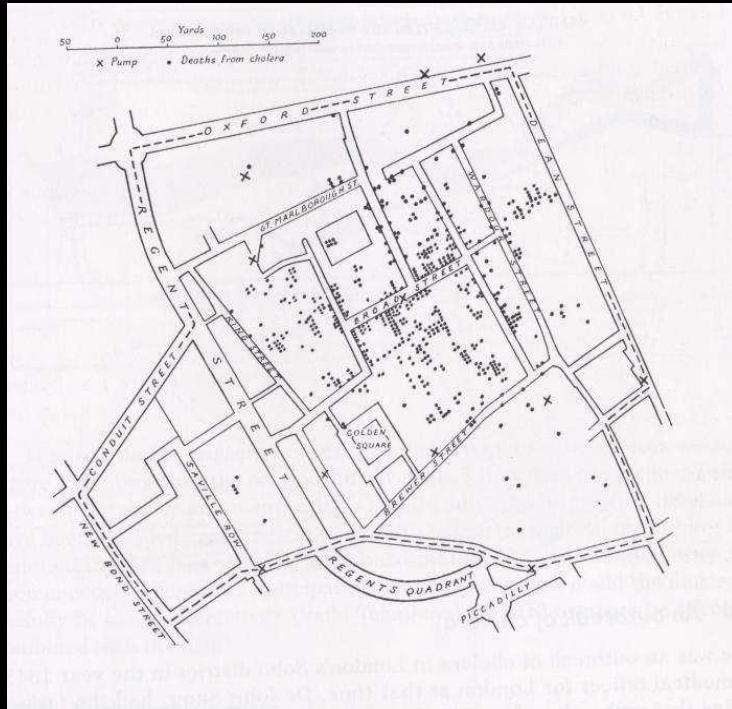
What are the visual structures?





What do you see?

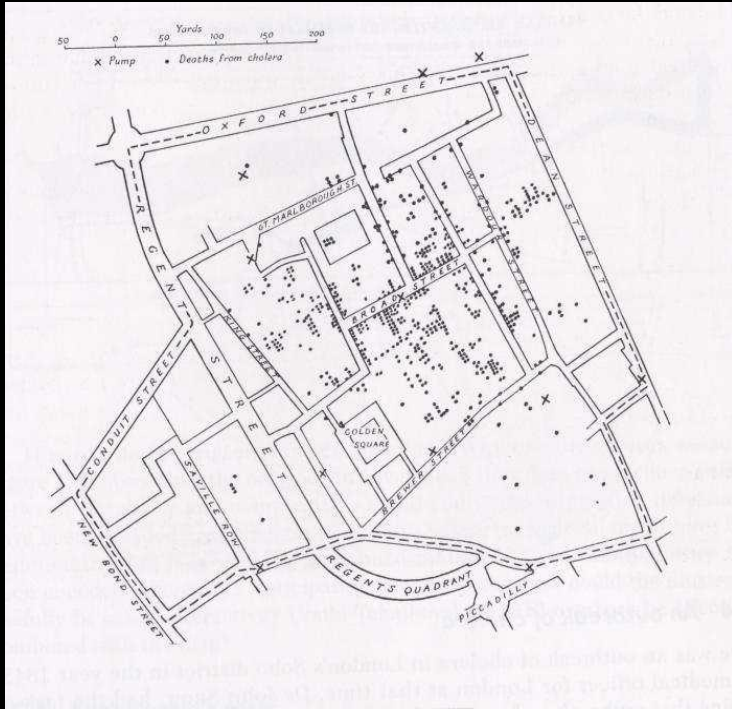
## Discussion



Raw Data:

Data Types:

# What do you think is the raw data? IVIS15



## Raw Data:

- DEATHS
- LOCATIONS
- STREETS
- NAMES
- WATER PUMPS

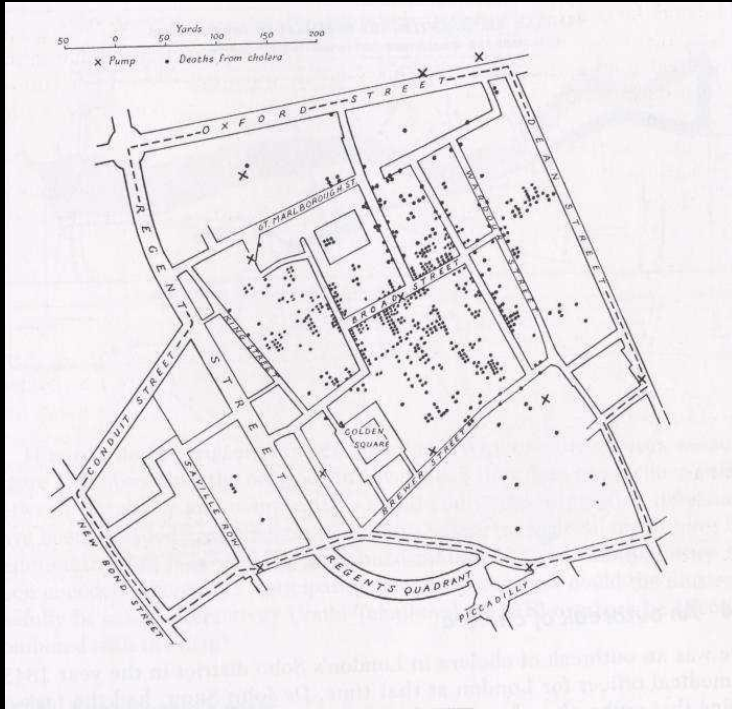
- CLUSTERS
- WHITE
- GRAY
- LINES
- LETTERS
- NUMBERS
- DOTTED LINES

## What do you see?

- DOTS
- CROSSES
- SCALE
- CORRELATIONS
- LEGENDS

- Coord sys
- Two exes
- Oxford
- 2d distribution chart
- 2d histogram

What do you think is the raw data?  
IVIS14



- Map
- White
- Black
- Dots
- Crosses
- Streets
- Names
- Scale
- Legend
  - Dead people
  - Location
  - Aggregate of time

**Discussion: What type of data types are there?**

In **Information Visualization**

- Categorical: you can name it
- Ordinal: you can sort it
- Numerical: you can compute it

## Discussion: What type of data types are there?

- In **Visualization**
- Spatial
    - Scalar
    - Vector
    - Tensor
  - Non-Spatial
    - 1D, 2D, 3D
    - Multivariate
    - Graph and Trees
    - Time

**Discussion: 2.**  
**What about data  
dimensionality?**

- Univariate
- Bivariate
- Trivariate
- Multivariate

### Discussion 3: what about data structures?

- Linear
  - Has only one neighbor to the left and right and no siblings above or below
- Temporal (?)
  - Why is this special?
- Map in 2D
  - Four neighbors
- Hierarchical
  - Trees
  - One parent
  - Many children
  - No links between siblings
- Networked
  - Many neighbors

## All about data

- Source
- Type
- Dimension
- Structure



## Data Sources

Stockholm travel

GPS

Sensors

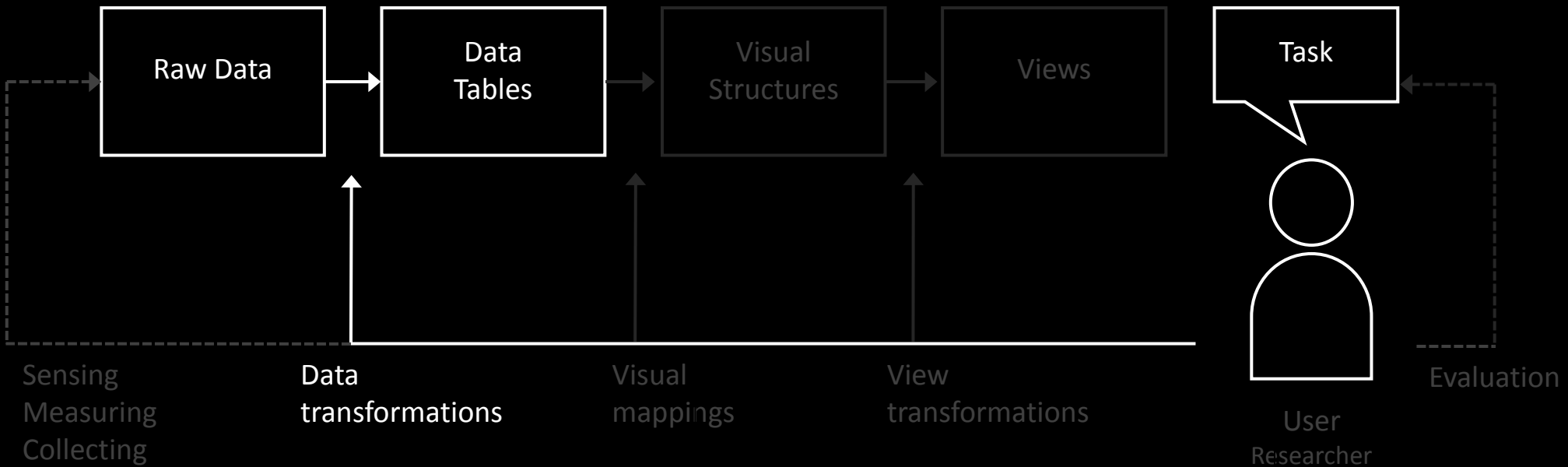
Quantified self

Health monitors

...

- Internet
- Gapminder
- Surveys
- Governments
- People
- Realstate companies
- Transportation
- Energy
- Financial
- Scientific
- Social Networks
- Sensors
- Social Registry
- Electronic Medical Records
- ...

# Data Tables and Data Transformations



# Discussion: 3. What are the typical data transformations?

## IVIS15 ANSWERS

- Zoom, Filter, Details on Demand, "history" or breadcrumbs, correlation, extraction
- Scaling, misc mathematical operations, cleaning etc.
- Zooming, panning, scrolling, focus+context and magic lense.
- "Assuming you mean view transformations:-Zooming-Panning-Scrolling-Focus+Context-Magic Lenses"

- "Zoom panning scrolling filtering focus + context magical lens"
- Typical data transformations: zooming, panning, scrolling, focus+context and magic lenses.
- The view transformations: Zooming, Panning, Scrolling, Focus and Context, Magic lenses
- "Zooming Panning Scrolling Focus+Context Magic Lenses"
- Summing, standard deviation, distributions, average, cleaning.

# Discussion: 3. What are the typical data transformations?

## IVIS15 ACCURATE ANSWERS

- Zoom, Filter, Details on Demand, "history" or breadcrumbs, correlation, extraction
- Scaling, misc mathematical operations, cleaning etc.
- Zooming, panning, scrolling, focus+context and magic lense.
- "Assuming you mean view transformations:-Zooming-Panning-Scrolling-Focus+Context-Magic Lenses"

- "Zoom panning scrolling filtering focus + context magical lens"
- Typical data transformations: zooming, panning, scrolling, focus+context and magic lenses.
- The view transformations: Zooming, Panning, Scrolling, Focus and Context, Magic lenses
- "Zooming Panning Scrolling Focus+Context Magic Lenses"
- Summing, standard deviation, distributions, average, cleaning.

# Discussion: 3. What are the typical data transformations?

## My view

### 1. Cleaning

#### 1. Filling missing values

1. Interpolating
2. Extrapolating
3. Eliminating

#### 2. Filtering noise

1. Low-pass filters
2. High-pass filters
3. Band-pass filters
4. Kalman filters

### 2. Normalizing

### 3. Aggregating

### 4. Averaging

### 5. Discretizing

### 6. Quantizing

### 7. Digitizing

### 8. Sampling

### 9. Scaling

### 10. Mapping:

1. Nominal to Ordinal
2. Nominal to Numerical
3. Ordinal to Numerical

### 11. In general

1. Signal Processing
2. Machine Learning
3. Statistics
4. Pattern Recognition
5. Computer Vision
6. AI

Can you give examples of data transformations that introduce a rationale gap in your visualization?

- Weighted aggregate where the developer, not the user, defines the weights.
- ...

## Discussion 4. What are the typical data tables and how are they used?

### IVIS15 ANSWERS:

- "Spatial, Geographical, Networks, Hierarchies, demographics"
  - Spatial, Geographic, Documents, time, hierarchies, Networks
  - Spatial, geographic, documents, time, hierarchies, networks and worldwide web.
  - "Just to name a few:Geographic -> Data representation according to its physical location, like data maps Hierarchies -> Show tree structures, like organization structures"
  - "Spatial Geographic Time Documents Networks WWW"
  - "Data Tables: Spatial (scientific), Geographic, Documents, Time, Hierarchies, Networks, World Wide Web"
- Data tables can categorize data in the following manners: Spatial (scientific), Geographic, Documents, Time, Hierarchies, Networks, Position
  - "Spatial - 3d model of anatomy Geographic – Maps Documents - Excel table Time – Timeline Hierarchies - Company leadership map Networks - Facebook open graph World Wide Web - router mapping "
  - "Spatial Geographic time hierarchies networks To show connections and correlations in the data"

# Data Models

- Items of interest
  - (students, courses, terms, ...)
- Attributes Characteristics or properties of data
  - (name, age, GPA, number, date, ...)
- Relations How two or more objects relate
  - (student takes course, course during term, ...)



# Data Tables

- Raw data → data model (table)
- Individual items are called *cases* (or points)
- Cases have variables (attributes or dimensions)

# Data Table Format

	Case <sub>1</sub>	Case <sub>2</sub>	Case <sub>3</sub>	...
Variable <sub>1</sub>	Value <sub>11</sub>	Value <sub>21</sub>	Value <sub>31</sub>	
Variable <sub>2</sub>	Value <sub>12</sub>	Value <sub>22</sub>	Value <sub>32</sub>	
Variable <sub>3</sub>	Value <sub>13</sub>	Value <sub>23</sub>	Value <sub>33</sub>	
...				...

$$f(\text{Case}_1) = \langle \text{Value}_{11}, \text{Value}_{12}, \dots \rangle$$

# Example

	<b>Joakim</b>	<b>Veronica</b>	<b>Ulf</b>	<b>...</b>
ID	8802014452	9011133322	9112113331	
Age	24	22	21	
Hair	Brown	Blond	Black	
Height	182	168	176	
...				...



## Standings

Rnk	Team	MP	W	D	L	GF	GA	+/-	Pts	
1	Malmö FF	30	19	6	5	56	30	26	63	=
2	AIK	30	17	7	6	54	32	22	58	=
3	IFK Göteborg	30	16	6	8	49	31	18	54	=
4	Kalmar FF	30	14	10	6	35	26	9	52	▲
5	Helsingborgs IF	30	14	7	9	61	41	20	49	▼
6	IF Elfsborg	30	12	10	8	49	34	15	46	=
7	Djurgårdens IF	30	12	8	10	38	44	-6	44	=
8	Åtvidabergs FF	30	11	7	12	37	37	0	40	▲
9	IFK Norrköping	30	11	6	13	45	47	-2	39	▼
10	BK Häcken	30	10	7	13	37	41	-4	37	▲
11	Mjällby AIF	30	10	6	14	46	47	-1	36	▼
12	Gefle IF	30	7	13	10	34	42	-8	34	=
13	IF Brommapojkarna	30	8	8	14	33	54	-21	32	=
14	Halmstads BK	30	7	10	13	32	46	-14	31	=
15	Östers IF	30	6	10	14	27	43	-16	28	=
16	Syrianska FC	30	3	5	22	26	64	-38	14	=

0

Like

0

Tweet

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+1



Share

UEFA Champions League Preliminary

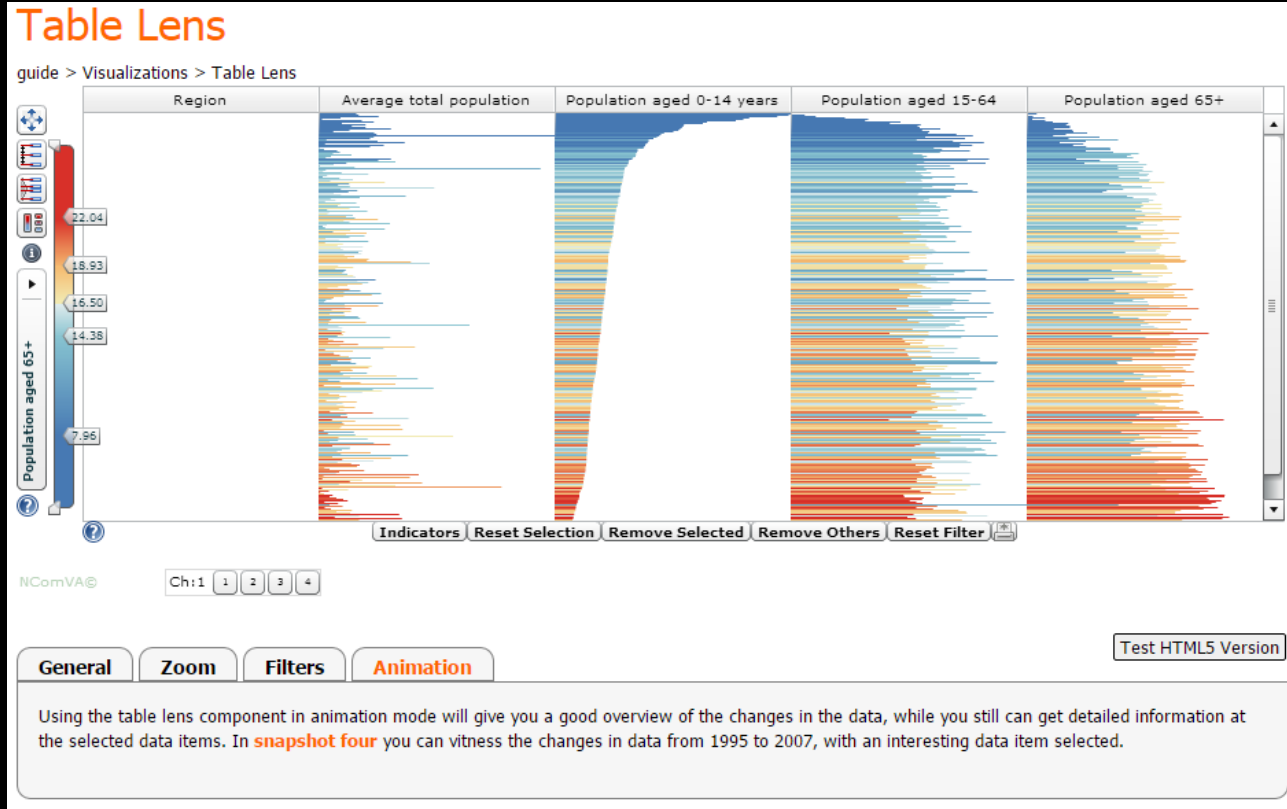
UEFA Europa League

UEFA Europa League depending on domestic cup

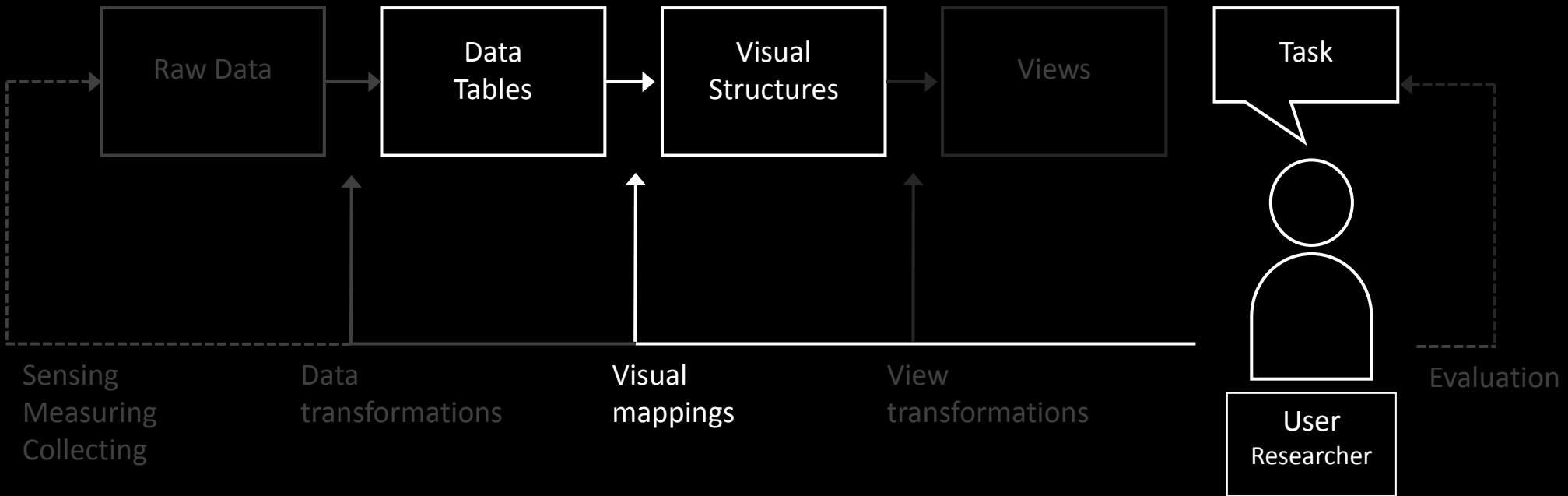
Relegation play-off

Relegation

# Visualizing Tables Directly



# Visual Mappings and Visual Structures



# A PERIODIC TABLE OF VISUALIZATION METHODS

<b>C</b> continuum											<b>G</b> graphic facilitation										
<b>Tb</b> table	<b>Ca</b> cartesian coordinates	<b>Data Visualization</b> Visual representations of quantitative data in schematic form (either with or without axes)										<b>Strategy Visualization</b> The systematic use of complementary visual representations in the analysis, development, formulation, communication, and implementation of strategies in organizations.									
<b>Pi</b> pie chart	<b>L</b> line chart	<b>Information Visualization</b> The use of interactive visual representations of data to amplify cognition. This means that the data is transformed into an image, it is mapped to screen space. The image can be changed by users as they proceed working with it										<b>Metaphor Visualization</b> Visual Metaphors position information graphically to organize and structure information. They also convey an insight about the represented information through the key characteristics of the metaphor that is employed									
		<b>Concept Visualization</b> Methods to elaborate (mostly) qualitative concepts, ideas, plans, and analyses.										<b>Compound Visualization</b> The complementary use of different graphic representation formats in one single schema or frame									
<b>B</b> bar chart	<b>Ac</b> area chart	<b>R</b> radar chart cobweb	<b>Pa</b> parallel coordinates	<b>Hy</b> hyperbolic tree	<b>Cy</b> cycle diagram	<b>T</b> timeline	<b>Ve</b> venn diagram	<b>Mi</b> mindmap	<b>Sq</b> square of oppositions	<b>Cc</b> concentric circles	<b>Ar</b> argument slide	<b>Sw</b> swim lane diagram	<b>Gc</b> gant chart	<b>Pm</b> perspectives diagram	<b>D</b> dilemma diagram	<b>Pr</b> parameter ruler	<b>Kn</b> knowledge map				
<b>Hi</b> histogram	<b>Sc</b> scatterplot	<b>Sa</b> sankey diagram	<b>In</b> information lense	<b>E</b> entity relationship diagram	<b>Pt</b> petri net	<b>Fl</b> flow chart	<b>Cl</b> clustering	<b>Lc</b> layer chart	<b>Py</b> minto pyramid technique	<b>Ce</b> cause-effect chains	<b>Tl</b> toulmin map	<b>Dt</b> decision tree	<b>Cp</b> cpm critical path method	<b>Cf</b> concept fan	<b>Co</b> concept map	<b>Ic</b> iceberg	<b>Lm</b> learning map				
<b>Tk</b> tukey box plot	<b>Sp</b> spectrogram	<b>Da</b> data map	<b>Tp</b> treemap	<b>Cn</b> cone tree	<b>Sy</b> system dyn./ simulation	<b>Df</b> data flow diagram	<b>Se</b> semantic network	<b>So</b> soft system modeling	<b>Sn</b> synergy map	<b>Fo</b> force field diagram	<b>Ib</b> ibis argumentation map	<b>Pr</b> process event chains	<b>Pe</b> pert chart	<b>Ev</b> evocative knowledge map	<b>V</b> Vee diagram	<b>Hh</b> heaven 'n' hell chart	<b>I</b> infomural				

**Cy** **Process Visualization**

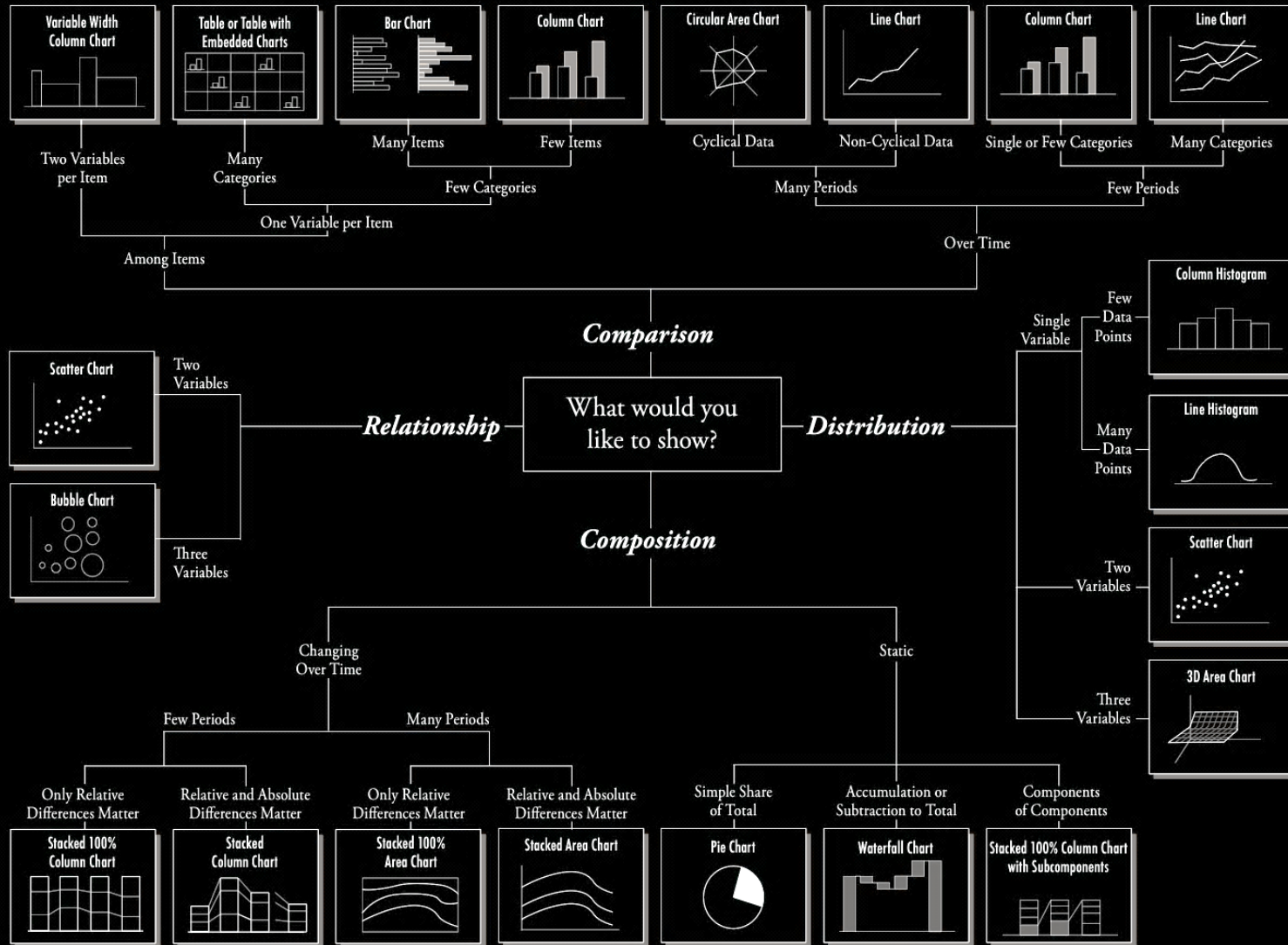
**Hy** **Structure Visualization**

- Overview**
- Detail**
- Detail AND Overview**
- Divergent thinking**
- Convergent thinking**

Note: Depending on your location and connection speed it can take some time to load a pop-up picture. version 1.5  
© Ralph Lengler & Martin J. Eppler, www.visual-literacy.org

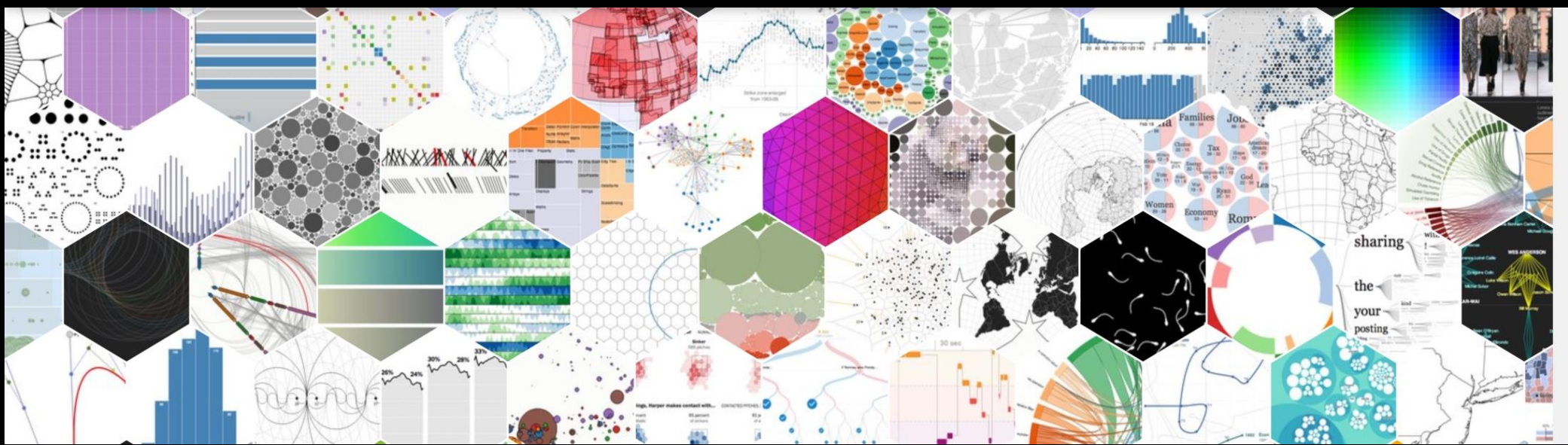
<b>Su</b> supply demand curve	<b>Pc</b> performance charting	<b>St</b> strategy map	<b>Oc</b> organisation chart	<b>Ho</b> house of quality	<b>Fd</b> feedback diagram	<b>Ft</b> failure tree	<b>Mq</b> magic quadrant	<b>Ld</b> life-cycle diagram	<b>Po</b> porter's five forces	<b>S</b> s-cycle	<b>Sm</b> stakeholder map	<b>Is</b> ishikawa diagram	<b>Tc</b> technology roadmap
<b>Ed</b> edgeworth box	<b>Pf</b> portfolio diagram	<b>Sg</b> strategic game board	<b>Mz</b> mintzberg's organigraph	<b>Z</b> zwickly's morphological box	<b>Ad</b> affinity diagram	<b>De</b> decision discovery diagram	<b>Bm</b> bcg matrix	<b>Stc</b> strategy canvas	<b>Vc</b> value chain	<b>Hy</b> hype-cycle	<b>Sr</b> stakeholder rating map	<b>Ta</b> taps	<b>Sd</b> spray diagram

# Chart Suggestions—A Thought-Starter

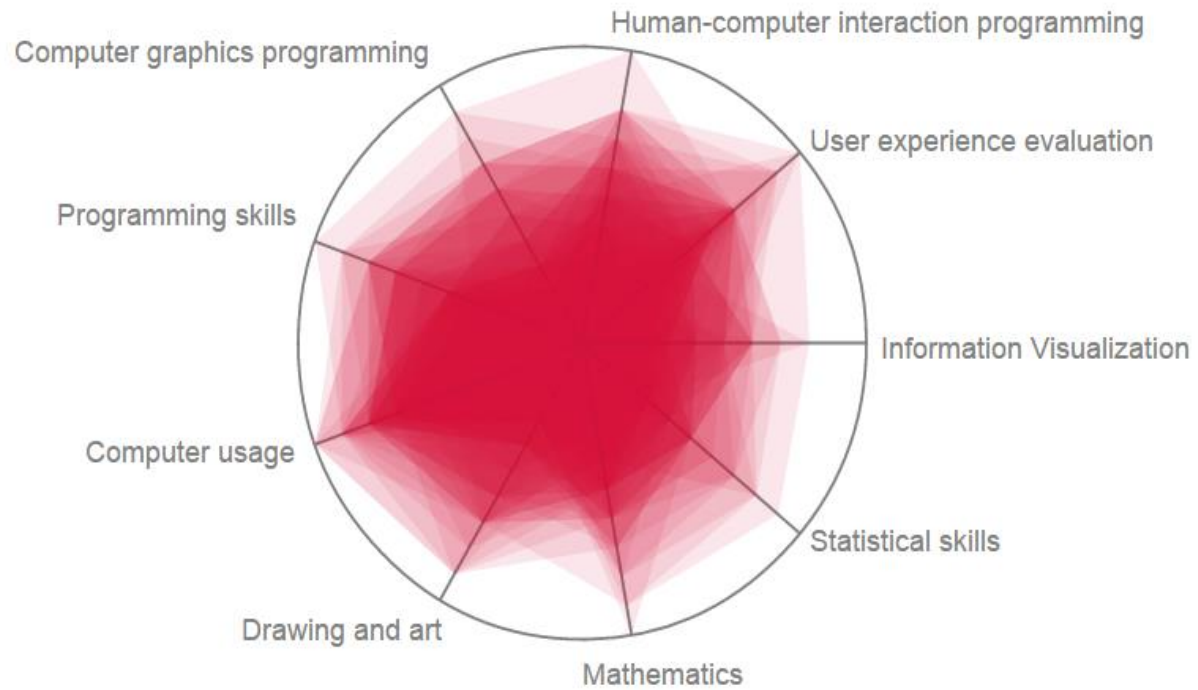




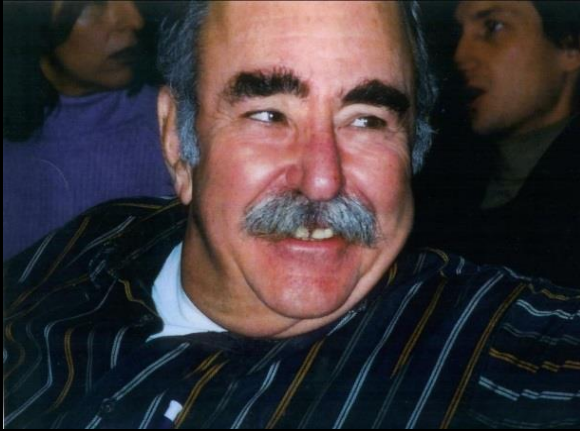
# D3JS Data-Driven Documents



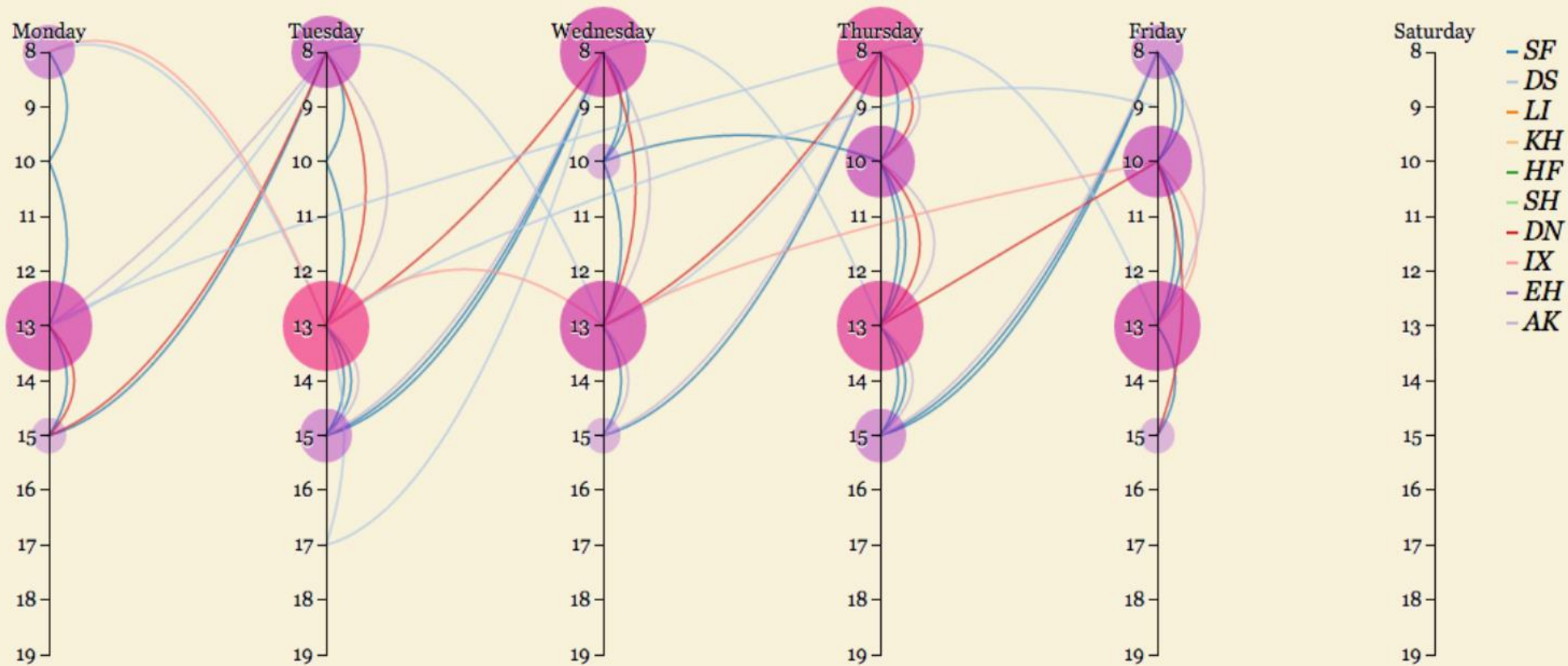
# Parallel Coordinates

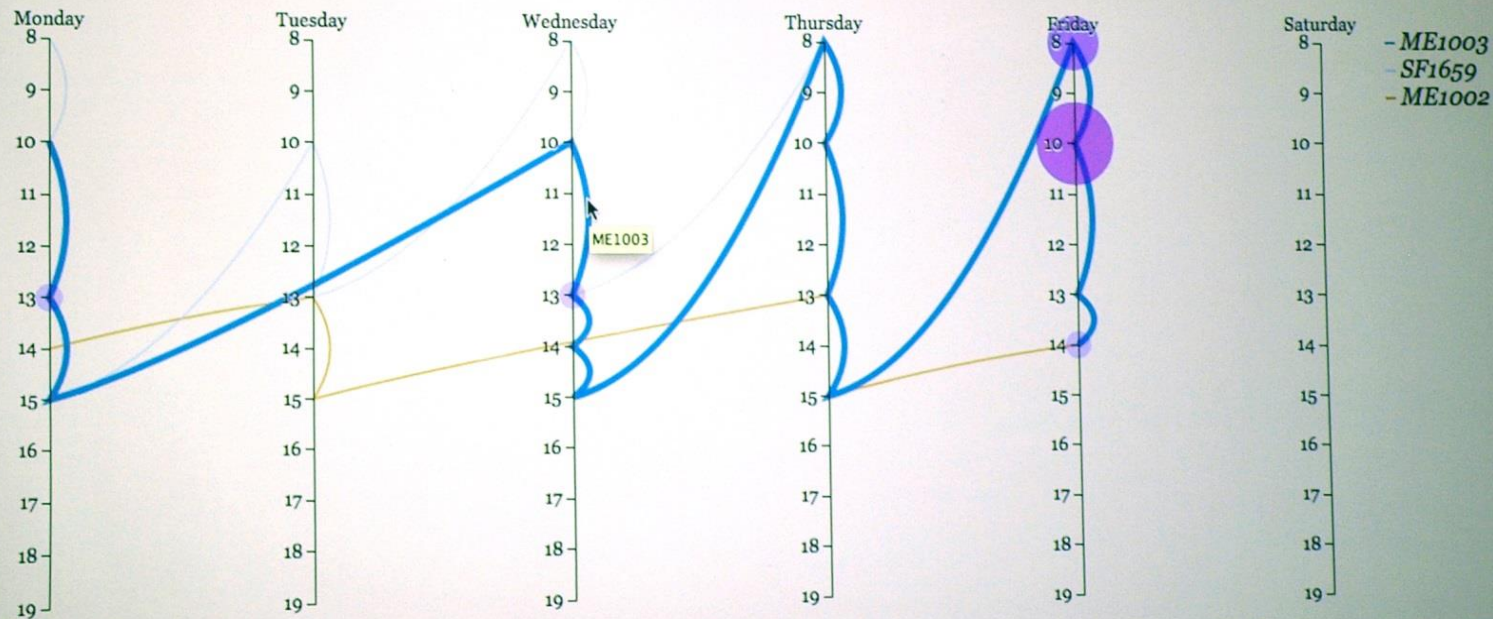


# Al Inselberg



While being a Ph.D. student in Mathematics at the University of Illinois (Champaign-Urbana), and studying multi-dimensional geometry I became frustrated by the *absence* of visualization. Basically, we were doing Algebra which was being interpreted as Geometry but without the fun and benefit of pictures. I kept wondering about ways to make accurate “multi-dimensional pictures” and derive insights about what may or may not be true in the multi-dimensional worlds. Since *parallelism* is the fundamental concept in geometry, and not orthogonality which uses the plane very fast, I experimented with putting the coordinate axes parallel to each other.





IVIS13 students Markus Felldin and Max Roth presenting their parallel coordinate visualization for scheduling.

# TimeEdit

**TimeEdit**

Vecka 31 - 50 2012 Textformat | Utöka

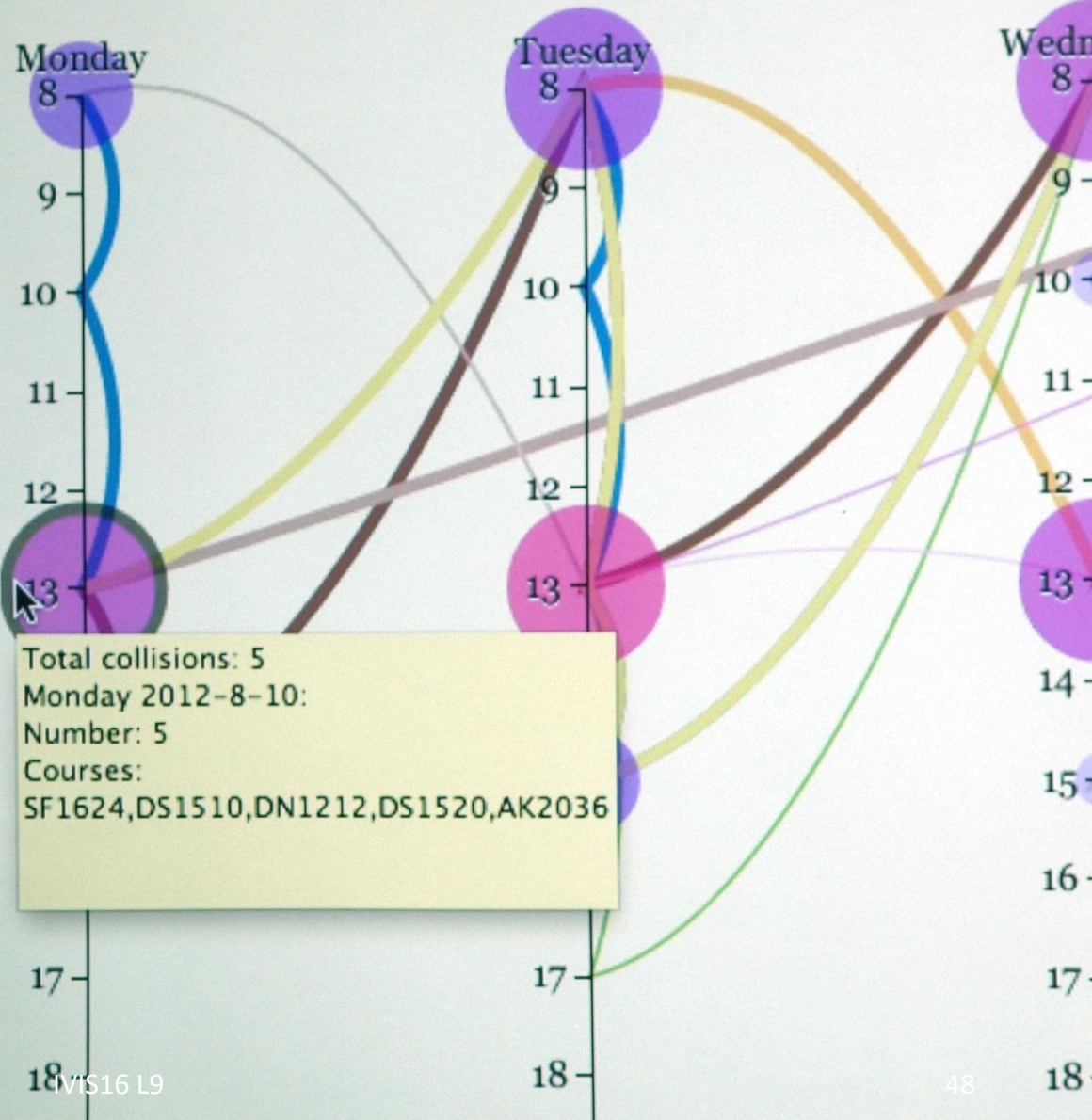
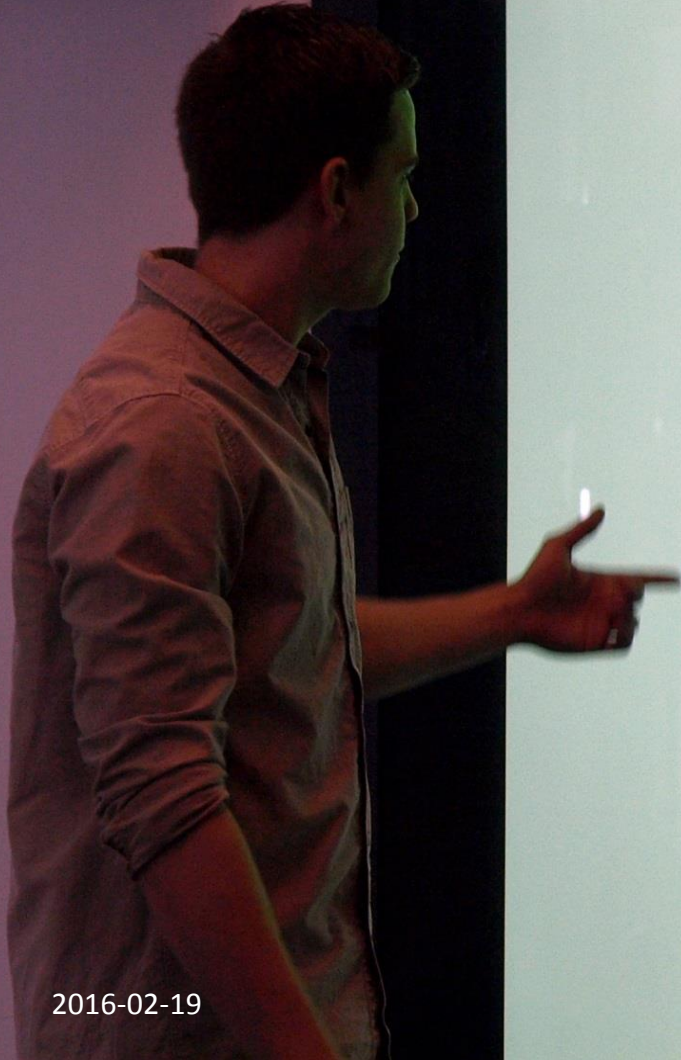
Kurs DD2440 Avancerade algoritmer  
Kurs A111YA Introduktion till Arkitekturket  
Kurs DD3015 Introduktion till programmering med GPGPU och användning för ve  
Kurs DH2320 Introduktion till visualisering och datorgrafik  
Kurs EQ1210 Introduktion till signalteori  
Kurs AK2017 Introduktionskurs i forskningsetik

Vecka 35	Måndag 27 aug	Tisdag 28 aug	Onsdag 29 aug	Torsdag 30 aug	Fredag 31 aug
08					
09					
10		10:00-12:00 DH2320 DH2320H121 Fh E31			
11					
12					
13	13:00-15:00 EQ1210, EQ1220 EQ1220H122 Fh Q26			13:00-15:00 EQ1210, EQ1220 EQ1220H122 Fh V34	
14				15:00-17:00 EQ1210, DH2320 EQ1220 DH2320H121 EQ1220H122 Fh Ova Q24, Q26	
15				15:00-17:00 EQ1210, DH2320 EQ1220 DH2320H121 EQ1220H122 Fh Ova Q24, Q26	
16					
17					
18					

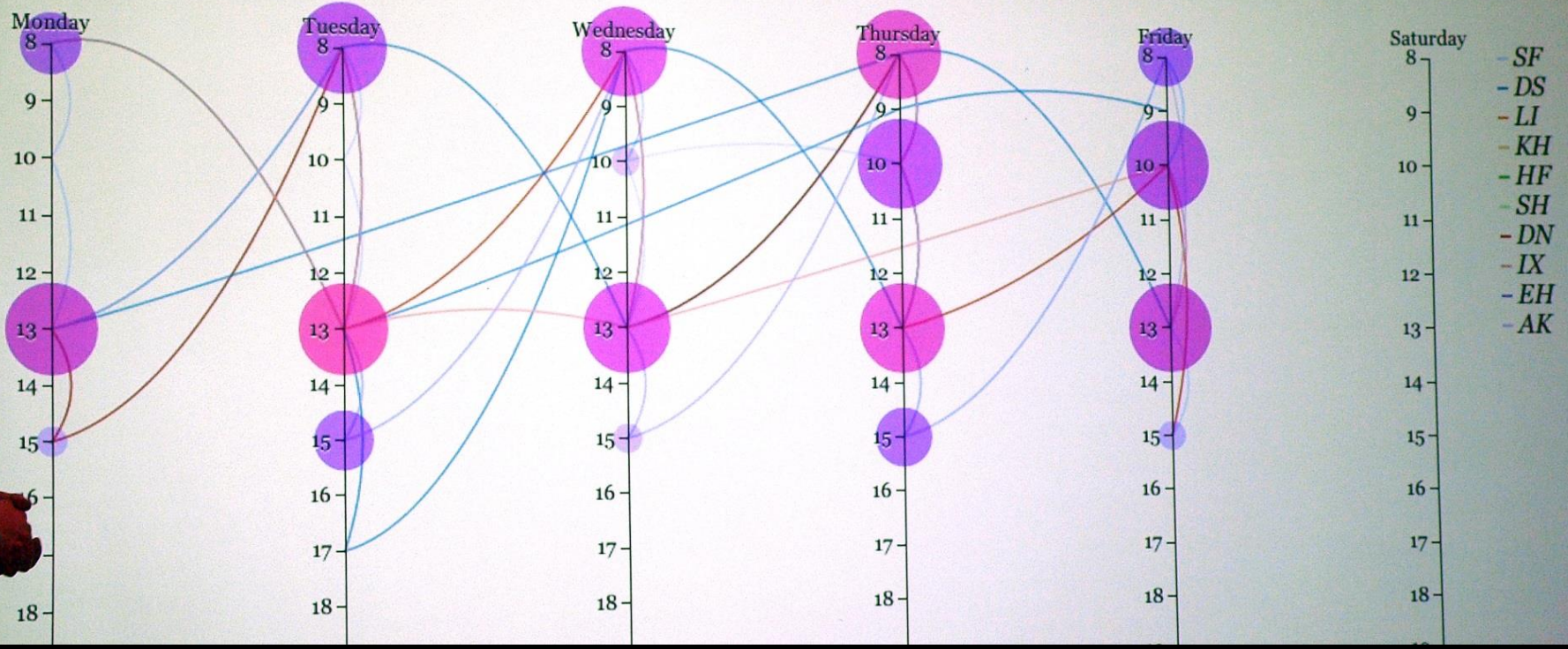
  

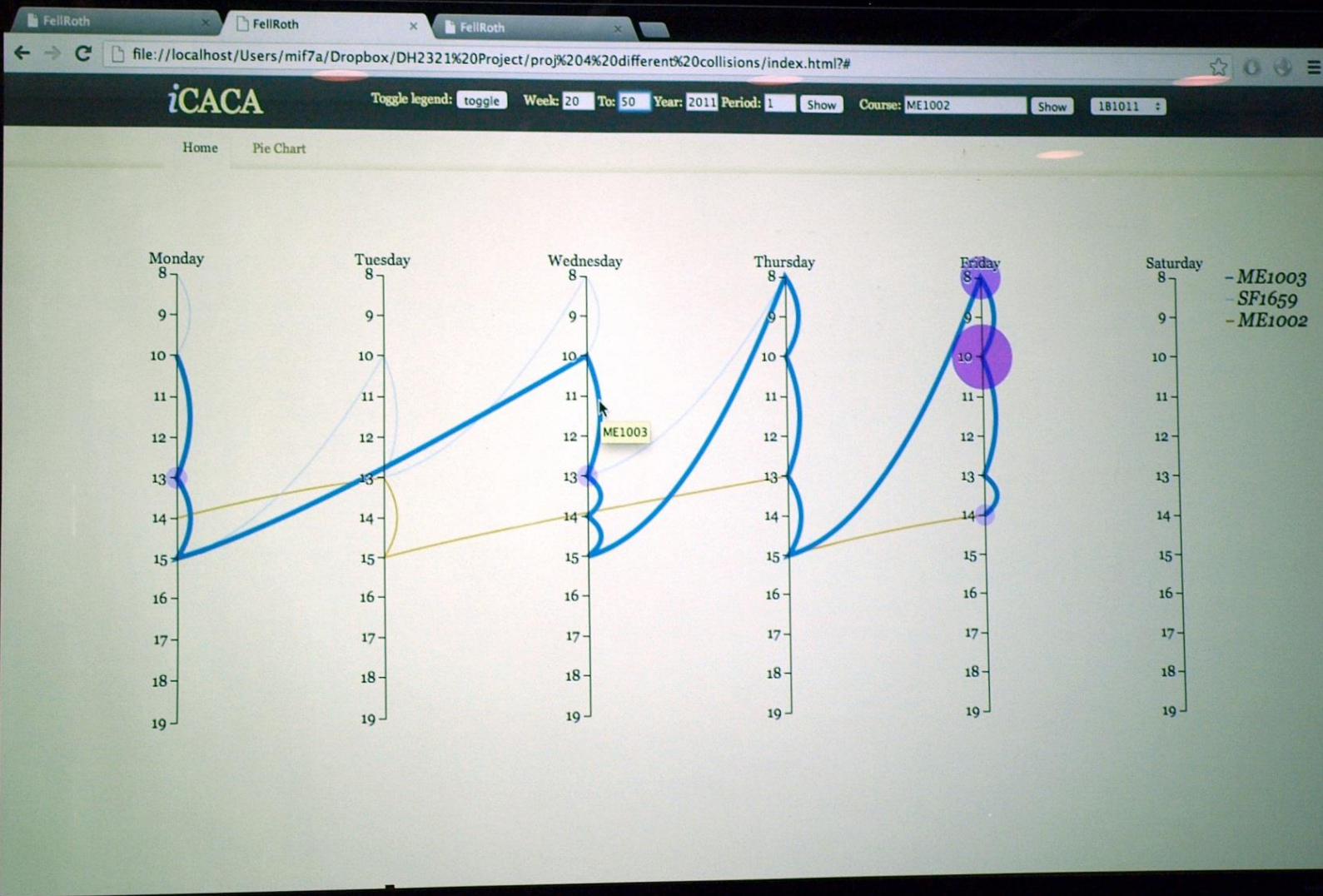
Vecka 36	Måndag 3 sep	Tisdag 4 sep	Onsdag 5 sep	Torsdag 6 sep	Fredag 7 sep
08	08:00-10:00 EQ1210, EQ1220 EQ1220H122 Fh Q34				
09					
10					
11					
12					
13	13:00-15:00 EQ1210, EQ1220	13:00-15:00 DH2320			13:00-15:00 EQ1210, EQ1220

March 4, 2013



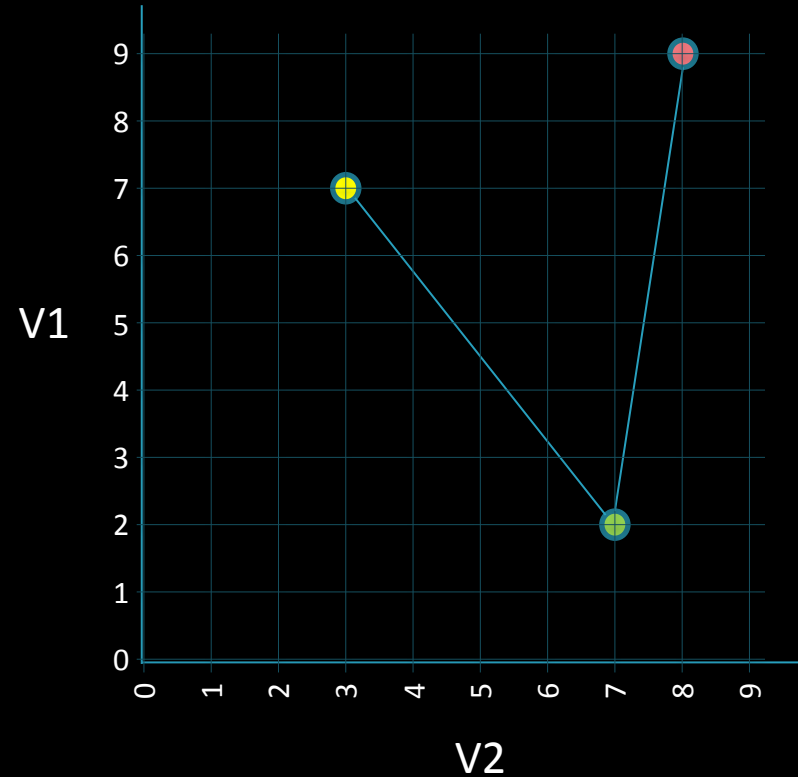






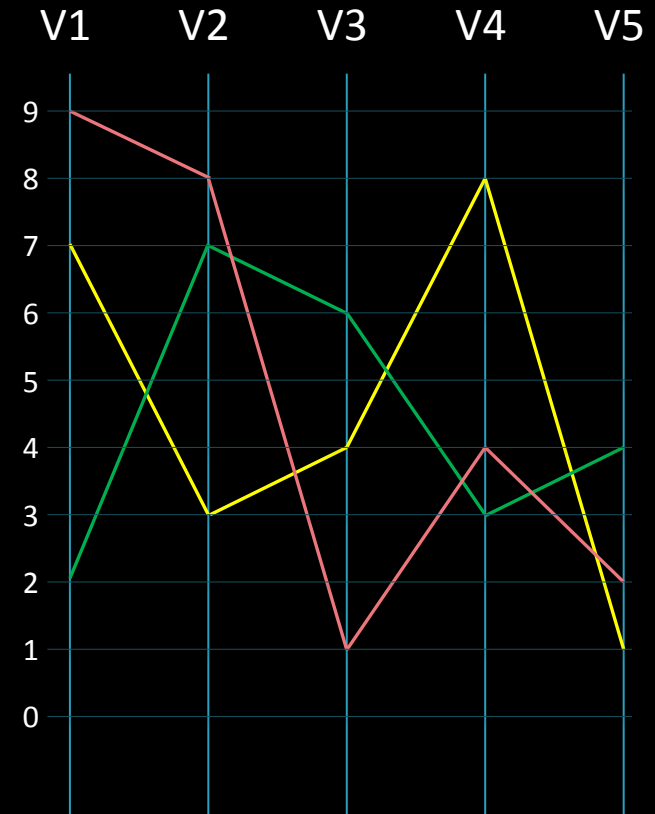
# Scatter Plot (Orthogonal Coordinates)

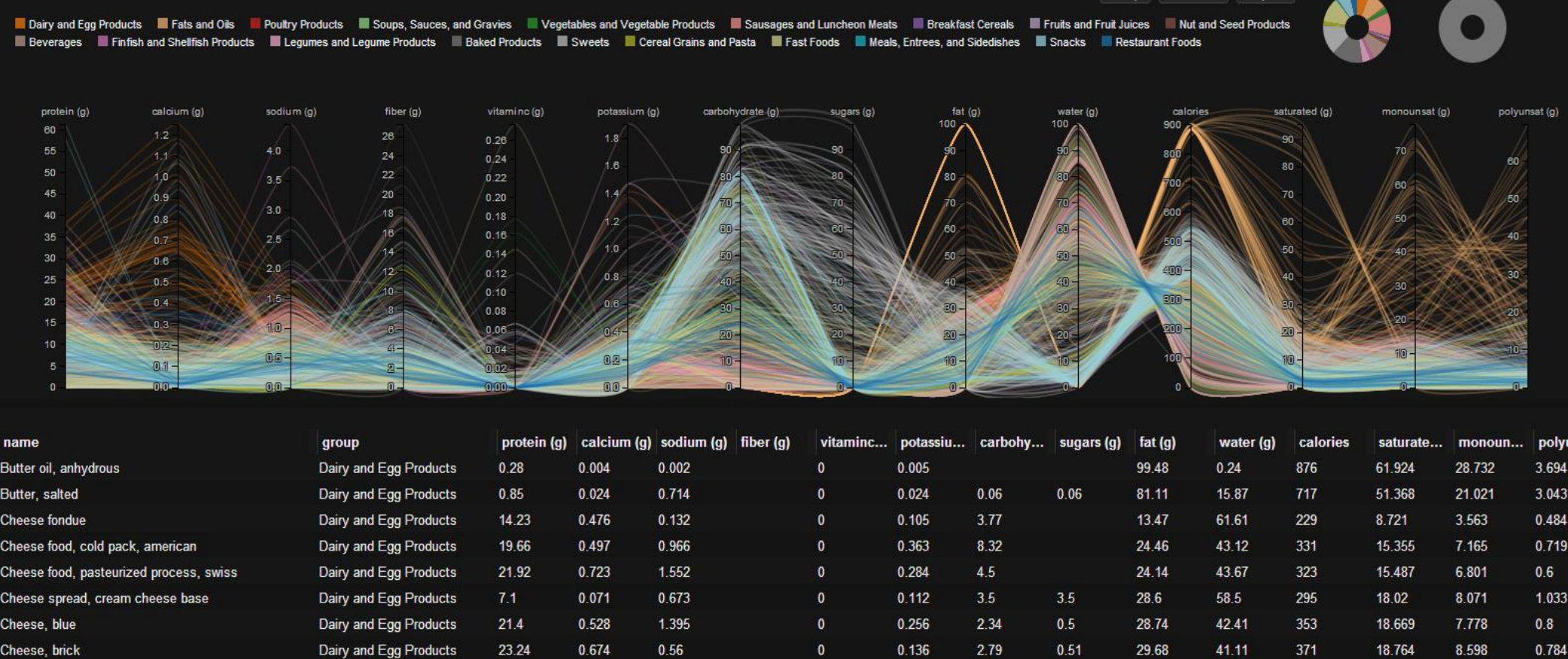
	V1	V2
D1	7	3
D2	2	7
D3	9	8



# Parallel Coordinates

	V1	V2	V3	V4	V5
D1	7	3	4	8	1
D2	2	7	6	3	4
D3	9	8	1	4	2





Other Links: [nutrition data](#), [tutorials](#), [car data](#), [gitHut](#), [gitHub](#), [angular brushing](#), [edge-bundling](#)

## Reading Assignment 5

due Feb 23, 2016

- Skog, Tobias, Sara Ljungblad, and Lars Erik Holmquist. "Between aesthetics and utility: designing ambient information visualizations." *Information Visualization, 2003. INFOVIS 2003. IEEE Symposium on*. IEEE, 2003. [LINK](#)
- Pousman, Zachary, John T. Stasko, and Michael Mateas. "Casual information visualization: Depictions of data in everyday life." *Visualization and Computer Graphics, IEEE Transactions on* 13.6 (2007): 1145-1152. [LINK](#)



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Thank you!  
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