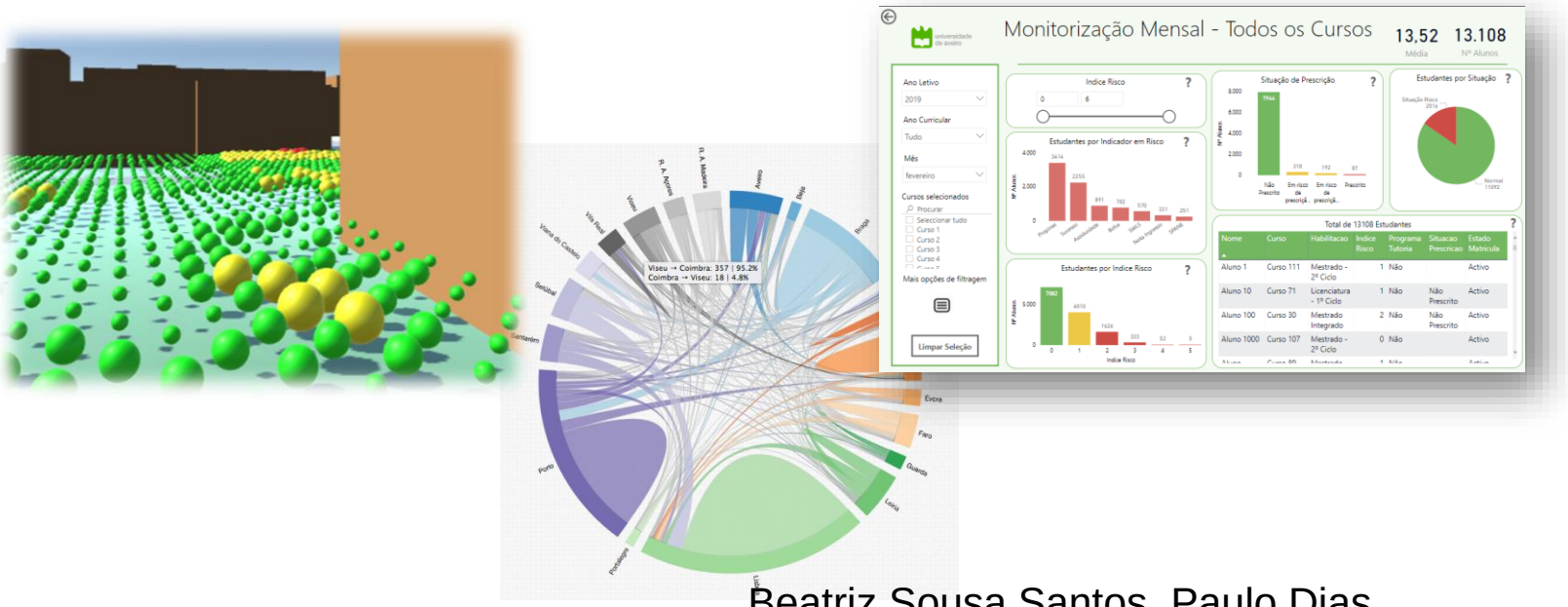
Universidade de Aveiro
Departamento de Electrónica,
Telecomunicações e Informática

Information Visualization course 2025
Introduction



Beatriz Sousa Santos, Paulo Dias

What is Visualization?

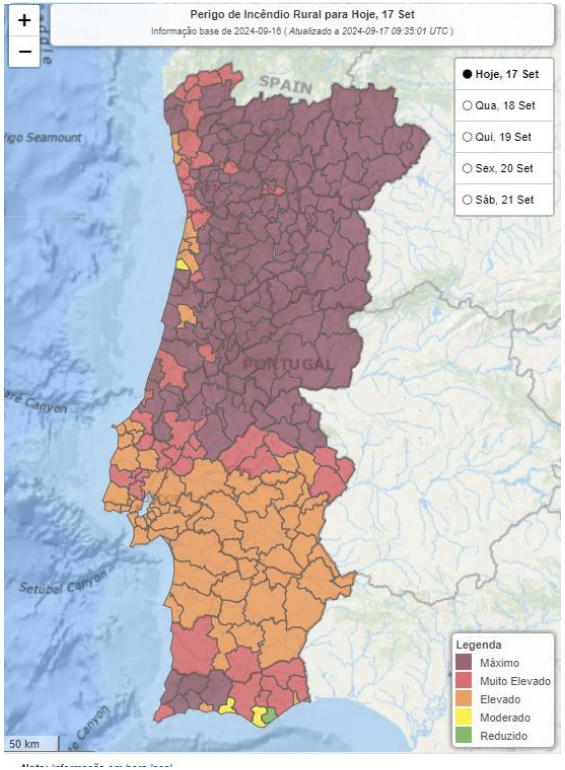
- Visualization is a field of Computing focused on how to **visually represent and explore large amounts of data**

- Taking advantage of the **human visual system capacities**

- Providing "**insights**" concerning the **phenomenon** behind the **data**

  example:

  https://www.ipma.pt/pt/riscoincendio/rcm.pt/



What it **is not**:

just "pretty pictures"!

This course:

- an introduction to: Data and Information Visualization
  Computer Graphics

- Information Visualization

Course web page: http://sweet.ua.pt/bss/courses/InfoVis/IV-home.htm

all materials are available in Moodle

Outline:

Introduction to Data and Information Visualization

Information Visualization:

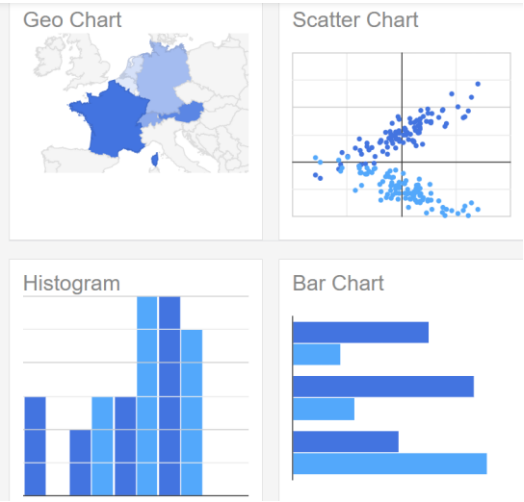
- Main issues
- Data and Design
- Representation
- Presentation
- Interaction
- Evaluation

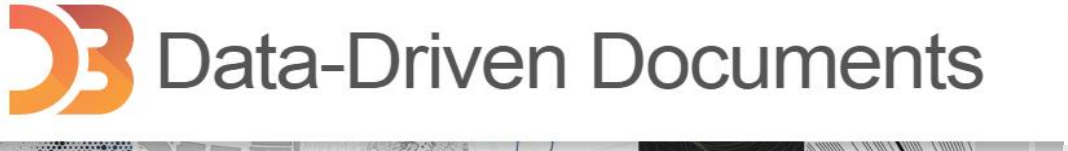
Introduction to Computer graphics:

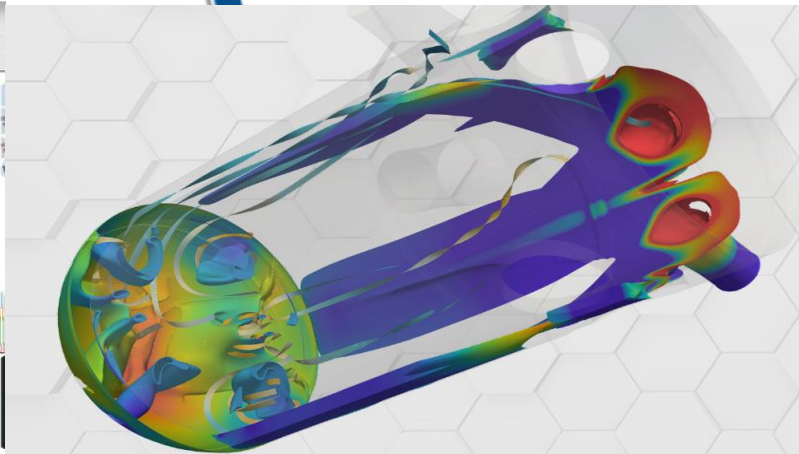
- Primitives, Geometric transformations (2D, 3D) and Visualization (2D, 3D)
- Introduction to visibility, illumination, surface rendering and color models

In Lab Classes we will use

- Visualization: Google Charts, D3
- Computer Graphics: SVG, VTK







Sessions

(subject to minor adjustments)

1 - Introduction to the course and to DataVis and InfoVis

1Lab – Introduction Labs

2 – Introduction to Data Vis and InfoVis (select a paper)

2Lab- Google Charts

3 – Main issues in InfoVis (Data and Design cycle) (select a paper)

3Lab – Introduction to SVG

4 - Representation: coding of value

4Lab – Introduction to D3.js (mini-project topics)

5 - Evaluation methods + Paper presentation

5Lab - Evaluation of a Vis application

6 – Representation: coding relation + Paper presentation

6Lab – Introduction to D3.js – (select a mini-project topic)

7 – Follow-up of the mini-project

7Lab - mockup evaluation

8 – Presentation + Paper presentation

8Lab - D3.js; mini-project

9 - Interaction + Paper Presentation

9Lab – D3.js mini-project

10 – Introduction to Computer Graphics + Paper presentation

10Lab – D3.js; mini-project

11 - Presentation and demo of the mini-project

11Lab – Presentation and demo of the mini-project

12 – Introduction to Computer Graphics + Paper presentation (CG assignment)

12Lab – Introduction to VTK

13 – Introduction to Computer Graphics + Paper presentation

13Lab – VTK exercises, CG assignment

14 – Introduction to Computer Graphics + Paper presentation

14Lab – VTK exercises, CG assignment

Dates to submit CG assignment TBA

Assessment

- Exam – 40% (January/2026)

- Mini-project - design, implementation and evaluation of a visual data exploration application – 40% (groups of two students)

- Computer Graphics assignment – 10%

- Paper presentation – 10% (groups of two students)

Notice: Working Students must contact paulo.dias@ua.pt until **October 6** to discuss their practical assessment deadlines

Assignments

- Are performed in groups of two students

- Paper presentation

  6/Oct/2026– select a paper and a presentation date

- Design, implementation and evaluation of a Visual Data Exploration application using UCD, with the following deliverables:

  select a topic

  LFP usability test

  Follow-up – presentation and submission of
  requirement analysis and proposed design (15 slides)

  Presentation and demo of the application

  date TBA – submission of the application

- Computer Graphics exercises

  date TBA - submission of VTK exercises

Design and implementation of a Visual Data Exploration Application Using a Human-Centered approach:

- Select a Data set to visualize
- Characterize target users, scenarios and identify interesting questions
- Propose a conceptual model for the application (including visualization idioms and interaction styles)
- Develop and evaluate a low fidelity prototype with users
- Develop the application using D3 (or other platform, subject to approval)
- Evaluate the application using at least an analytical method

Analyzing and presenting a

- Each group of two students must:

- Select an **InfoVis** long paper from:
  - IEEEVis2024
  - EuroVis2025
  - Or from another recent conference or journal issue (subject to approval)

- Propose it until 6/Oct/2025 to bss@ua.pt
  Indicating preferences concerning presentation date

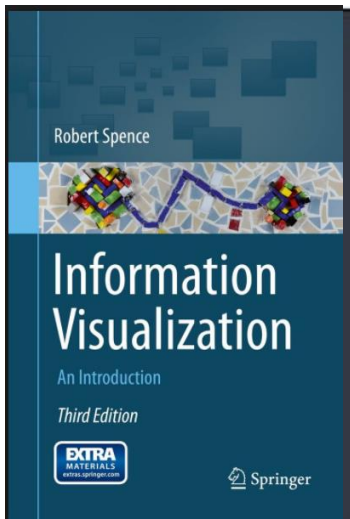
- Read the presentation guidelines

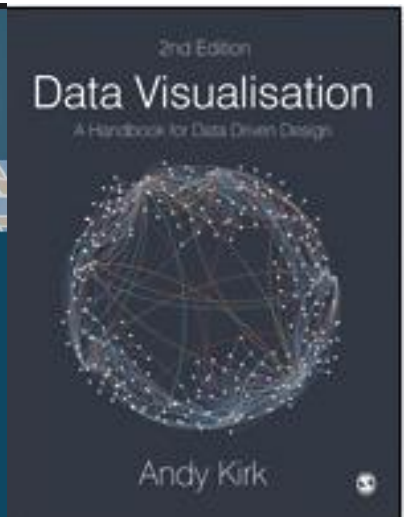
- Make a presentation and submit the slides

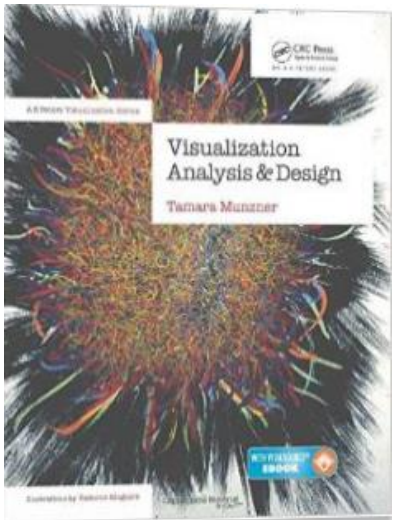
Help:
Laramee, R. S. (2011). How to Read a Visualization Research Paper: Extracting the Essentials. *IEEE Computer Graphics and Applications*, *May/June*, 78–82.
https://ieeexplore.ieee.org/document/5754296

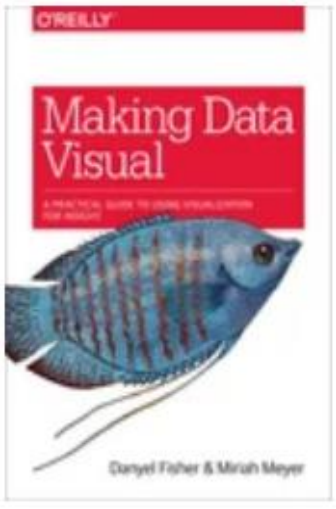
Main Bibliography - Visualization

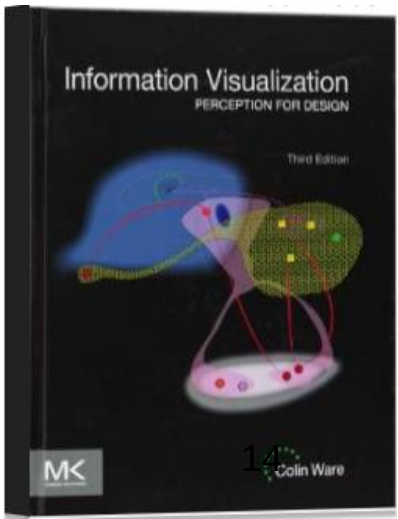
- Spence, R., *Information Visualization, An Introduction*, Springer, 2014
- Munzner, T., *Visualization Analysis and Design* * , A K Peters/CRC Press, 2014
- Kirk, A., *Data VisualisationA Handbook for Data Driven Design*, 2nd. Ed., Sage, 2019
- Fisher, D., Meyer, M., *Making Data Visual. A practical Guide to using Visualization for insight* *, O'Reilly, 2017
- Ware, C., *Information Visualization, Perception to Design* *, 3nd ed.,Morgan Kaufmann, 2013
- Explore books marked with * and other books available at the playlist: Playlist: CT- Visualization











Other Books

- Spence, R., *Information Visualization, Design for Interaction*, 2nd ed., Prentice Hall, 2007
- Wilke, C., Fundamental of Data Visualization, 2019
- Kirk, A., *Data Visualization: A successful design process* * , Pack Publishing, 2012
- Bederson, B. , B. Shneiderman, *The Craft of Information Visualization: Readings and Reflections*, Morgan Kaufmann, 2003
- Card, S., J. Mackinlay, and B. Shneiderman, *Readings in Information Visualization: Using Vision to Think,* Morgan Kaufmann, 1999
- Keim, D., Kohlhammer, J., Ellis, G., & Mansmann, F., *Solving problems with Visual Analytics*, Eurographics, 2012
- Keim, D., Rossi, F., Seidl, T., Verleysen, M., & Wrobel, S. (2012). *Information Visualization, Visual Data Mining and Machine Learning* (Dagstuhl Seminar 12081). Dagstuhl Reports, 2(2), 58–83. http://doi.org/10.4230/DagRep.2.2.58

…

Other bibliography

- Tufte, E., *The Visual Display of Quantitative Information*, 2nd. ed., Graphics Press, 2001
- Tufte, E., *Envisioning Information,* Graphics Press, 1990
- Friendly, M., "Milestones in the history of thematic cartography, statistical graphics, and data visualization", 2009
- Few, S., "Data Visualization for Human Perception". In: Soegaard, M. and Dam, R. (eds.). *The Encyclopedia of Human-Computer Interaction*, 2nd Ed. The Interaction Design Foundation https://www.interaction-design.org/encyclopedia/data_visualization_for_human_perception.html

Bibliography – Computer Graphics

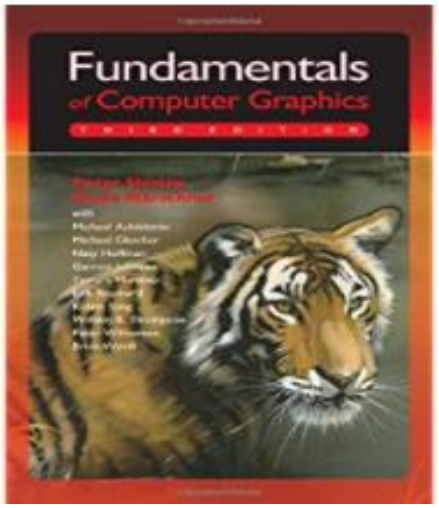
- Shirley, P. M. Ashikhmin, S. Marschner, *Fundamentals of Computer Graphics**, 3rd Edition, 3rd ed., A K Peters/CRC Press, 2021

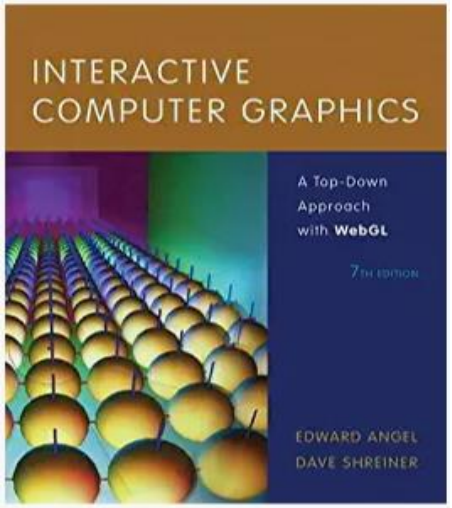
- Angel, E., D. Shreiner, *Interactive Computer Graphics: A Top-Down Approach with WebGL*, 7th ed, Pearson, 2014

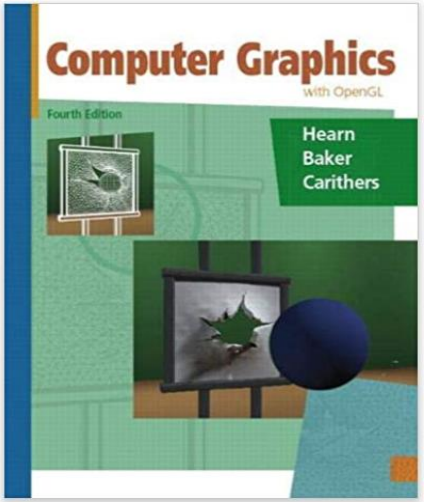
- Hearn, D., M. P. Baker, W. Carithers*, Computer Graphics with OpenGL*, 4th ed., Prentice Hall, 2010

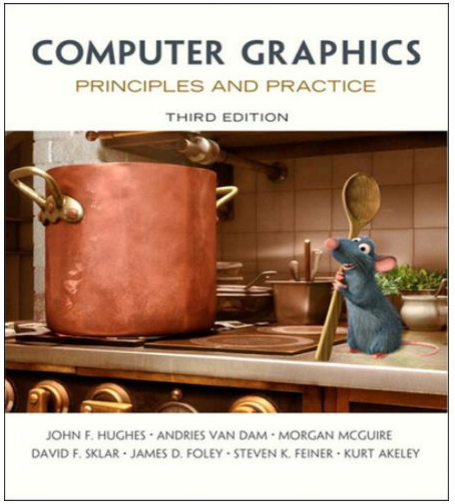
Explore books with * and other books available at the playlist:

[Playlist: Computer Graphis (oreilly.com)]









To probe further
Scientific Journals/Conferences

IEEE Transactions on Visualization and Computer Graphics

IEEE Computer Graphics and Applications

Computer Graphics Forum

Computers and Graphics

Information Visualization

IEEE Vis (http://ieeevis.org/)

Eurovis

A selection of Visualization books to read online:
https://learning.oreilly.com/playlists/f68d0022-1b58-4374-9af5-280d221d4c7e/

On-line courses

Data Visualization – Johns Hopkins - NYU

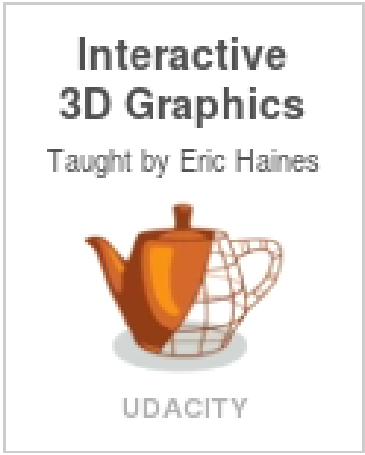
[Data Visualization | Coursera]

Data Visualization and D3.js

[D3.js and Data Visualization | Udacity]

Interactive 3D Graphics, by Eric Haines

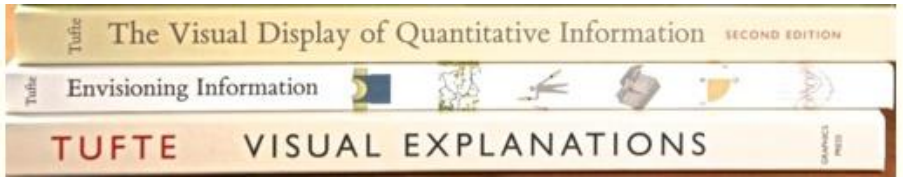
[Interactive 3D Graphics | Udacity]



Interesting links

- http://www.infovis-wiki.net/
- https://eagereyes.org/
- http://www.perceptualedge.com/
- http://www.thefunctionalart.com/
- https://www.edwardtufte.com/tufte

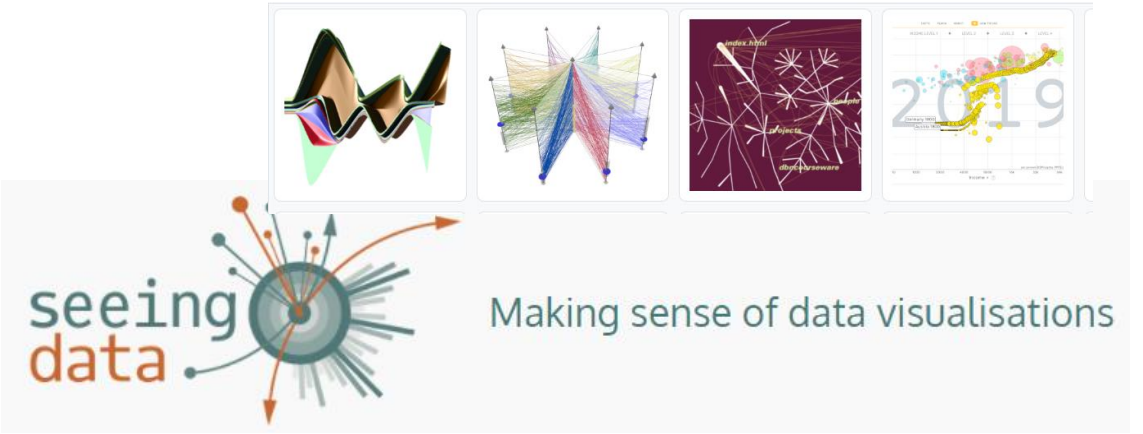
Visual Business Intelligence
for enlightening analysis and communication



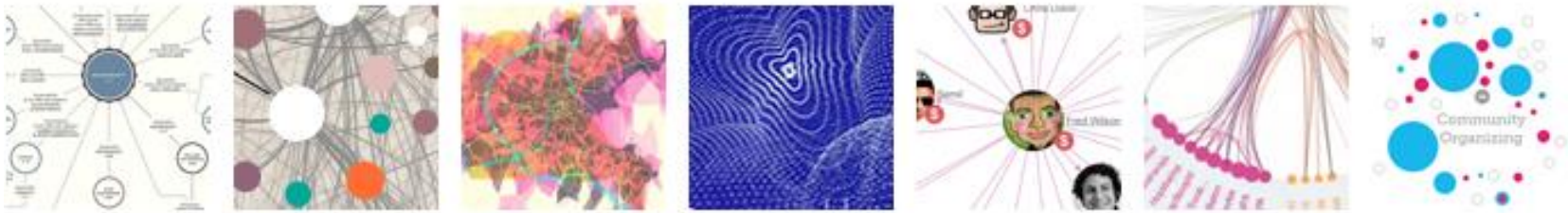
Interesting links

MULTIPLE VIEWS Visualization Research Explained

- https://medium.com/multiple-views-visualization-research-explained
- https://browser.timeviz.net/
- http://seeingdata.org/
- https://flowingdata.com/about
- http://www.visualcomplexity.com/vc/



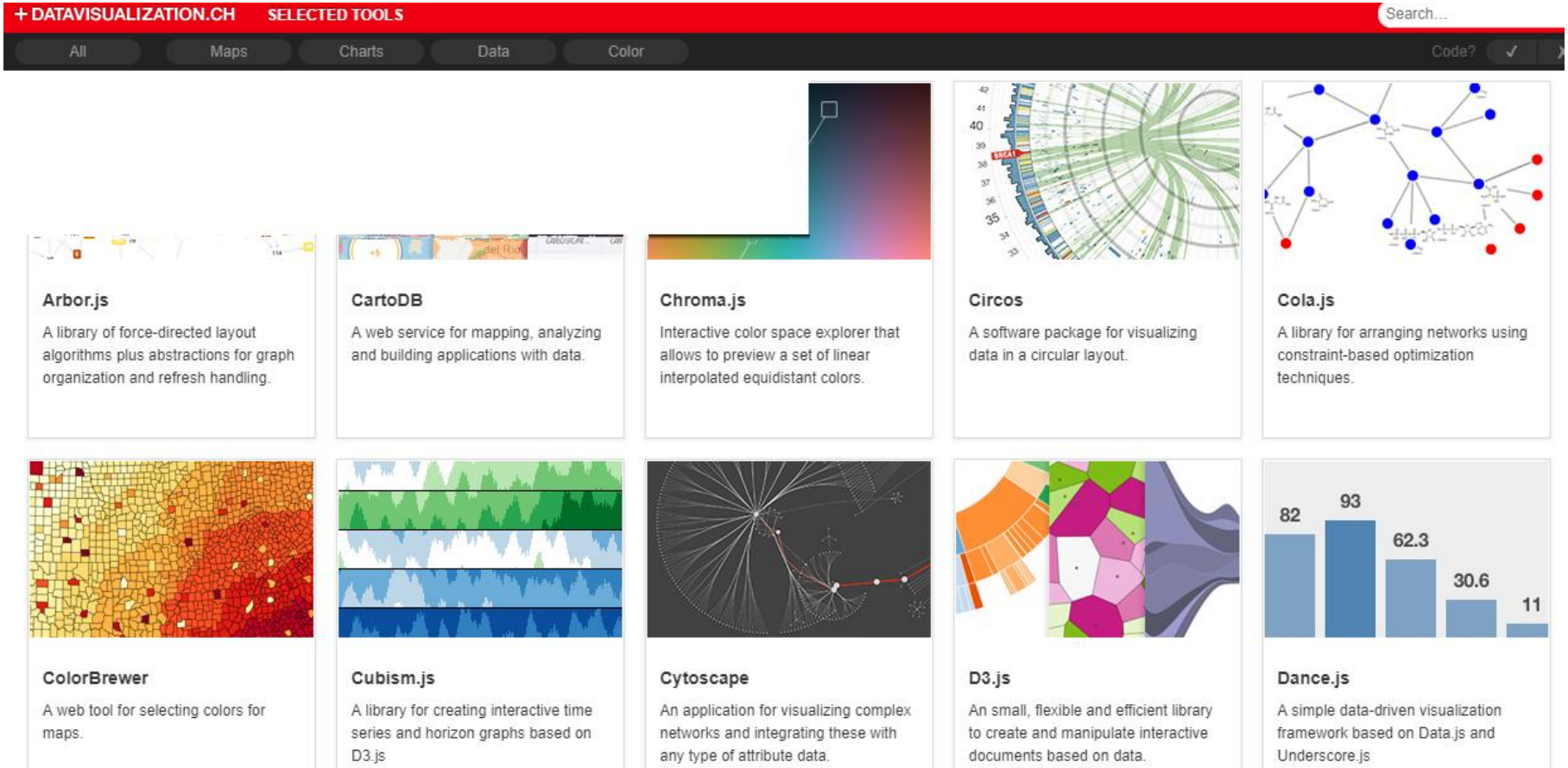
FLOWINGDATA



Visualization Tools

- There are a lot, of different types and with different purposes

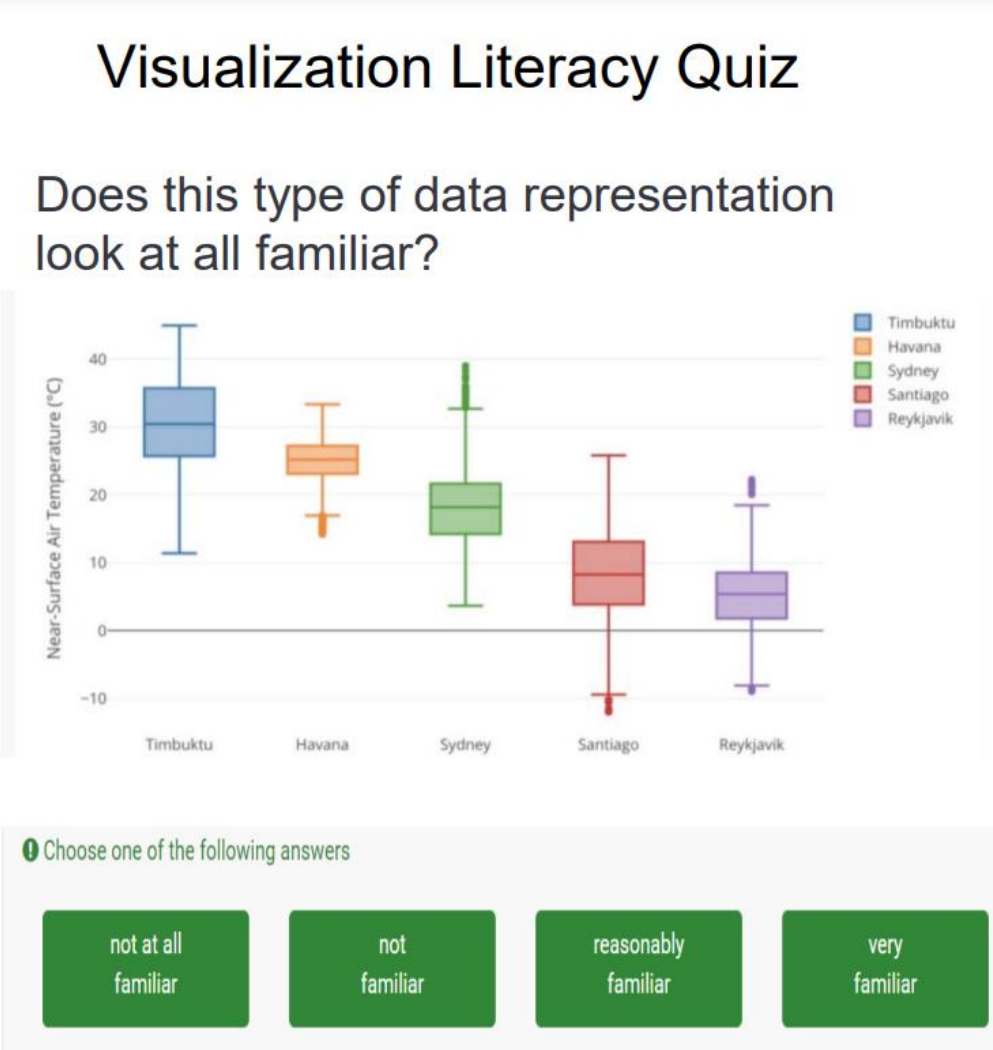
  (see e.g. Datavisualization.ch Selected Tools)

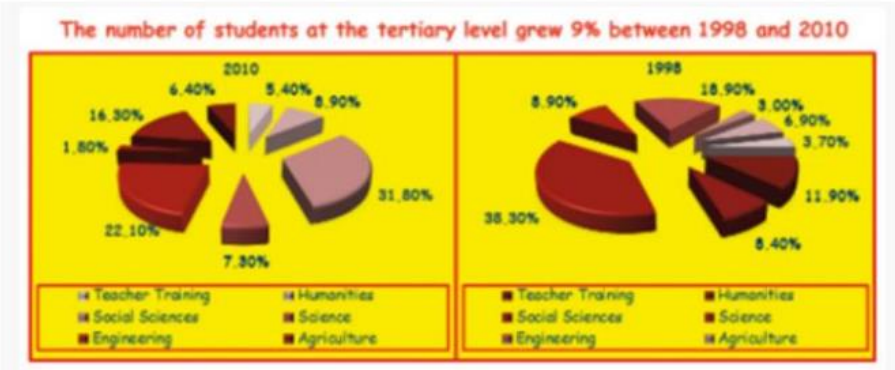


2024 Gartner Magic Quadrant for Analytics and Business Intelligence (BI) Platforms

Business Intelligence: Capabilities enabling organizations to make better decisions, take informed actions, and implement more efficient business processes

Visualization Literacy Quiz





- [Visualization Literacy Quiz]