Introduction to Information Visualisation

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Web site:
https://isds.tugraz.at/keith/

Slides:
https://keithandrews.com/talks/2022/2022-10-27-ivis-dh/

Course Notes:
https://courses.isds.tugraz.at/ivis/ivis.pdf

27 Oct 2022, Centre for Information Modelling, University of Graz.

Sales Data as a Table

Month	Salesperson A	Salesperson B
2012-01	28,366	23,274
2012-02	27,050	21,732
2012-03	29,463	23,845
2012-04	32,561	28,732
2012-05	28,050	24,023
2012-06	30,100	26,089
2012-07	22,343	19,026
2012-08	21,506	17,903
2012-09	24,664	19,387
2012-10	28,842	23,490
2012-11	30,621	25,873
2012-12	36,254	28,490

Sales Data as a Line Chart

Information Visualisation

"Let my dataset change your mindset."
[Hans Rosling, title of talk at TED@State, 03 Jun 2009]

Information visualisation (InfoVis) is the visual presentation of abstract information spaces and structures, together with accompanying interactions, so as to facilitate their rapid assimilation and understanding.

[Hans Rosling; *Stats that Reshape Your Worldview*;
TED 2006 Talk, 22 Feb 2006.
https://ted.com/talks/hans_rosling_the_best_stats_you_ve_ever_seen]

Visualisation

The broader field of visualisation has three main sub-fields:

- InfoVis:
  Information Visualisation (InfoVis) deals with abstract information structures, such as hierarchies, networks, or multidimensional spaces.

- GeoVis:
  Geographic Visualisation (GeoVis) is map-based. The data typically has inherent 2d or 3d spatial coordinates, and is generally shown in relation to a map.

- SciVis:
  Scientific Visualisation (SciVis) typically involves concrete (3d) objects, for example a medical scan of part of the body, or a simulation of air flow around an aircraft wing. SciVis visualisations often depict flows, volumes, and surfaces in (3d) space.

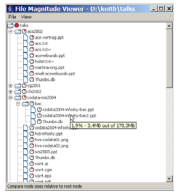
Data Visualisation (DataVis) = InfoVis + GeoVis.

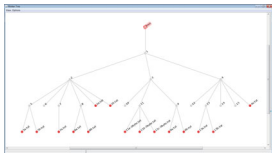
Visual Analytics = DataVis (frontend) + Analytics (backend).

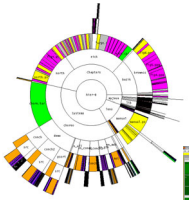
Interactive Information Visualisation

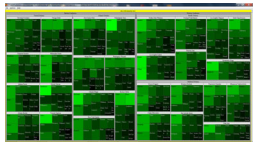
- Visual Representation + Interaction.
- Two main use cases:
  - Explore (Analyse): help researchers explore and analyse.
  - Explain (Present): present results and insights to a wider public.

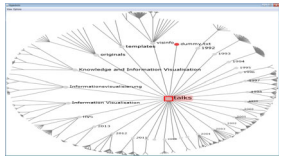
Visualising Hierarchies

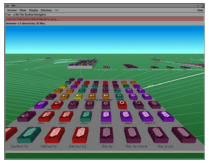


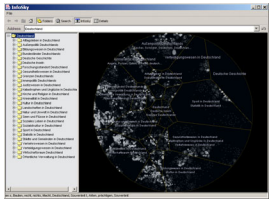












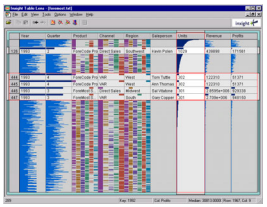
Hyperbolic Browser

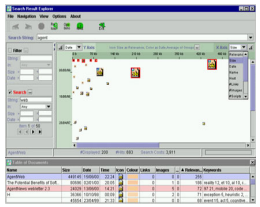
D3-Hypertree [Michael Glatzhofer and Keith Andrews, 2019]
https://keithandrews.com/demos/ivis/hypertree/hypertree-products/
https://hyperbolic-tree-of-life.github.io/
https://github.com/glouwa/d3-hypertree
https://observablehq.com/@glouwa

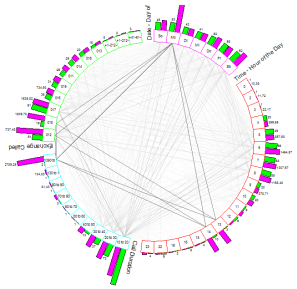
Voronoi Treemap

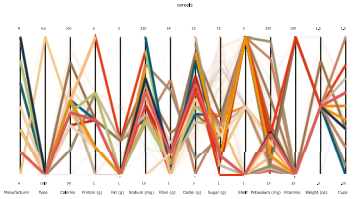
VoroTree [Christopher Oser and Keith Andrews, 2022]
https://somestudentcoder.github.io/vorotree/
https://github.com/somestudentcoder/vorotree

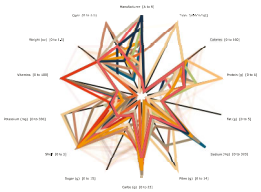
Visualising Multidimensional Metadata

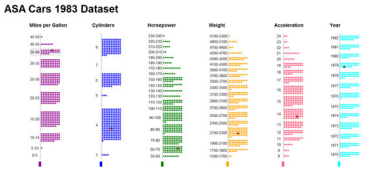










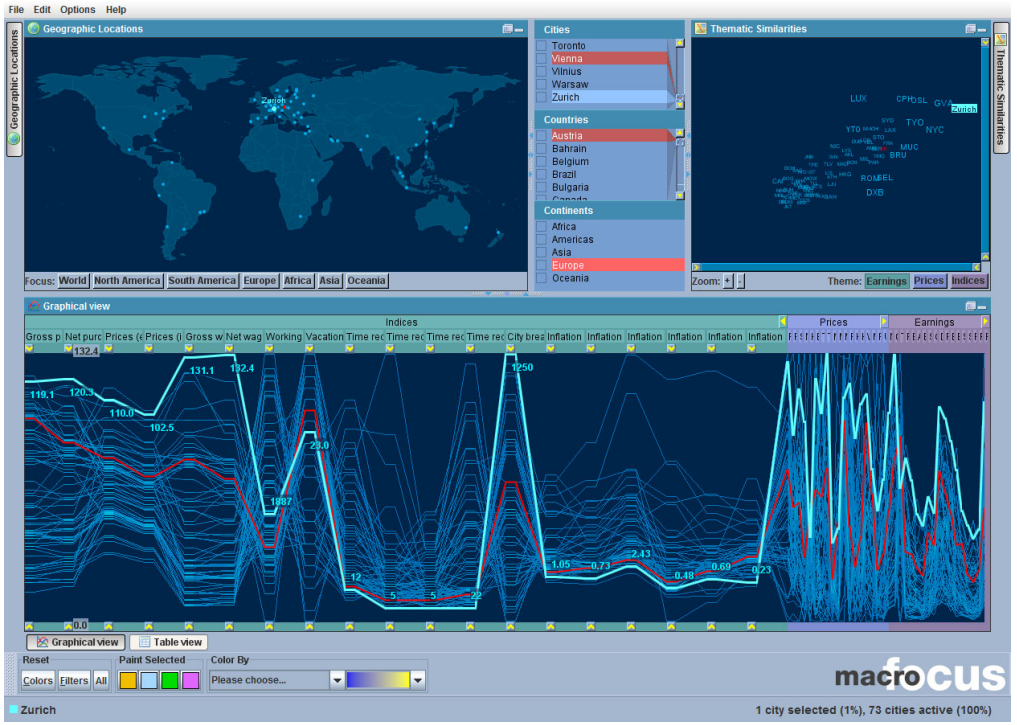


Multidimensional Data as a Table

City	Net Purchasing Power	Prices (incl. rent)	Net Wages	Working Time [hours per year]	Vacation [paid working days per year]	Time Required for Big Mac [minutes]	Time Required for iPhone 4S 16gb [hours]	City Break	Inflation 2011
Amsterdam	90.1	69.1	69.4	1755	24	15	44	720	2.48
Athens	60.5	58.2	40.0	1822	22	29	86	590	3.10
Auckland	82.9	67.8	63.5	1852	20	15	51	580	4.03
Bangkok	31.4	48.2	17.4	2312	7	36	165	550	3.81
Barcelona	78.6	65.6	58.7	1760	29	18	52	740	3.05
Beijing	29.9	51.8	18.0	1979	9	34	184	730	5.42
Berlin	97.1	64.1	70.1	1742	28	16	56	720	2.48
Bogotá	40.7	47.0	22.0	1981	15	52	142	540	3.42
Bratislava	50.7	47.1	27.3	1884	23	31	126	490	4.08
Brussels	78.5	68.8	59.5	1729	20	19	54	730	3.47
Budapest	32.0	50.4	18.1	1912	22	49	206	740	3.90
Buenos Aires	46.2	47.7	25.4	1830	13	45	187	620	9.78
Bucharest	34.0	34.8	13.5	1836	26	57	230	370	5.81
Caracas	25.7	85.4	23.4	1878	17	80	272	830	26.09
...									

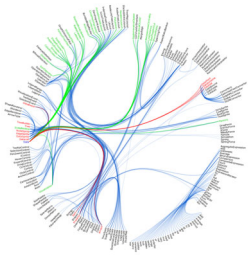
UBS Prices and Earnings Survey 2012 [UBS, 2012]
https://www.ubs.com/microsites/prices-earnings/open-data.html

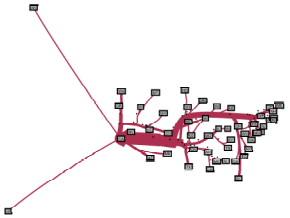
Parallel Coordinates and Similarity Maps

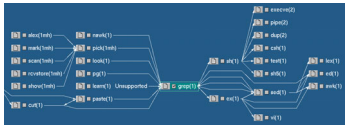


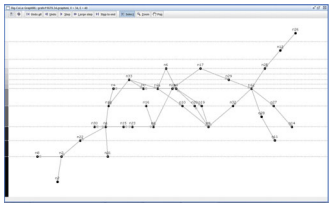
InfoScope, macrofocus.com [Brodbeck and Girardin, 2003]
doi:10.1109/CMV.2003.1215008

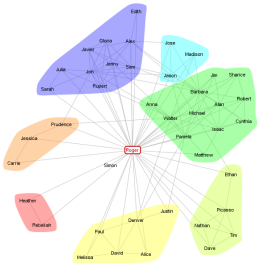
Visualising Networks

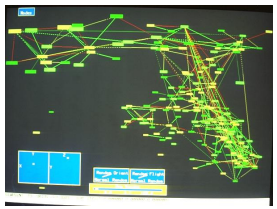




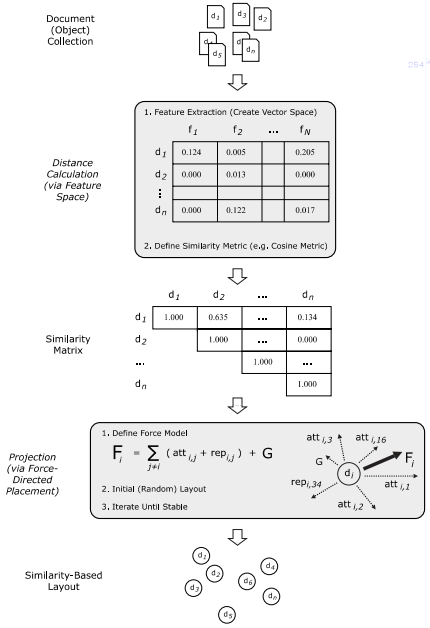


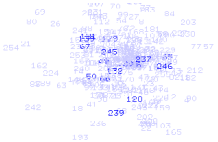


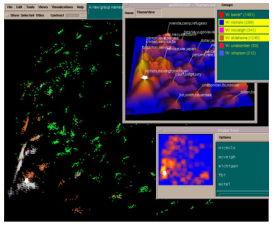


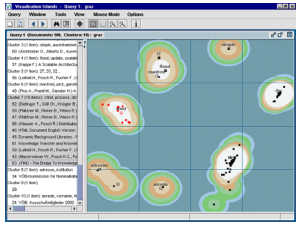


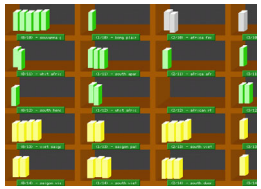
Visualising Object Collections (Feature Spaces)



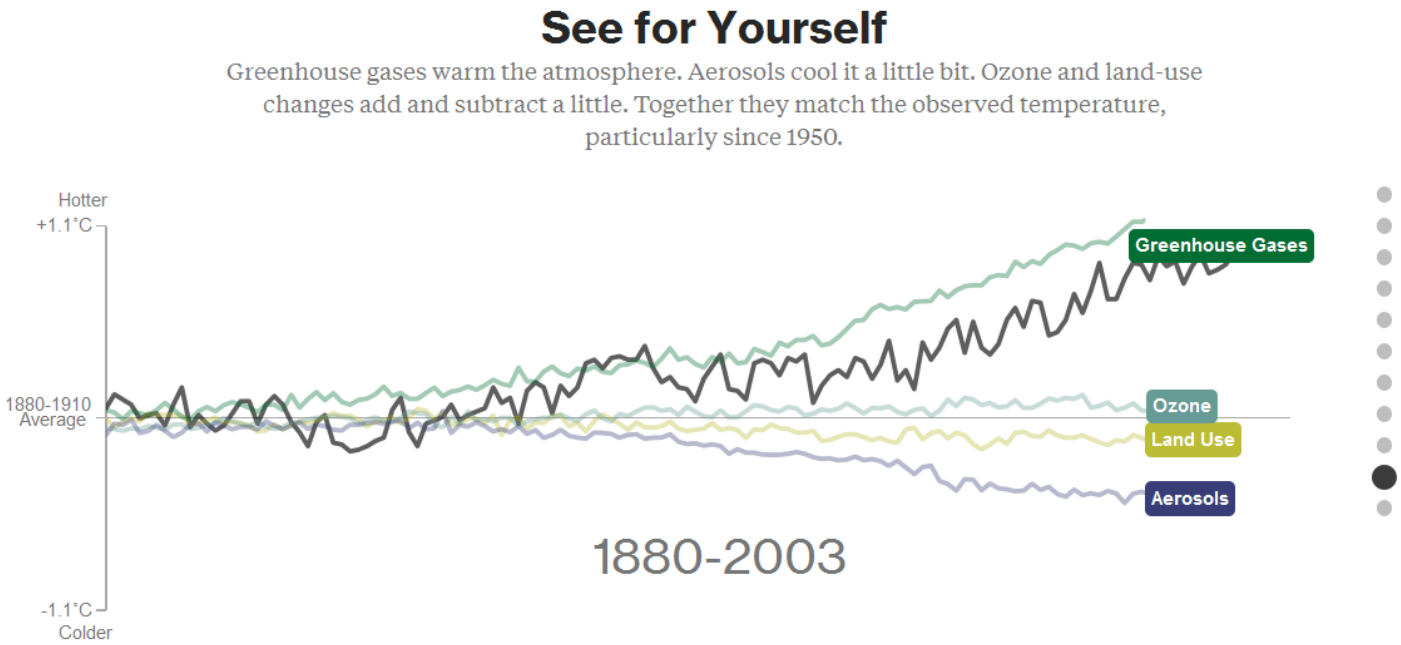






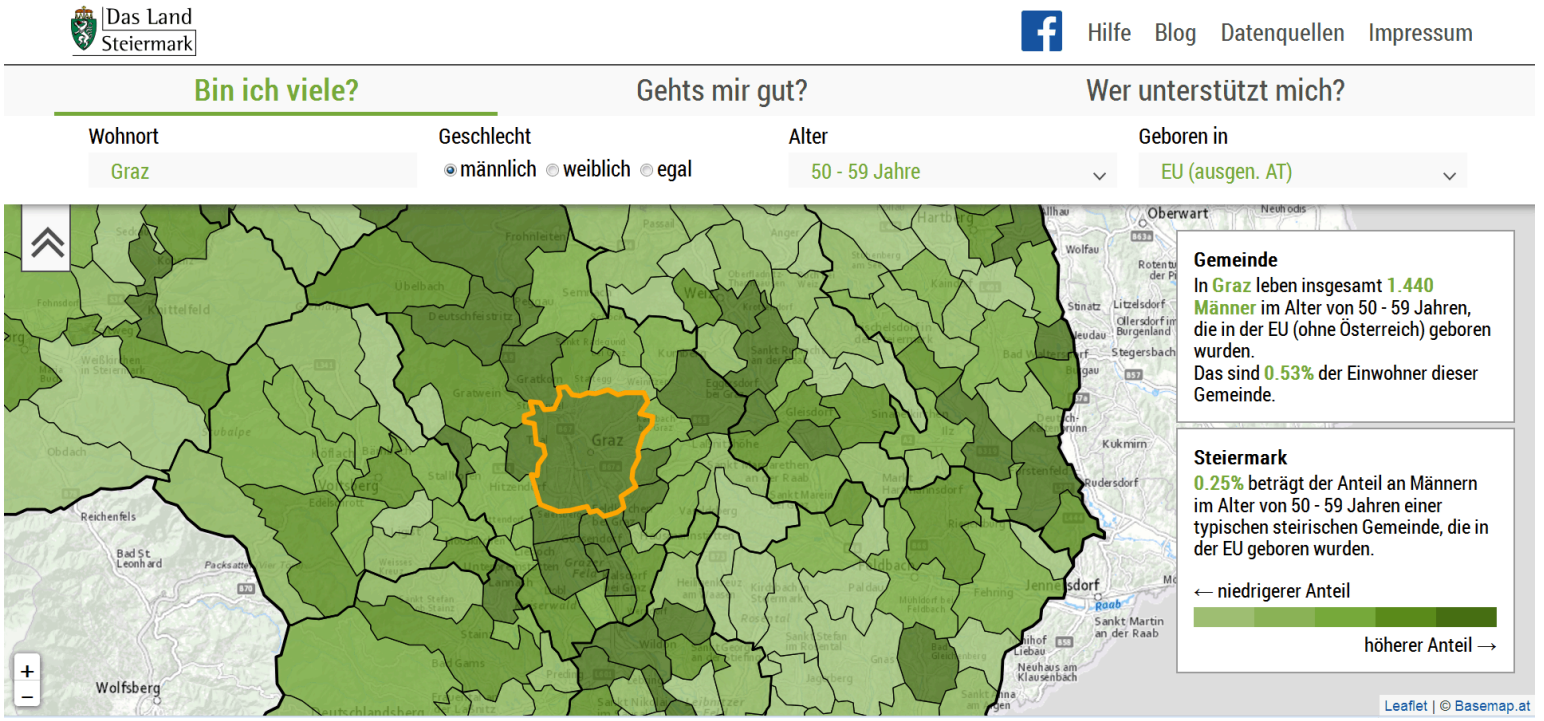


Bloomberg: What's Really Warming the World



[Bloomberg Business, 24 Jun 2015]
https://bloomberg.com/graphics/2015-whats-warming-the-world/

Styrian Diversity Visualisation



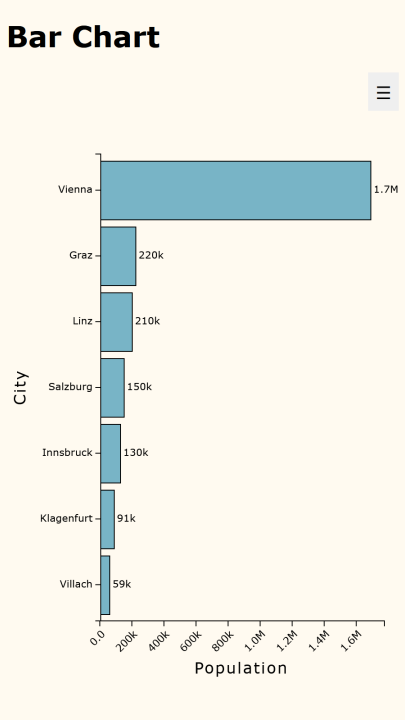
IICM + FH Joanneum + Land Steiermark [Andrews et al, 2015]
http://diversitaet.steiermark.at/steirische-vielfalt/

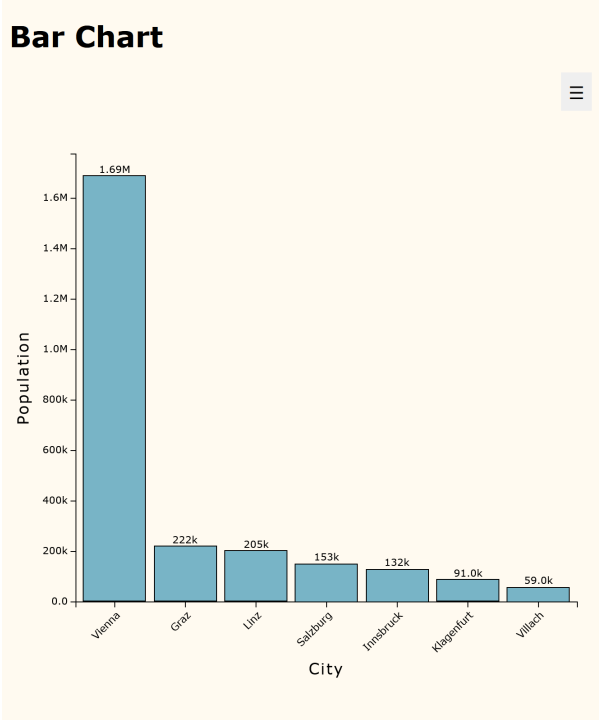
Responsive Information Visualisation

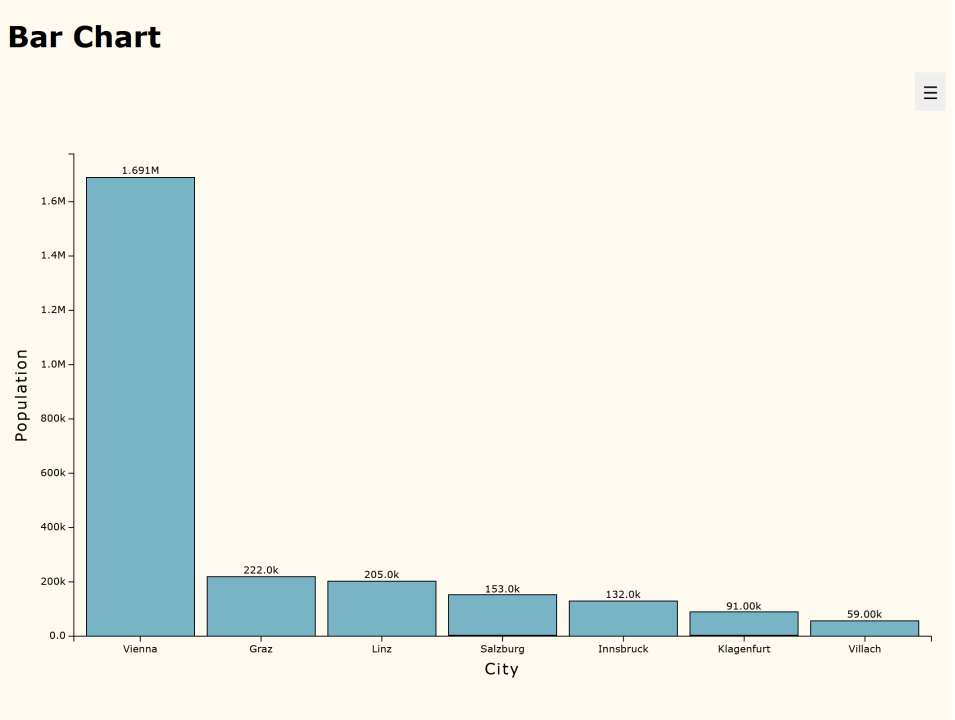
- *Scalable* Visualisations:
  - Scale fluidly (but nothing else).

- *Responsive* Visualisations:
  - Responsive Layout: Change layout at breakpoints, scale fluidly between breakpoints.
  - Responsive Display Density: Support higher and lower resolutions, data point sampling.
  - Responsive Interaction: Provide selective support for touch, keyboard, mouse, motion events, etc. Larger tap areas.

RespVis

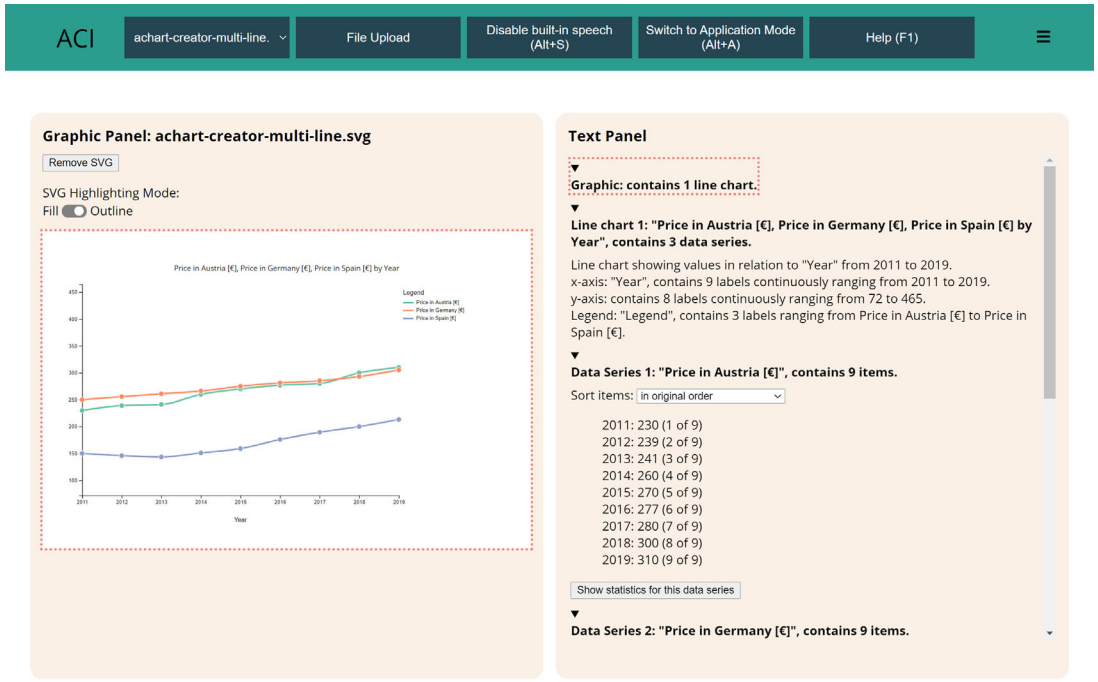






RespVis [Peter Oberrauner and Keith Andrews, 2022]
https://respvis.netlify.app/examples/
https://github.com/AlmostBearded/respvis
https://projects.isds.tugraz.at/respvis/

Experimental Accessible Charts



Achart Interpreter [Christopher Kopel and Keith Andrews, 2021]
https://tugraz-isds.github.io/achart-interpreter
https://github.com/tugraz-isds/achart-interpreter

Conferences

- *EuroVis 2023*; 12-16 Jun 2023, Leipzig, Germany.
  eurovis.org
- *IEEE Vis 2022*; 16-21 Oct 2022, Oklahoma City, USA (hybrid)
  ieeevis.org

Books (HowTo Guides)

- Stephen Few; *Show Me the Numbers: Designing Tables and Graphs to Enlighten*; 2nd Edition, Analytics Press, Jun 2012. ISBN 0963488414
- Andy Kirk; *Data Visualisation*; 2nd Edition, Sage Publications, 08 Jul 2019. ISBN 1526468921
- Danyel Fisher and Miriah Meyer; *Making Data Visual*; O'Reilly, 12 Jan 2018. ISBN 1491928468
- Cole Nussbaumer Knaflic; *Storytelling with Data*; Wiley, 02 Nov 2015. ISBN 1119002257
- Stephen Few; *Now You See It: Simple Visualization Techniques for Quantitative Analysis*; Analytics Press, 2009. ISBN 0970601980
- Stephen Few; *Information Dashboard Design: Displaying Data for At-A-Glance Monitoring*; 2nd Edition, Analytics Press, Aug 2013. ISBN 1938377001

Books (Hardcore InfoVis)

- Tamara Munzner; *Visualization Analysis and Design: Abstractions, Principles, and Methods*; A. K. Peters, 26 Nov 2014. ISBN 1466508914
- Matthew Ward, Georges Grinstein, and Daniel Keim; *Interactive Data Visualization*; 2nd Edition, CRC Press, 29 May 2015. ISBN 1482257378
- Christian Tominski and Heidrun Schumann; *Interactive Visual Data Analysis*; A. K. Peters, 30 Apr 2020. ISBN 0367898756
- Colin Ware; *Information Visualization: Perception for Design*; 4th Edition, Morgan Kaufmann, 11 Mar 2020. ISBN 0128128755

Videos

- Hans Rosling; *Stats that Reshape Your Worldview*; TED 2006 Talk, 22 Feb 2006.
  https://ted.com/talks/hans_rosling_the_best_stats_you_ve_ever_seen
- David McCandless; *The Beauty of Data Visualization*; TED Global 2010 Talk, 14 Jul 2010.
  https://ted.com/talks/david_mccandless_the_beauty_of_data_visualization
- Keith Andrews; *Illuminating Data Through Visualisation*; TEDxGraz Talk, 06 Nov 2015.
  https://youtu.be/fnyKj8r0CN4

Thank You!

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https://isds.tugraz.at/keith/

These slides:
https://keithandrews.com/talks/2022/2022-10-27-ivis-dh/

Course Notes on Information Visualisation:
https://courses.isds.tugraz.at/ivis/ivis.pdf