

Information Visualization: Tasks, Techniques, & Tools

SWEN422

Human Computer Interaction

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SWEN 422 – Lecture Schedule

- Week 6 – Information Visualization
- Week 7 – Information Visualization
- Week 8 – Information Visualization
- Week 9 – Gestural Interfaces
- Week 10 - AR/VR
- Week 11 - AR/VR
- Week 12 - no lectures (work on project)

https://ecs.wgtn.ac.nz/Courses/SWEN422_2024T1/LectureSchedule

Assignment 2

- Essay
- Review one paper
- Topics:
 - Information Visualization
 - Gestural Interfaces
 - AR/VR
- Length: 3 pages
- Assessment Weighting: 35%
- Due: **2359 Friday 17 May**

https://ecs.wgtn.ac.nz/Courses/SWEN422_2024T1/Assignment2

Assignment 3

- Design (e.g. personas, paper, Figma) and Develop visualizations (e.g. D3 / Unity / Unreal)
- x3 visualizations minimum
- Work in teams 2-4 people
 - Team Signup by **2359 Friday 26 April**
- No individuals
- Data set: COVID-19
- Assessment Weighting: 35%
- Due: **2359 Friday 14 June**

https://ecs.wgtn.ac.nz/Courses/SWEN422_2024T1/Assignment3

Assignment 3 Rubric

- **Team Project Code Grade: 15%**
 - Visualizations (60%)
 - Code Base (20%)
 - Video (20%)
- **Individual Final Report Grade: 20%**
 - Written Communication (25%)
 - Key Design Decisions (25%)
 - Justifications / Alternative Designs (25%)
 - Development Tools Critique (25%)

Proposal:

Assignment 2 and 3 Weightings

- Assignment 2 from 35% -> **30%**
- Assignment 3 from 35% -> **40%**
 - Individual Final Report 20% -> **25%**
 - Group Component 15% (stays same)

How Do We Visualize?

- **Know the Data**
 - Number of attributes
 - Date types: ordinal vs ordered (ordinal or quantitative)
 - Trustworthiness: bad fields, inaccuracies, missing values
- **Know your purpose (& audience)**
 - What do you/they want to see?
 - What might you/they want to focus on?
- **Decide how to use visual variables to encode the data**
 - Requires awareness of:
 - Human perceptual system
 - Display capacity
 - Characteristics of data (size, type)
 - Task

Information Visualization Reference Model

Data Management

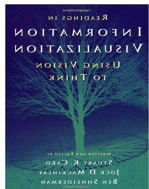
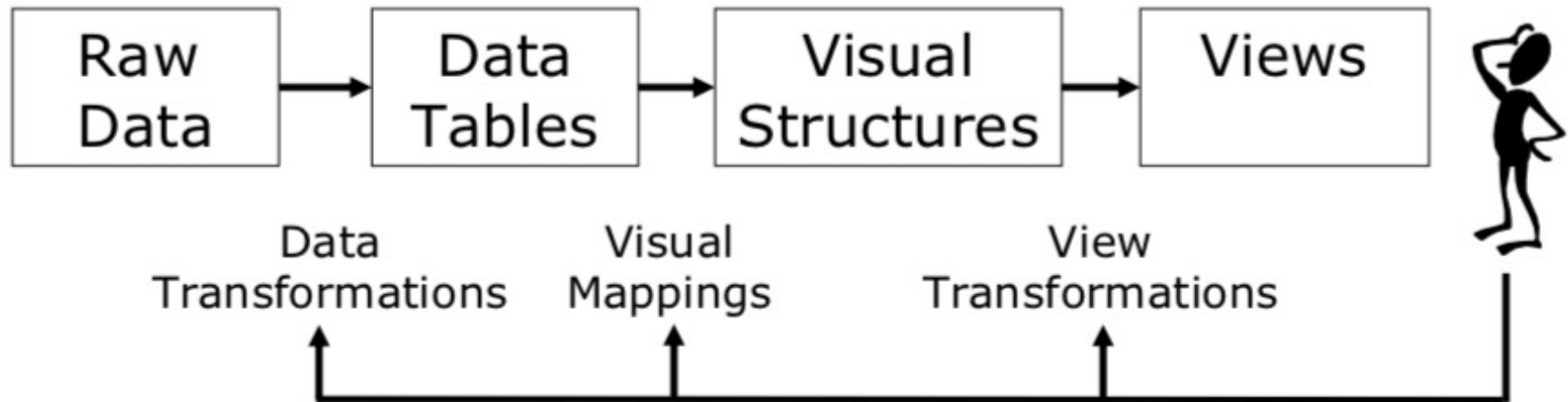
Contribute Data
Clean Data
Categorize Data
Moderate Data

Visualization

Select Data Sources
Apply Visual Encoding
Author Software

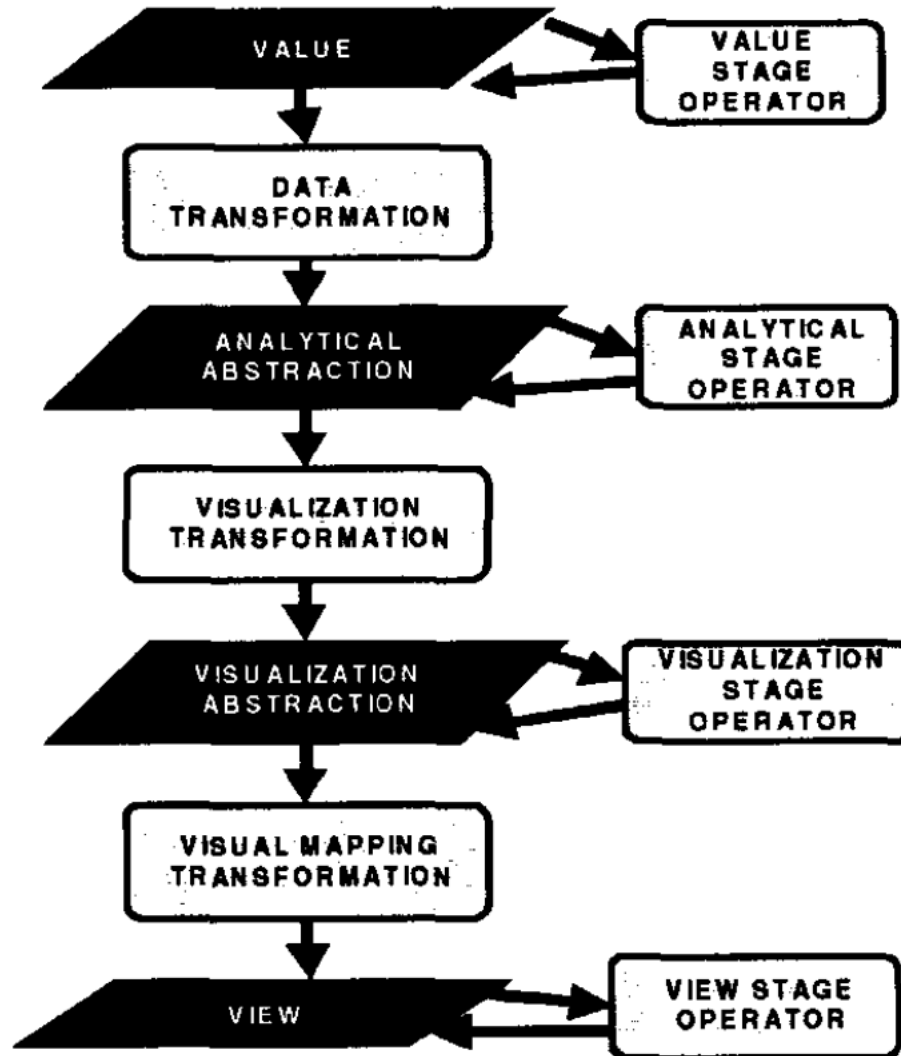
Visual Analytics

Observations
Hypotheses
Evidence (+/-)
Summarize
Report / Presentation



Readings in Information Visualization: Using Vision to Think
Card, Mackinlay, Shneiderman, 1999

Data State Model



Data Visualization Tasks

Information Seeking Mantra

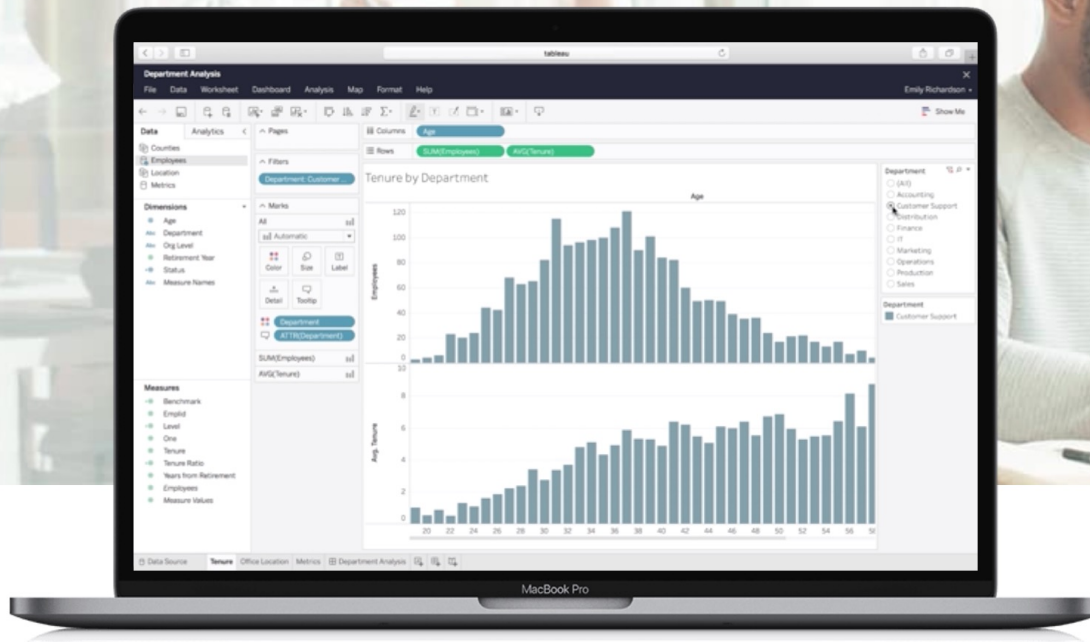
- **Overview:** Gain an overview of the entire collection.
- **Zoom :** Zoom in on items of interest.
- **Filter:** Filter out uninteresting items.
- **Details-on-demand:** Select an item or group and get details when needed.
- **Relate:** View relationships among items.
- **History:** Keep a history of actions to support undo, replay, and progressive refinement.
- **Extract:** Allow extraction of sub-collections and of the query parameters.

Tableau

Changing the way you think about data

THE TABLEAU PLATFORM

SEE IT IN ACTION



<https://www.tableau.com/>

<https://www.tableau.com/academic/students>

<https://public.tableau.com/s/>

PowerBI

Sales Report Option 1 - Power BI Desktop Nitin Khanna (MSIT)

File **Home** Insert Modeling View Help

Clipboard: Paste, Cut, Copy, Format painter
 Data: Get data, Excel, Power BI datasets, SQL Server, Enter data, Recent sources
 Queries: Transform data, Refresh data
 Insert: New visual, Text box, More visuals
 Calculations: New measure, Quick measure
 Share: Publish

OVERVIEW Sales Report

\$5.3M Australia \$5.3M Canada \$2.6M France \$2.3M Germany \$3.3M UK \$21.8M USA

Key influencers Top segments

What influences NSAT to be 7 ?

When... ..the likelihood of NSAT being 7 increases by

- UnitPrice is 298 - 299.9 → 10.20x
- UnitPrice is 196.9 - 199 → 6.58x
- Manufacturer is Litware, Inc. → 2.64x
- Color is Brown → 2.57x
- StockType is High → 1.96x
- Manufacturer is Contoso, Ltd → 1.34x
- Color is Silver → 1.29x

Units by Country and Sales Size

Country	Units
United States	~45K
Canada	~10K
Australia	~8K
Great Britain	~5K
France	~3K
Germany	~2K

Sales Amount by Brand Name

Brand Name	Sales Amount
Contoso	\$9M
Adventure Works	\$6M
Proseware	\$5M
Fabrikam	\$5M
Wide World Importers	\$5M
Southridge Video	\$2M
Litware	\$5M
A. D...	\$2M
Northw...	\$1M

Units Sold by Year, Quarter and Manufacturer

2014 Qtr 1, 2014 Qtr 2, 2014 Qtr 3, 2014 Qtr 4

Sales Amount by Year, Month and Brand Name

2013 February, Contoso, Proseware, Adventure Works, Other, Wide World Import..., 2013 March

Visualizations: Bar, Line, Pie, Map, etc.
 Filters: Add data fields here
 Drill through: Cross-report, Off, Keep all filters

Overview +

Page 1 of 1

Tour Through Visualization Zoo

- **Time-Series Data:** index charts, stacked charts, small multiples, horizon graphs
- **Statistical Distributions:** histograms, stem and leaf, Q-Q plots, scatter plot matrix, parallel coordinates
- **Maps:** cartography, flowmaps, choropleth, graduated symbol maps, cartograms
- **Hierarchies:** node-link, indented trees, adjacency diagrams, enclosure diagrams, dendrogram, sunburst, treemaps
- **Networks:** graphs, force-directed, arc diagrams, matrix diagrams

<https://queue.acm.org/detail.cfm?id=1805128>

A Brief History of Data Visualization - <https://www.youtube.com/watch?v=N00g9Q9stBo>

A PERIODIC TABLE OF VISUALIZATION METHODS

>☀< C continuum	<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Data Visualization Visual representations of quantitative data in schematic form (either with or without axes)</p> <p>Information Visualization 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</p> <p>Concept Visualization Methods to elaborate (mostly) qualitative concepts, ideas, plans, and analyses.</p> </div> <div style="width: 45%;"> <p>Strategy Visualization The systematic use of complementary visual representations in the analysis, development, formulation, communication, and implementation of strategies in organizations.</p> <p>Metaphor Visualization 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</p> <p>Compound Visualization The complementary use of different graphic representation formats in one single schema or frame</p> </div> </div>												☀ G graphic facilitation						
>☀< Tb table	>☀< Ca cartesian coordinates													>☀< Me meeting trace	>☀< Mm metro map	☀ Tm temple	<☀> St story template	>☀< Tr tree	☐ Ct cartoon
>☀< Pi pie chart	>☀< L line chart													>☀< Co communication diagram	>☀< Fp flight plan	>☀< Cs concept sceleton	☀ Br bridge	>☀< Fu funnel	☀ Ri rich picture
>☀< B bar chart	>☀< Ac area chart	>☀< R radar chart cobweb	>☀< Pa parallel coordinates	>☀< Hy hyperbolic tree	>☀< Cy cycle diagram	>☀< T timeline	>☀< Ve venn diagram	<☀> Mi mindmap	<☀> Sq square of oppositions	>☀< Cc concentric circles	>☀< Ar argument slide	>☀< Sw swim lane diagram	>☀< Gc gant chart	<☀> Pm perspectives diagram	>☀< D dilemma diagram	<☀> Pr parameter ruler	☀ Kn knowledge map		
>☀< Hi histogram	>☀< Sc scatterplot	>☀< Sa sankey diagram	>☀< In information lense	>☀< E entity relationship diagram	>☀< Pt petri net	>☀< Fl flow chart	<☀> Cl clustering	>☀< Lc layer chart	>☀< Py minto pyramid technique	>☀< Ce cause-effect chains	>☀< Tl toulmin map	>☀< Dt decision tree	>☀< Cp cpm critical path method	<☀> Cf concept fan	>☀< Co concept map	☀ Ic iceberg	☀ Lm learning map		
>☀< Tk tukey box plot	>☀< Sp spectrogram	>☀< Da data map	>☀< Tp treemap	>☀< Cn cone tree	>☀< Sy system dyn./simulation	>☀< Df data flow diagram	<☀> Se semantic network	>☀< So soft system modeling	☀ Sn synergy map	<☀> Fo force field diagram	>☀< Ib ibis argumentation map	>☀< Pr process event chains	>☀< Pe pert chart	<☀> Ev evocative knowledge map	>☀< V Vee diagram	<☀> Hh heaven 'n' hell chart	☀ I informal		

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.

© Ralph Lengler & Martin J. Eppler, www.visual-literacy.org

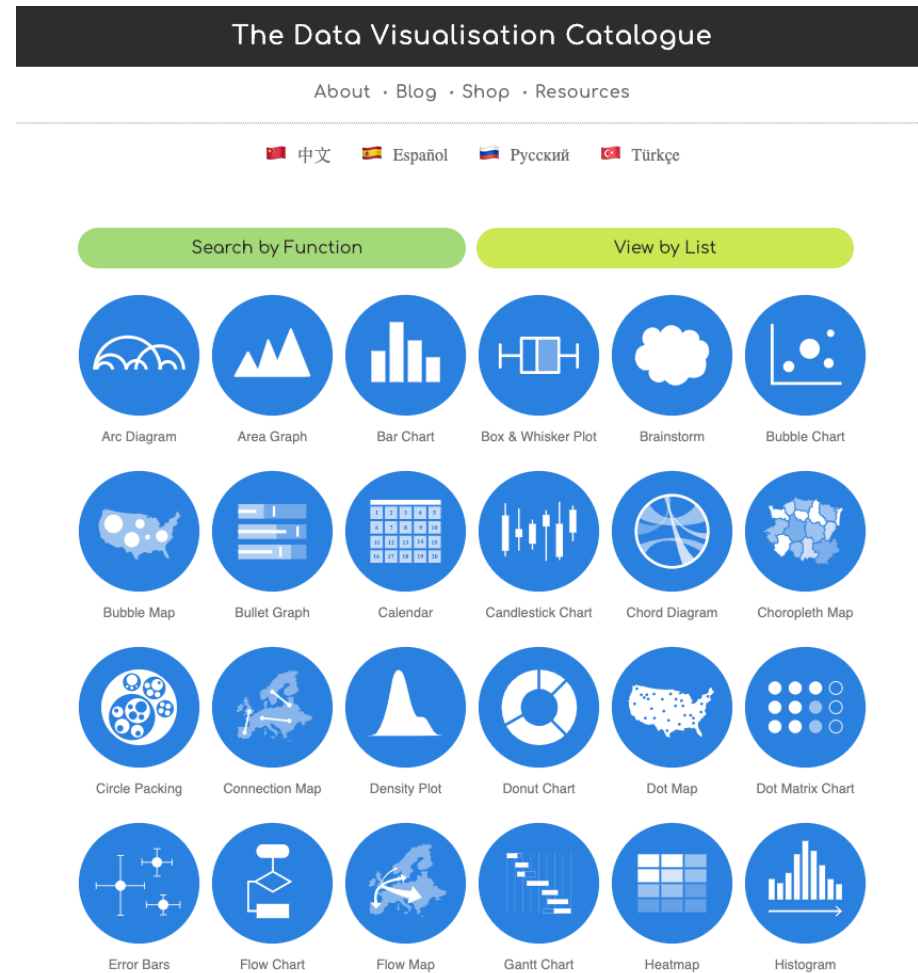
version 1.5

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

https://www.visual-literacy.org/periodic_table/periodic_table.html

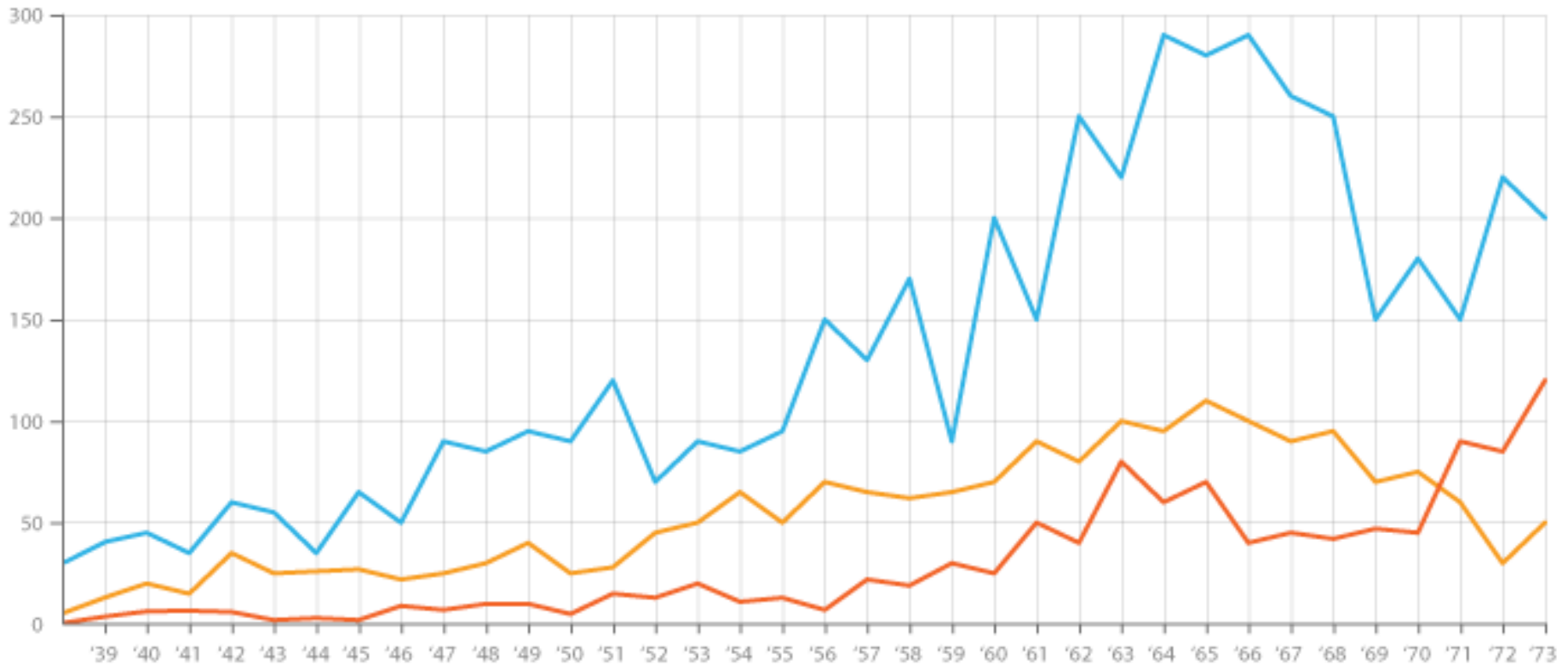
DataViz Catalogue

- Graphs/Plots
- Diagrams
- Tables
- Other
- Maps/Geographical



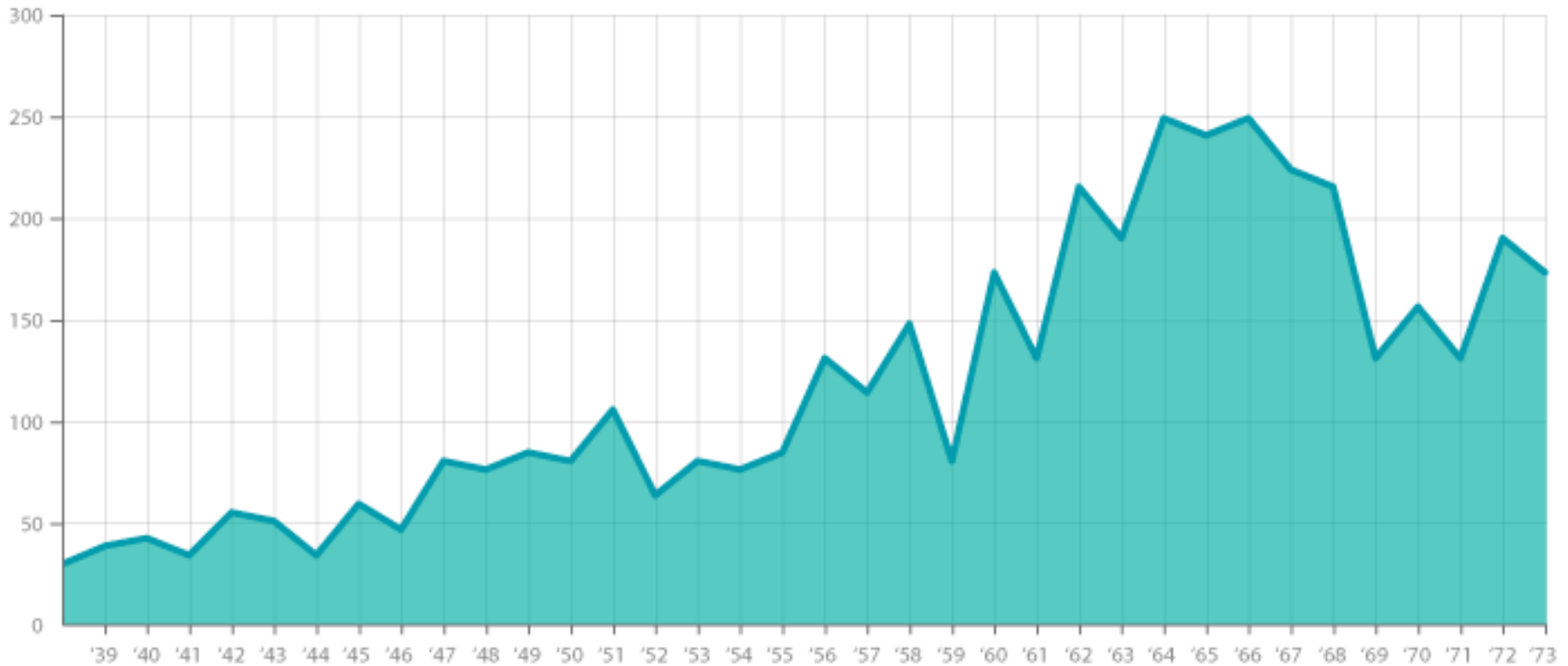
<https://datavizcatalogue.com>

Line Graph



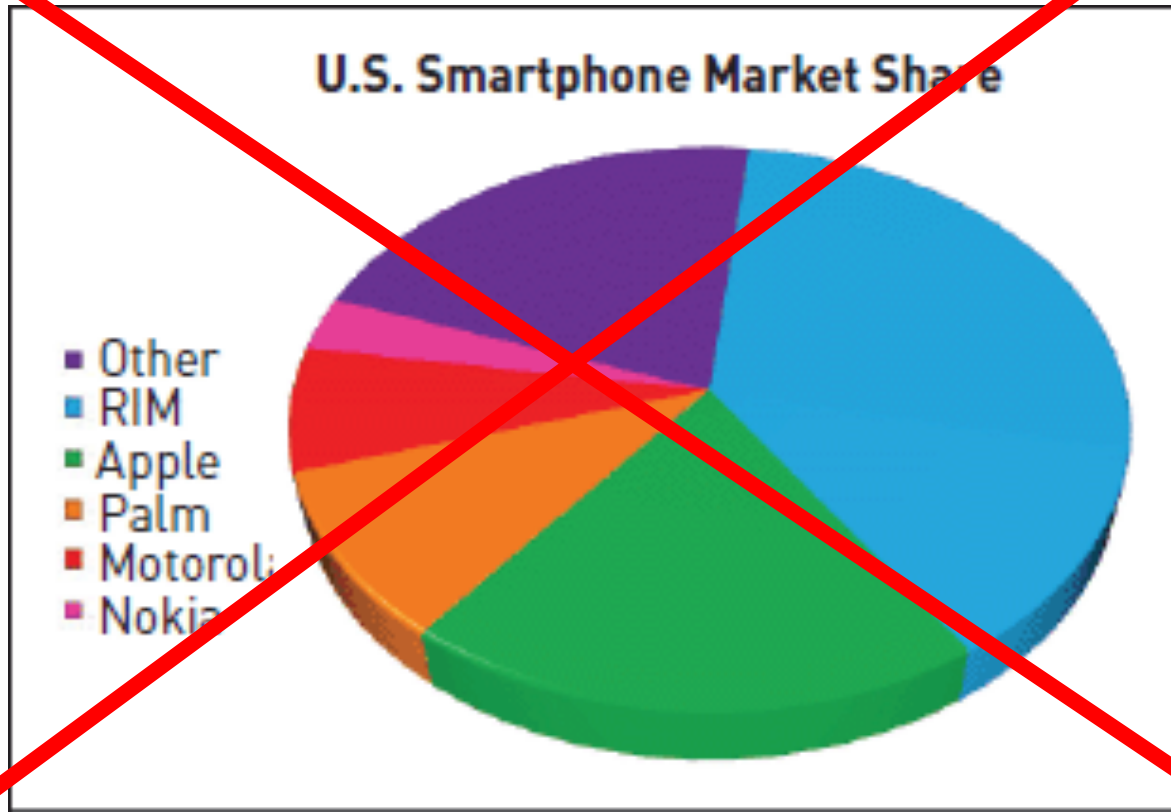
https://datavizcatalogue.com/methods/line_graph.html

Area Chart



https://datavizcatalogue.com/methods/area_graph.html

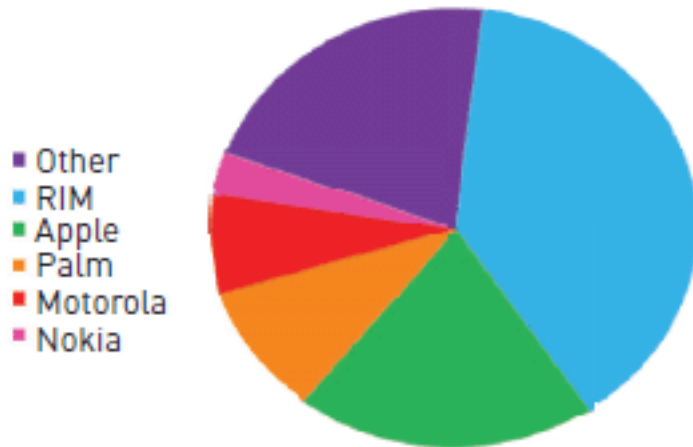
Pie Chart



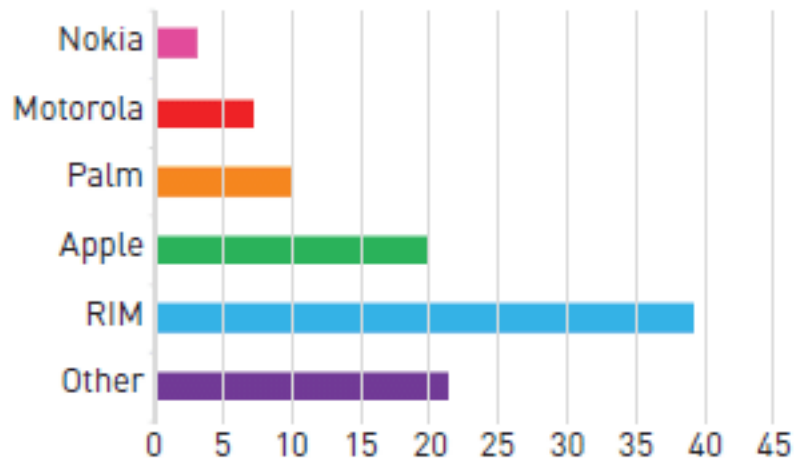
https://datavizcatalogue.com/methods/pie_chart.html

Pie Chart

U.S. Smartphone Market Share

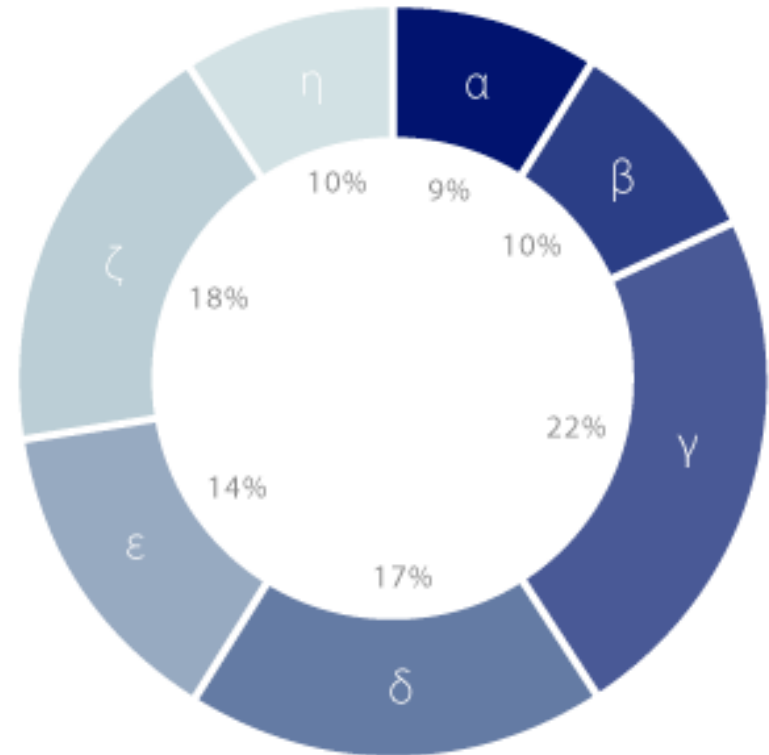
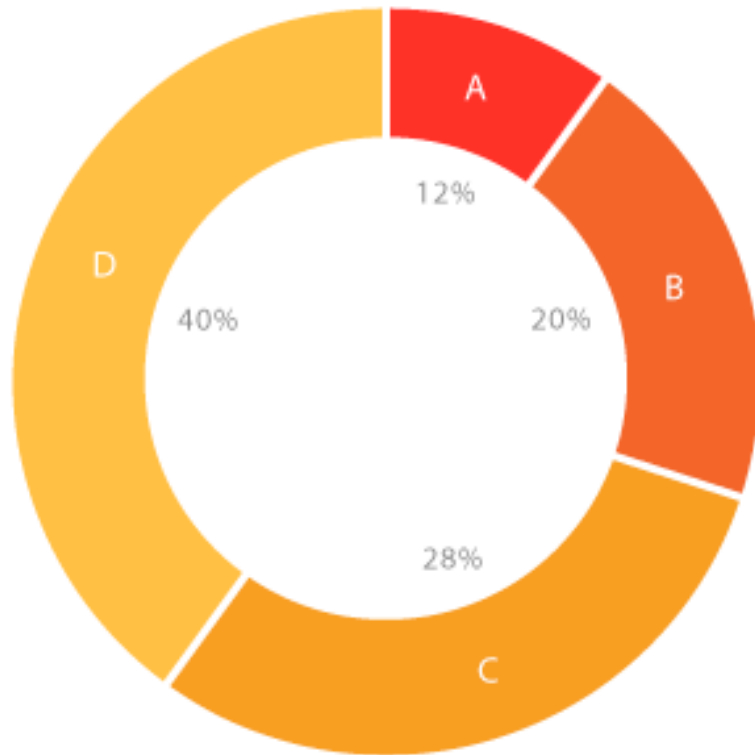


U.S. Smartphone Market Share



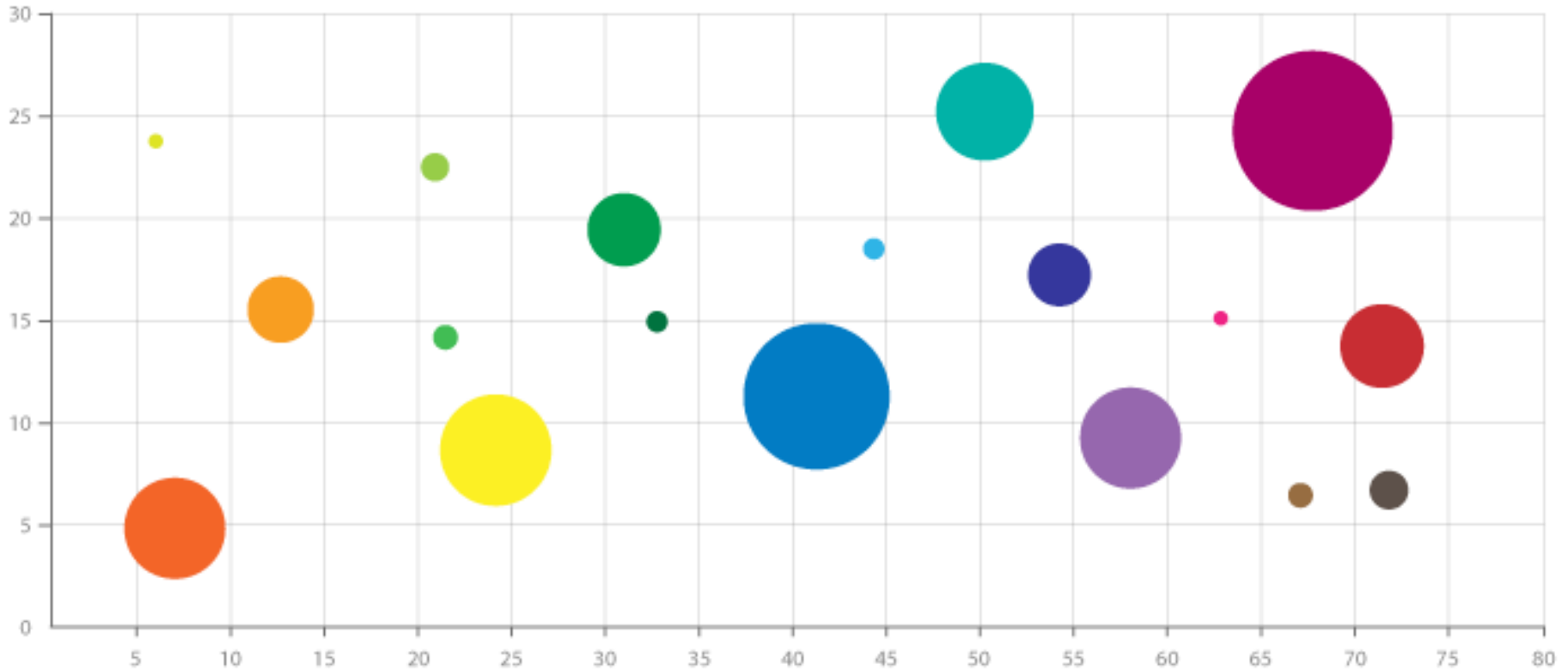
- Cannot show more than a few values, because as the number of values shown increases, the size of each segment/slice becomes smaller.
- They take up more space than their alternatives, due to their size and for the usual need for a legend.
- They are not great for making accurate comparisons between groups of Pie Charts. This being that it is harder to distinguish the size of items via area when it is for length.

Donut Chart



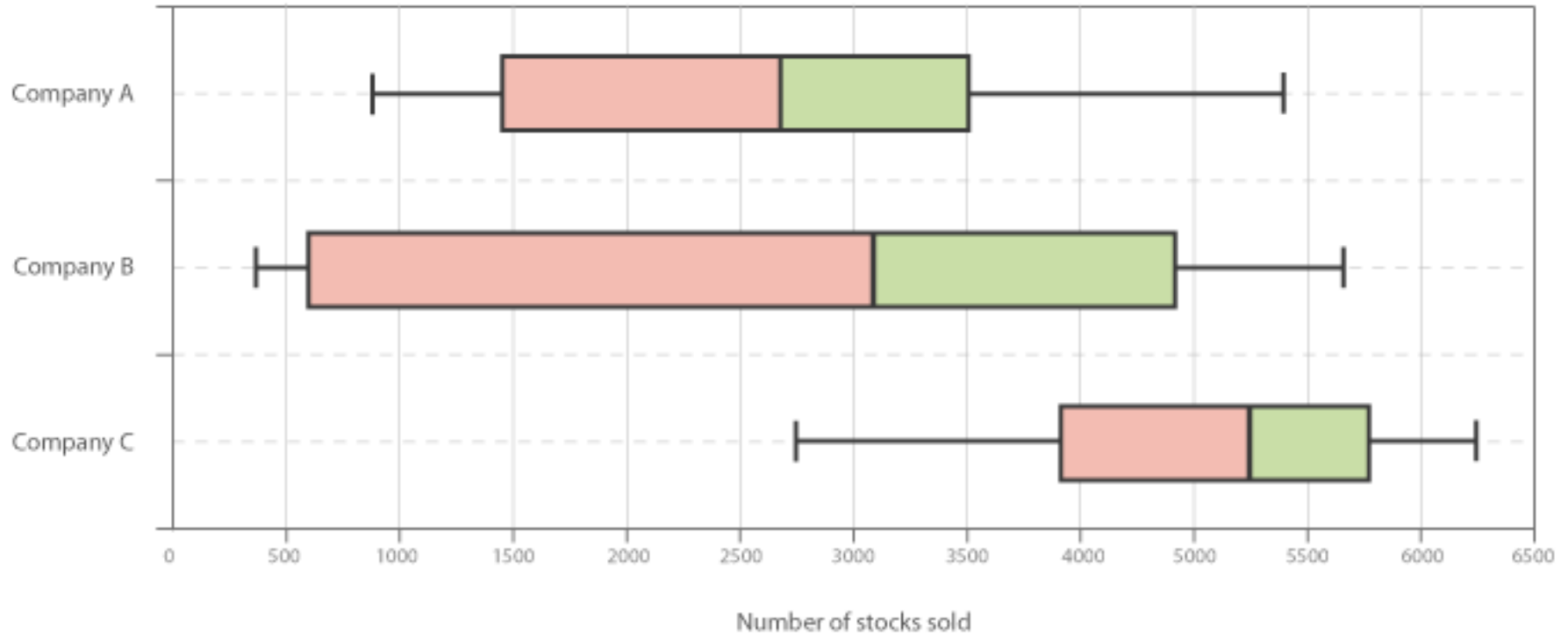
https://datavizcatalogue.com/methods/donut_chart.html

Bubble Chart



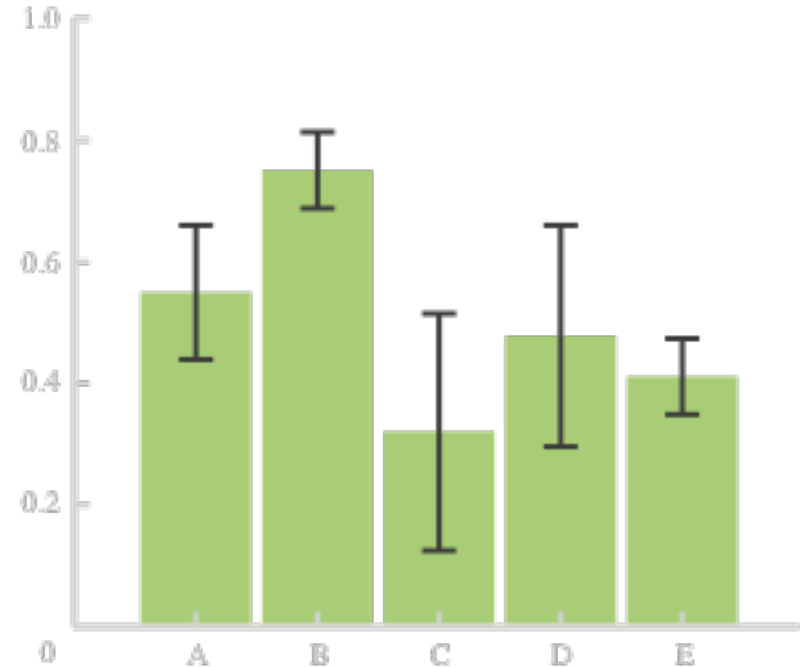
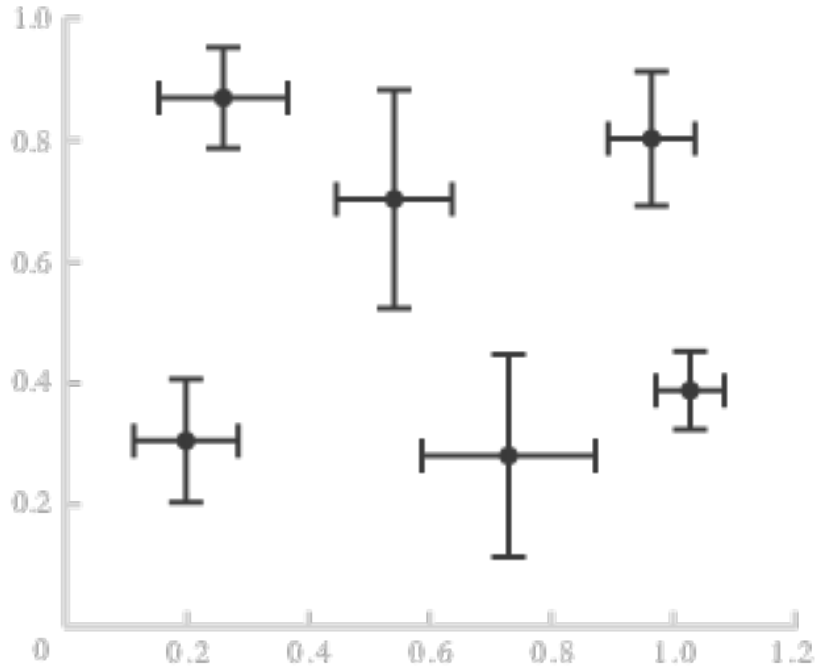
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Box and Whisker Plot



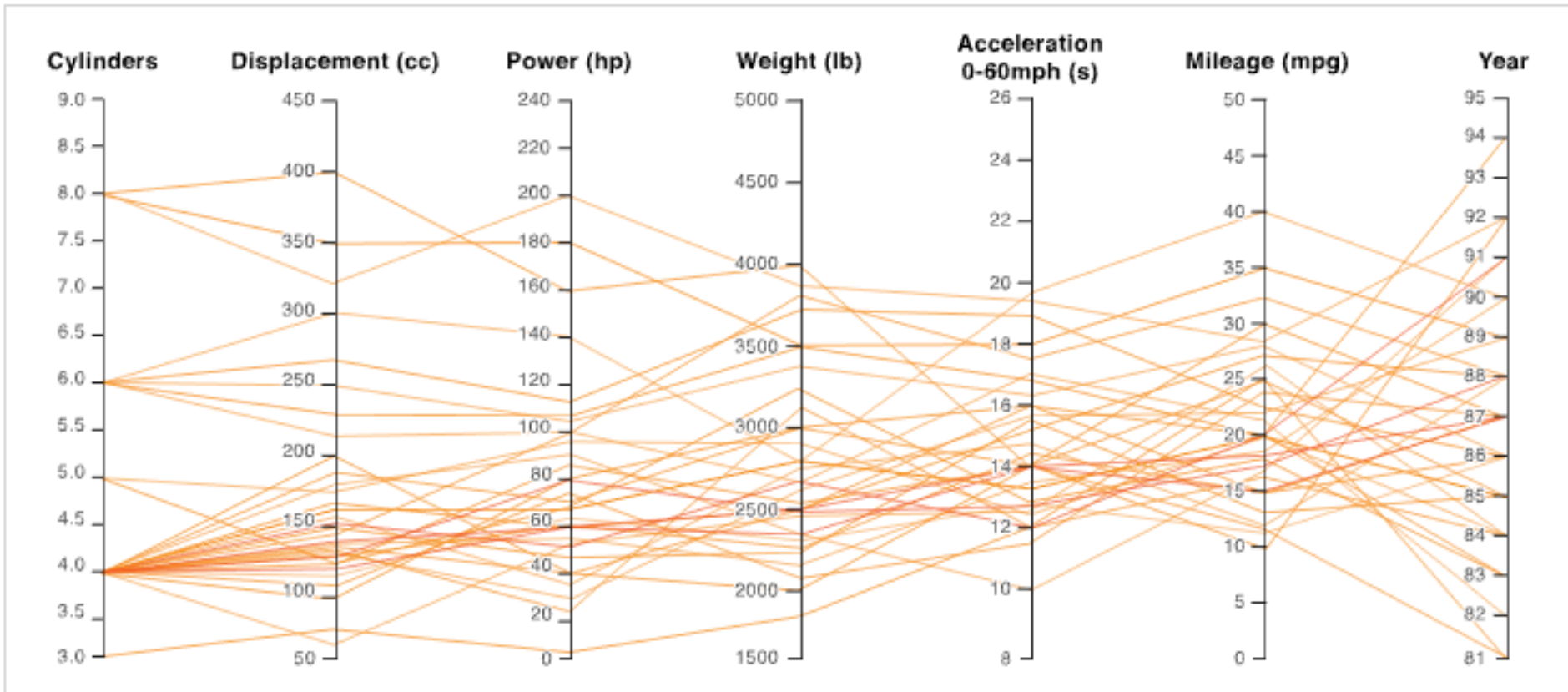
https://datavizcatalogue.com/methods/box_plot.html

Error Bars



https://datavizcatalogue.com/methods/error_bars.html

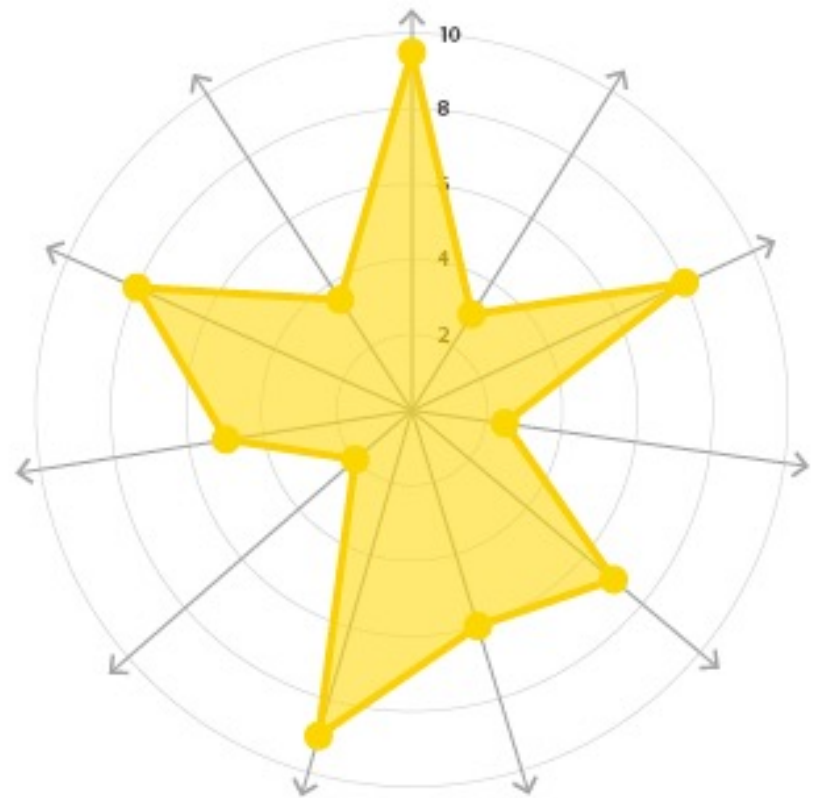
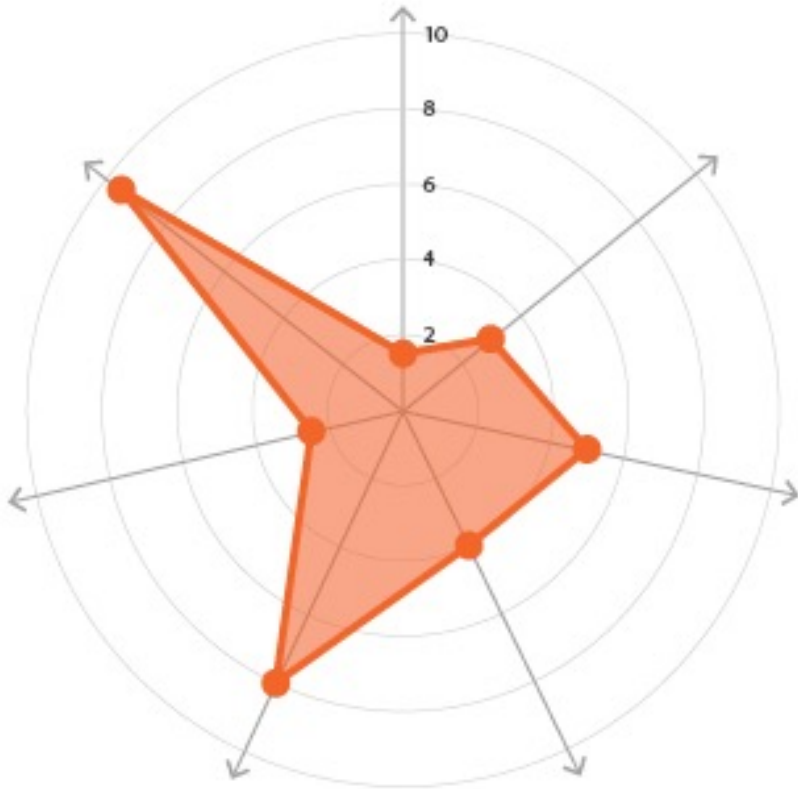
Parallel Coordinates Plot



https://datavizcatalogue.com/methods/parallel_coordinates.html

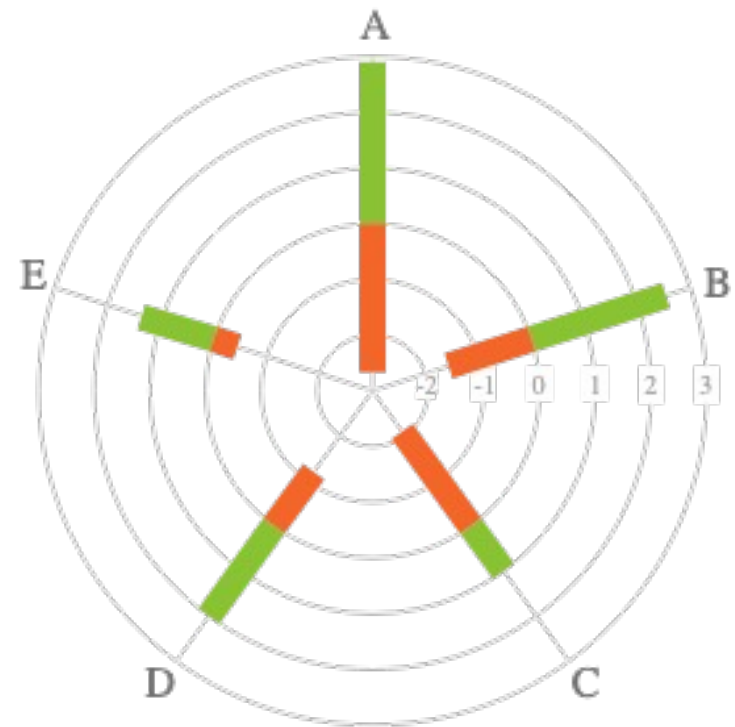
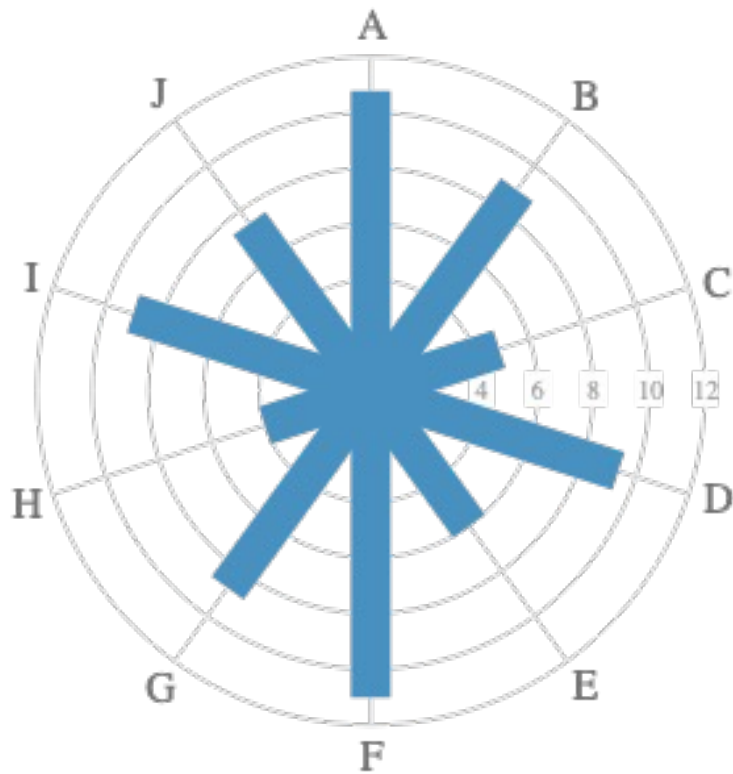
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Radar Chart



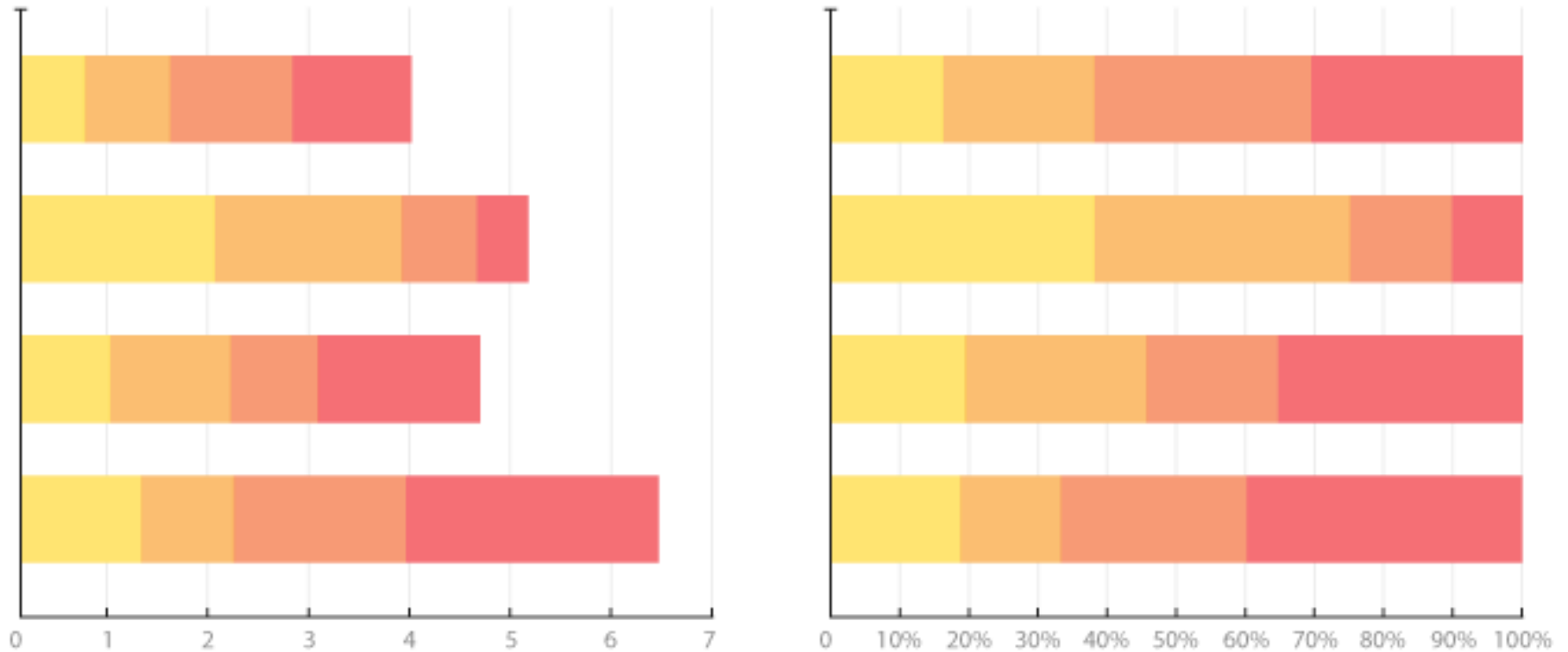
https://datavizcatalogue.com/methods/radar_chart.html

Radial Chart



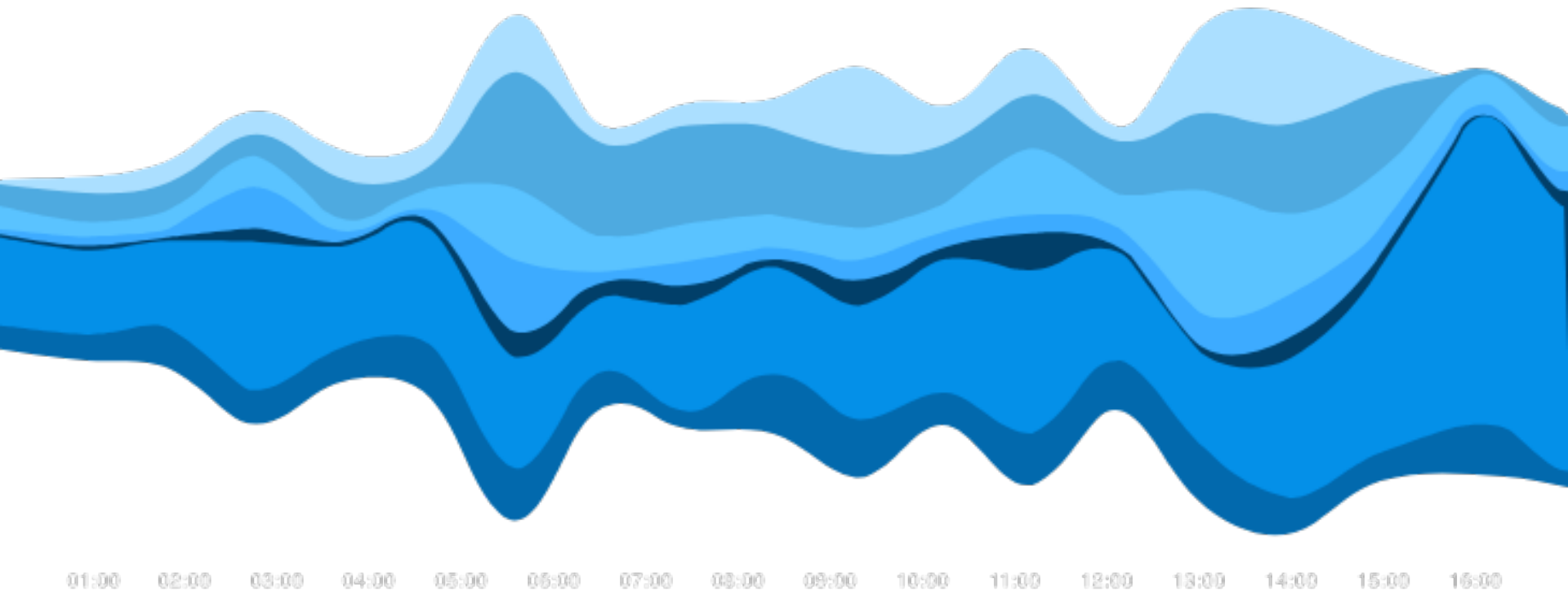
https://datavizcatalogue.com/methods/radial_column_chart.html

Stacked Bar Graph



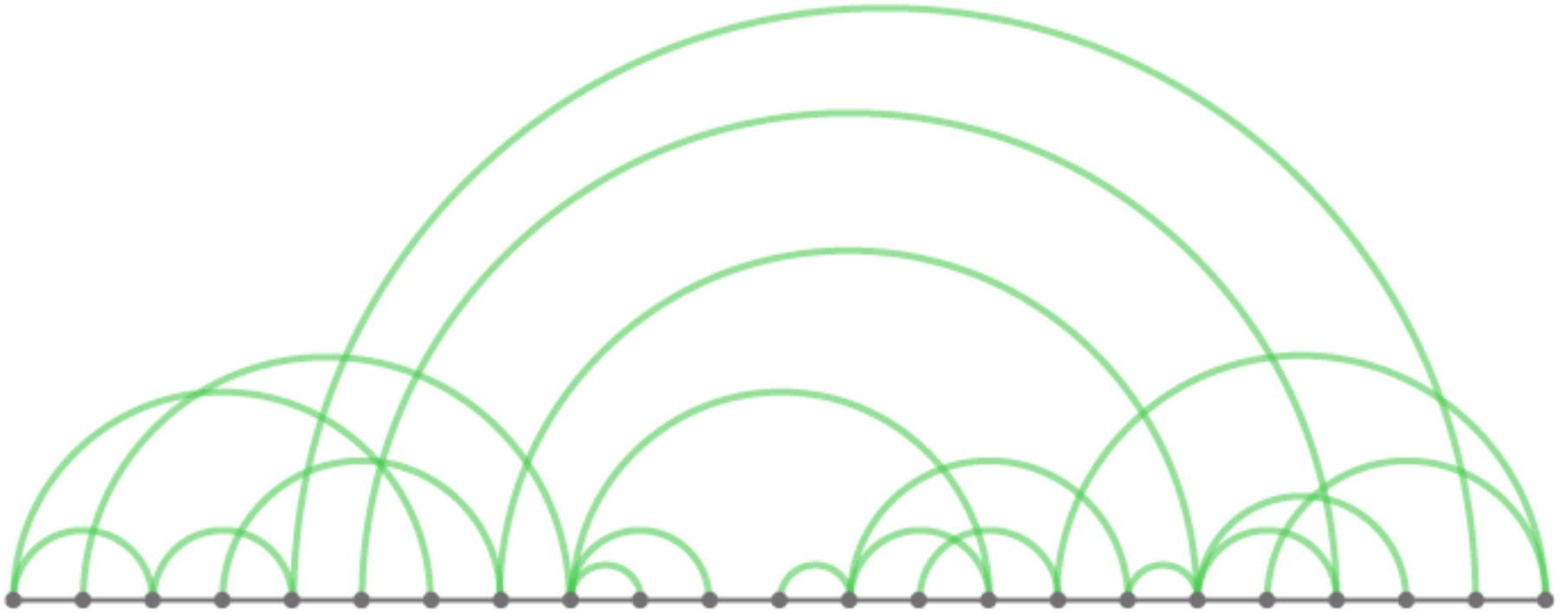
https://datavizcatalogue.com/methods/stacked_bar_graph.html

Steam Graphs



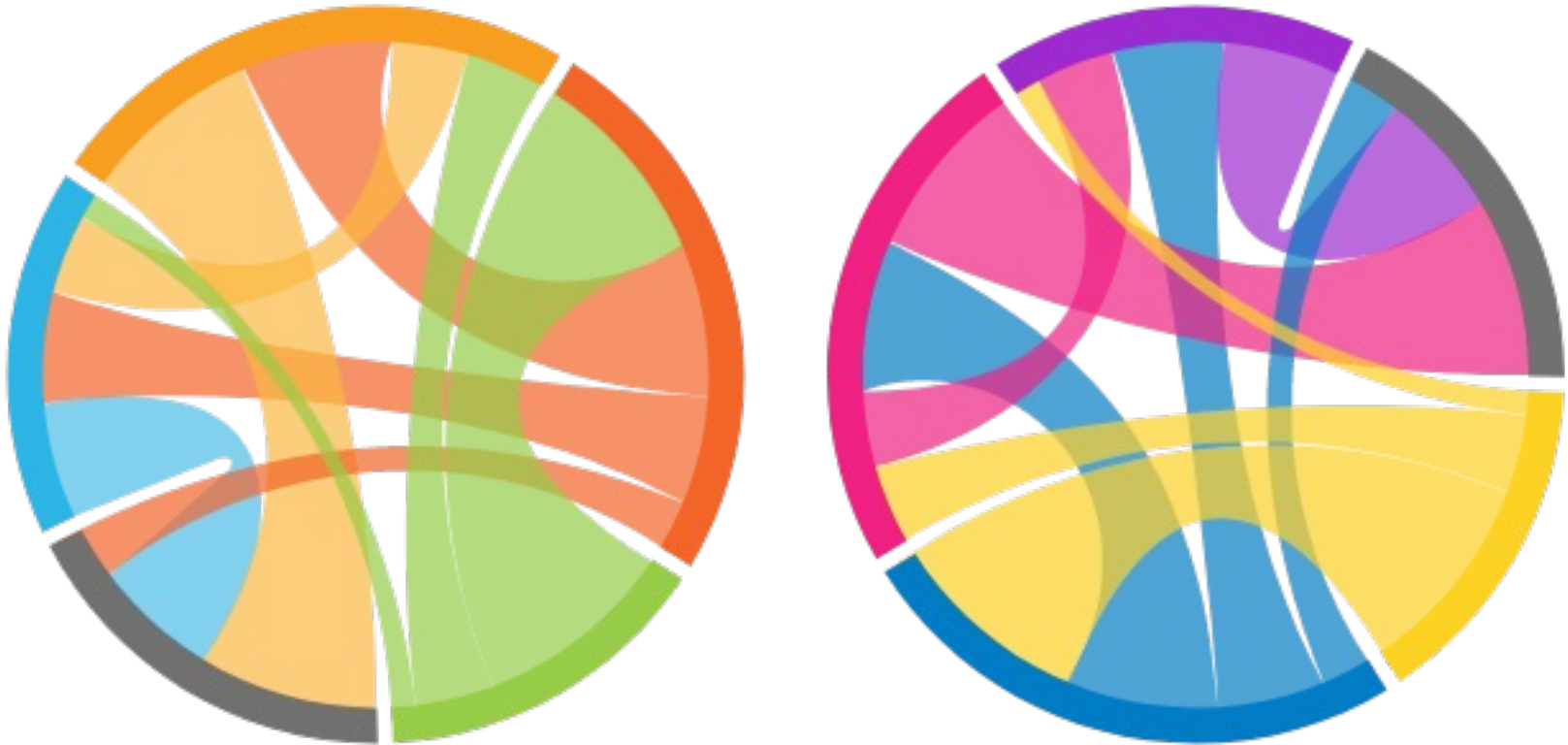
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Arc Diagrams



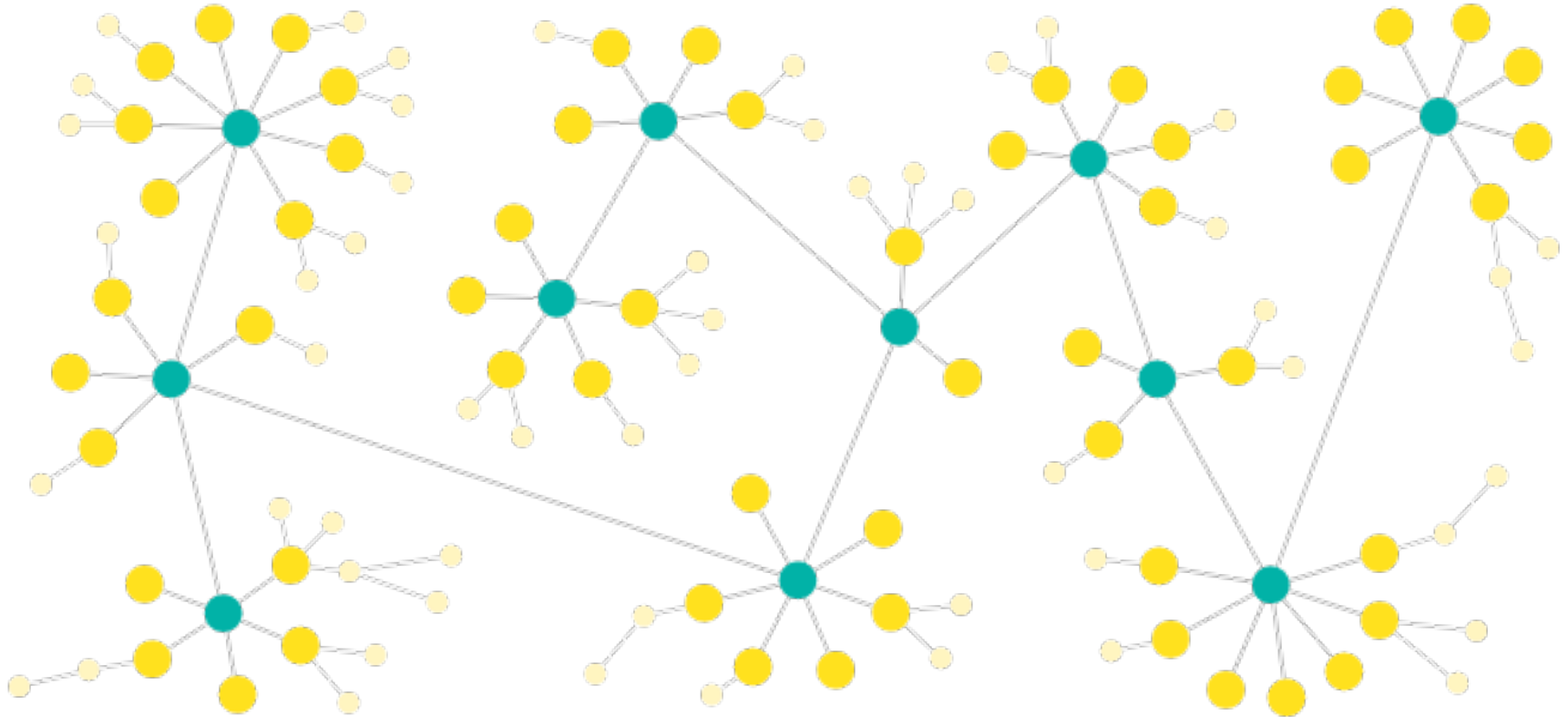
https://datavizcatalogue.com/methods/arc_diagram.html

Chord Diagram



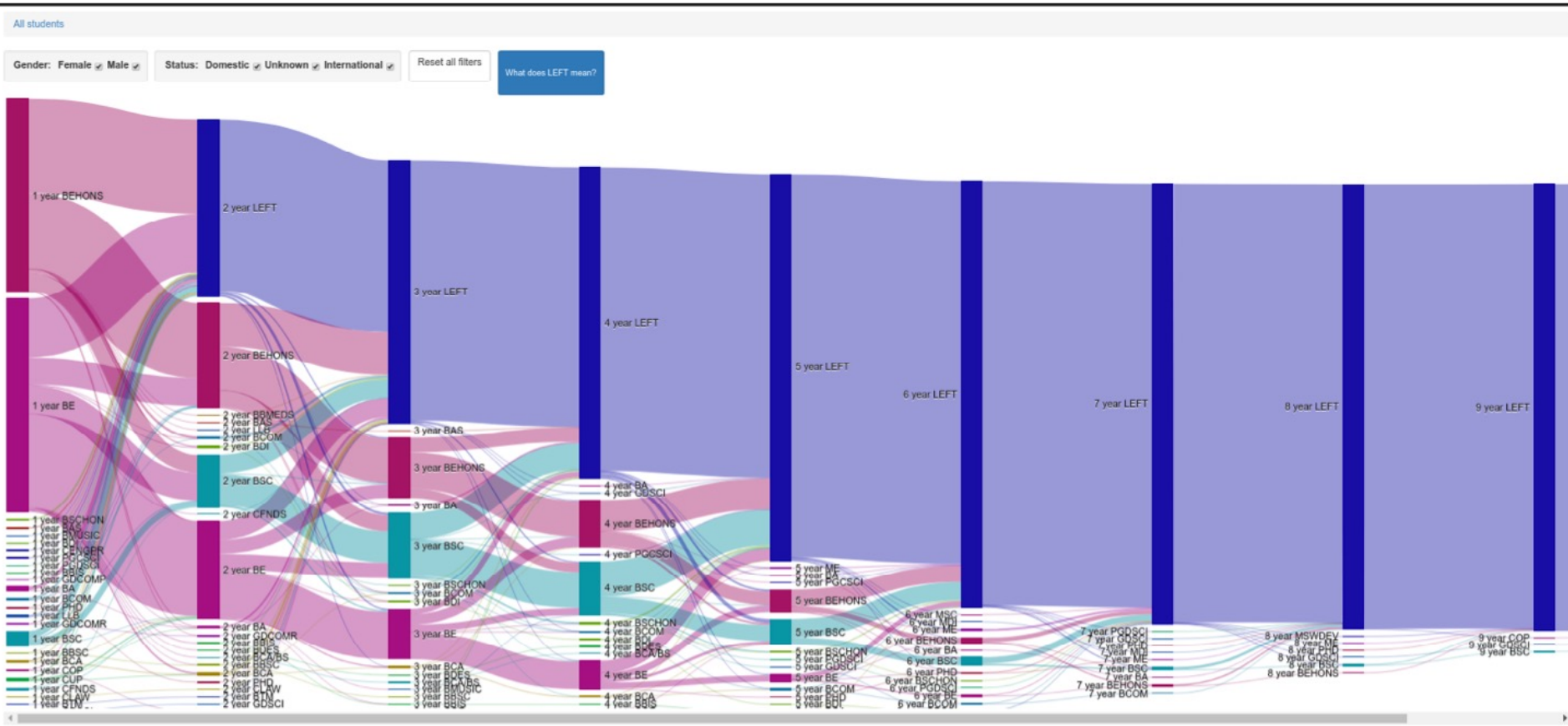
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Network Diagram



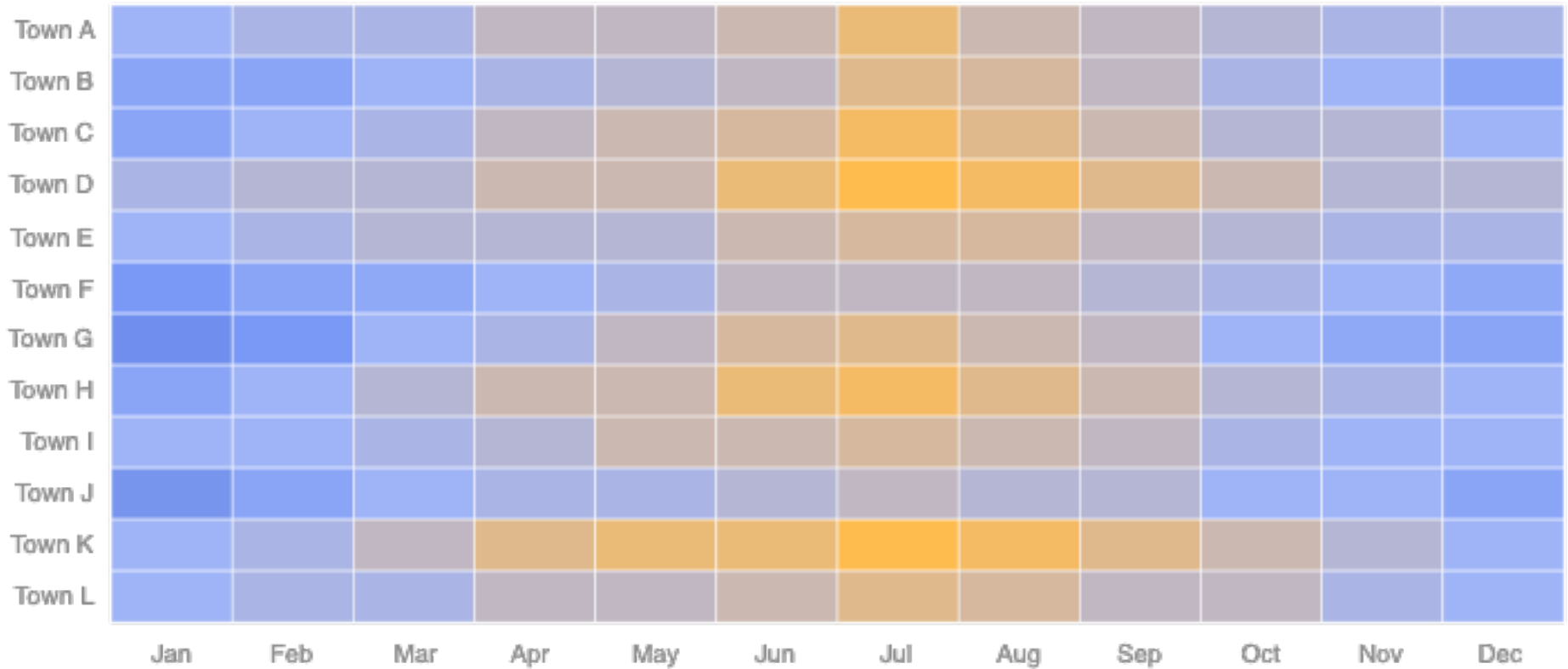
https://datavizcatalogue.com/methods/network_diagram.html

Sankey Diagram



https://datavizcatalogue.com/methods/sankey_diagram.html

Heatmap (Matrix)



<https://datavizcatalogue.com/methods/heatmap.html>

Stem and Leaf Plot

Northbound	Hour	Southbound
45 20 03	5	05 48
55 49 32 20 13 01	6	02 23 35 57
58 53 49 44 38 32 25 19 13 08 02	7	00 07 16 20 26 30 37 46 52 59
59 57 54 50 47 44 39 35 31 28 24 21 18 14 09 05 00	8	01 08 12 17 21 29 31 35 39 44 49 53 58
52 48 44 39 34 29 23 18 12 05	9	03 10 18 27 32 37 45 51 58
53 47 41 37 32 27 22 15 07	10	00 07 14 21 30 39 48 57
55 49 35 29 23 16 08 01	11	06 11 19 27 34 41 50 59
56 48 44 39 32 27 21 14 05	12	02 15 30 45 57
50 45 35 30 25 20 15 05	13	03 10 18 23 29 37 45 56
52 43 32 24 12 03	14	00 09 18 27 39 48 57
58 44 31 26 15 06	15	01 17 29 41 55
56 40 30 22 11	16	10 25 38 50
55 41 32 23 14 01	17	00 20 34 53
58 49 42 36 28 22 16 09	18	05 14 21 29 37 45 56
57 51 46 39 33 28 23 17 13 08 02	19	02 09 14 19 23 27 32 36 40 44 48 53 57
52 43 30 21 15 06	20	09 17 26 34 40 49 55
45 30 16 03	21	10 20 30 40 50
50 30 10	22	15 35 55

https://datavizcatalogue.com/home_list.html

Dot Matrix Chart

Bedfordshire



Cambridgeshire



Cheshire



Cornwall



Cumbria



Derbyshire



Devon



Durham



Essex



Herefordshire



Hertfordshire

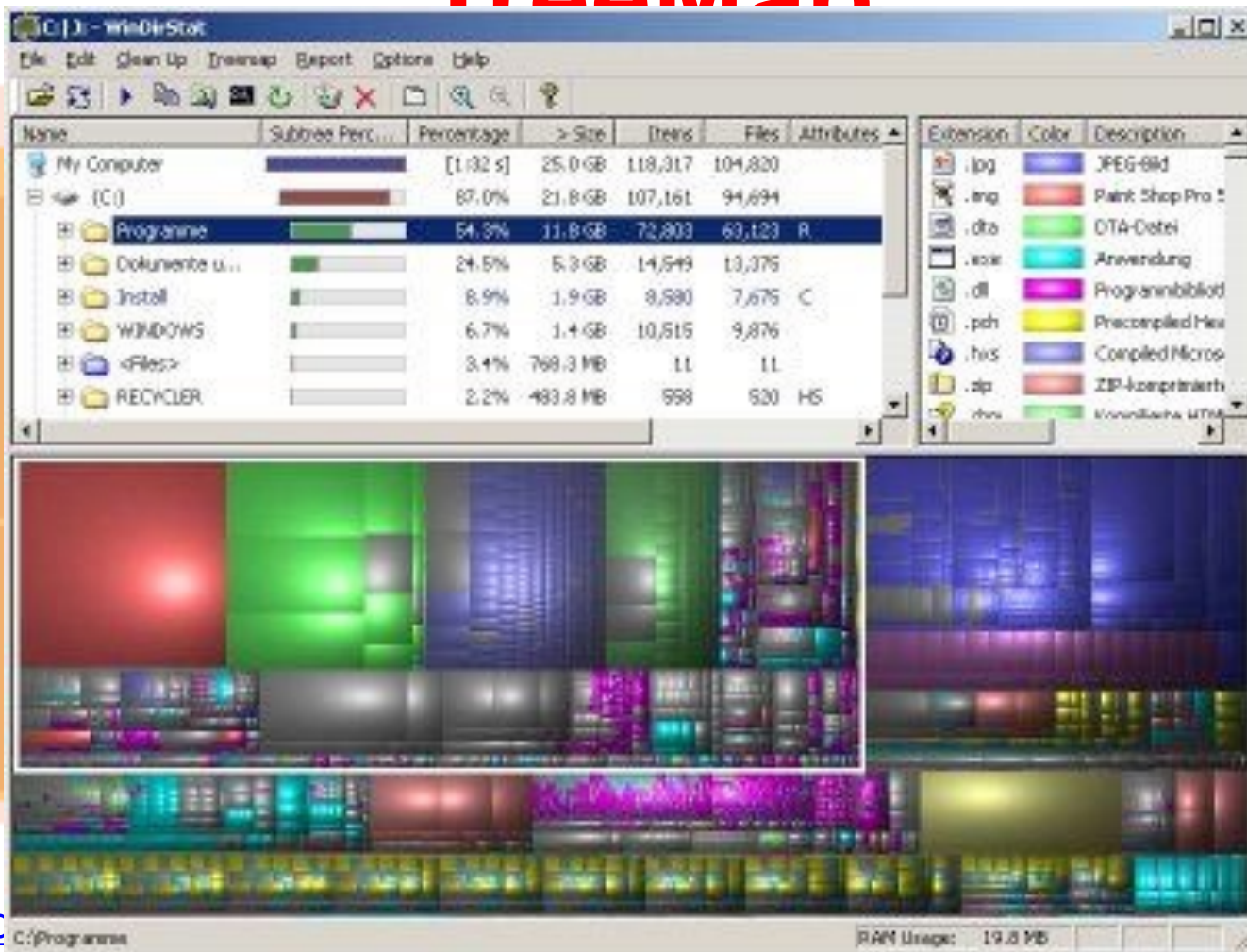


Lancashire



https://datavizcatalogue.com/methods/dot_matrix_chart.html

TreeMan



Zebra Finches

Budgerigars

Reptiles

Geckos

Snakes

Chameleon

Bearded Dragon

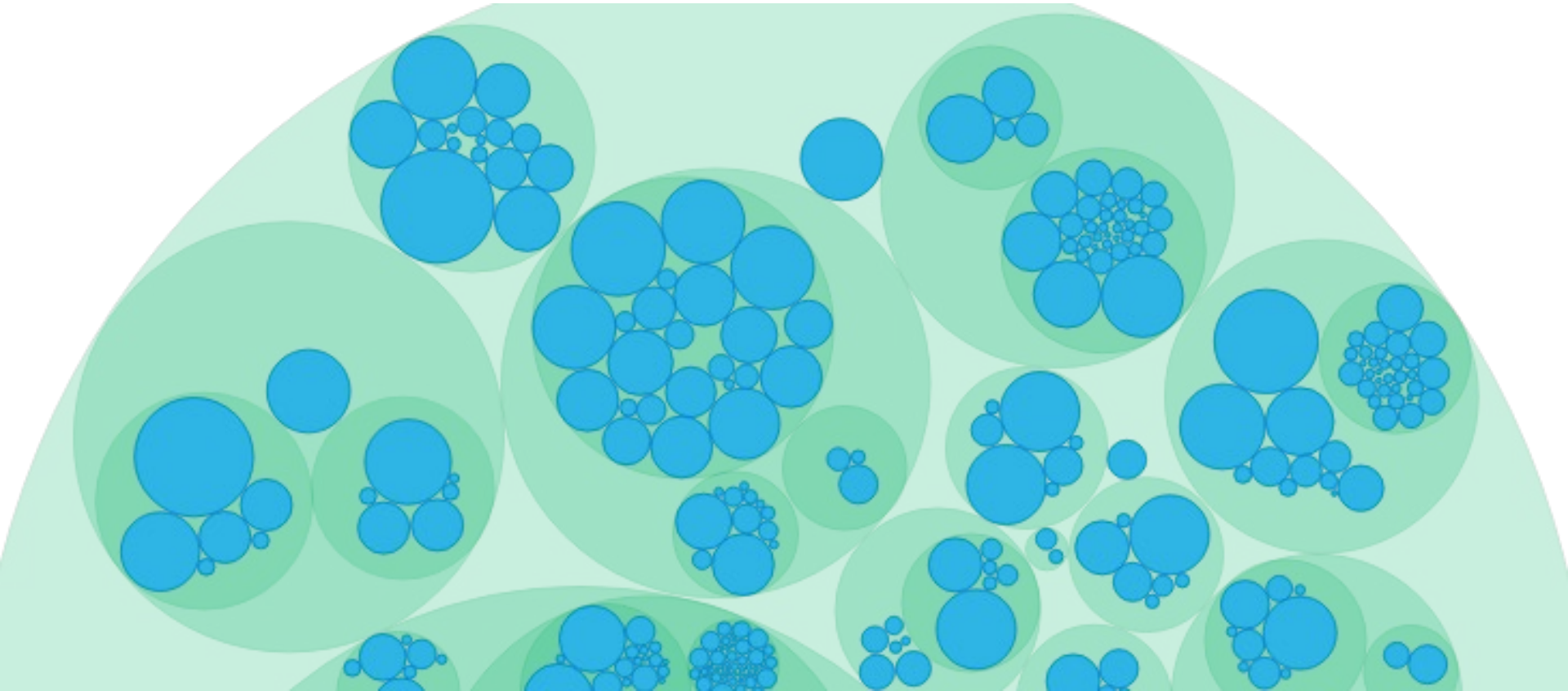
Monitor

<https://c>
<http://www.cs.umd.edu/hcil/treemap-history/index.shtml>

Tree visualization with tree-maps: 2-d space-filling approach

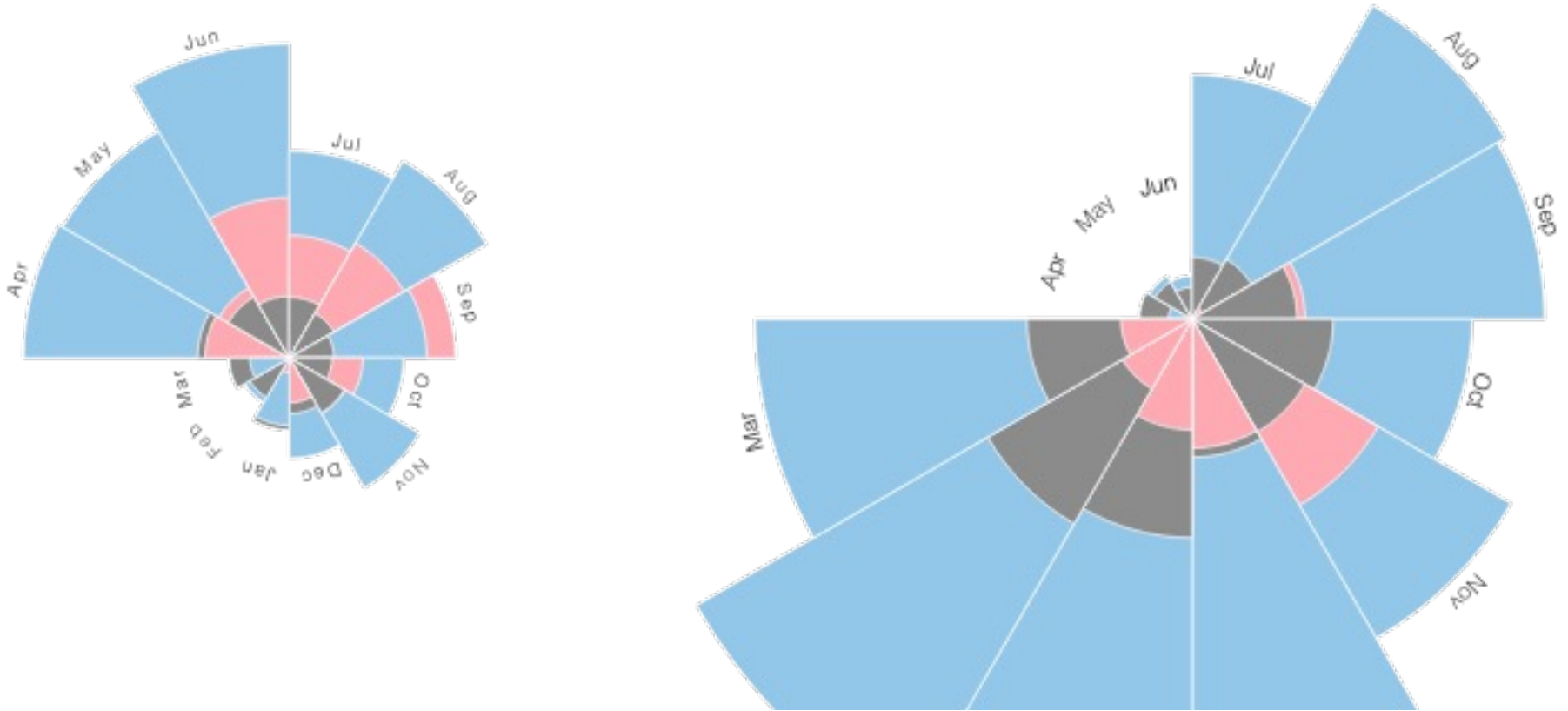
<https://doi.org/10.1145%2F102377.115768>

Circle Packing



https://datavizcatalogue.com/methods/circle_packing.html

Rose Chart



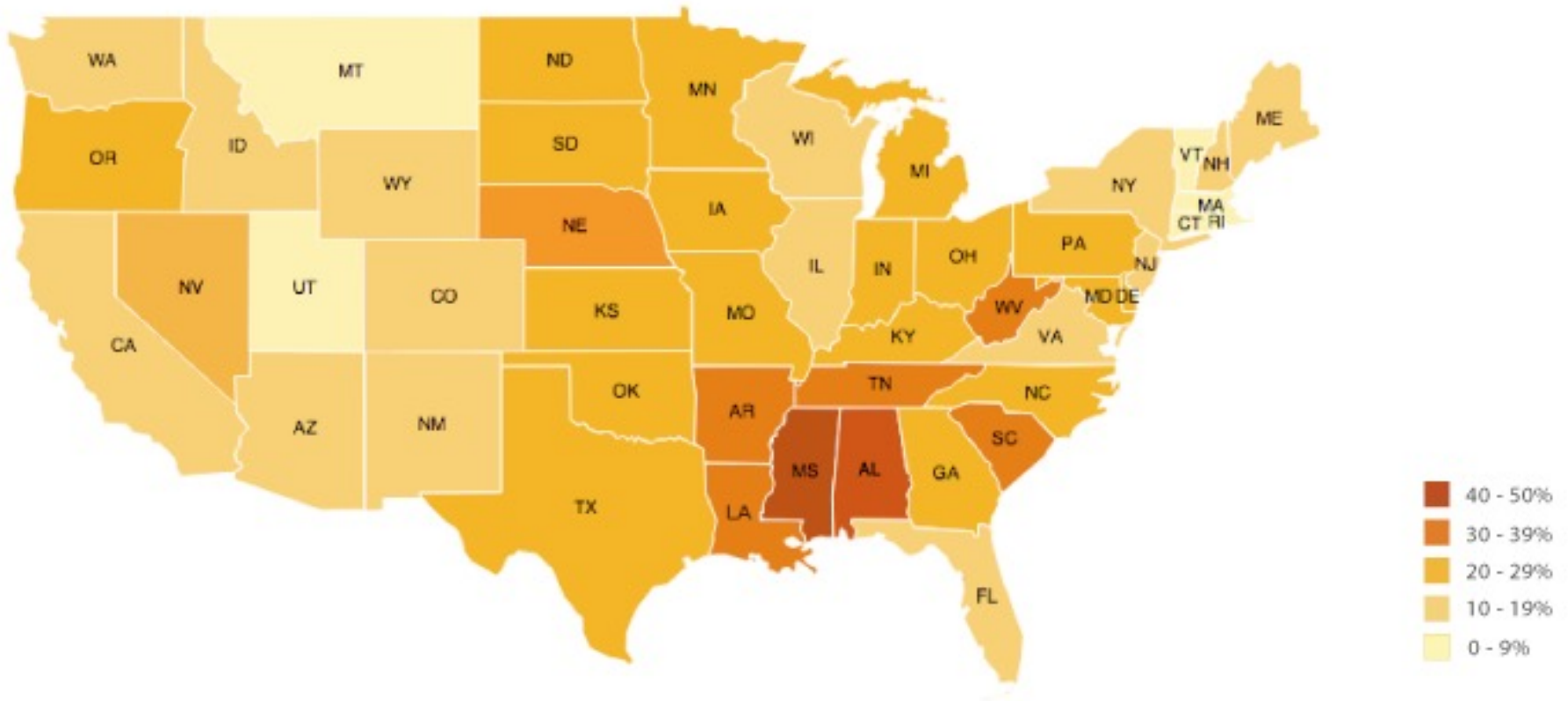
https://datavizcatalogue.com/methods/nightingale_rose_chart.html

Sunburst Diagram



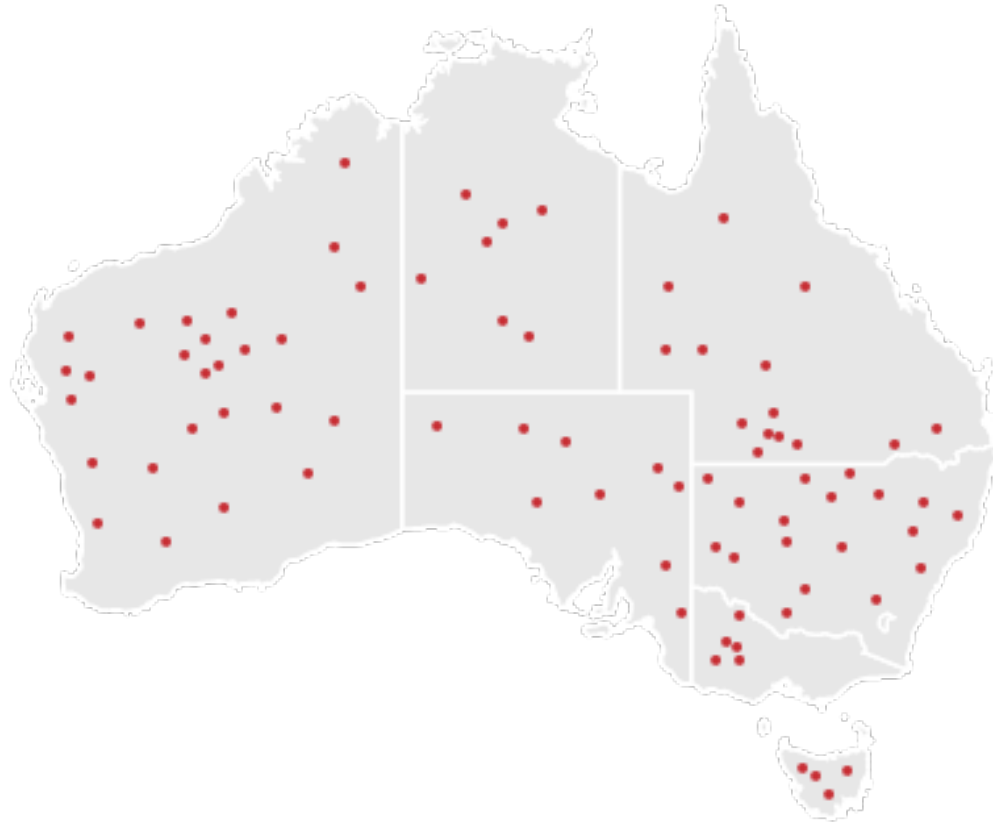
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Choropleth Map



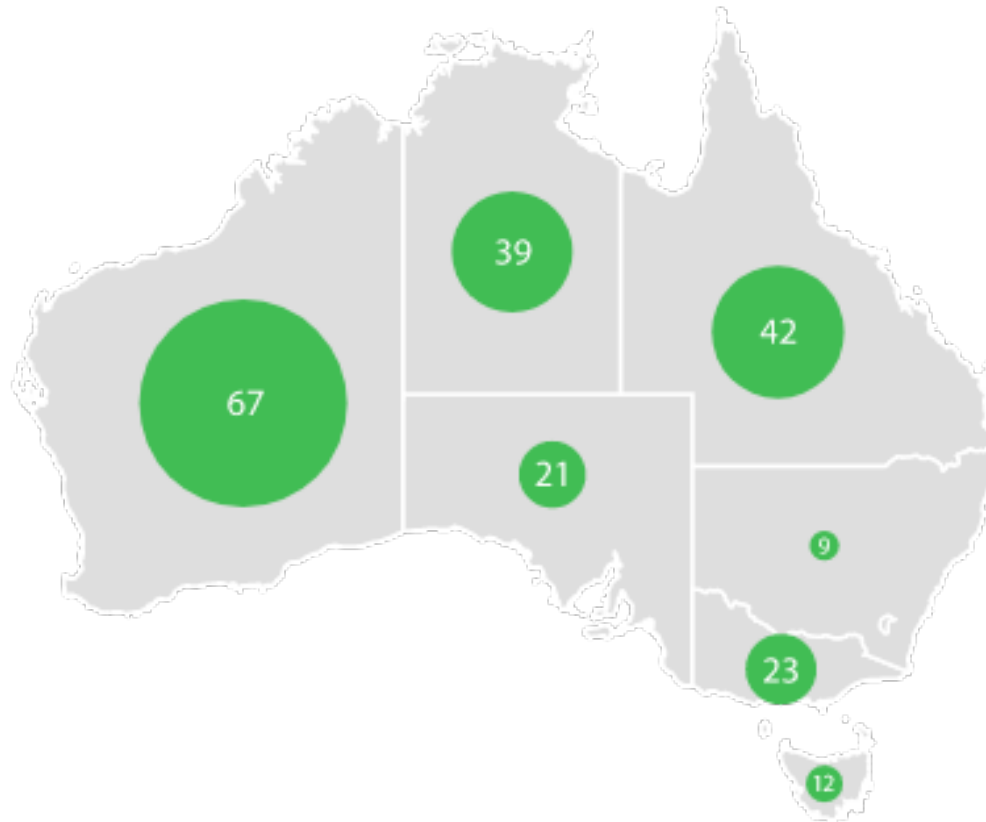
<https://datavizcatalogue.com/methods/choropleth.html>

Dot Map



https://datavizcatalogue.com/methods/dot_map.html

Bubble Map



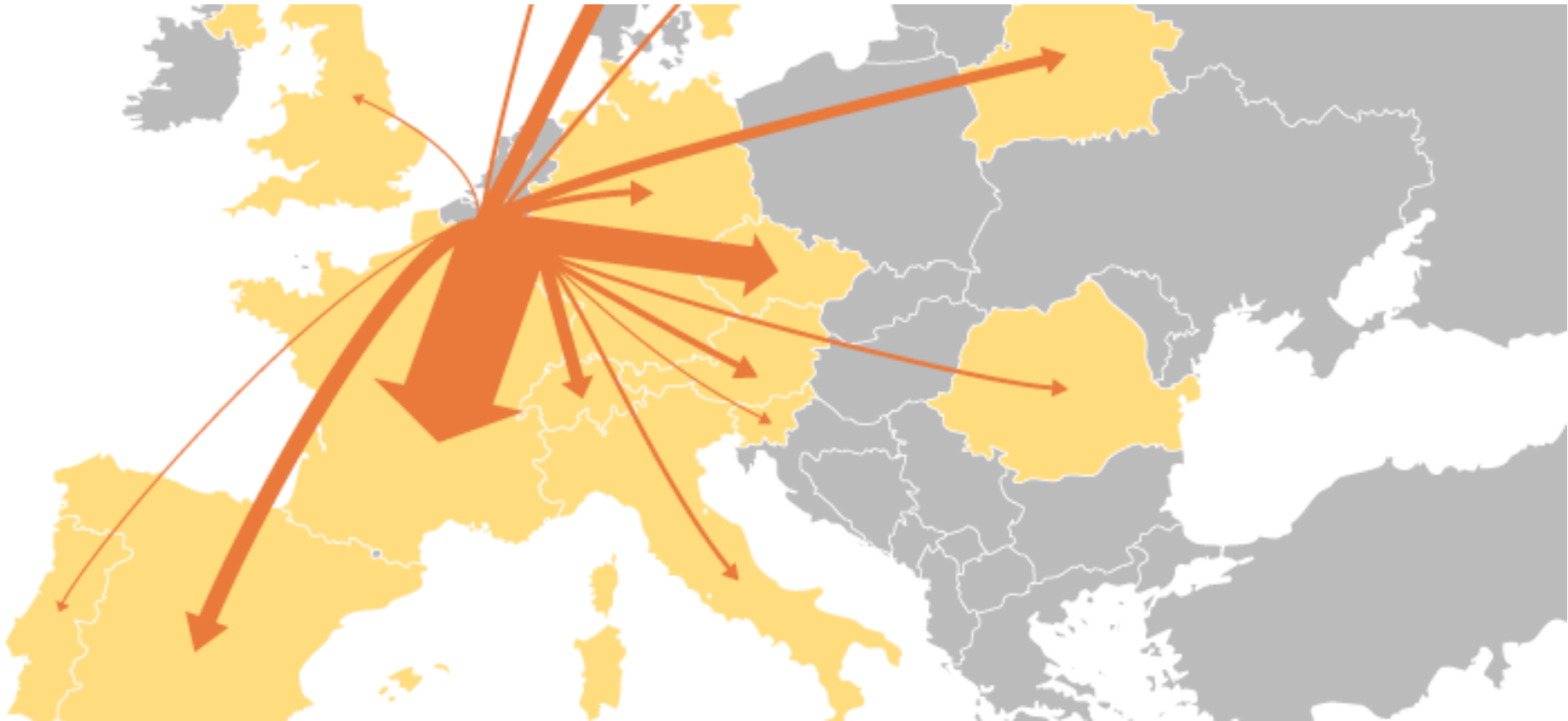
https://datavizcatalogue.com/methods/bubble_map.html

Connection Map



https://datavizcatalogue.com/methods/connection_map.html

Flow Map



https://datavizcatalogue.com/methods/flow_map.html

Next Steps

- **Readings:**
 - [Considering Visual Variables as a Basis for Information Visualisation](#). Sheelagh Carpendale. Research report 2001-693-16, Department of Computer science, University of Calgary, Calgary, AB, Canada, 2003.
- **Team Signup:** work in teams 2-4 people by **2359 Friday 26 April**