

Using Space Effectively: 2D II

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CS 294-10: Visualization
Fall 2007

Assignment 3: Visualization Software

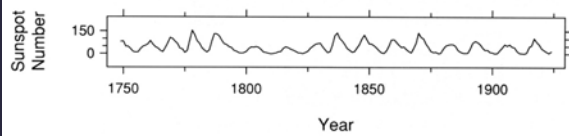
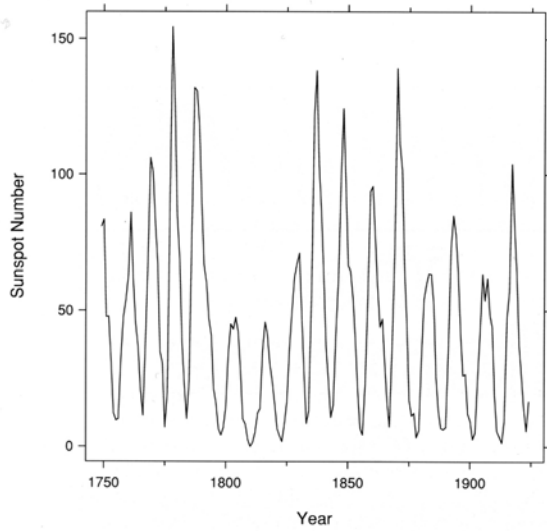
Create an interactive visualization application – you choose data domain and visualization technique.

1. Describe data and storyboard interface
due Oct 3 (before class)
2. Implement interface and produce final writeup
due Oct 15 (before class)
3. Submit the application and a final writeup on the wiki



Can work alone or in pairs
Final write up due before class on **Oct 15, 2007**

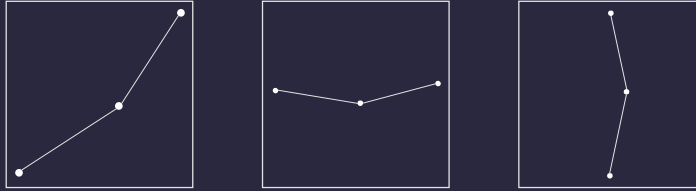
Banking to 45 Degrees



William S. Cleveland
*The Elements of
Graphing Data*

Banking to 45 degrees

To facilitate perception of trends, maximize smallest angle between line segments (orientation resolution)



Two segments are maximally discriminable when avg absolute angle is 45°

Optimize the *aspect ratio* to bank to 45°

Aspect-ratio banking techniques

Median-Absolute-Slope

$$\alpha = \text{median } |s_i| R_x / R_y$$

Average-Absolute-Slope

$$\alpha = \text{mean } |s_i| R_x / R_y$$

Average-Absolute-Orientation

Unweighted

$$\sum_i \frac{|\theta_i(\alpha)|}{n} = 45^\circ$$

Max-Orientation-Resolution

Global (over all i, j s.t. $i \neq j$)

$$\sum_i \sum_j |\theta_i(\alpha) - \theta_j(\alpha)|^2$$

Weighted

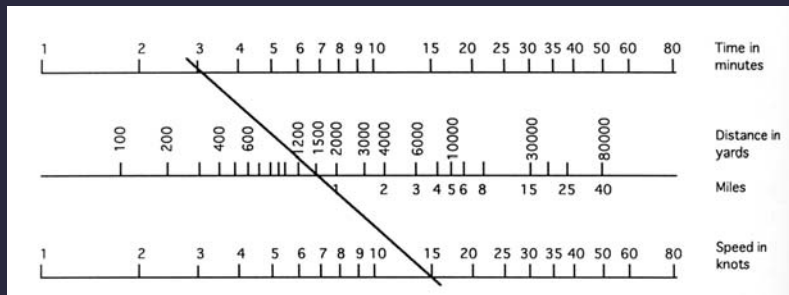
$$\frac{\sum_i |\theta_i(\alpha)| l_i(\alpha)}{\sum_i l_i(\alpha)} = 45^\circ$$

Local (over adjacent segments)

$$\sum_i |\theta_i(\alpha) - \theta_{i+1}(\alpha)|^2$$

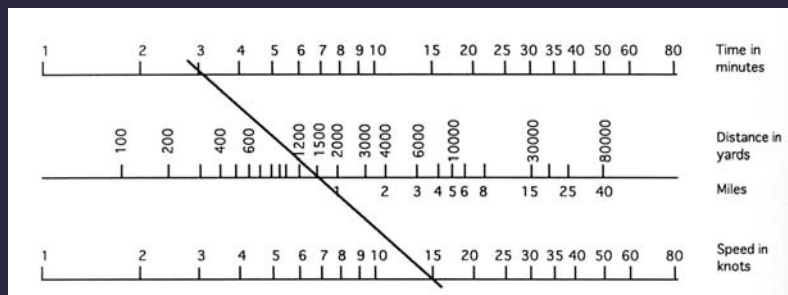
Graphical Calculations

Nomograms



Sailing: The Rule of Three

Nomograms

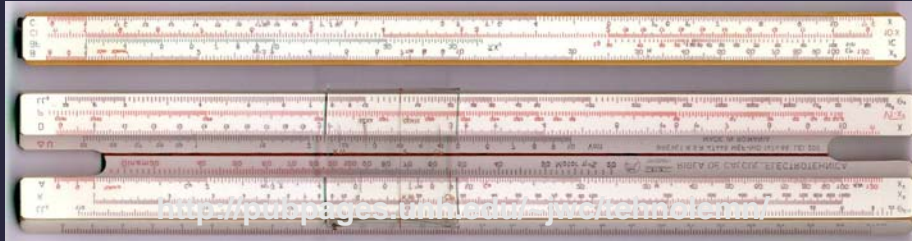


1. Compute in any direction; fix $n-1$ params and read n th param
2. Illustrate sensitivity to perturbation of inputs
3. Clearly show domain of validity of computation

Theory

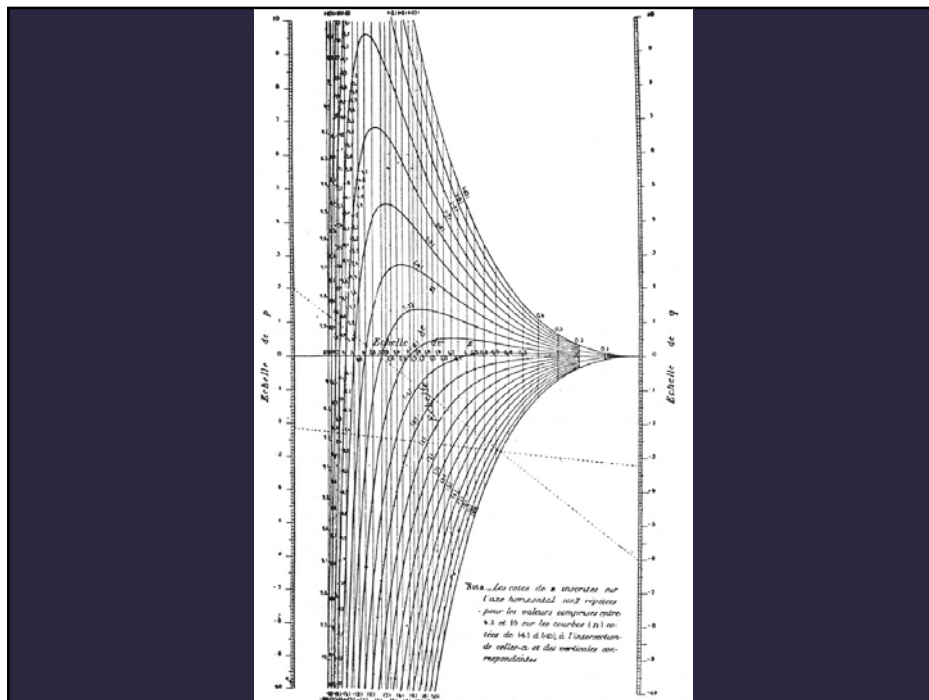
$$\begin{vmatrix} x_1(u) & y_1(u) & w_1(u) \\ x_2(v) & y_2(v) & w_2(v) \\ x_3(s, t) & y_3(s, t) & w_3(s, t) \end{vmatrix} = 0$$

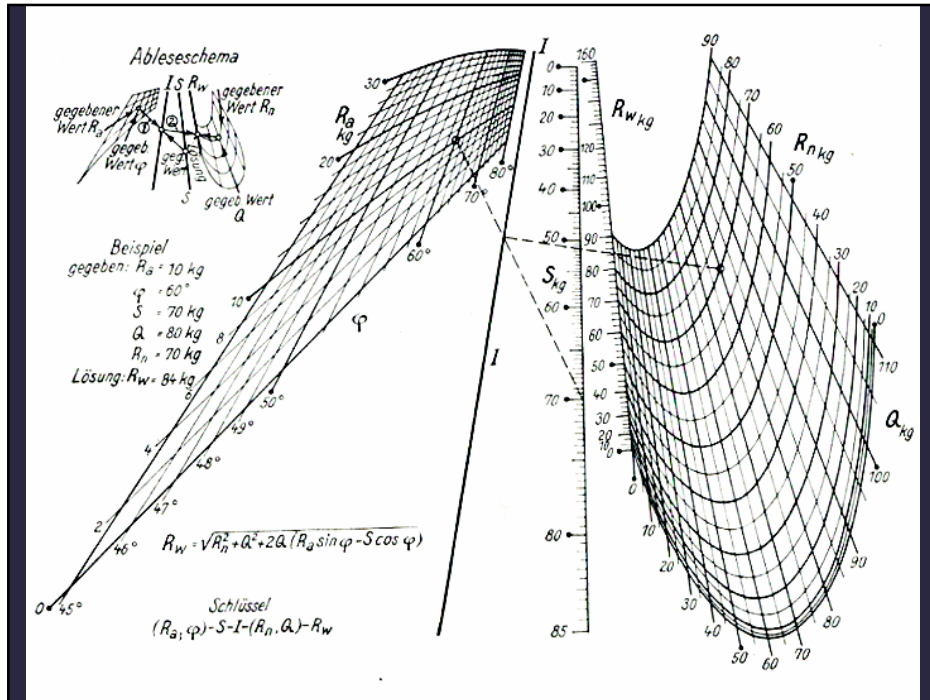
Slide rule



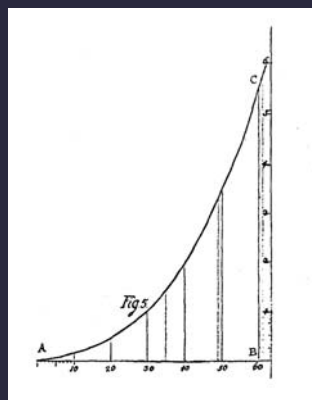
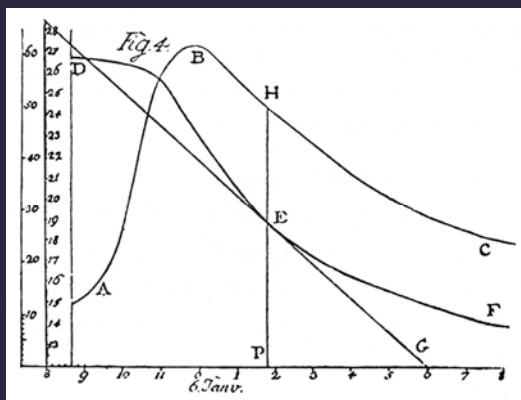
Model 1474-66 Electrotechnica 18 Scales

Tehnolemn Timisoara Slide Rule Archive
<http://pubpages.unh.edu/~jwc/tehnolemn/>

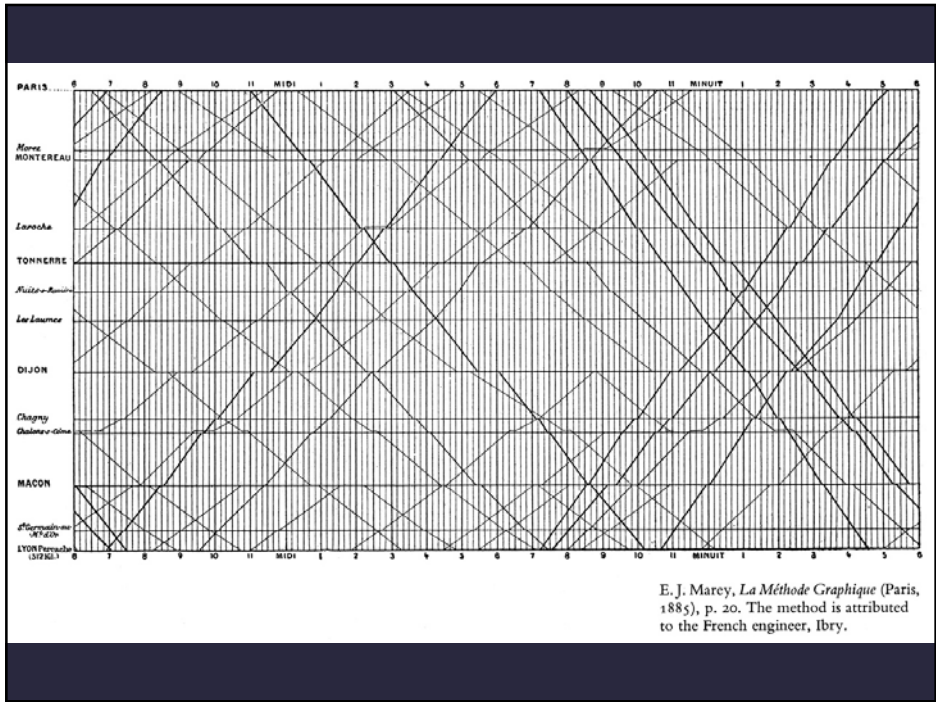




Lambert's graphical construction



Johannes Lambert used graphs to study the rate of water evaporation as function of temperature [from Tufte 83]

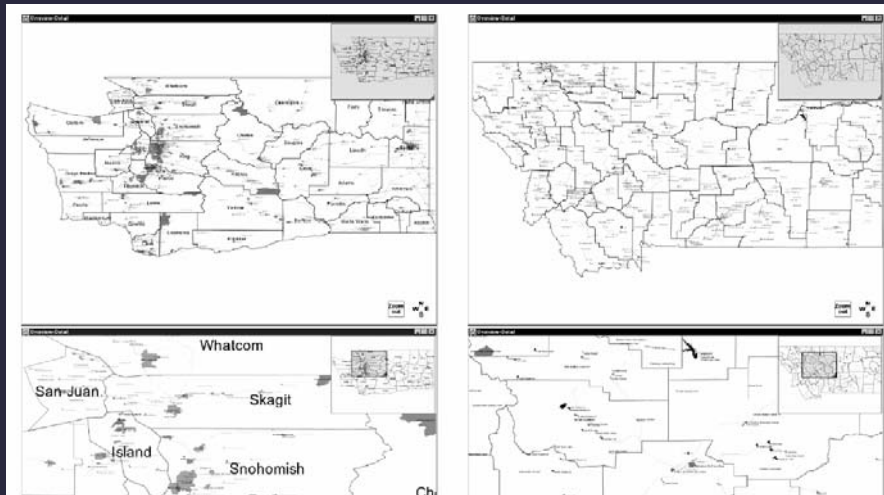


Zooming



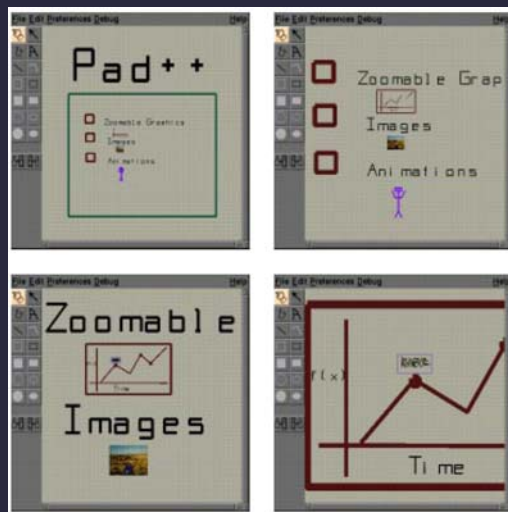
Eames' Powers of Ten [<http://www.powersof10.com/>]

Overview + details



[Hornbaek et al. 2002]

Interactive zooming



Pad++ [Bederson and Hollan 94]

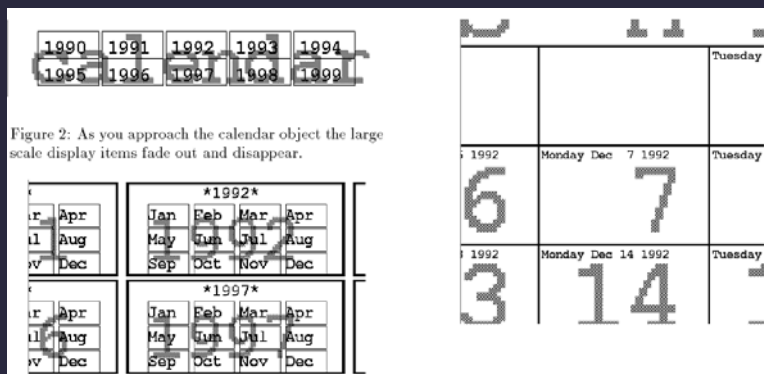


Pad++

[Play video](#)

Semantic zooming

Change visual representations as zoom level changes



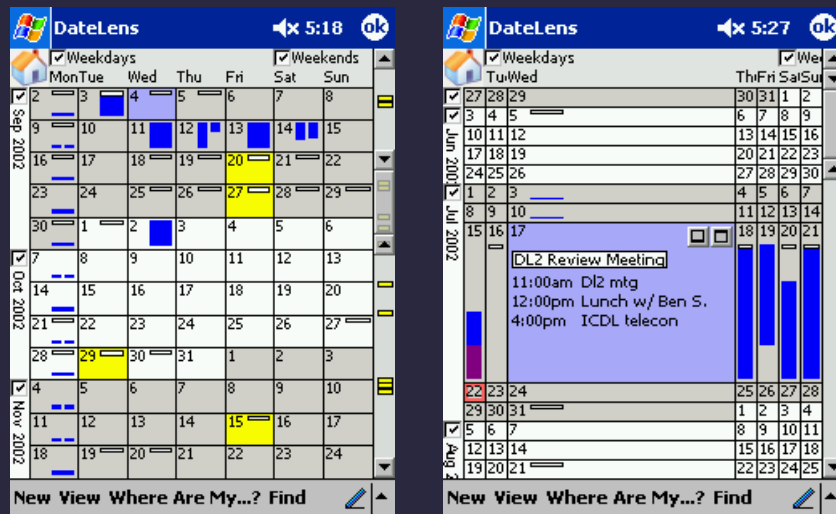
PAD [Perlin and Fox 93]

TableLens [Rao & Card 94]

League	Players	At Bats	Hits	Home Runs	Runs	Rbi
N	52 Andres ...	321	87	10	39	42
	53 Jose Cruz	479	133	10	48	72
	54 Bo Diaz	474	129	10	50	56
	55 Tony Pena	510	147	10	56	52
A	191 Reggie J.	419	101	18	65	58

<http://www.inxight.com/products/sdks/tl/>

DateLens

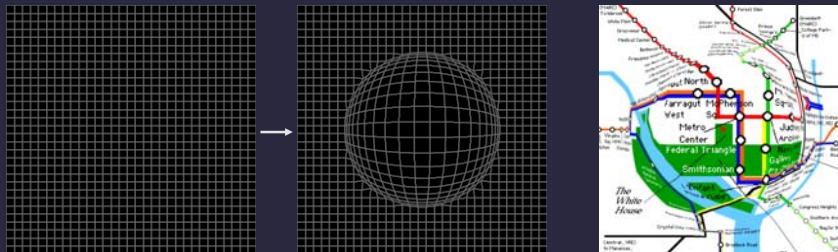


[Bederson et al. 04]

Distortion

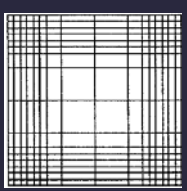
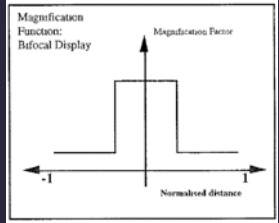
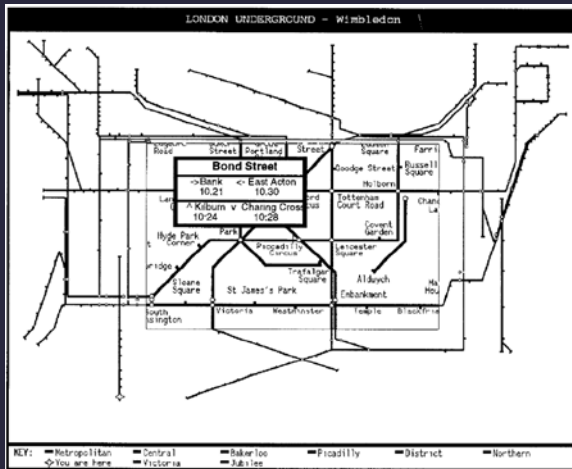
Single view detail + context

- Focus area – local details
- De-magnified area – surrounding context
- Like a rubber sheet with borders tacked down



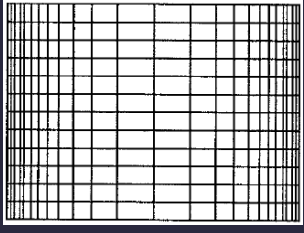
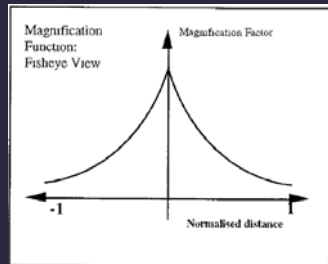
Nonlinear Magnification Infocenter [<http://www.cs.indiana.edu/%7Eetkeahy/research/nlm/nlm.html>]

Bifocal display [Leung and Apperley 94]

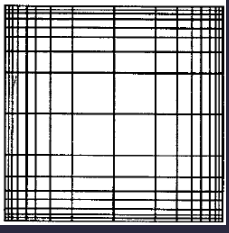


2D distortion

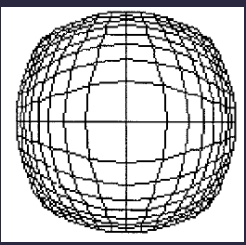
Fisheye [Leung and Apperley 94]



1D

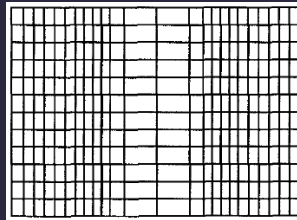
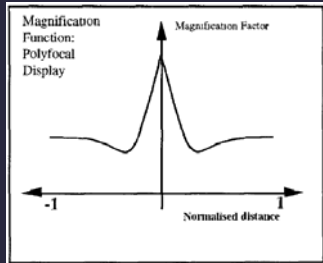


2D

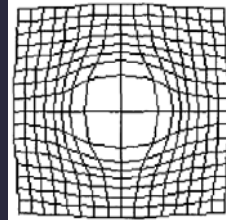


Polar

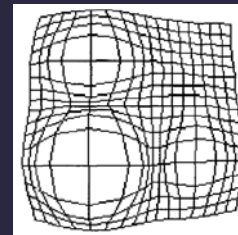
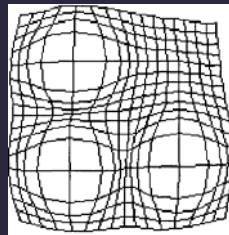
Nonlinear magnification [Leung and Apperley 94]



1D

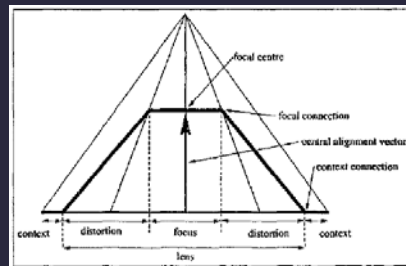
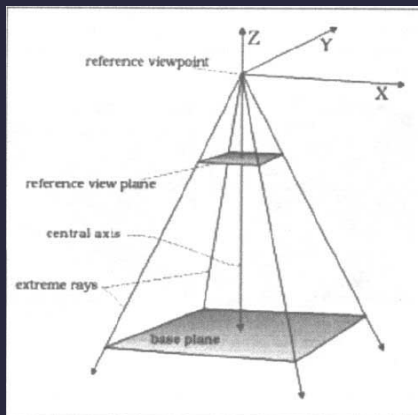


2D

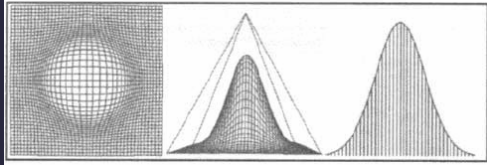


Multifocal

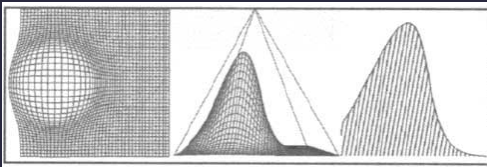
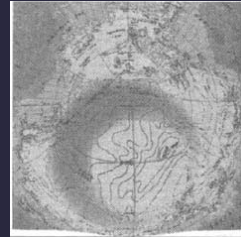
3D pliable surface [Carpendale & Montagnese 01]



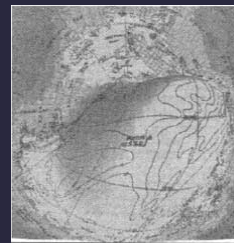
Aligned and sheared [Carpendale & Montagnese 01]



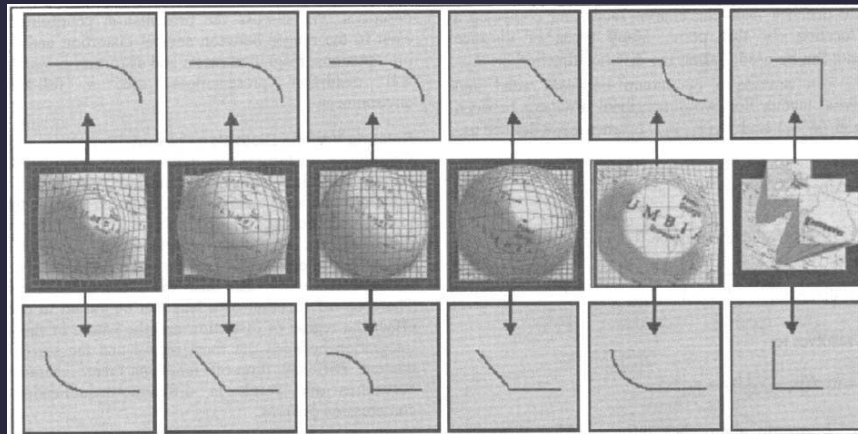
Aligned with viewer



Sheared



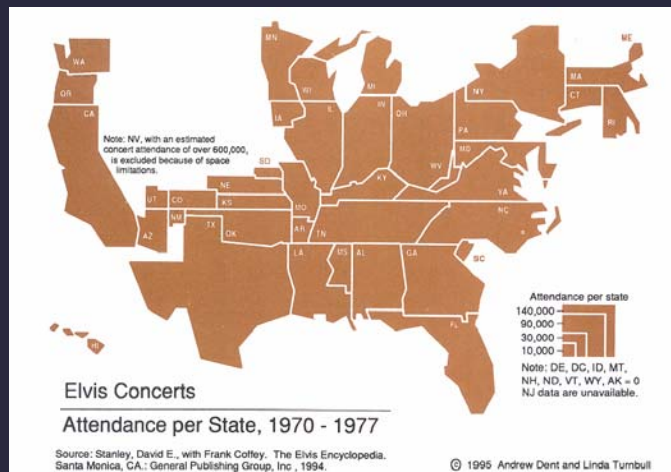
6 types of distortions [Carpendale & Montagnese 01]



Gaussian, Cosine, Hemisphere, Linear, Inverse Cosine and Manhattan.
 Top row shows transition from focus to distortion, bottom row from distortion to context.

Cartographic Distortions

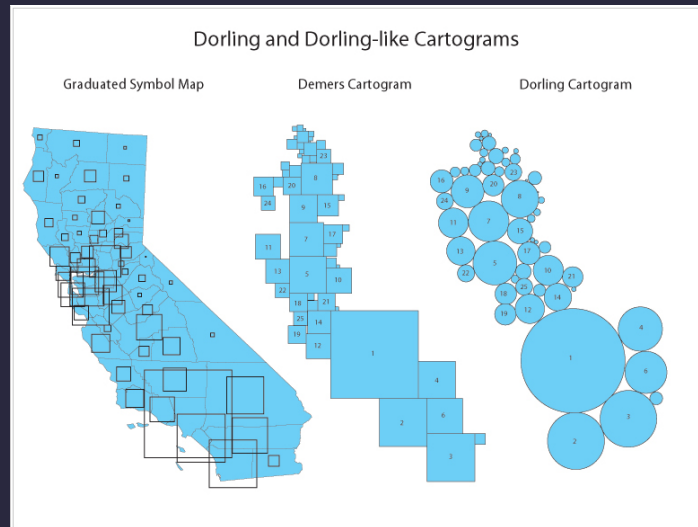
Cartograms: Distort areas



Scale area by data

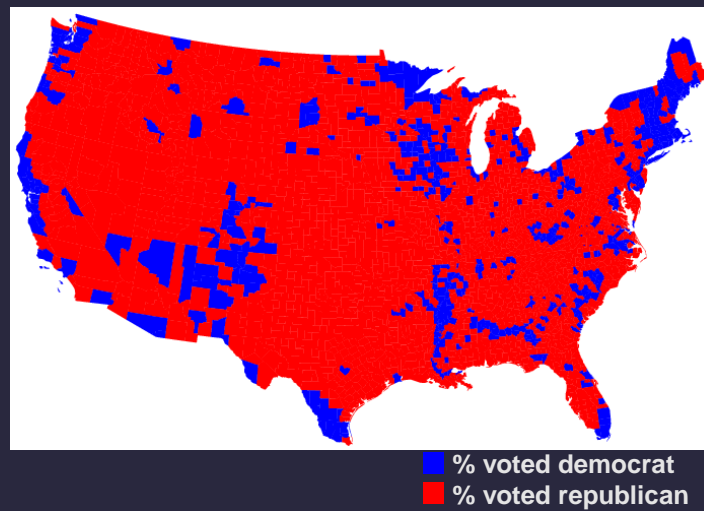
[From *Cartography*, Dent]

Dorling cartogram



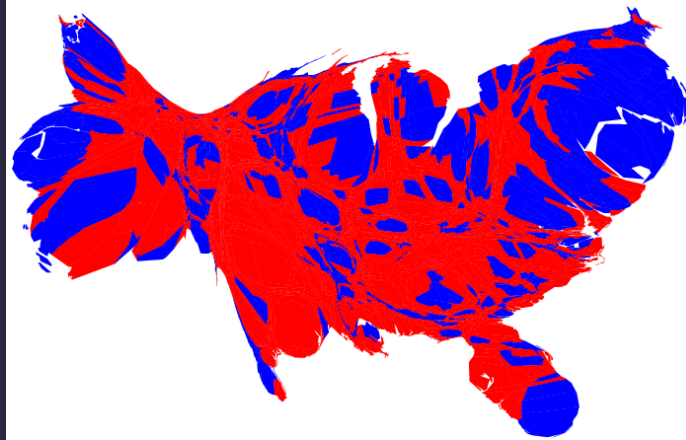
http://www.ncgia.ucsb.edu/projects/Cartogram_Central/types.html



Election 2004 map



<http://www-personal.umich.edu/~mejn/election/>

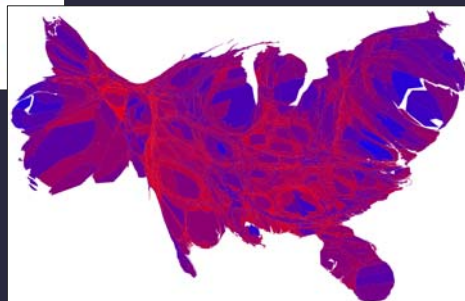
Election 2004 map



 % voted democrat
 % voted republican

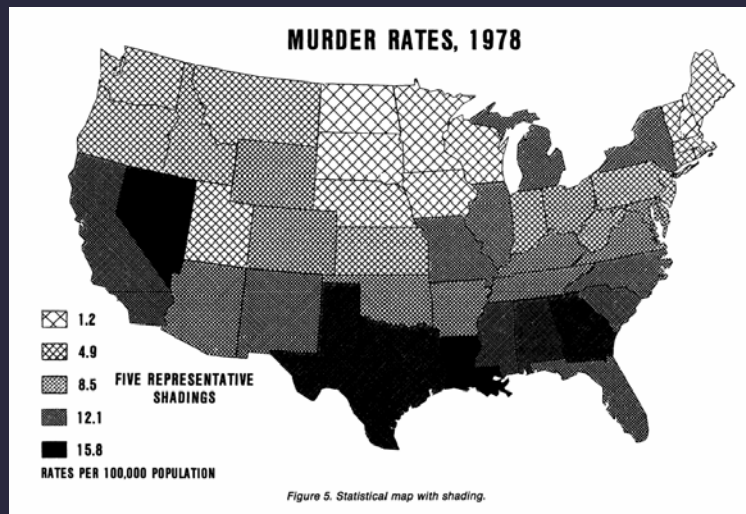
<http://www-personal.umich.edu/~mejn/election/>

Election 2004 map



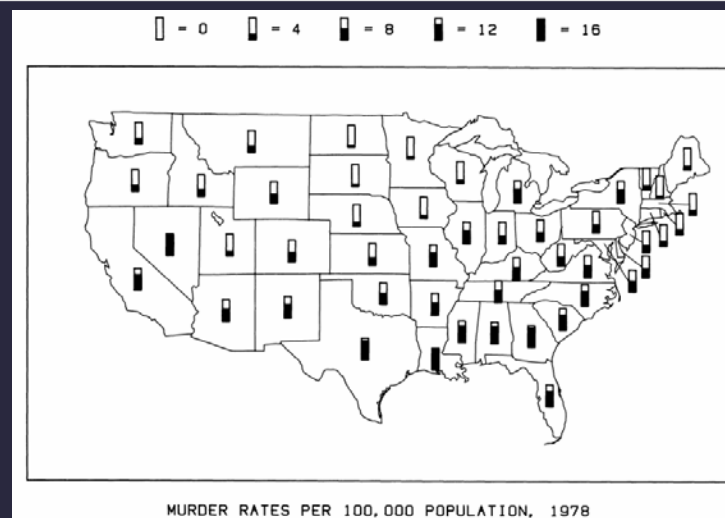
<http://www-personal.umich.edu/~mejn/election/>

Statistical map with shading



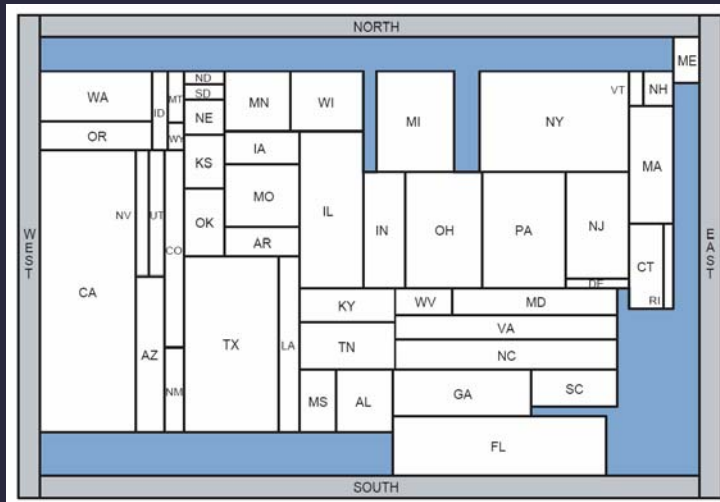
[Cleveland and McGill 84]

Framed rectangle chart



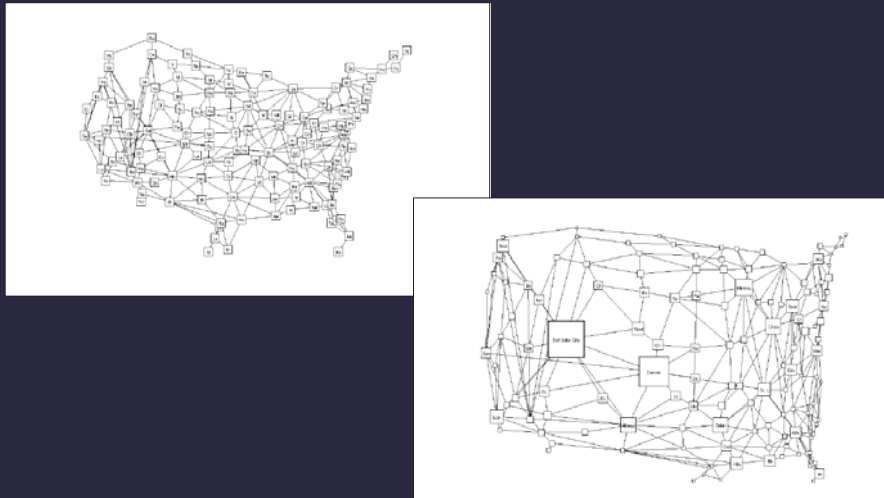
[Cleveland and McGill 84]

Rectangular cartogram



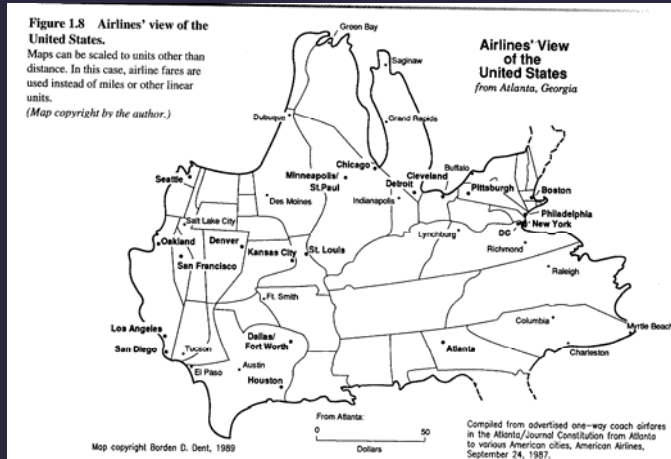
American population [van Kreveld and Speckmann 04]

States as nodes in a graph



Graphical fish-eye views of graphs [Sarkar & Brown 92]

Distorting distances



Scale distance by data

[From *Cartography*, Dent]

London underground

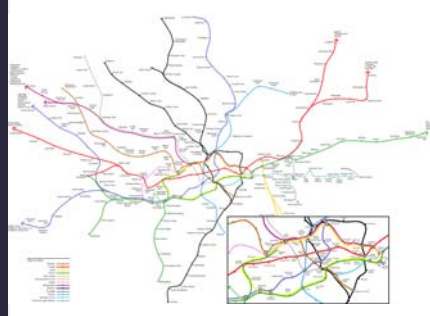


<http://www.thetube.com/content/history/map.asp>

Comparison to geographic map



Distorted



Undistorted

Summary

- Space is the most important visual variable
- Geometric properties of spatial transforms support geometric reasoning
- Show data with as much resolution as possible
- Use distortions to emphasize important information