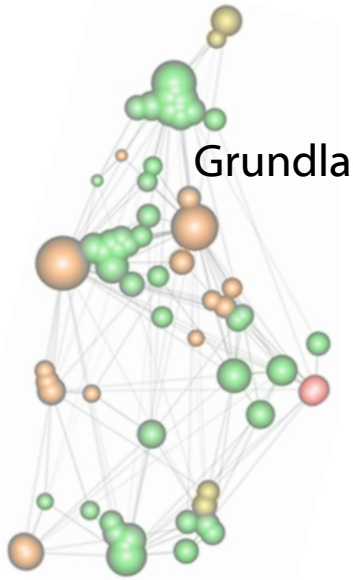
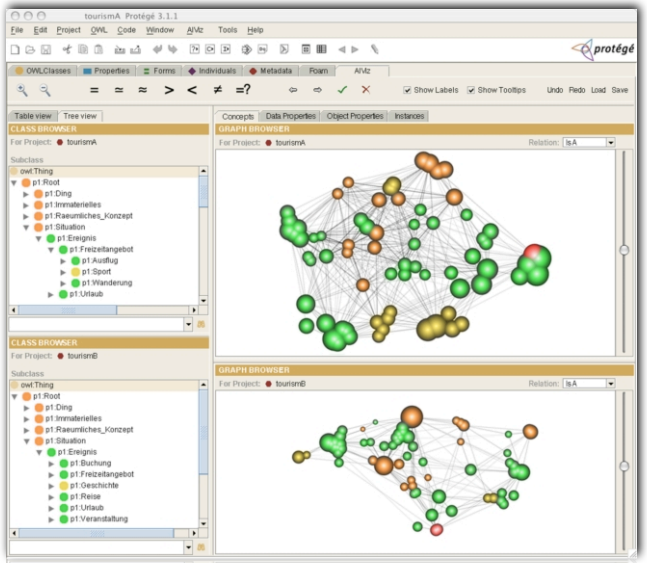


Grundlagen methodischen Arbeitens Informationsvisualisierung [WS0607 | 01]

Monika Lanzenberger
lanzenberger@ifs.tuwien.ac.at

25. 10. 2006

Current InfoVis Research Activities: AlViz



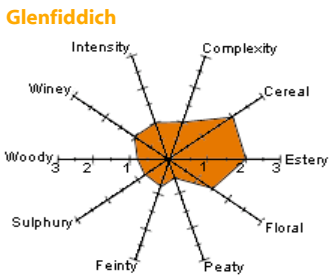
[Lanzenberger et al., 2006]

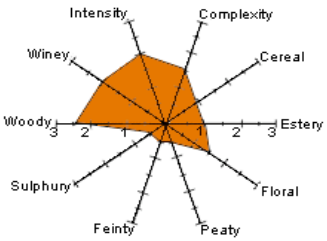
AlViz & Trondheim

Topics VO.01

- Motivation - Examples
- Definitions and Goals
- Knowledge Crystallization
- Exploration Techniques
- Visual Encoding Techniques
- Summary

- Taste is very abstract
- 10 basic tastes
- Intensity [0, 3]
  - Wheel chart
  - Points - form a polygon
  - Polygon's properties give quick access to the represented taste



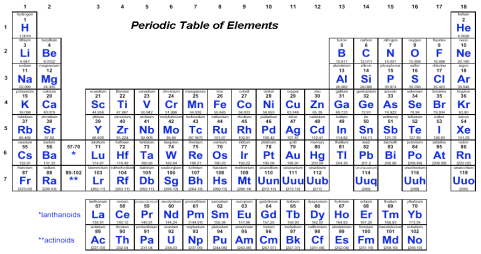


The Balvenie (12 y.)

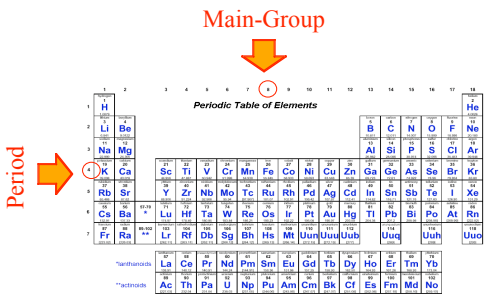
[http://www.scotchwhisky.com]

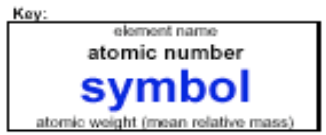
Periodic Table

- Invented by Dimitri Mendeleyev
- Structured and classified Representation of all chemical elements and their properties
- Predicted the existence of several elements before they were discovered

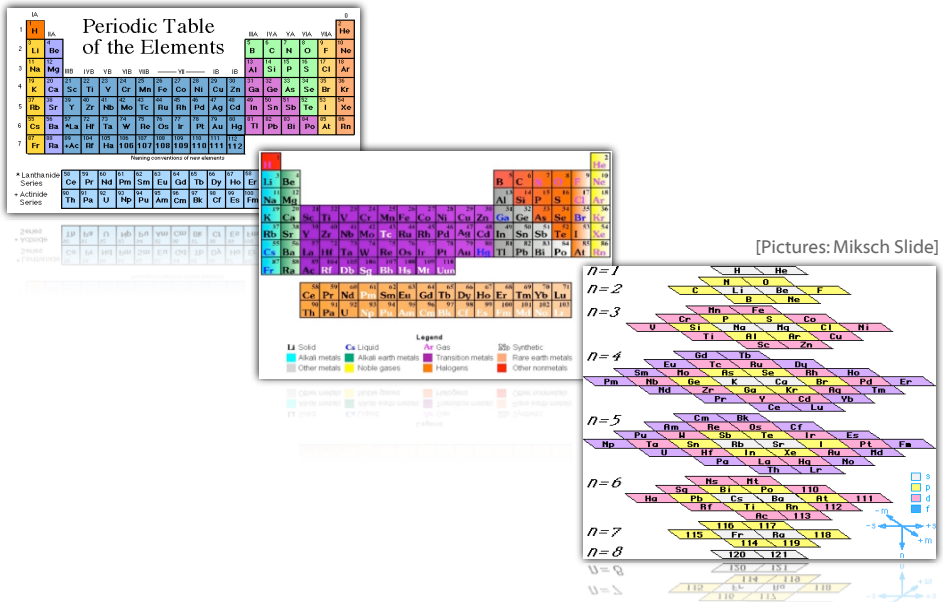


[Pictures: Miksch Slide]



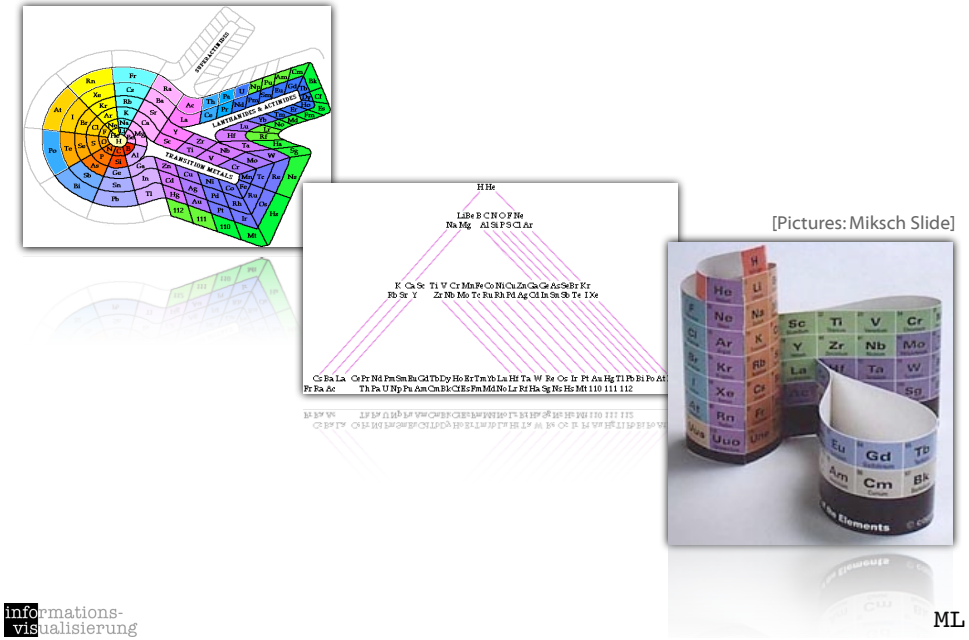


[Pictures: Miksch Slide]



[Pictures: Miksch Slide]

Example 2: Chemical Elements



[Pictures: Miksch Slide]

Example 3: The Challenger Disaster

January 27, 1986 -
Space shuttle Challenger explodes 72 seconds after launch.

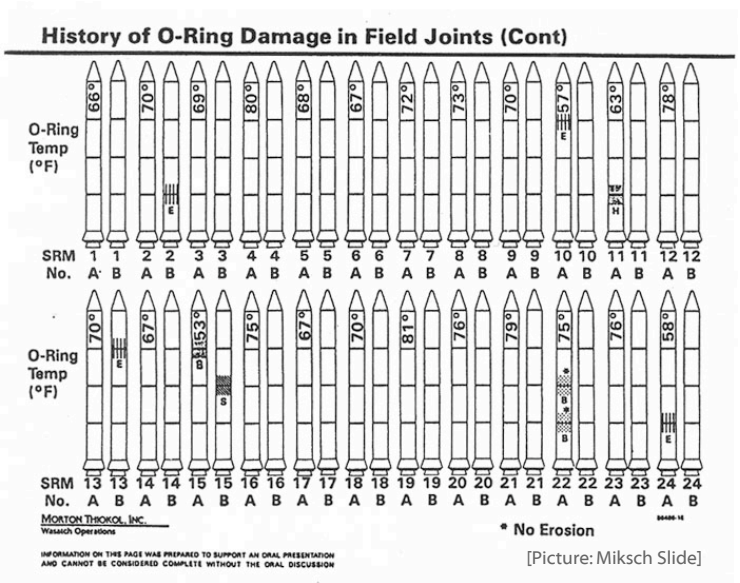
Sealing-rings in the right booster were damaged due to weather conditions.

Reliability-problems of the so called O-rings were known.

The manufacturer of the boosters warned NASA before launch that the expected cold temperatures might be an extra risk.
NASA did not see any correlation between the failing of O-rings and the temperatures.

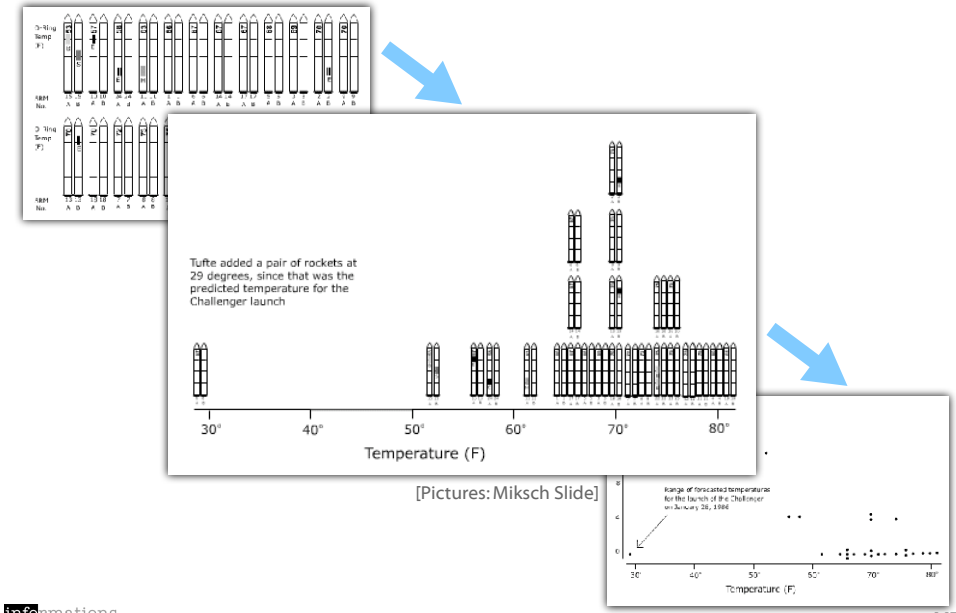
[Pictures: Miksch Slide]

Example 3: The Challenger Disaster



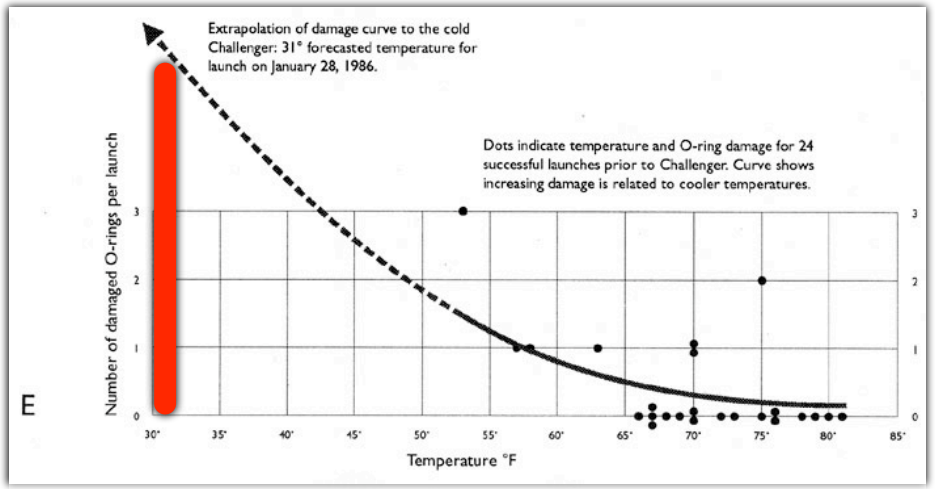
[Picture: Miksch Slide]

Example 3: The Challenger Disaster



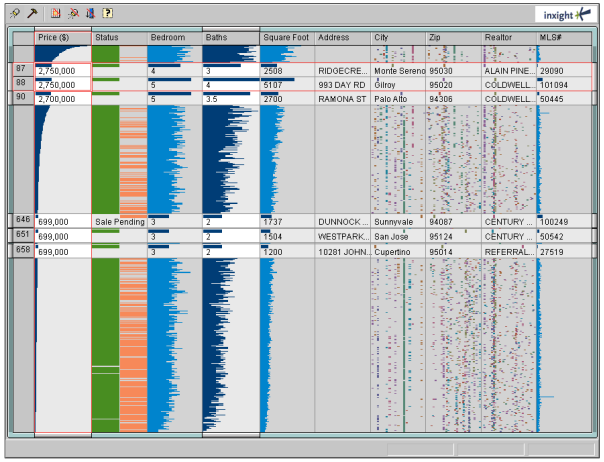
[Pictures: Miksch Slide]

Example 3: The Challenger Disaster



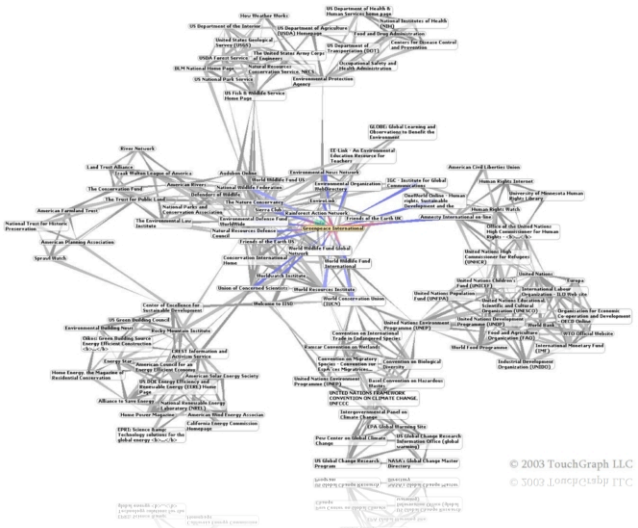
[Pictures: Rester Slide]

Example 4: inxight TableLens



[http://www.inxight.com/demos/tl_housing/tl_housing.html]

Example 5: TouchGraph GoogleBrowser



[http://www.touchgraph.com/TGGoogleBrowser.html]

Topics VO.01

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- Visual Encoding Techniques
- Summary

Data

"input signals to sensory and cognitive processes"

Information

"data with an associated meaning"

Knowledge

"the whole body of data and information together with cognitive machinery that people are able to exploit to decide how to act, to carry out tasks and to create new information"

[Schreiber et al., 1999]

InfoVis is ...

... the process of transforming data, information, and knowledge into visual form making use of humans' natural visual capabilities.

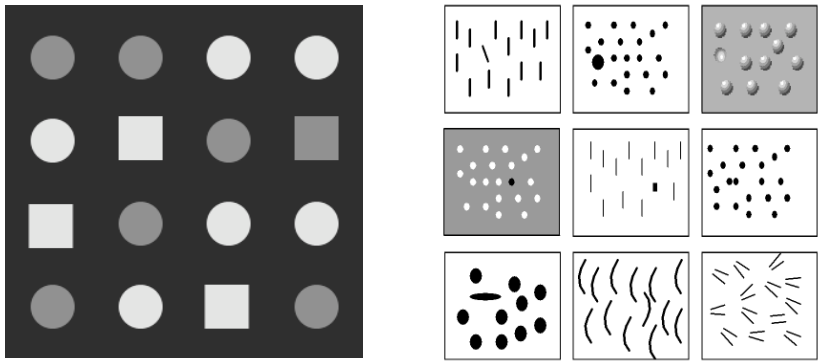
... the computer-assisted use of visual processing to gain understanding.

... providing the user with an overview first and then details on demand (<-> text).

... based on pre-attentive features (< 200ms).

[Card & Mackinlay,1997, Gershon, Eick, Card,1998, Ware, 2000]

Information Visualization is ...



... based on pre-attentive features (< 200ms).

[Card & Mackinlay1997, Gershon, Eick, Card:1998, Ware, 2000]

„It is important to distinguish information visualization from scientific visualization (SciVis).

In scientific visualization what is seen primarily relates to, and represents visually, something physical. Thus, the flow of a water in a pipe or the nature of the weather in a mountainous area [...] are displayed directly superimposed on or at least close to a realistic representation of the physical thing.

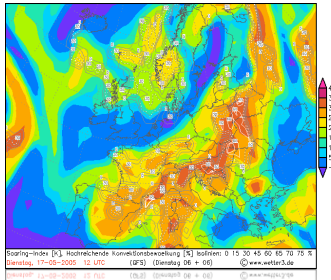
By contrast, information visualization tends to deal with abstract quantities such as baseball scores, connections between known criminals, fluctuating exchange rates and electrical voltages.„

[Spence: Information Visualization. 2001]

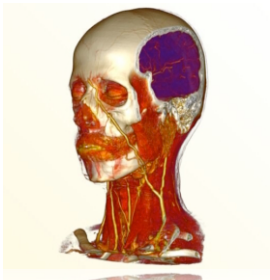
SciVis

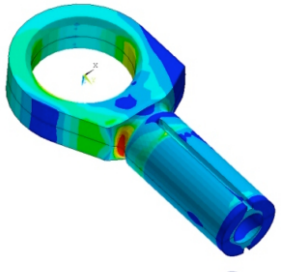
21

- deals with physical data (e.g., human body, tourist maps, molecules, weather forecast, ...)
- abstract data may be involved
- spatial reference is determined



[Pictures: Rester Slide]





InfoVis: Using space

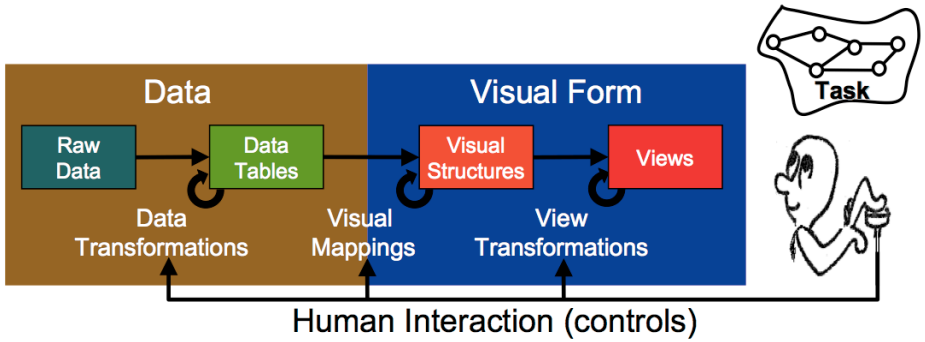
22

- Visualization of abstract data (e.g., financial transactions, insurance risks, etc.) means to find spatial representations (2D, 3D).
- No inherent spatial structure available, so the designer / user needs to decide which dimensions are represented by space: Mapping.

Mapping

23

Visualization Reference Model



[Mackinlay, 2000][Card et al.,1999]

InfoVis: Kinds of Data

24

- Entities (e.g., people, terms) and relations (e.g., part-of, is-a)
- Both can have sets of attributes (duration, color, time, etc.)
- Types of attributes
  1. nominal, ordinal, interval, ratio
  2. Category data (nominal),
     integer data (ordinal),
     real-number data (interval & ratio)
- High-frequency versus high-structural

[Ware: Information Visualization, 2000]

InfoVis: Heterogeneous Data ... 25

Multi-Dimensionality
... contain more than three dimensions and are multi-variate

Multi-Modality
... a combination of data from different sources

Structural Complexity
... ranging from low-structured (simple data structure, but many instances, e.g., flow data, volume data) to high-structured data (complex data structure, but only a few instances, e.g., business data)

Disparity
... contain different types of information in the different dimensions

Largeness
... consist of at least hundreds of thousands of data points

Spatiality
... contain at least one (non-scalar) spatial component and non-spatial data

Time-Dependency
... data is given at several points in time

Types of InfoVis 26

Visualizations are characterized by their purpose for ...

Exploration
the user searches for structures and unknown relations which provide her or him with new insights about the data under investigation.

Analysis
starting with certain hypotheses about the data the user tries to prove them by goal-oriented investigations.

Presentation
static visualization of facts which are fixed a priori.

[Schumann et al., 2000]

InfoVis & Cognition 27

Visualization can facilitate cognition by ...

... increasing the memory and processing resources available to the user.
... reducing the search for information.
... using visual representations to enhance the detection of patterns.
... enabling perceptual inference operations.
... using perceptual attention mechanisms for monitoring.
... encoding information in a manipulable medium.

[Card, Mackinlay, Shneiderman: Readings in Information Visualization, 1999]

Topics VO.01 28

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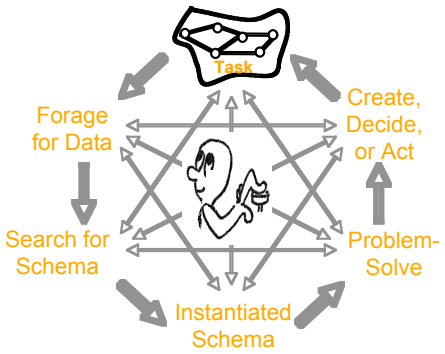
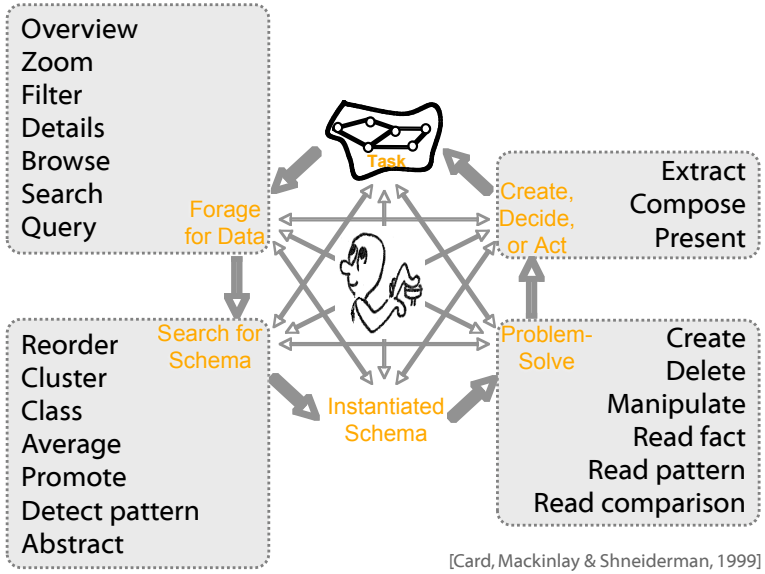
Knowledge Crystallization



[Card, Mackinlay & Shneiderman, 1999]

Knowledge Crystallization Sub-tasks



[Card, Mackinlay & Shneiderman, 1999]

Topics VO.01

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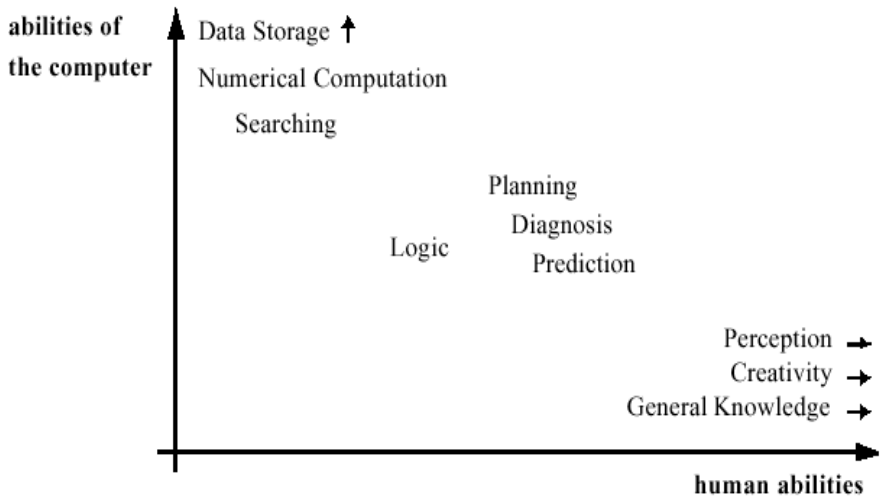
Human Abilities versus Computers



[Keim, 2001]

High-level Tasks

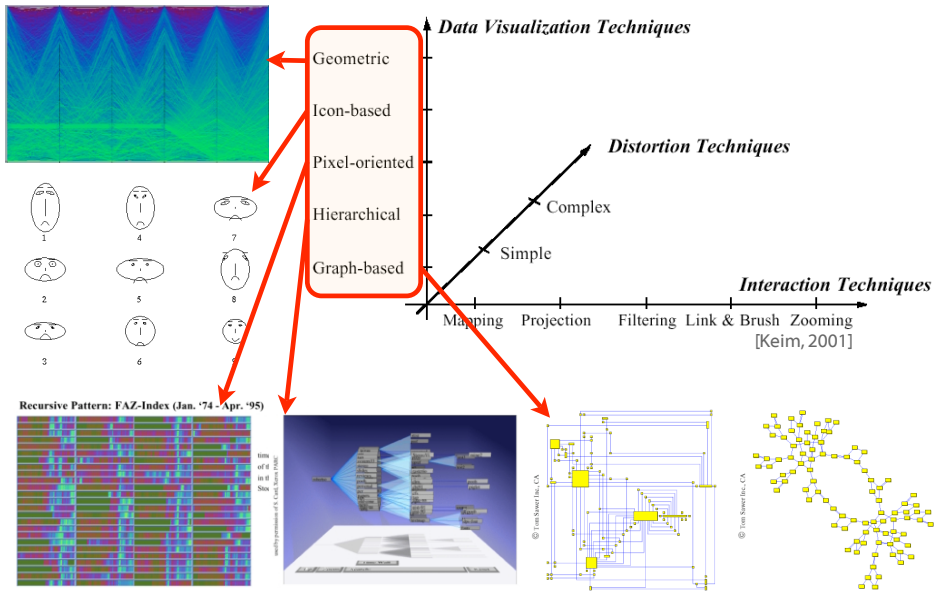
1	overview	gain an overview of the entire set of data
2	zoom	adjust the size of items of interest
3	filter	remove uninteresting items
4	details-on-demand	select one or more items and get details
5	relate	identify relationships between items
6	history	keep a history of actions to support undo/redo
7	extract	extract subsets of items for separate analysis

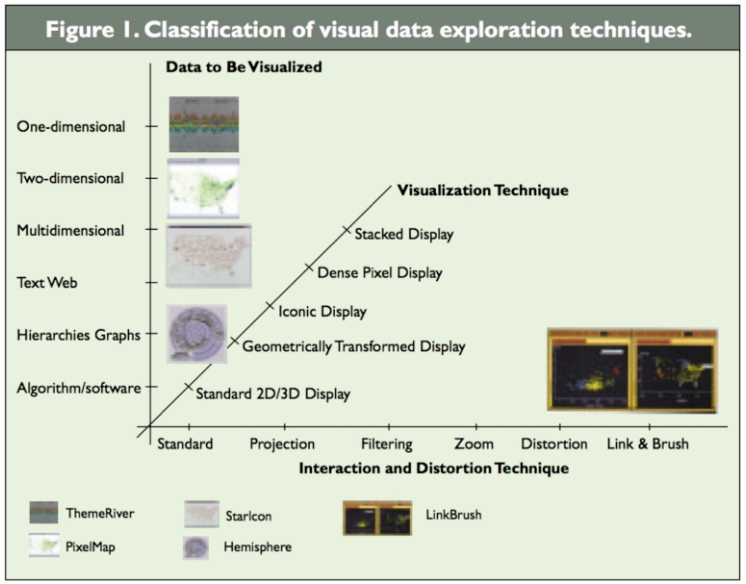
[Shneiderman: The eyes have it, 1996]

"There are many visual design guidelines but the basic principle might be summarized as the Visual Information Seeking Mantra:

Overview first, zoom and filter, then details-on-demand !
Overview first, zoom and filter, then details-on-demand !
Overview first, zoom and filter, then details-on-demand !
Overview first, zoom and filter, then details-on-demand !
Overview first, zoom and filter, then details-on-demand !
Overview first, zoom and filter, then details-on-demand !
Overview first, zoom and filter, then details-on-demand !
Overview first, zoom and filter, then details-on-demand !
Overview first, zoom and filter, then details-on-demand !
Overview first, zoom and filter, then details-on-demand ! "

[Shneiderman: The eyes have it, 1996]





[Keim, 2001]

Coupling views by:

- **Slaving**
  movements in one view are automatically propagated in the other views

- **Linking**
  connects the data items of one view with the data items of the other views e.g., done by **brushing**: user selects and highlights items in one view and the corresponding items are highlighted automatically

[Baldonado, 2000]

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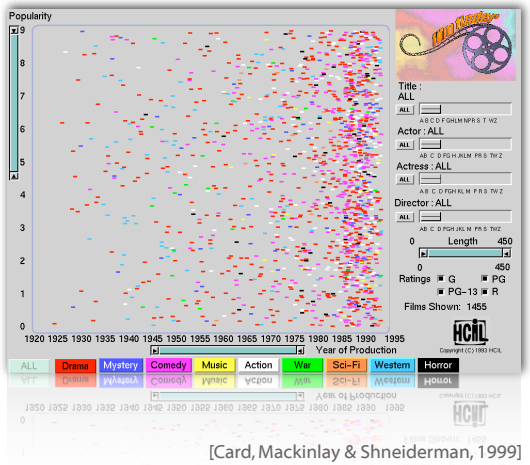
Different ways in encoding information visually:

- Space
  (See details next slide)
- Marks (in space)
  Points, lines, areas, volumes
- Connections & enclosures
- Retinal properties
  Crispness, shape, resolution, transparency, color, grayscale
- Temporal changes
- Viewpoint transformations

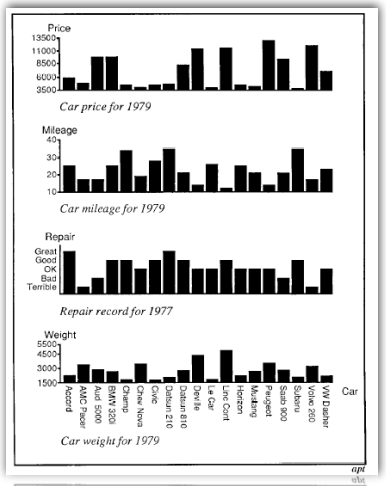
[Card, Mackinlay & Shneiderman, 1999]

- Composition
  The orthogonal placement of axes, creating a 2D metric space



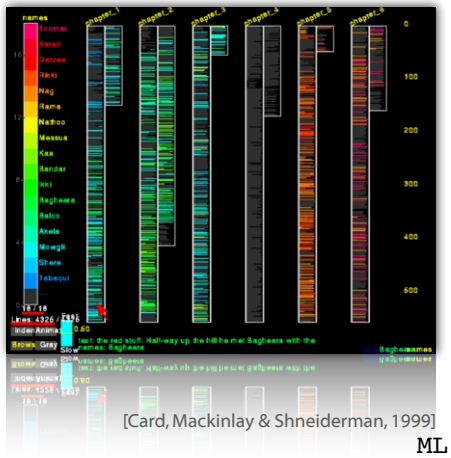
[Card, Mackinlay & Shneiderman, 1999]

- Composition
  The orthogonal placement of axes, creating a 2D metric space
- Alignment
  The repetition of an axis at a different position in the space



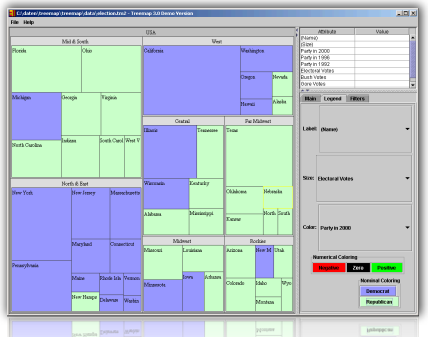
[Card, Mackinlay & Shneiderman, 1999]

- Composition
  The orthogonal placement of axes, creating a 2D metric space
- Alignment
  The repetition of an axis at a different position in the space
- Folding
  The continuation of an axis in an orthogonal direction



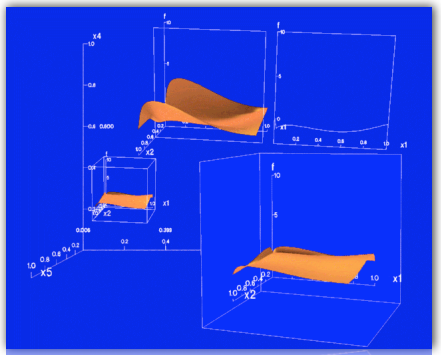
[Card, Mackinlay & Shneiderman, 1999]

- Composition
  The orthogonal placement of axes, creating a 2D metric space
- Alignment
  The repetition of an axis at a different position in the space
- Folding
  The continuation of an axis in an orthogonal direction
- Recursion
  The repeated subdivision of space



[Card, Mackinlay & Shneiderman, 1999]

- Composition
  The orthogonal placement of axes, creating a 2D metric space
- Alignment
  The repetition of an axis at a different position in the space
- Folding
  The continuation of an axis in an orthogonal direction
- Recursion
  The repeated subdivision of space
- Overloading
  The reuse of the same space



[Card, Mackinlay & Shneiderman, 1999]

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- is a very complex task.
- can help to get insight into data more quickly.
- is a kind of abstraction.
- requires preparation and sensible handling of the information.
- should make use of the properties of human visual perception.
- requires sensible handling, relative to the task.
- is a big challenge, if you want to do it good.

... Silvia Miksch and
... Markus Rester

for making nice slides of previous classes available.