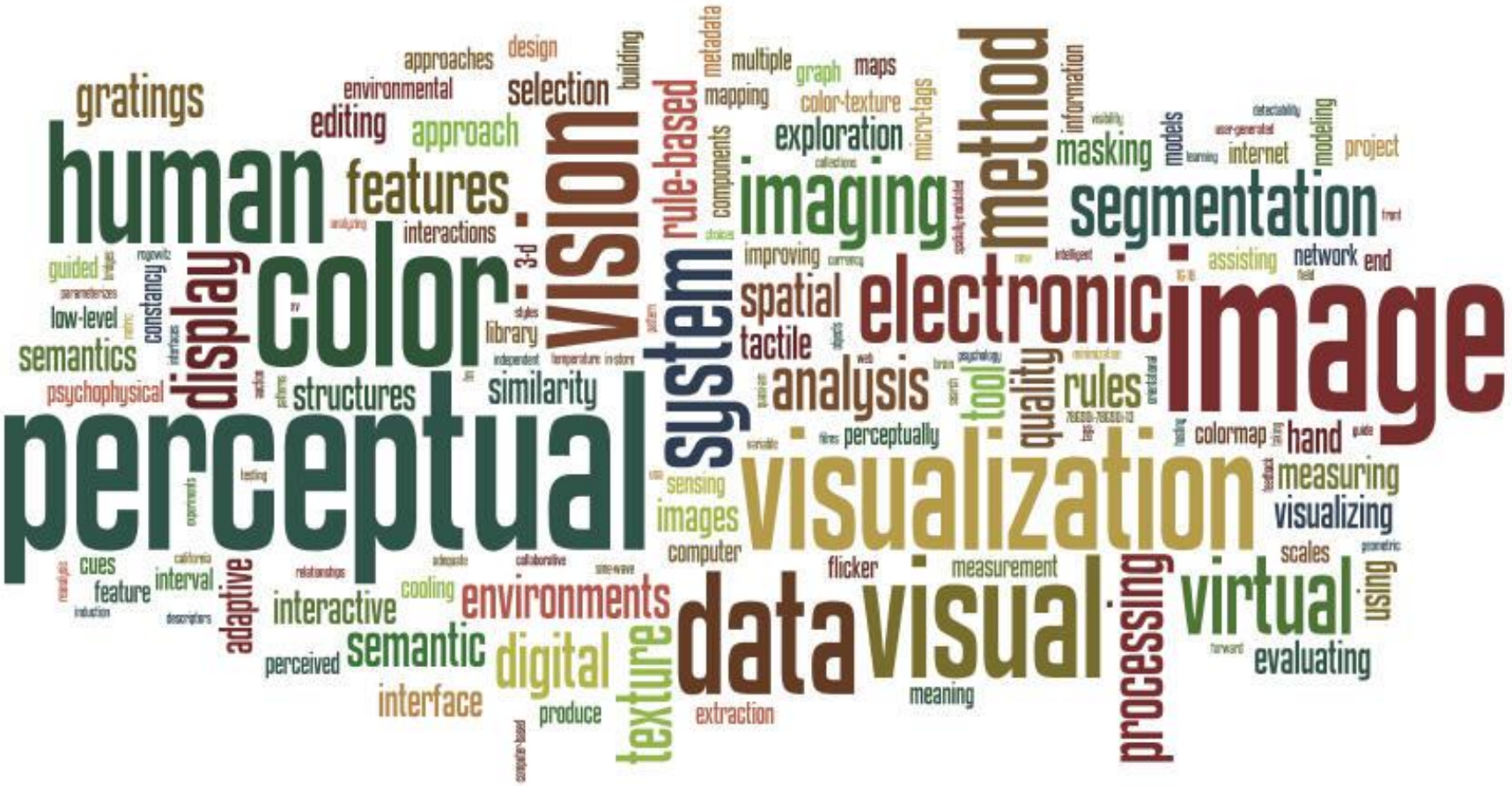
Frontiers of Visualization
Passions, Challenges and Wishes

Bernice E. Rogowitz
Visual Perspectives
bernice.e.rogowitz@gmail.com

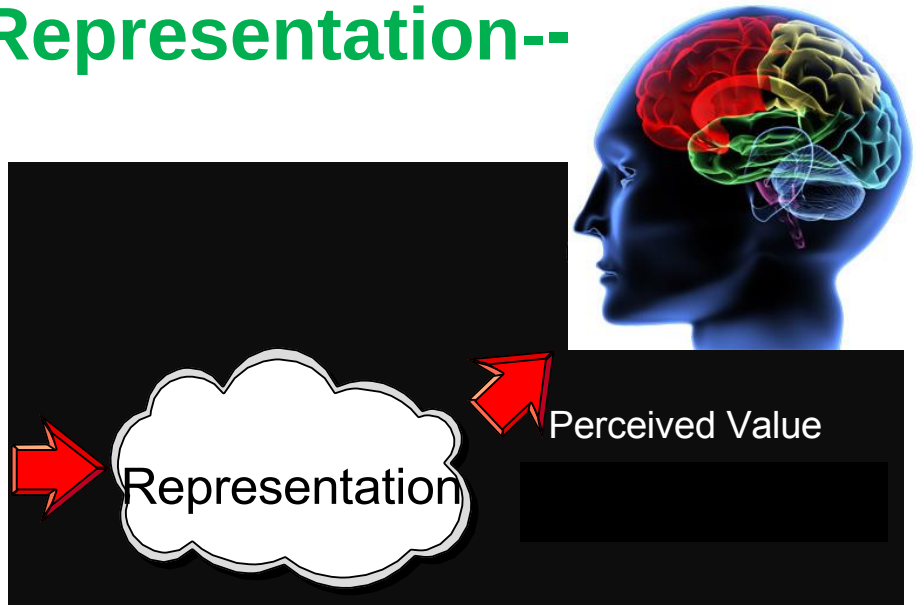
Who is Bernice Rogowitz?....



Word cloud of titles of 80 publications and patents, using wordle.net

What I'm Passionate About…

- **Perception and Visual Representation--**



Data values

MXP.USD.Spot.	MXP.USD.Vol.	MXP.USD.PnL.
0.118832	0.137188	114564.1158
0.118149	0.115969	-48707.9507
0.118086	0.131445	51803.99755
0.118443	0.132781	58951.08763
0.11905	0.116318	-46097.4066
0.117538	0.133376	97975.05433
0.119826	0.128072	167225.3143
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0.117703	0.11729	1977.801513
0.119735	0.129778	163145.5884
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0.118032	0.12166	-8446.88587
0.117519	0.122433	46316.33933
0.119049	0.118973	-24946.8717

Monte Carlo Risk Analysis Data

- **Many visual dimensions**
- **Many different tasks**
- **Many different perceptual, cognitive, and affective systems**

Colormaps for Representing Magnitude

MXP.USD.Spot	MXP.USD.Vol.	MXP.USD.PnL.
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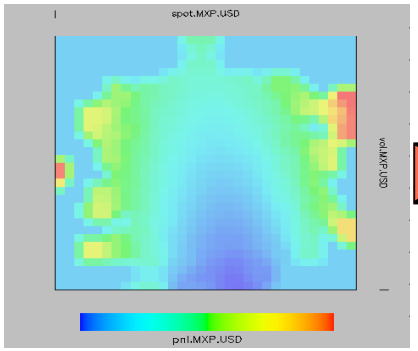
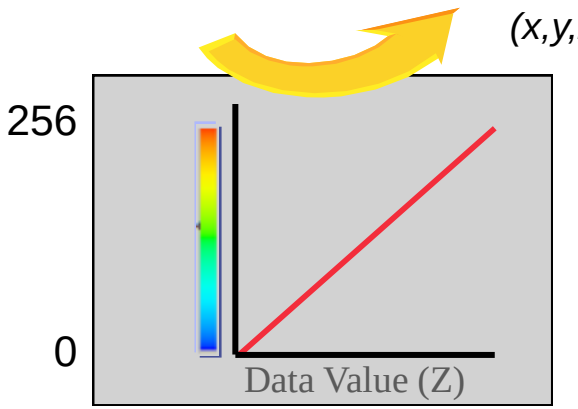


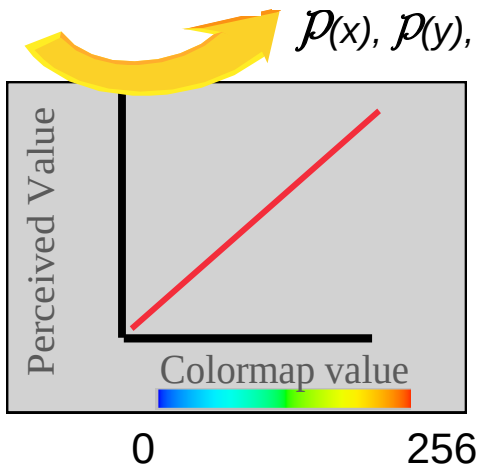
Representation value

(x,y,z)

Perceived value

$\mathcal{P}(x)$, $\mathcal{P}(y)$, $\mathcal{P}(z)$

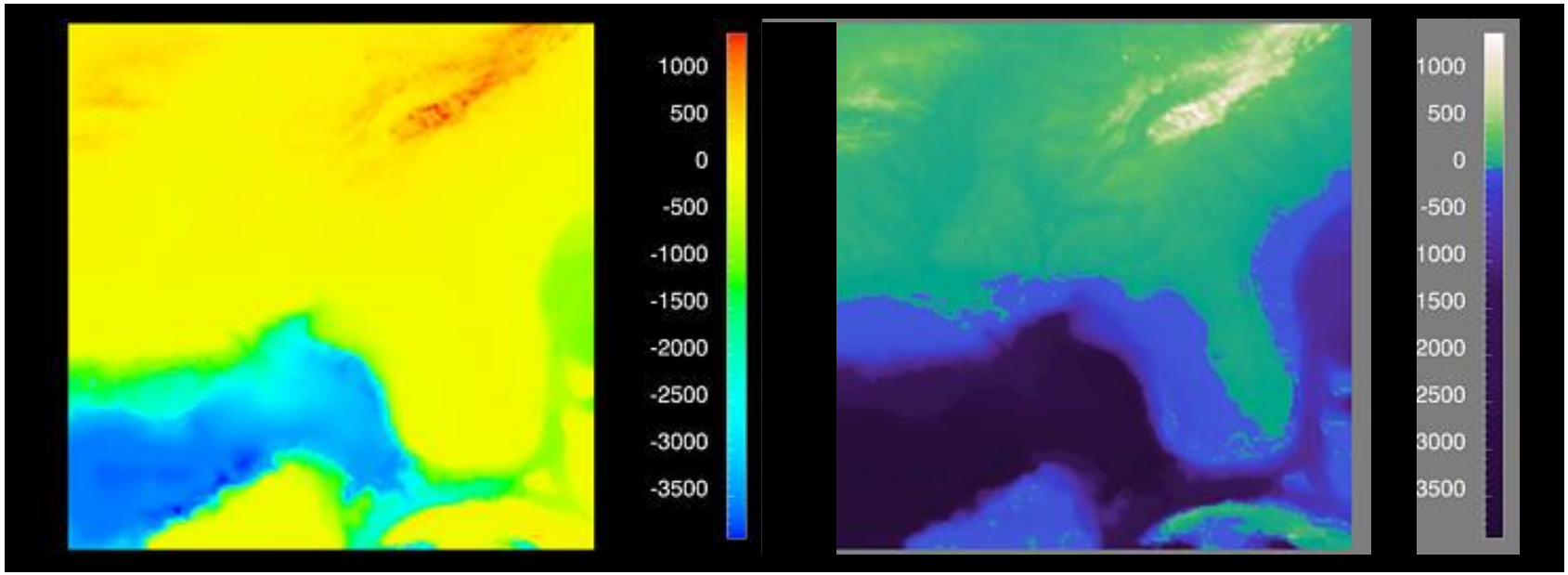




Do equal steps in the data correspond to equal perceptual steps?

Representing magnitude with the (still) ubiquitous Rainbow Colormap

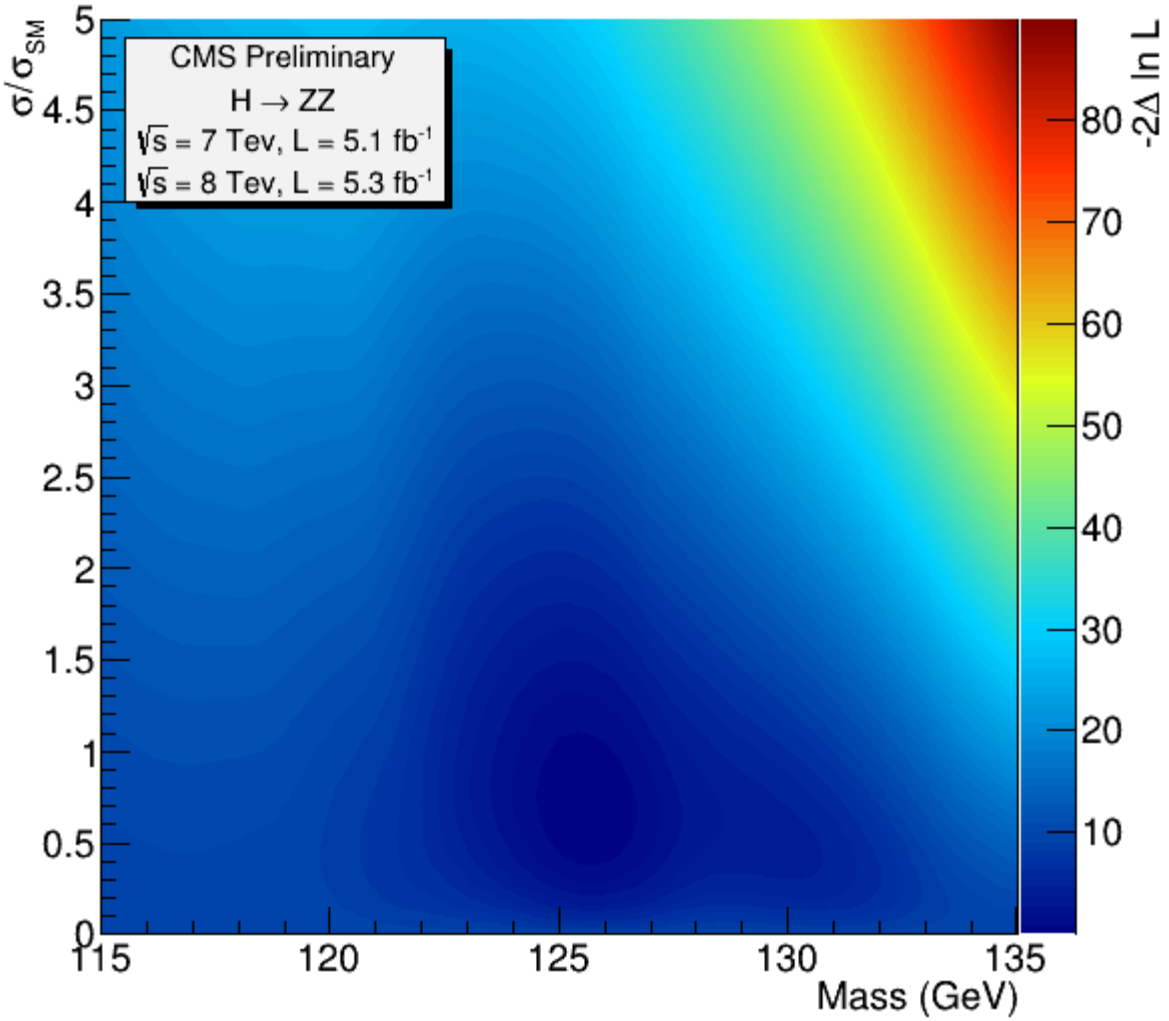
Two different views of the same data



To faithfully represent magnitude for high spatial-frequency data, the colormap needs a monotonic luminance component; hue can be used to highlight and name.

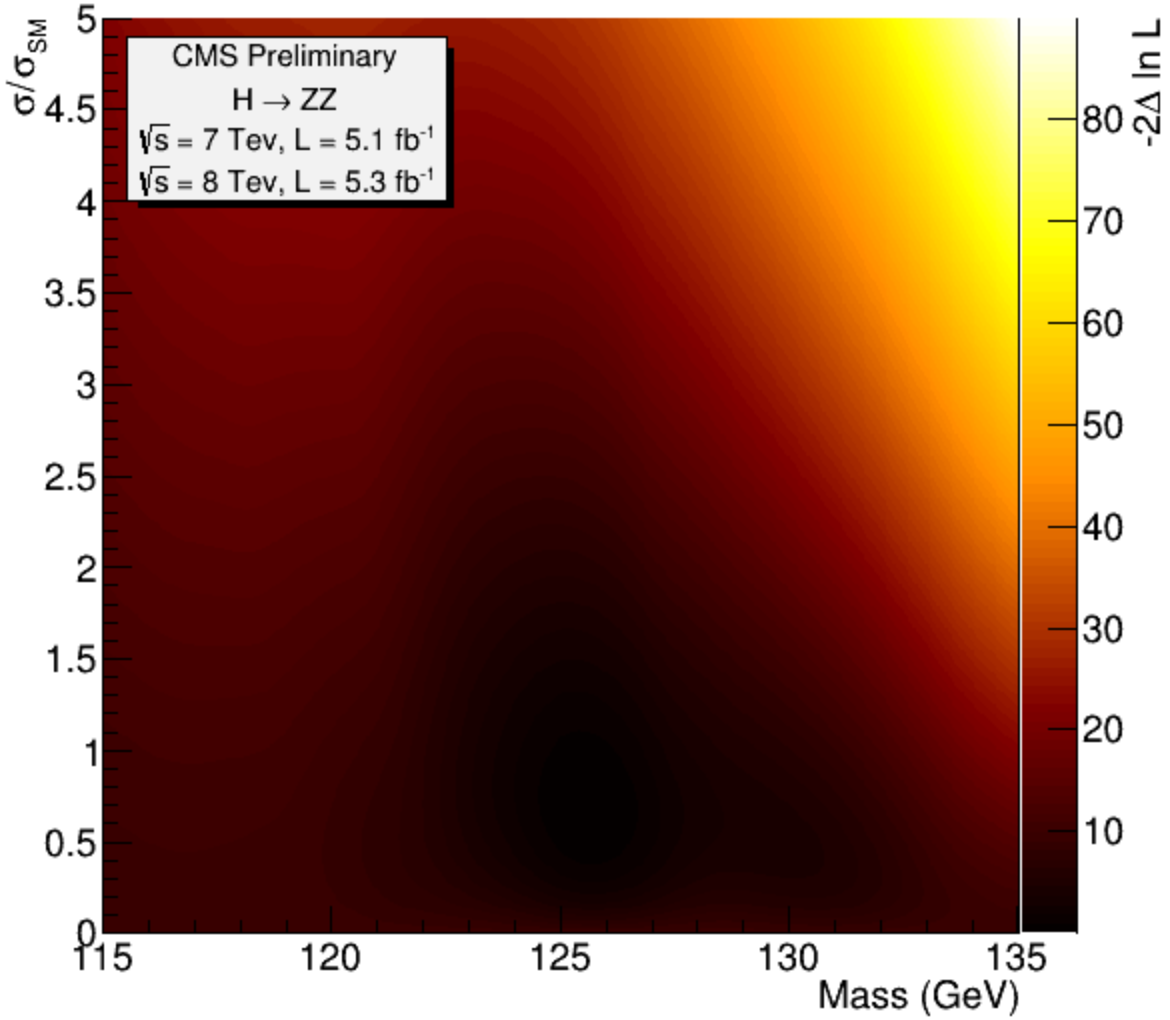
Rogowitz and Treinish, “The End of the Rainbow”

Representing the Higgs-Boson Data



Higgs Boson data from CERN, showing the mass measured at a particle detector when accelerated particles collided, showing the "signature" voltage at ~125 GeV/cm2. (Rogowitz and Couet, http://root.cern.ch/drupal/content/rainbow-color-map

Monotonic Luminance Color Map



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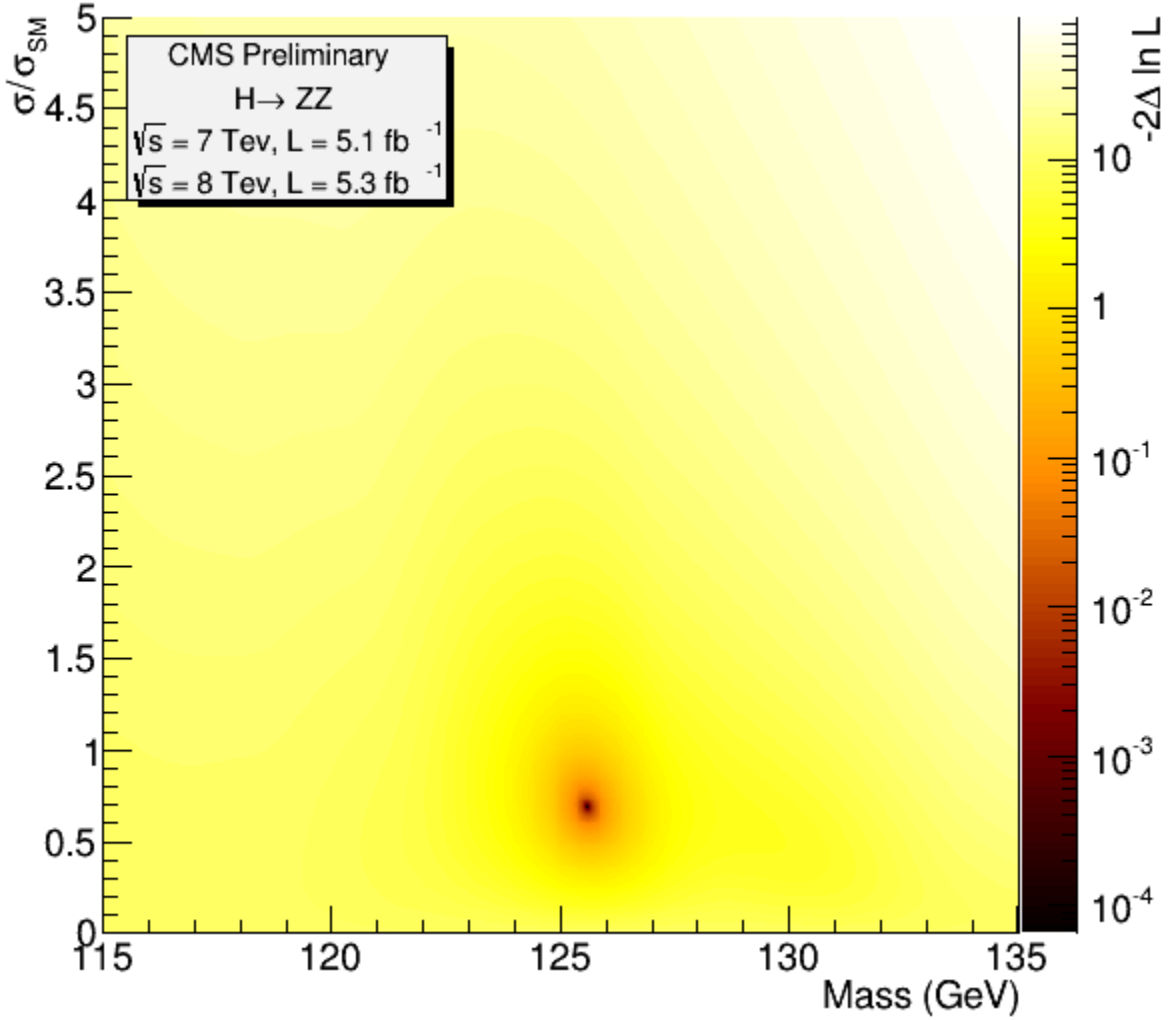
Log Transform



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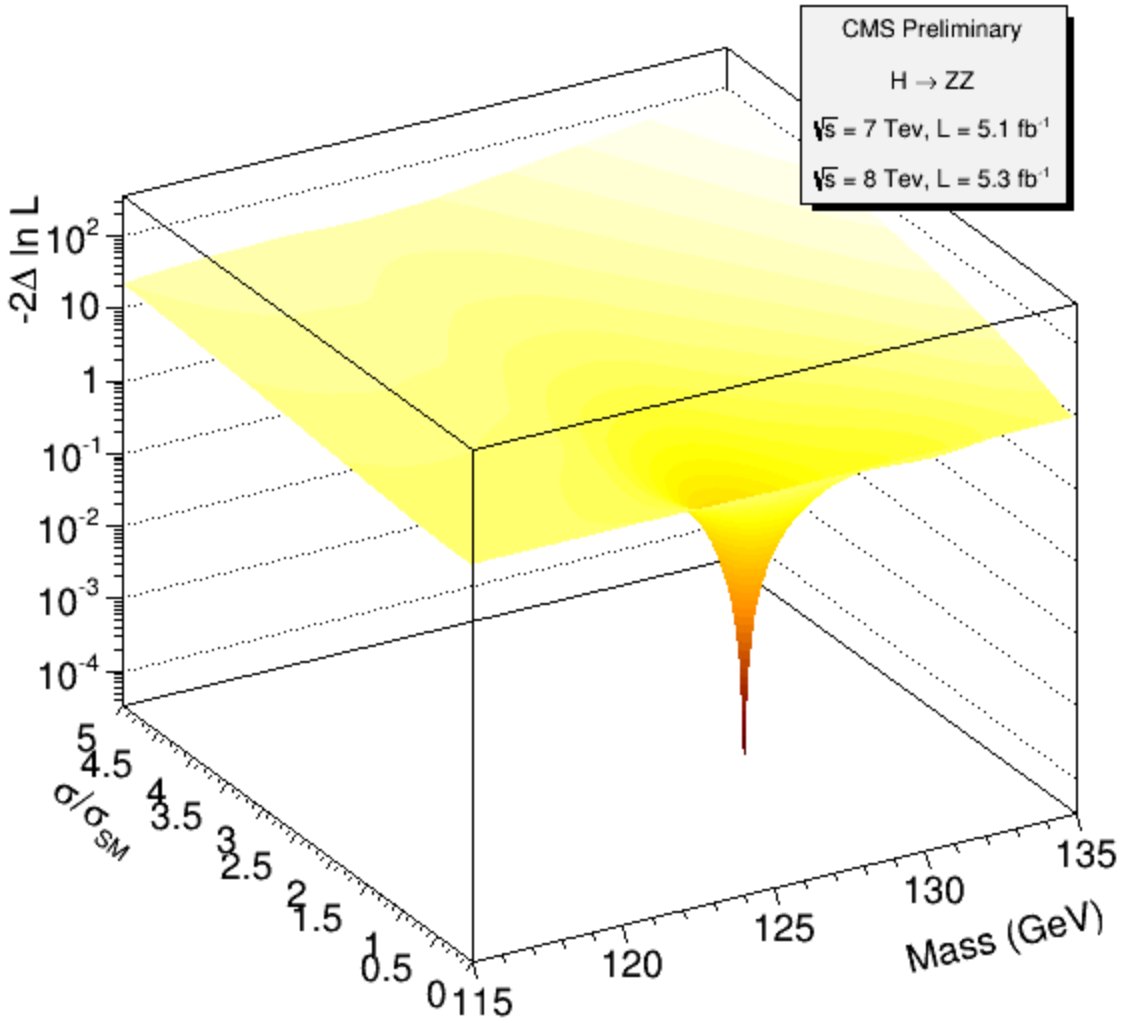
Deformed Surface- redundant coding



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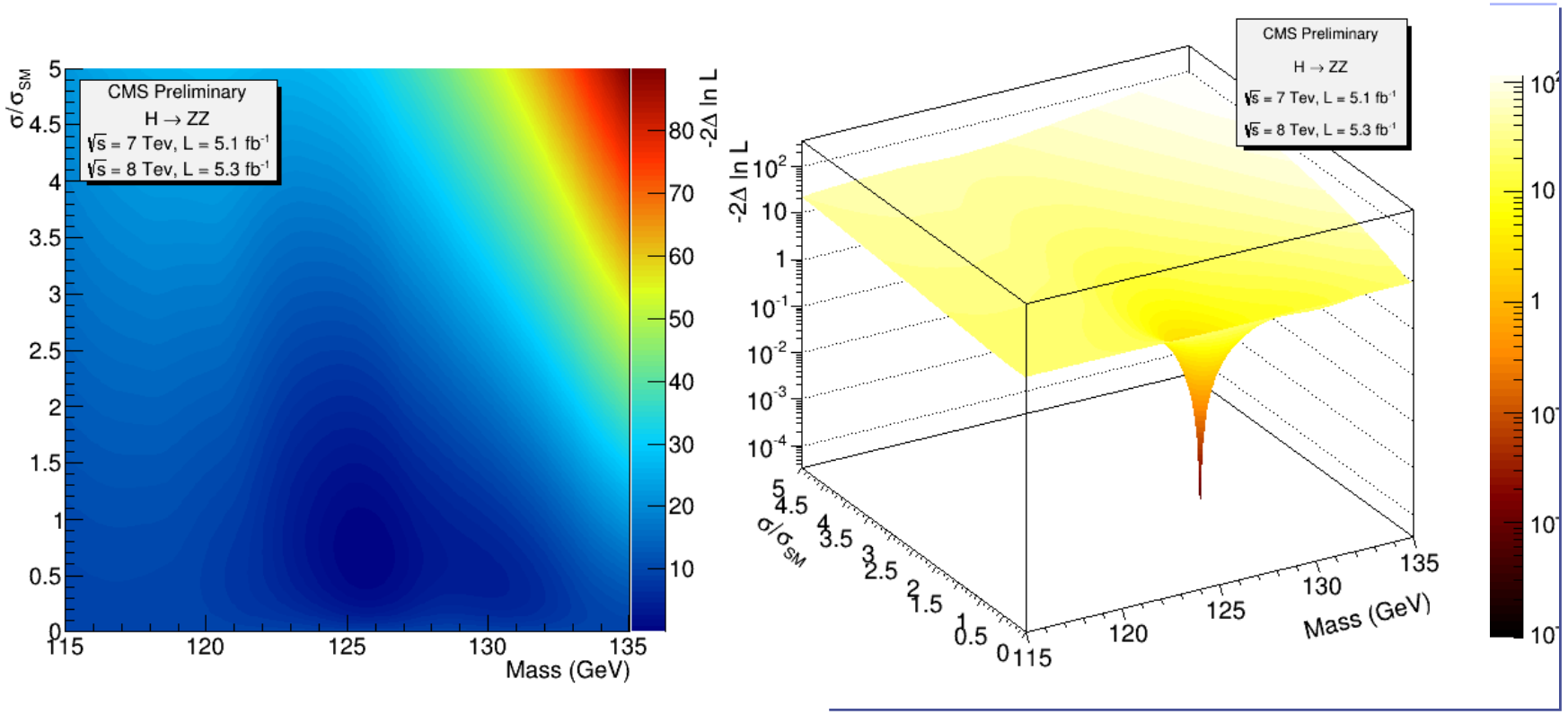
Two visualizations of the Higgs-Boson data



There are many choices in how to represent data, which can significantly influence how the data will be perceived and interpreted.

What I'm Passionate About…

- **Matching the representation to the task**

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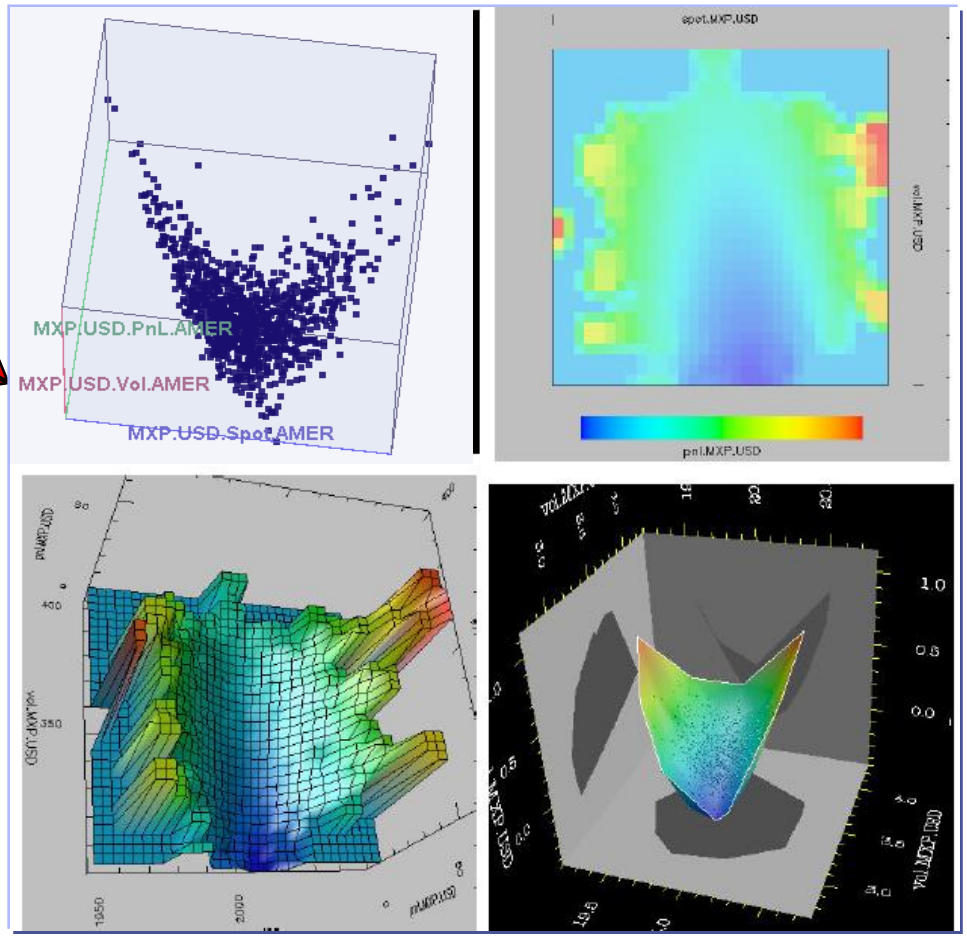
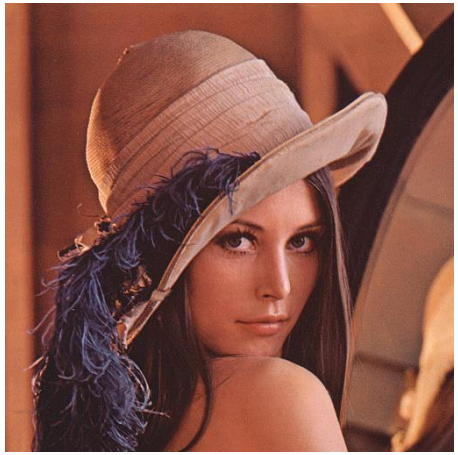
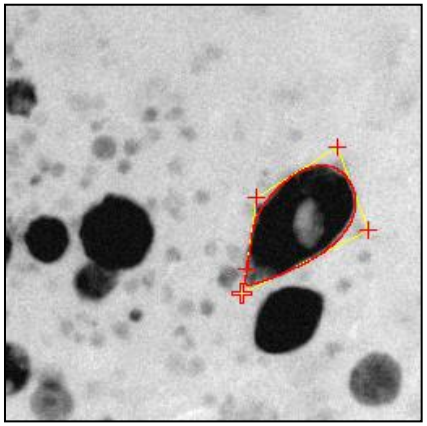


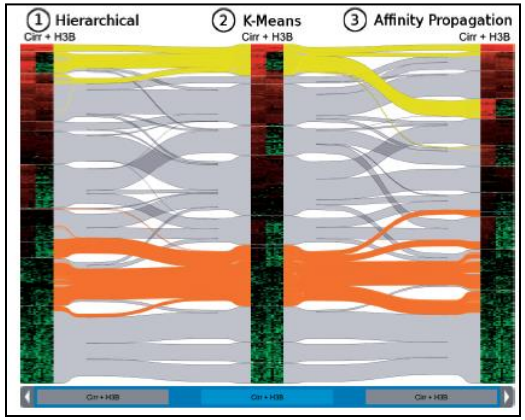
What I'm Passionate About…

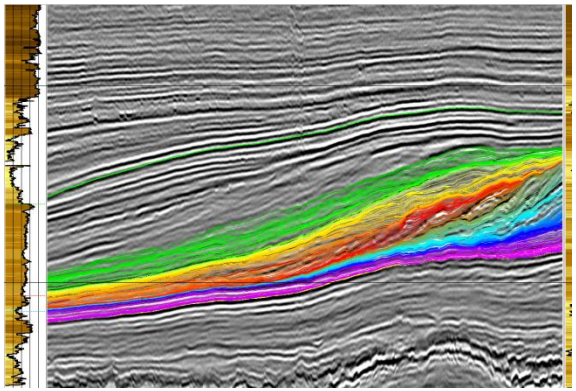
- **Semantic Features--**

- How to represent, explore, discover meaningful features in the data
  - Image artifacts
  - Diagnostic indicators in medical images
  - Correlations, outliers and interaction effects
  - Signatures in geological data
  - etc.





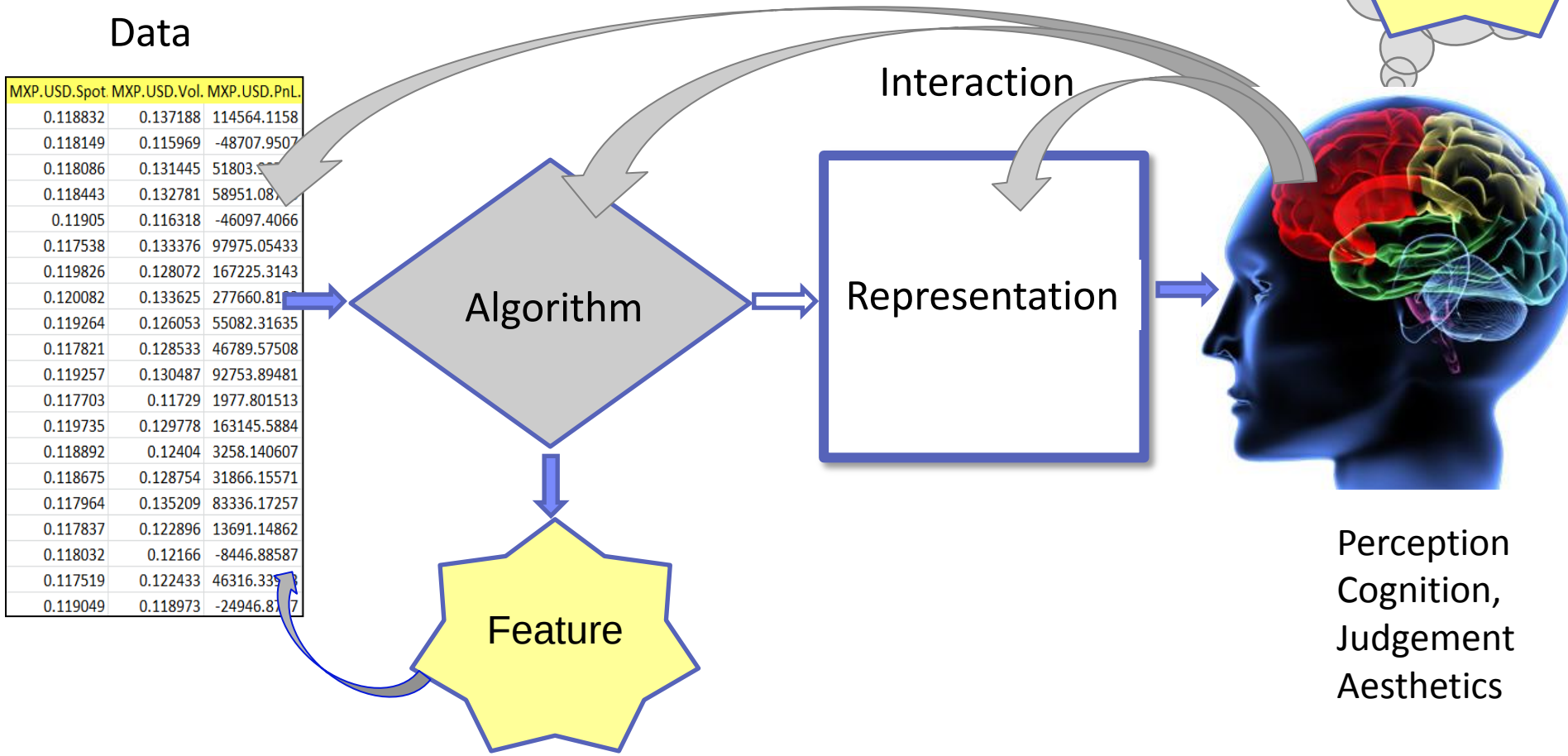




What I'm Passionate About…

- **Interacting with visual and algorithmic operations**

….visualization as an analysis tool



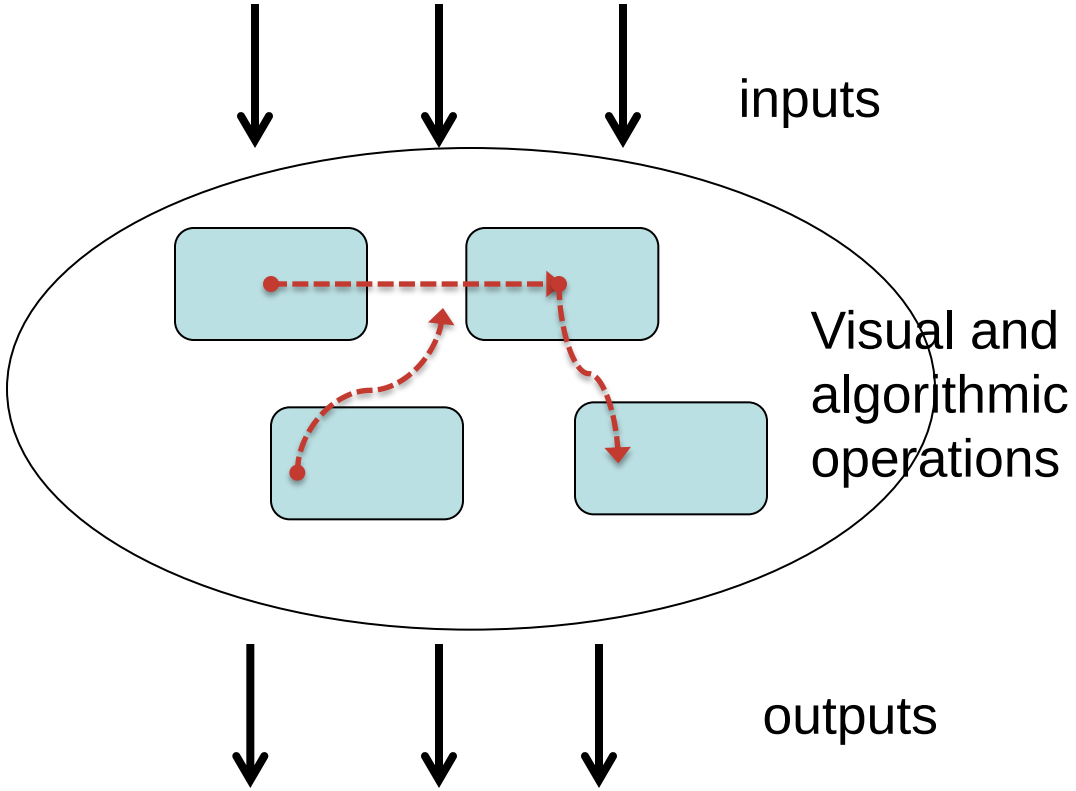
Current Challenges

- **Entrenched Attitudes**
  - Visualization is the “pretty picture” you make after all the “real” work is done
  - Why is perception research relevant? Everyone can see what looks good!
  - Evaluation studies are just a painful stumbling block to getting a Vis paper accepted
  - All you need for visualization is a smart programmer and a nifty visualization tool
- **Gaps in the Data Science Curriculum**
  - Human perception and cognition; Methods for problem solving and analysis; Experimental design; Broadening of the application base (Scientific, medical, humanities, finance, social/advertising)

My Wish List

- **Visualizing Models -**

- What are the moving parts of a model? How do they interact? Where are the sensitivities?
- Goal: Visualization techniques that enable better insight into the actual workings of a model.



My Wish List

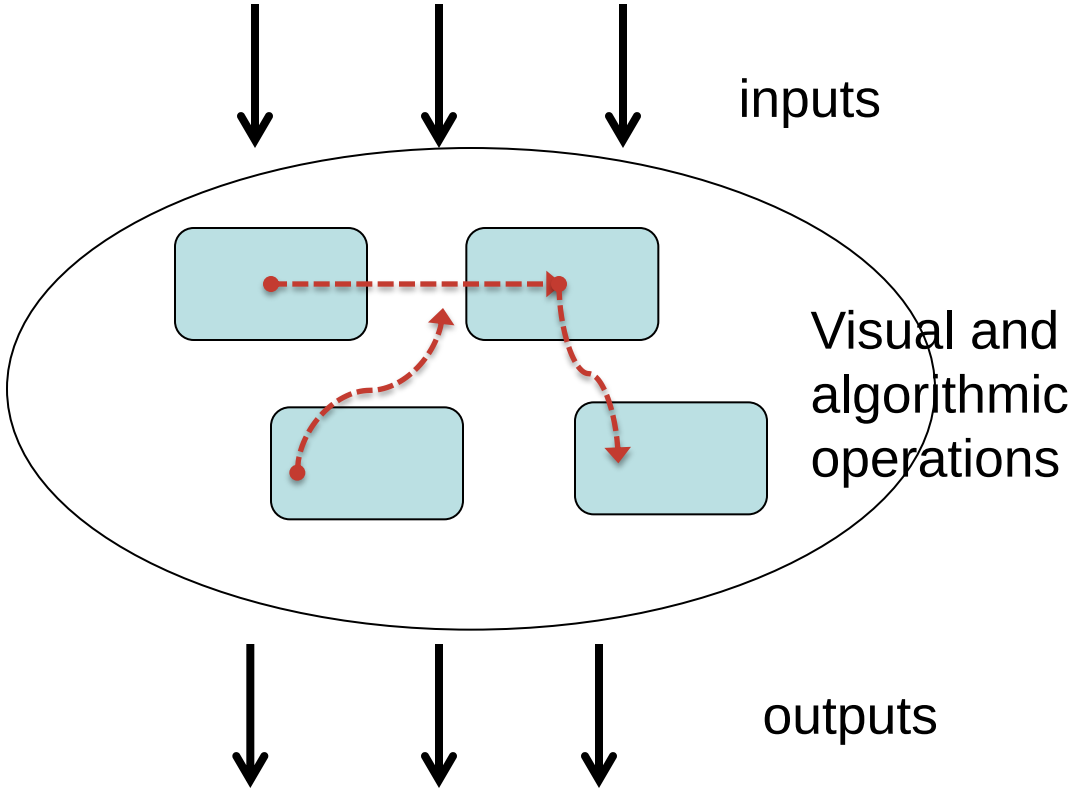
- **Analysis and Problem Solving**

- Descriptive Analysis
- Hypothesis Generation

  Exploratory Data Analysis

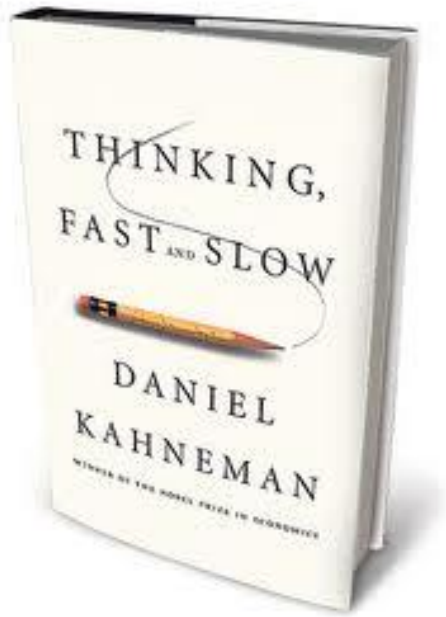
  What-if analysis
- Design

  Interactive selection of tools, methods, and constraints



My Wish List

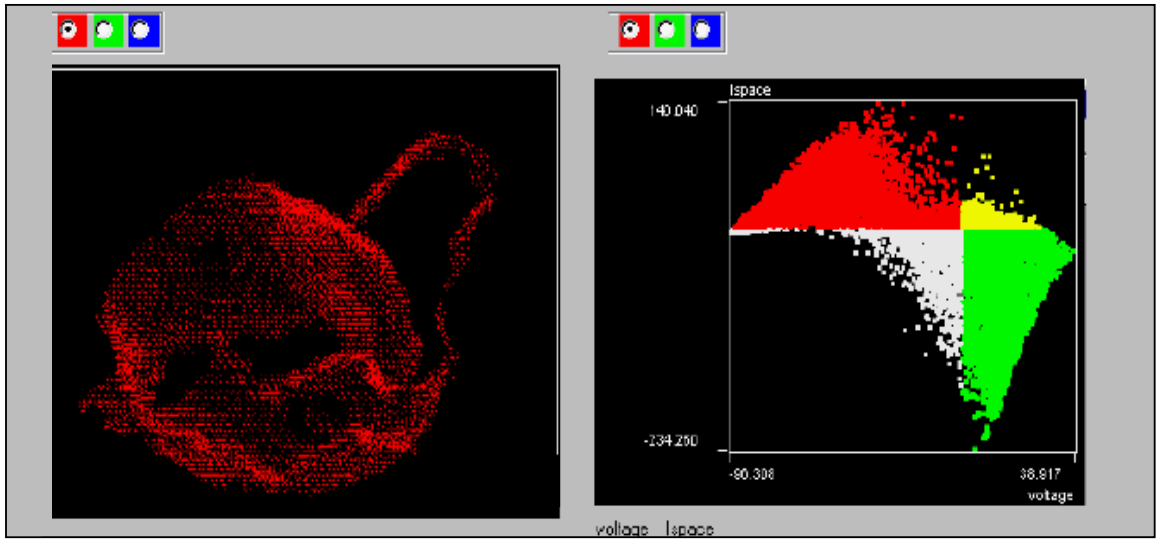
- **Risk, uncertainty and interaction effects**



- Humans make systematic mistakes judging probabilities, evaluating risk, and understanding interactions
- Opportunity for Visualization tools
- Evaluation

My Wish List

- **Haptic interfaces**



- "Feeling" interaction effects in visualized models, uncertainty in 3-D objects, or physical properties
- Editing and shaping surfaces
- Goal– Understanding how and where haptic interfaces enhance pattern recognition and problem solving. And why.

My Wish List

- **Taxonomy of analysis tasks**
  ...and enabling visualization methods

Spatial comparisons

Discontinuities, anomalies and outliers

Temporal comparisons

Feature identification and characterization

Identifying interaction effects

Aesthetics

Emotion

Memory

Attention

Naming/identification

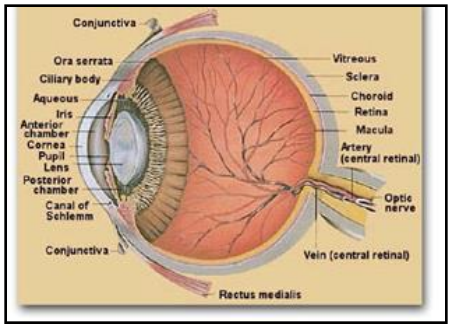
Magnitude estimation

Detection/Recognition

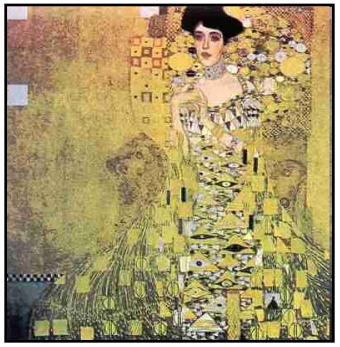
- What are the fundamental components of analysis?
- What visual, perceptual and cognitive mechanisms are entrained?
- Goal: Visualization techniques that support and stimulate the visual and cognitive processes involved in analysis

My Biggest Wish …a Science of Visualization

Drawing



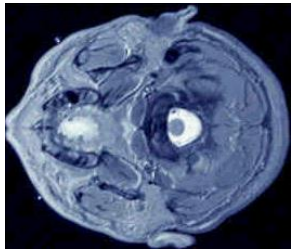
Illustration



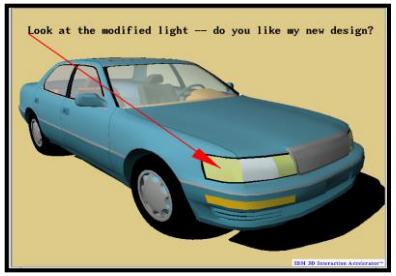
Painting

Design

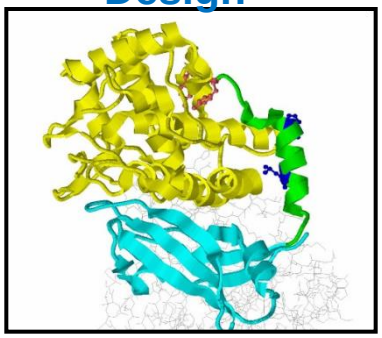
Photography



Imaging

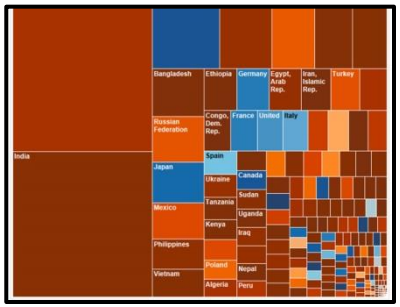


Computer Aided Design

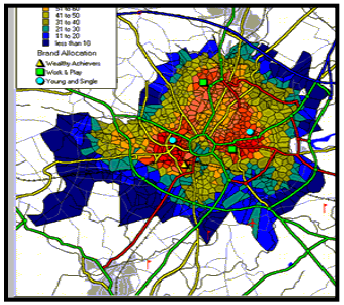


Computer Graphics

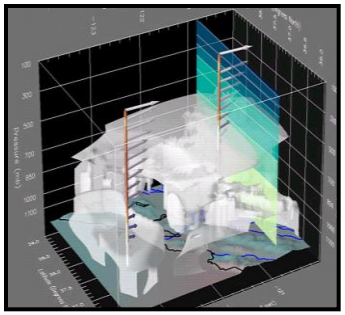
Charting



InfoVis



GIS



Scientific Visualization