Towards Perception-aware Interactive Data Visualization Systems

Eugene Wu / Arnab Nandi
Columbia University / The Ohio State University
Interaction
Interaction
Interactive Visualization
Output Awareness

- Don’t show more data than # pixels in output

Approximation

- Read less data & render approximate results

M4 (database community)  Error bars, uncertainty

Immens (viz community)  Sampling/OnlineAgg
Perceptual Awareness
Resolution Awareness
Create Vis
Graphical Perception Cleveland et al.

TYPE 1

TYPE 4

logerr

true value

true value
Just Noticeable Difference

how much change before you notice?

\[ \text{JND} \sim k \times \text{Magnitude} \]

Weber’s Law
Steven’s Law
Perceptual Functions as Abstractions

Univariate (Cleveland)
\[ p_{\text{enc}}(\text{true value}) = \text{err of perceived value} \]

Bivariate (JND)
\[ p_{\text{enc}}(\text{true val}_1, \text{true val}_2) = \text{err of perceived difference} \]
Exploration Specifications

```
SELECT gb_0, ..., gb_m, agg_0(v_0), ...
FROM (  
    SELECT gb'_0, ..., gb'_p, agg'_0(v'_0), ...
    FROM T1 (JOIN T2 ON a_x)?  
    WHERE gb'_0 = ? and ... a'_0 = ? ...  
    GROUP BY gb'_0, ..., gb'_p  
) as exploration_data
WHERE gb_0 = ? and ... a_0 = ?, ... and a_n = ?
GROUP BY gb_0, ..., g_m
RENDERED BY <chart>, E_1, ...,  
PERCEIVED BY P_1, ...
```
Animated Graphical Perception
Logerr vs fps
facetted on rate of change
The Wu Lab at Columbia

DB

Vis
The Wu Lab at Columbia
The Wu Lab at Columbia
interactive data systems

arnab’s research group at ohio state

End User Interaction / Next Gen Interfaces

My Work

Database Systems

Fast, Low-latency, Rapid query-response

Human-in-the-loop

Iterative, Session-oriented, ad-hoc
Exploration Specifications
+
Perceptual Accuracy

http://perceptvis.github.io

This work is supported by the National Science Foundation