

Towards Perception-aware Interactive Data Visualization Systems

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(faster)

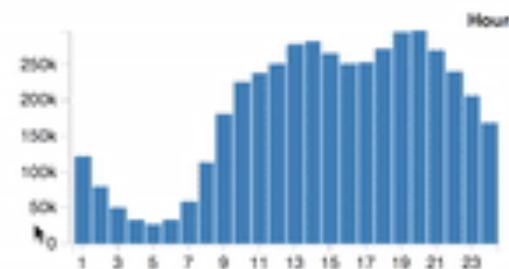
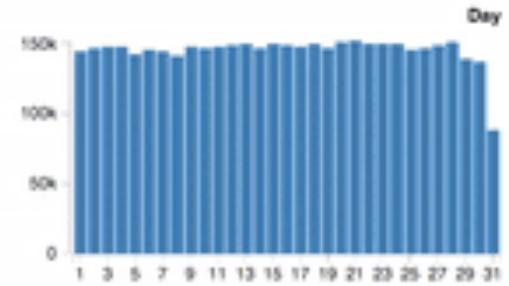
VIZ

Interaction



Interaction





Interactive Visualization

Output Awareness

Don't show more data
than # pixels in output

M4 (database community)

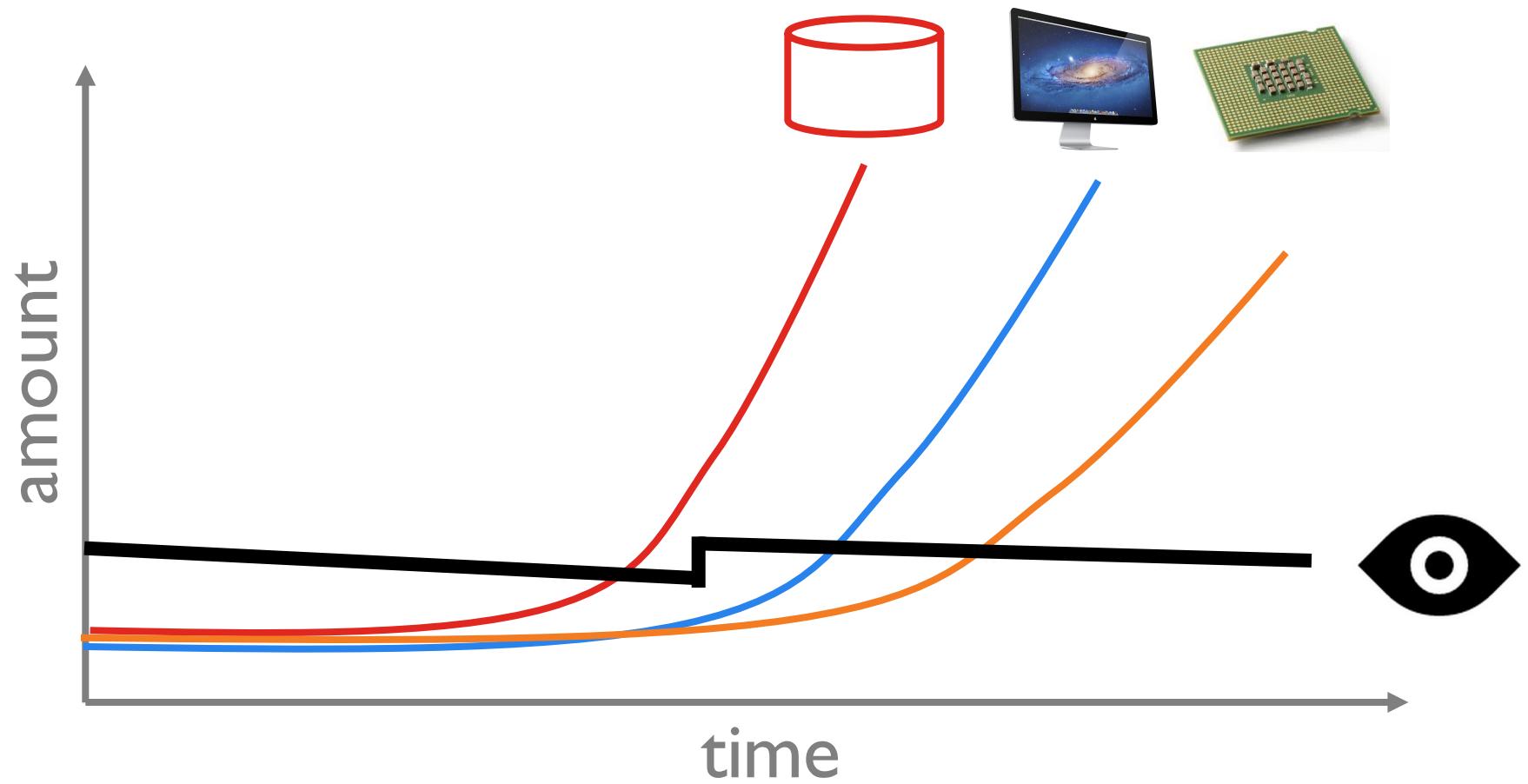
Immens (viz community)

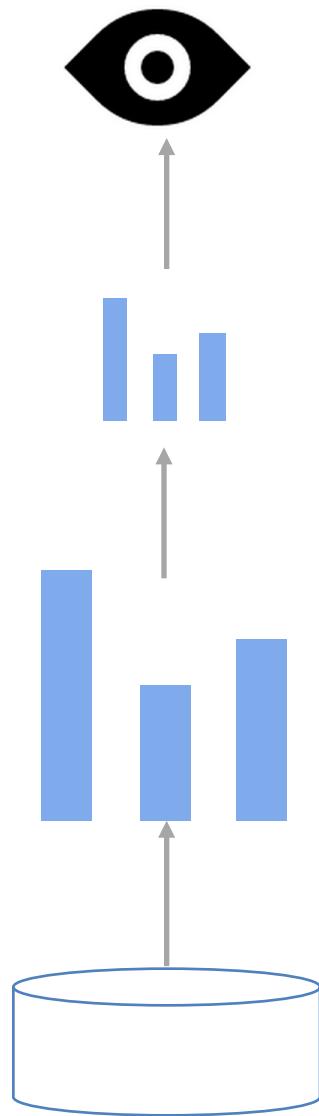
Approximation

Read less data & render
approximate results

Error bars, uncertainty

Sampling/OnlineAgg





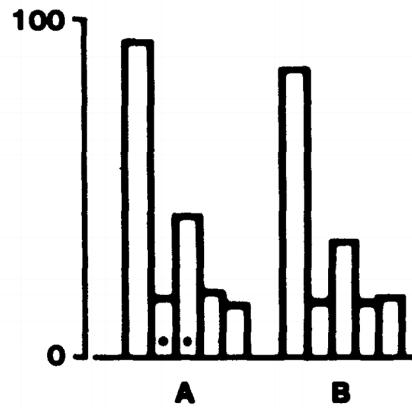
Perceptual Awareness

Resolution Awareness

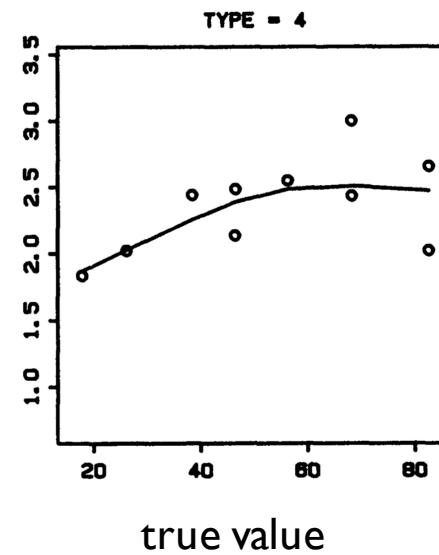
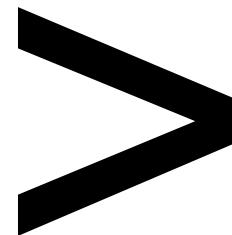
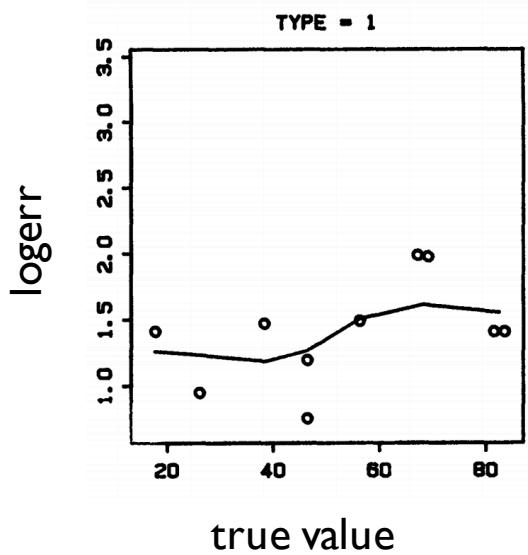
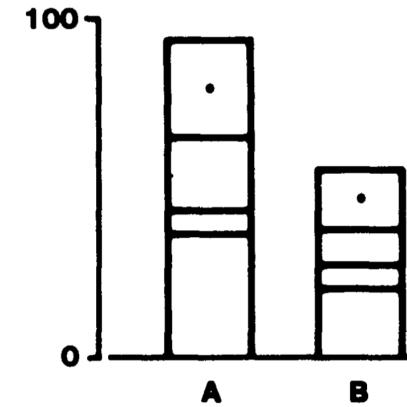
Create Vis

Graphical Perception Cleveland et al.

TYPE 1



TYPE 4



Just Noticeable Difference

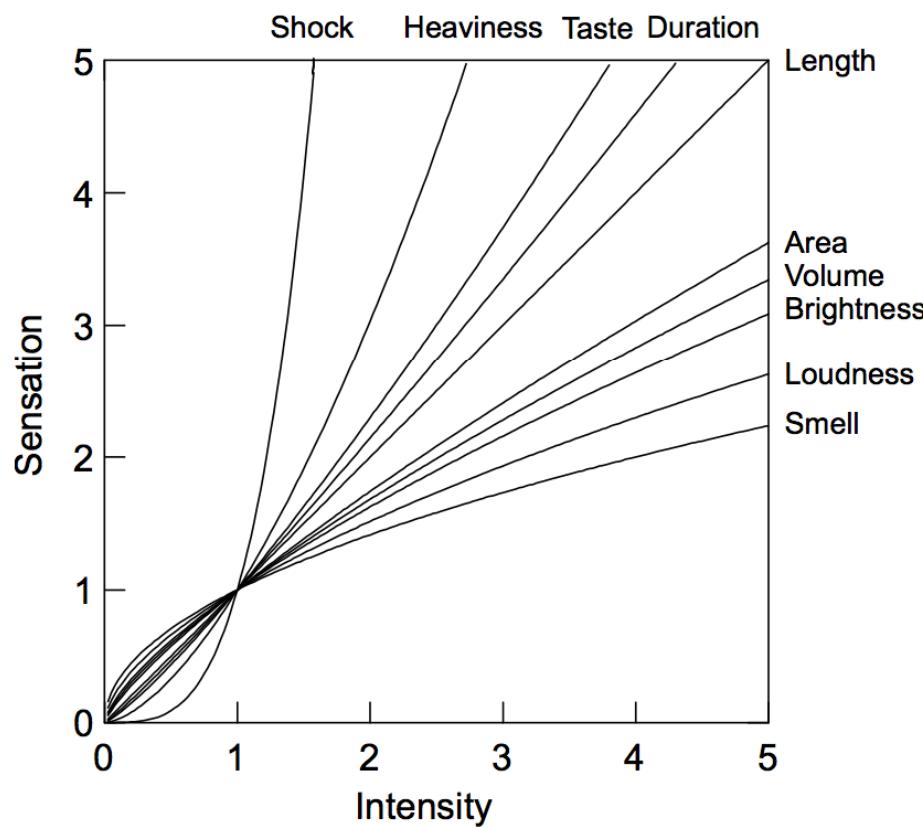
how much change before you notice?

$$JND \sim k * \text{Magnitude}$$

Weber's Law

Steven's Law

Just Noticeable Difference



Δ Magnitude before
user notices

$$JND \sim k * \text{Magnitude}$$

Weber's Law
Steven's Law

Let's use graphical perception
for interactive visualizations

Perceptual Functions as Abstractions

Univariate (Cleveland)

$$P_{enc}(\text{true value}) = \text{err of perceived value}$$

Bivariate (JND)

$$P_{enc}(\text{true val}_1, \text{true val}_2) = \text{err of perceived difference}$$

Exploration Specifications

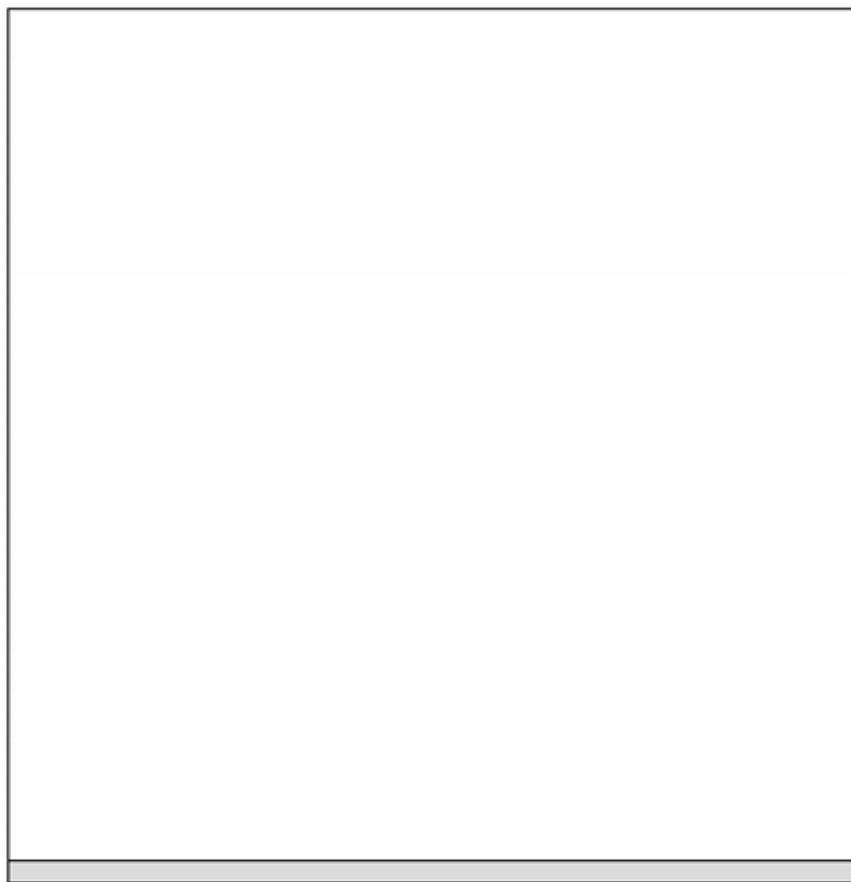
```
SELECT gb0, ..., gbm, agg0(v0), ...
  FROM (
    SELECT gb'0, ..., gb'p, agg'0(v'0), ...
      FROM T1 (JOIN T2 ON ax) ?
      WHERE gb'0 = ? and ... a'0 = ? ...
      GROUP BY gb'0, ..., gb'p
    ) as exploration-data
  WHERE gb0 = ? and ... a0 = ?, ... and an = ?
  GROUP BY gb0, ..., gm
  RENDERED BY <chart>, E1, ...
PERCEIVED BY P1, ...
```

HCI Community Perceptual Studies

Perceptual Functions

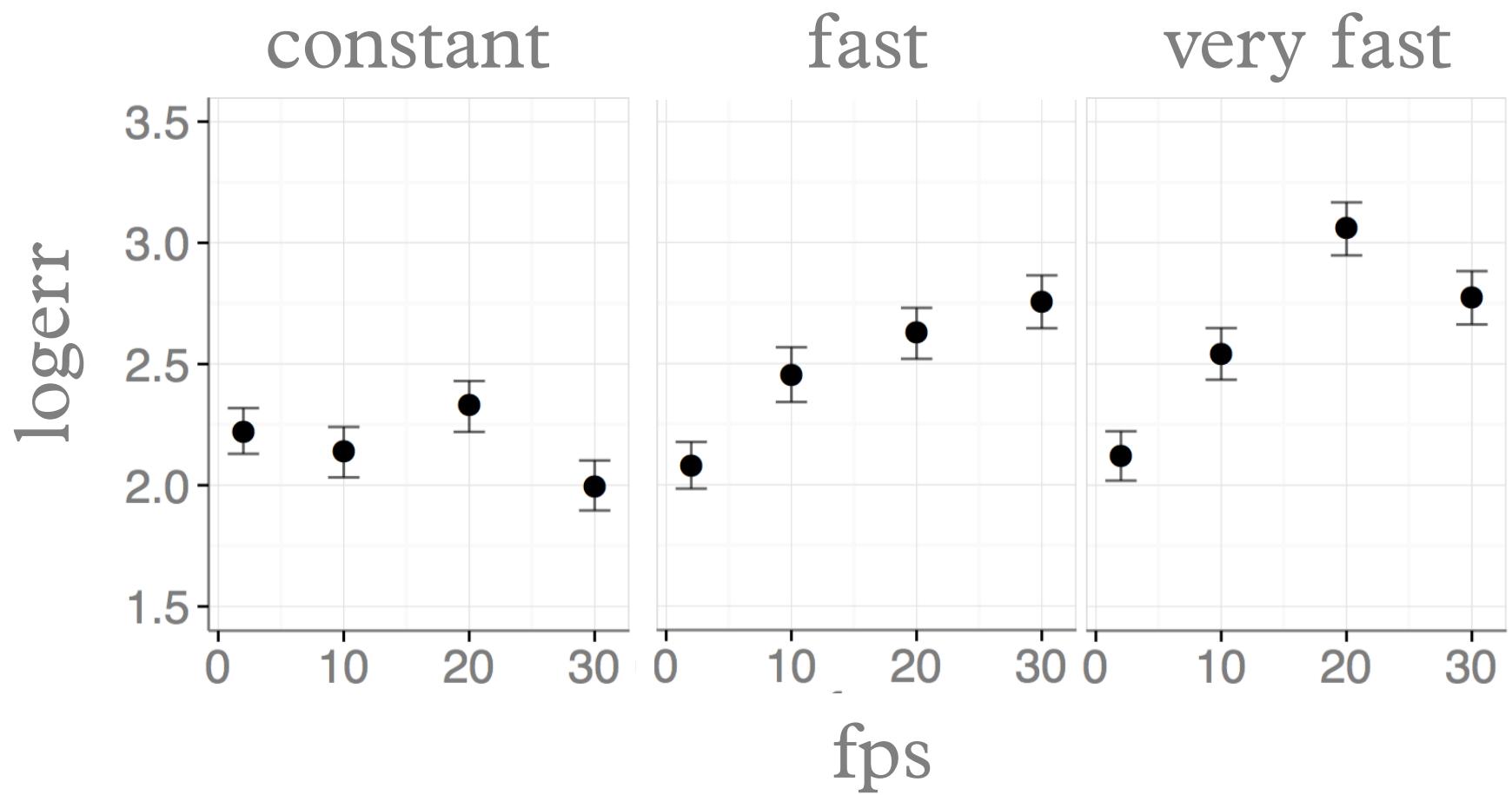
Database Community Optimizations

Animated Graphical Perception

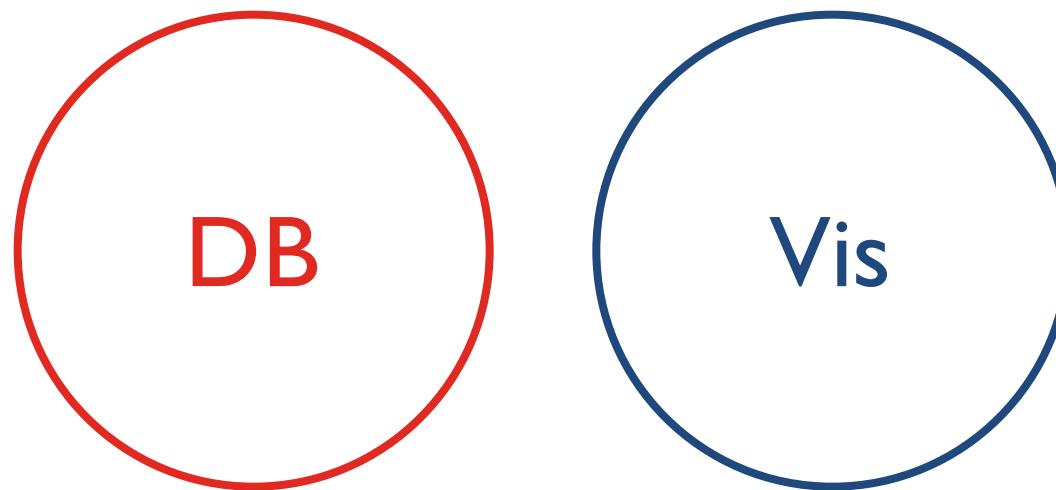


Logerr vs fps

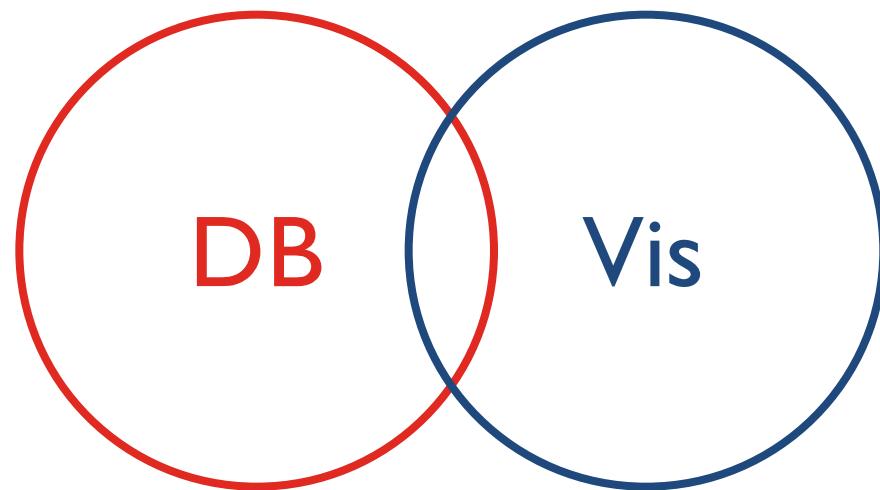
faceted on rate of change



The Wu Lab at Columbia



The Wu Lab at Columbia

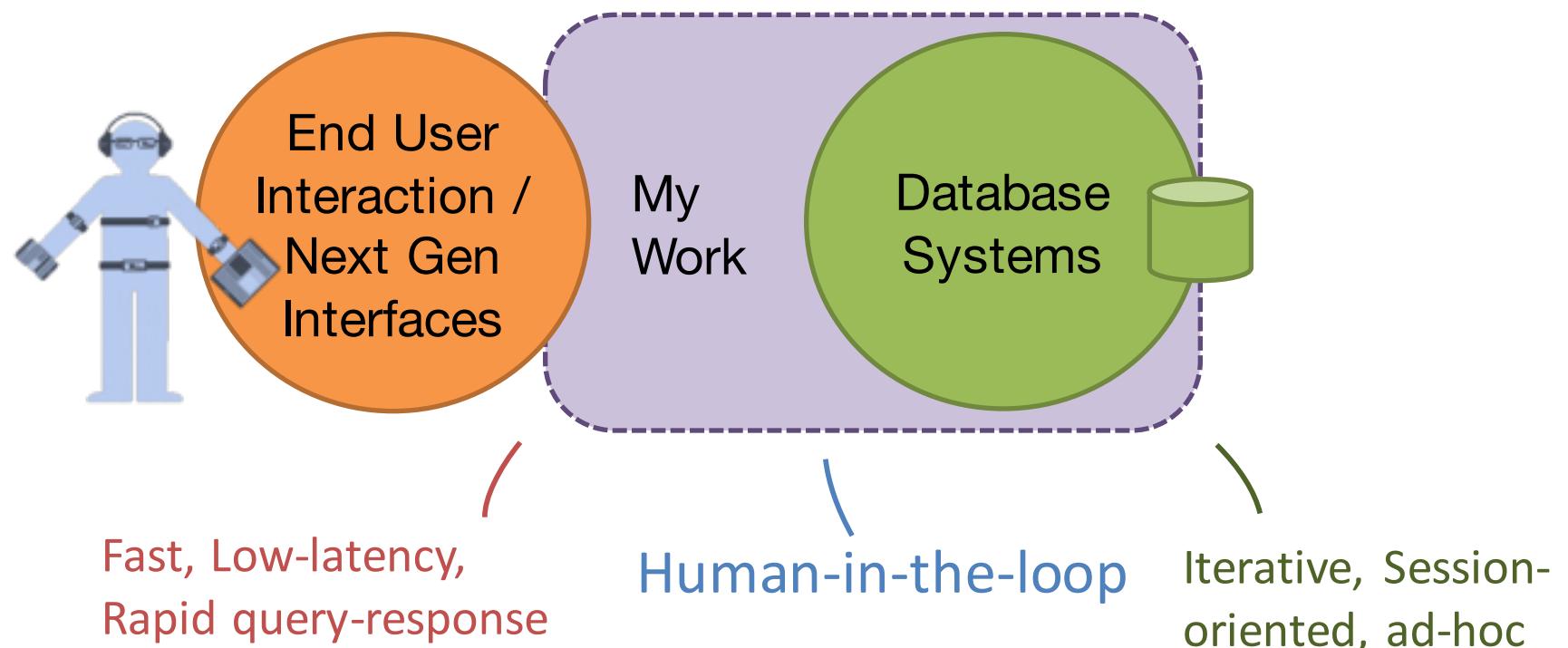


The Wu Lab at Columbia



interactive data systems

arnab's research group at ohio state



Exploration Specifications + Perceptual Accuracy

<http://perceptvis.github.io>



*This work is supported by the
National Science Foundation*



