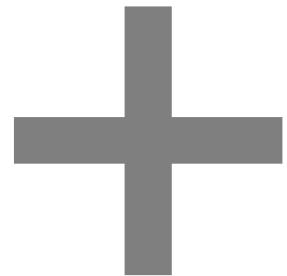


# Towards Perception-aware Interactive Data Visualization Systems

Eugene Wu / Arnab Nandi

Columbia University / The Ohio State University



(faster)

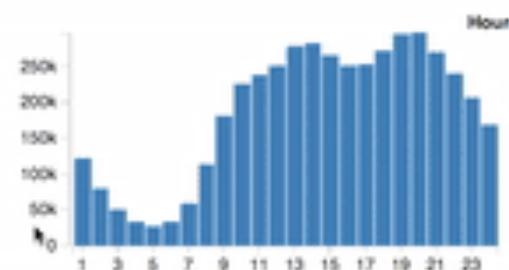
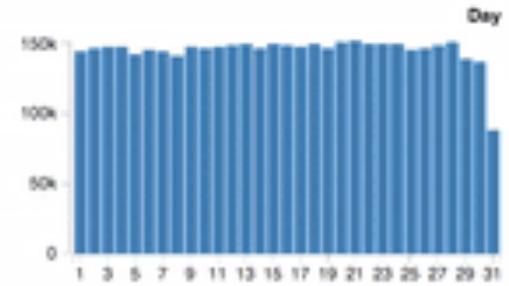
**VIZ**

# Interaction



# Interaction





# Interactive Visualization

# Output Awareness

Don't show more data  
than # pixels in output

M4 (database community)

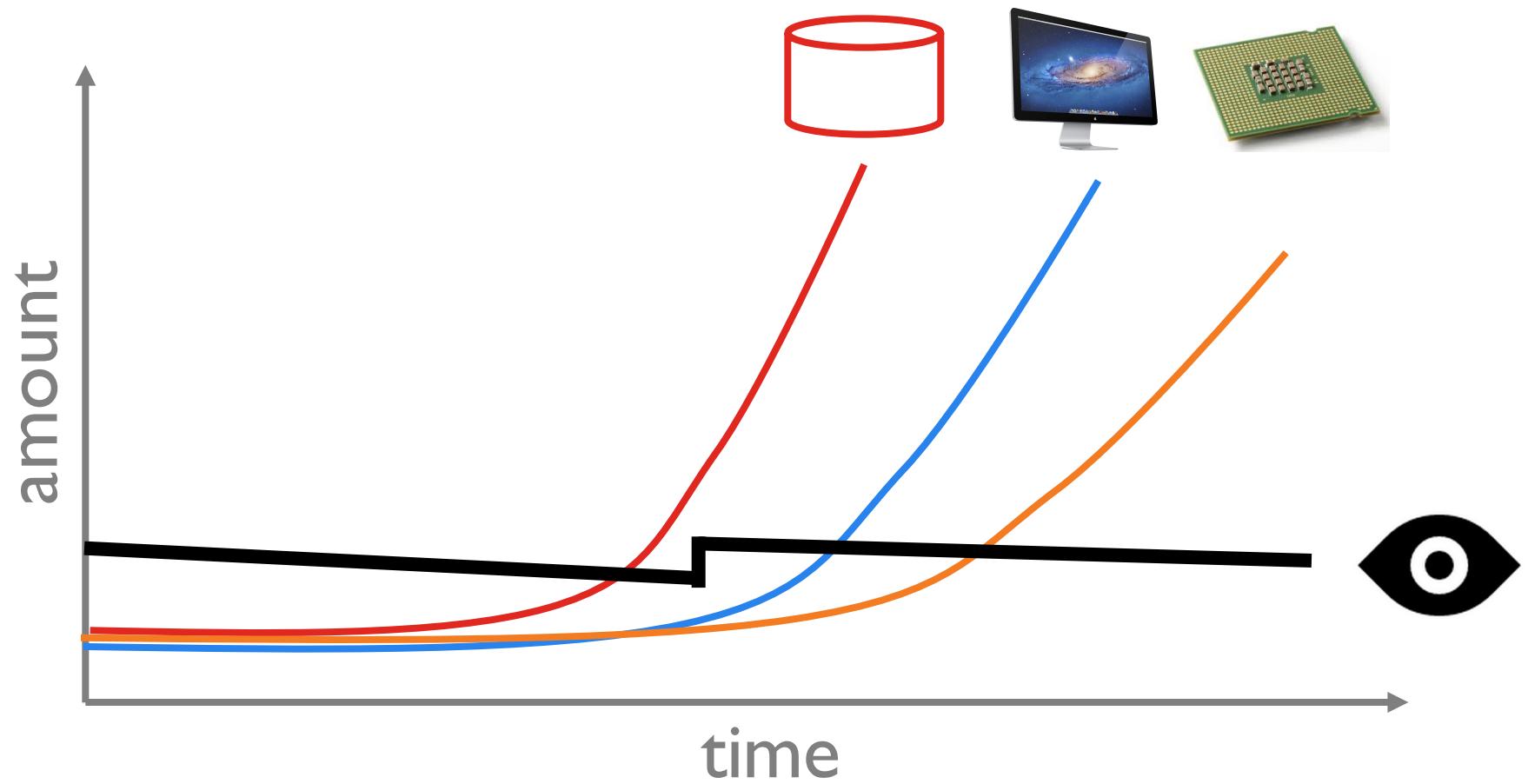
Immens (viz community)

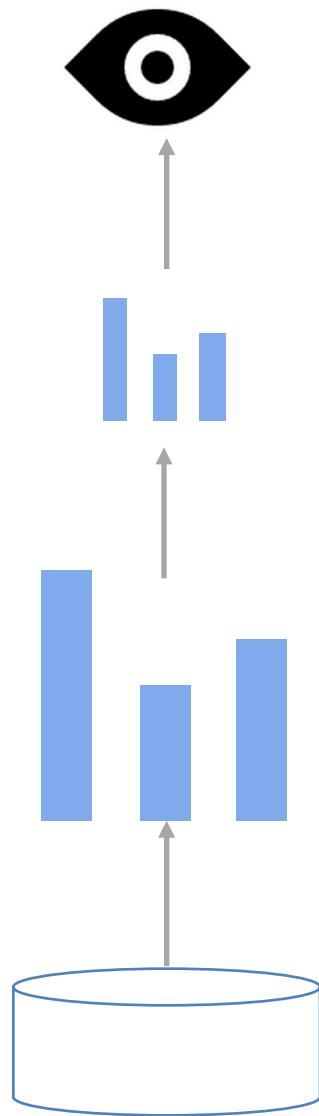
# Approximation

Read less data & render  
approximate results

Error bars, uncertainty

Sampling/OnlineAgg





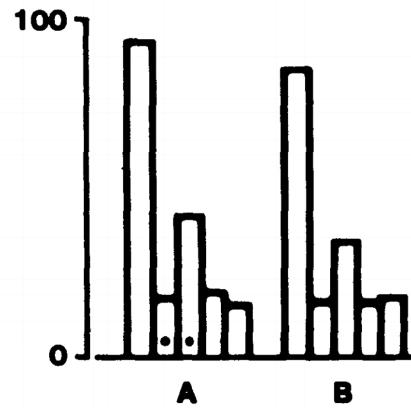
**Perceptual Awareness**

**Resolution Awareness**

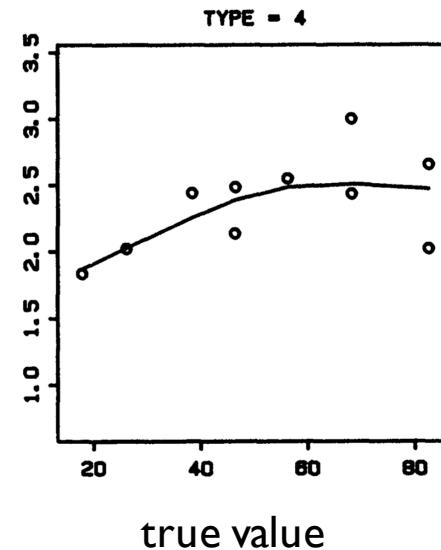
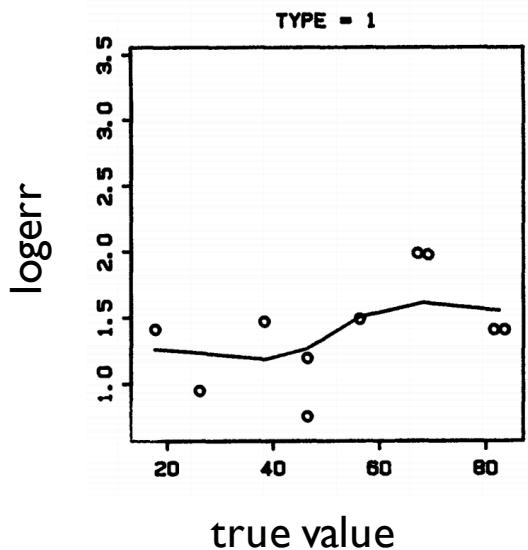
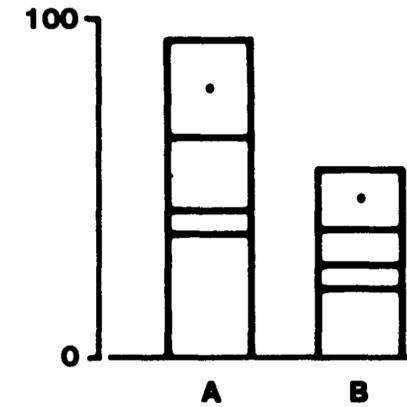
**Create Vis**

# 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

# 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

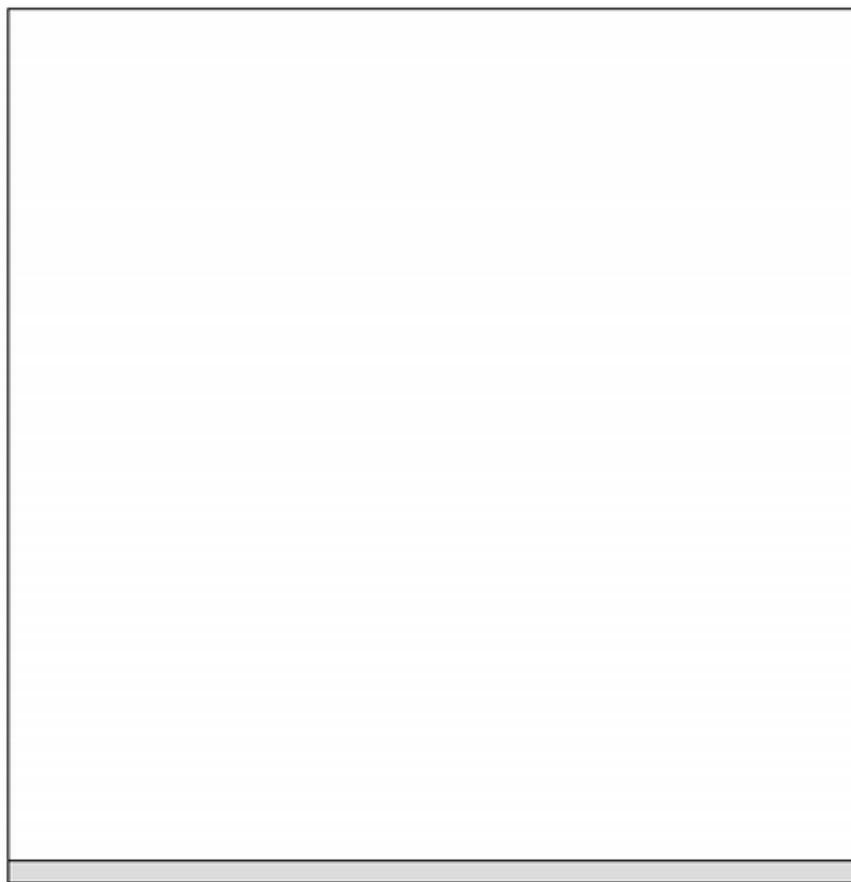
```
SELECT gb0, ..., gbm, agg0(v0), ...
  FROM (
    SELECT gb'0, ..., gb'p, agg'0(v'0), ...
      FROM T1 (JOIN T2 ON ax) ?
      WHERE gb'0 = ? and ... a'0 = ? ...
      GROUP BY gb'0, ..., gb'p
    ) as exploration-data
  WHERE gb0 = ? and ... a0 = ?, ... and an = ?
  GROUP BY gb0, ..., gm
  RENDERED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

# HCI Community Perceptual Studies

## Perceptual Functions

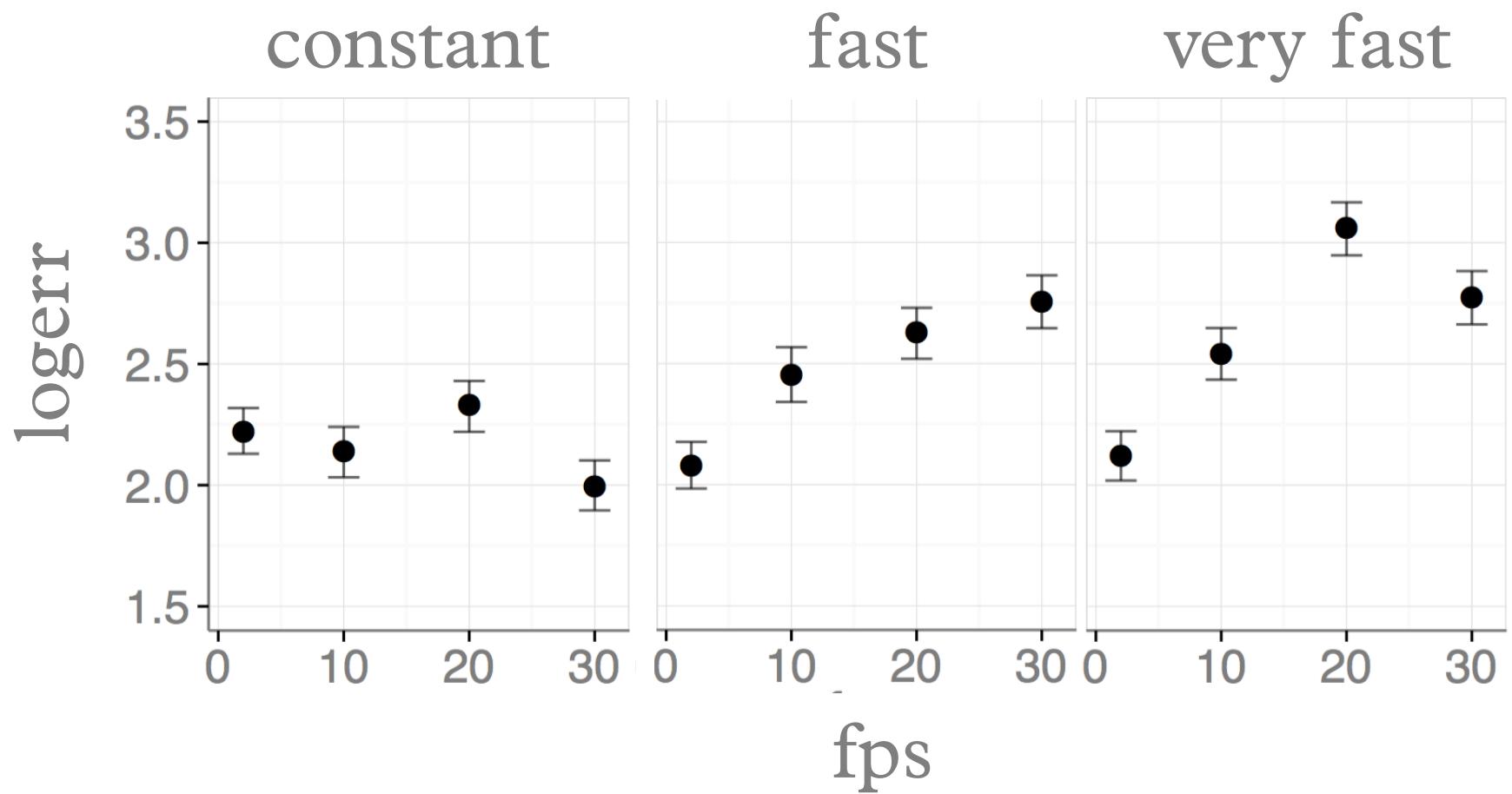
# Database Community Optimizations

# Animated Graphical Perception

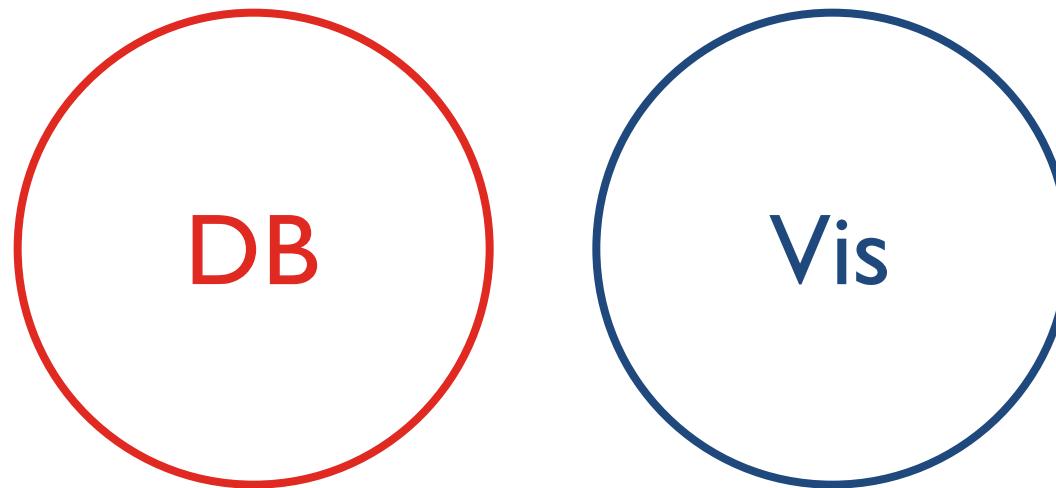


# Logerr vs fps

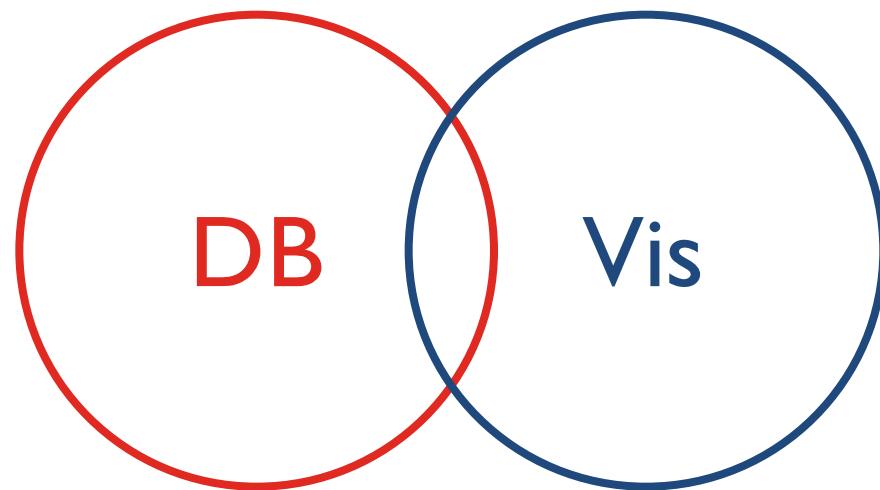
faceted on rate of change



# The Wu Lab at Columbia



# The Wu Lab at Columbia

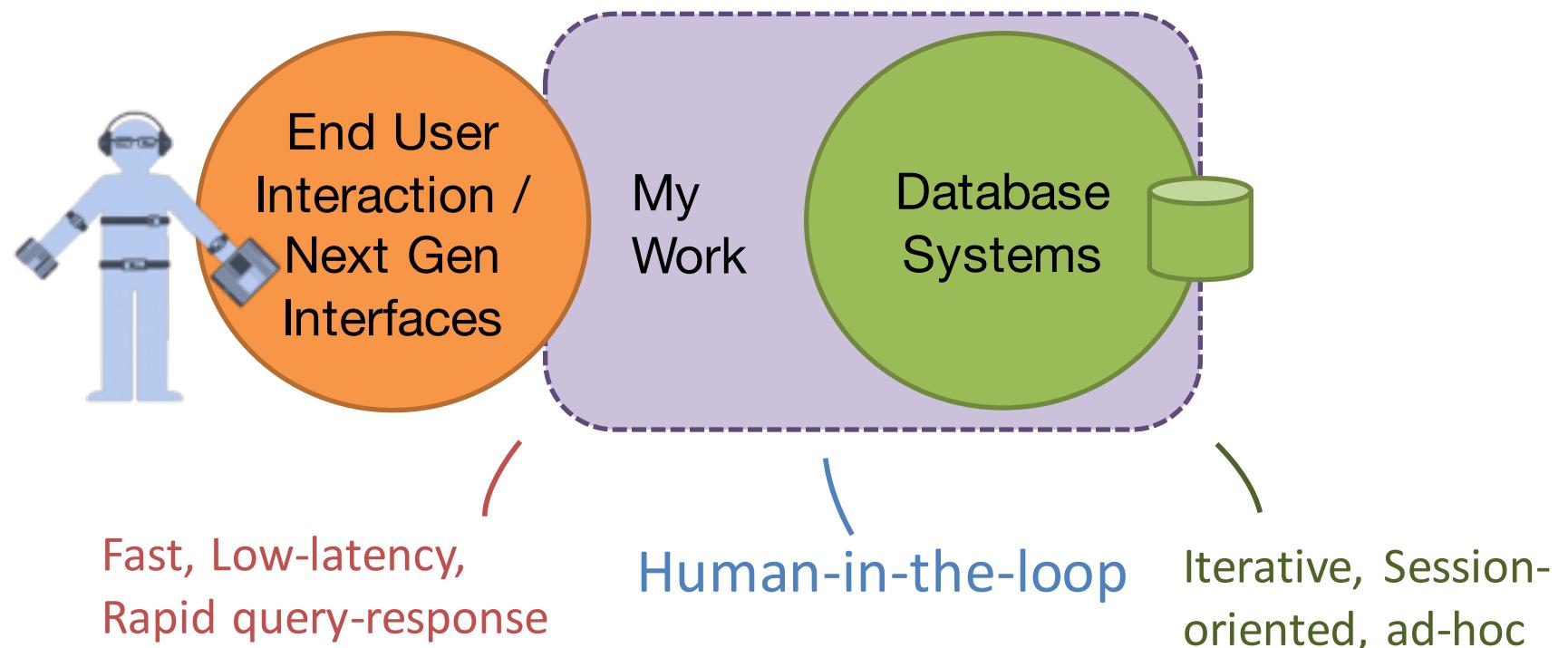


# The Wu Lab at Columbia



# interactive data systems

arnab's research group at ohio state



# Exploration Specifications + Perceptual Accuracy

<http://perceptvis.github.io>



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