Visual Analytics– Intersection with AI Part 1

Dr. Ab Mosca (they/them)

Reminder

- **Final Project Presentations start Thursday! (12/05)**
- Be prepared to present on Thursday (order will be random)
- Milestone 4 instructions list everything that I'm looking for in your VA tool and your presentation

- You may revise and resubmit any assignments until the end of finals (12/18)

Plan for Today

- Definitions
  - ML
  - AI
- Why do we care?
  - Explainable AI
  - ML for Vis

Defn: Machine Learning

Machine learning (**ML**) is a field of study in artificial intelligence concerned with the development and study of statistical algorithms that can learn from data and generalize to unseen data, and thus perform tasks without explicit instructions

- Natural language processing
- Computer vision
- Speech recognition
- Email filtering
- Predictive analytics

https://en.wikipedia.org/wiki/Machine_learning#cite_note-1

Defn: Artificial Intelligence

Artificial intelligence (**AI**) is a field of research in computer science that develops and studies methods and software that enable machines to perceive their environment and use learning and intelligence to take actions that maximize their chances of achieving defined goals.

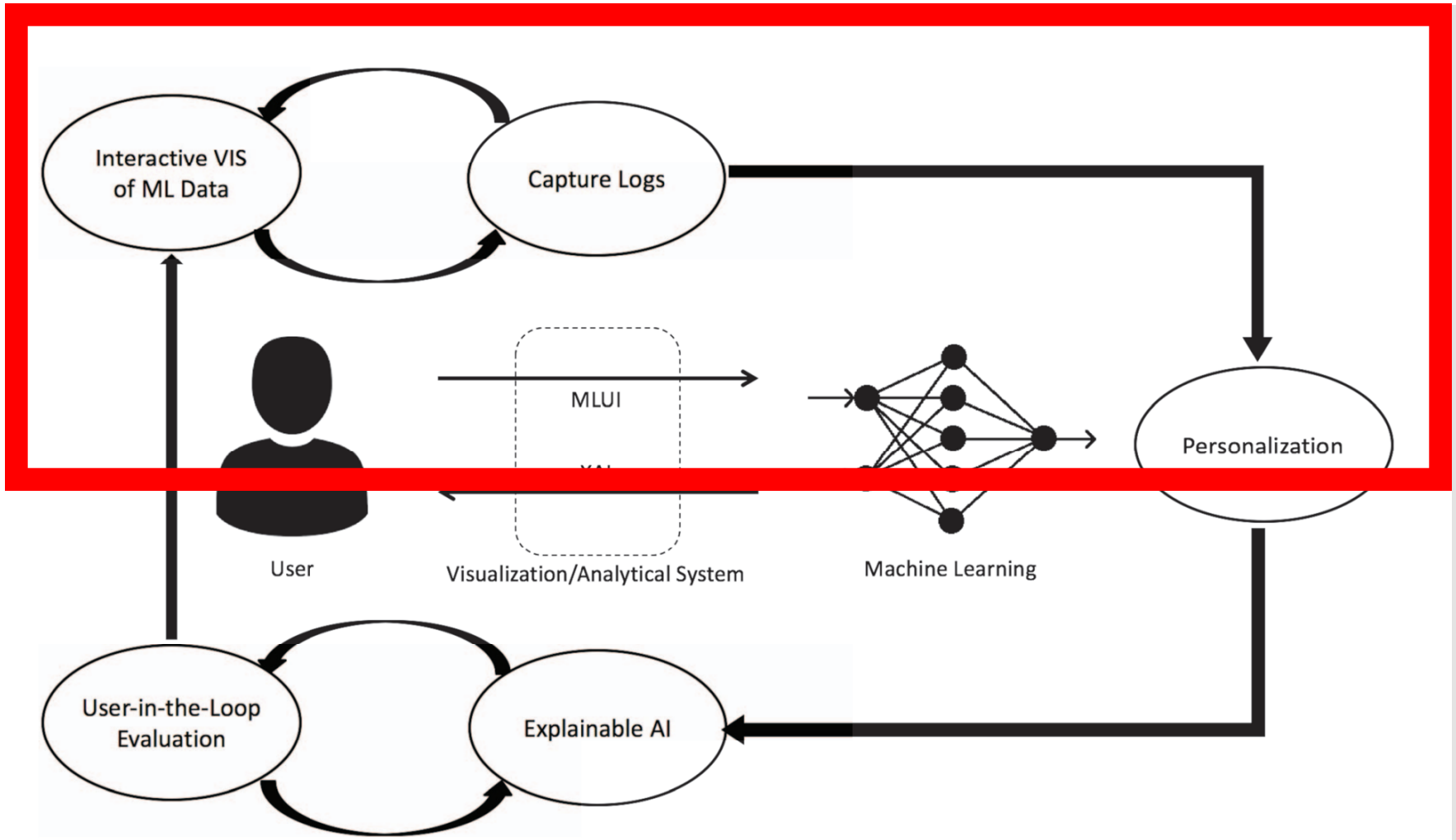
- Search engines
- Recommendation systems
- Interacting via speech (ex. Siri)
- Autonomous vehicles
- Generative creative tools (ex. ChatGPT)

https://en.wikipedia.org/wiki/Artificial_intelligence#CITEREFRussellNorvig2021

Discussion

How do ML/AI intersect with Visual Analytics?

Intersection of AI and Vis



Machine Learning from User Interaction for Visualization and Analytics: A Workshop-Generated Research Agenda. 2019.

Machine Learning from User Interactions (MLUI)

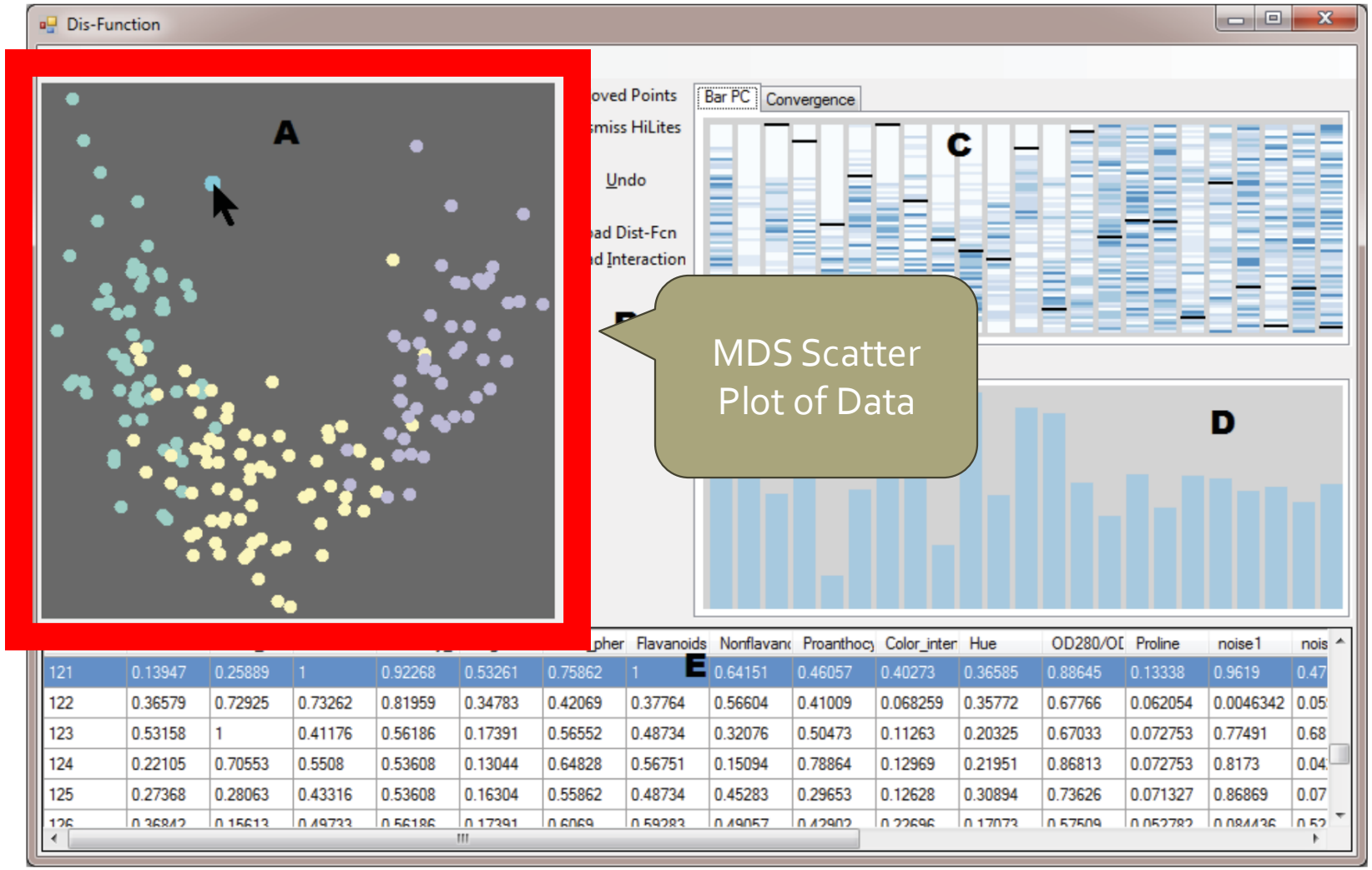
Big Idea: visual analytic systems learn from user interactions to produce better analyses

How?

1. User interprets ML model using VA system
2. User interacts with VA system
3. VA system logs (one or more) interactions
4. Learning process is initiated
5. New ML model is communicated to user

Machine Learning from User Interactions (MLUI)

Example: Dis-function Brown et al. 2012

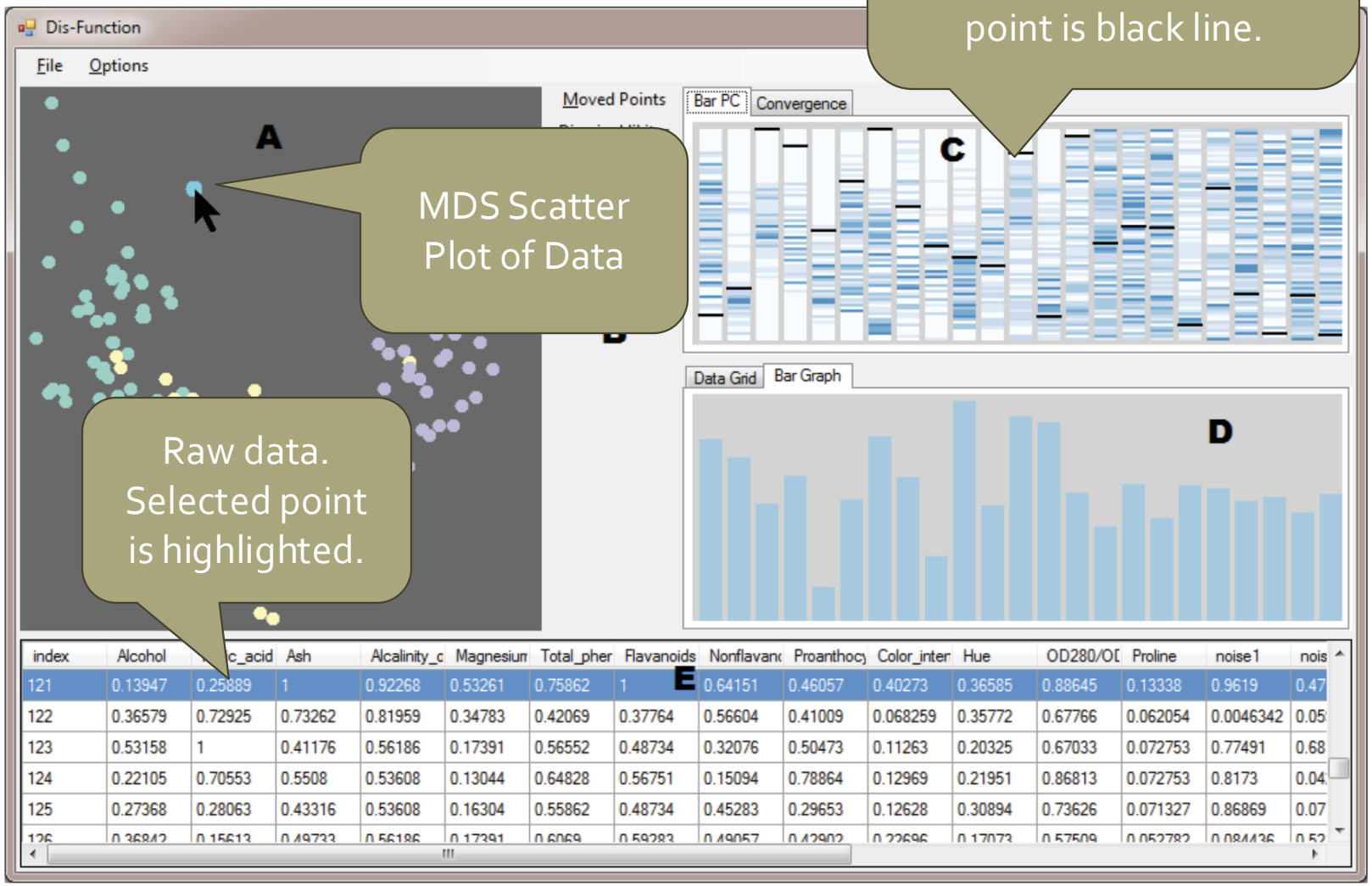


Recall: MDS (Multidimensional Scaling)

1. Choose a good distance metric
2. Compute a pairwise distance matrix
3. Find a 2D embedding that preserves those distances

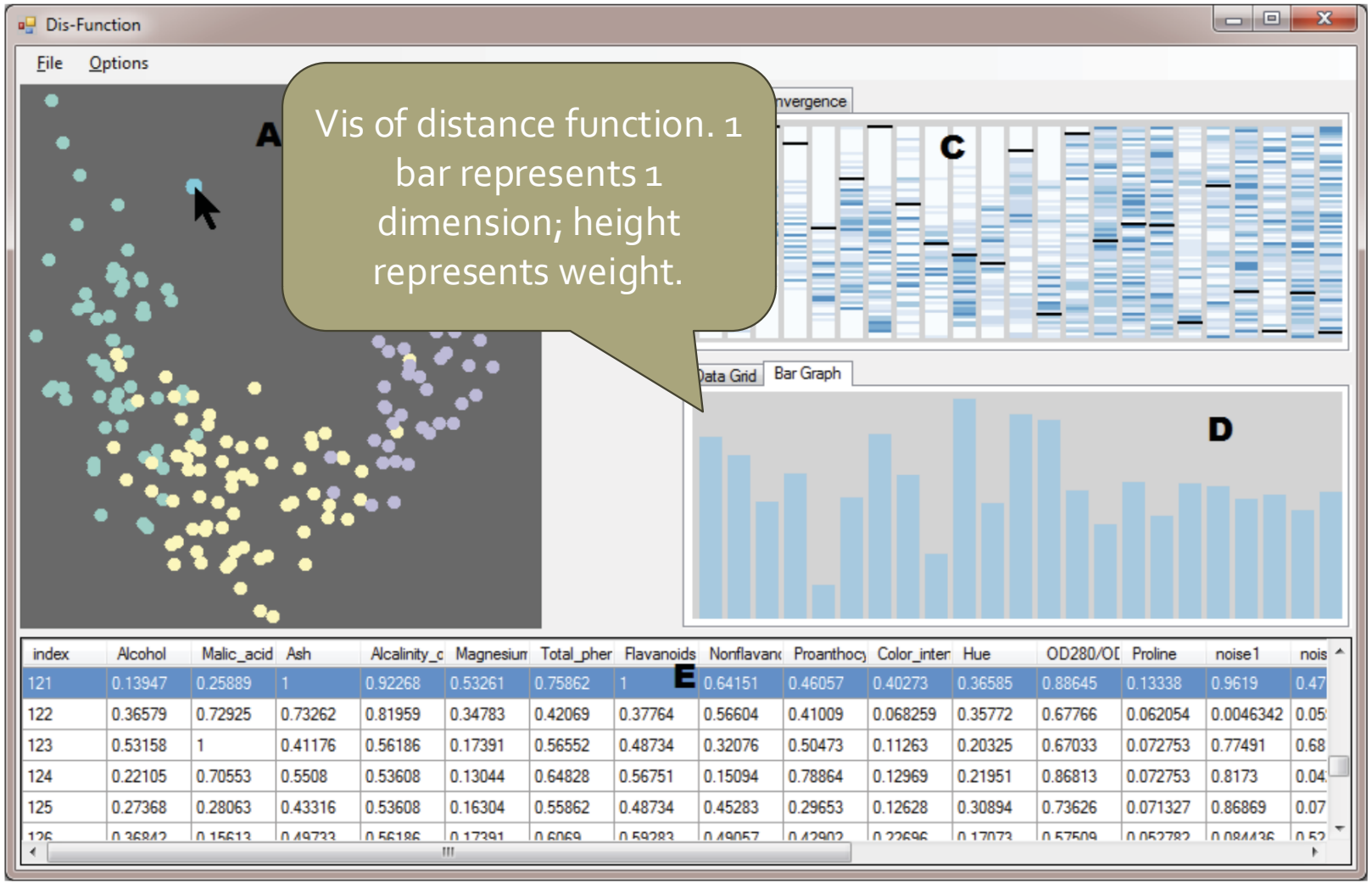
Machine Learning from User Interactions (MLUI)

Example: Dis-function Brown et al.



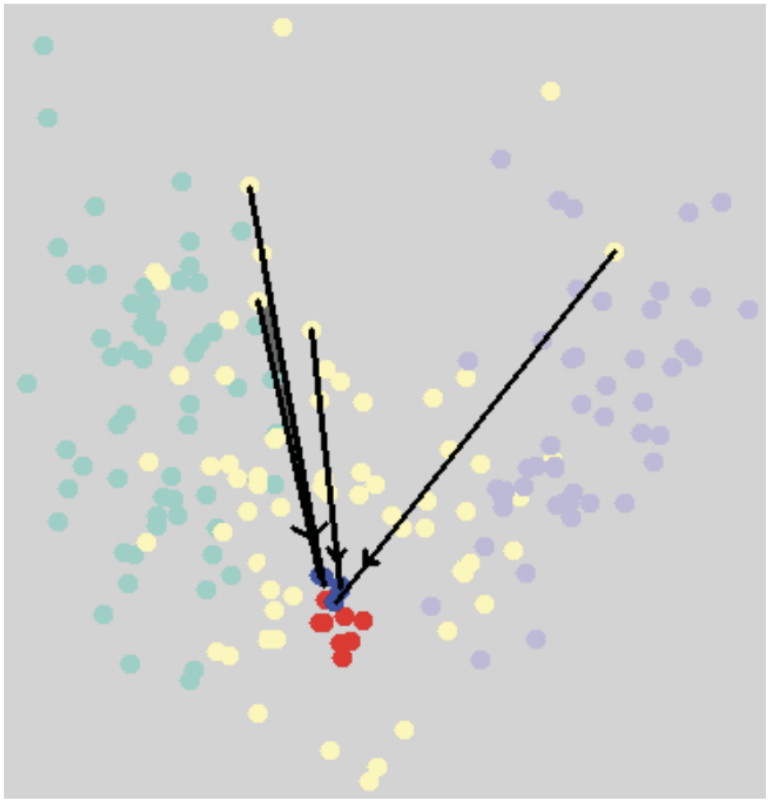
Machine Learning from User Interactions (MLUI)

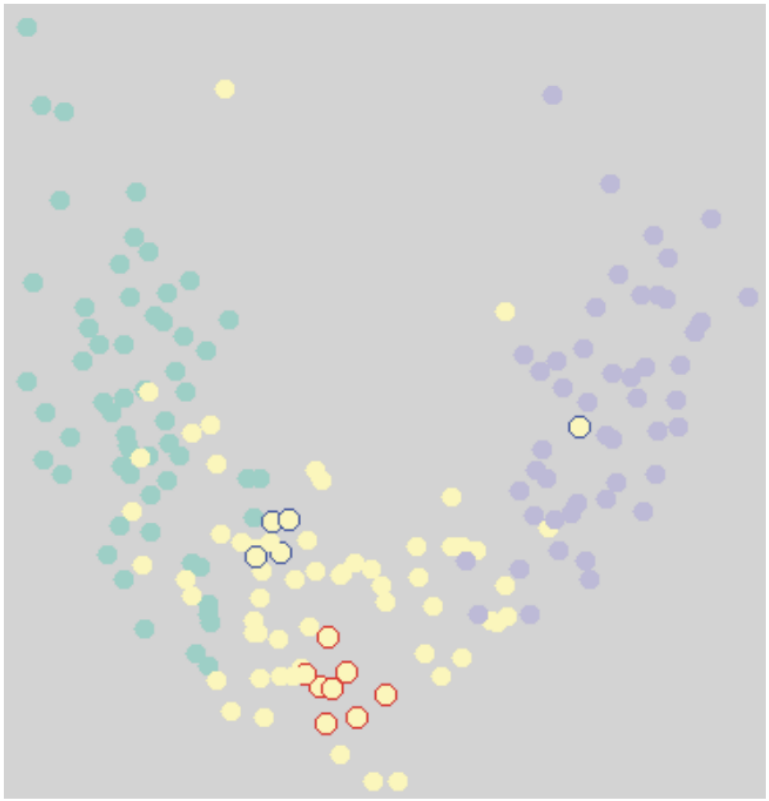
Example: Dis-function Brown et al. 2012



Machine Learning from User Interactions (MLUI)

Example: Dis-function Brown et al. 2012





Machine Learning from User Interactions (MLUI)

Example: Lumos Narechania et al. 2021

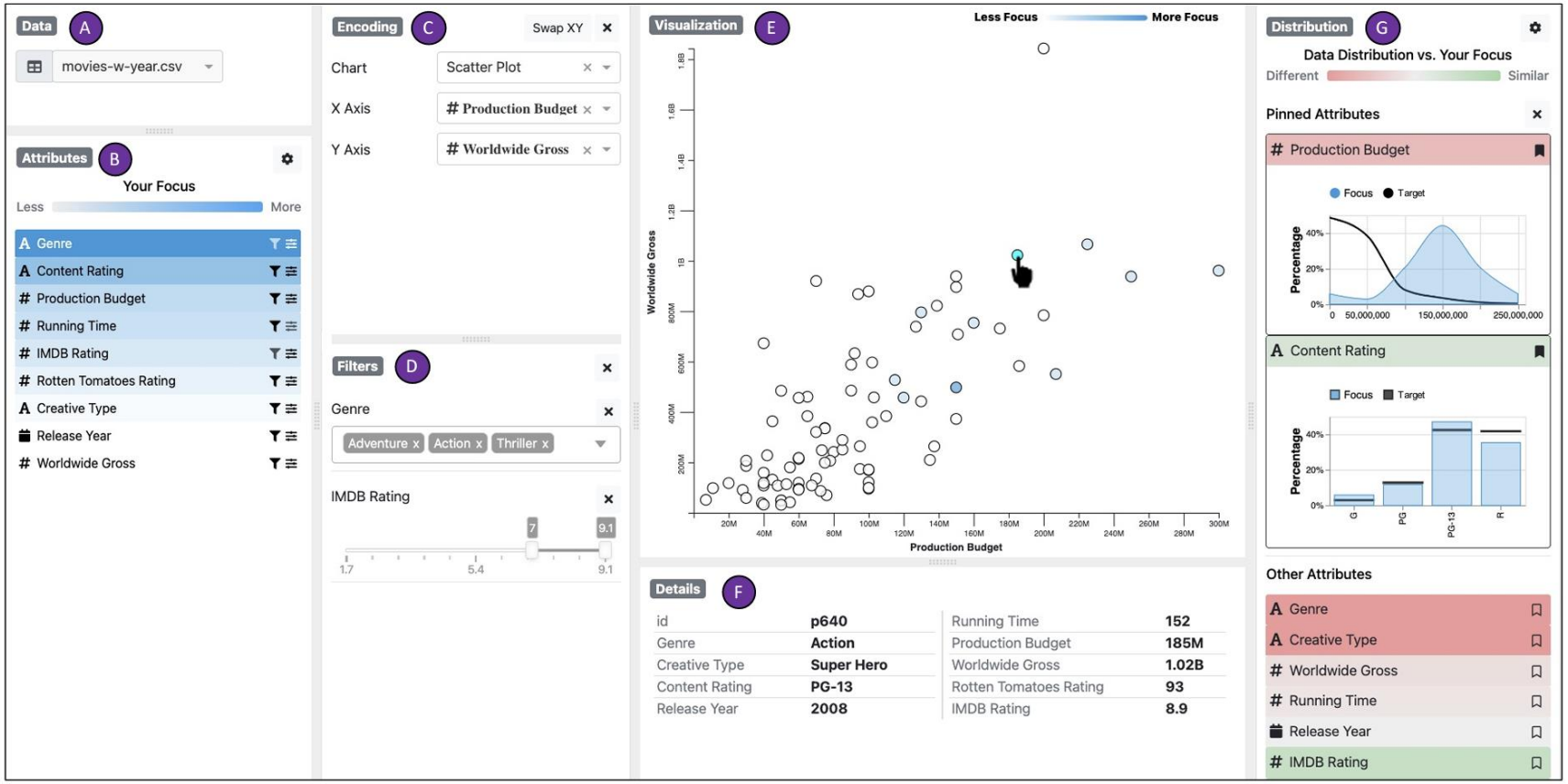
Try it out: https://bit.ly/lumos-235-demo

Explore the data.

What does it show you as you explore?

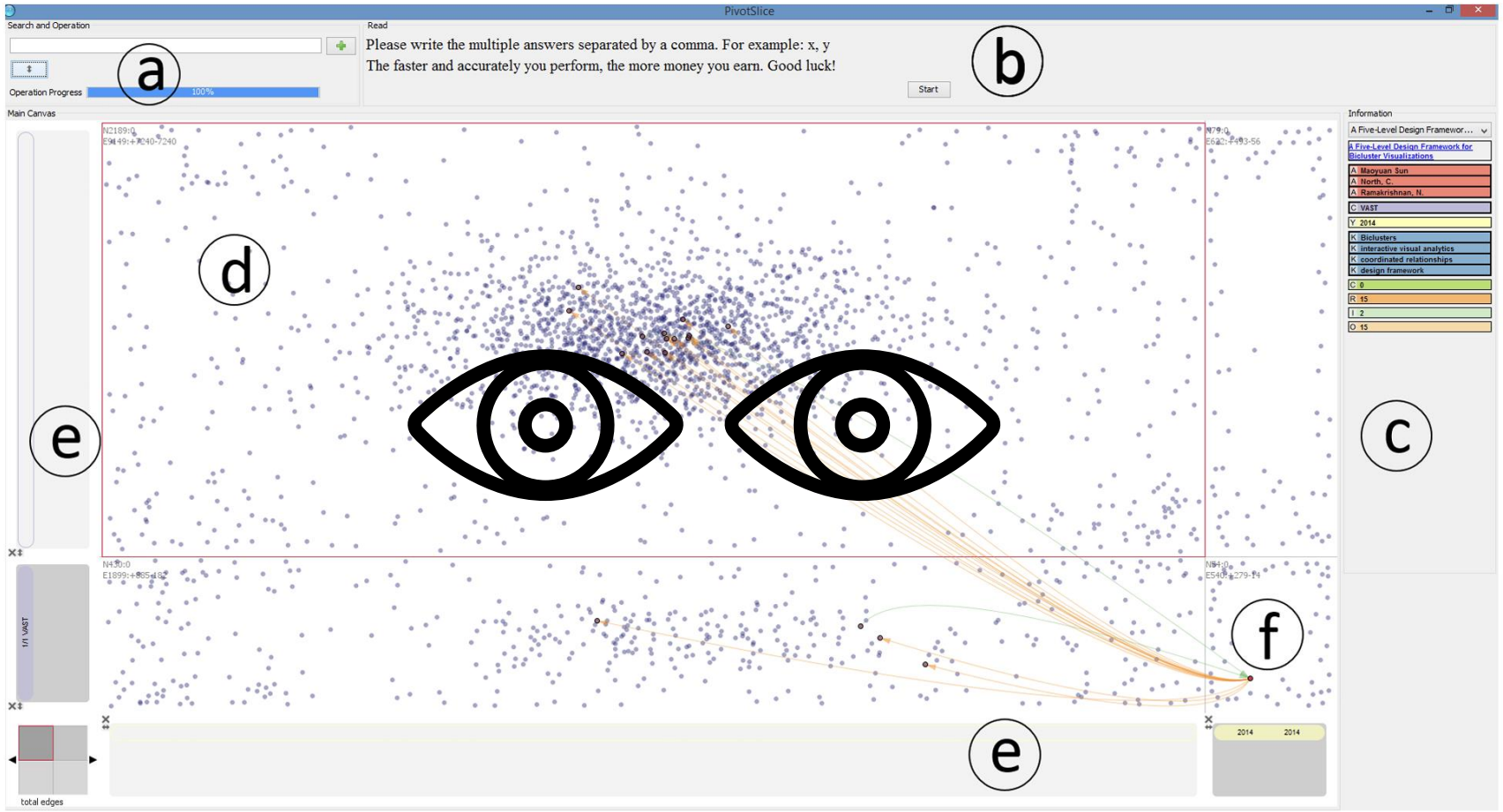
Machine Learning from User Interactions (MLUI)

Example: Lumos Narechania et al. 2021



Machine Learning from User Interactions (MLUI)

Example: Contextual Assistance Panwar et al. 2018



Machine Learning from User Interactions (MLUI)

Example: Contextual Assistance Panwar et al. 2018

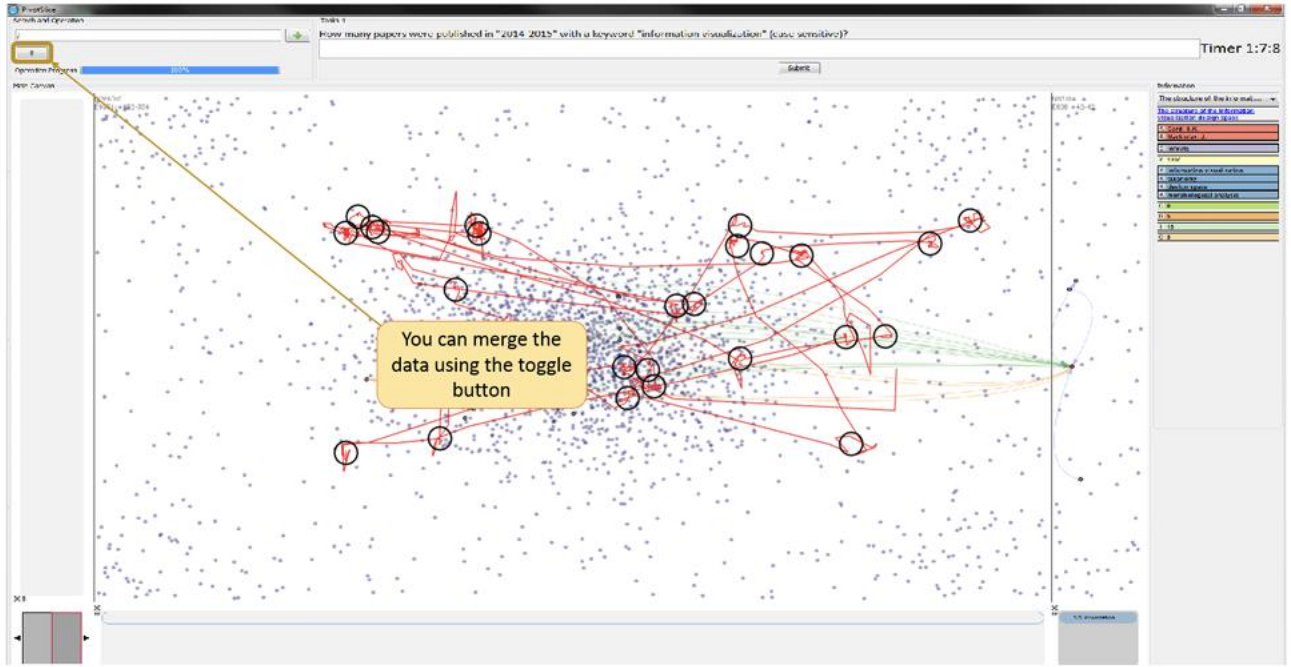
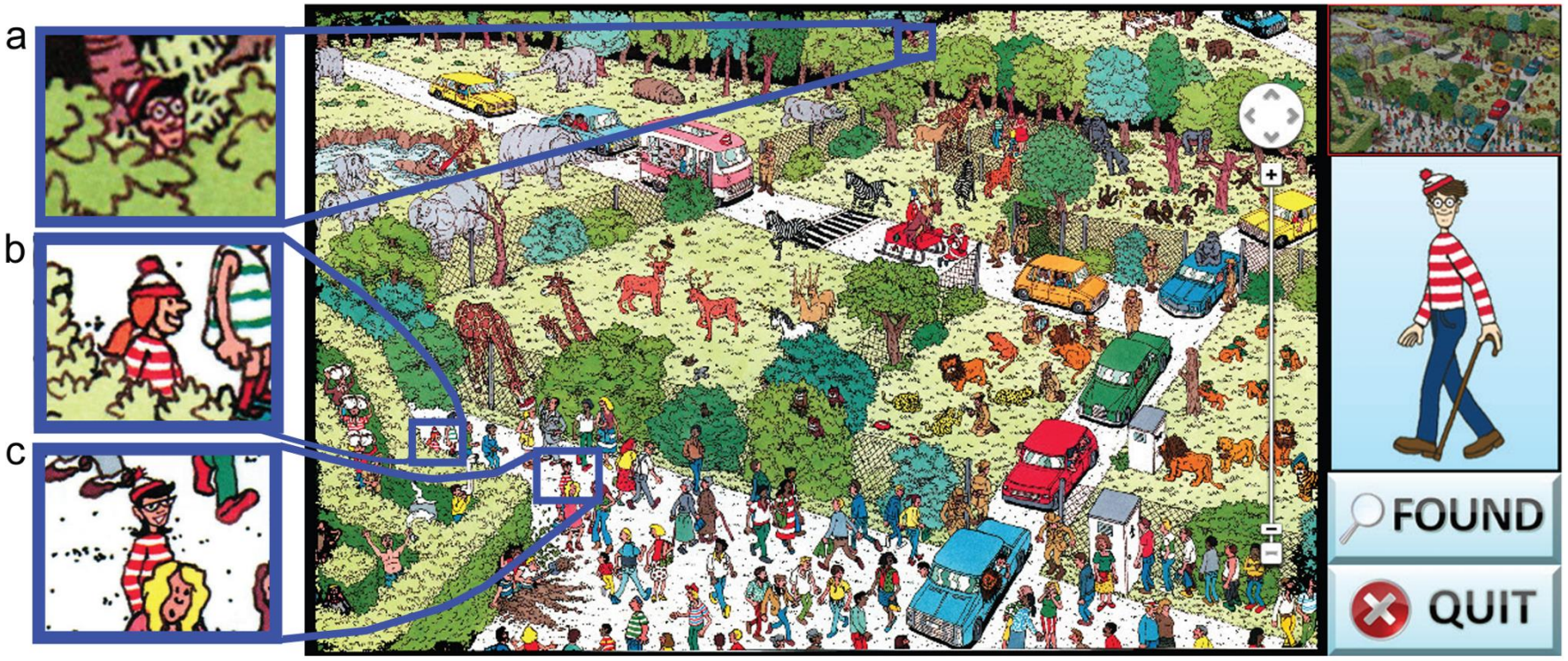


Figure 5: Dataset operation suggestion. Here, the system detected the context as dataset-related and then suggested operations that can be done on the dataset. The red lines are the gaze path and black circles represents fixations.

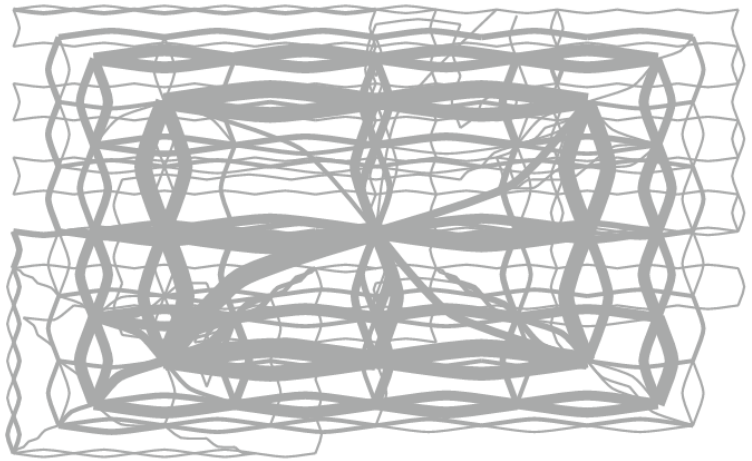
Machine Learning from User Interactions (MLUI)

Example: Finding Waldo Brown et al. 2014

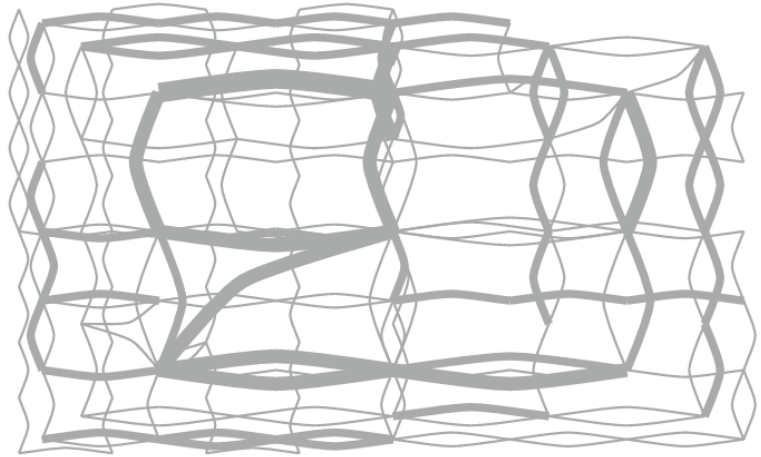


Machine Learning from User Interactions (MLUI)

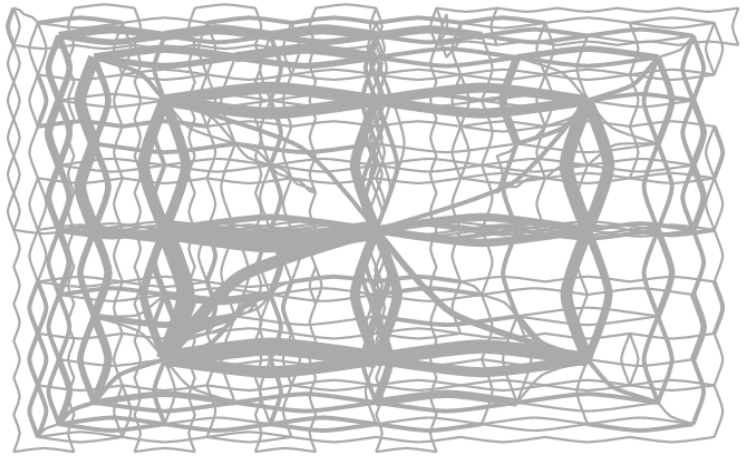
Example: Finding Waldo Brown et al. 2014



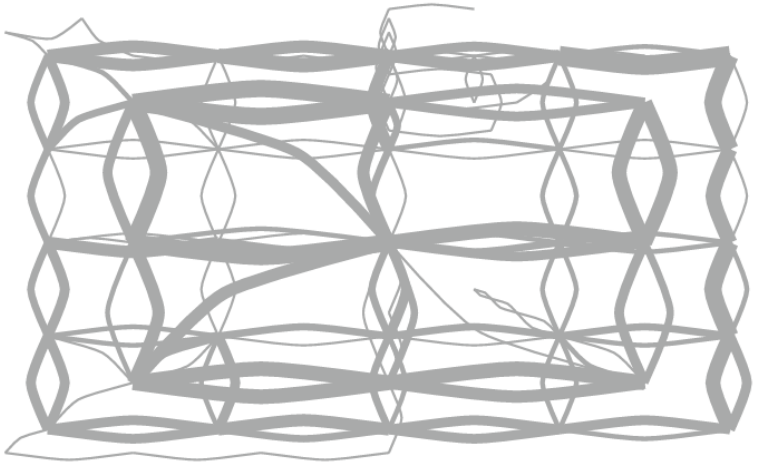
(a) Slow



(b) Fast



(c) External LOC



(d) Internal LOC

Machine Learning from User Interactions (MLUI)

Big Idea: visual analytic systems learn from user interactions to produce better analyses

How?

1. User interprets ML model using VA system
2. User interacts with VA system
3. VA system logs (one or more) interactions
4. Learning process is initiated
5. New ML model is communicated to user

Logging Interactions

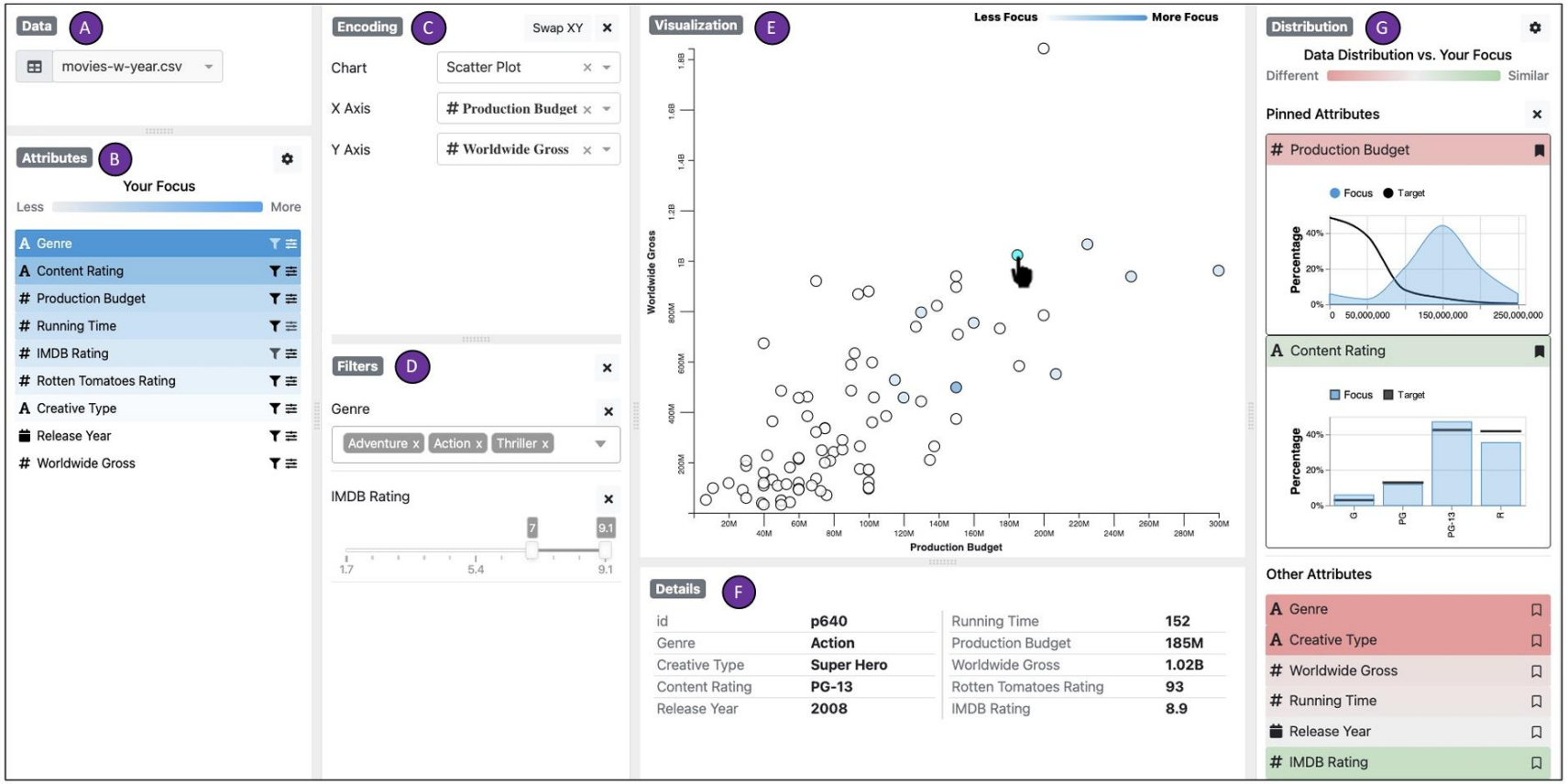
Dis-function Brown et al. 2012

What did they need to log?

Logging Interactions

Example: Lumos Narechania et al. 2021

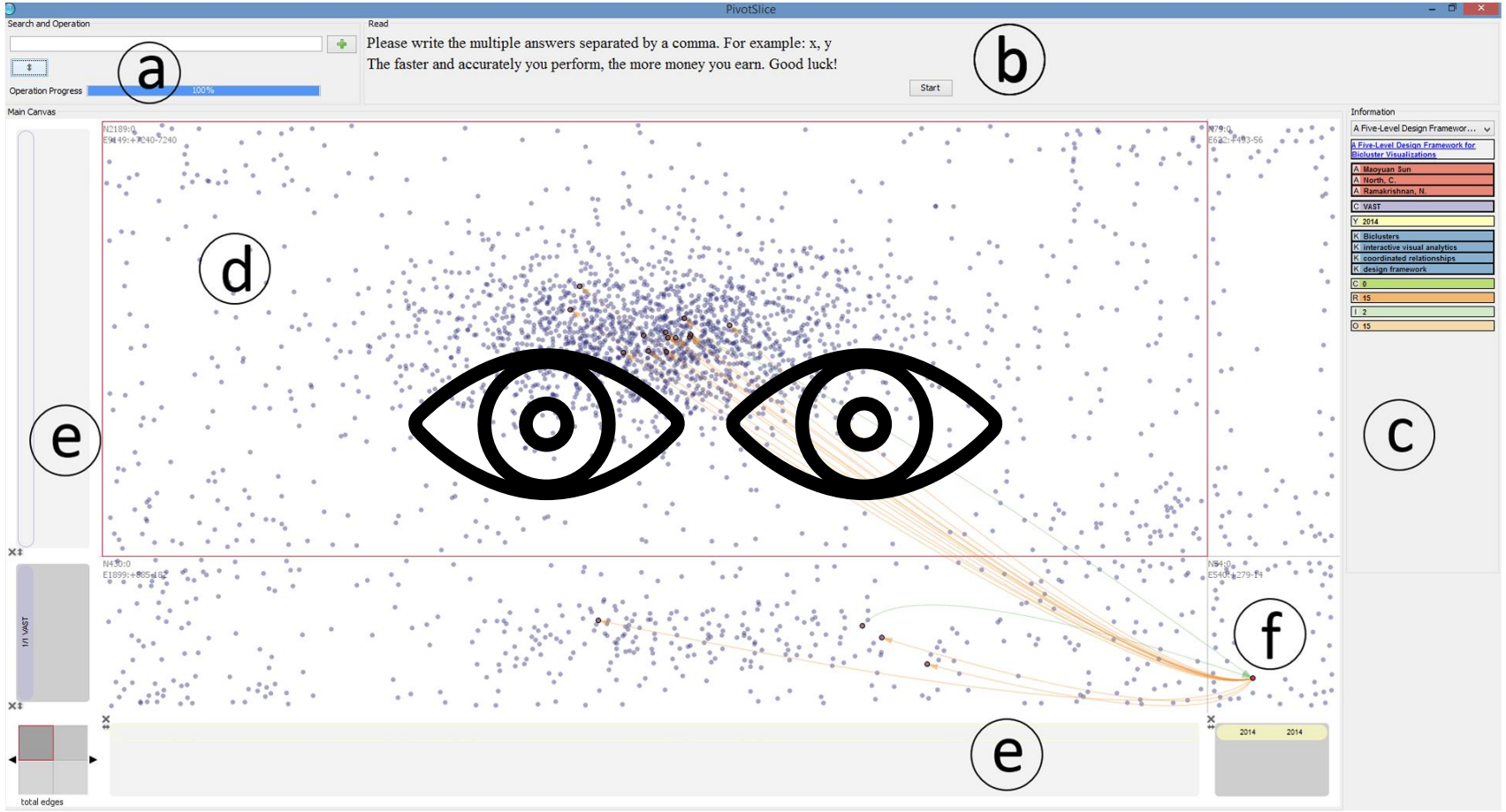
What did they need to log?



Logging Interactions

Example: Contextual Assistance Panwar et al. 2018

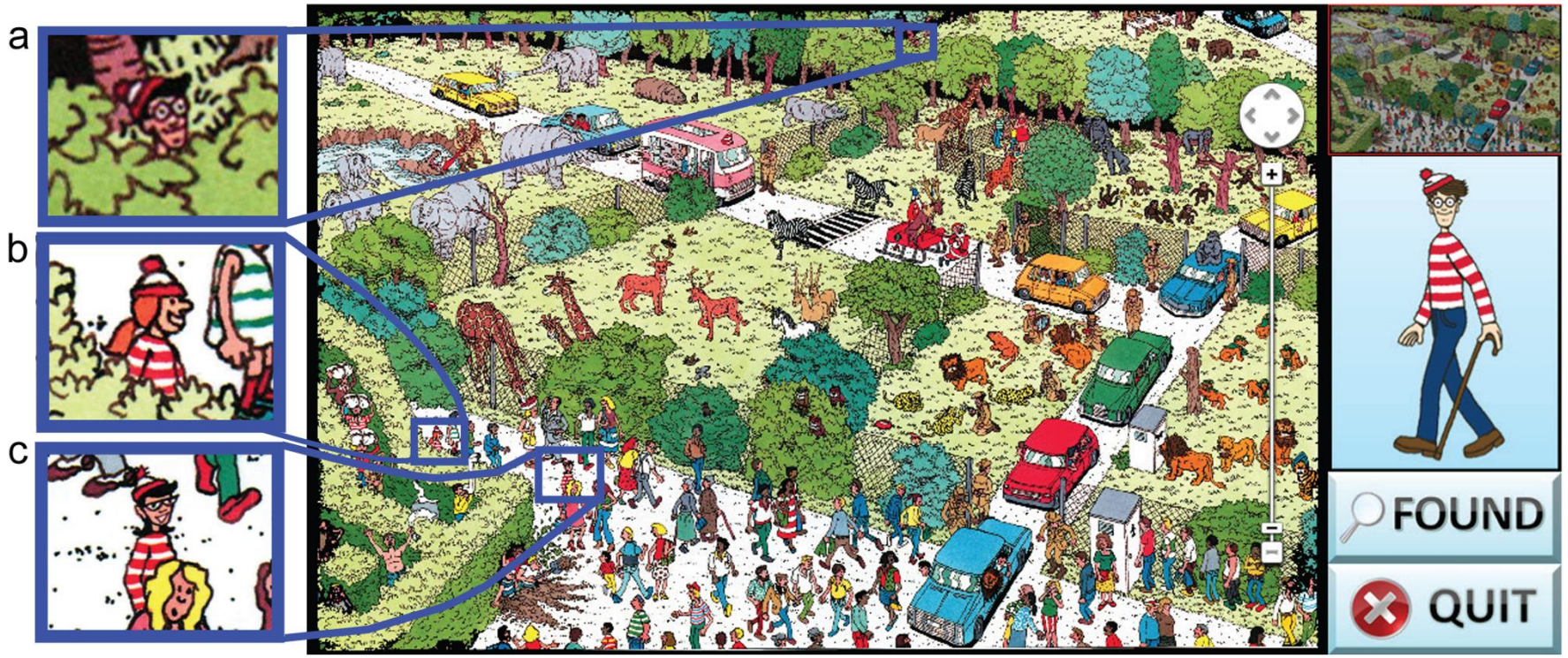
What did they need to log?



Logging Interactions

Example: Finding Waldo Brown et al. 2014

What did they need to log?



Logging Interactions

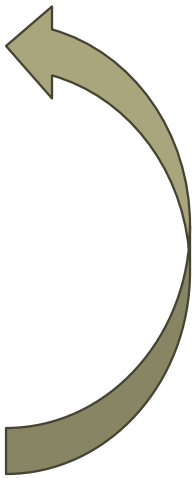
- Need to choose carefully "what" to capture
  - What input streams do we want?
    - Clicks?
    - Eye gaze?
    - Mouse strokes?
    - Hover?
  - Is there important context?
    - Do we need pixel location?
    - Do we need associated data point?
    - Do we need associated interface element?

Machine Learning from User Interactions (MLUI)

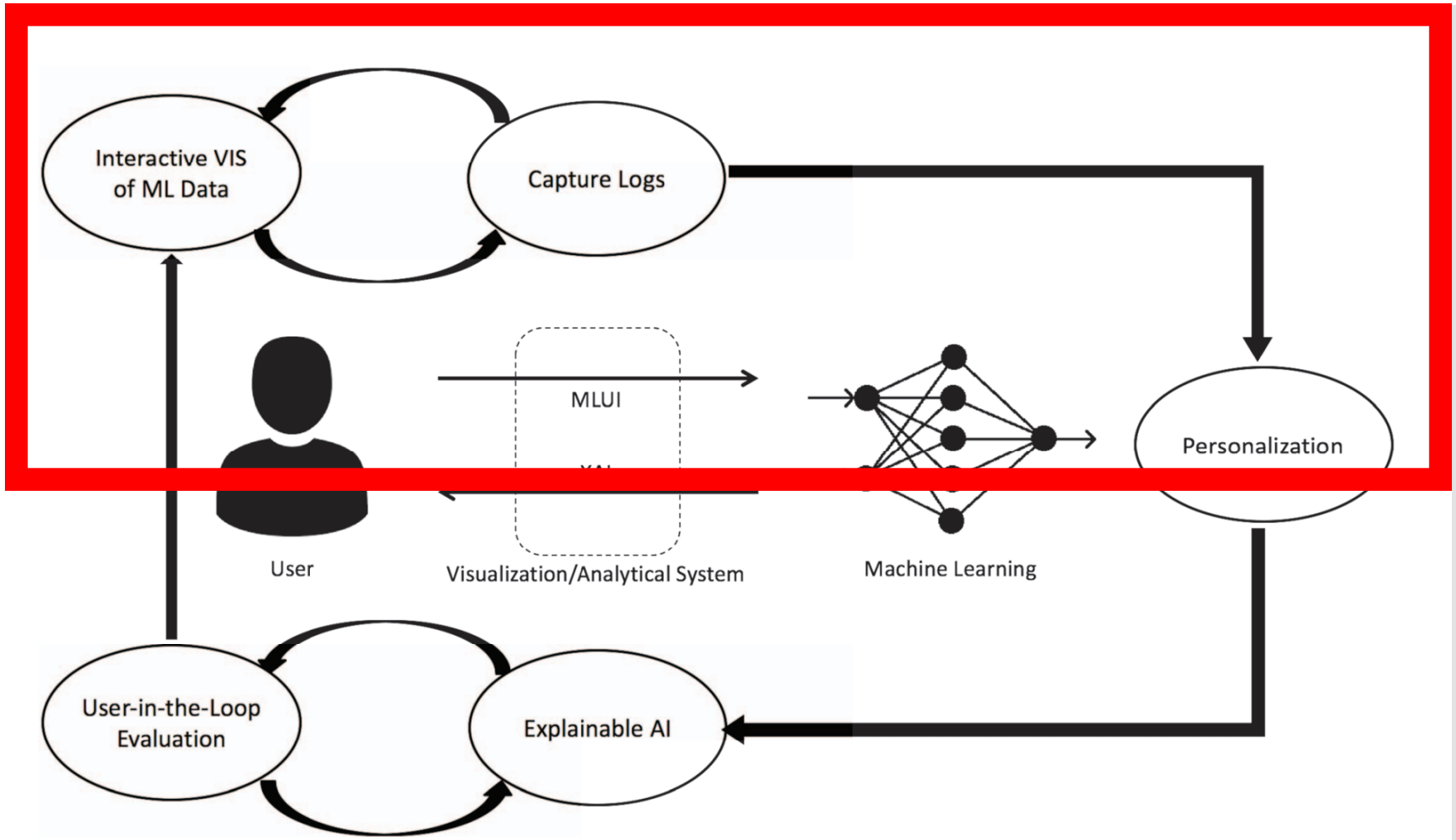
Big Idea: visual analytic systems learn from user interactions to produce better analyses

How?

1. User interprets ML model using VA system
2. User interacts with VA system
3. VA system logs (one or more) interactions
4. Learning process is initiated
5. New ML model is communicated to user



Intersection of AI and Vis



Machine Learning from User Interaction for Visualization and Analytics: A Workshop-Generated Research Agenda. 2019.

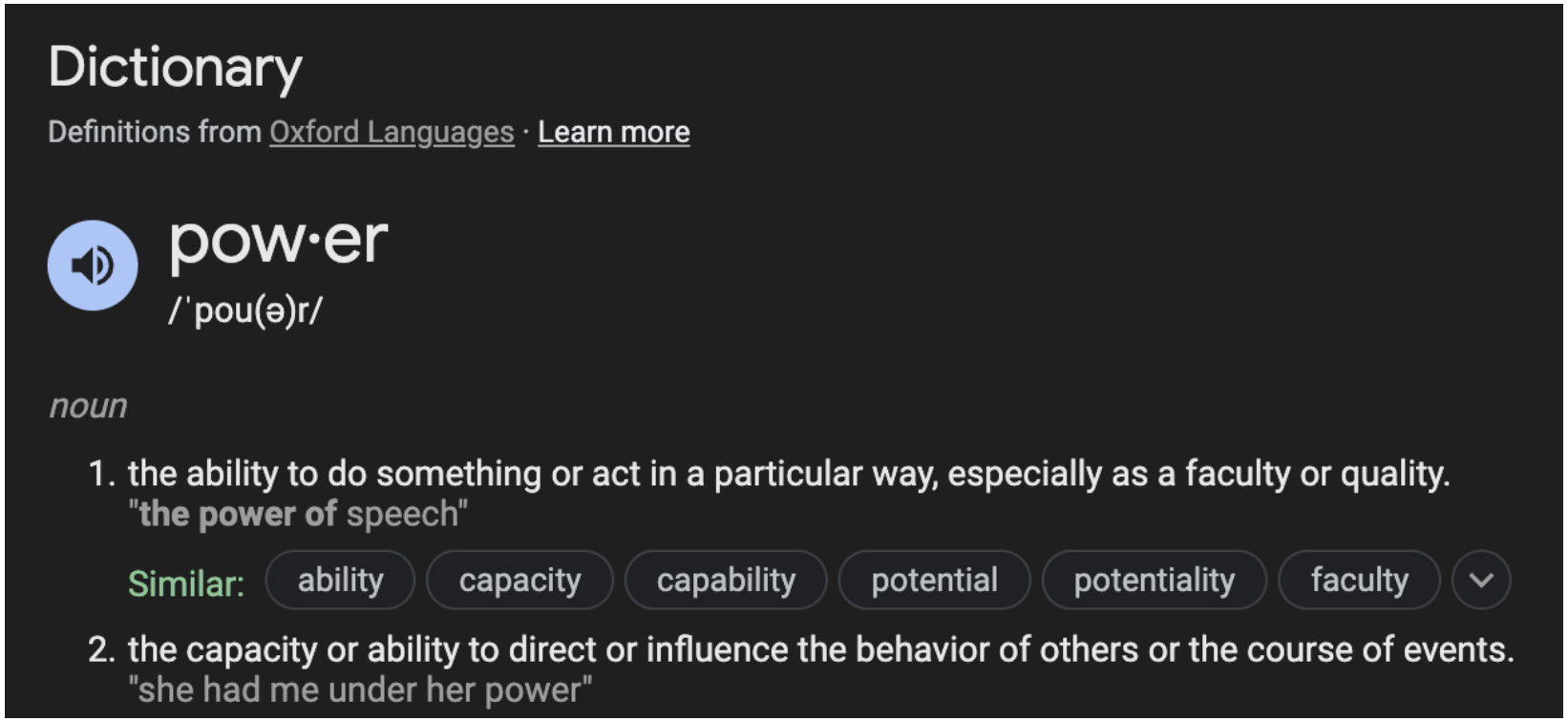
Discussion

First a step back…

Where is AI currently used for decision making?

Power

When AI is used for decision making, who holds more power, the person making the decision or the person affected by it?



Explainable AI (XAI)

Big idea:

If AI is going to be used for decision making, we must be able to explain *how* it produces its decisions.

Using visualization to communicate the inner workings of an AI model is one avenue towards XAI.

Explainable AI (XAI)

Let's explore:

Annual Workshop for Visualization for AI Explainability: **https://visxai.io/**

- Pair up with 1-2 classmates
- Choose an XAI Vis from the Hall of Fame (bottom of the website)
- Explore the vis
- Using *only* the XAI Vis, create a 5 minute presentation that teaches others how the model works (be prepared to share!)