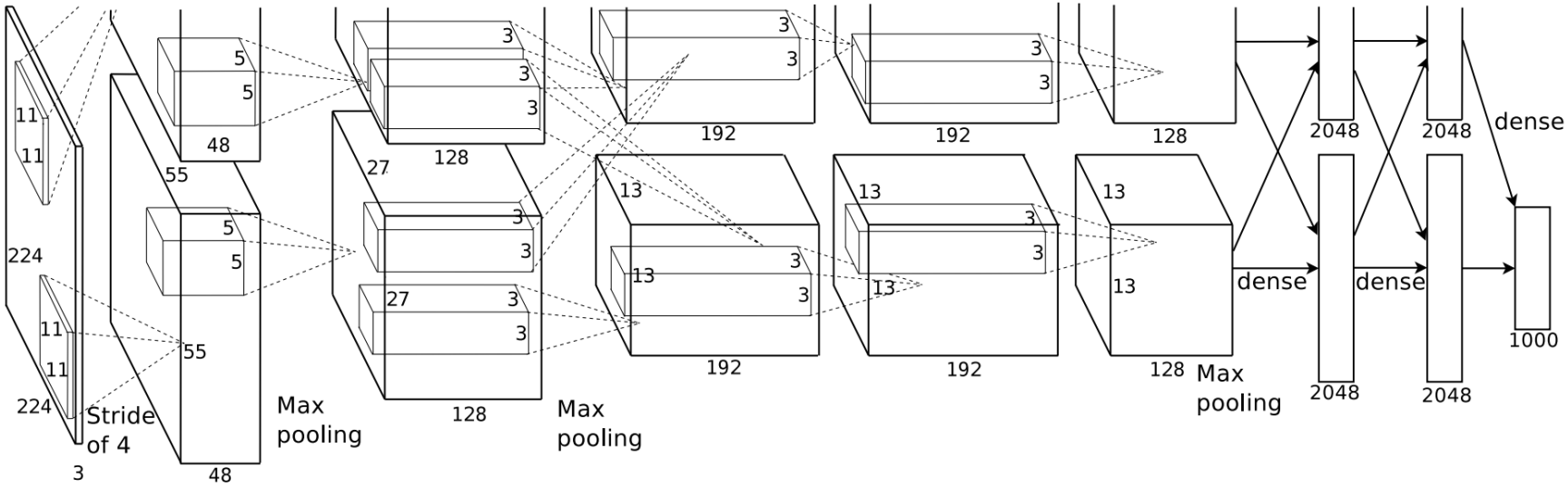
Seein' In

Interactive Visualization of the Convolutional Neural Network (CNN)

Tanner Schmidt

Problem

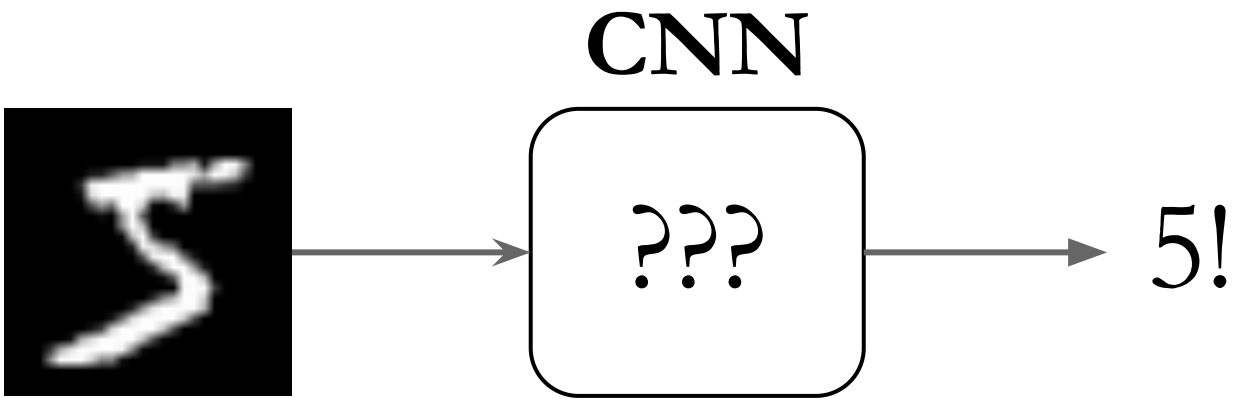
- Convolutional neural networks have recently been wildly successful in computer vision
- They essentially apply an obscenely high-dimensional operator to an input image



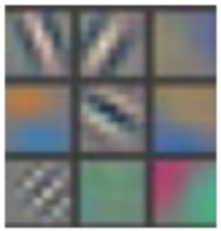
Krizhevsky et al. 2012

Problem

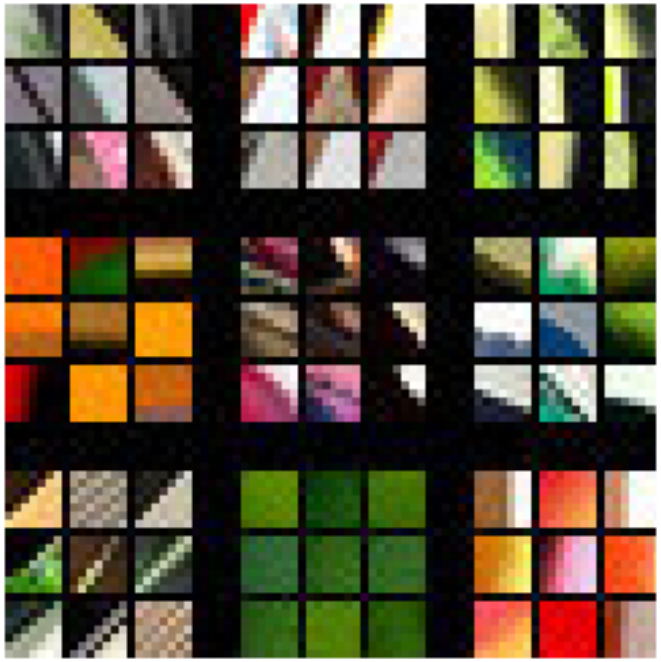
- Are CNNs a black box?
- Can we understand more about what they're doing?



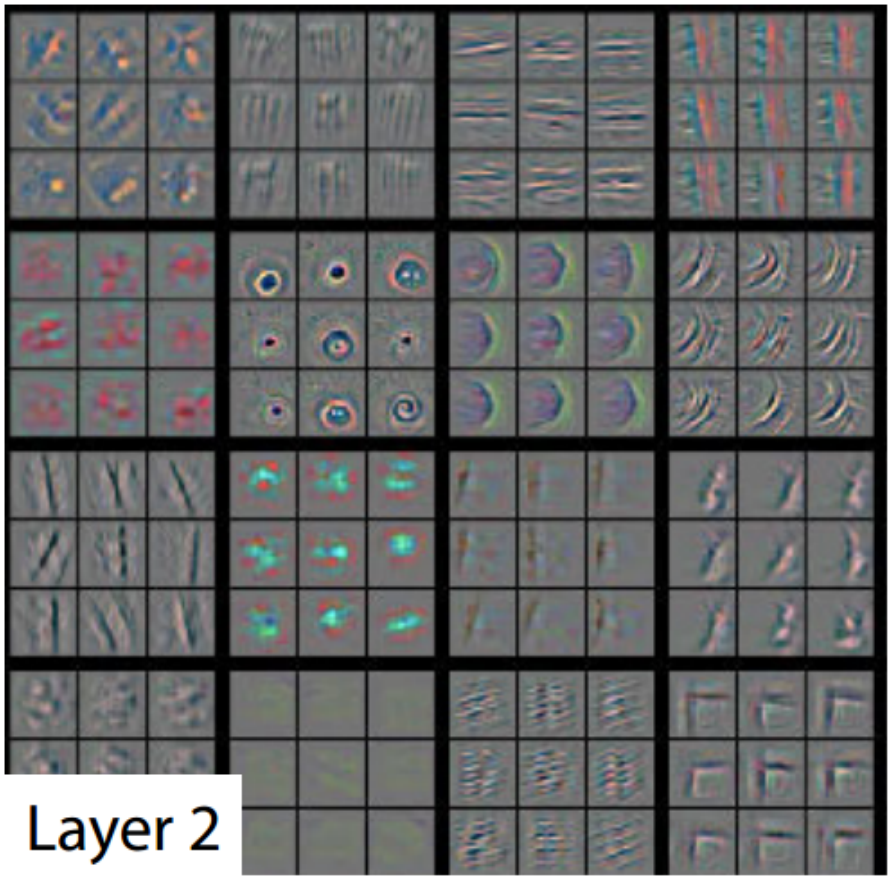
Related Work

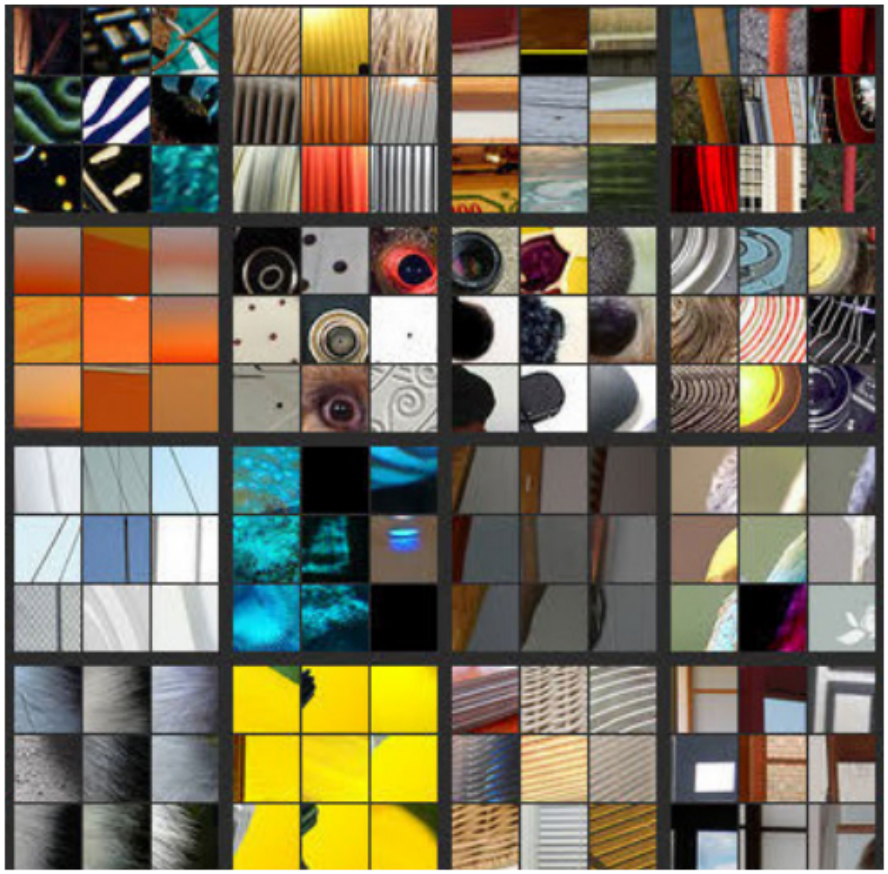


Layer 1

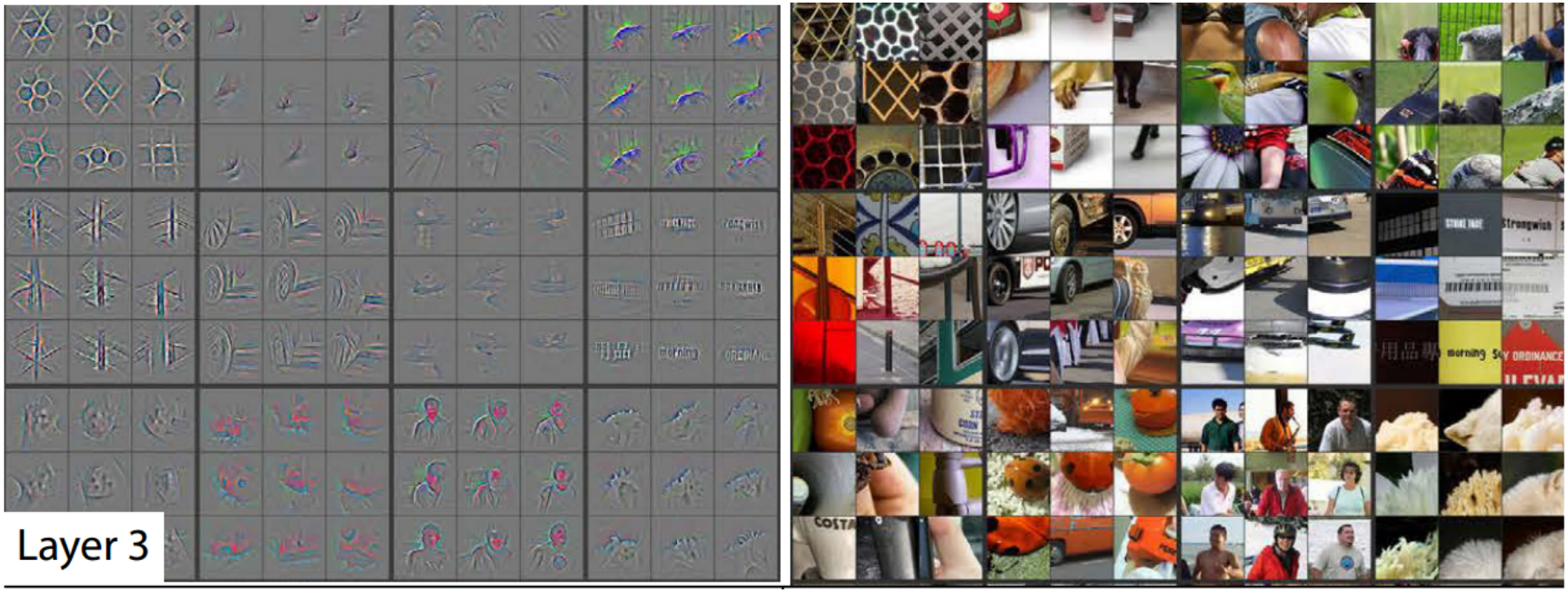


Zeiler et al. 2014

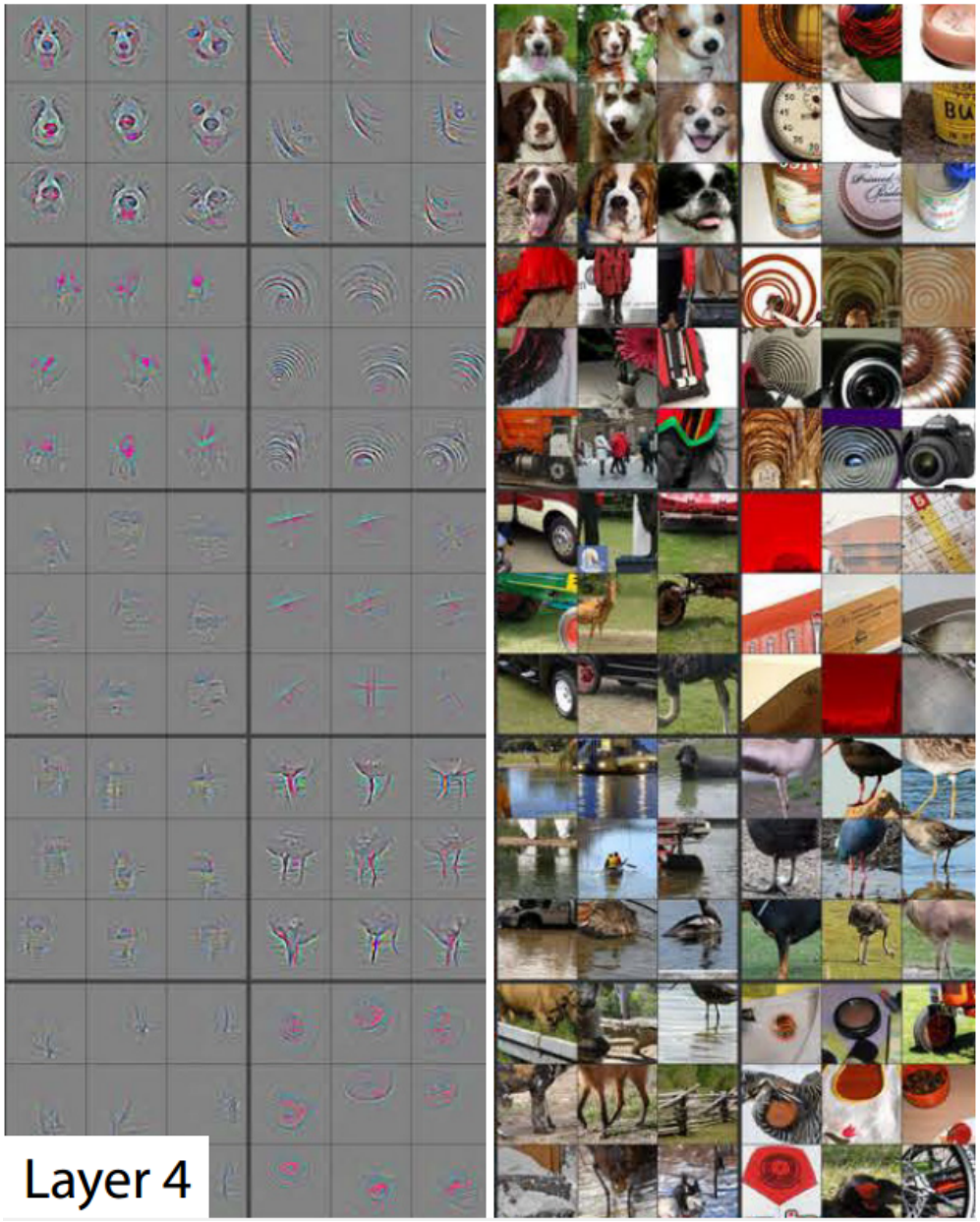




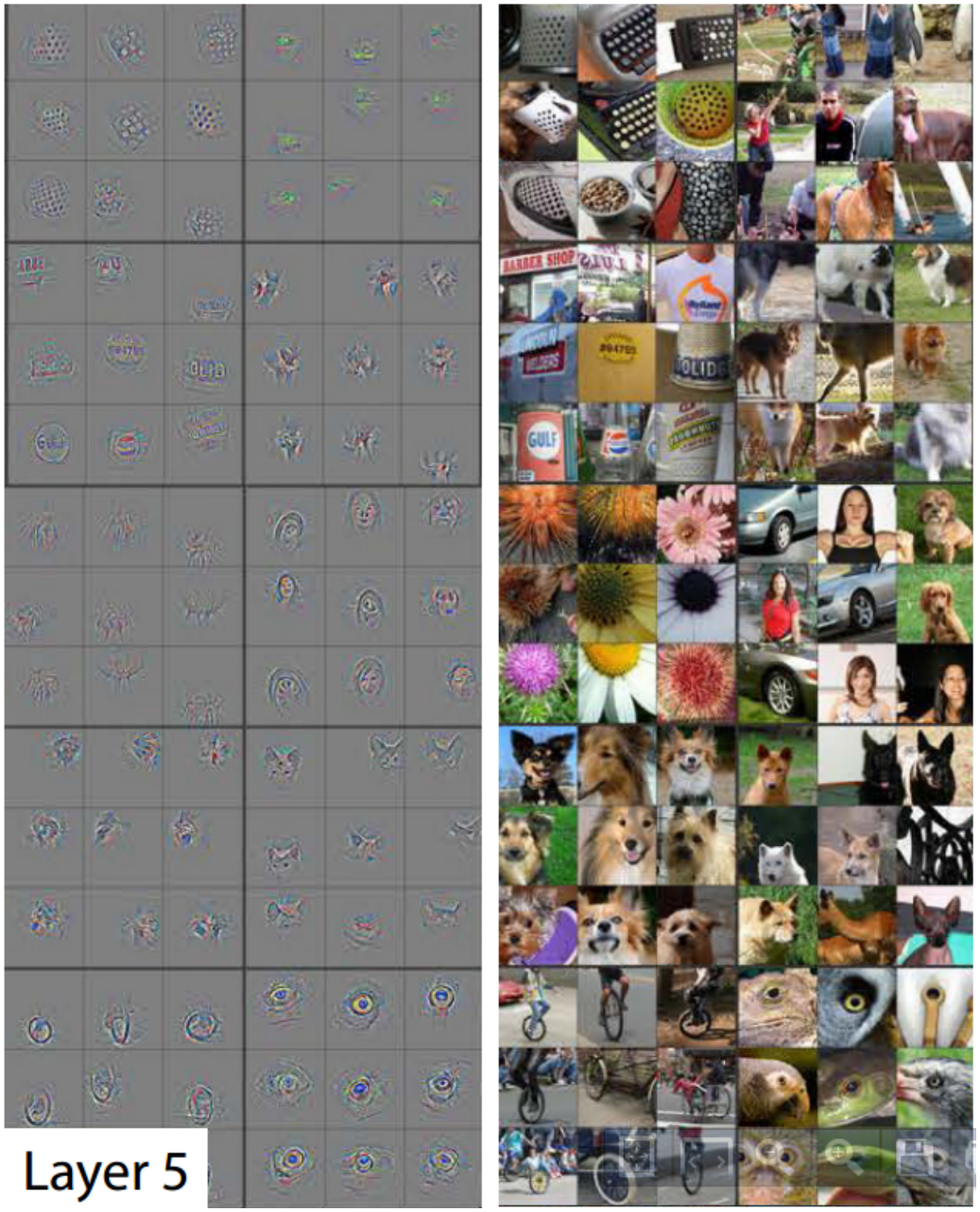
Zeiler et al. 2014



Zeiler et al. 2014

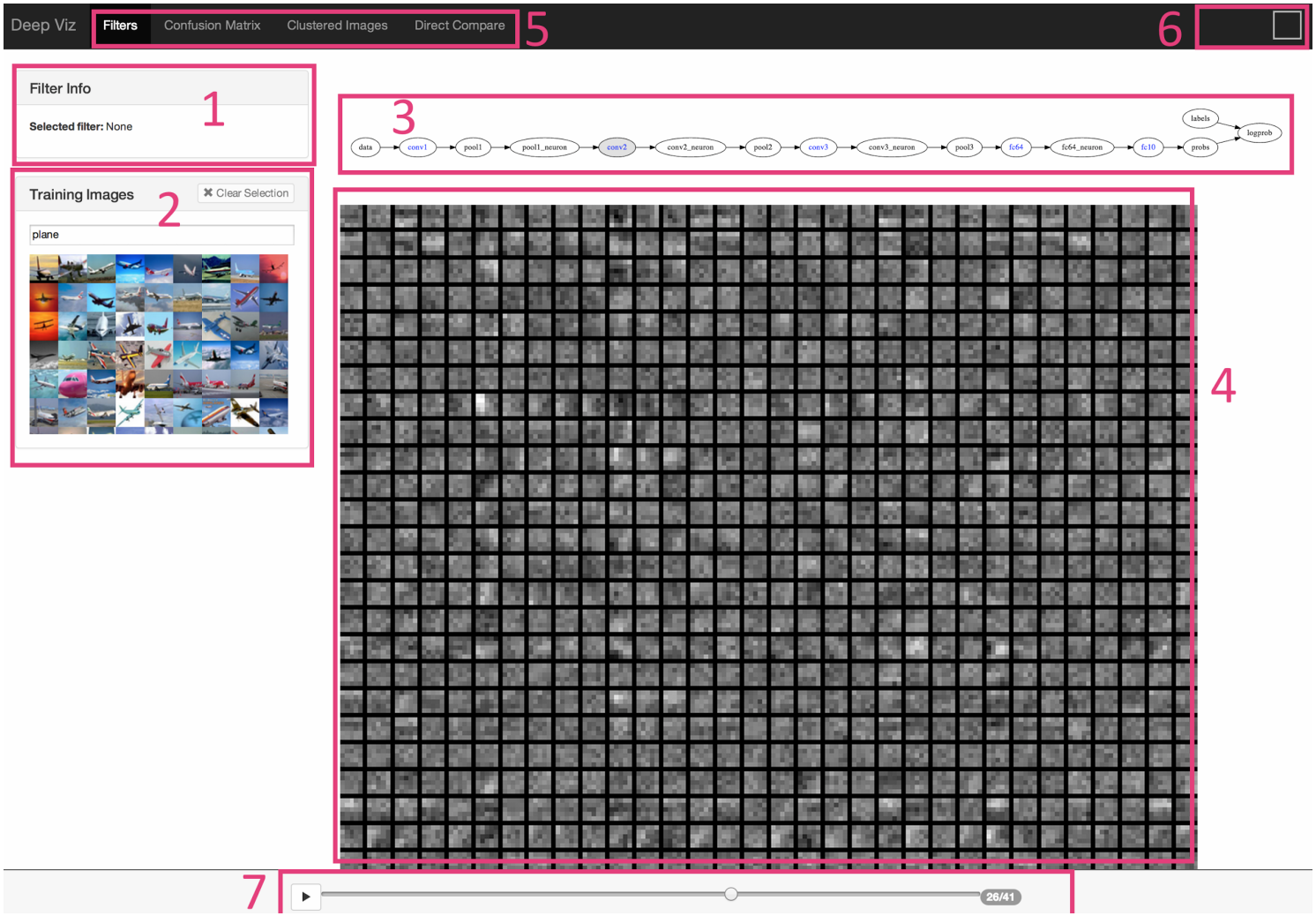


Zeiler et al. 2014



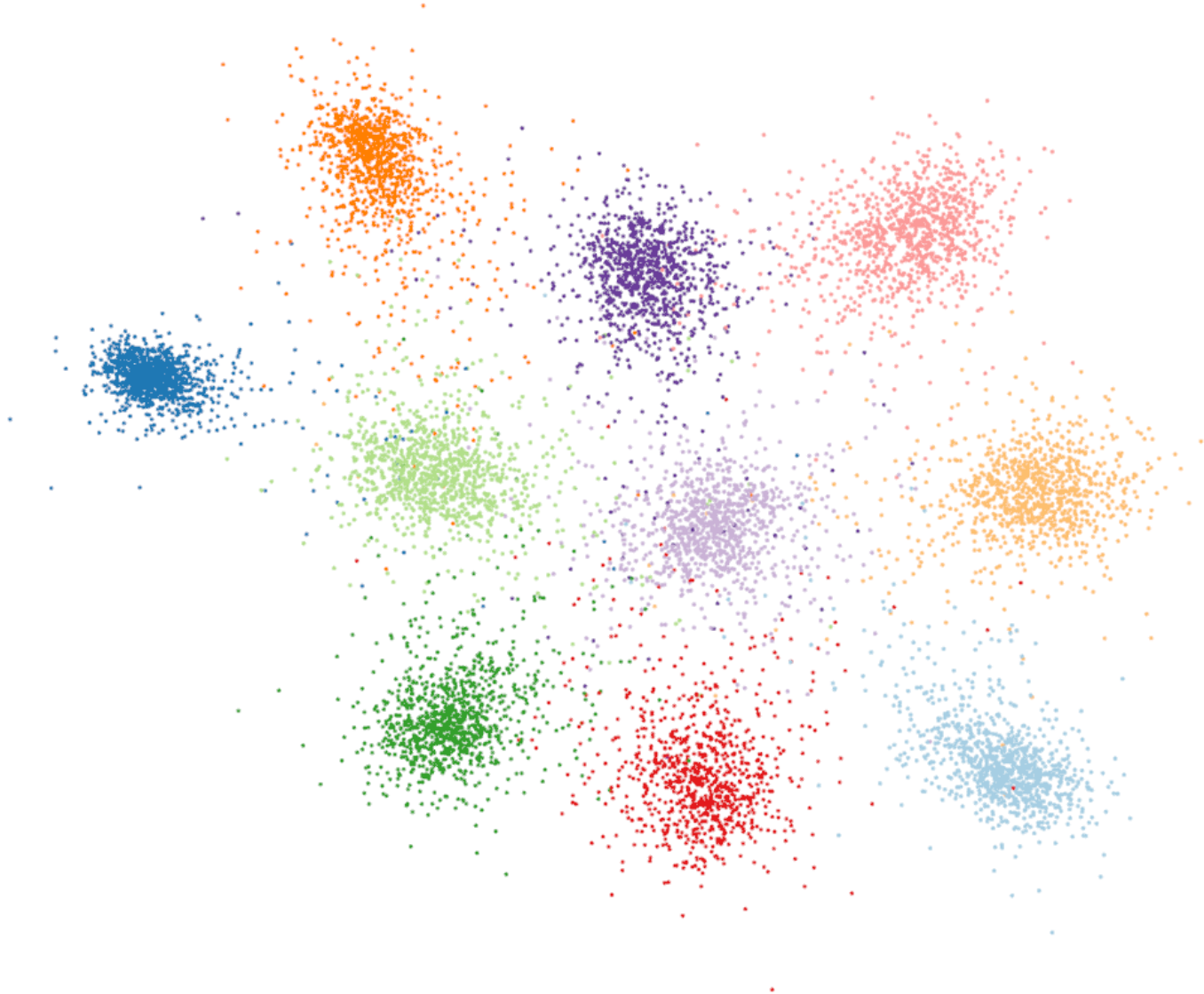
Zeiler et al. 2014

Related Work: deepViz



Bruckner et al. 2014

Current Progress



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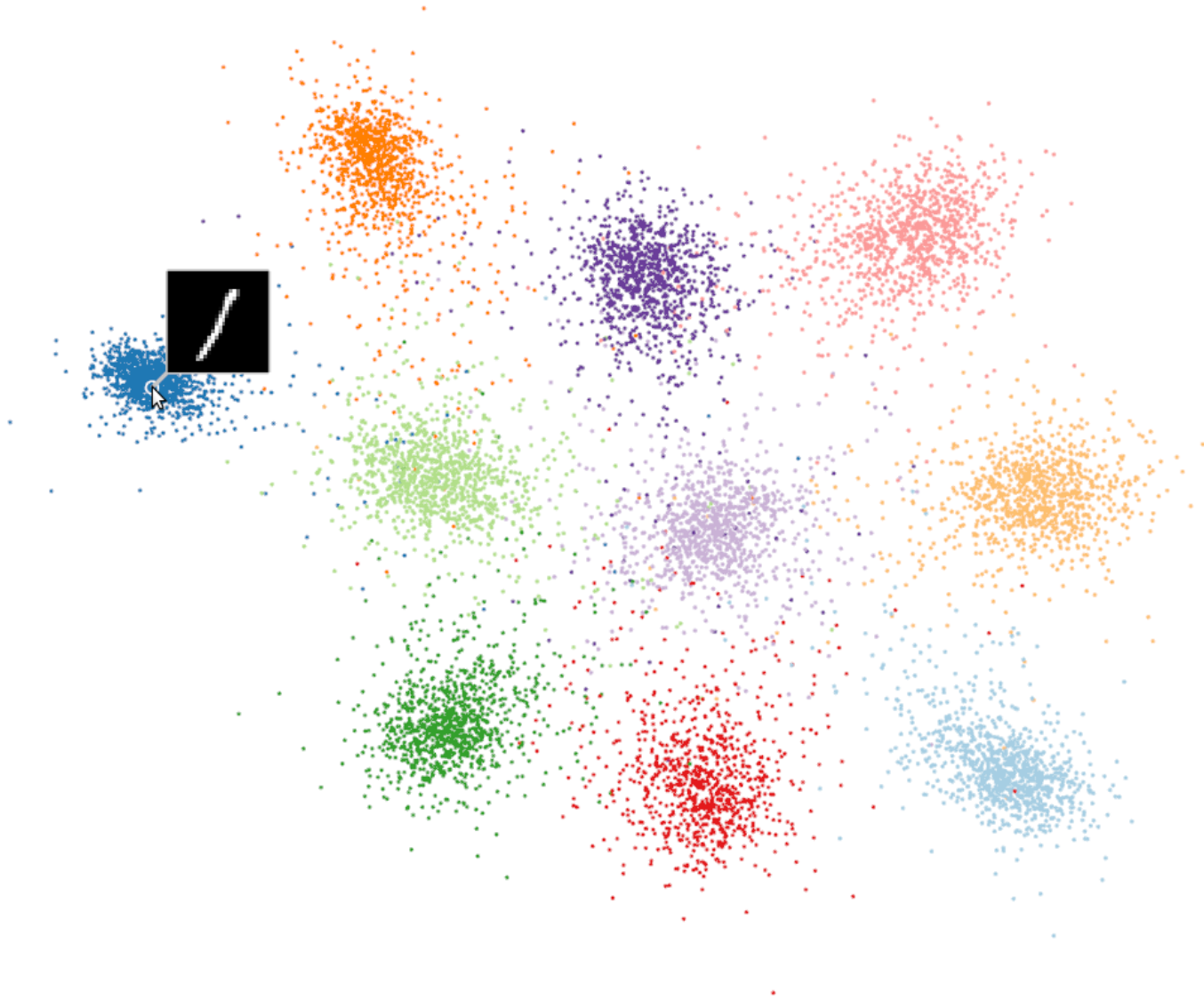

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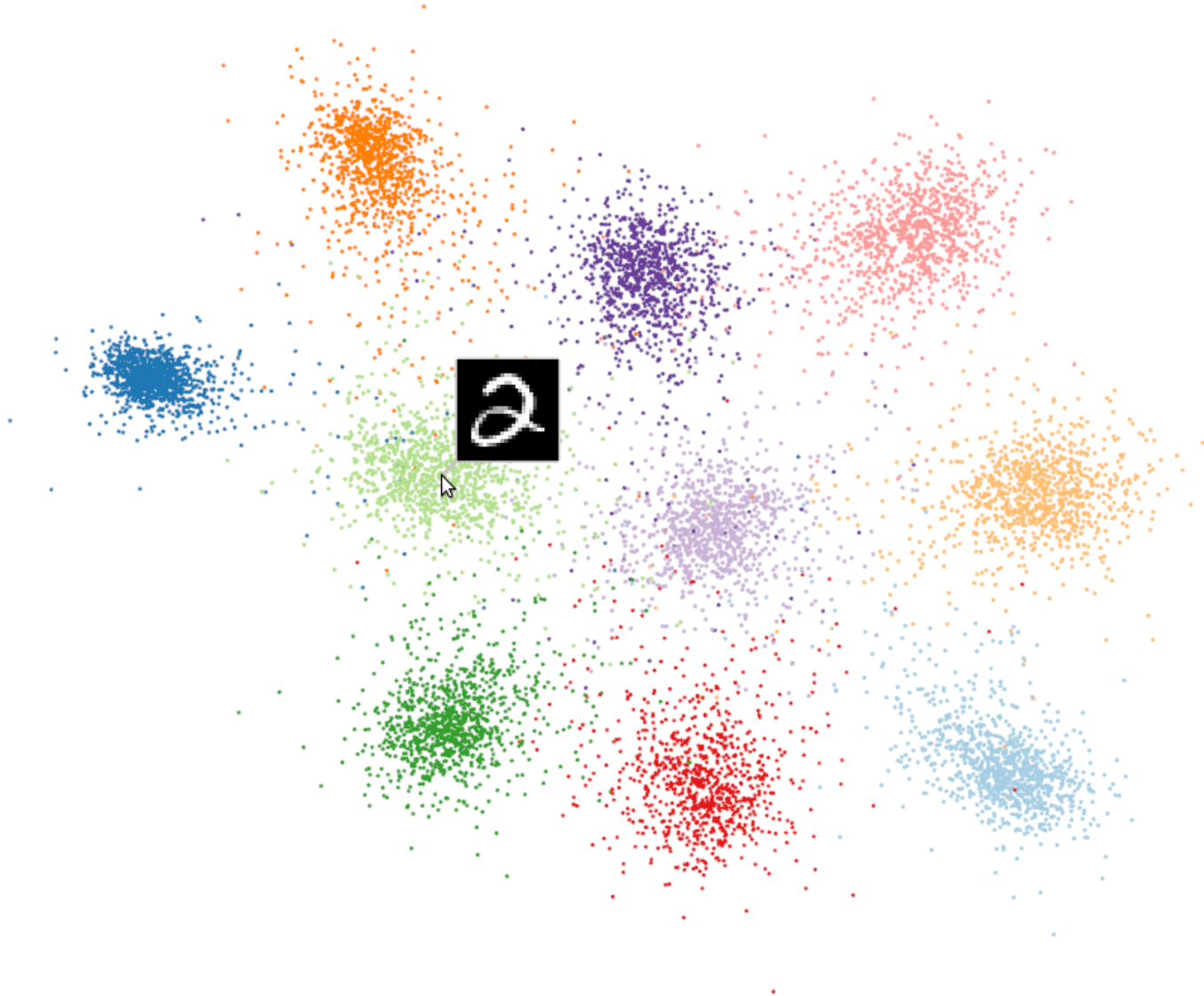

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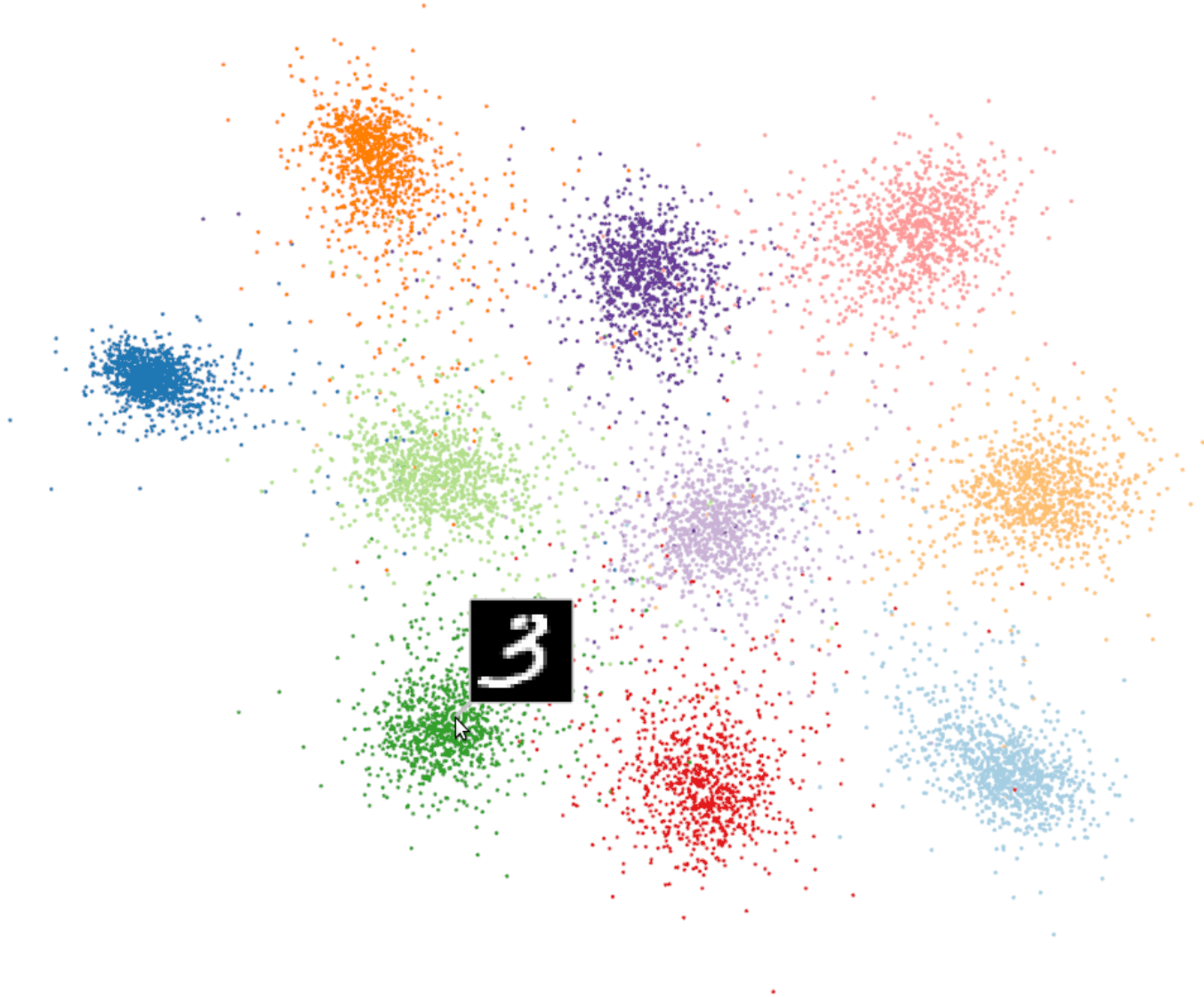

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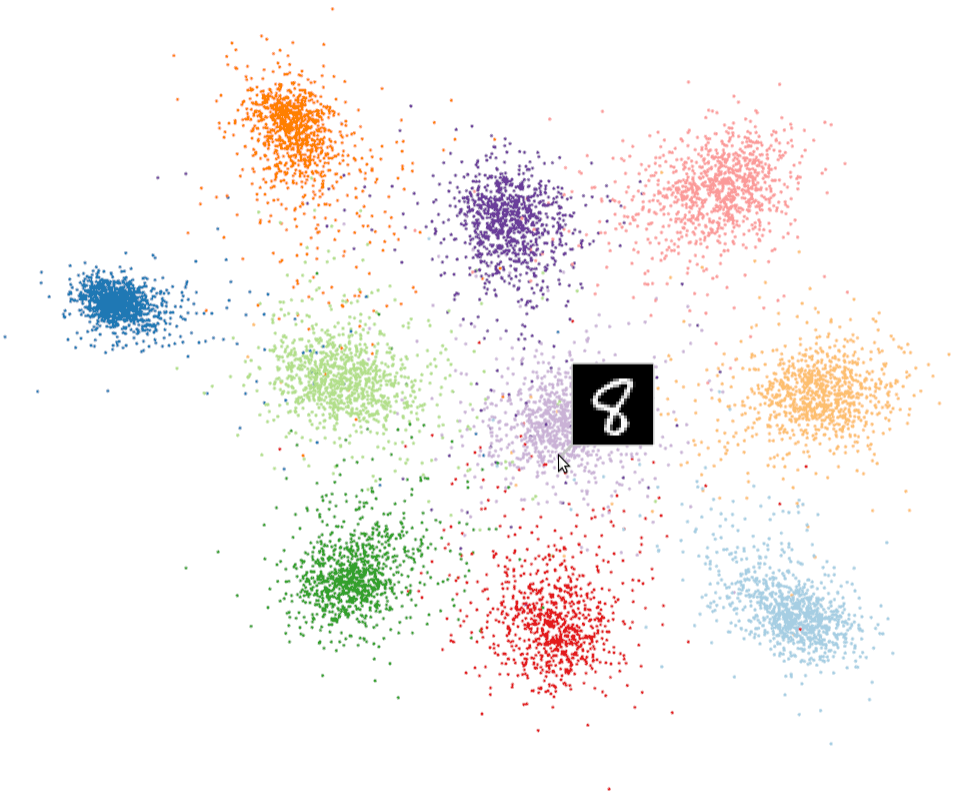
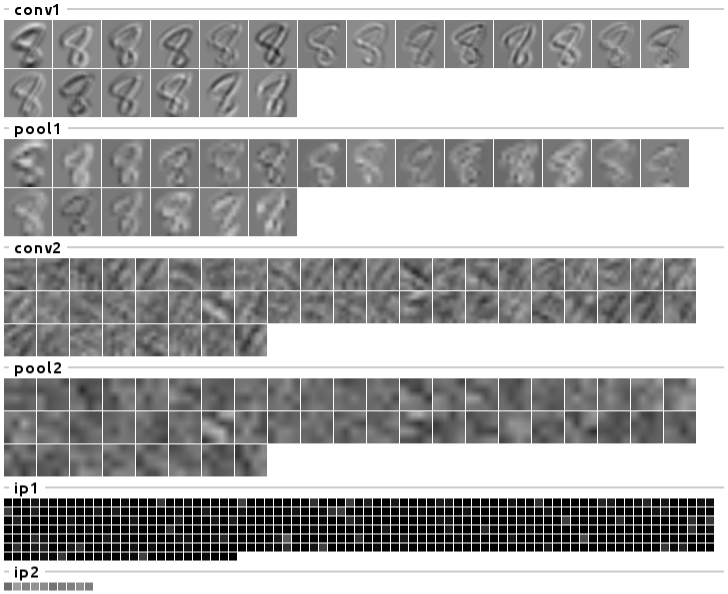
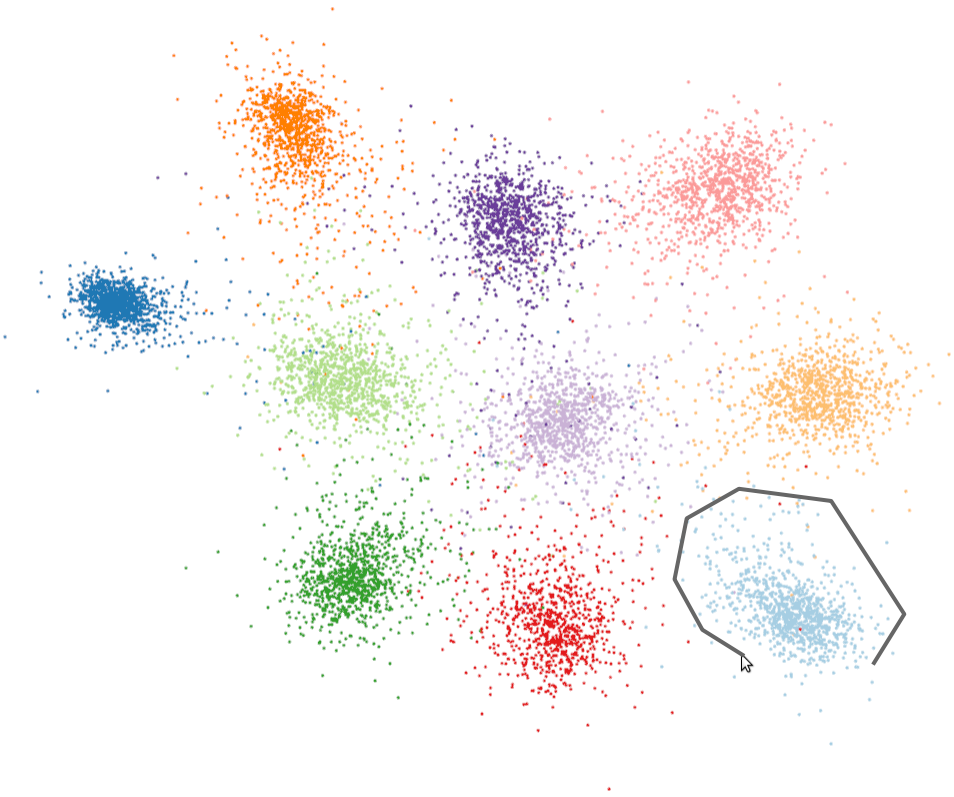
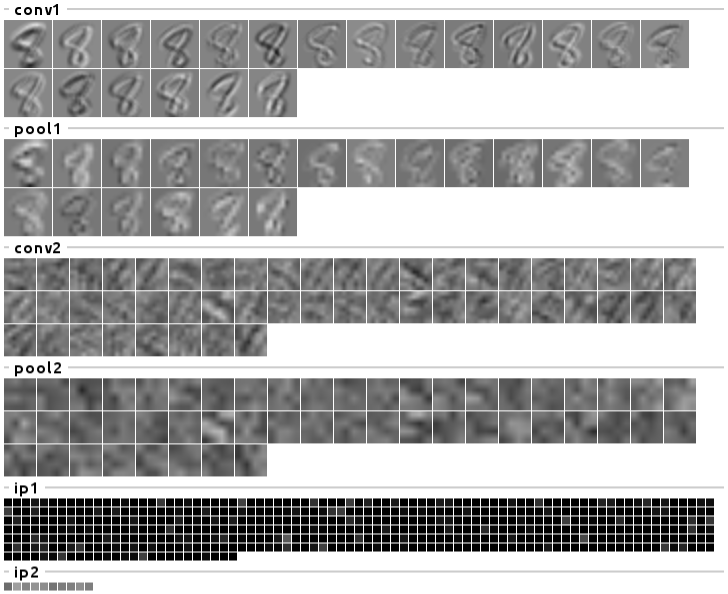




Future Plans: Next Step





aggregate response

Future Plans: Reasonable Ideas

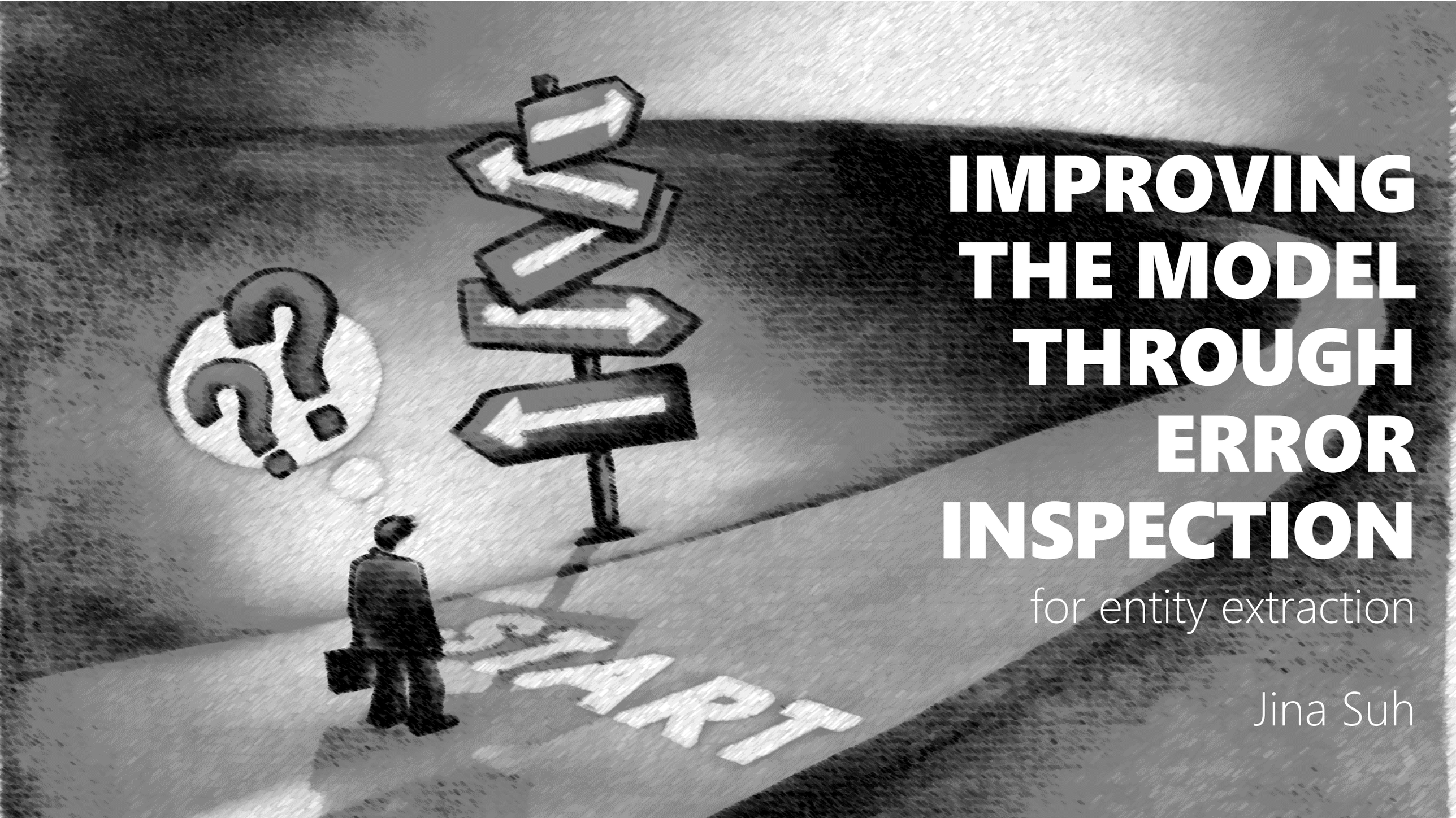
- Show ‘embedding’ for intermediate layers
  - Small multiples?
  - Parallel coordinates?
  - Approximately distance-preserving projection from N dimensions to 2? (e.g. t-SNE)
- Back-project filter activation
  - Allow user to click pixel in feature map and show what led to activation, à la Zeiler et al.
- Video mode
  - Animations showing visually how filter responses are computed
  - Can be useful for teaching someone how CNNs operate

Future Plans: Crazy Ideas

- Hallucination mode
  - Allow user to select point in embedding space and ‘hallucinate’ possible images that would land there
- Draw mode
  - Allow user to draw a new digit and push it through the network
  - Allow user to modify existing digits and see how their embedding changes

Questions

- Which of visualization techniques that I just talked about seem most compelling?
- Are there other techniques I didn't mention which might also be compelling?
- Did anything I said in the past 3 minutes make any sense whatsoever?



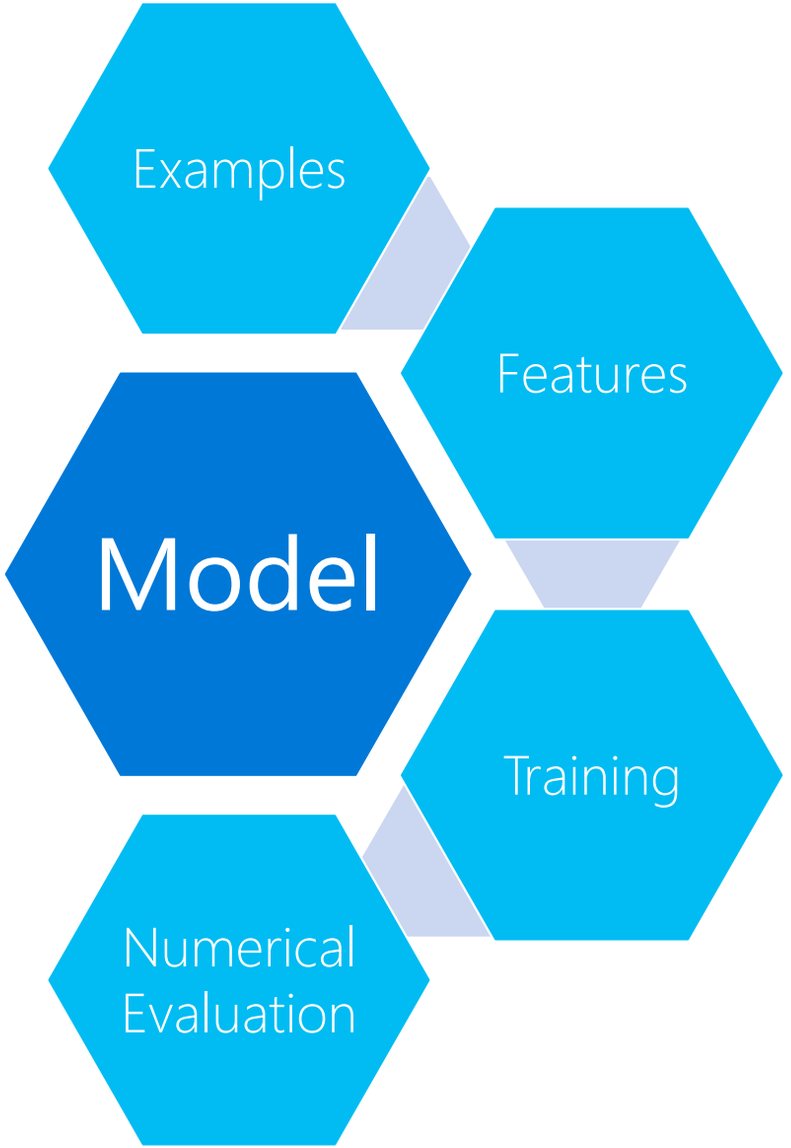
IMPROVING THE MODEL THROUGH ERROR INSPECTION

for entity extraction

Jina Suh

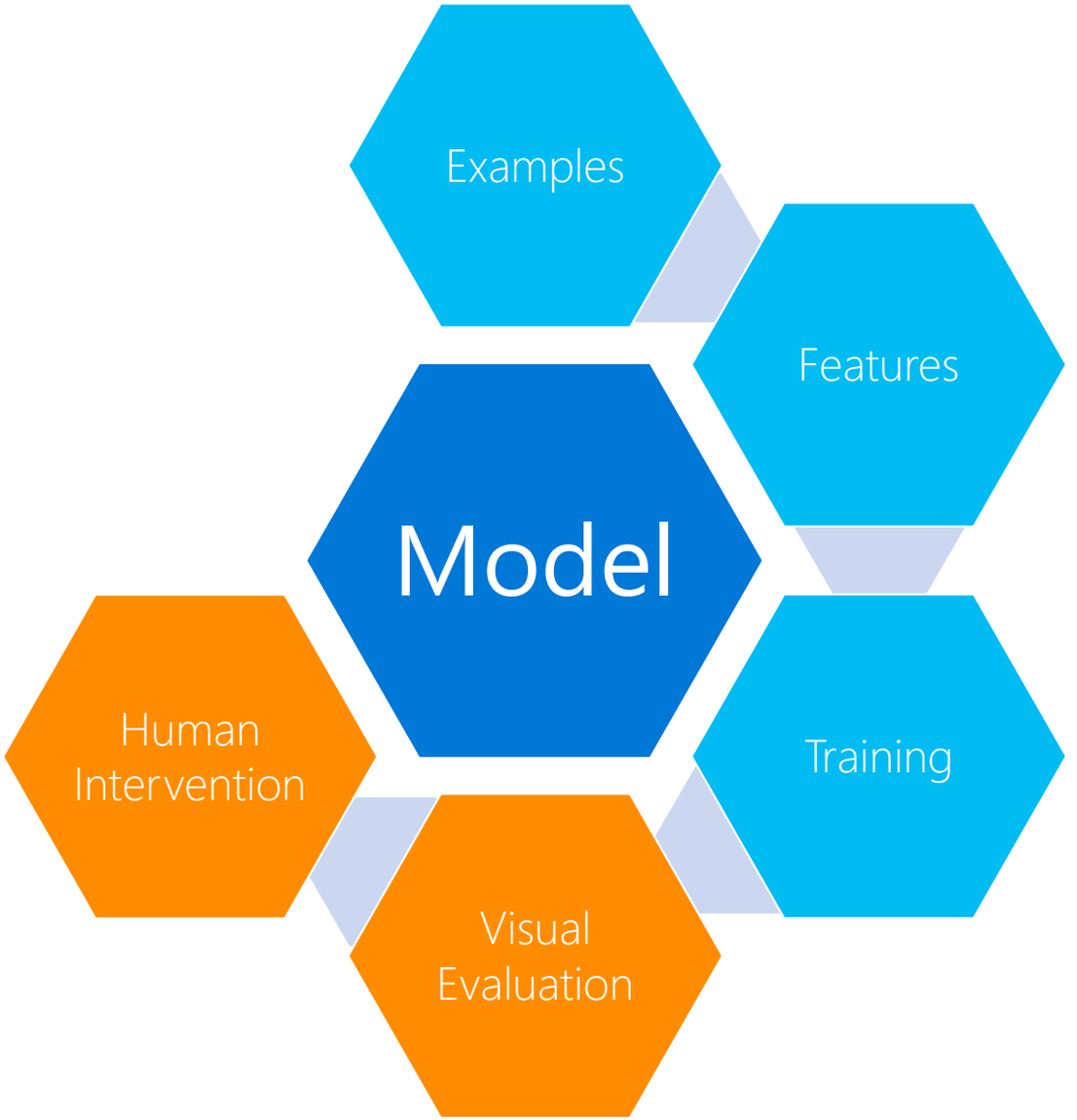
CLASSICAL MACHINE LEARNING

- Restrictive
- Expensive
- Slow Training
- Difficult to Troubleshoot



INTERACTIVE MACHINE LEARNING

- Human in the Loop
- Iterative
- Fast Training
- Visual Evaluation
- Direct intervention



HELPING HUMANS GUIDE THE MODEL

- Effective Labeling
- Effective Featuring
- Effective Evaluation

HELPING HUMANS GUIDE THE MODEL

- Effective Labeling
- **Effective Featuring**
- **Effective Evaluation**

ENTITY EXTRACTION

Frequently requested contacts

Office of Admissions (Seattle undergraduate)

Box 355852
1410 NE Campus Parkway
Seattle WA 98195-5852

Office of the Registrar

225 Schmitz Hall
Campus Box 355850
Seattle, WA 98195-5850

Human Resources/Employment

uwhires@uw.edu

206-543-2544

Generic address for forms: 1410 NE Campus Parkway Seattle, WA 98195

Street: 1410 NE Campus Parkway
City: Seattle
State: WA
Zip: 98195

DATA DOMAIN

- Open Directory Platform (ODP) web pages
- 2-300 “true” labels according to hierarchy
  - Address = Street + City + State + Zip
- Model predictions for addresses
- Individual token labels and predictions
- Individual token transition labels and predictions
- Uncertainty scores for model prediction

HYPOTHESIS

By showing the error and the uncertainty in the model prediction, the users will be able to add, remove, or modify the features to improve the model performance.

Error Evaluation + Featuring → Better Model

VISUALIZATION TASKS

- Step 1: Is my model performing at a satisfactory level?

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- Step 1: Is my model performing at a satisfactory level?
- Step 2: Where is my model performing poorly?
- Step 3: Why is my model performing poorly?
- Step 4: This is how I would distinguish the examples.

VISUALIZATION TASKS

- Step 1: Is my model performing at a satisfactory level?
- Step 2: Where is my model performing poorly?
- Step 3: Why is my model performing poorly?
- Step 4: This is how I would distinguish the examples.
- Step 5: Did my explanation fix the problem?

VISUALIZATION TASKS

- Step 1: Is my model performing at a satisfactory level?
- Step 2: Where is my model performing poorly?
- Step 3: Why is my model performing poorly?
- Step 4: This is how I would diagnose/finish the examples.
- Step 5: Did my explanation fix the problem?

VISUALIZATION COMPONENTS

1. Performance Summary and Detail

2. Example Inspection

3. Featuring

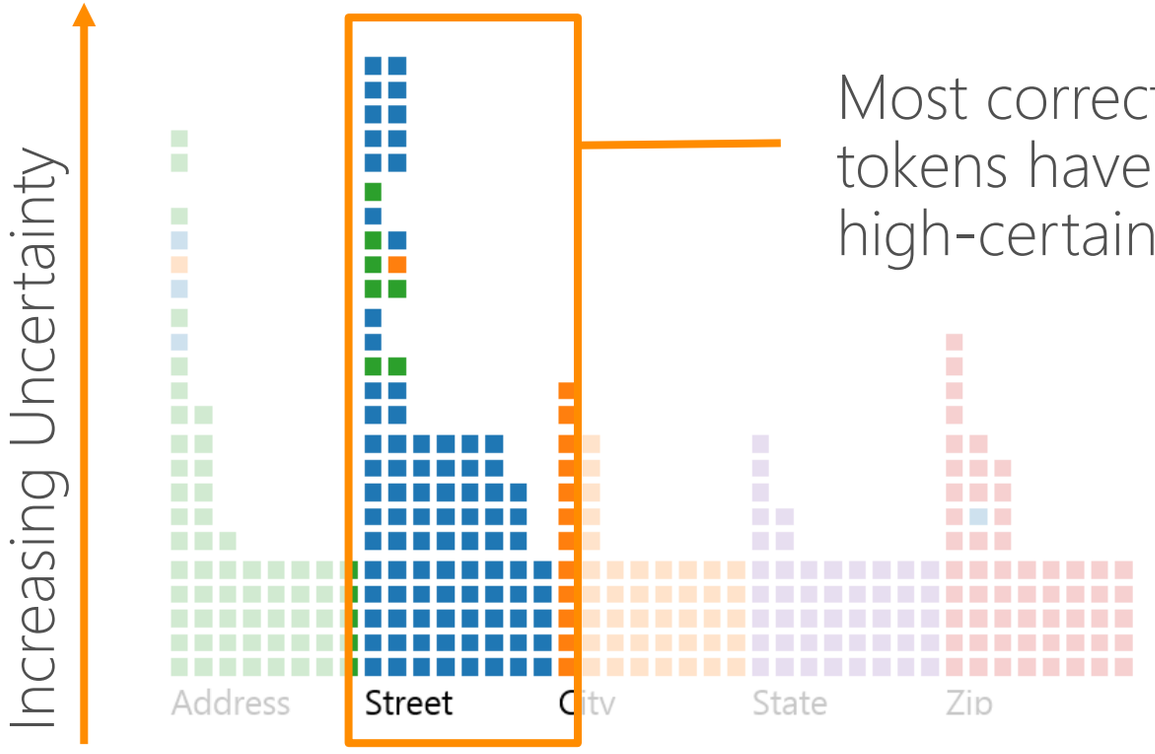
4. Training Status

PERFORMANCE SUMMARY

VISUALIZATION COMPONENTS

1. Performance Summary and Detail

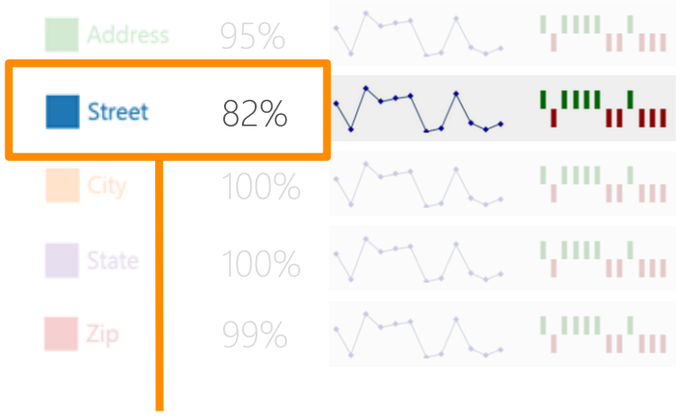
Is my model performing at a satisfactory level?



Most correct tokens have high-certainty

Model Tracker

OR

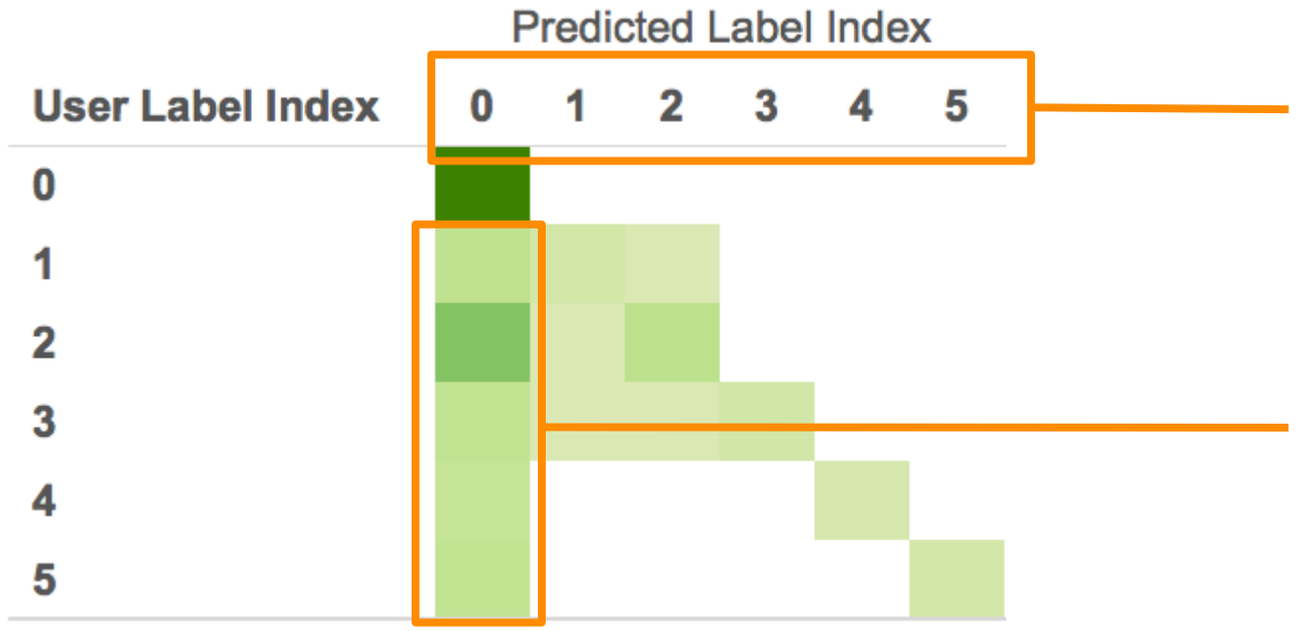


Street accuracy is below my acceptance threshold

Summary Accuracy

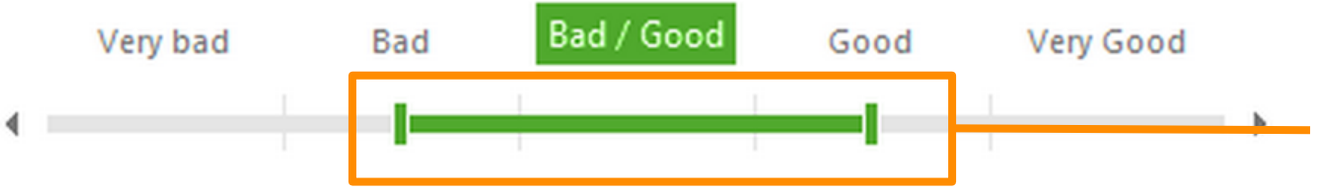
PERFORMANCE DETAIL

Where is my model performing poorly?



6 Token Tags (City, State, etc)
25 Token Transition Tags (City -> State)

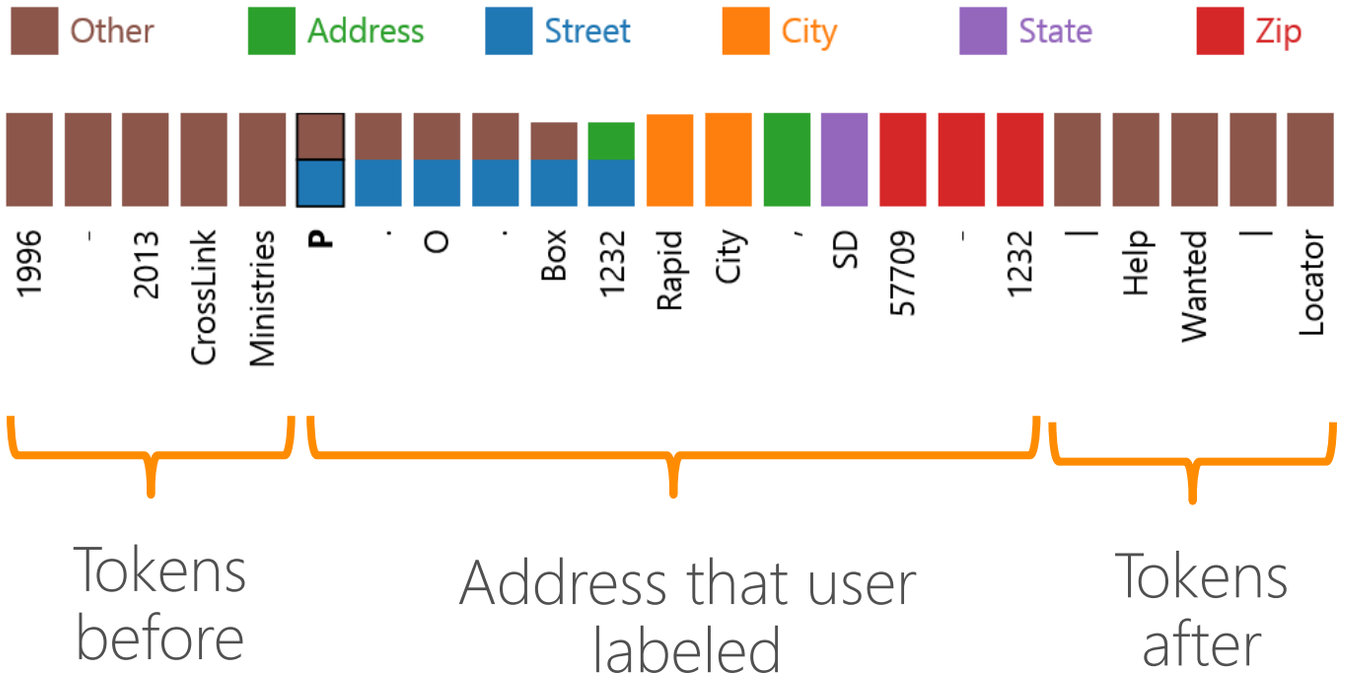
Off-Diagonal = Errors
Click a box to retrieve examples



Filter on uncertainty score to focus on examples that the model is having trouble with.

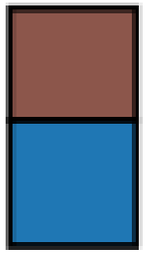
EXAMPLE INSPECTION

Why is my model performing poorly?



EXAMPLE INSPECTION

Why is my model performing poorly?

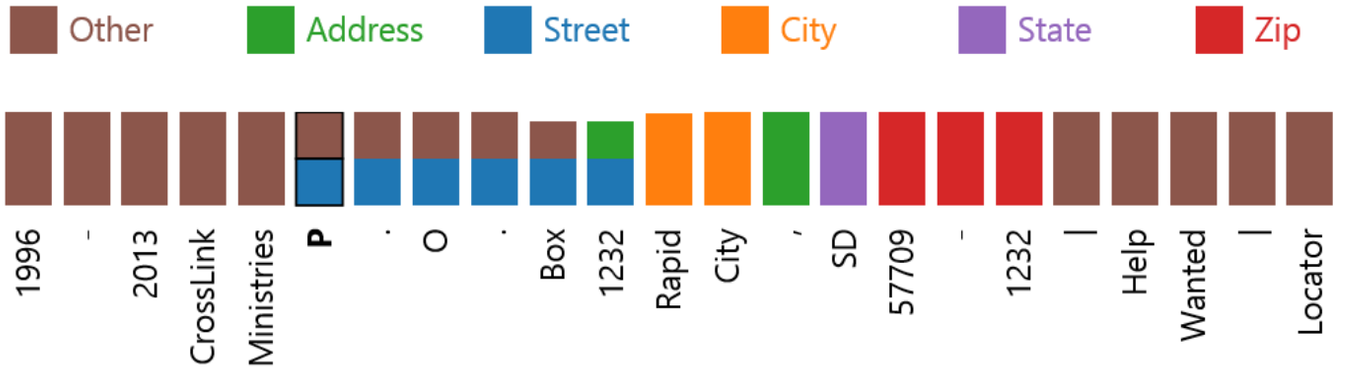


Predicted Label

User Label

Box

Token



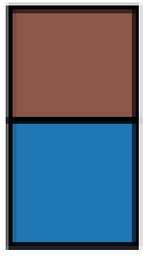
Tokens before

Address that user labeled

Tokens after

EXAMPLE INSPECTION

Why is my model performing poorly?



Predicted Label

User Label

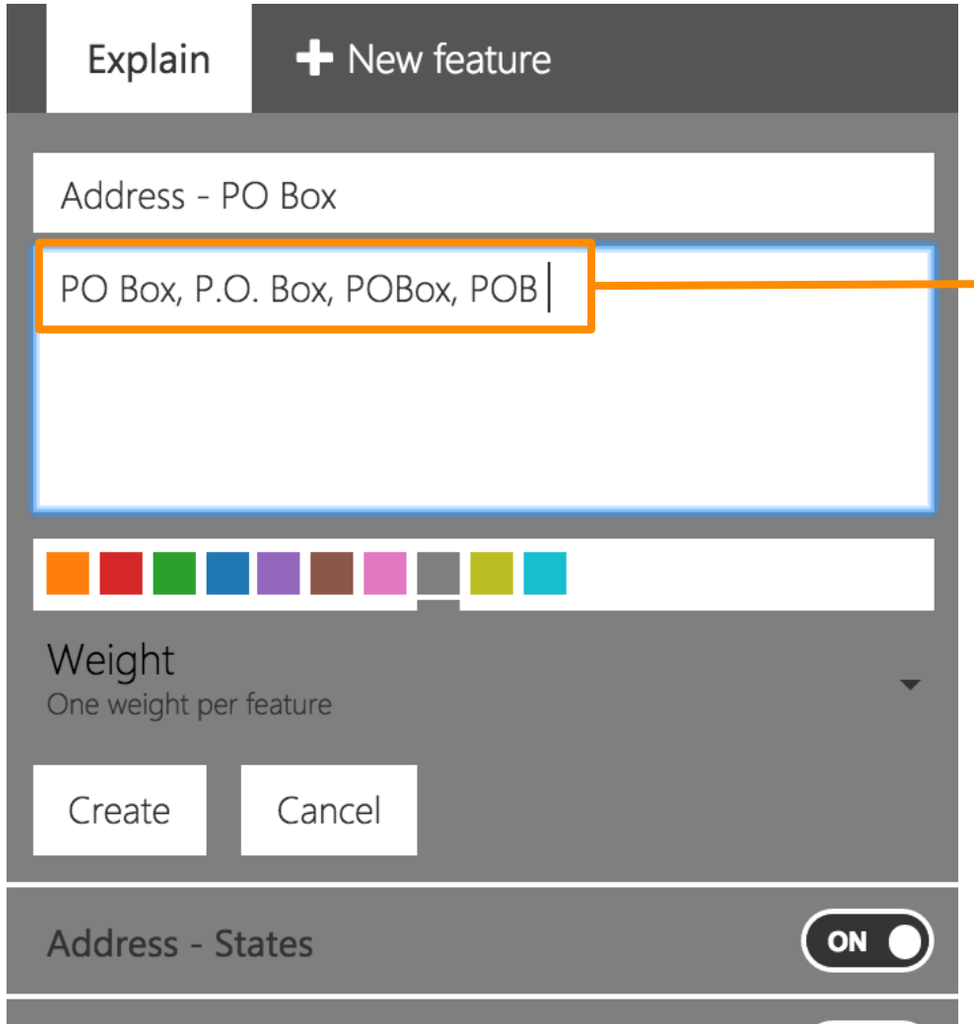
Box

Token

Model doesn't understand "PO Box"

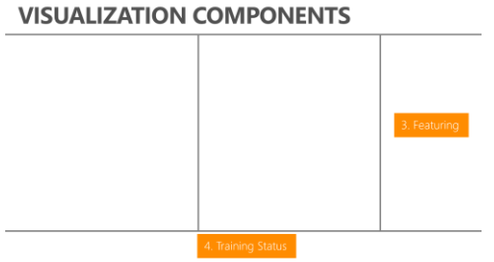
FEATURING

This is how I would distinguish the examples.



Semantic group of words

VALIDATION



Did my explanation fix the problem?

- Fast training in the background (~3-10 seconds)
- Look back at the performance summary and detail
- Open research questions
  - Change indication (besides animation)
  - Local vs Global
  - Branch from last known good

VISUALIZATION QUESTIONS

- What is the best way to encode 2 dimensions (item count and uncertainty score) in each square of the matrix visualization?
- What is the best way to convey changes in the matrix visualization?
- For example inspection, should I optimize for readability of the prediction and the user label? OR should I optimize for detecting discrepancies between the label and the prediction?

A Visualization Tool for Human-in-the-loop Machine Learning

Brian Dolhansky and Marco Túlio Ribeiro

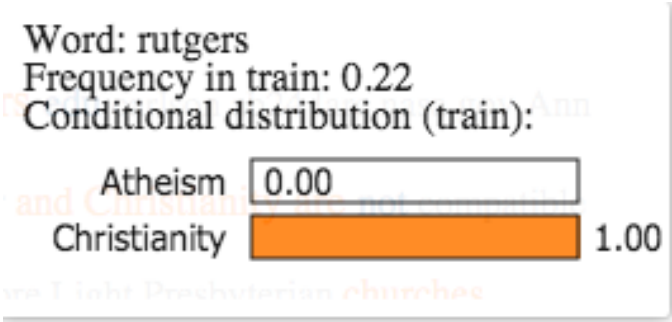
CSE 512 Final Project Progress

Problem description

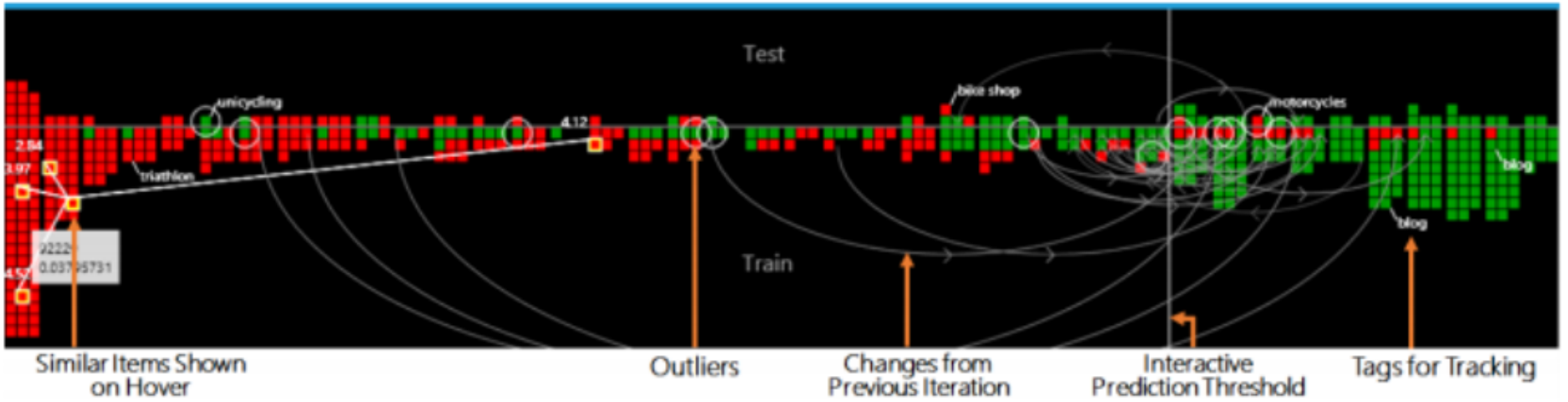
- Machine learning is hard to understand, and tweak
  - Hard to know how to improve
  - Hard to evaluate performance
  - Hard to provide feedback
- For understanding and evaluation:
  - Global understanding
  - Individual predictions
- Feedback: future work

Example: 20 newsgroups

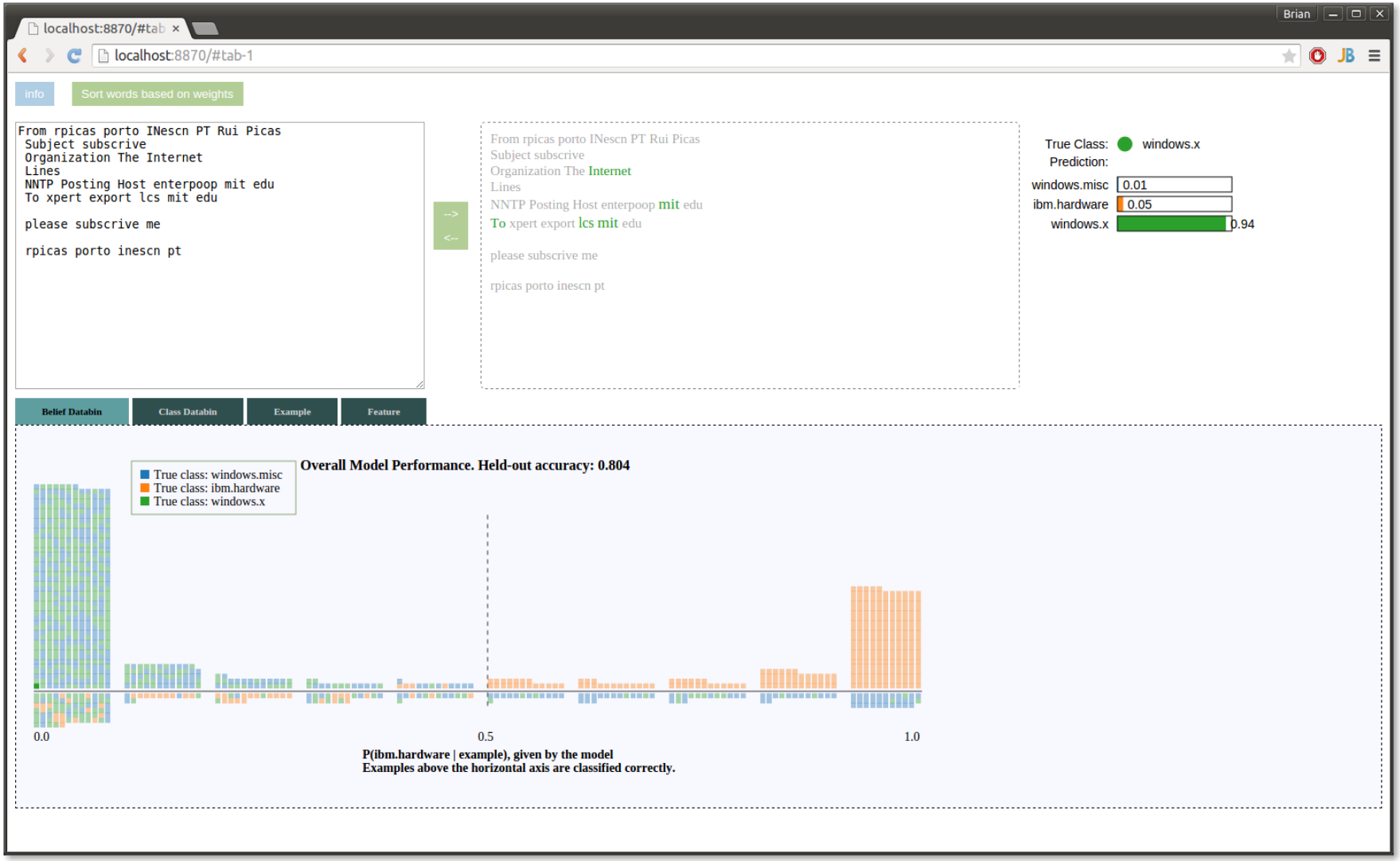
- Christianity vs Atheism: baseline accuracy 92.3%
- Example problem: headers



Prior work - Modeltracker



Current progress



Current progress

```
From sthong eniac seas upenn edu Steven Hong
 Subject LOOKING FOR ORGANIZER
 Distribution comp
 Organization University of Pennsylvania Philadelphia PA
USA
 Lines 18
 Nntp Posting Host eniac seas upenn edu

 Looking for ORGANIZER program for Windows
 Currently have Lotus Organizer not bad but looking for
better
 Should have calender scheduler
 Should have to do list
 Nice additions Address Phone Book
 Diary
 Please any suggestions Shareware Public or Copyrighted
 Please EMAIL sthong eniac seas upenn edu
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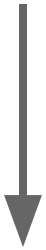

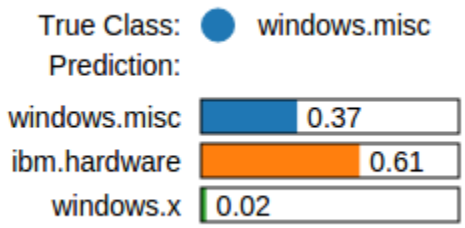

Current progress

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Looking for ORGANIZER program for Windows
Currently have Lotus Organizer not bad but looking for
better
Should have calender scheduler
Should have to do list
Nice additions Address Phone Book
Diary
Please any suggestions Shareware Public or Copyrighted
Please EMAIL sthong eniac seas upenn edu



Steven Hong
Email Address sthong eniac seas upenn edu
University of Pennsylvania
Engineering Class of 1996
```

--> <--

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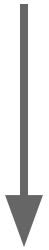

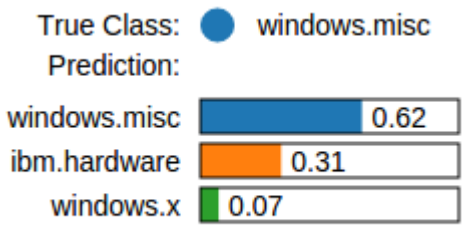

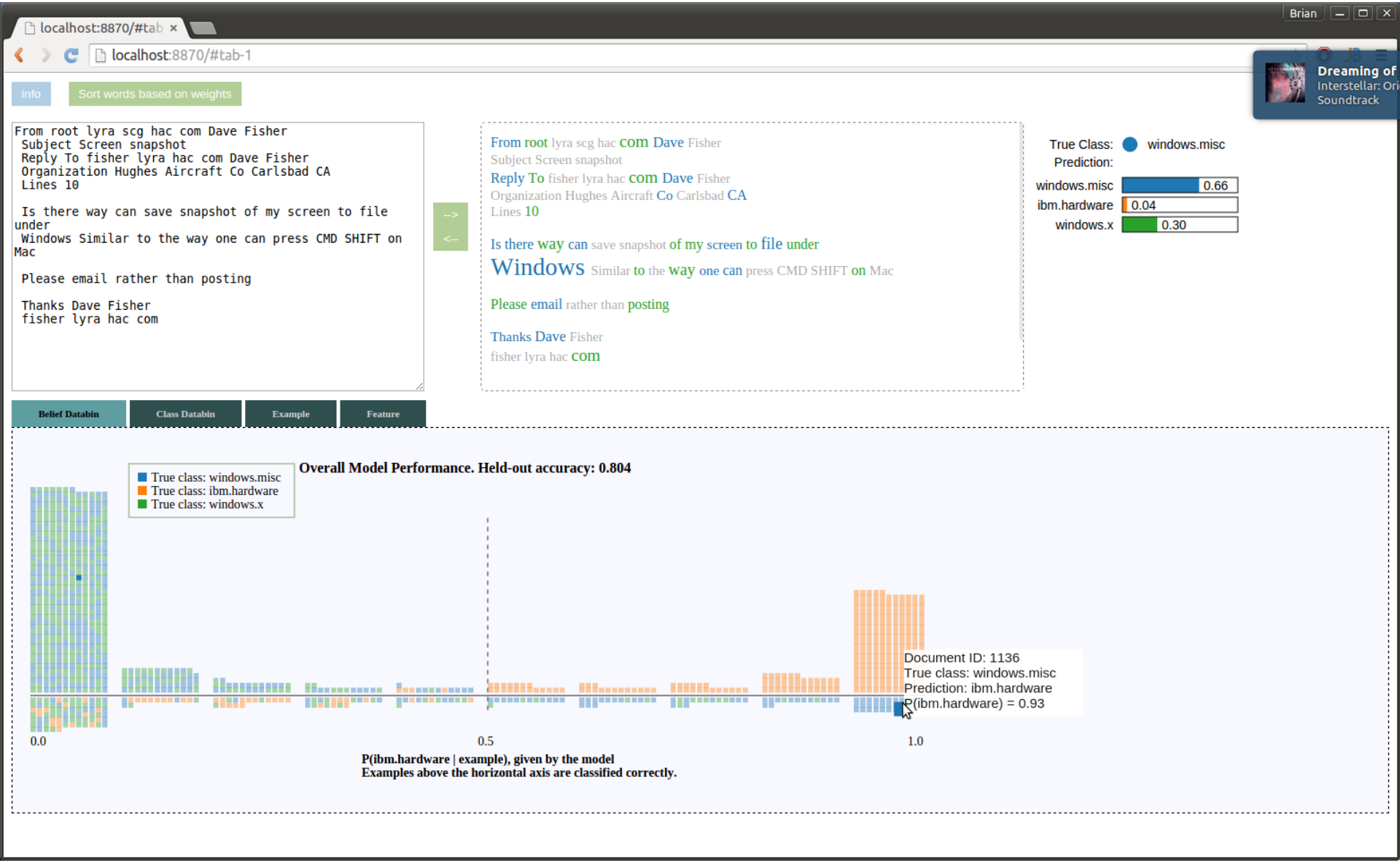
localhost:8870/#tab
Brian
localhost:8870/#tab-1
Dreaming of
Interstellar: Ori
Soundtrack
info
Sort words based on weights
From root lyra scg hac com Dave Fisher
Subject Screen snapshot
Reply To fisher lyra hac com Dave Fisher
Organization Hughes Aircraft Co Carlsbad CA
Lines 10
Is there way can save snapshot of my screen to file under
Windows Similar to the way one can press CMD SHIFT on Mac
Please email rather than posting
Thanks Dave Fisher
fisher lyra hac com
-->
<--
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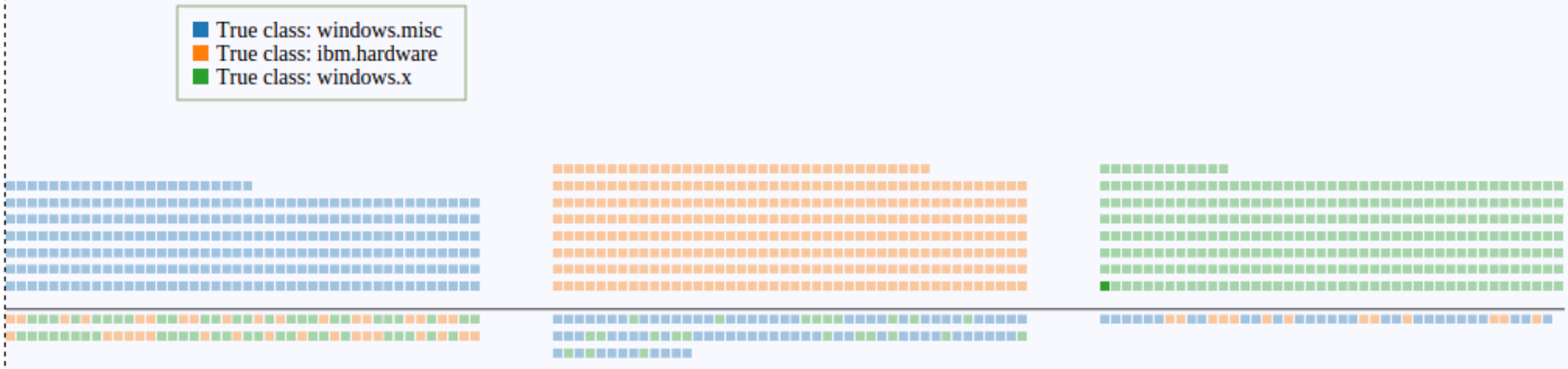
Please email rather than posting
Thanks Dave Fisher
fisher lyra hac com
True Class: windows.misc
Prediction:
windows.misc 0.66
ibm.hardware 0.04
windows.x 0.30
Belief Databin
Class Databin
Example
Feature
True class: windows.misc
True class: ibm.hardware
True class: windows.x
Overall Model Performance. Held-out accuracy: 0.804
Document ID: 1136
True class: windows.misc
Prediction: ibm.hardware
P(ibm.hardware) = 0.93
0.0
0.5
1.0
P(ibm.hardware | example), given by the model
Examples above the horizontal axis are classified correctly.

localhost:8870/#tab
Brian
localhost:8870/#tab-1
info
Sort words based on weights
From rpicas porto INescn PT Rui Picas
Subject subscrive
Organization The Internet
Lines
NNTP Posting Host enterpoop mit edu
To xpert export lcs mit edu
please subscrive me
rpicas porto inescn pt
-->
<--
From rpicas porto INescn PT Rui Picas
Subject subscrive
Organization The Internet
Lines
NNTP Posting Host enterpoop mit edu
To xpert export lcs mit edu
please subscrive me
rpicas porto inescn pt
True Class: windows.x
Prediction:
windows.misc 0.01
ibm.hardware 0.05
windows.x 0.94
Belief Databin
Class Databin
Example
Feature
True class: windows.misc
True class: ibm.hardware
True class: windows.x
Overall Model Performance. Held-out accuracy: 0.804
Document ID: 1065
True class: ibm.hardware
Prediction: windows.misc
P(windows.x) = 0.04
0.0
0.5
1.0
P(windows.x | example), given by the model
Examples above the horizontal axis are classified correctly.

Belief Databin | Class Databin | Example | Feature

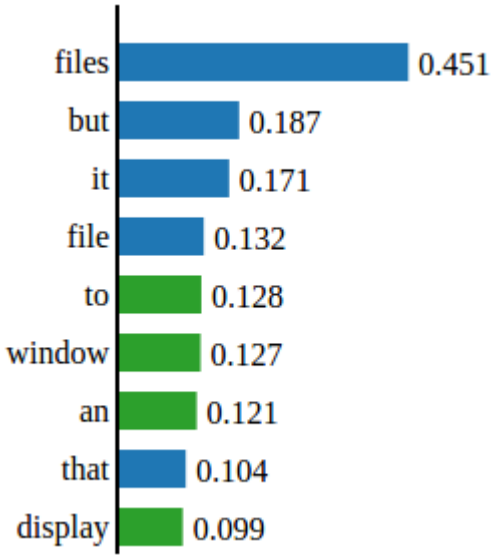


Future work

Handling lots of data

Location	Federal Government	State/Local Government	Medical Professionals	Insurance Companies	Employers	Consumers
Jackson	3.6	3.0	5.7	1.8	3.6	7.8
Seattle	4.3	4.0	5.9	1.6	2.3	7.3
Denver	4.2	4.0	6.4	2.5	3.8	6.8
Providence	4.1	3.8	6.8	2.3	2.8	8.0
Miami	5.0	4.5	5.5	2.3	3.0	6.9
Indianapolis	4.9	3.9	6.1	2.2	3.3	7.6
Detroit	3.5	3.7	6.8	1.4	2.4	7.6
Phoenix	3.9	3.7	5.2	2.0	3.4	7.7
Des Moines	5.0	4.7	5.4	2.2	2.6	6.7
Philadelphia	4.4	4.4	6.0	1.5	3.1	6.7
Sacramento	3.8	3.8	6.4	2.5	2.9	7.4
Billings	5.1	4.7	6.0	2.4	4.0	6.3
New York	5.2	4.1	6.7	1.4	2.1	7.7
Tucson	3.9	3.4	6.2	2.6	3.2	6.6
Salt Lake City	4.6	4.7	4.9	2.6	3.1	6.8
Average	**4.4**	**4.0**	**6.0**	**2.1**	**3.0**	**7.2**

Handling different types of data



Better feature interaction/visualizations

Discussion questions

1. As an ML novice/expert, would this tool be useful for debugging?

2. Does the “databin” visualization effectively convey what the model is doing?

3. How might you visualize large amounts of data?

Visual Toolbox for Classification

Final Project Progress Report

CSE 512

Amit Meir and Yoni Fintzi

Introduction

- Classification is one of the most common tasks in Statistics and ML.
- The data analyst must optimize performance while preserving interpretability, parsimony and scientific plausibility.
- Building a classifier is an iterative process involving:
  - Data exploration
  - Variable selection.
  - Model Assessment.

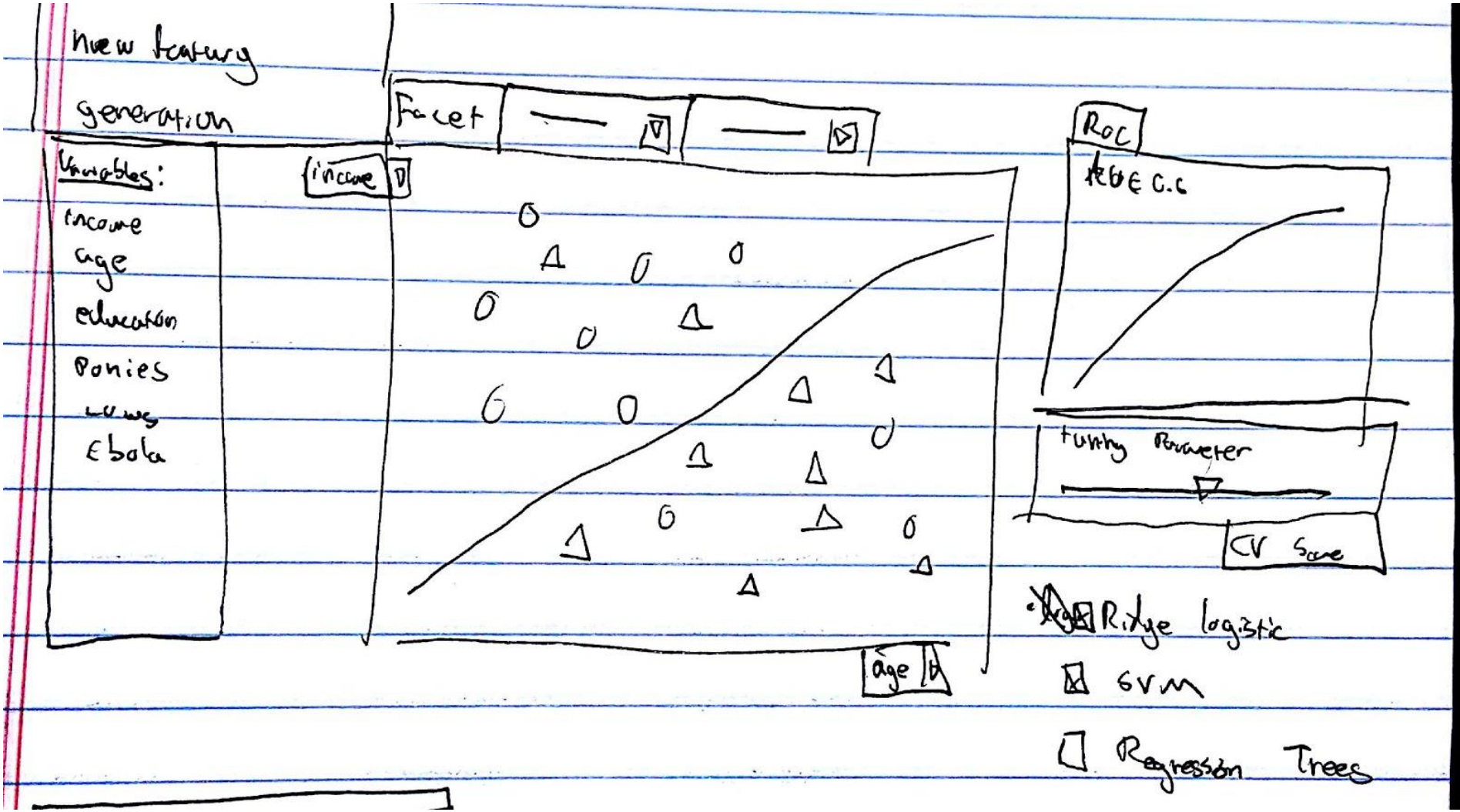
Visual Toolbox for Classification

We propose to construct a tool that will allows the user to:

- Explore basic aspects of a data set visually.
- Generate new features in a guided manner.
- Fit and tune different classifiers to the data.
- Diagnose and compare the performance of different classifiers visually and qualitatively.

Previous Work

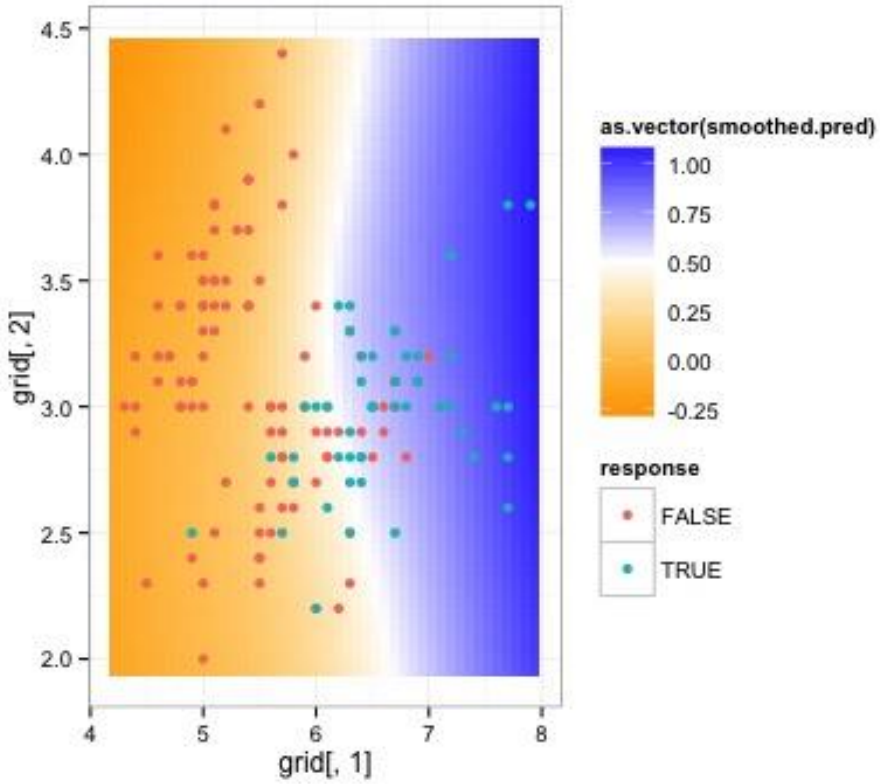
- Seo and Shneiderman [2004] built a system for data exploration, where possible data views are ranked different criteria.
- Muhlbacher and Piringer [2013] constructed a tool for building regression models.
- Garg et al. [2008] built a classification tool based on Logic Programming.

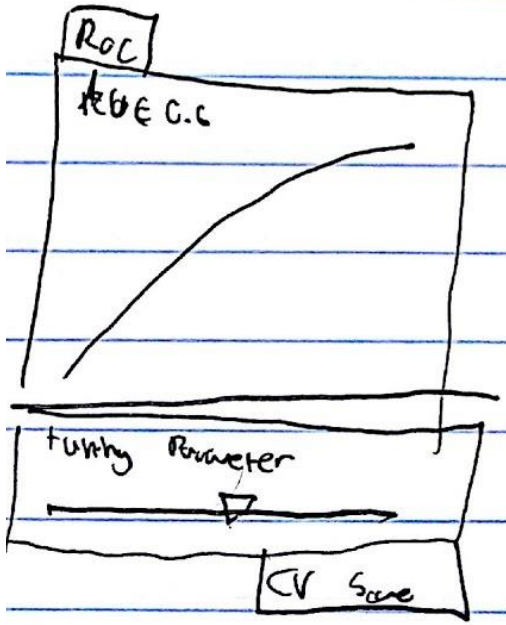

new feature
generation
Variables:
income
age
education
Ponies
Ebola
Facet
income
age
ROC
tune C.c
tuning Parameter
CV Score
Ridge logistic
SVM
Regression Trees

new features generation

Variables:

- income
- age
- education
- Ponies
- ~~Lions~~
- Ebola





- [x] Ridge logistic
- [ ] SVM
- [ ] Regression Trees

Questions

- What operations should the tool support for constructing the model?
- Additional data views and operations to assist with evaluating the model?
- How can we make the tool intuitive for non-professionals?

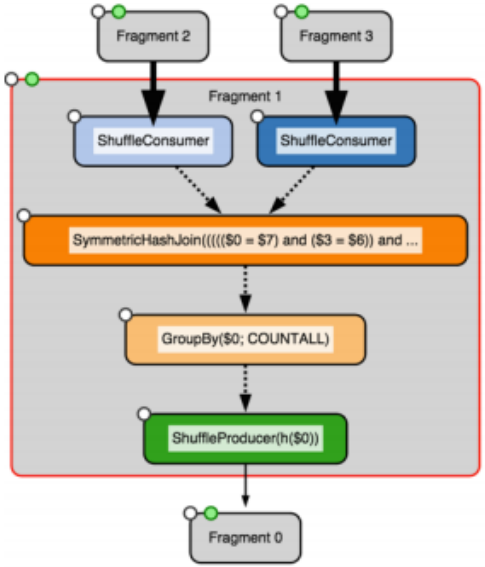
Thank You!

HYBRIDPerfopticon

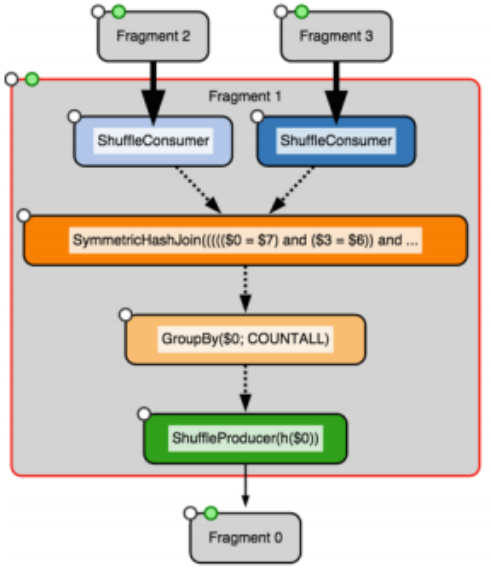
Brandon Haynes & Shrainik Jain

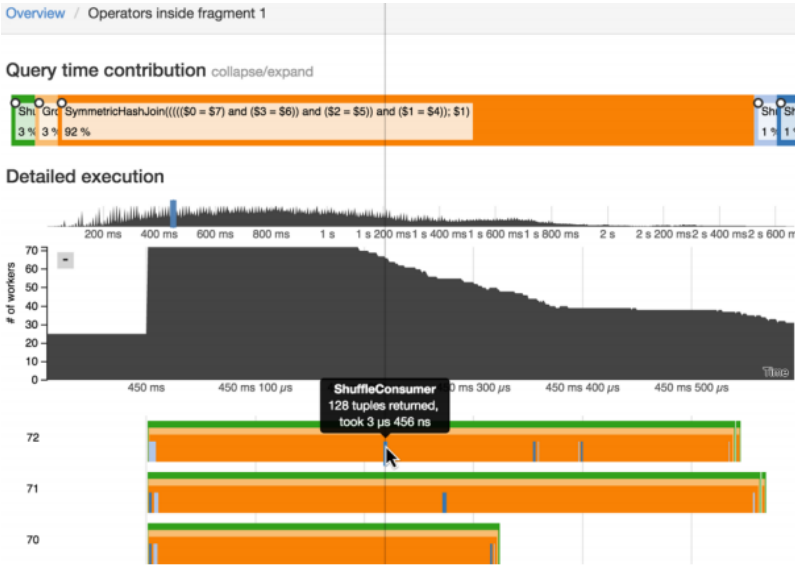
We’ve seen Perfopticon before.

We’ve seen Perfopticon before.



We've seen Perfopticon before.





What about multiple databases?

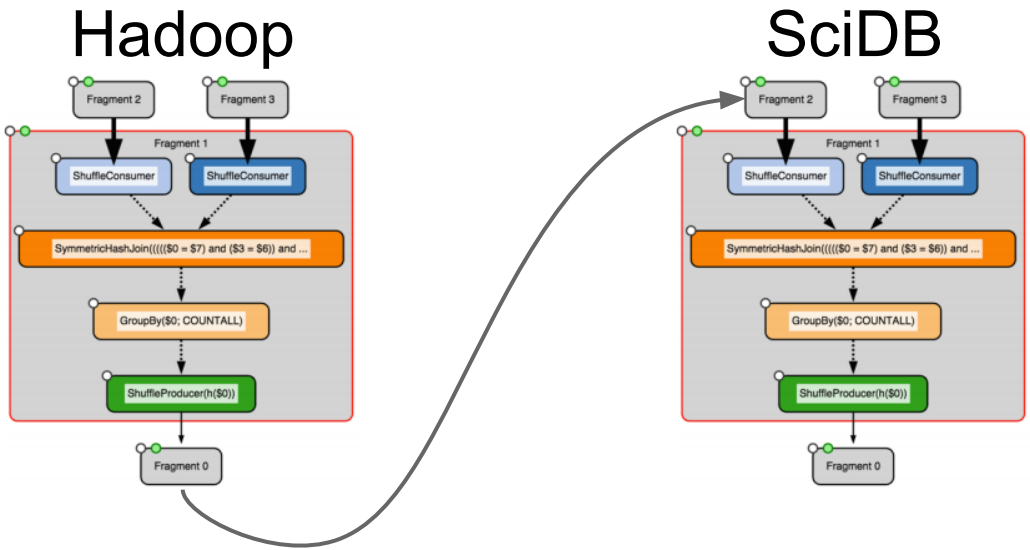
What about multiple databases?

Hadoop

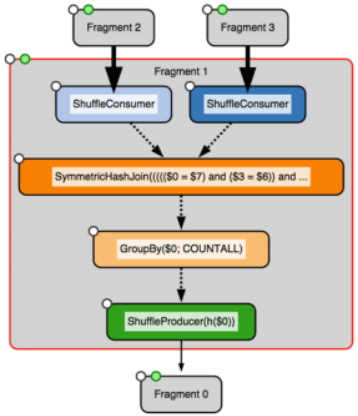
SciDB

What about multiple databases?

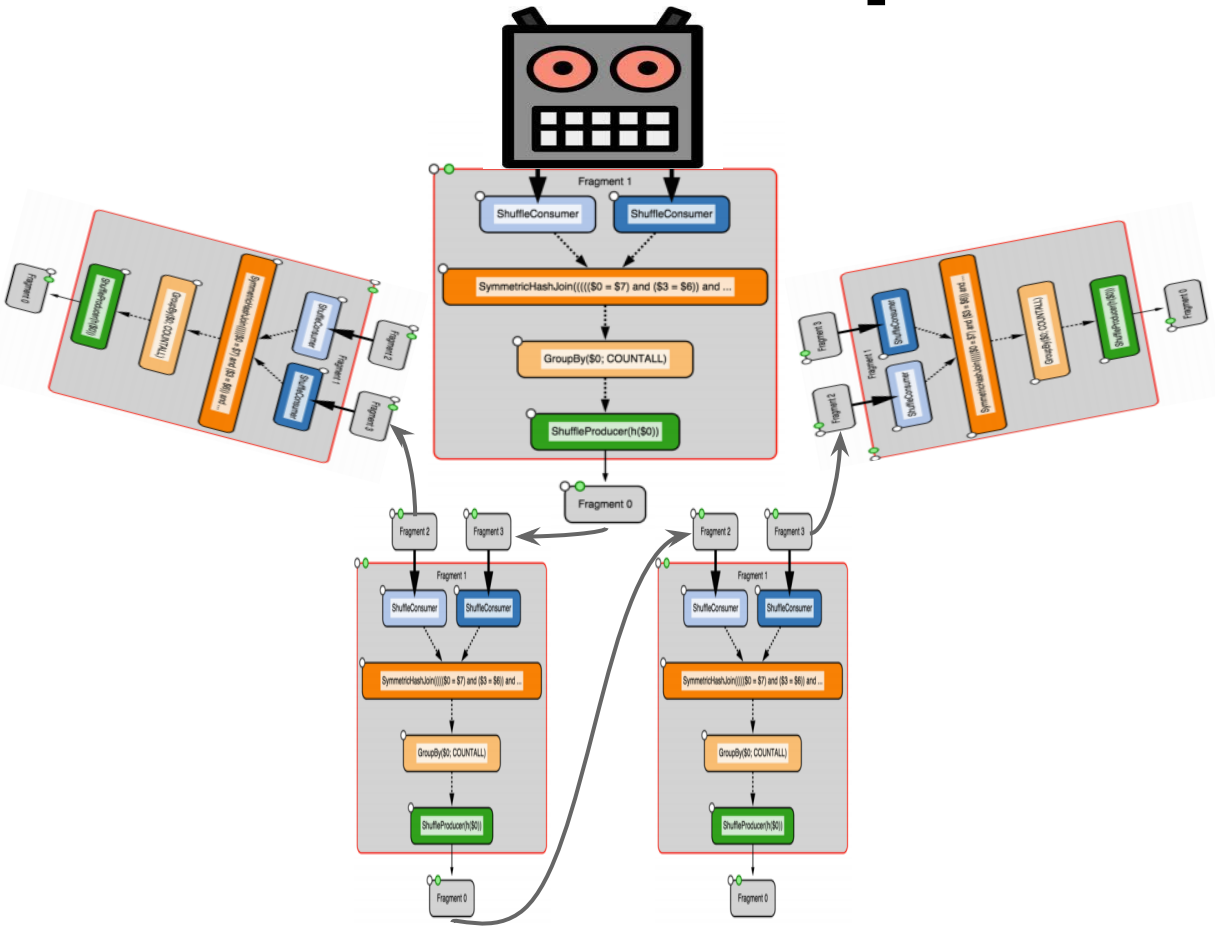
What about multiple databases?



Perfopticon



HYBRIDPerfopticon

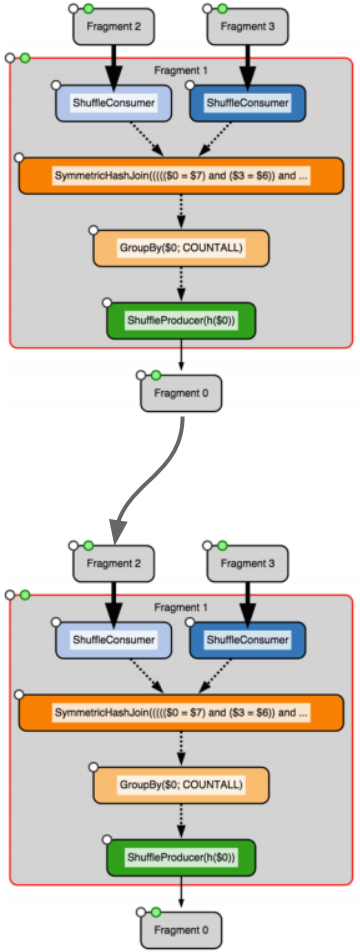


We'll focus on:

1. Two database systems: Myria and SciDB
2. Visualizing plans occurring across these systems
3. Highlighting inter-database transfer, a common bottleneck
4. Communicating inter-operator cardinality and skew

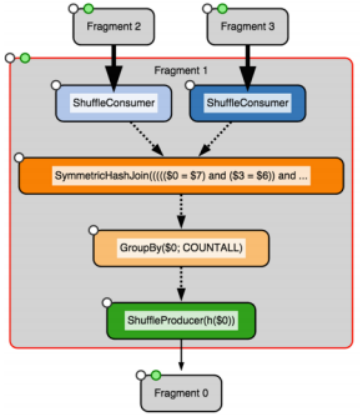
Some Challenges

1. **Which operators belong to with systems?**

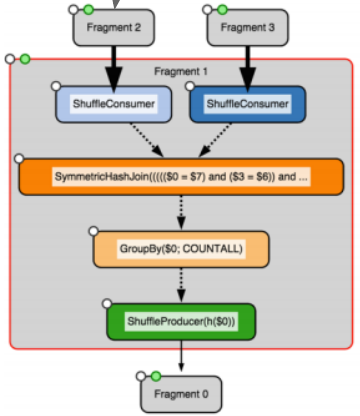


1. **Which operators belong to with systems?**

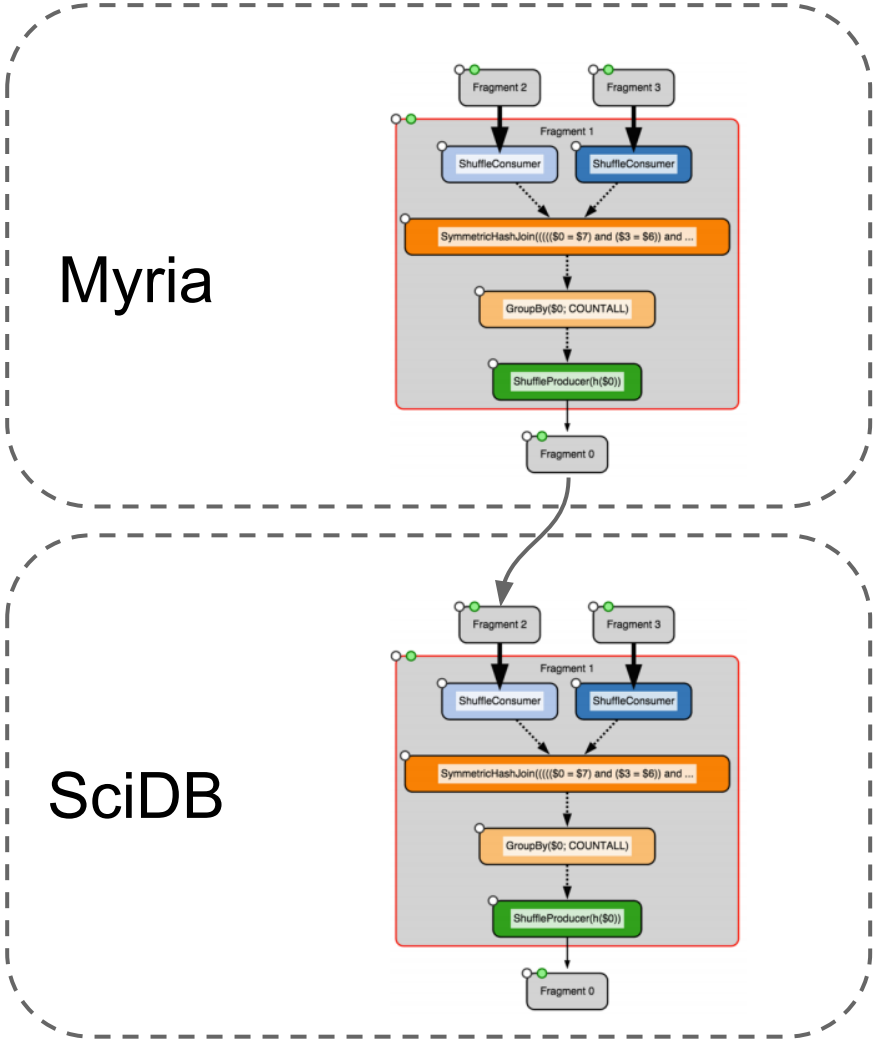
Myria



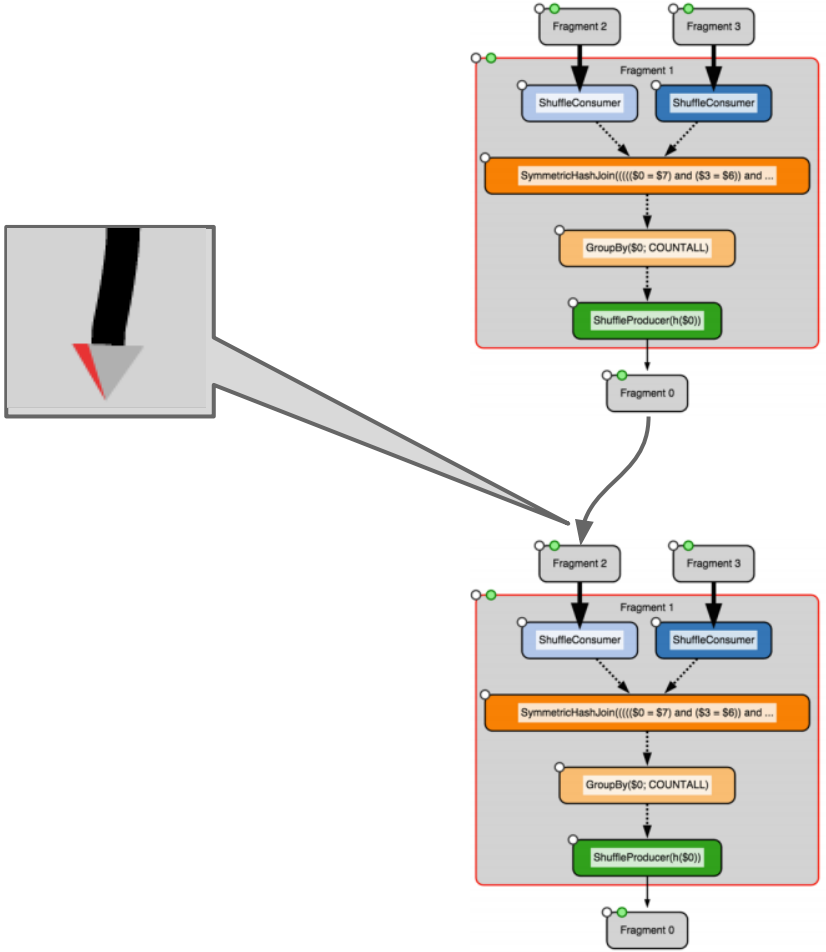
SciDB



1. **Which operators belong to with systems?**



2. **Displaying shuffle skew**

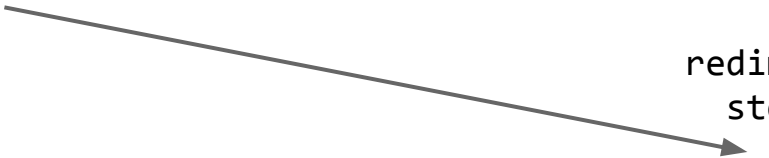


3. Instrumenting non-relational databases

```
redimension(
  store(
    regrid(
      scan(transform),
      1, 2,
      avg(value), bin(value)),
    result),
  template,
  count(id));

redimension(
  store(
    regrid(
      scan(transform),
      1, 2,
      avg(value), bin(value)),
    result),
  template,
  count(id));
```

3. Instrumenting non-relational databases

Operator types not found in relational systems
(parallels often exist)

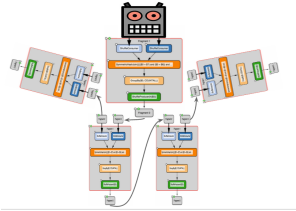


```
redimension(
  store(
    regrid(
      scan(transform),
      1, 2,
      avg(value), bin(value)),
    result),
  template,
  count(id));

redimension(
  store(
    regrid(
      scan(transform),
      1, 2,
      avg(value), bin(value)),
    result),
  template,
  count(id));
```

3. Instrumenting non-relational databases

Atomic unit is an array chunk, **not** a tuple

```
redimension(
  store(
    regrid(
      scan(transform),
      1, 2,
      avg(value), bin(value)),
    result),
  template,
  count(id));

redimension(
  store(
    regrid(
      scan(transform),
      1, 2,
      avg(value), bin(value)),
    result),
  template,
  count(id));
```



Key Challenges

Visualization:

1. Displaying plan/profiling data from multiple sources in real-time
2. Indicating skew
3. Aggregating and displaying SciDB queries as unified programs

Systems:

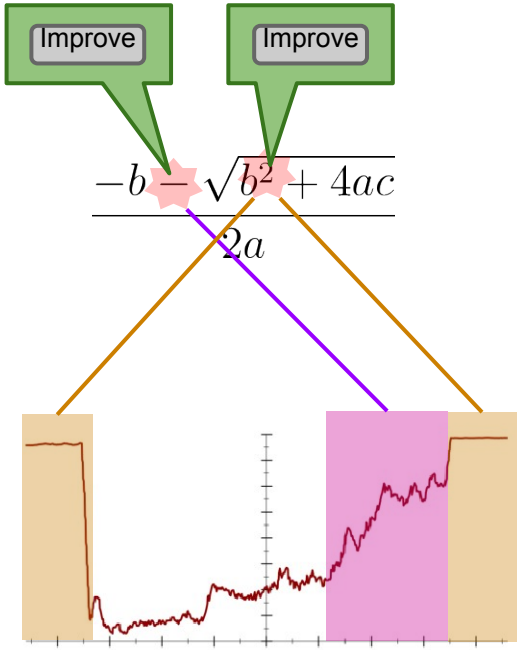
4. Instrumenting SciDB operators
5. Combining subgraphs into a unified plan
6. Exposing profiling data via HTTP
7. Quantifying SciDB transfer metrics

Herbie Interface Visualization

The Problem

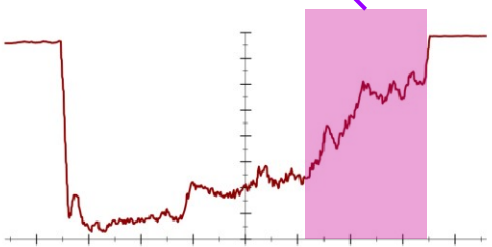
- Teach users how to identify and address floating point issues

Design



Design

$$\frac{-b-\sqrt{b^2+4ac}}{2a}$$

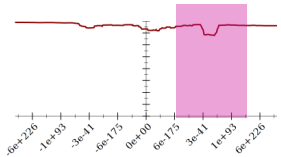


Apply the rule:

$$a-b \to \log \frac{e^a}{e^b}$$

to get:

$$\frac{\log \frac{e^{-b}}{e^{\sqrt{b^2-4ac}}}}{2a}$$



Apply the rule:

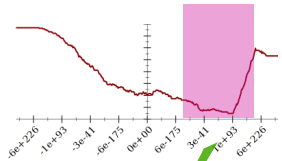
$$a-b \to \frac{a^2-b^2}{a+b}$$

to get:

$$\frac{(-b)^2-\sqrt{b^2-4ac}^2}{-b+\sqrt{b^2-4ac}}/2a$$

and simplify to:

$$\frac{2c}{-b+\sqrt{b^2-4ac}}$$

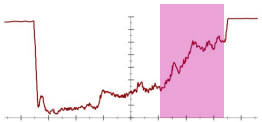


Apply the rule:

$$a \to 1*a$$

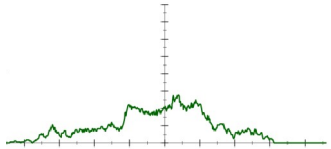
to get:

$$\frac{1*(-b-\sqrt{b^2-4ac})}{2a}$$



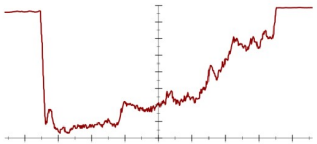
Design

Current combination



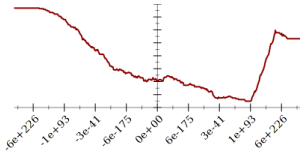
Choose

$$\frac{-b - \sqrt{b^2 + 4ac}}{2a}$$



Choose

$$\frac{2c}{-b + \sqrt{b^2 - 4ac}}$$



■ ■ ■

Questions

- Does this seem like an intuitive way to navigate?
- Does this increase intuition about the accuracy of floating point expressions?

FlowViz

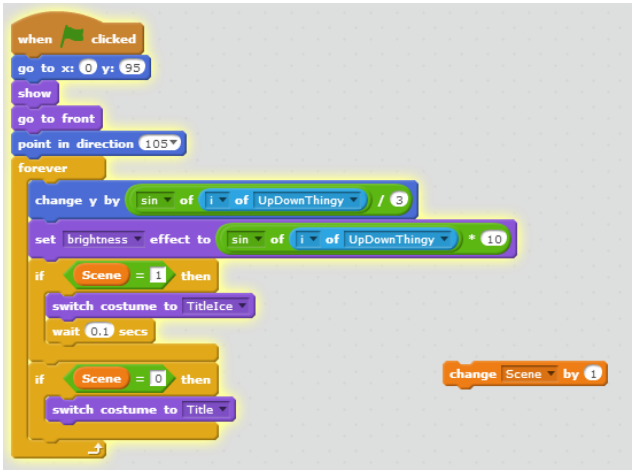
a Visualization Toolkit for Developing Visual Programming Languages

Sonya Alexandrova and Alex Fiannaca

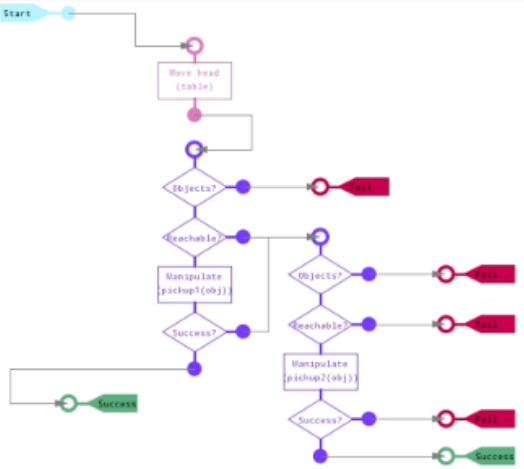
Visual Programming Languages

Represented as flow charts:

- Nodes - “Code”
- Edges - Program Flow



Allows non-expert end users to code systems



VPLs share many properties but there are no unified tools for developing VPLs

Our Project

Implement a visualization toolkit that provides an interface for developers to create new VPLs

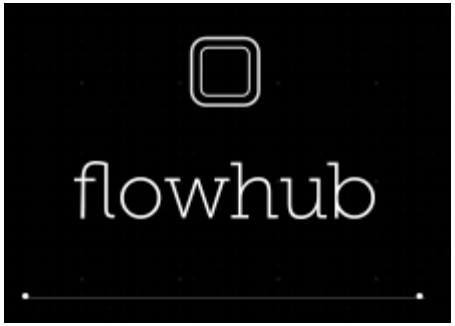
- Declarative (JSON) configuration spec
- Intuitive Default Interactions
- Extensible
- Downloadable graph spec

Big picture:

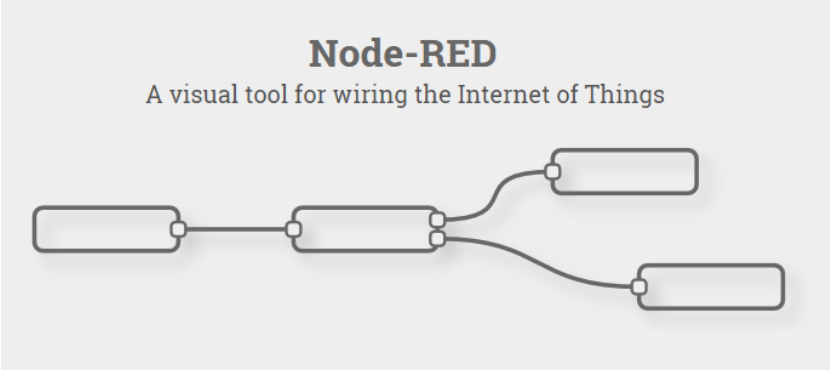
Constraint-aware interactive graph visualization system!

Current Systems

No toolkits exist for creating new VPLs

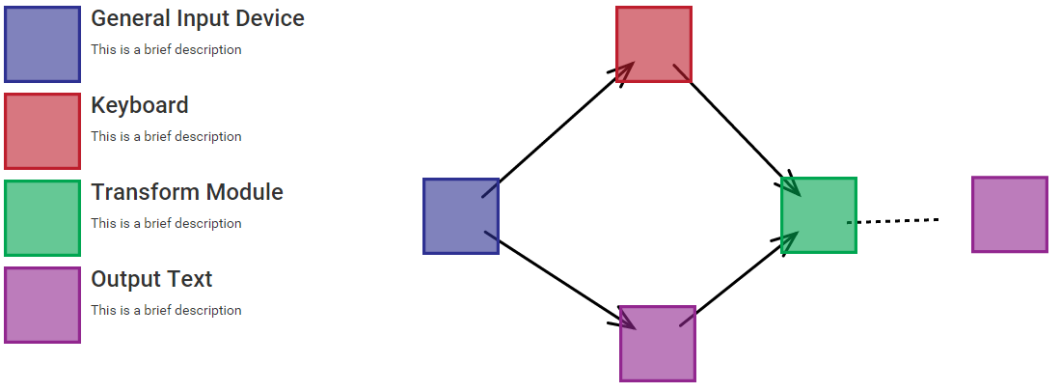


Existing tools are VPLs which allow developers and end users to write visual programs



Current Project State

```
var App = new FlowViz.App('config.json', 'svg#InteractiveViz', {

    ready: function() {
        this.Legend.Create('div#LeftSidebar');
    }

});
```




```
{
  "name": "MapAll",
  "connectEvt": "dblclick",
  "draggable": true,
  "layout": "right",
  "types": [{
    "type": "InputDevice",
    "name": "General Input Device",
    "view": "<?xml version=\"1.0\" encoding=\'
    "desc": "This is a brief description",
    "clickItems": null,
    "callbacks": null,
    "constraints": {
      "incoming": "none",
      "outgoing": "Transform.*"
    },
    "subtypes": [{
    ...
```

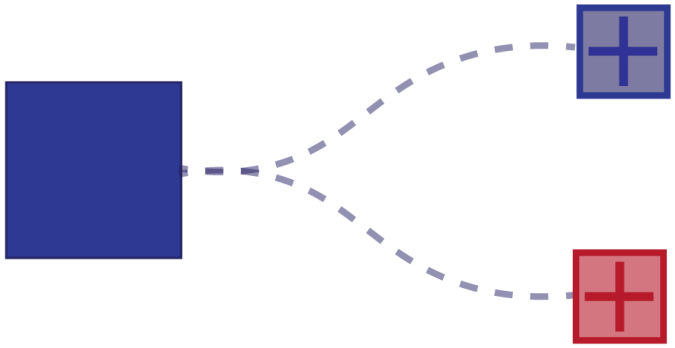
- Devs specify node types and display through config file
- Our system has an internal representation of the graph, and uses D3 and the svg stored in the config file to generate the visualization
- We have default add-on tools (e.g. a Legend generator)

In Progress

Enforce constraints

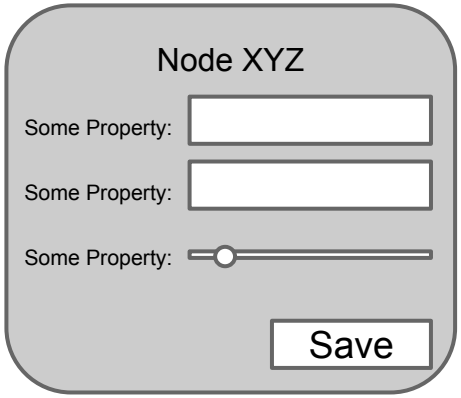
```
"constraints": {
  "incoming": ["InputDevice.*", "Transform.*"],
  "outgoing": ["Transform.*", "Action.*"]
},
```

Enable interaction callbacks



Enable auto-completion

Enable node “options” interface



Enable edge “options” interface

Questions

1. Which features should we add?
2. Does it make sense for multiple edges between nodes to automatically bundle?
3. Are there constraints besides parent-child constraints that would be useful to include?

Visualizing Changes from User Interaction

Jane Hoffswell

Vega is a declarative visualization language.

Vega Live Editor

Jane

localhost:8080/examples/editor/

Vega | brush | Format | Parse

Visualization | Renderer | Canvas

```
{
  "width": 200,
  "height": 200,

  "signals": [
    {
      "name": "brush_start",
      "init": {"x": 0, "y": 0},
      "streams": [{"type": "mousedown", "expr": "p"}]
    },
    {
      "name": "brush_end",
      "init": {"x": 0, "y": 0},
      "streams": [
        {"type": "mousedown, mouseup, [mousedown, mouseup] > mousemove", "expr": "
p"}
      ]
    }
  ],

  "predicates": [
    {
      "name": "xRange",
      "type": "in",
      "item": {"arg": "x"},
      "range": [{"signal": "brush_start.x"}, {"signal": "brush_end.x"}],
      "scale": {"arg": "xScale"}
    },

    {
      "name": "yRange",
      "type": "in",
      "item": {"arg": "y"},
      "range": [{"signal": "brush_start.y"}, {"signal": "brush_end.y"}],
      "scale": {"arg": "yScale"}
    },

    {
      "name": "inRange",
      "type": "&&",
      "operands": [
        {"predicate": "xRange"},
        {"predicate": "yRange"}
      ]
    }
  ],
```

Vega Live Editor

Jane

localhost:8080/examples/editor/

Vega

brush

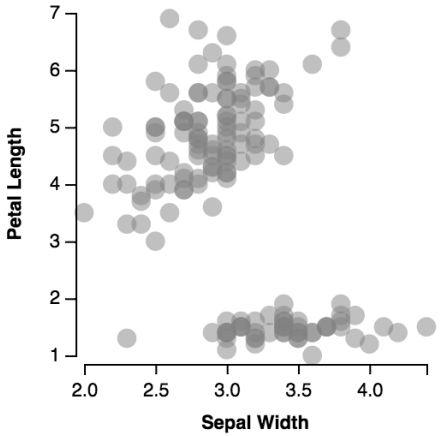
Format

Parse

Visualization

Renderer Canvas

```
{
  "width": 200,
  "height": 200,

  "signals": [
    {
      "name": "brush_start",
      "init": {"x": 0, "y": 0},
      "streams": [{"type": "mousedown", "expr": "p"}]
    },
    {
      "name": "brush_end",
      "init": {"x": 0, "y": 0},
      "streams": [
        {"type": "mousedown, mouseup, [mousedown, mouseup] > mousemove", "expr": "
p"}
      ]
    }
  ],

  "predicates": [
    {
      "name": "xRange",
      "type": "in",
      "item": {"arg": "x"},
      "range": [{"signal": "brush_start.x"}, {"signal": "brush_end.x"}],
      "scale": {"arg": "xScale"}
    },

    {
      "name": "yRange",
      "type": "in",
      "item": {"arg": "y"},
      "range": [{"signal": "brush_start.y"}, {"signal": "brush_end.y"}],
      "scale": {"arg": "yScale"}
    },

    {
      "name": "inRange",
      "type": "&&",
      "operands": [
        {"predicate": "xRange"},
        {"predicate": "yRange"}
      ]
    }
  ],
```



But what happens when something goes wrong?

Vega Live Editor

Jane

localhost:8080/examples/editor/

Vega | brush | Format | Parse

Visualization | Renderer | Canvas

```
{
  "width": 200,
  "height": 200,

  "signals": [
    {
      "name": "brush_start",
      "init": {"x": 0, "y": 0},
      "streams": [{"type": "mousedown", "expr": "p"}]
    },
    {
      "name": "brush_end",
      "init": {"x": 0, "y": 0},
      "streams": [
        {"type": "mousedown, mouseup, [mousedown, mouseup] > mousemove", "expr": "
p"}
      ]
    }
  ],

  "predicates": [
    {
      "name": "xRange",
      "type": "in",
      "item": {"arg": "x"},
      "range": [{"signal": "brush_start.x"}, {"signal": "brush_end.x"}],
      "scale": {"arg": "xScale"}
    },

    {
      "name": "yRange",
      "type": "in",
      "item": {"arg": "y"},
      "range": [{"signal": "brush_start.y"}, {"signal": "brush_end.y"}],
      "scale": {"arg": "yScale"}
    },

    {
      "name": "inRange",
      "type": "&&",
      "operands": [
        {"predicate": "xRange"},
        {"predicate": "yRange"}
      ]
    }
  ],
```

Vega Live Editor

Jane

localhost:8080/examples/editor/

Vega

brush

Format

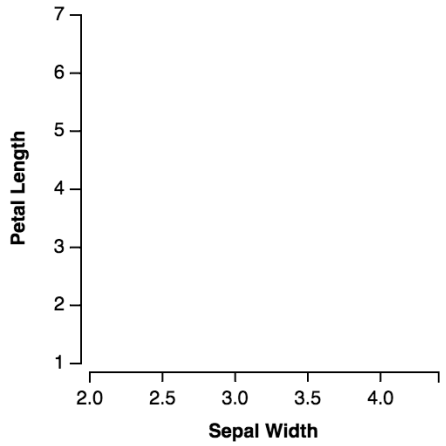
Parse

Visualization

Renderer

Canvas

```
{
  "width": 200,
  "height": 200,

  "signals": [
    {
      "name": "brush_start",
      "init": {"x": 0, "y": 0},
      "streams": [{"type": "mousedown", "expr": "p"}]
    },
    {
      "name": "brush_end",
      "init": {"x": 0, "y": 0},
      "streams": [
        {"type": "mousedown, mouseup, [mousedown, mouseup] > mousemove", "expr": "
p"}
      ]
    }
  ],

  "predicates": [
    {
      "name": "xRange",
      "type": "in",
      "item": {"arg": "x"},
      "range": [{"signal": "brush_start.x"}, {"signal": "brush_end.x"}],
      "scale": {"arg": "xScale"}
    },

    {
      "name": "yRange",
      "type": "in",
      "item": {"arg": "y"},
      "range": [{"signal": "brush_start.y"}, {"signal": "brush_end.y"}],
      "scale": {"arg": "yScale"}
    },

    {
      "name": "inRange",
      "type": "&&",
      "operands": [
        {"predicate": "xRange"},
        {"predicate": "yRange"}
      ]
    }
  ],
```



Vega Live Editor

Jane

localhost:8080/examples/editor/

Vega

brush

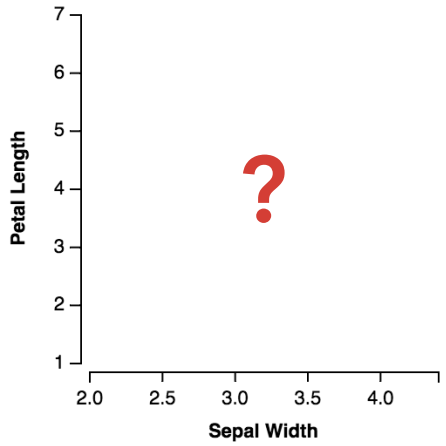
Format

Parse

Visualization

Renderer Canvas

```
{
  "width": 200,
  "height": 200,

  "signals": [
    {
      "name": "brush_start",
      "init": {"x": 0, "y": 0},
      "streams": [{"type": "mousedown", "expr": "p"}]
    },
    {
      "name": "brush_end",
      "init": {"x": 0, "y": 0},
      "streams": [
        {"type": "mousedown, mouseup, [mousedown, mouseup] > mousemove", "expr": "
p"}
      ]
    }
  ],

  "predicates": [
    {
      "name": "xRange",
      "type": "in",
      "item": {"arg": "x"},
      "range": [{"signal": "brush_start.x"}, {"signal": "brush_end.x"}],
      "scale": {"arg": "xScale"}
    },

    {
      "name": "yRange",
      "type": "in",
      "item": {"arg": "y"},
      "range": [{"signal": "brush_start.y"}, {"signal": "brush_end.y"}],
      "scale": {"arg": "yScale"}
    },

    {
      "name": "inRange",
      "type": "&&",
      "operands": [
        {"predicate": "xRange"},
        {"predicate": "yRange"}
      ]
    }
  ],
```



Vega Live Editor

Jane

localhost:8080/examples/editor/

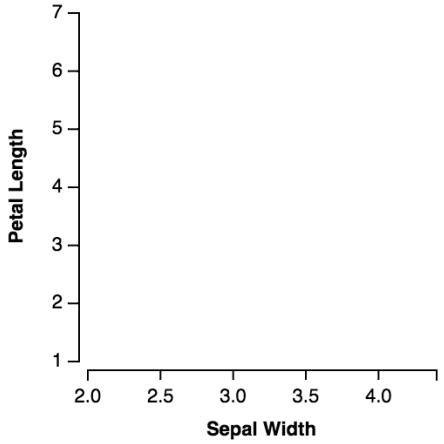
Vega

brush | Format | Parse

```
{
  "width": 200,
  "height": 200,

  "signals": [
    {
      "name": "brush_start",
      "init": {"x": 0, "y": 0},
      "streams": [{"type": "mousedown", "expr": "p"}]
    },
    {
      "name": "brush_end",
      "init": {"x": 0, "y": 0},
      "streams": [
        {"type": "mousedown, mouseup, [mousedown, mouseup] > mousemove", "expr": "
p"}
      ]
    }
  ],

  "predicates": [
    {
      "name": "xRange",
      "type": "in",
      "item": {"arg": "x"},
      "range": [{"signal": "brush_start.x"}, {"signal": "brush_end.x"}],
      "scale": {"arg": "xScale"}
    },

    {
      "name": "yRange",
      "type": "in",
      "item": {"arg": "y"},
      "range": [{"signal": "brush_start.y"}, {"signal": "brush_end.y"}],
      "scale": {"arg": "yScale"}
    },

    {
      "name": "inRange",
      "type": "&&",
      "operands": [
        {"predicate": "xRange"},
        {"predicate": "yRange"}
      ]
    }
  ],
```

Visualization

Renderer: Canvas



Console | Search | Emulation | Rendering

Clear console log.

Preserve log

```
interactive: true, items: Array[1], bounds: bounds…}
▶ bounds: bounds
▶ def: Object
  interactive: true
▼ items: Array[1]
  ▼ 0: Item
      _id: 488
      _prev: undefined
    ▶ _scales: Object
    ▶ axes: Array[2]
    ▶ axisItems: Array[2]
    ▶ bounds: bounds
    ▶ bounds:prev: bounds
    ▶ datum: Object
      height: 200
    ▼ items: Array[2]
      ▼ 0: Object
        ▶ bounds: bounds
        ▶ def: Object
        ▶ group: Item
          interactive: true
        ▼ items: Array[150]
          ▼ [0 … 99]
            ▶ 0: Item
            ▶ 1: Item
            ▶ 2: Item
            ▶ 3: Item
            ▶ 4: Item
            ▶ 5: Item
            ▶ 6: Item
            ▶ 7: Item
            ▶ 8: Item
            ▶ 9: Item
            ▶ 10: Item
            ▶ 11: Item
            ▶ 12: Item
            ▶ 13: Item
            ▶ 14: Item
            ▶ 15: Item
            ▶ 16: Item
            ▶ 17: Item
            ▶ 18: Item
            ▶ 19: Item
            ▶ 20: Item
            ▶ 21: Item
            ▶ 22: Item
            ▶ 23: Item
            ▶ 24: Item
            ▶ 25: Item
            ▶ 26: Item
            ▶ 27: Item
            ▶ 28: Item
            ▶ 29: Item
```

How can we make the debugging process easier?

Related Work: D3 vs. Vega

	Pro	Con
D3	flexibility & debug support	user responsible for some internal control flow
Vega	internal optimizations without user	limited debug support

Visualizing Changes from User Interaction

Vega Live Editor

Jane

localhost:8080/examples/editor/

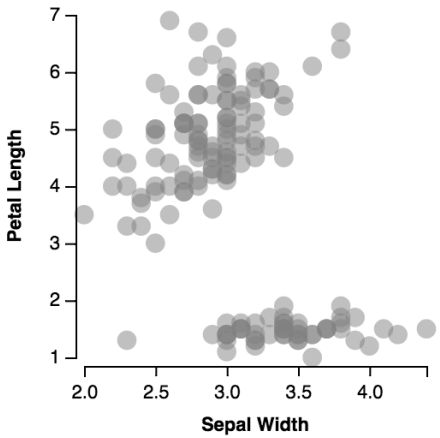
Vega

brush | Format | Parse

```
{
  "width": 200,
  "height": 200,

  "signals": [
    {
      "name": "brush_start",
      "init": {"x": 0, "y": 0},
      "streams": [{"type": "mousedown", "expr": "p"}]
    },
    {
      "name": "brush_end",
      "init": {"x": 0, "y": 0},
      "streams": [
        {"type": "mousedown, mouseup, [mousedown, mouseup] > mousemove", "expr": "
p"}
      ]
    }
  ],

  "predicates": [
    {
      "name": "xRange",
      "type": "in",
      "item": {"arg": "x"},
      "range": [{"signal": "brush_start.x"}, {"signal": "brush_end.x"}],
      "scale": {"arg": "xScale"}
    },

    {
      "name": "yRange",
      "type": "in",
      "item": {"arg": "y"},
      "range": [{"signal": "brush_start.y"}, {"signal": "brush_end.y"}],
      "scale": {"arg": "yScale"}
    },

    {
      "name": "inRange",
      "type": "&&",
      "operands": [
        {"predicate": "xRange"},
        {"predicate": "yRange"}
      ]
    }
  ],
```

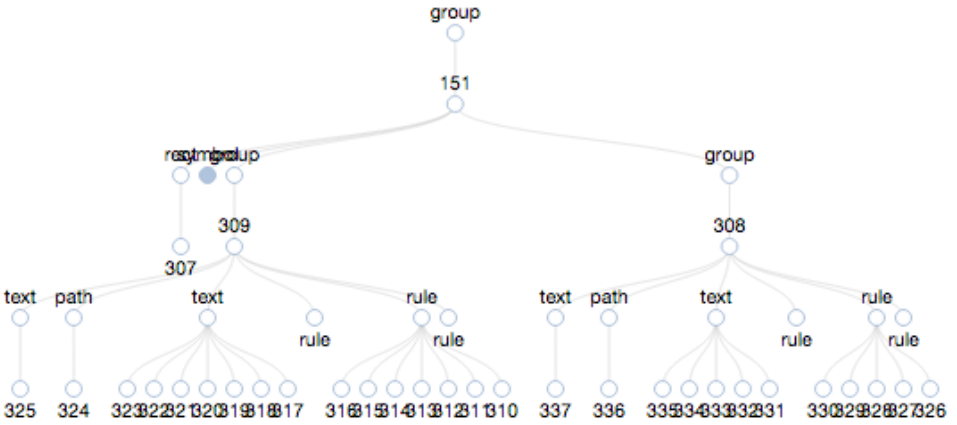
Visualization

Renderer: Canvas



Scenegraph

Show All



Vega Live Editor

Jane

localhost:8080/examples/editor/

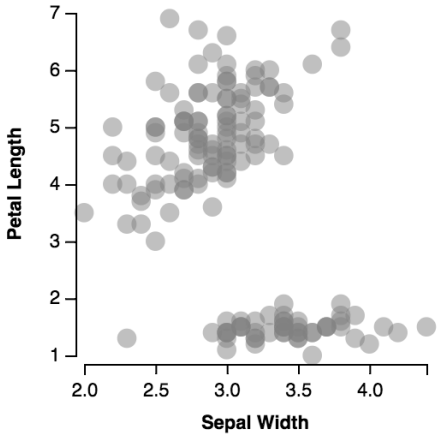
Vega

brush | Format | Parse

```
{
  "width": 200,
  "height": 200,

  "signals": [
    {
      "name": "brush_start",
      "init": {"x": 0, "y": 0},
      "streams": [{"type": "mousedown", "expr": "p"}]
    },
    {
      "name": "brush_end",
      "init": {"x": 0, "y": 0},
      "streams": [
        {"type": "mousedown, mouseup, [mousedown, mouseup] > mousemove", "expr": "
p"}
      ]
    }
  ],

  "predicates": [
    {
      "name": "xRange",
      "type": "in",
      "item": {"arg": "x"},
      "range": [{"signal": "brush_start.x"}, {"signal": "brush_end.x"}],
      "scale": {"arg": "xScale"}
    },

    {
      "name": "yRange",
      "type": "in",
      "item": {"arg": "y"},
      "range": [{"signal": "brush_start.y"}, {"signal": "brush_end.y"}],
      "scale": {"arg": "yScale"}
    },

    {
      "name": "inRange",
      "type": "&&",
      "operands": [
        {"predicate": "xRange"},
        {"predicate": "yRange"}
      ]
    }
  ],
```

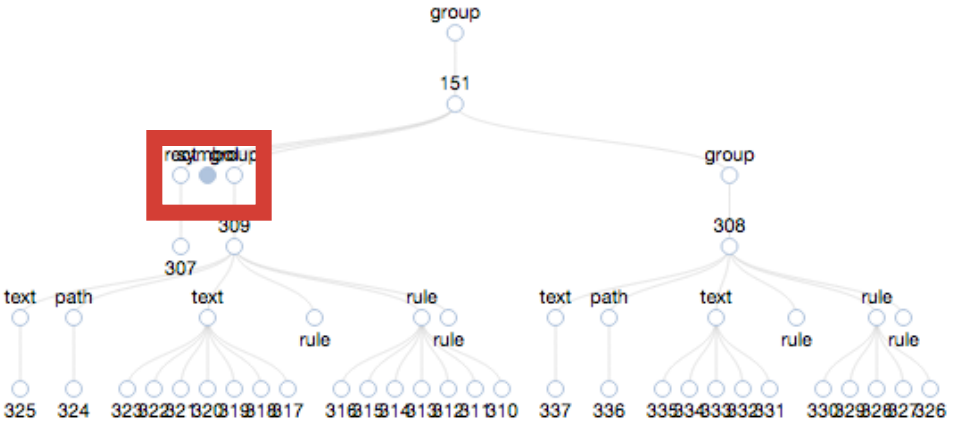
Visualization

Renderer: Canvas



Scenegraph

Show All



Vega Live Editor

Jane

localhost:8080/examples/editor/

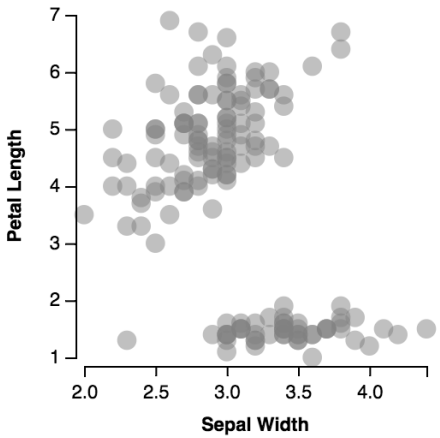
Vega

brush | Format | Parse

```
{
  "width": 200,
  "height": 200,

  "signals": [
    {
      "name": "brush_start",
      "init": {"x": 0, "y": 0},
      "streams": [{"type": "mousedown", "expr": "p"}]
    },
    {
      "name": "brush_end",
      "init": {"x": 0, "y": 0},
      "streams": [
        {"type": "mousedown, mouseup, [mousedown, mouseup] > mousemove", "expr": "
p"}
      ]
    }
  ],

  "predicates": [
    {
      "name": "xRange",
      "type": "in",
      "item": {"arg": "x"},
      "range": [{"signal": "brush_start.x"}, {"signal": "brush_end.x"}],
      "scale": {"arg": "xScale"}
    },

    {
      "name": "yRange",
      "type": "in",
      "item": {"arg": "y"},
      "range": [{"signal": "brush_start.y"}, {"signal": "brush_end.y"}],
      "scale": {"arg": "yScale"}
    },

    {
      "name": "inRange",
      "type": "&&",
      "operands": [
        {"predicate": "xRange"},
        {"predicate": "yRange"}
      ]
    }
  ],
```

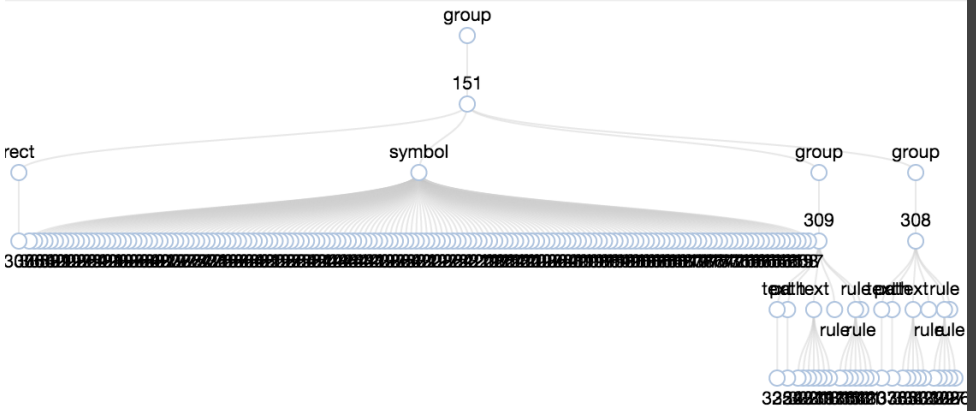
Visualization

Renderer: Canvas



Scenegraph

Show All



Vega Live Editor

Jane

localhost:8080/examples/editor/

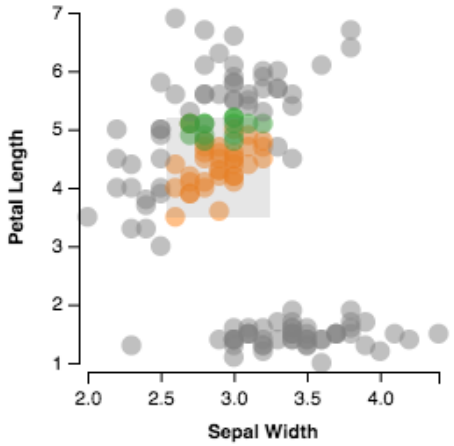
Vega

brush | Format | Parse

```
{
  "width": 200,
  "height": 200,

  "signals": [
    {
      "name": "brush_start",
      "init": {"x": 0, "y": 0},
      "streams": [{"type": "mousedown", "expr": "p"}]
    },
    {
      "name": "brush_end",
      "init": {"x": 0, "y": 0},
      "streams": [
        {"type": "mousedown, mouseup, [mousedown, mouseup] > mousemove", "expr": "
p"}
      ]
    }
  ],

  "predicates": [
    {
      "name": "xRange",
      "type": "in",
      "item": {"arg": "x"},
      "range": [{"signal": "brush_start.x"}, {"signal": "brush_end.x"}],
      "scale": {"arg": "xScale"}
    },

    {
      "name": "yRange",
      "type": "in",
      "item": {"arg": "y"},
      "range": [{"signal": "brush_start.y"}, {"signal": "brush_end.y"}],
      "scale": {"arg": "yScale"}
    },

    {
      "name": "inRange",
      "type": "&&",
      "operands": [
        {"predicate": "xRange"},
        {"predicate": "yRange"}
      ]
    }
  ],
```

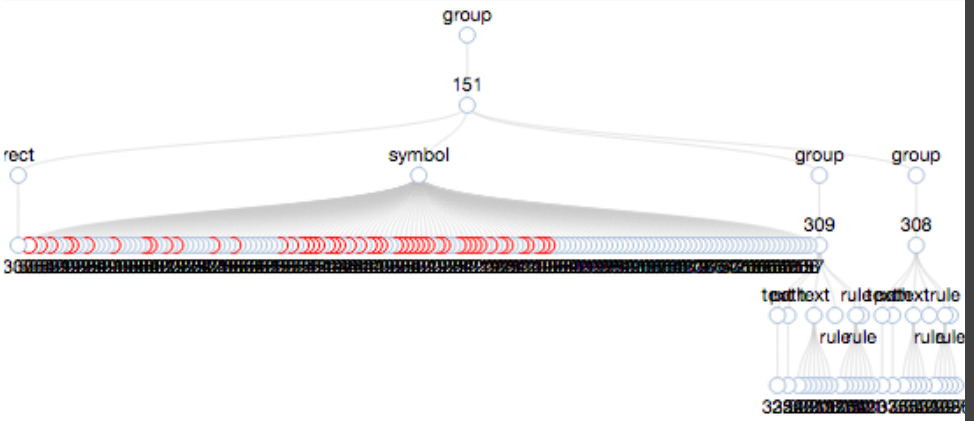
Visualization

Renderer: Canvas



Scenegraph

Show All



Vega Live Editor

Jane

localhost:8080/examples/editor/

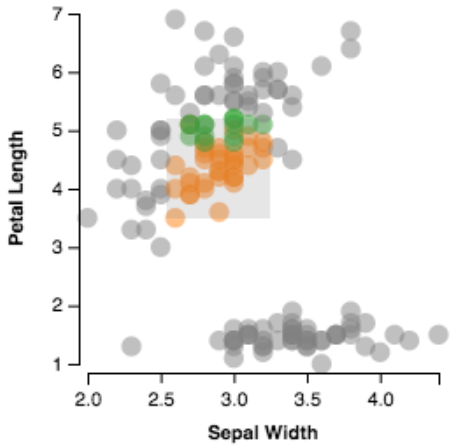
Vega

brush | Format | Parse

```
{
  "width": 200,
  "height": 200,

  "signals": [
    {
      "name": "brush_start",
      "init": {"x": 0, "y": 0},
      "streams": [{"type": "mousedown", "expr": "p"}]
    },
    {
      "name": "brush_end",
      "init": {"x": 0, "y": 0},
      "streams": [
        {"type": "mousedown, mouseup, [mousedown, mouseup] > mousemove", "expr": "
p"}
      ]
    }
  ],

  "predicates": [
    {
      "name": "xRange",
      "type": "in",
      "item": {"arg": "x"},
      "range": [{"signal": "brush_start.x"}, {"signal": "brush_end.x"}],
      "scale": {"arg": "xScale"}
    },

    {
      "name": "yRange",
      "type": "in",
      "item": {"arg": "y"},
      "range": [{"signal": "brush_start.y"}, {"signal": "brush_end.y"}],
      "scale": {"arg": "yScale"}
    },

    {
      "name": "inRange",
      "type": "&&",
      "operands": [
        {"predicate": "xRange"},
        {"predicate": "yRange"}
      ]
    }
  ],
```

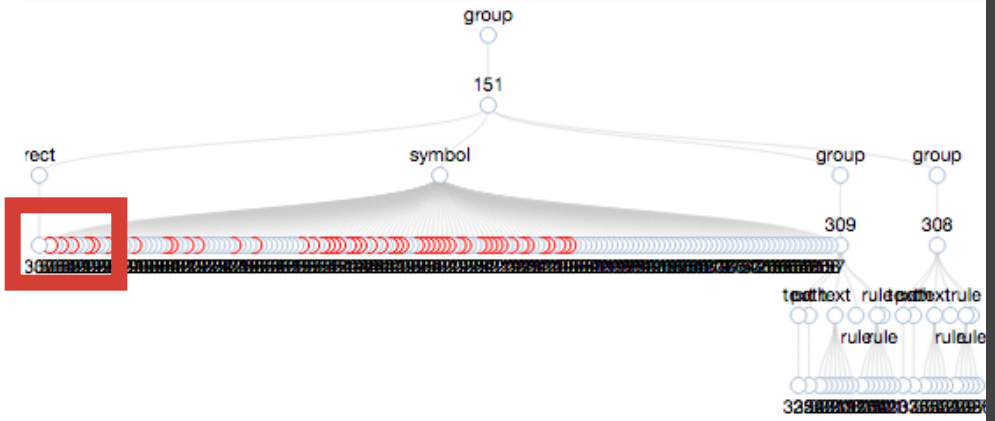
Visualization

Renderer: Canvas



Scenegraph

Show All



x	y	fill	fill opacit	petal length	sepal width
4	61	grey	0.5	1.4	3.5
32	8	grey	0.5	4.6	3.1
21	19	grey	0.5	2.8	5.2
4	33	grey	0.5	6.9	2.1

x	y	fill	fill opacit	petal length	sepal width
4	61	orange	0.5	1.4	3.5
32	8	green	0.5	4.6	3.1
21	19	grey	0.5	2.8	5.2
4	33	orange	0.5	6.9	2.1

Vega Live Editor

Jane

localhost:8080/examples/editor/

Vega

scatter_matrix

Format

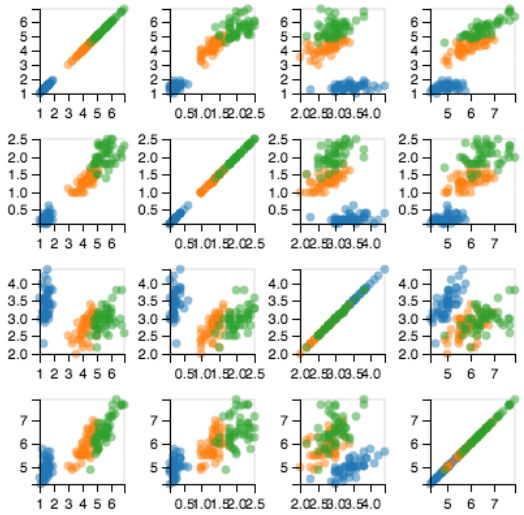
Parse

```
{
  "width": 400,
  "height": 400,
  "data": [
    {
      "name": "iris",
      "url": "data/iris.json"
    },
    {
      "name": "fields",
      "values": ["petalLength", "petalWidth", "sepalWidth", "sepalLength"]
    }
  ],
  "scales": [
    {
      "name": "gx",
      "type": "ordinal",
      "range": "width",
      "round": true,
      "domain": {"data": "fields", "field": "data"}
    },
    {
      "name": "gy",
      "type": "ordinal",
      "range": "height",
      "round": true,
      "domain": {"data": "fields", "field": "data"}
    },
    {
      "name": "c",
      "type": "ordinal",
      "domain": {"data": "iris", "field": "species"},
      "range": "category10"
    }
  ],
  "legends": [
    {
      "fill": "c",
      "title": "Species",
      "offset": 10,
      "properties": {
        "symbols": {
          "fillOpacity": {"value": 0.5},
          "stroke": {"value": "transparent"}
        }
      }
    }
  ],
  "marks": [
    {
      "type": "group",
      "from": {
        "data": "fields",
        "transform": [{"type": "cross"}]
      },
      "properties": {
```

Visualization

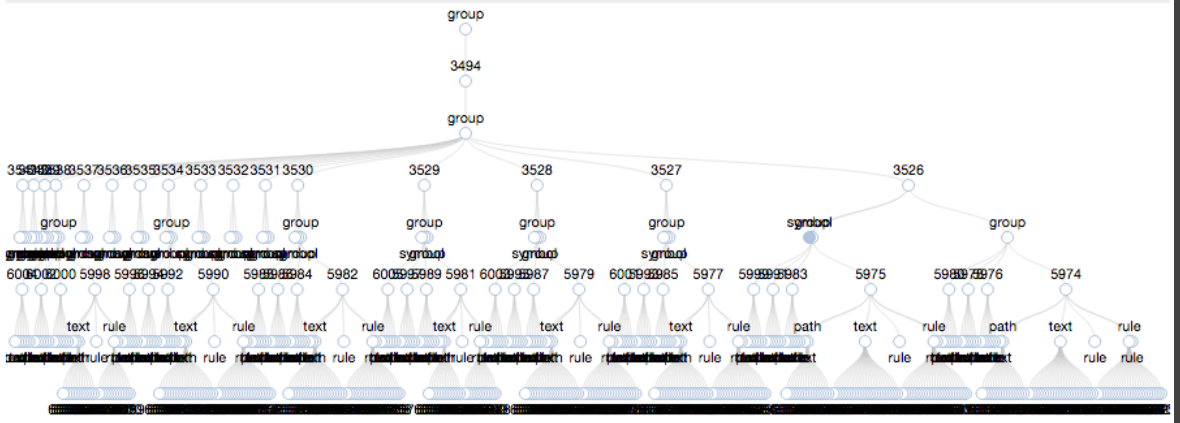
Renderer

Canvas



Scenegraph

Show All



Vega Live Editor

Jane

localhost:8080/examples/editor/

Vega

scatter_matrix

Format

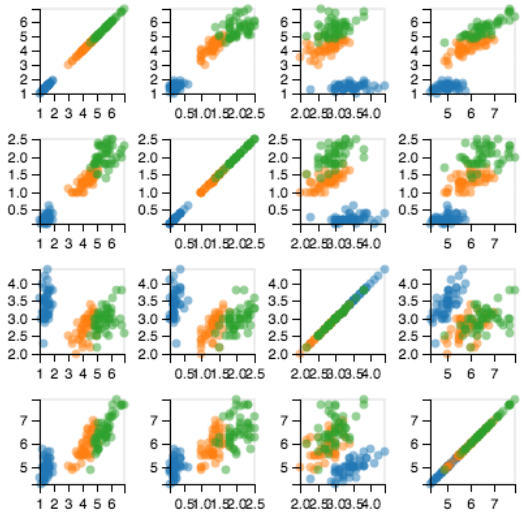
Parse

```
{
  "width": 400,
  "height": 400,
  "data": [
    {
      "name": "iris",
      "url": "data/iris.json"
    },
    {
      "name": "fields",
      "values": ["petalLength", "petalWidth", "sepalWidth", "sepalLength"]
    }
  ],
  "scales": [
    {
      "name": "gx",
      "type": "ordinal",
      "range": "width",
      "round": true,
      "domain": {"data": "fields", "field": "data"}
    },
    {
      "name": "gy",
      "type": "ordinal",
      "range": "height",
      "round": true,
      "domain": {"data": "fields", "field": "data"}
    },
    {
      "name": "c",
      "type": "ordinal",
      "domain": {"data": "iris", "field": "species"},
      "range": "category10"
    }
  ],
  "legends": [
    {
      "fill": "c",
      "title": "Species",
      "offset": 10,
      "properties": {
        "symbols": {
          "fillOpacity": {"value": 0.5},
          "stroke": {"value": "transparent"}
        }
      }
    }
  ],
  "marks": [
    {
      "type": "group",
      "from": {
        "data": "fields",
        "transform": [{"type": "cross"}]
      },
      "properties": {
```

Visualization

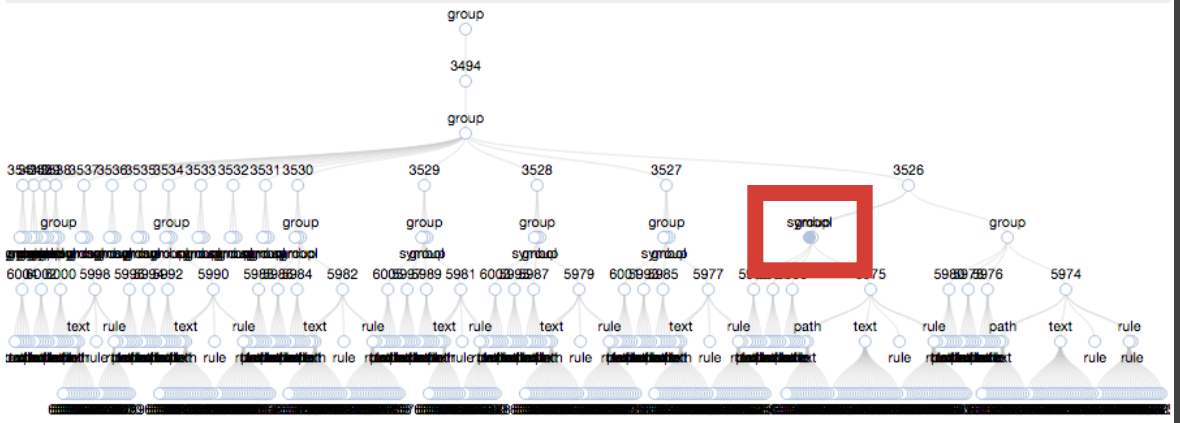
Renderer

Canvas



Scenegraph

Show All



Vega Live Editor

Jane

localhost:8080/examples/editor/

Vega

scatter_matrix

Format

Parse

```
{
  "width": 400,
  "height": 400,
  "data": [
    {
      "name": "iris",
      "url": "data/iris.json"
    },
    {
      "name": "fields",
      "values": ["petalLength", "petalWidth", "sepalWidth", "sepalLength"]
    }
  ],
  "scales": [
    {
      "name": "gx",
      "type": "ordinal",
      "range": "width",
      "round": true,
      "domain": {"data": "fields", "field": "data"}
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      }
    }
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```
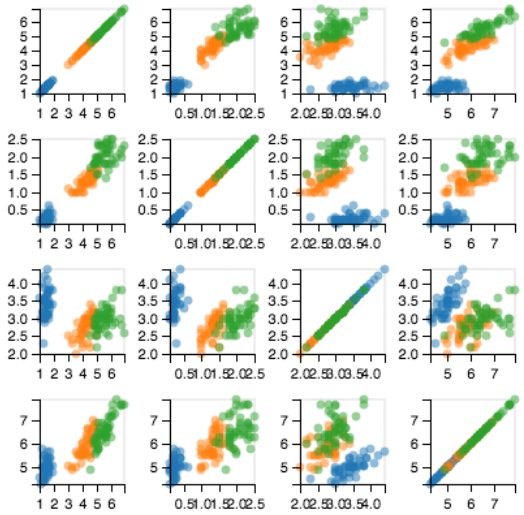

Visualization

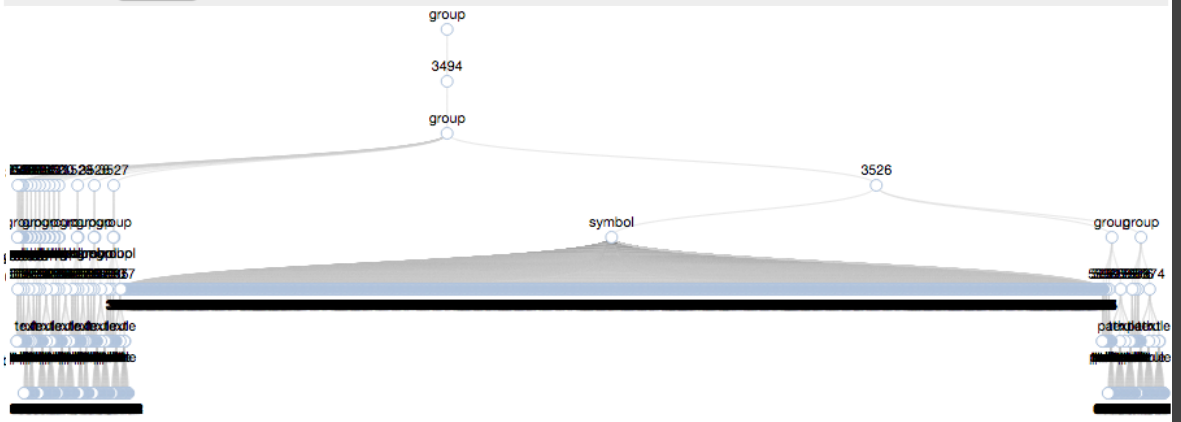
Renderer

Canvas



Scenegraph

Show All



Please let me know if you have questions or feedback!!

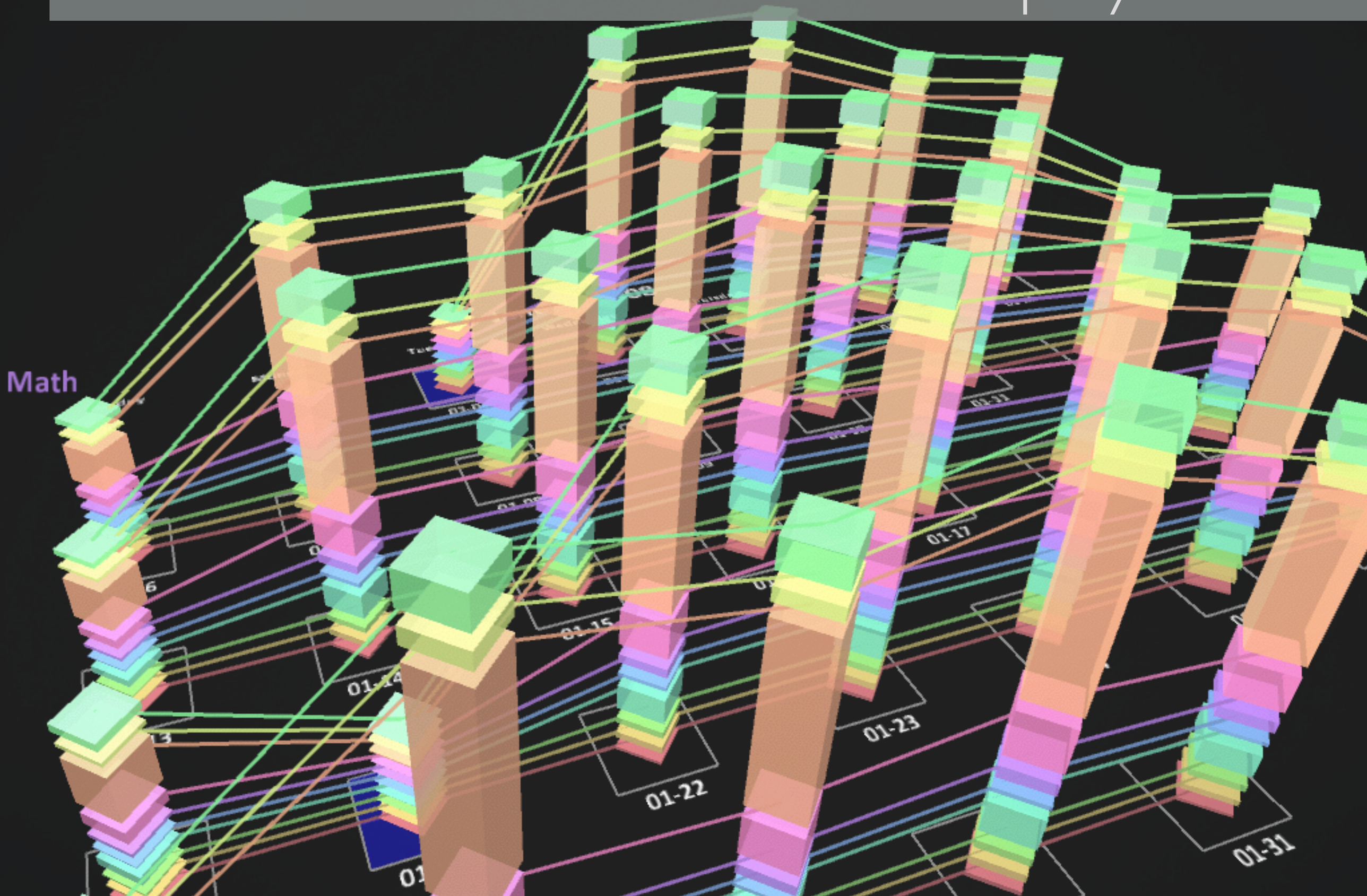
- What strategies could be effective for **simplifying** the scenegraph?
- How should I **surface relevant internal information** associated with the nodes?
- What **automatic labels** should be shown?
- What **types of interactions/tasks** might a user want to perform?
- Is there a **better representation** for this data?

VIRTUAL REALITY + DATA VIZ

Aditya Sankar

2D data visualization is limited by screen real estate

3D visualizations on 2D displays suck!



Virtual Reality is now inexpensive and accessible!

RELATED WORK

- CAVE displays [1]
  - Shown demonstrable improvement in data visualization tasks, especially with spatial and volumetric data
  - Are prohibitively expensive!

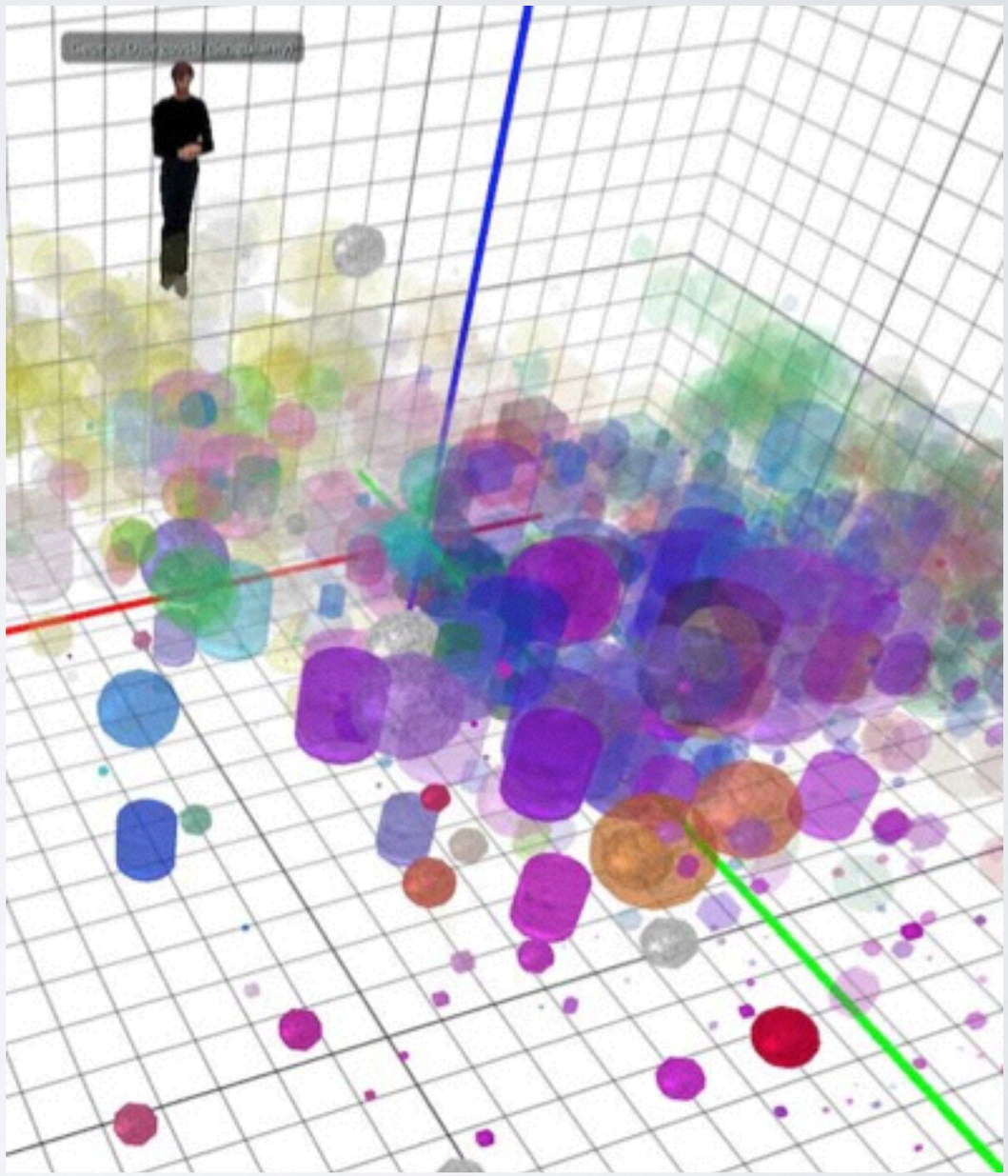
1. Cruz-Neira, et.al. Surround-screen projection-based virtual reality: The design and implementation of the cave. SIGGRAPH ’93

VR + VIZ

- Donalek et. al. [2] conduct closely related research

- Show benefits of VR

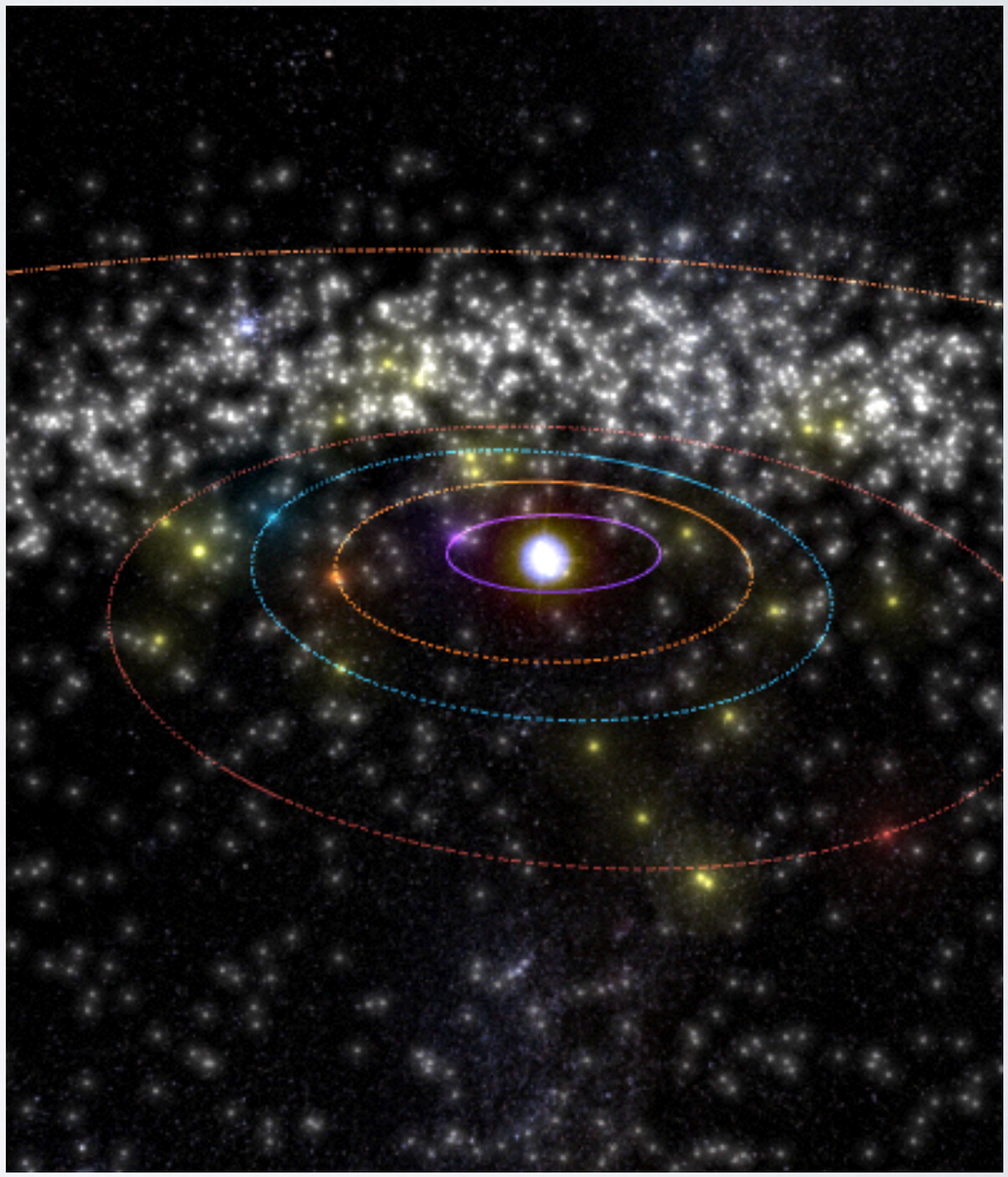
- Focus more on methods for down projecting high-dimensional "big data"

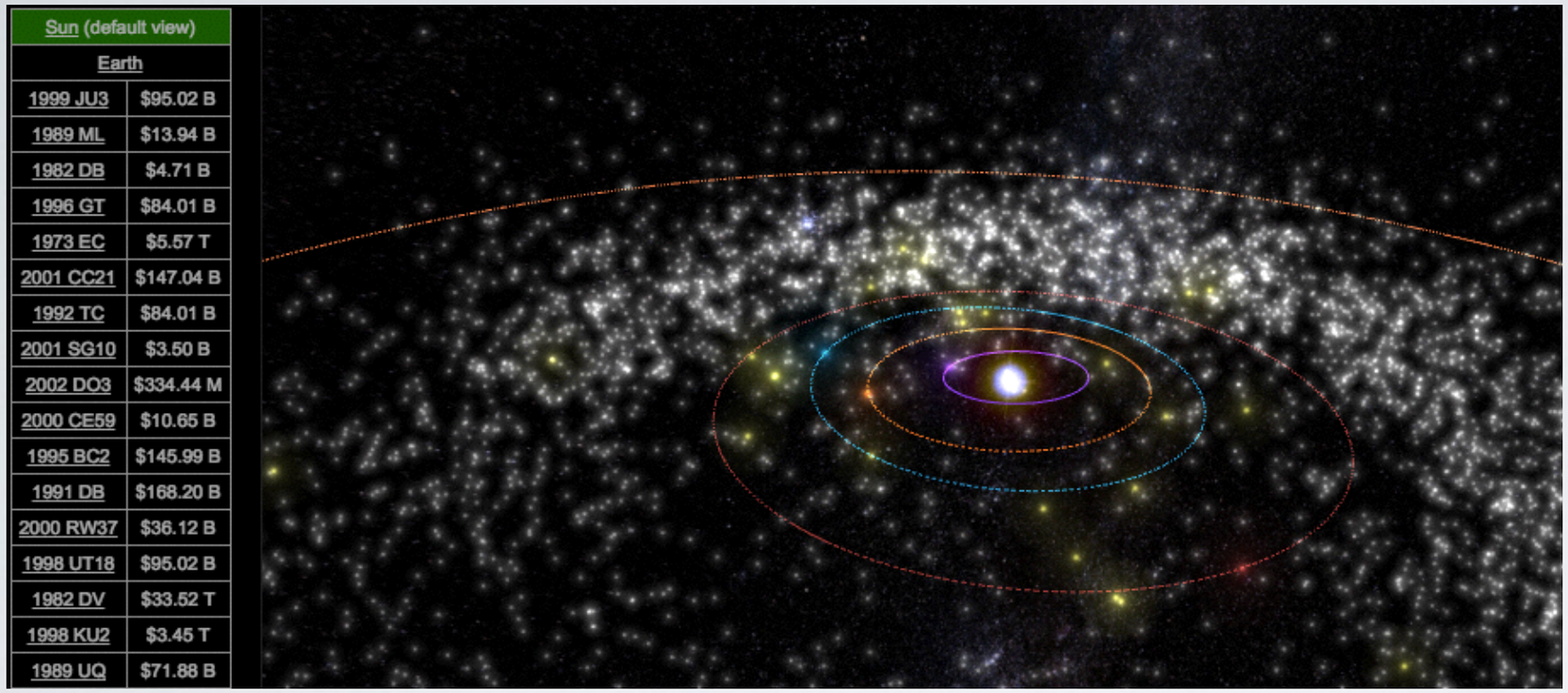


2. Donalek, C., et.al. Immersive and collaborative data visualization using virtual reality platforms. IEEE conf on Big Data

ASTERANK

- Catalog of 600,000 asteroids based on:
  - Name, Mass, Estimated Value
  - Data sourced from NASA JPL and others
  - 3D to 2D web interface with point and click controls





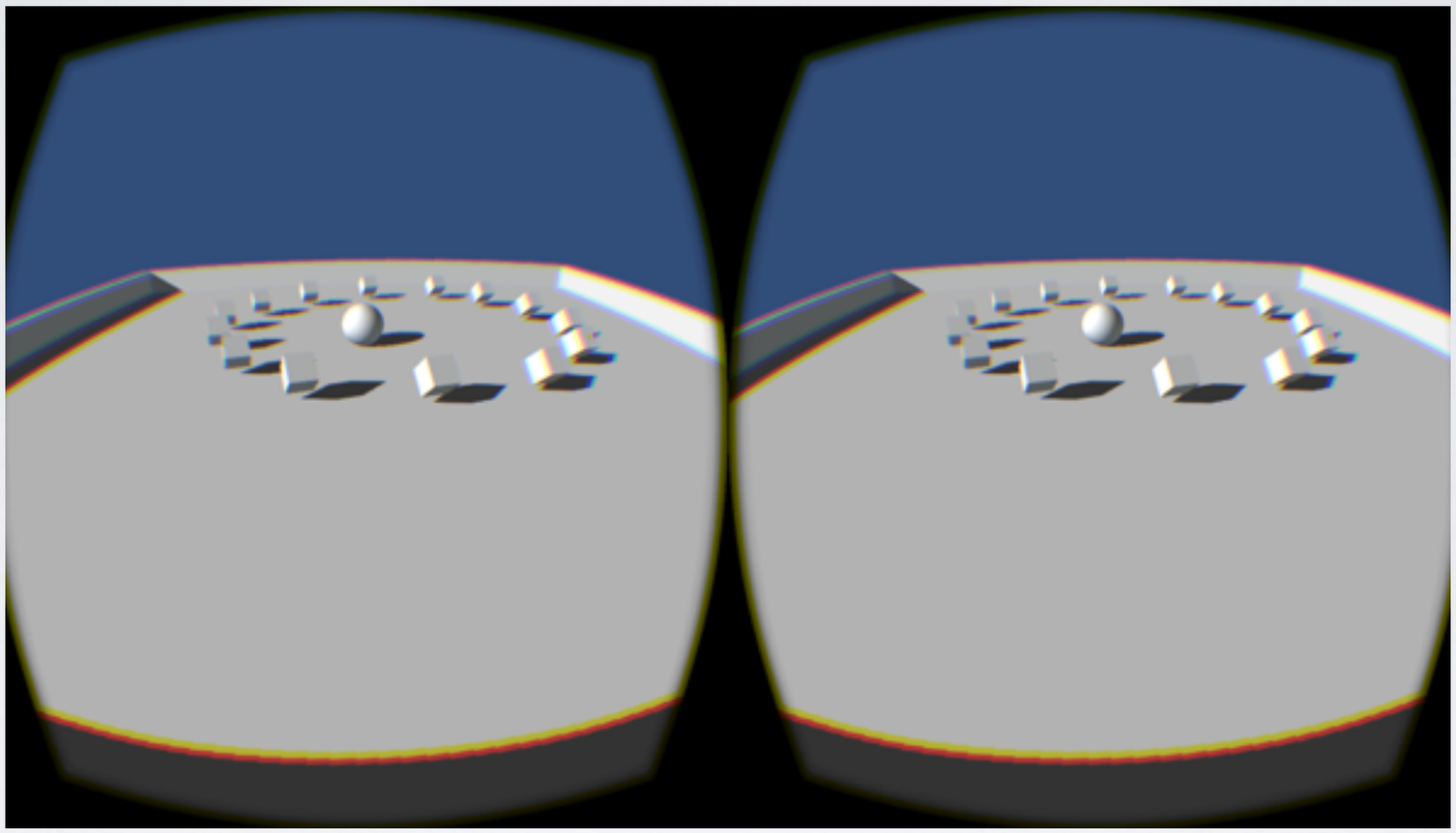
PROJECT PROPOSAL

Visualize and interact with asteroid data using Oculus Rift

INTERACTION

- Gaze to select & drill-down
- Focus + context using Lens
- Touch trackpad to translate / zoom

CURRENT PROGRESS



- Set up Oculus dev environment
- Built toy project in Unity
- Studied Asterank data format
- Able to hook into API

COMPLETION PLAN

- Currently working on solar system model in Unity
- Import asteroid data as particles in a physics simulation (gravity field, initial position, velocity)
- Implement and evaluate interaction techniques

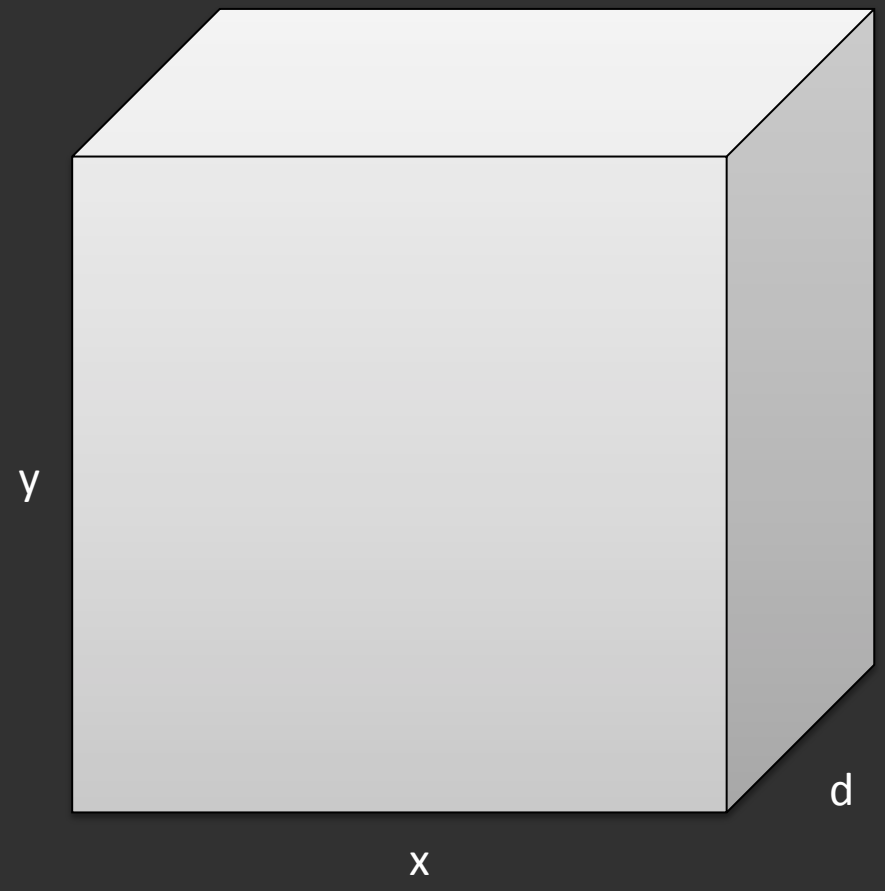
FEEDBACK

- Other interaction techniques to explore?
- How can VR benefit abstract data viz?
- General comments; how else can VR be useful in Data Viz?

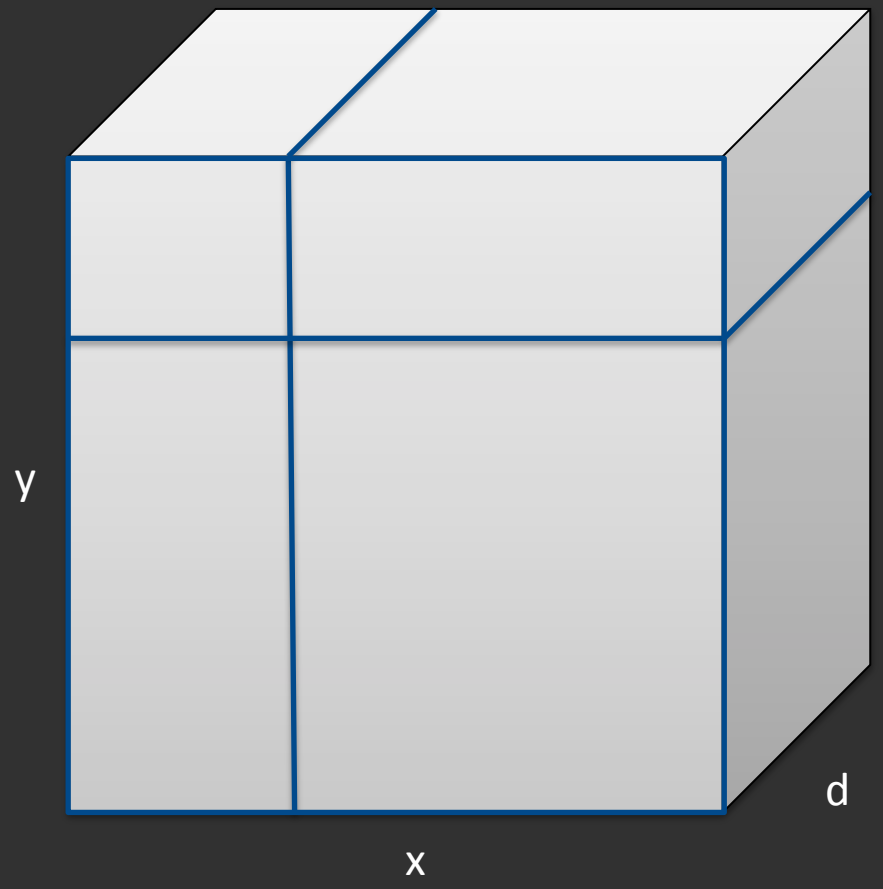
Disparity Space Visualization

Juliet Fiss

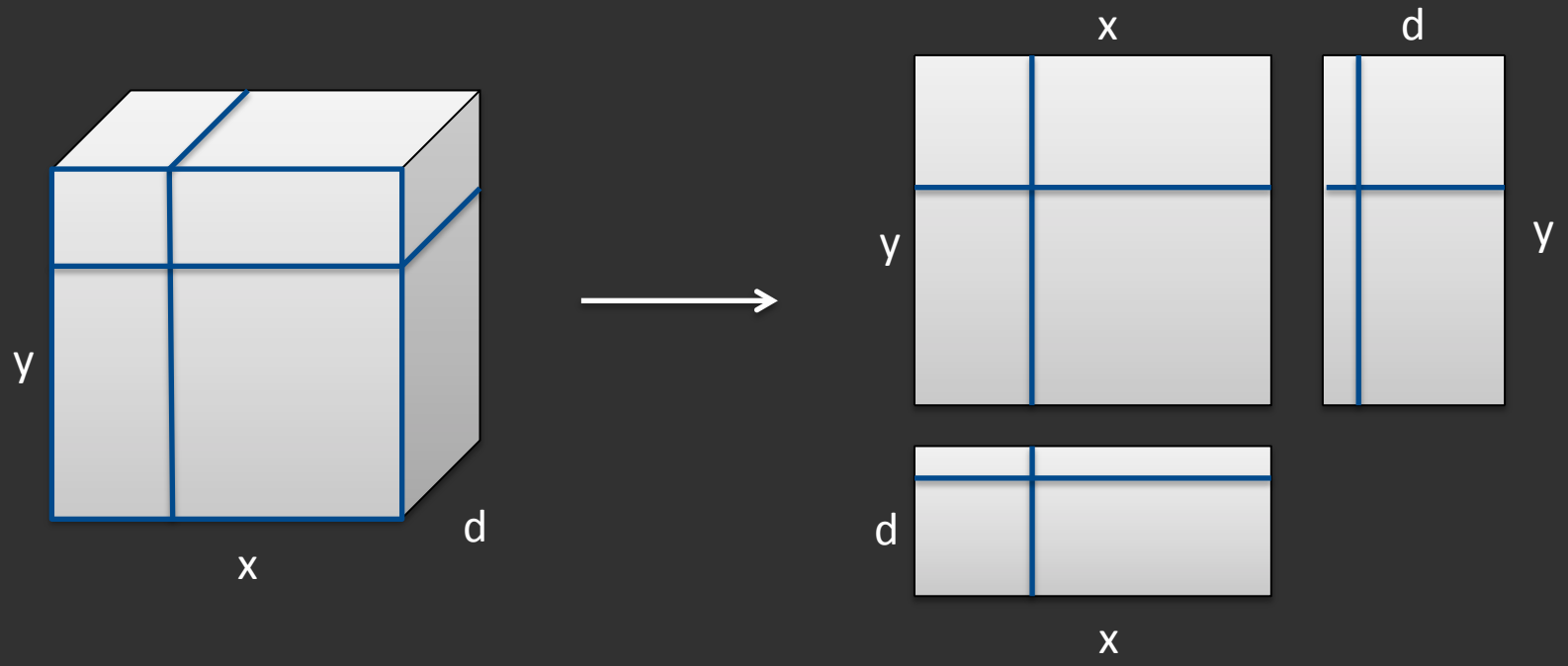
Disparity Space



Selected (x, y, d)



Disparity Space Visualization



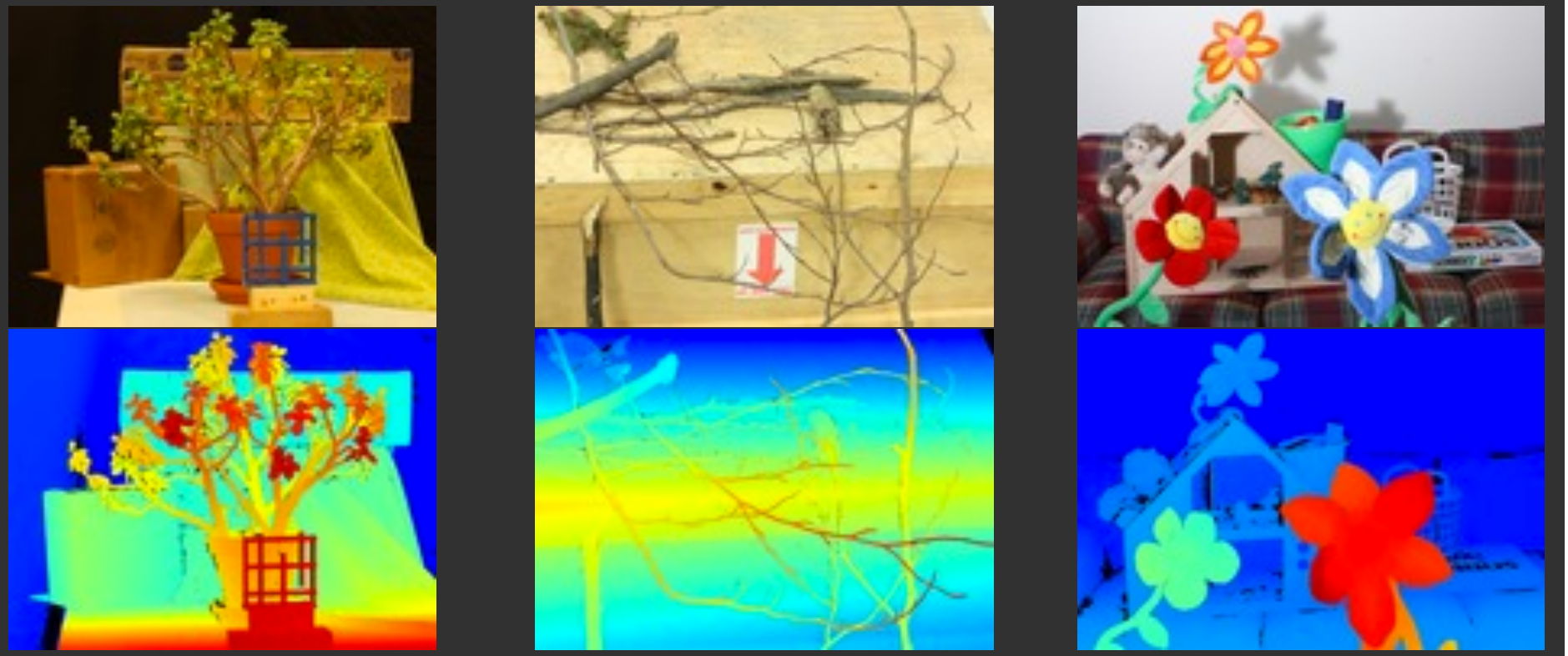
Question #1

How to show selected (x, y, d) without obscuring image content?

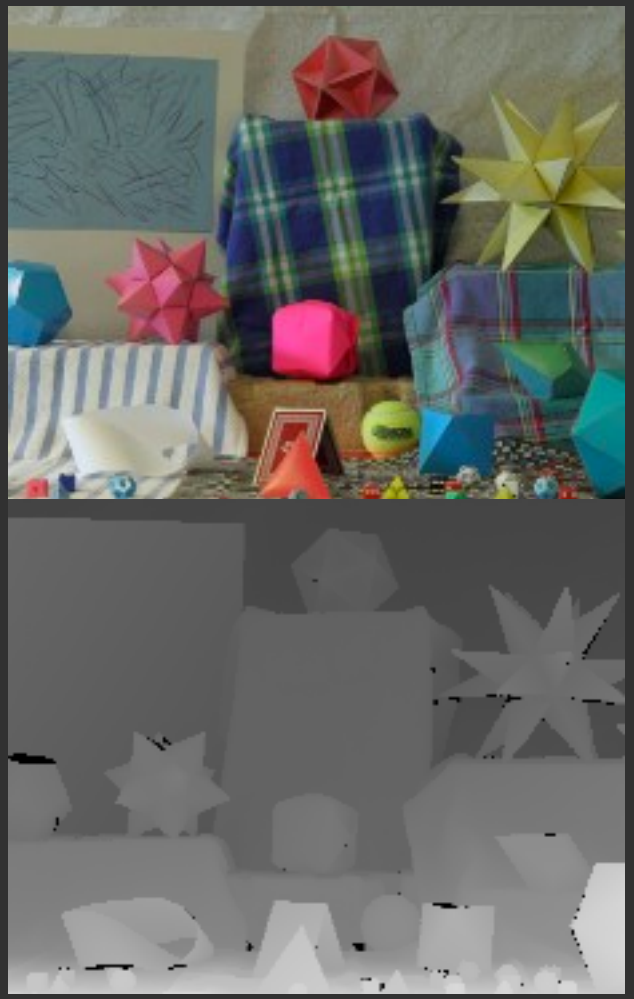
Question #2: How to Encode Depth and Uncertainty?

Standard: Hue = Depth, Luminance = Uncertainty

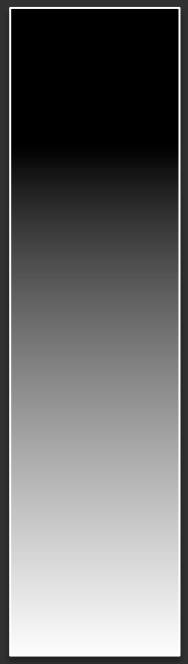
Problem: Depth Scale Hard to Interpret



Luminance = Depth & Uncertainty

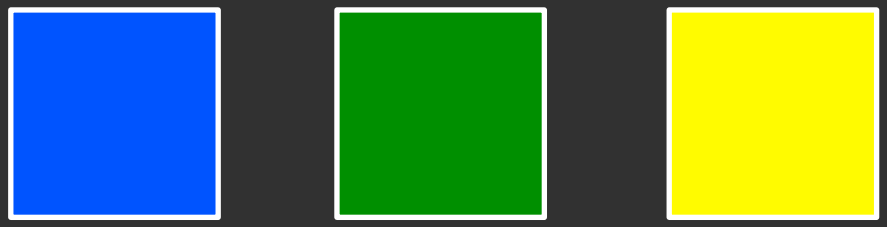


Proposed Encoding



Luminance = Depth

Color = Uncertainty (low, medium, high)



Video

- http://homes.cs.washington.edu/~juliet/dsivis.html

Visualizing Third-Party Content on Web Pages

Ryan Russell, Adrian Sham, Lindsey Nguyen, Johnson Goh

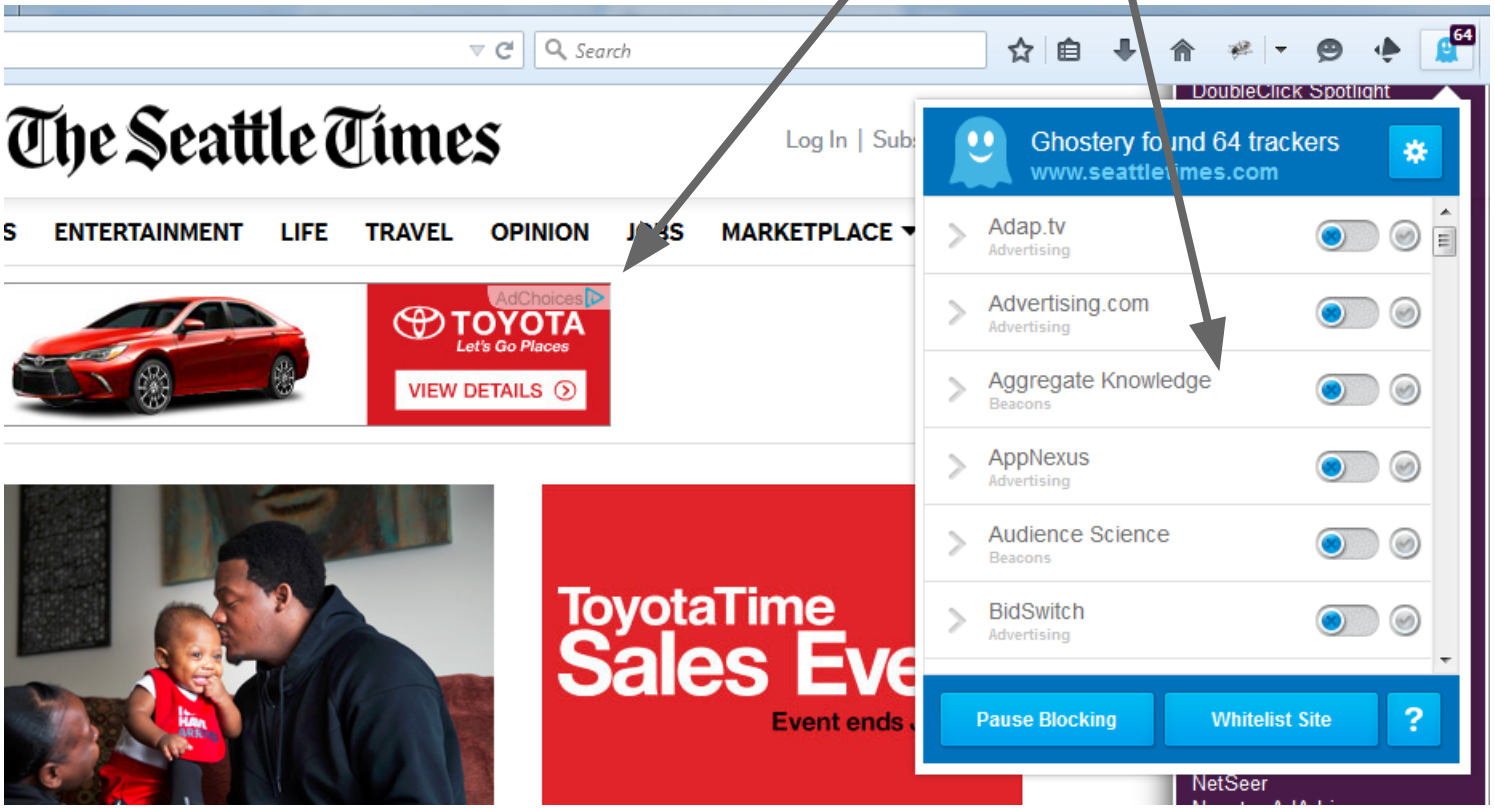
The problem

- Third-party tracking on the web is a privacy issue
- Many browser plug-ins can help users understand how much tracking is happening and by whom
- However, hard for user to identify ***where*** on a page third-party content actually is and by whom

Example (Ghostery)

1. Where is this ad coming from?

2. Who should I block?



One page view

- Give the user the ability to quickly identify third party content
- Allow the user to mouse over a specific element to display more information

West Seattle couple bequeaths it all — $847,215 — to Uncle Sam

First dinosaur bone found in state, 80 million years later Updated 11:19 am

Thousands of teachers hit streets — and Dems walk out in Olympia

Q&A: How to see if your car is affected by Takata air-bag recall

Expensive bonsai stolen from Federal Way museum recovered Updated 11:06 am

Air Force launches hush-hush Boeing-built rocket into space Updated 10:46 am

State's jobless rate shrinks to 5.5 percent, close to U.S. average Updated 10:36 am

Family life: Anthony Johnson and wife Shaunte Nance-Johnson play with son Kaine-Carter Johnson. (Lindsey Wasson / The Seattle Times)

After a stormy childhood, Tacoma's Anthony Johnson hopes for a bright future

Johnson played Division I basketball at Montana, walked down the red carpet at the ESPYs and briefly shared a court with Kobe Bryant. He also has spent long years sorting through his issues, which included a childhood beating that still affects his eyesight.

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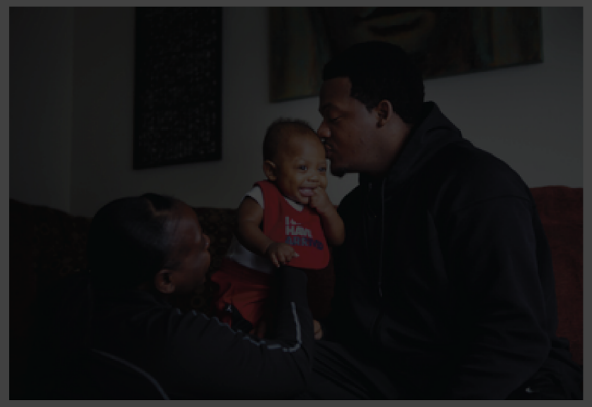

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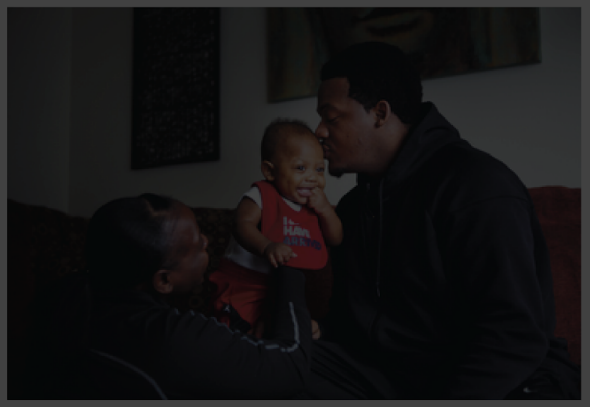

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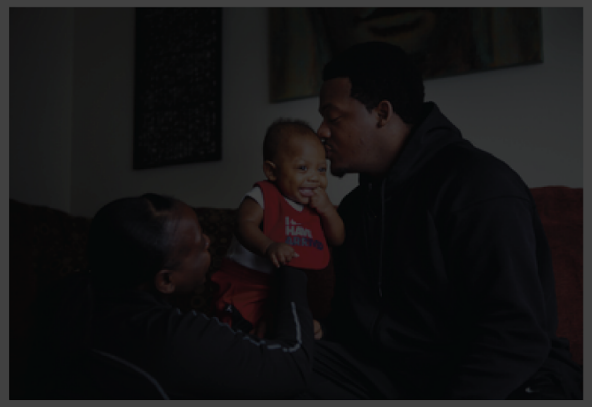

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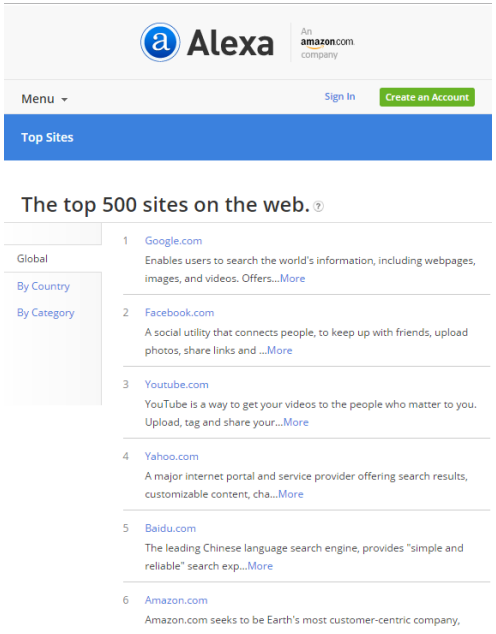
Final Visualization

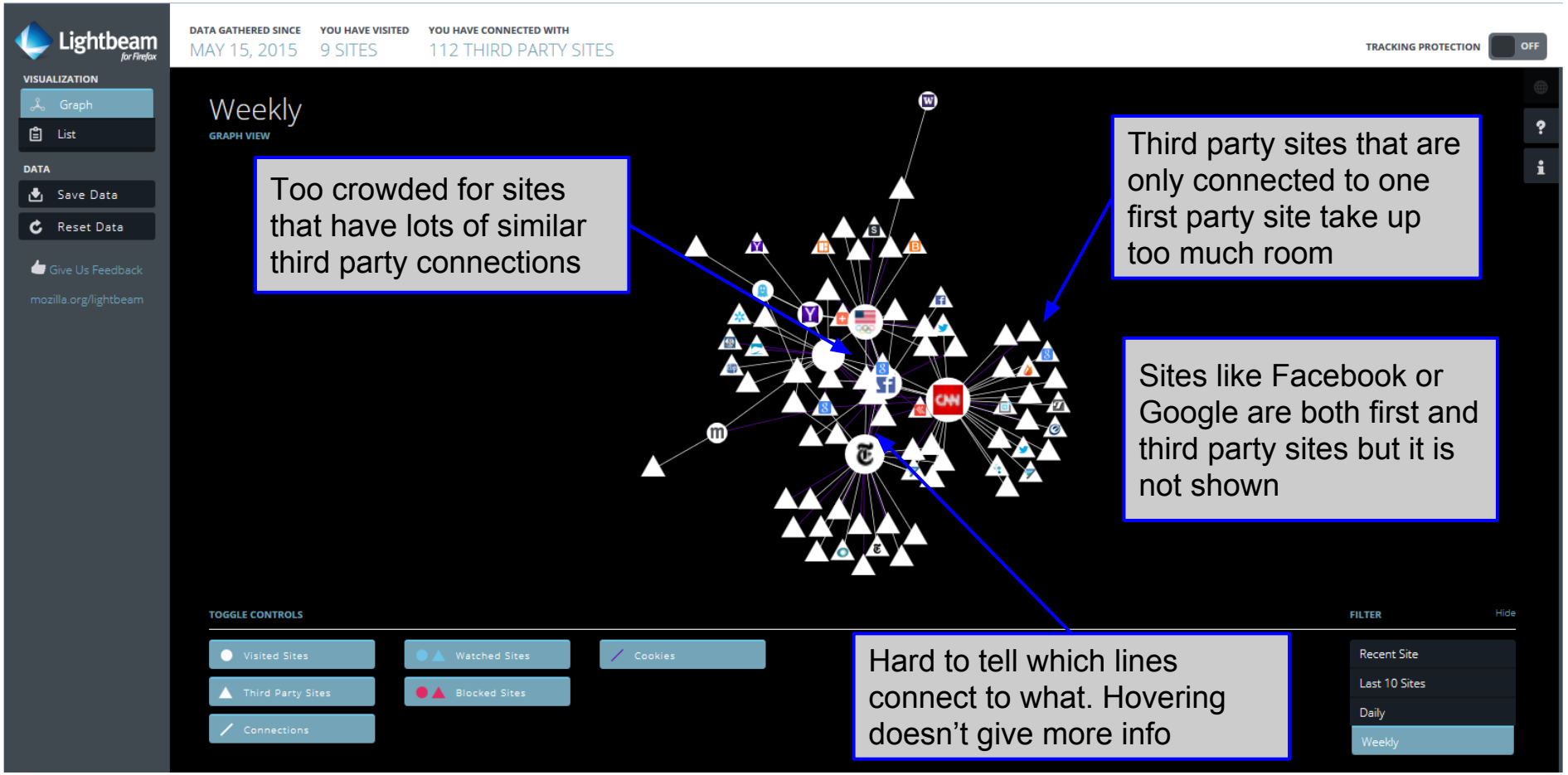
- Get top ~1000 sites of the world from Alexa
- Use chrome driver to visit all sites
- Gather data by using our previous extension
- Create final network graph using this data

Two possible options...



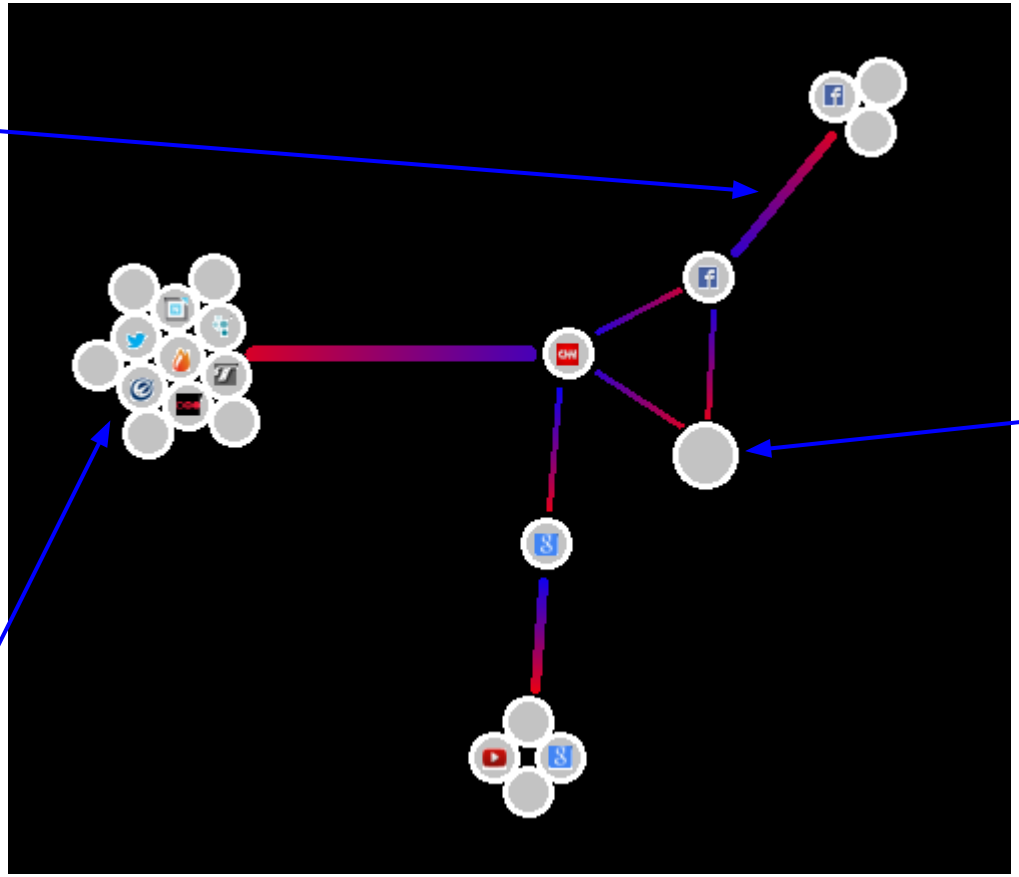
Option 1: Graph

something similar to Lightbeam



Option 1: Graph

Gradient lines show connection from first party (blue) to third party (red)



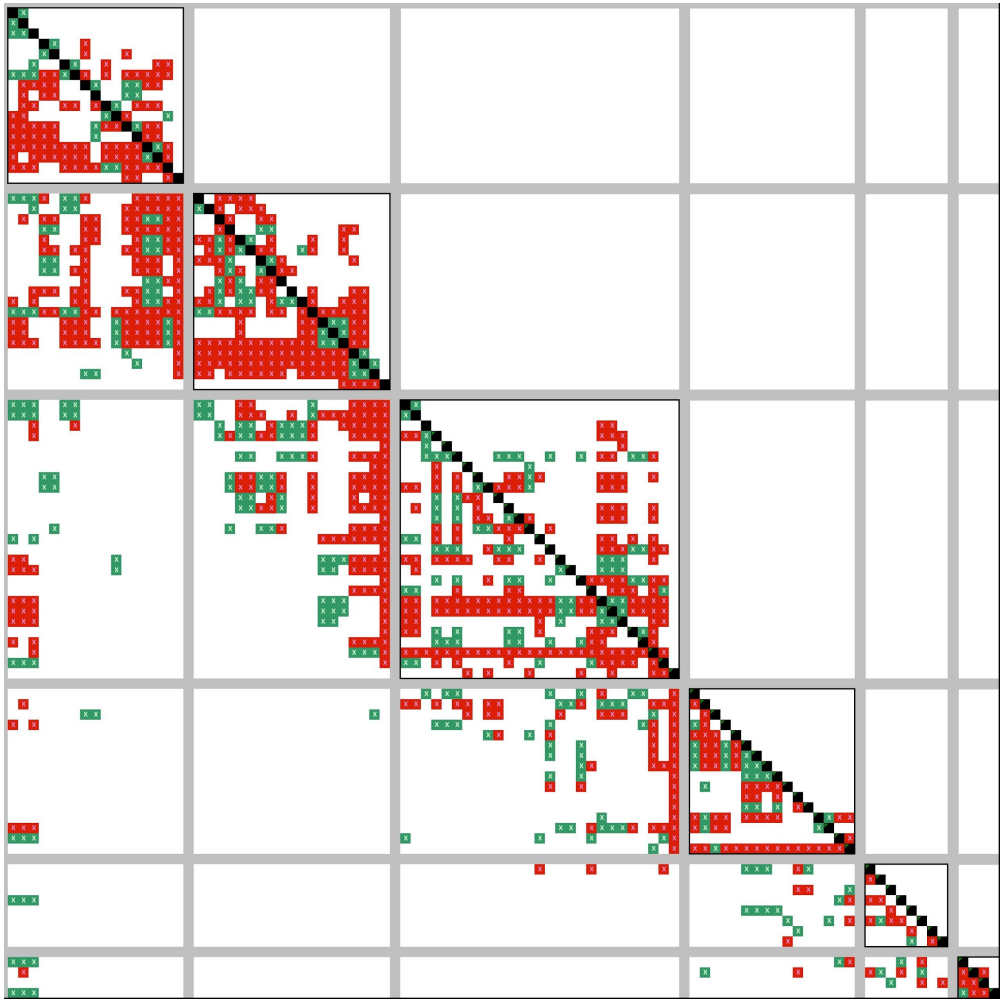
Third party sites with the same connections bundle together with the lines growing larger

Size of circle is dependent on number of sites it is a third party of. Sites contained on more sites will be larger.

The goal is to display sites that have access to the most sites. In this example the larger node is “doubleclick.net” which is a third party for both CNN and Facebook.

Option 2: Matrix Diagram

- third party sites as rows
- first part sites as columns
- box colored by chosen other variable?
- problem: graph not dense enough?

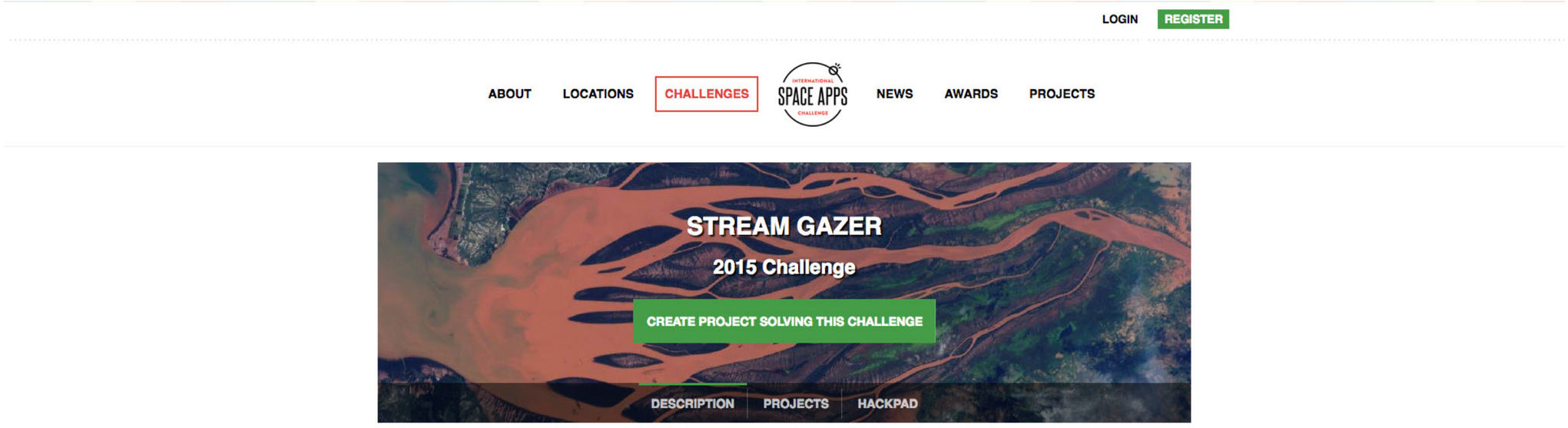


Questions

- Have we made it easier for users to discover the origin of third party content?

- Graph or Matrix view? What are the pros and cons for each?

INSPIRATION



Hashtags:

#earth, #streamgazer, #intermediate

Contact:

streamgazer@spaceappschallenge.org

Tags:

Model, Imagery, Platform, Data Visualization

DATA

15 min. volume measurements from 9,000+ sites back to 2007.
Daily summaries at 100k's of sites dating back several decades.

REST Web Services

HOME REST SERVICES SOAP SERVICES DOCUMENTATION EXAMPLES LINKS FAQ CONTACT US

USGS Statistics Web Service

You can use this service to retrieve daily, monthly or annual statistics for a USGS site and parameter.

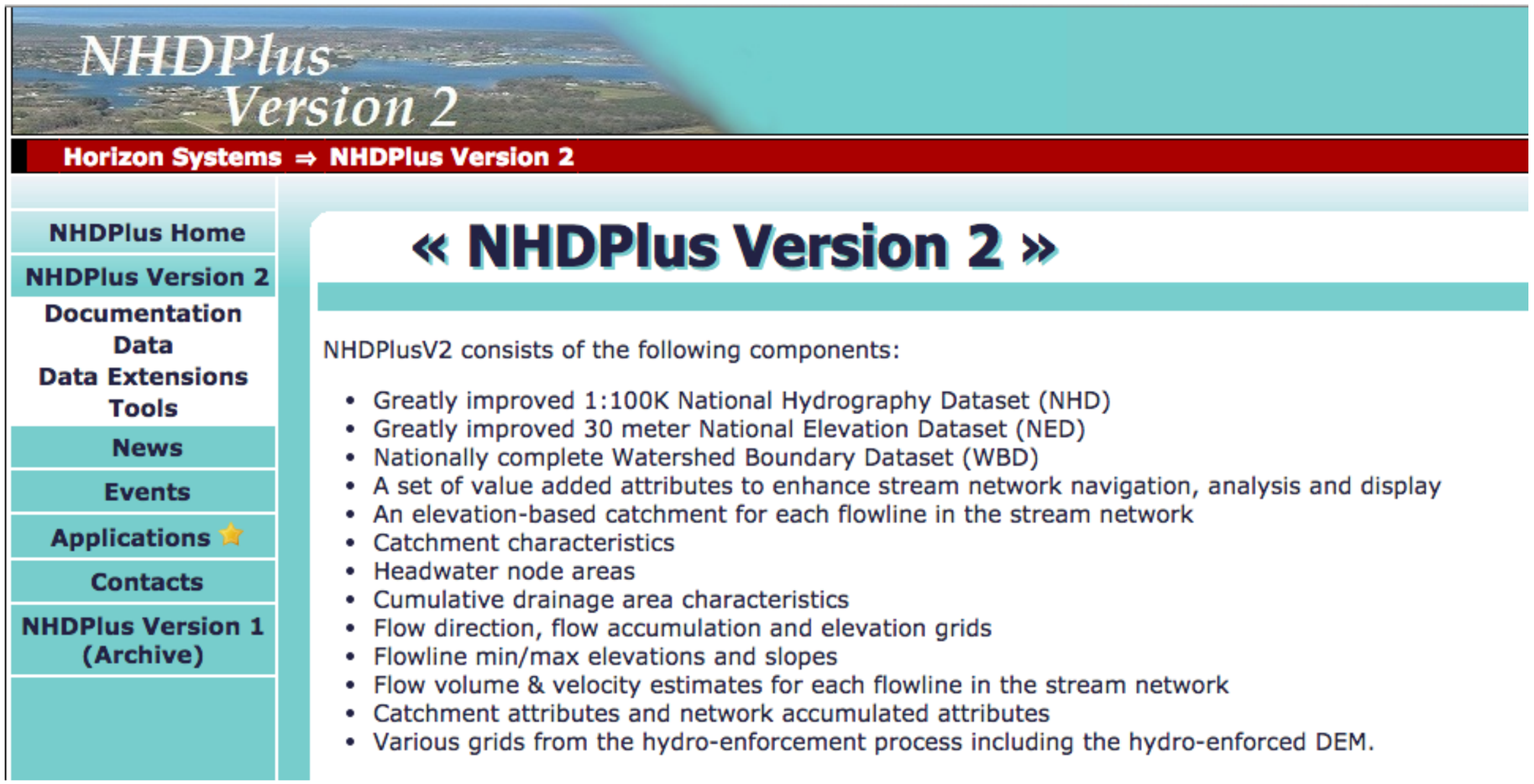
To provide statistics, the site must serve time-series data, i.e. data is collected via an automated means and at regular interva
sure your query is qualifed with the argument `&hasDataTypeCd=dv`.

The service serves statistics based on approved data only. Recent data is considered provisional and is thus not approve
value may be left blank depending on the service called.

Please join the USGS Water Data for the Nation Notification List. This way you will receive an announcement when ch

DATA

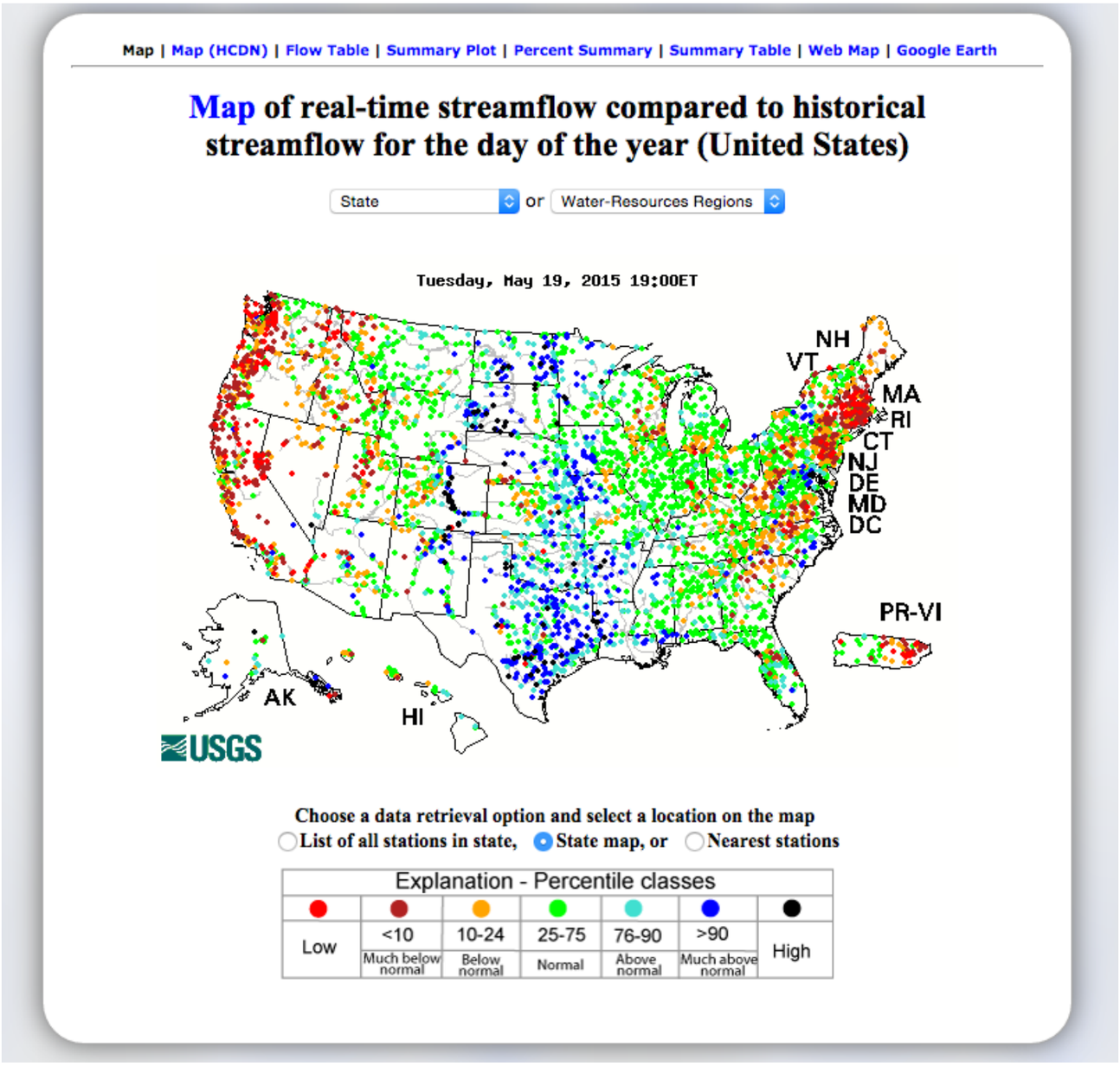
Comprehensive geospatial data



So What?

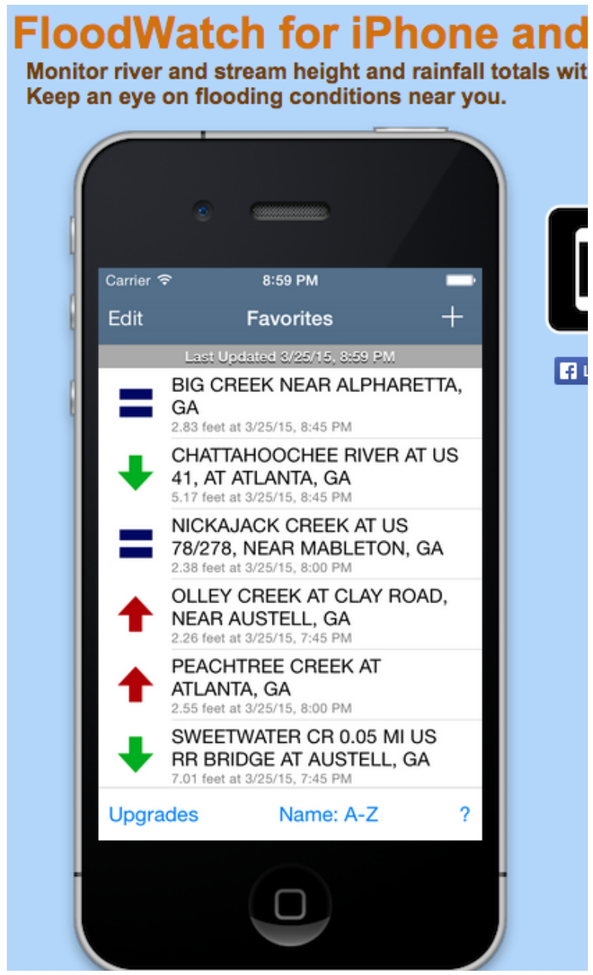
EXISTING WORK

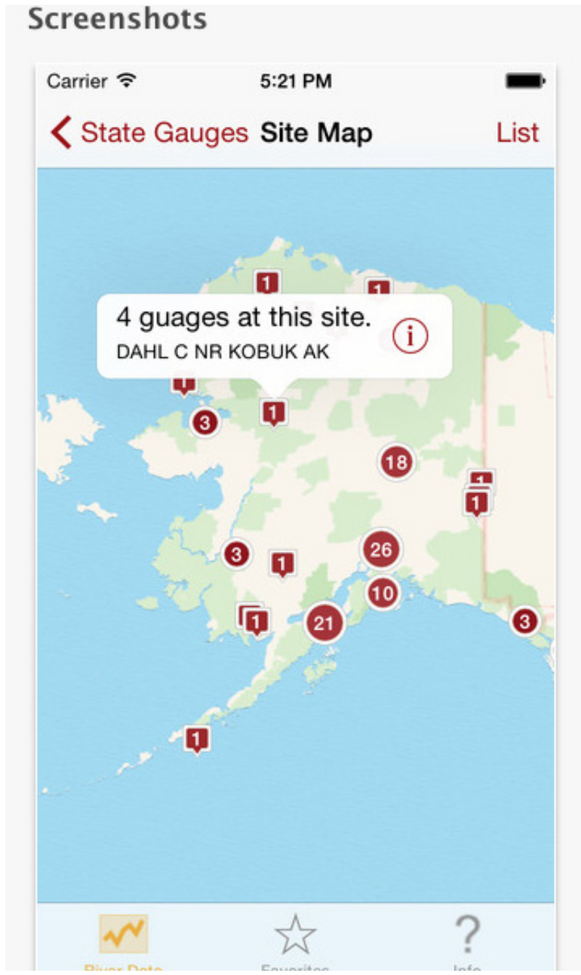
Existing visualizations leave room for improvement.



EXISTING WORK

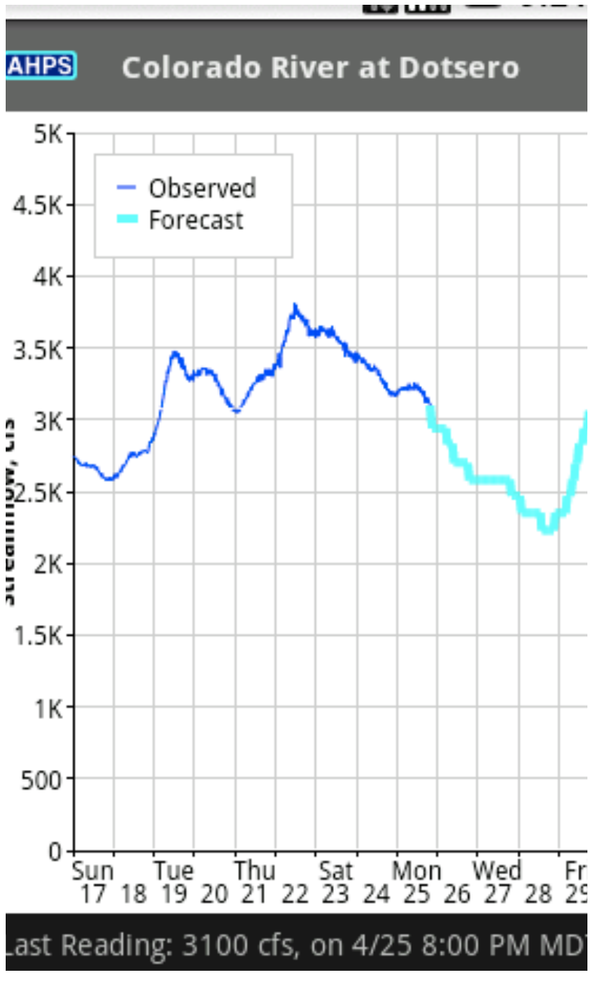
Commercial applications have a limited focus...

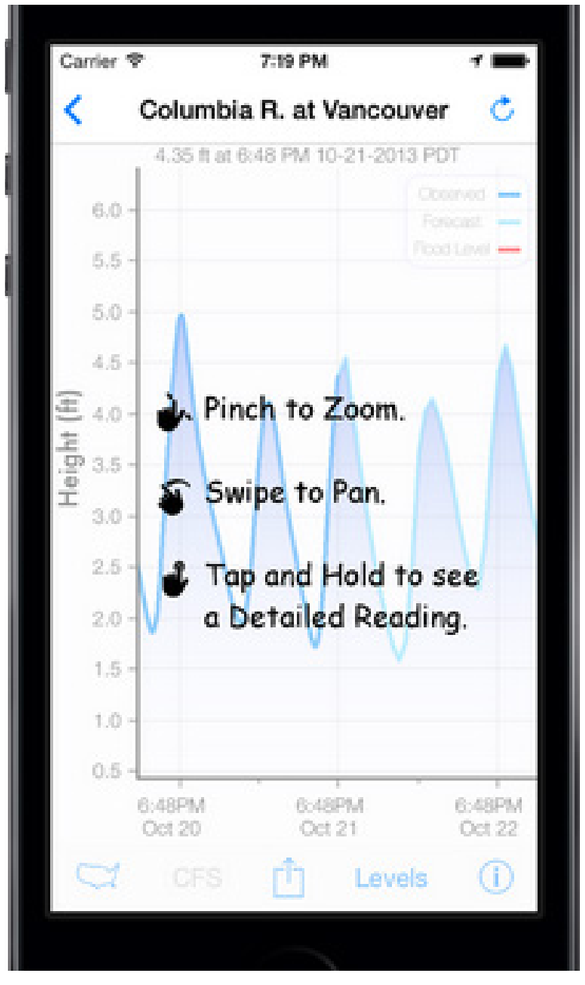


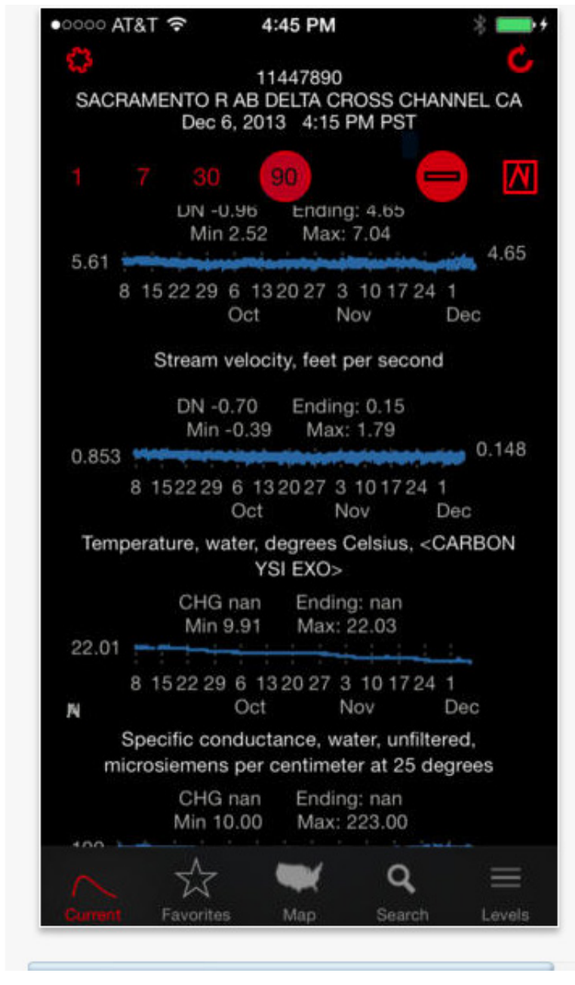


EXISTING WORK

...and disregard best practices







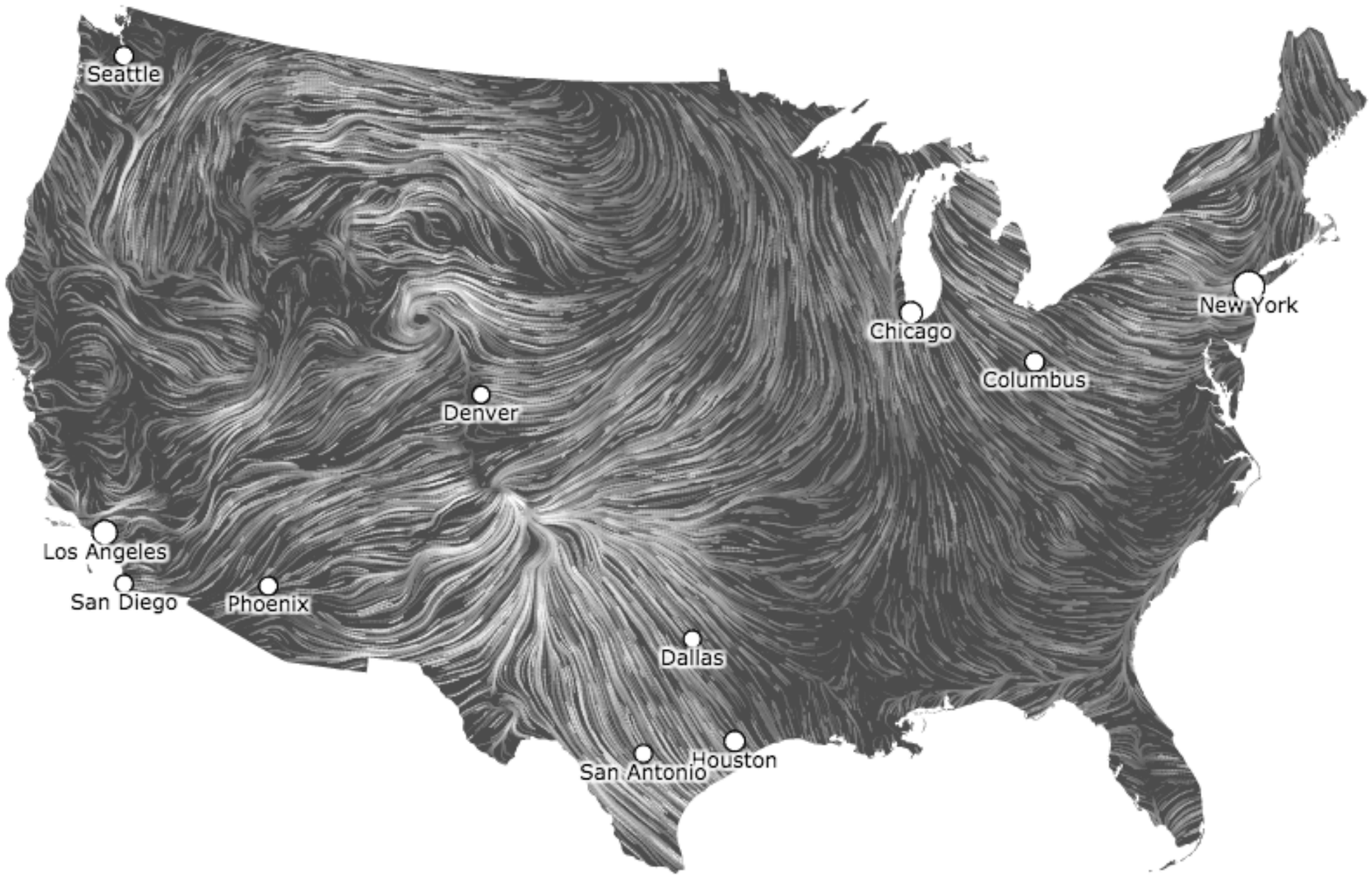
EXISTING WORK

Mapping the rivers has been done.

WITH THIS DATA

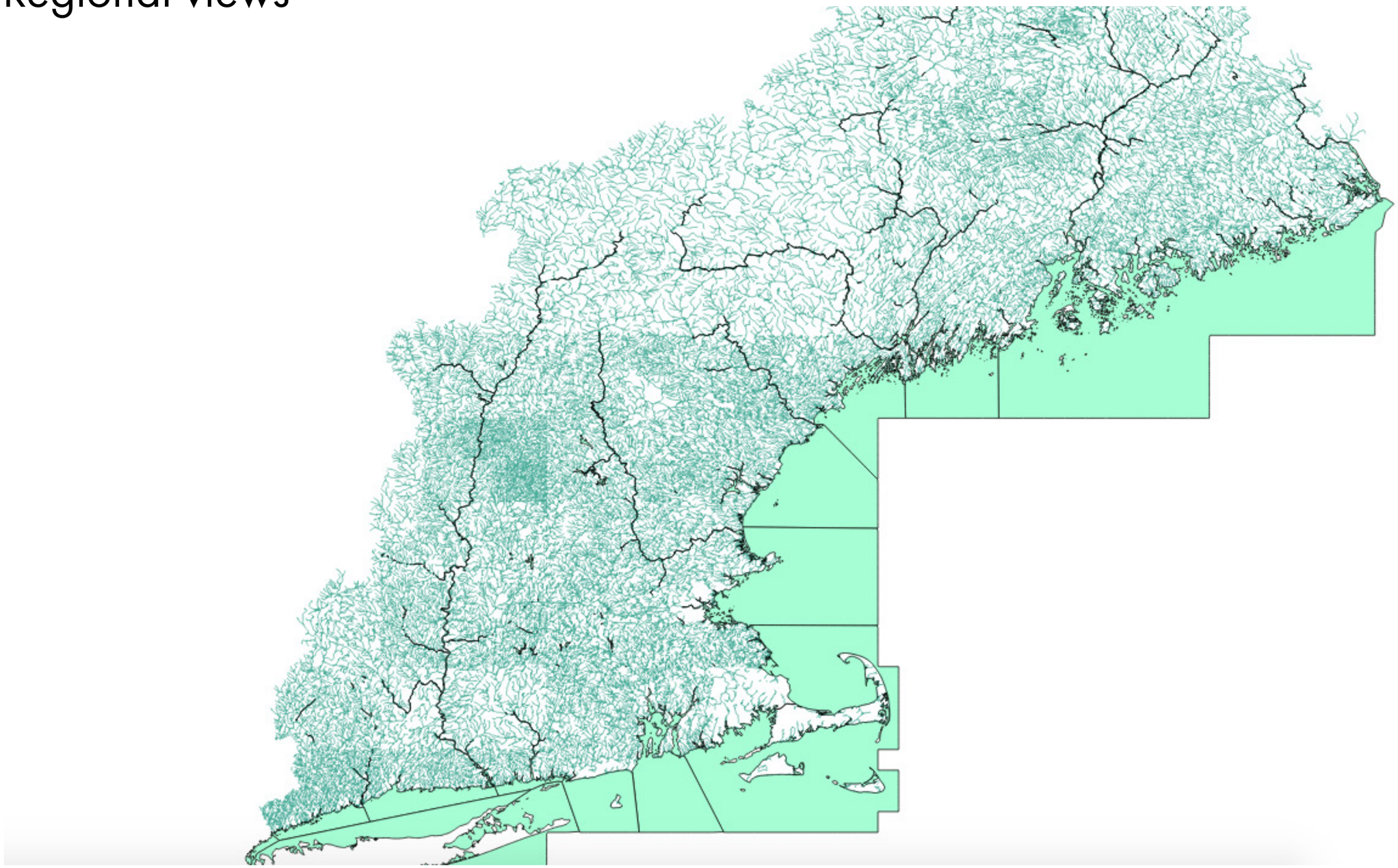
Local, regional and national comparisons.
Time series. Historical events.

How can we visualize streamflow nationwide?



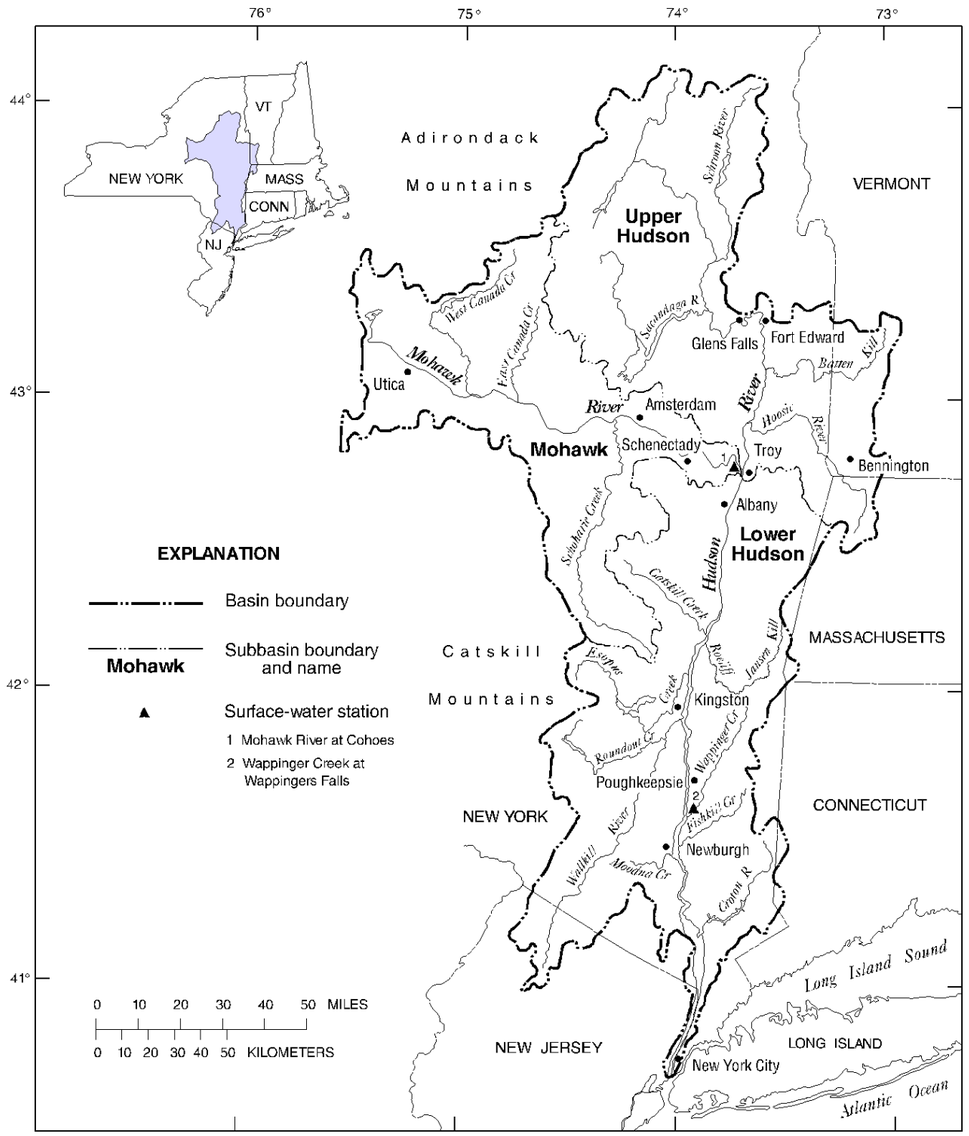
WITH THIS DATA

Regional views



WITH THIS DATA

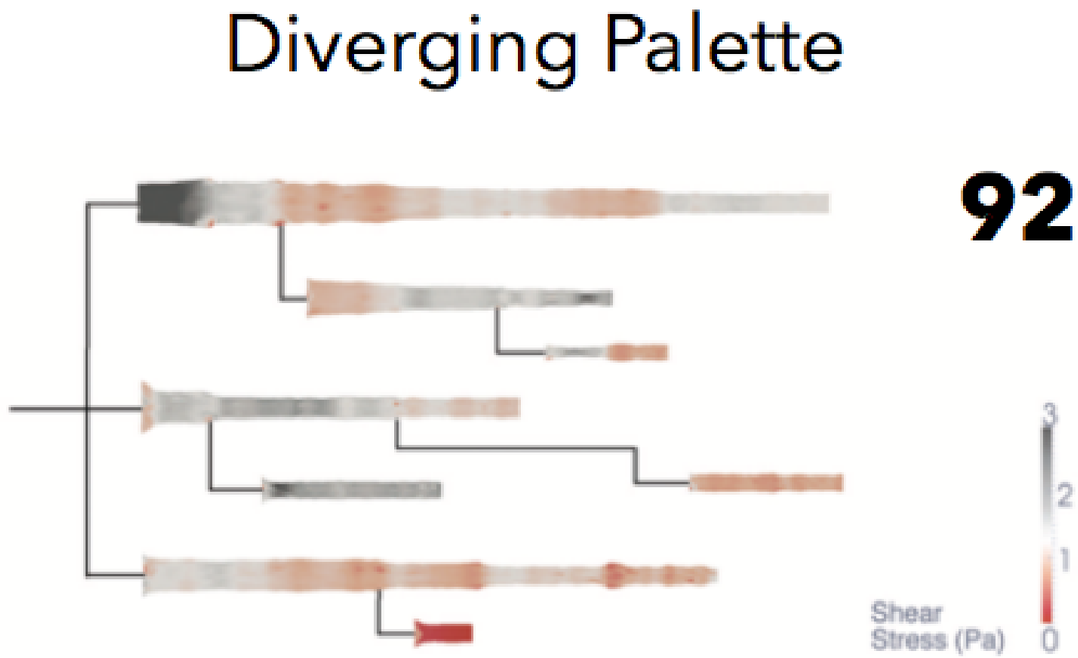
Locally relevant networks



Base from U.S. Geological Survey digital data 1:2,000,000, 1972
Albers Equal-Area Conic projection
Standard parallels 29° 30' and 45° 30', central meridian -74°

WITH THIS DATA

Alternative representations



WITH OTHER DATA

How does streamflow data relate to...

DROUGHT

NOAA National Climatic Data Center
National Oceanic And Atmospheric Administration

DOC > NOAA > NESDIS > NCDC Search Field: Search NCDC

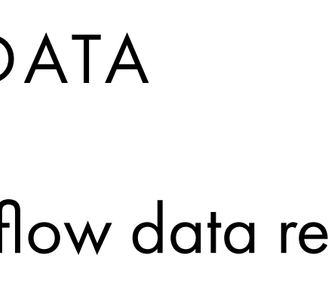
NCDC / Climate Monitoring / Palmer Indices / Search / Help

Climate of 2013 - April
U.S. Palmer Drought Indices

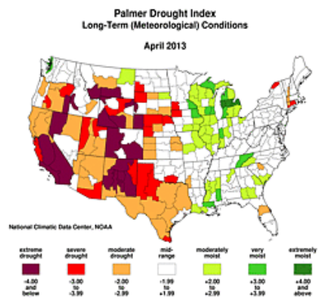
National Climatic Data Center, 15 May 2013

Current Palmer Drought Indices

The Palmer Z Index shows how monthly moisture conditions depart from normal (short-term drought and wetness). The animated maps to the right show the geographical pattern of the moisture anomalies for the last 12 months. On these maps, the red shading denotes dry conditions while the green shading indicates wet conditions.



larger Z Index animated image



The Palmer Drought Index (PDI) maps show long-term (cumulative) *meteorological* drought and wet conditions. The animated maps to the left show how the geographical pattern of the long-term (meteorological) moisture conditions has changed over the last 12 months. On these maps, the red shading denotes drought conditions while the green shading indicates wet conditions.

STORMS

NOAA NATIONAL CLIMATIC DATA CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Home Contact Us About NCDC Help

NCDC > Storm Events Database

Storm Events Database

Data Access
- Search
- Bulk Data Download (CSV)
- Storm Data Publication

Documentation
- Database Details
- Version History
- Storm Data FAQ
- NOAA's NWS Documentation
- Tornado EF Scale

External Resources
- NOAA's SPC Reports
- NOAA's SPC WCM Page
- NOAA's NWS Damage Assessment Toolkit
- ESRI/FEMA Civil Air Patrol Images
- SHELDUS
- USDA Cause of Loss Data

Storm Events Database

The Storm Events Database contains the records used to create the official NC documenting:

a. The occurrence of storms and other significant weather phenomena havin loss of life, injuries, significant property damage, and/or disruption to comr
b. Rare, unusual, weather phenomena that generate media attention, such a Florida or the San Diego coastal area; and
c. Other significant meteorological events, such as record maximum or minir precipitation that occur in connection with another event.

The database currently contains data from **January 1950 to January 2015**, as Weather Service (NWS). Due to changes in the data collection and processing are unique periods of record available depending on the event type. NCDC has and standardization of event types but has not changed any data values for loc damage, narratives and any other event specific information. Please refer to th more information.

Select State or Area
-- All States and Areas --
Search

-- or --

Narrative Text Se
Text Search

The Storm Events Database has changed greatly over time. Please refer to t for detailed version information and release dates. If you have questions, ple

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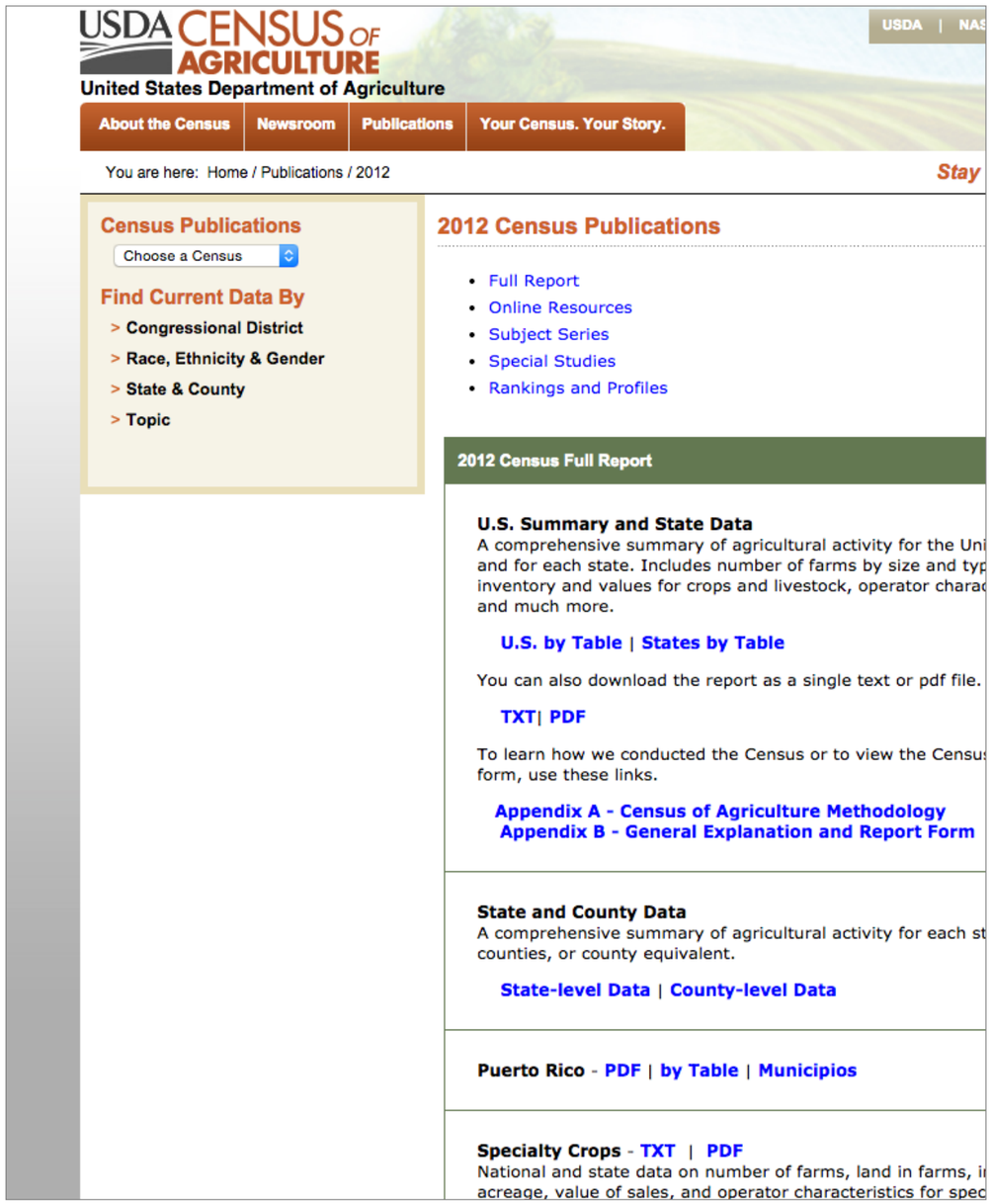
USA.gov Ready

WITH OTHER DATA

How does streamflow data relate to...

AGRICULTURE



INFRASTRUCTURE

CHALLENGES

Define scope.

Filter data.

Vector tiling.

Interactivity.

FEEDBACK

What interests **you** about these numbers?

How granular should I go?

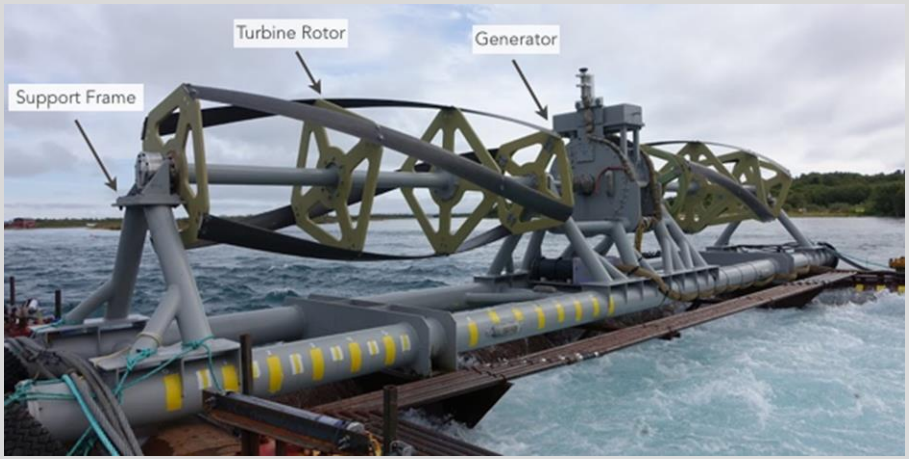
Raise your hand if you can teach me to back end.

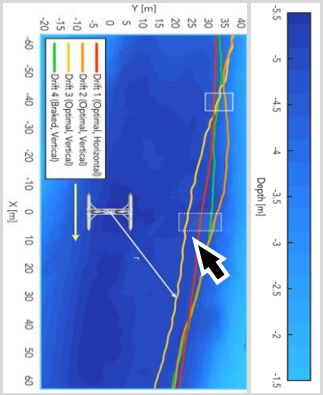
VISUALIZING THE ACOUSTIC CHARACTERISTICS OF A HYDROKINETIC TURBINE

RAMONA BARBER AND TRAVIS THONSTAD

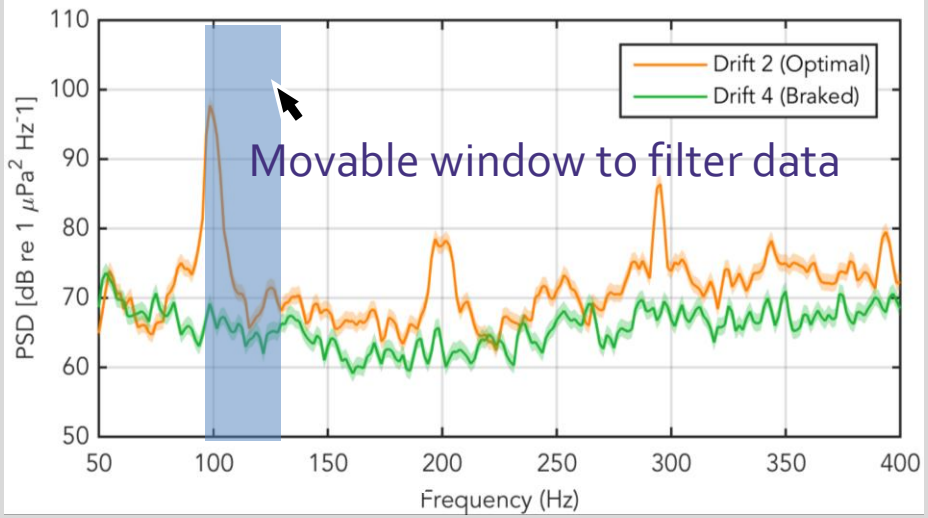
ENERGY FROM CURRENTS

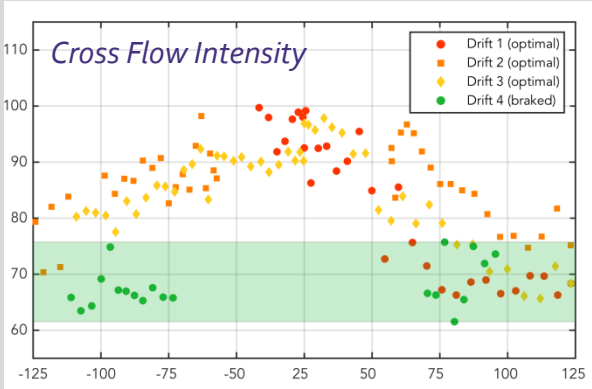
Hydrokinetic turbines operate similarly to wind turbines, by extracting kinetic energy from a moving fluid and converting it to electricity. Due to the sensitive nature of marine and other underwater environments, it is essential to understand the potential impacts of hydrokinetic turbines before they are commercially deployed. One step in this process is to study the acoustic signature of a turbine under various operating conditions.

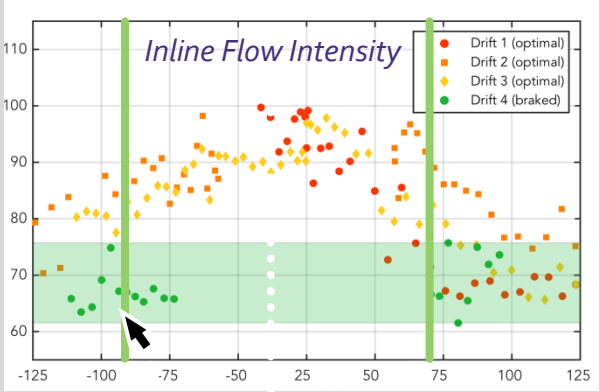




Mouse-over runs to highlight data in other windows







Movable lines show attenuation up and downstream of turbine for comparison and updates cross-flow map

QUESTIONS

- Would a heatmap of acoustic pressures be redundant with the linear plots, or useful as another way to visualize the area?
- We have information about how fast the turbine was spinning, which changes along each run independently as the drifts did not happen at the same time. Could that data be encoded in a useful way?
- Should there be an option to select specific runs for visualization, or is the proposed linking/highlighting strategy enough?
- Is the interaction intuitive or does there need to be explanation?
- Is there something you can imagine that you would want to do that is currently not supported?

Better Tools for Fault Diagnosis

Nat Guy & Nick Reiter
CSE 512

Description

- Vehicle telemetry systems have lots of data
- There's automatic fault detection, but root cause diagnosis typically requires a domain expert
- Current tools == lots of mini-plots, thousands of mostly unsorted data channels

We want to create a fault diagnosis system where:

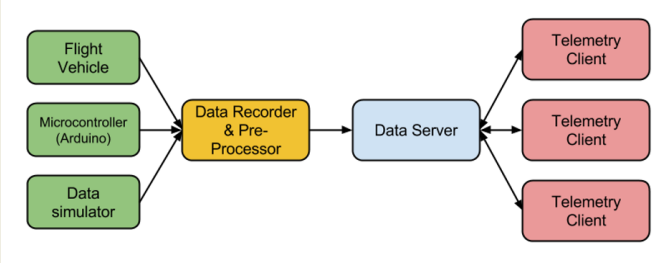
- Users are assisted in finding root causes and patterns
- Users don't need extensive expert knowledge to begin to look for root causes

Prior Work

- “An Interactive Visualization System for Analyzing Spacecraft Telemetry” (APL)
- “Visually mining and monitoring massive time series” (Lin et al)
- Much work is proprietary/undocumented
  - NASA (some projects documented)
  - SpaceX, United Launch Alliance
- Our work seeks to find cleaner, more intuitive ways to show data and their relationships, with a more dynamically configurable (rather than static) interface

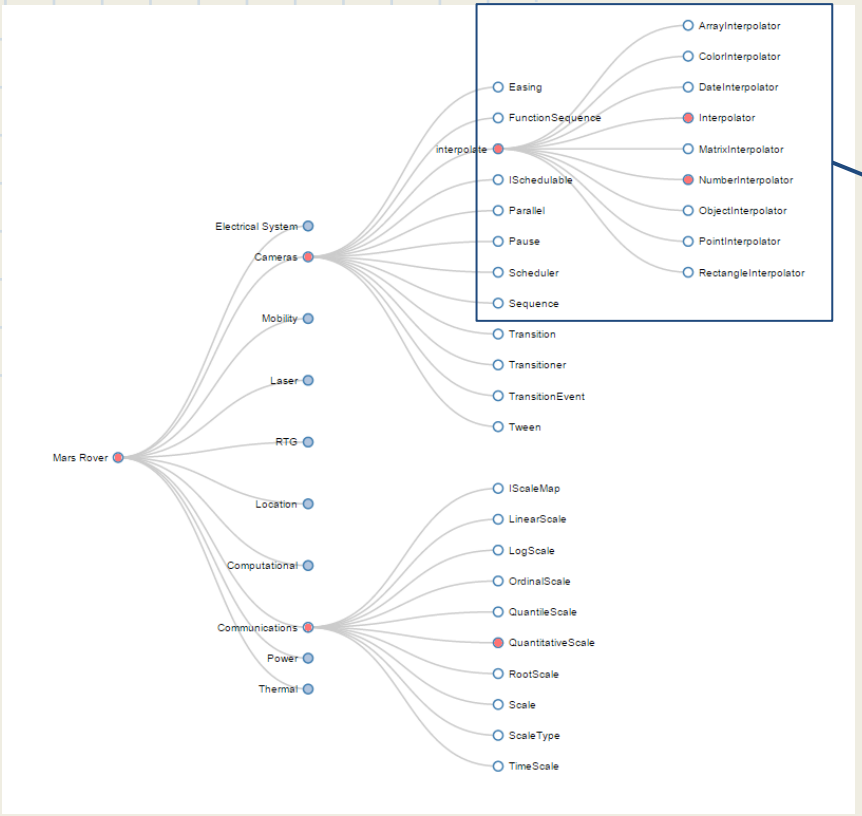
Current Progress

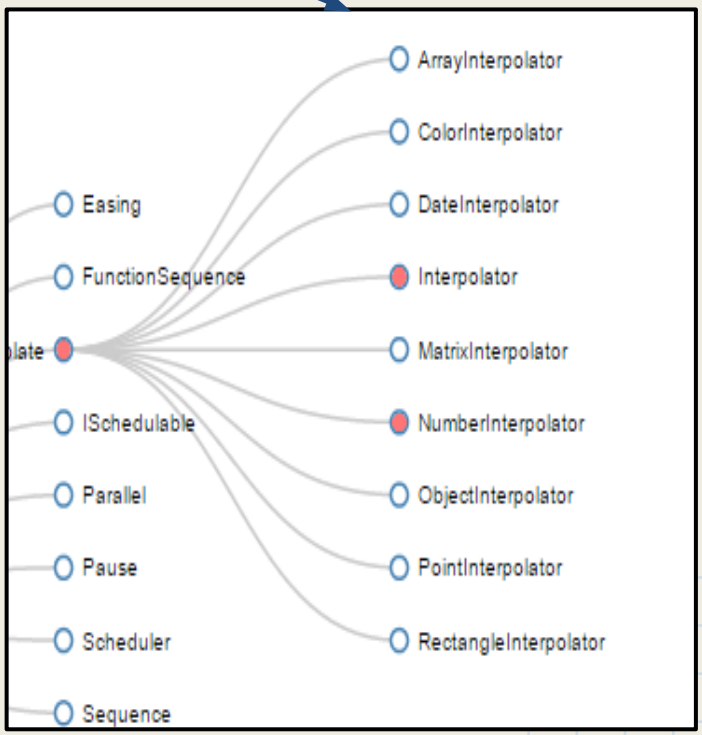
- Generating simulated data
- Loading data channel metadata and fault detection rules from metafiles
- Client-server data communication (client: telemetry client)



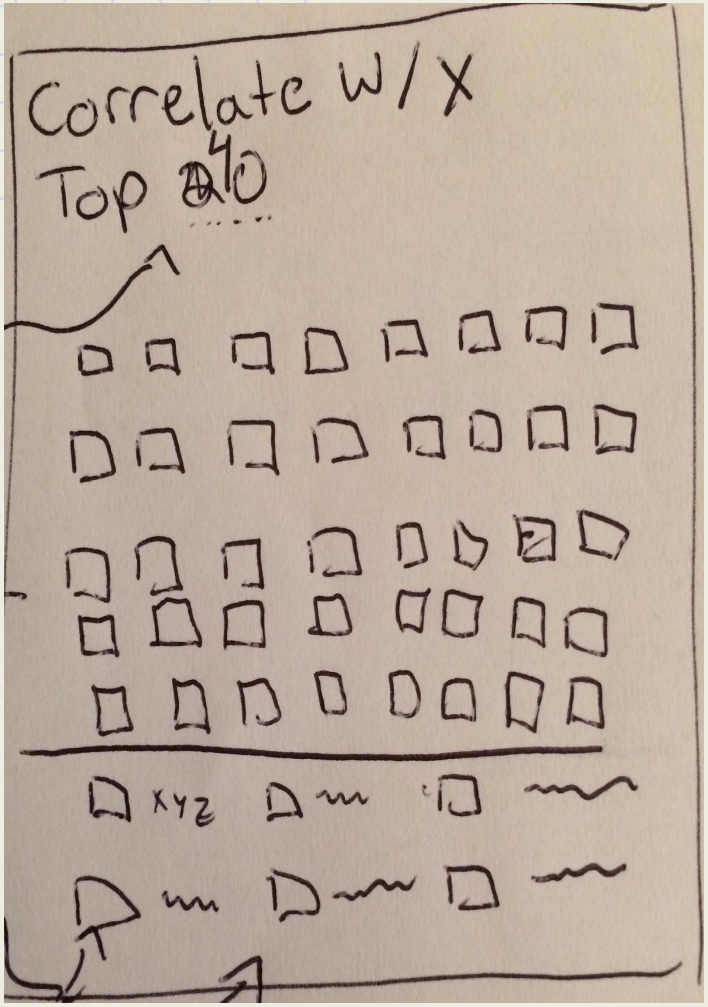
System Features

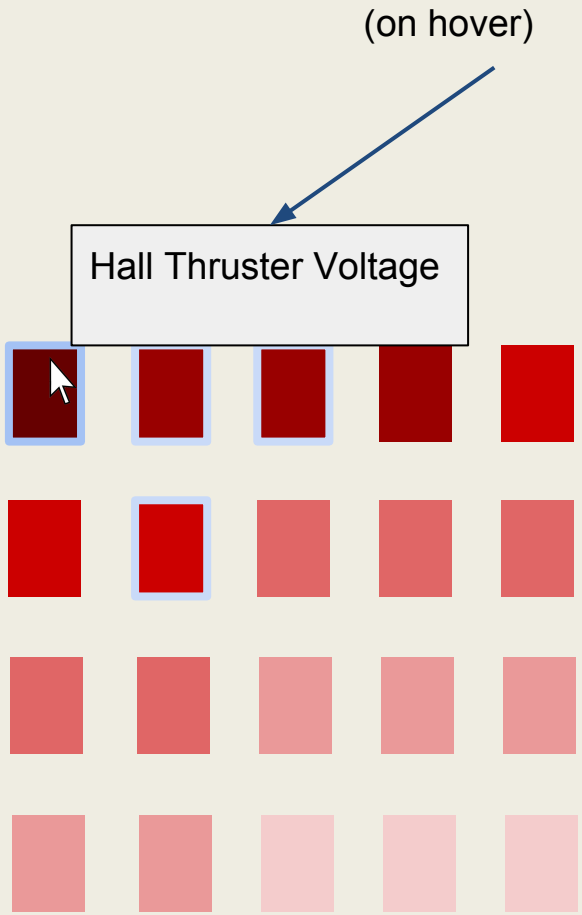
- Degree of interest tree showing relevant channels
  - Hierarchy of channel relationships
- Automatic fault detection based on basic rules
- When a fault occurs, determines correlated channels
- Detailed charts provide channel visualization
- Simple interface to find faulted channels easily
- Users can mark data of interest and easily compare channels



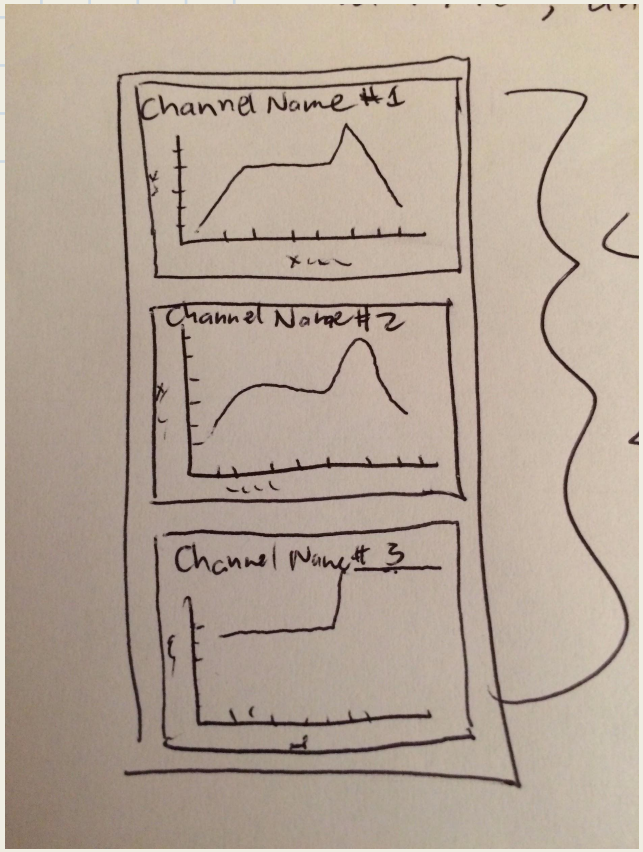


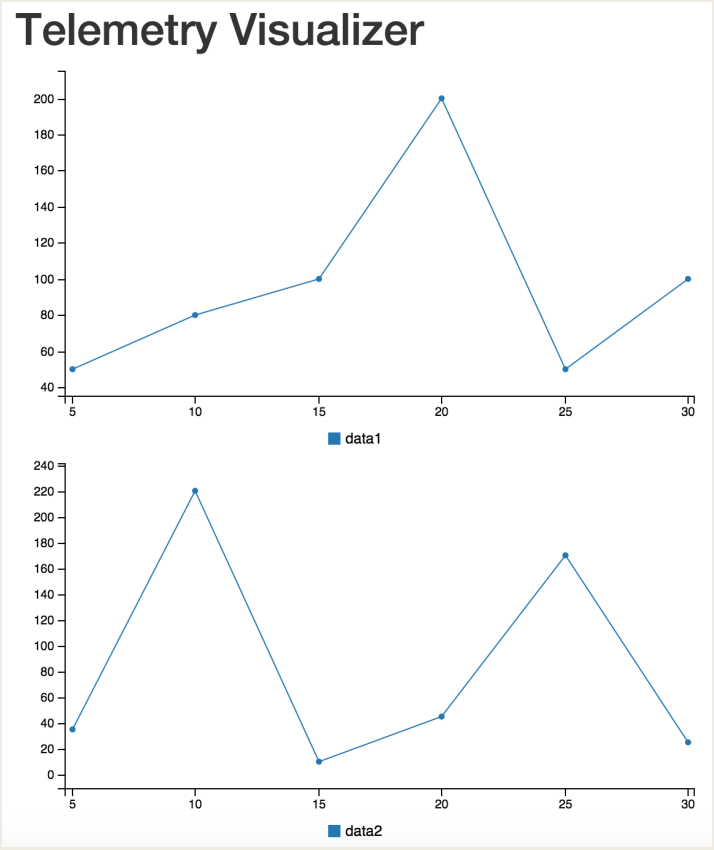
Degree of interest channel hierarchy containing status information





When a fault occurs, shows top *n* correlated channels for a selected channel





An example of stacked detail charts for various telemetry channels

Questions

- Best viz for showing correlation between datasets? (Corr. matrix? Graph structure?)
- How to get discoverability of certain data within a dataset of thousands of channels?
- Is there a solution for channel navigation that would allow DoI trees without requiring manual division into a hierarchy with small numbers of children per parent?

Student Data for Teacher Intervention

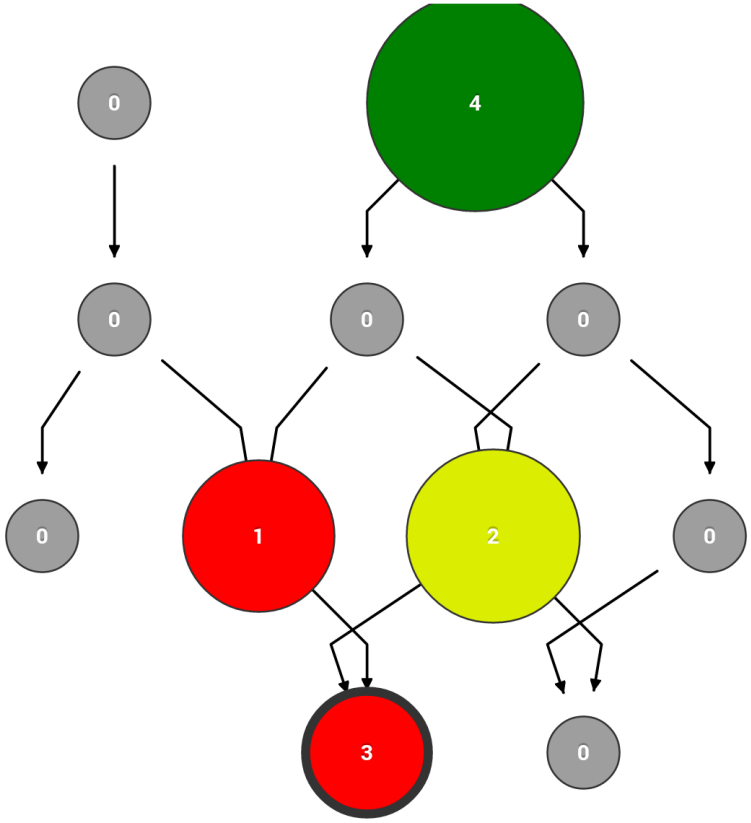
Yvonne Chen & Nell O'Rourke

Motivation

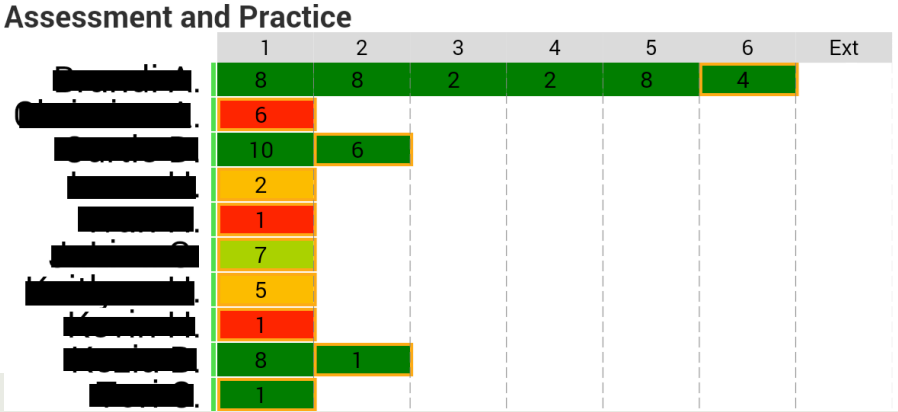
- Prior work
  - Student data is very useful for teachers
- Enlearn
  - Tablet based math software for students and teacher in classroom
- Current visualizations
  - Learning Map aggregates student progress
  - Teacher dashboard
- Problem
  - Inappropriate real time visualizations
  - Not actionable

Current Real Time Visualization

Real Time (Software)

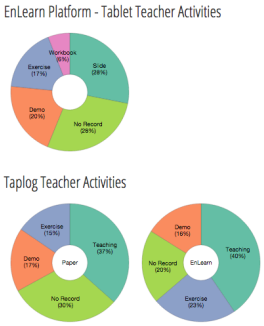


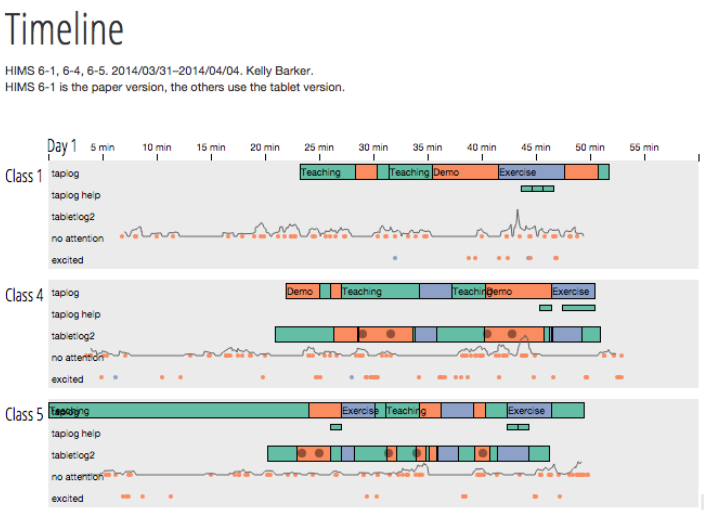
- Dislikes
  - Clumsy interface
  - Aggregate data not useful
  - Learning Map not useful, prefer old dashboard
- Wishlist
  - Quick, actionable suggestions



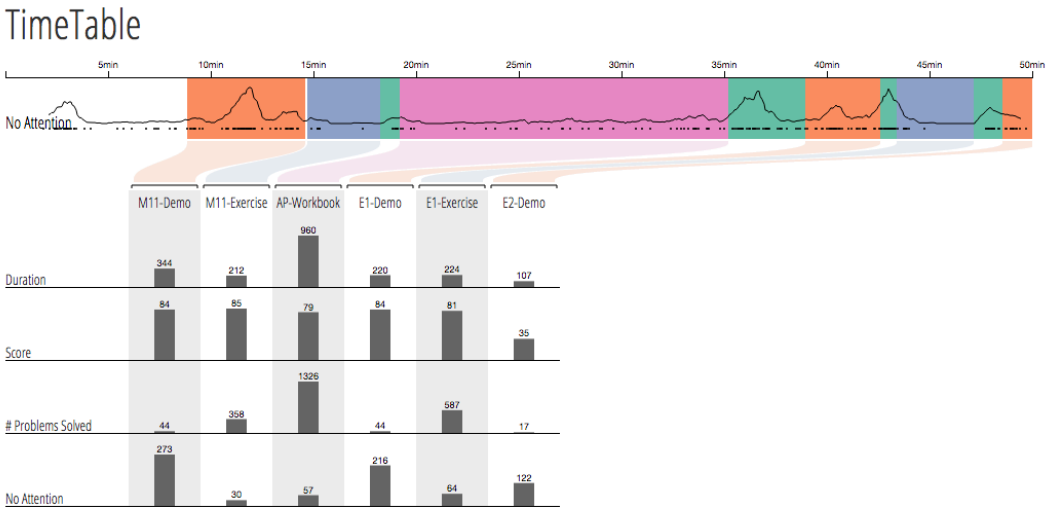
Current Web Based Visualization

Post Analysis (Web-based)





- Problems
  - Never designed for teacher use; hence, cluttered
  - Teachers are not data scientists
  - Also need actionable suggestions



Progress

- Met Enlearn staff, learned about teacher frustrations and needs
- Deeply explored data using A3 visualization
- Next steps
  - Design
  - Prototype
  - Iterate
  - Polish

Comments?

- Suggestions for visualizations that combine aggregate and individual data?
- What are some techniques to create at-a-glance visuals?
- Any issues specific to creating tablet based visualizations?
- Specific improvements based on below visualizations: