

# Class Activity

5 students with their opinion on six topics. What can you tell?

P1 [0, -0, 0, 0, 0, 3],

P2 [1, -1, 1, 2, 1, 6],

P3 [2, -2, 4, 4, 0.5, 2],

P4 [3, -3, 9, 6, 0.33, 4],

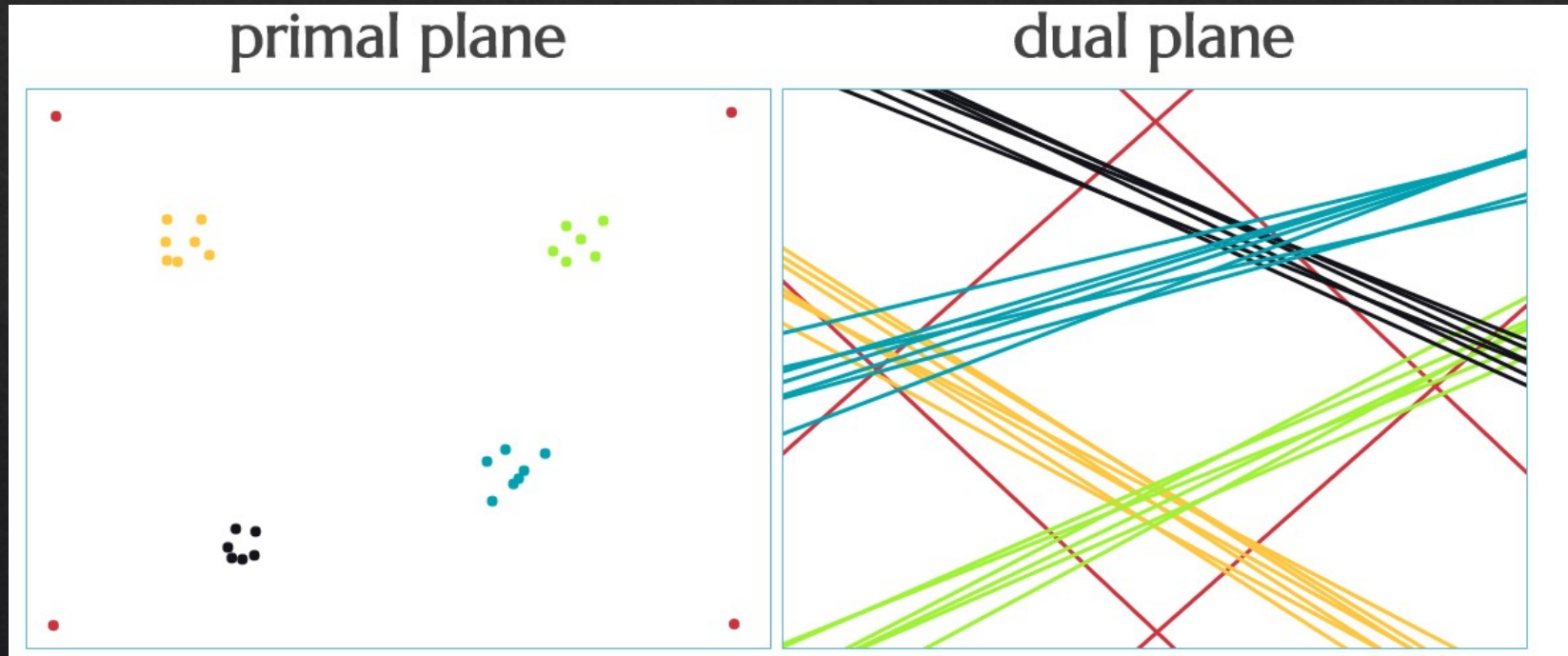
P5 [4, -4, 16, 8, 0.25, 9]

# Dealing with Multidimensional Data using Parallel Coordinates

Debajyoti Mondal  
University of Saskatchewan

# Background Concept: Point-Line Duality

The point-line duality is the most fundamental concept for parallel coordinates (Inselberg, 1985)

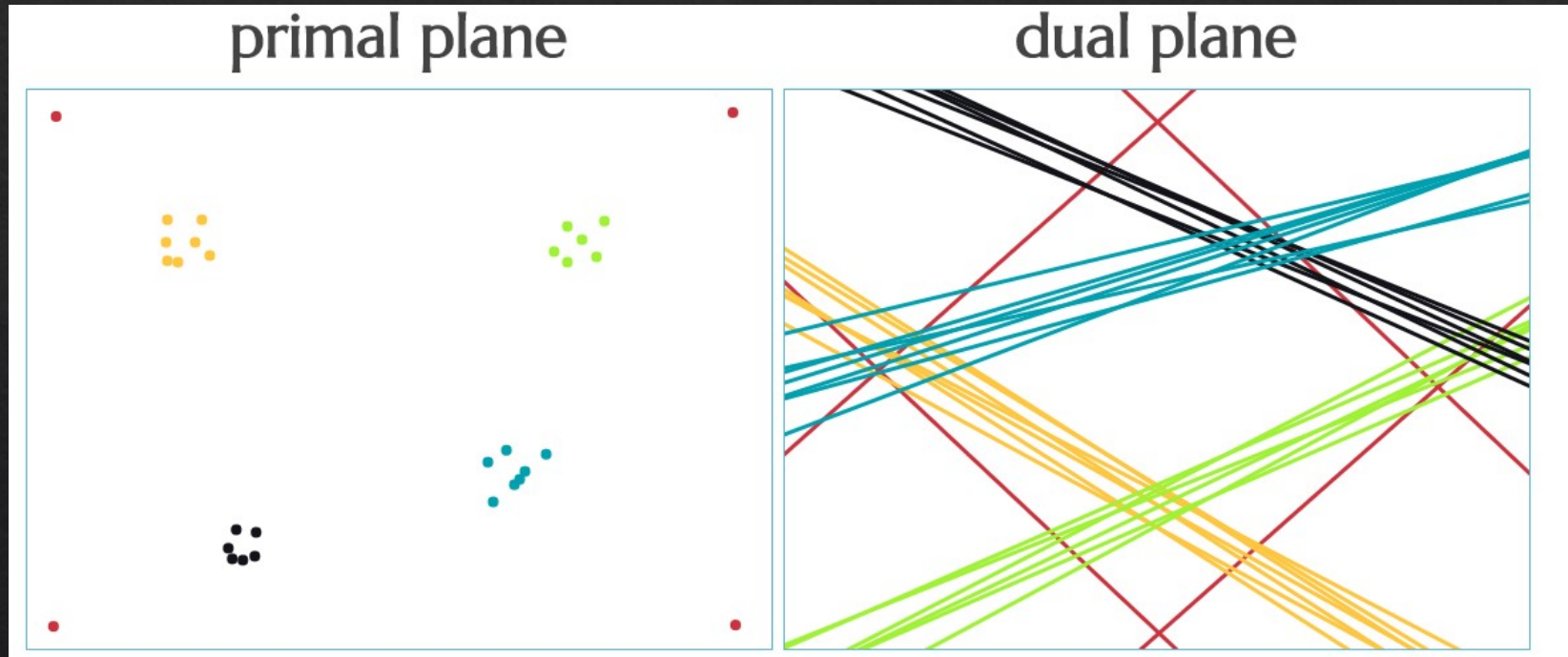


<http://students.cec.wustl.edu/~tdeck/duality/>



# Background Concept: Point-Line Duality

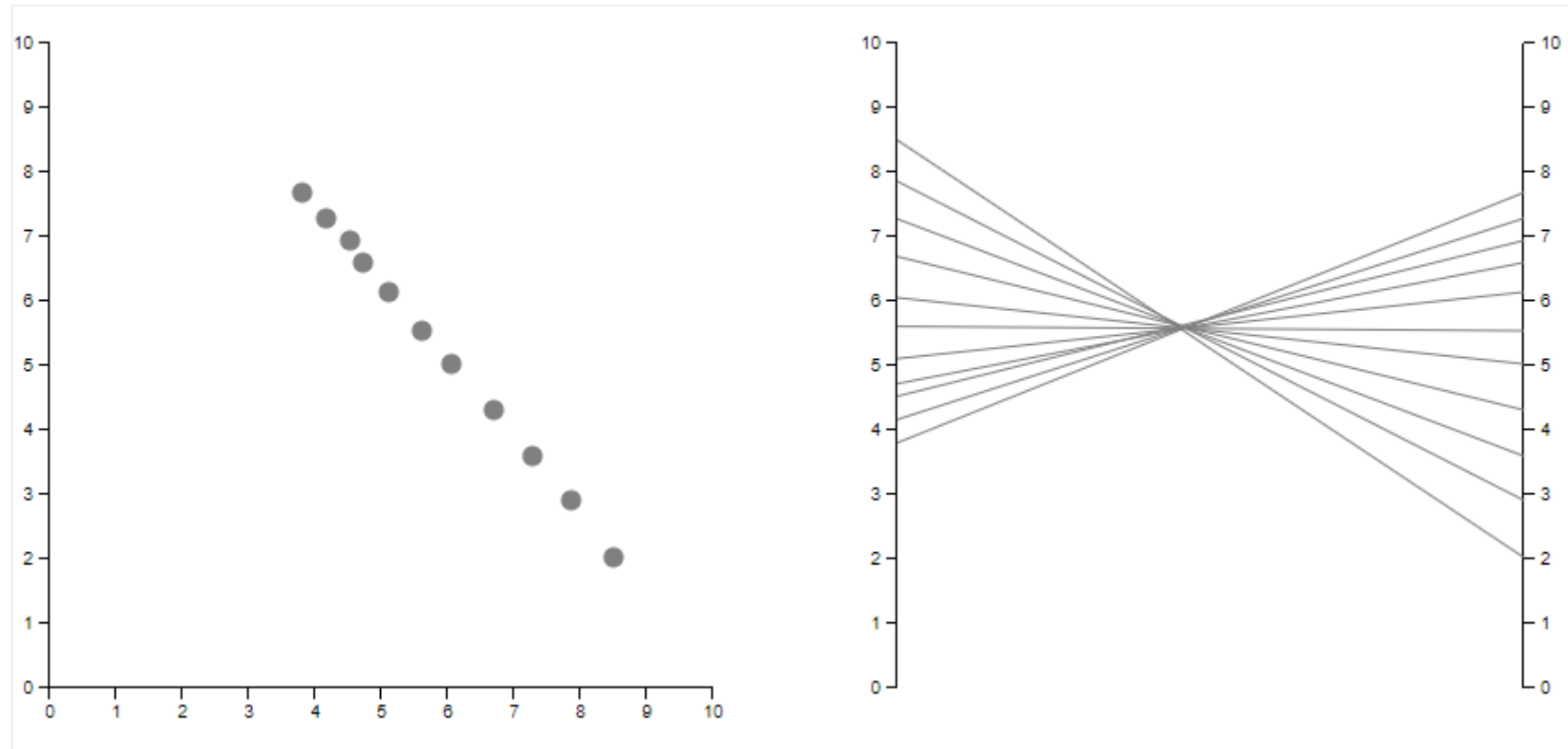
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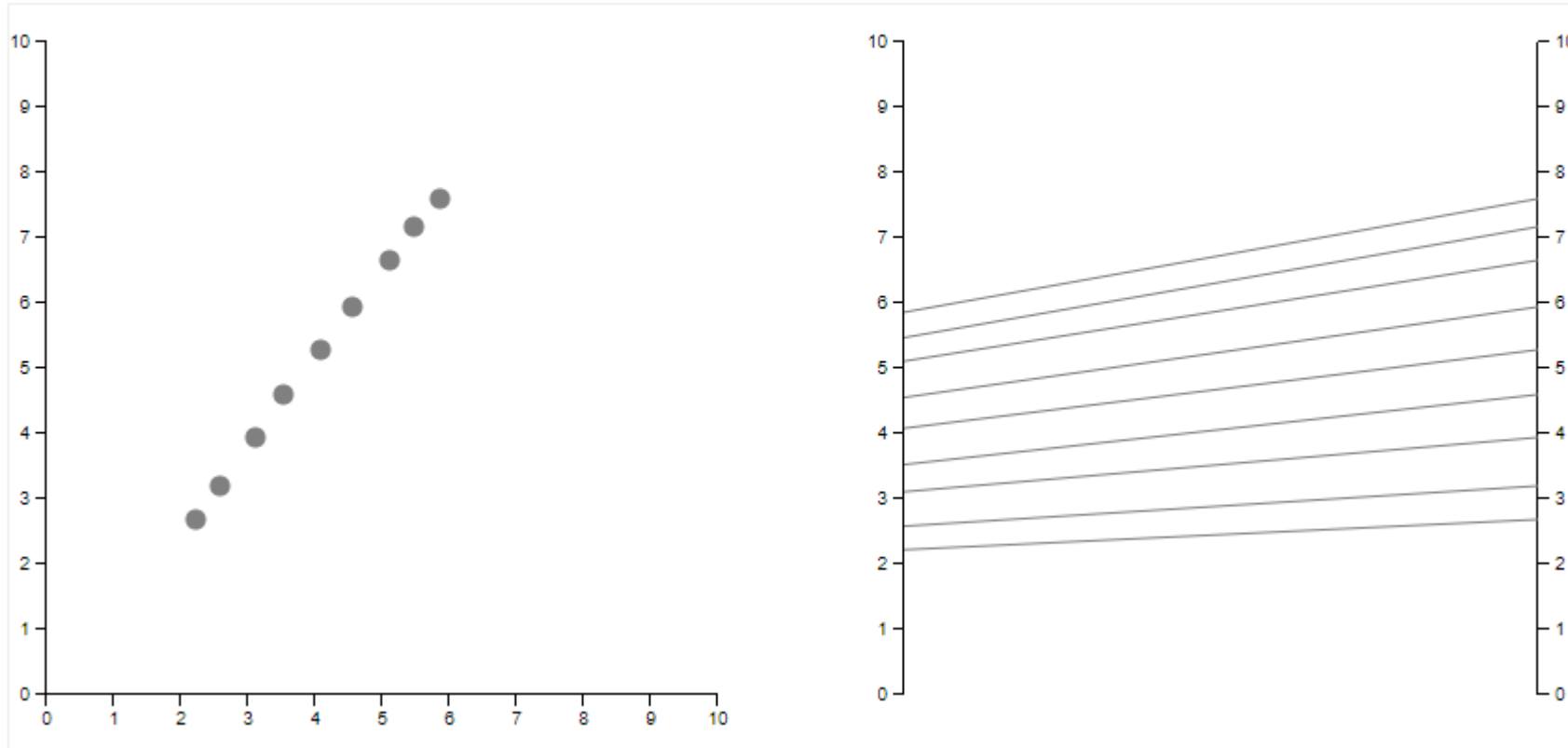
# Background Concept: Point-Line Duality

## Point-Line Duality in Parallel Coordinates



# Background Concept: Point-Line Duality

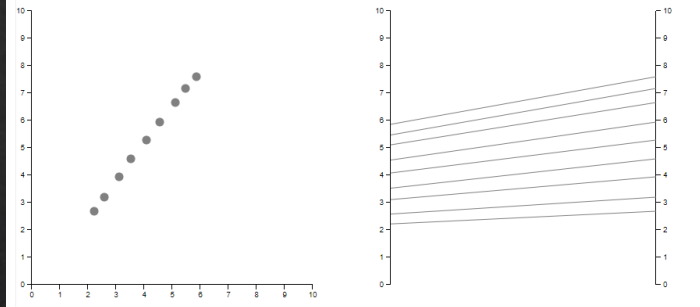
## Point-Line Duality in Parallel Coordinates



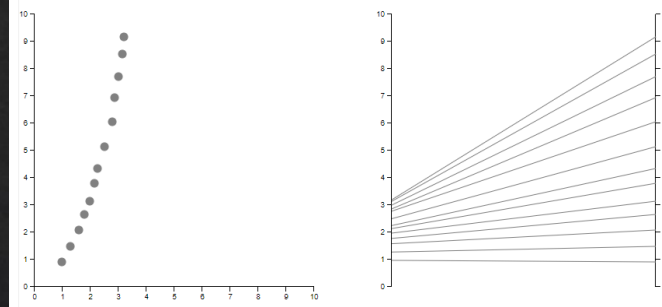


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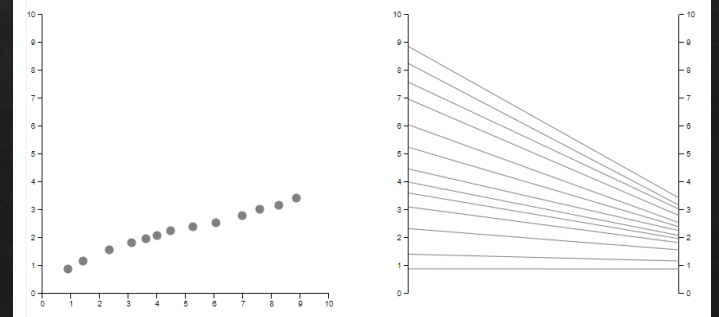
Point-Line Duality in Parallel Coordinates



Point-Line Duality in Parallel Coordinates

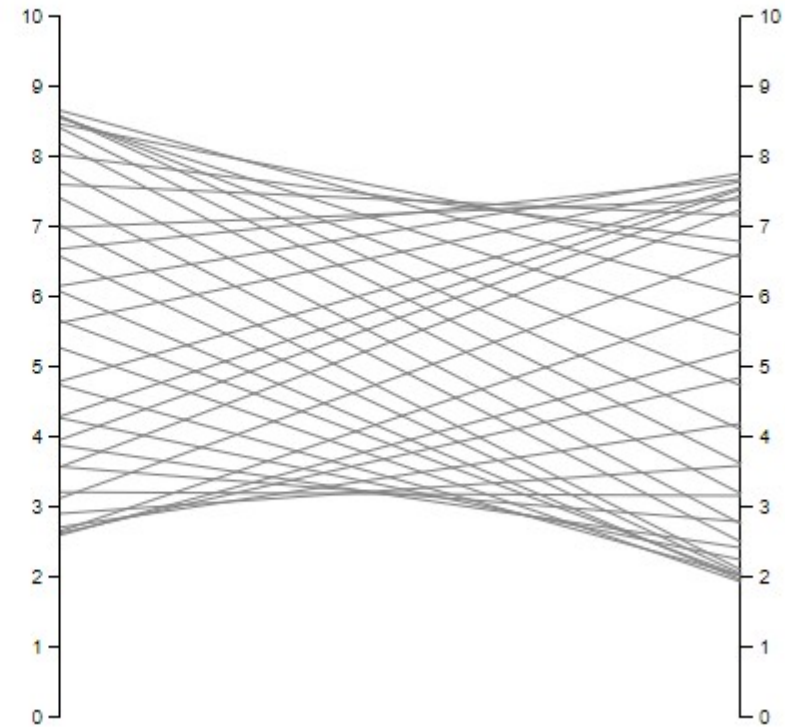
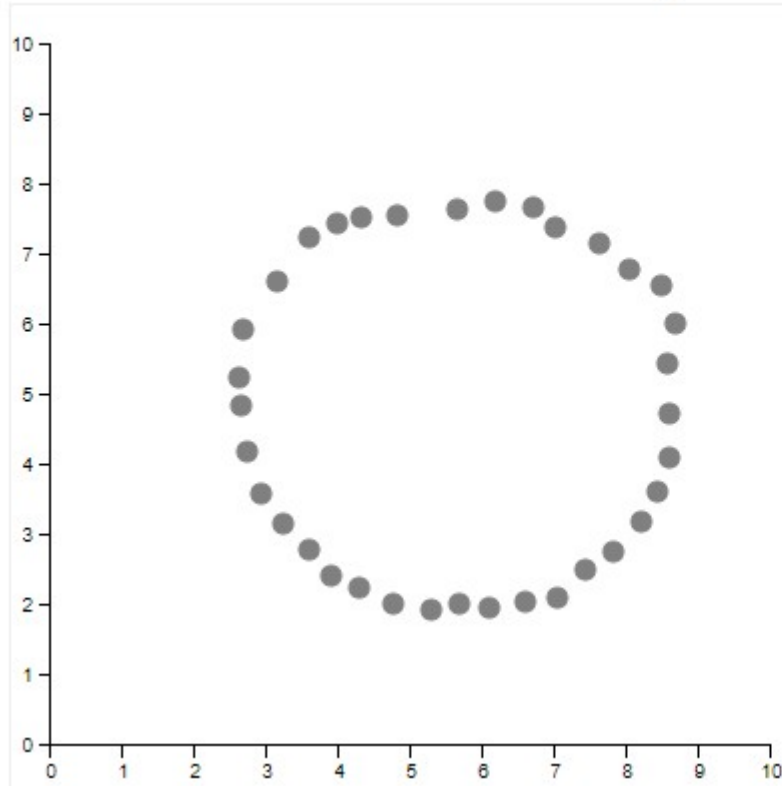


Point-Line Duality in Parallel Coordinates



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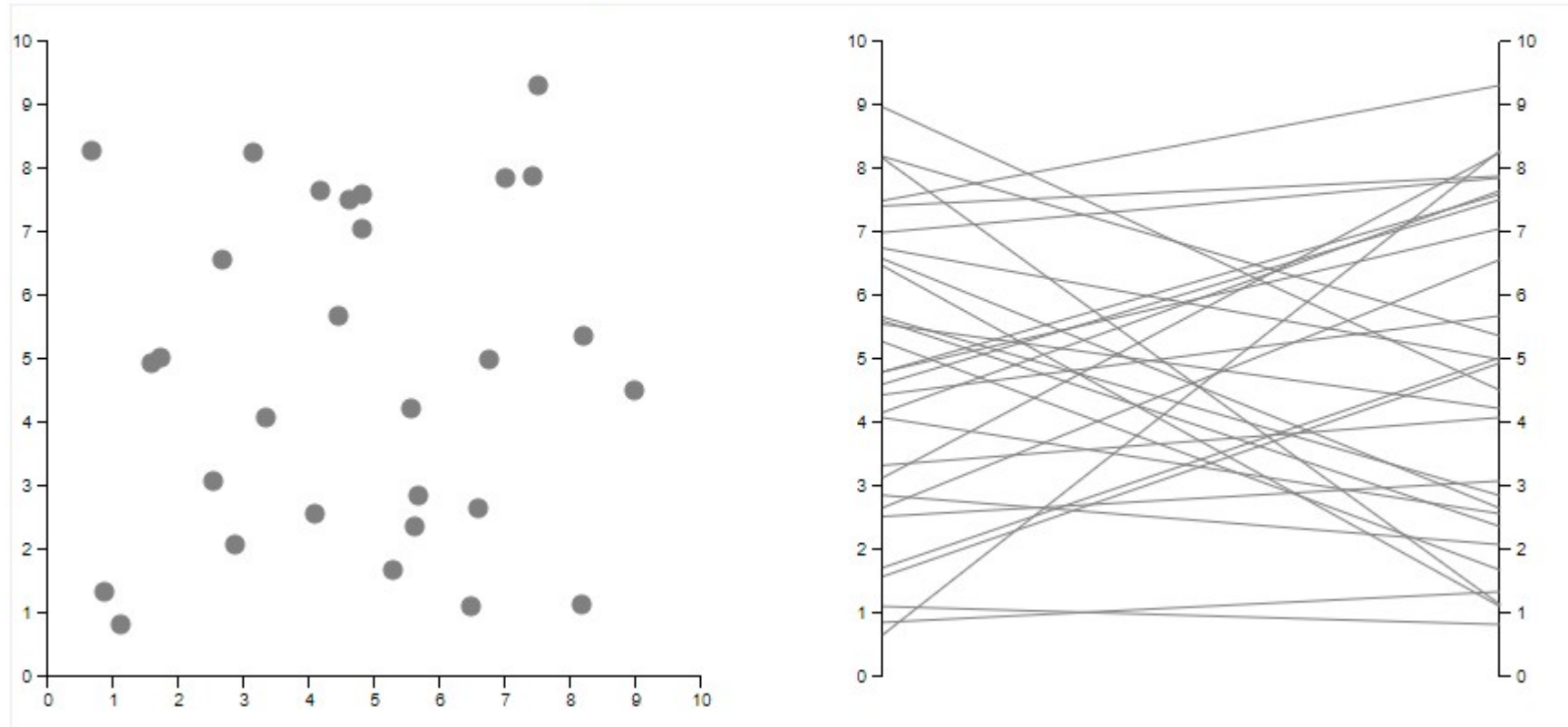
## Point-Line Duality in Parallel Coordinates





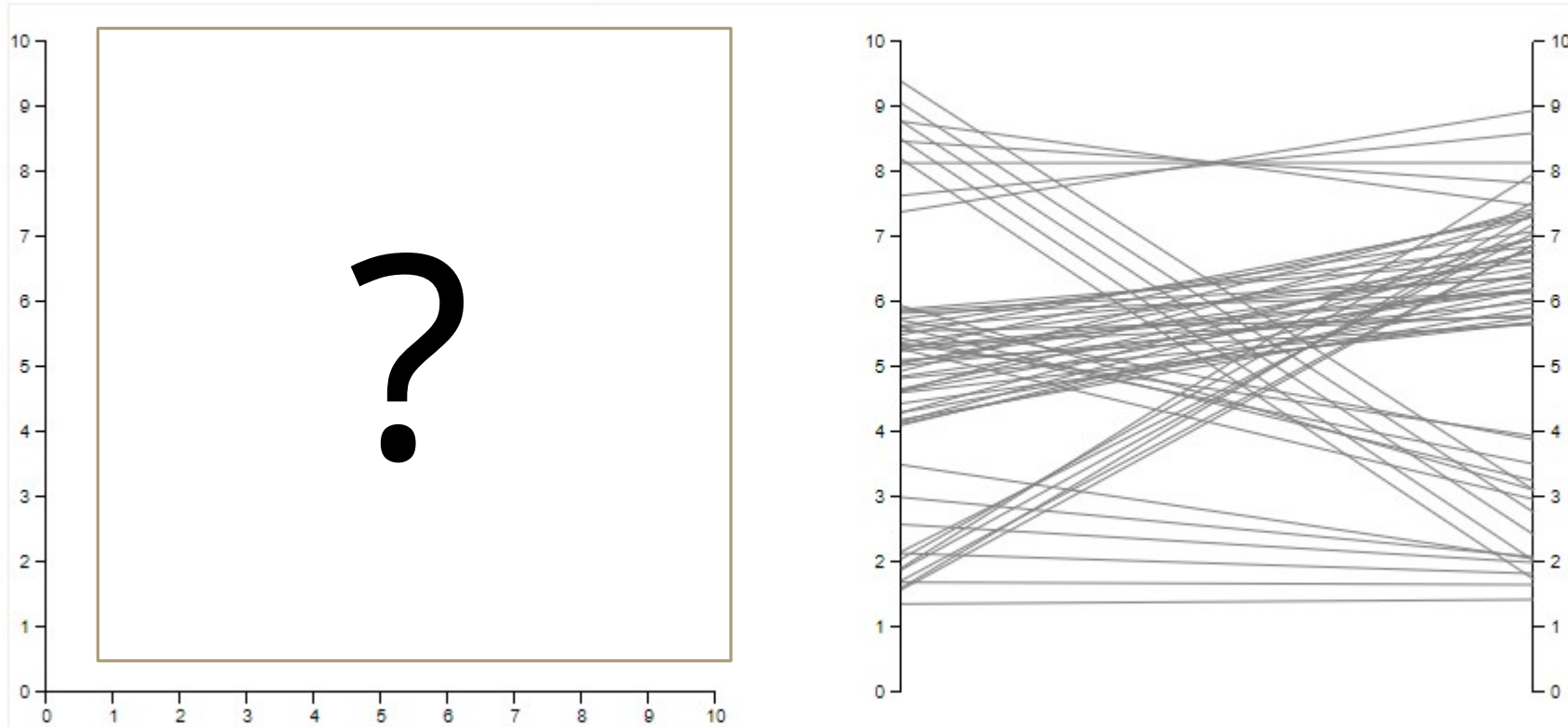
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## Point-Line Duality in Parallel Coordinates



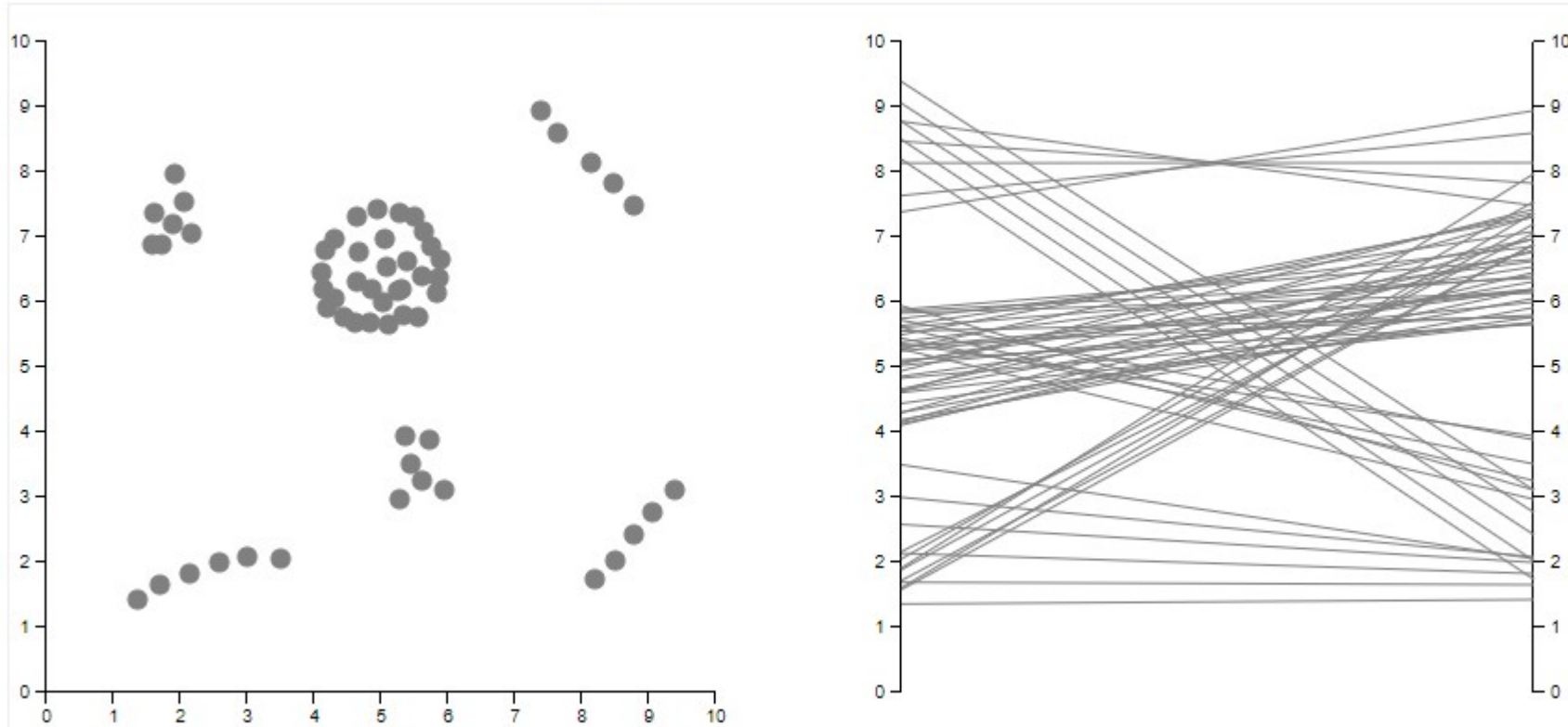
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## Point-Line Duality in Parallel Coordinates



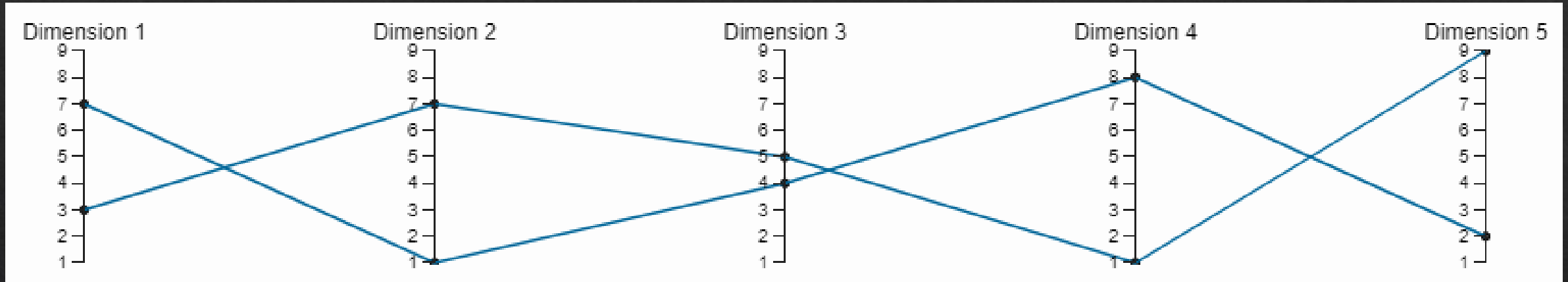
# Background Concept: Point-Line Duality

## Point-Line Duality in Parallel Coordinates





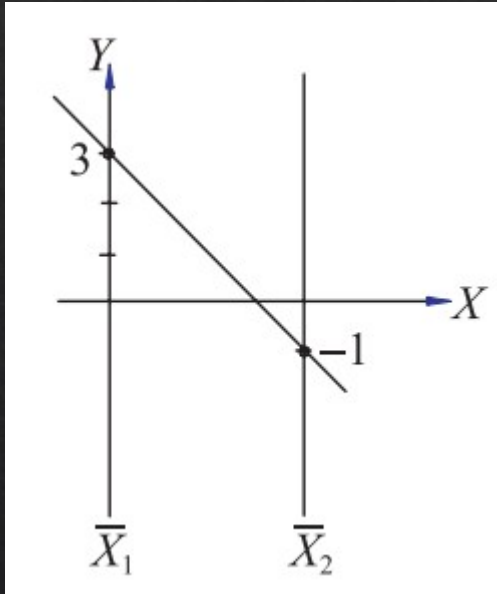
# Parallel Coordinates



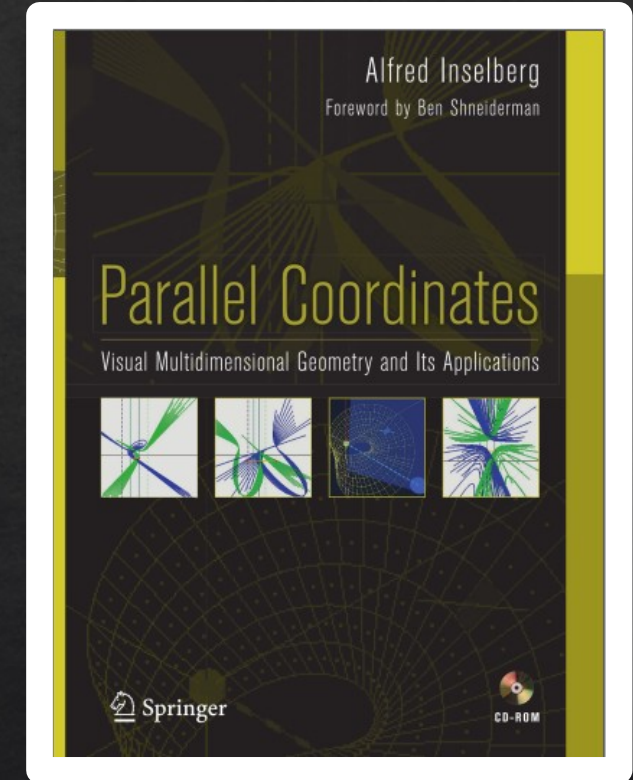
Fundamental ideas of parallel coordinates:

1. axes are drawn in parallel.
2. points are represented by lines.

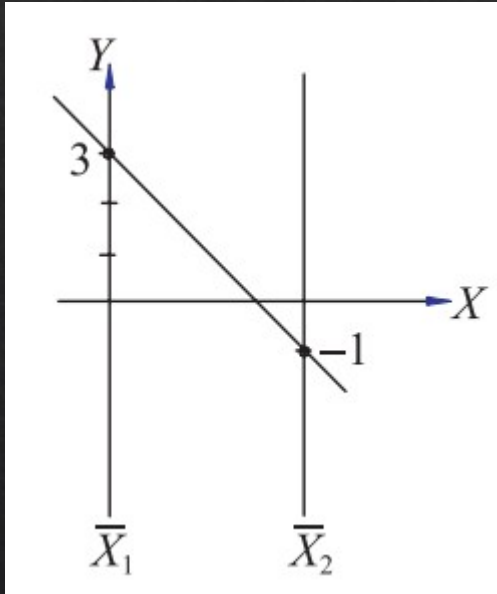
# Brief Overview of Another Deep Theory



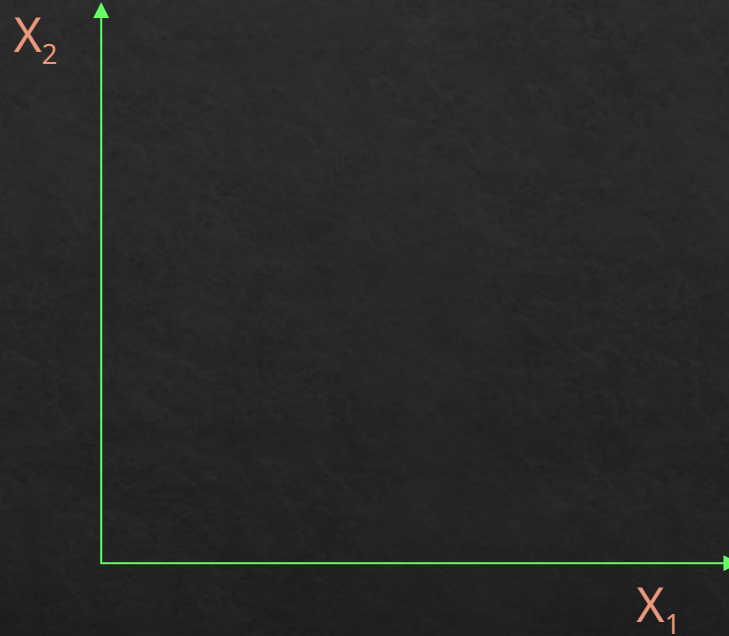
$$y = m x + b$$



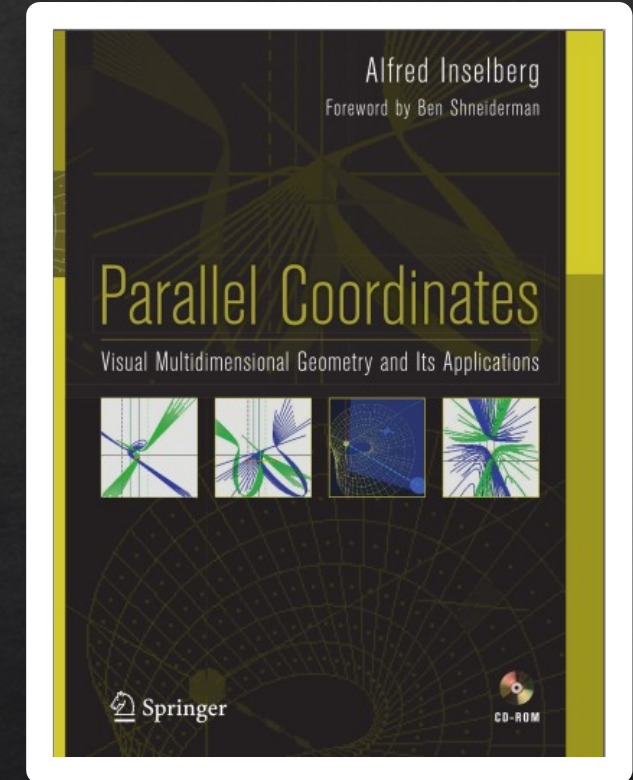
# Brief Overview of Another Deep Theory



$$y = -x + 3$$
$$m = -1$$
$$b = 3$$

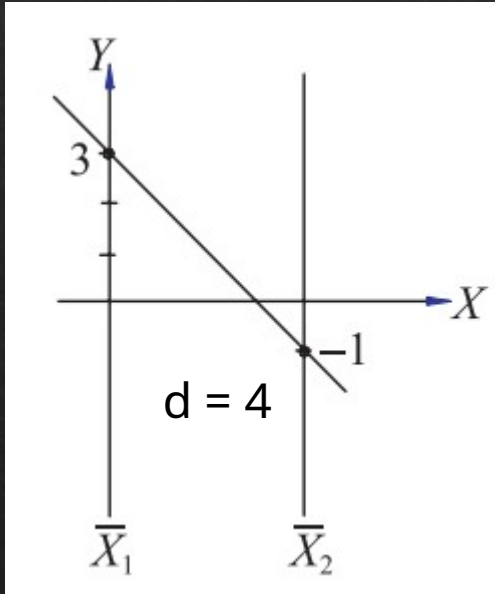


$$\left( \frac{d}{1-m}, \frac{b}{1-m} \right)$$

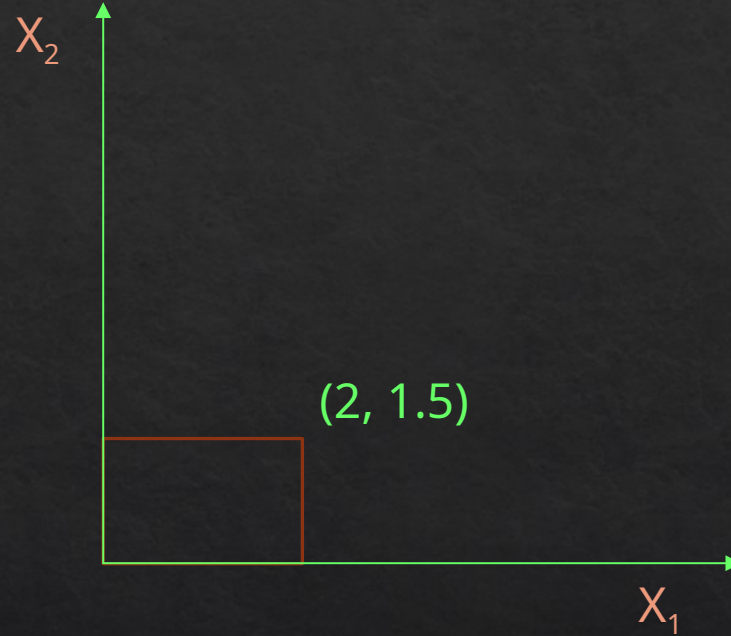




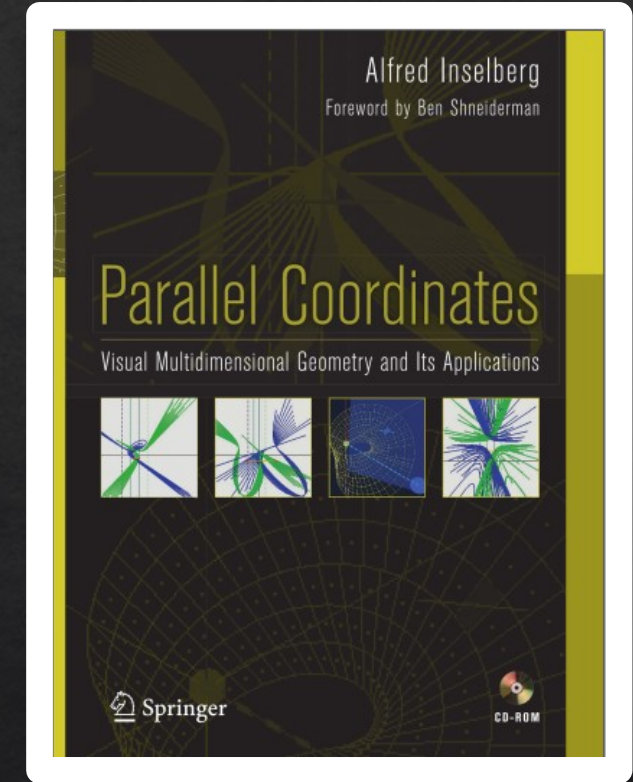
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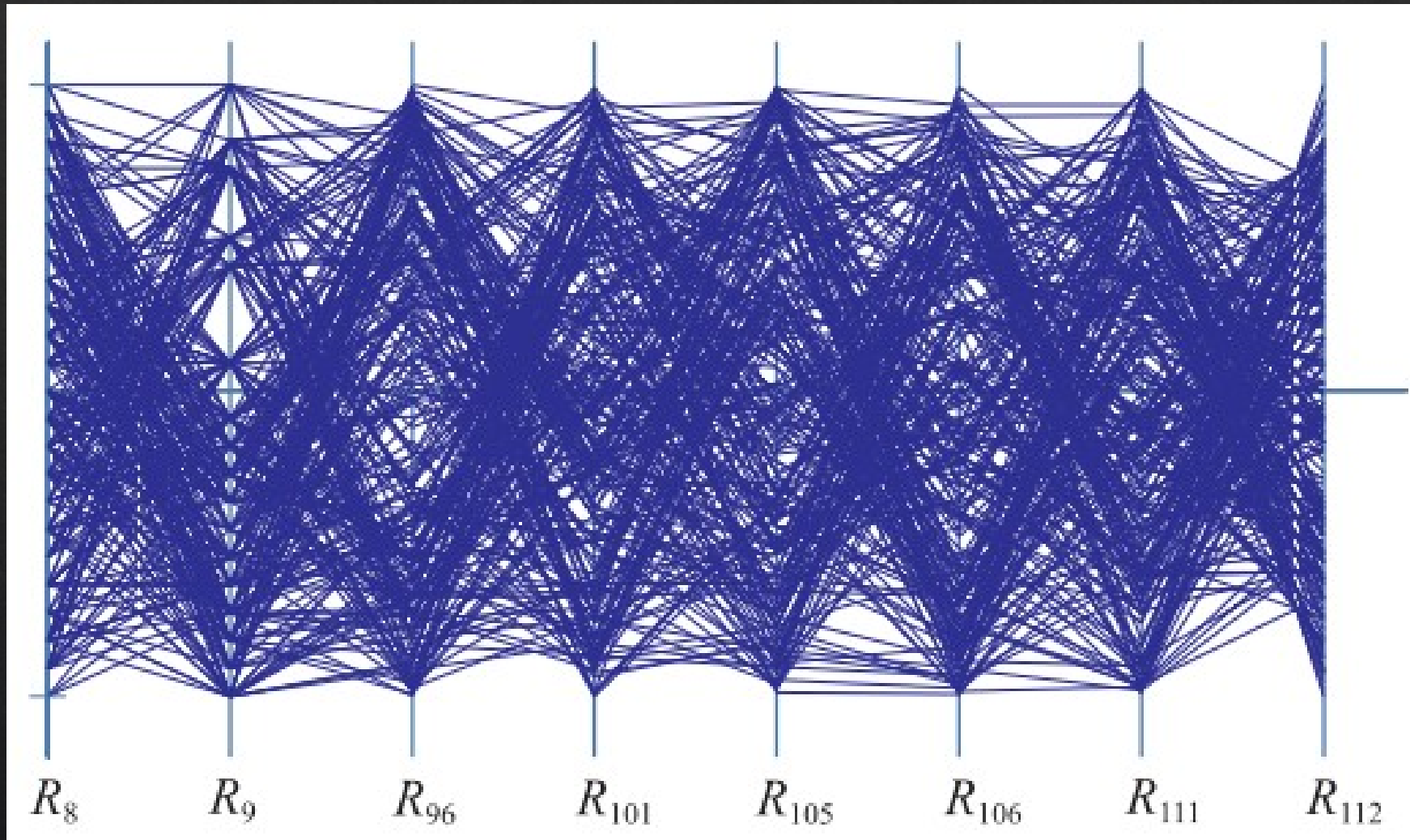
$$\begin{aligned}y &= -x + 3 \\m &= -1 \\b &= 3\end{aligned}$$



$$\left( \frac{d}{1-m}, \frac{b}{1-m} \right)$$



# Parallel Coordinates: Industry Example



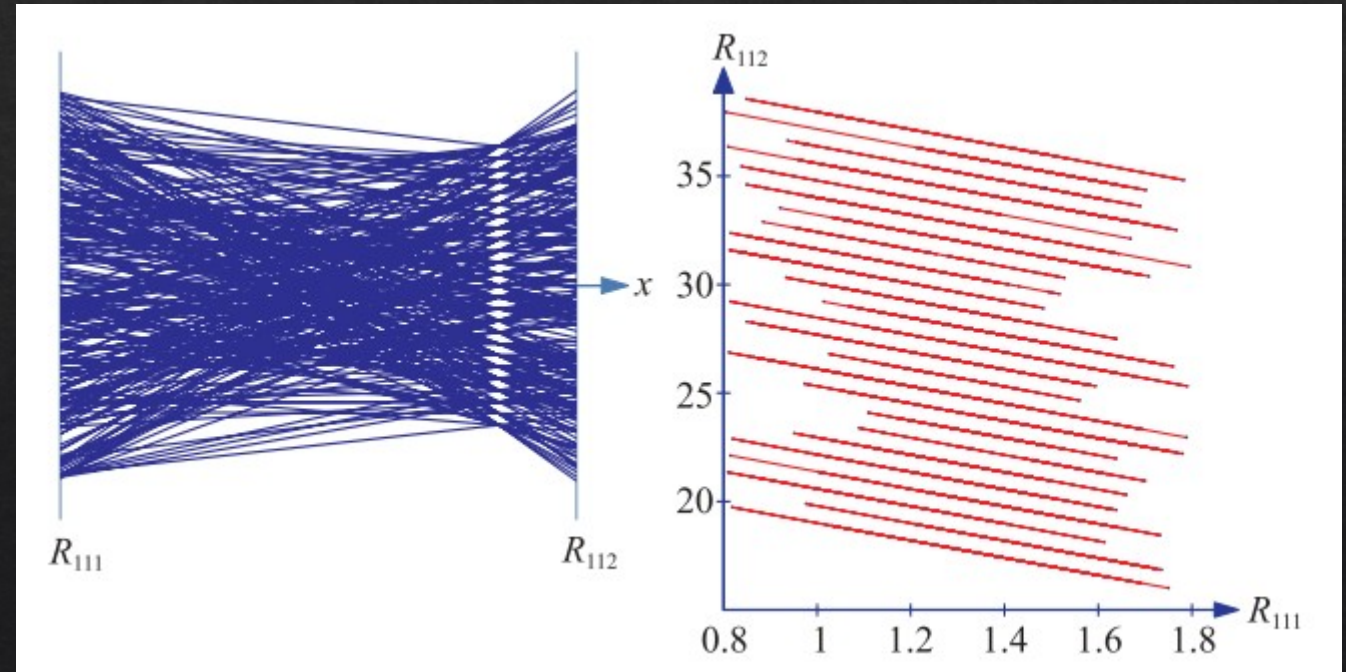
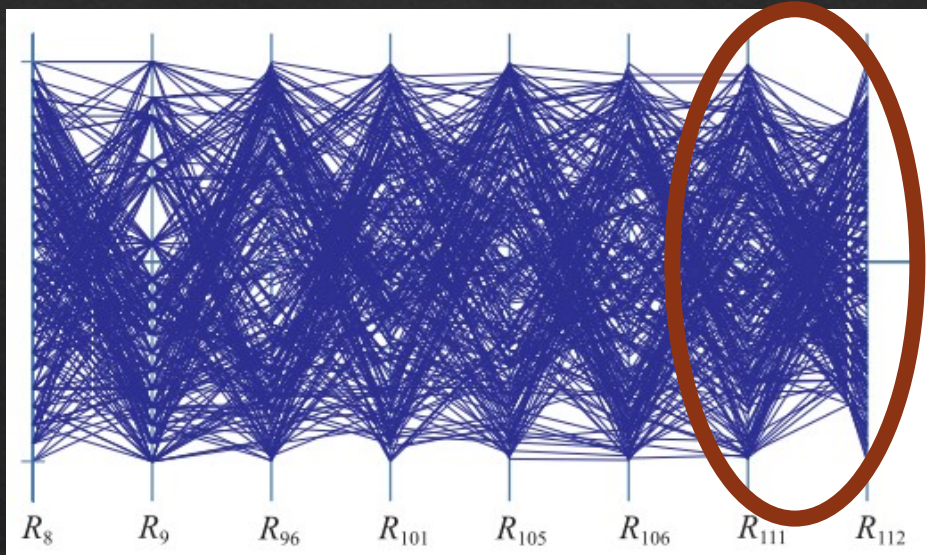
## Top Hat Q3.3:

### Can **Parallel Coordinate** Handle BigData?

- A. Lots of data → lots of lines → nothing visible
- B. Dimensions are parallel → never run out of space!
- C. Pattern – if visible – is only between the adjacent dimensions
- D. All the above are true

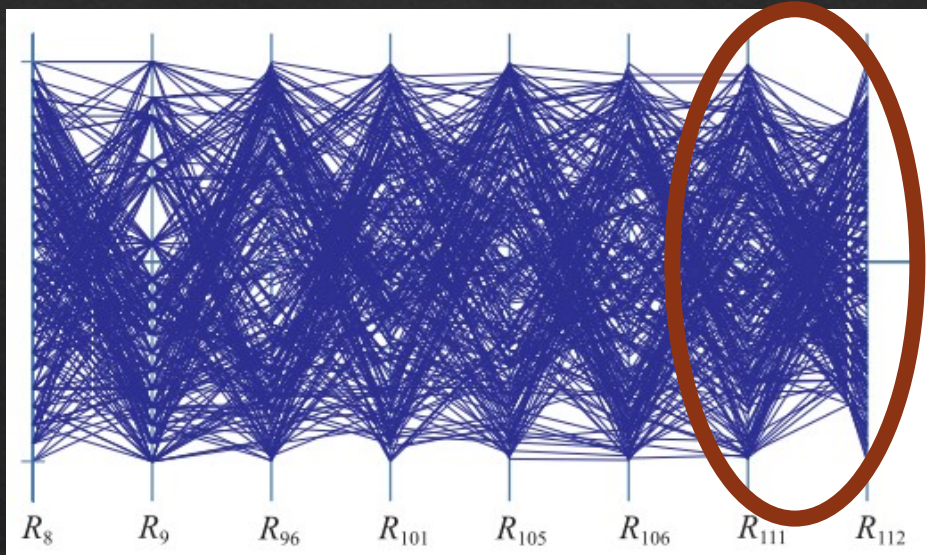


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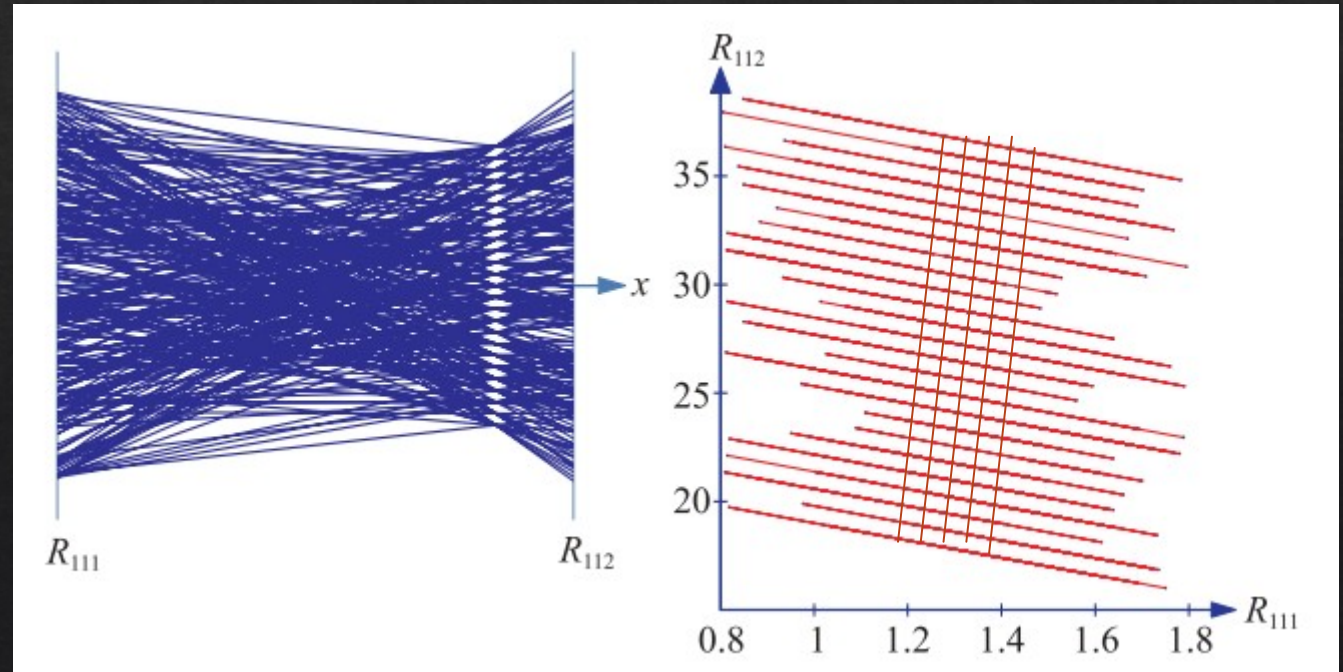




# Parallel Coordinates: Industry Example



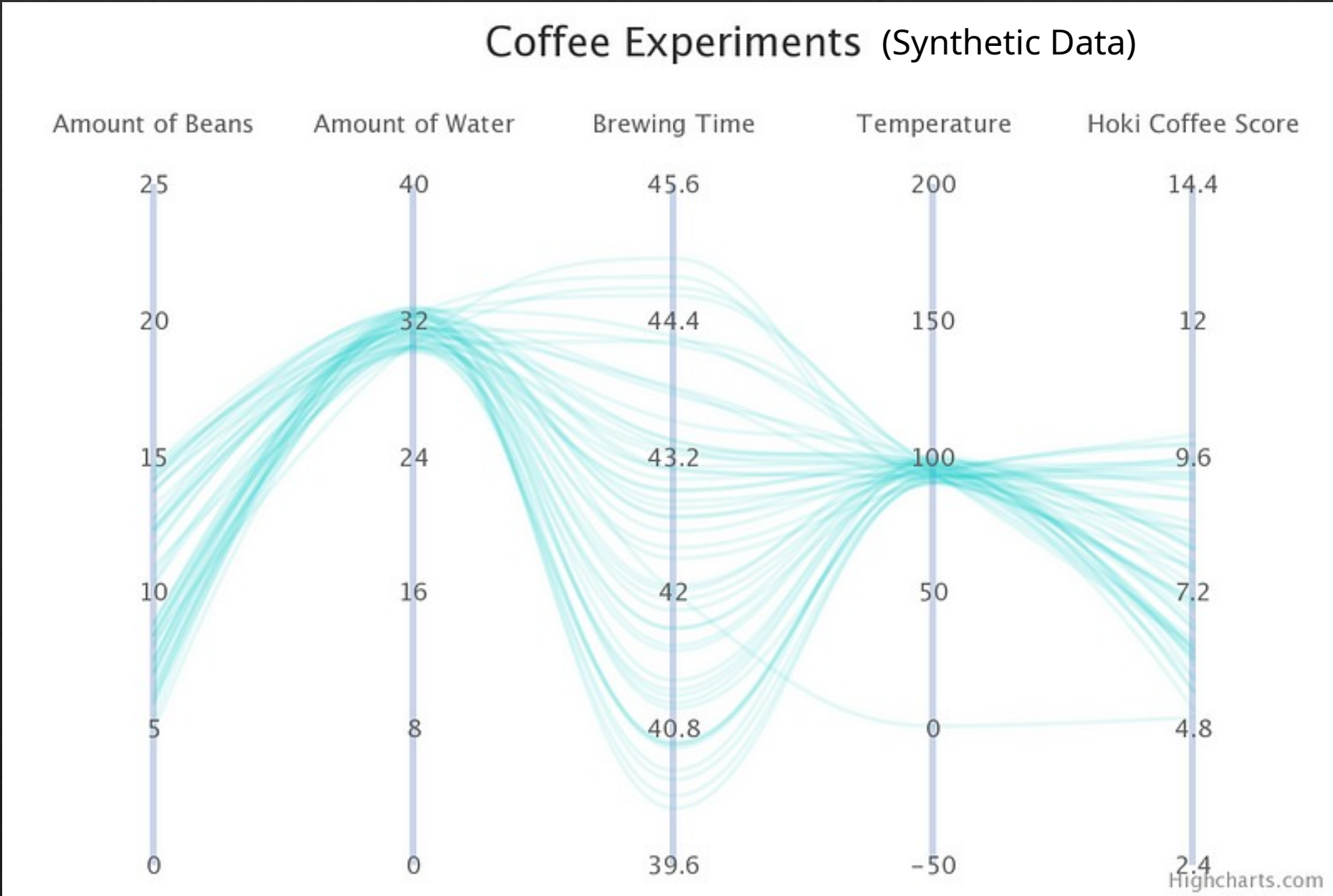
Is there a missing parameter?



Class Activity:

Can you find any useful information from this plot?

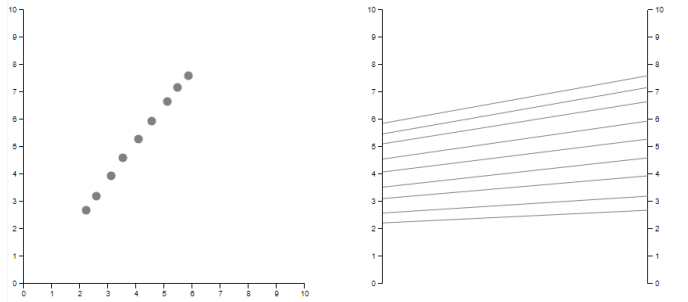
- If so, please write it down.
- If not, how could you improve the plot?



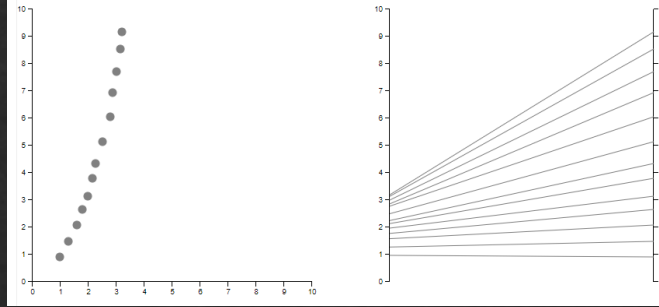


# Scale Matters

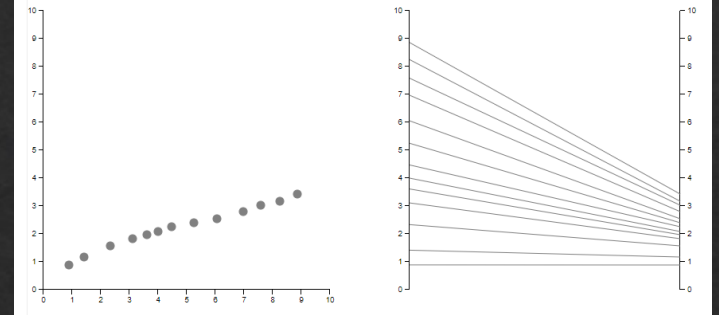
Point-Line Duality in Parallel Coordinates



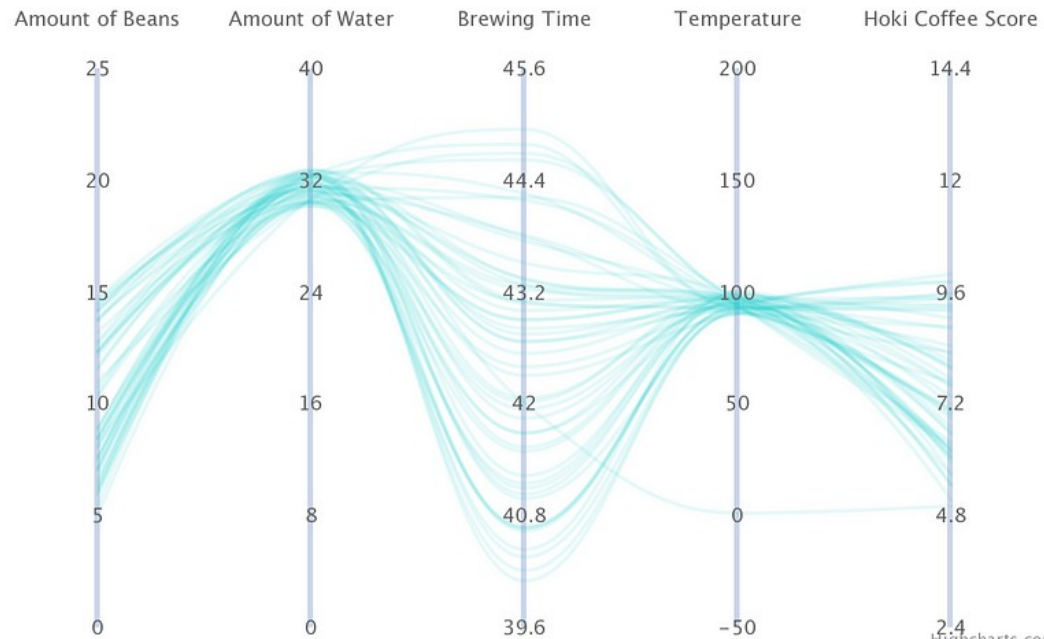
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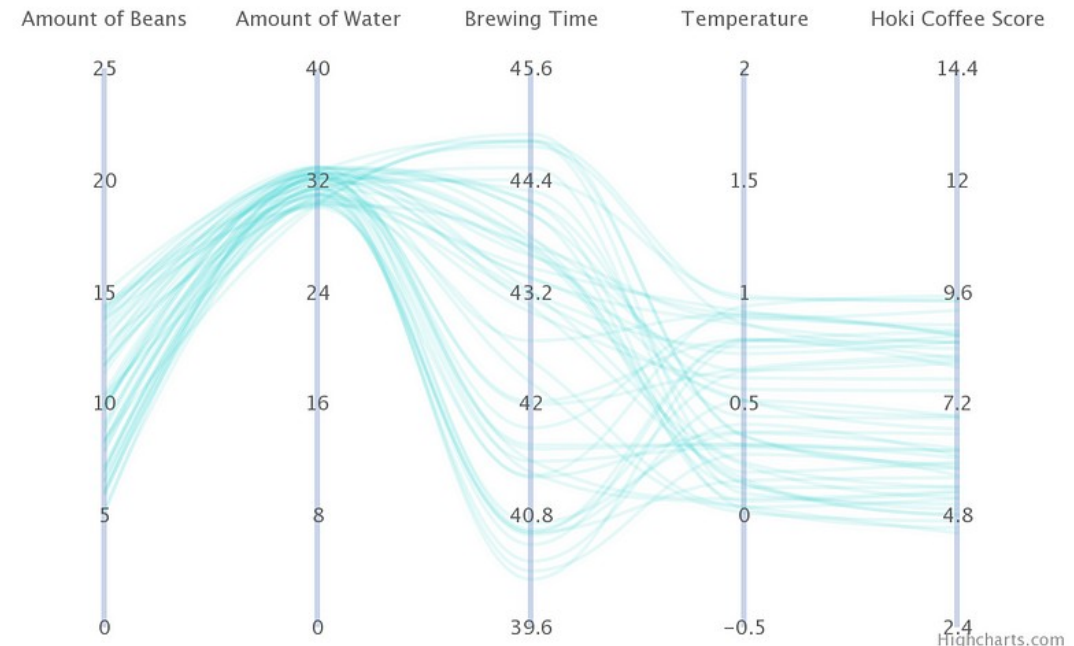
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Coffee Experiments (Synthetic Data)

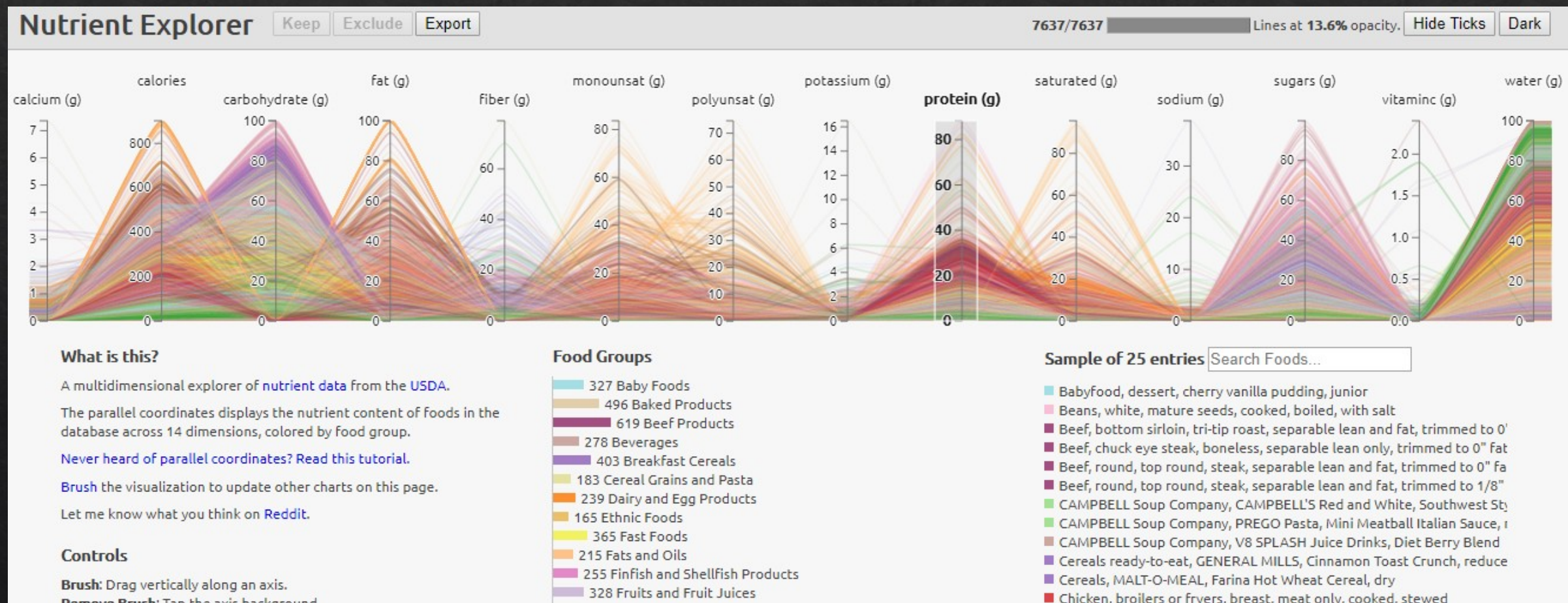


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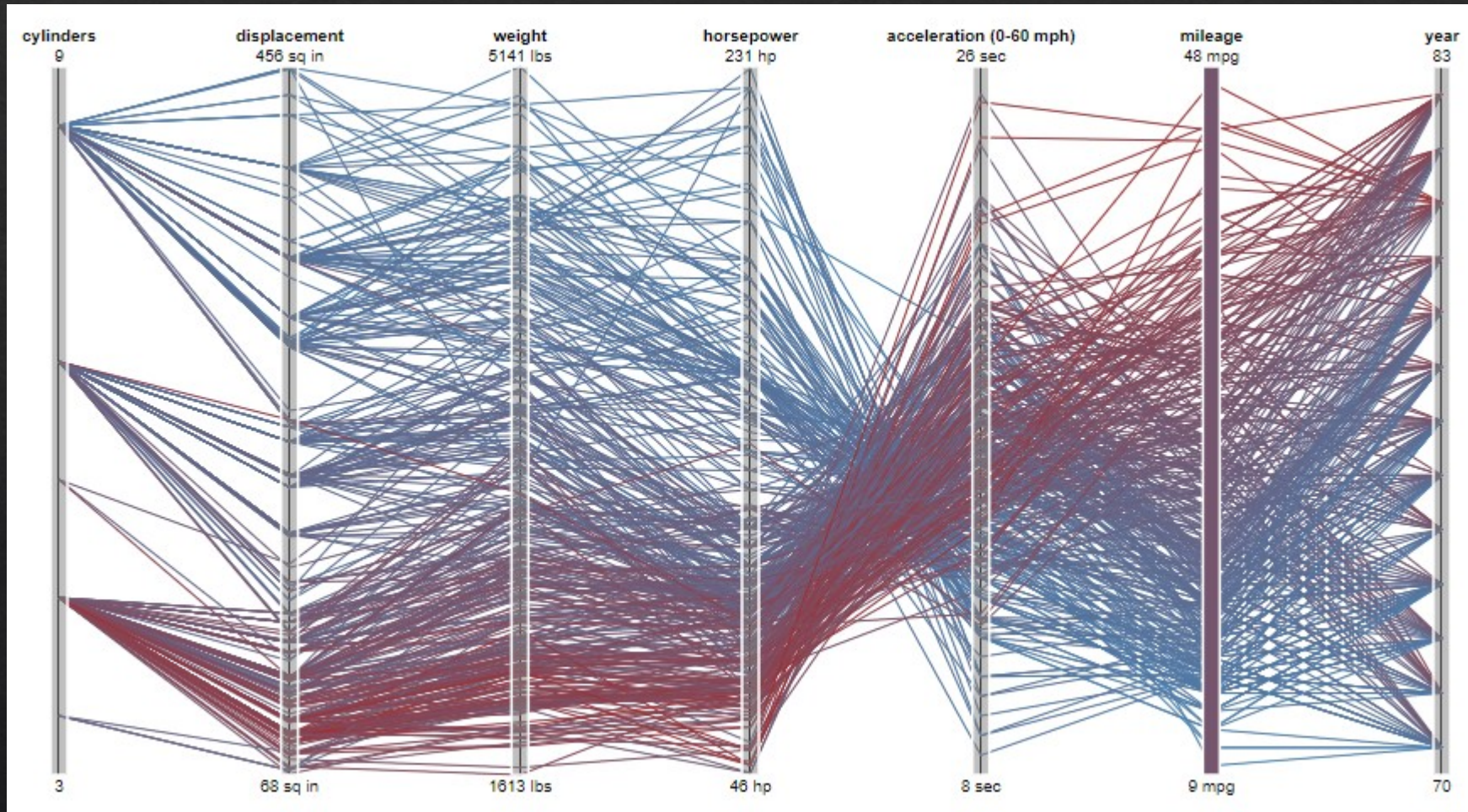
# Interaction: Brushing & Sliding

<https://gist.github.com/syntagmatic/c9fb69e425a3c07cfbd09169941fbf46>





# Interaction: Brushing & Sliding



<http://mbostock.github.io/protovis/ex/cars.html>



# Limitations

Lots of over-plotting can make it impossible to read

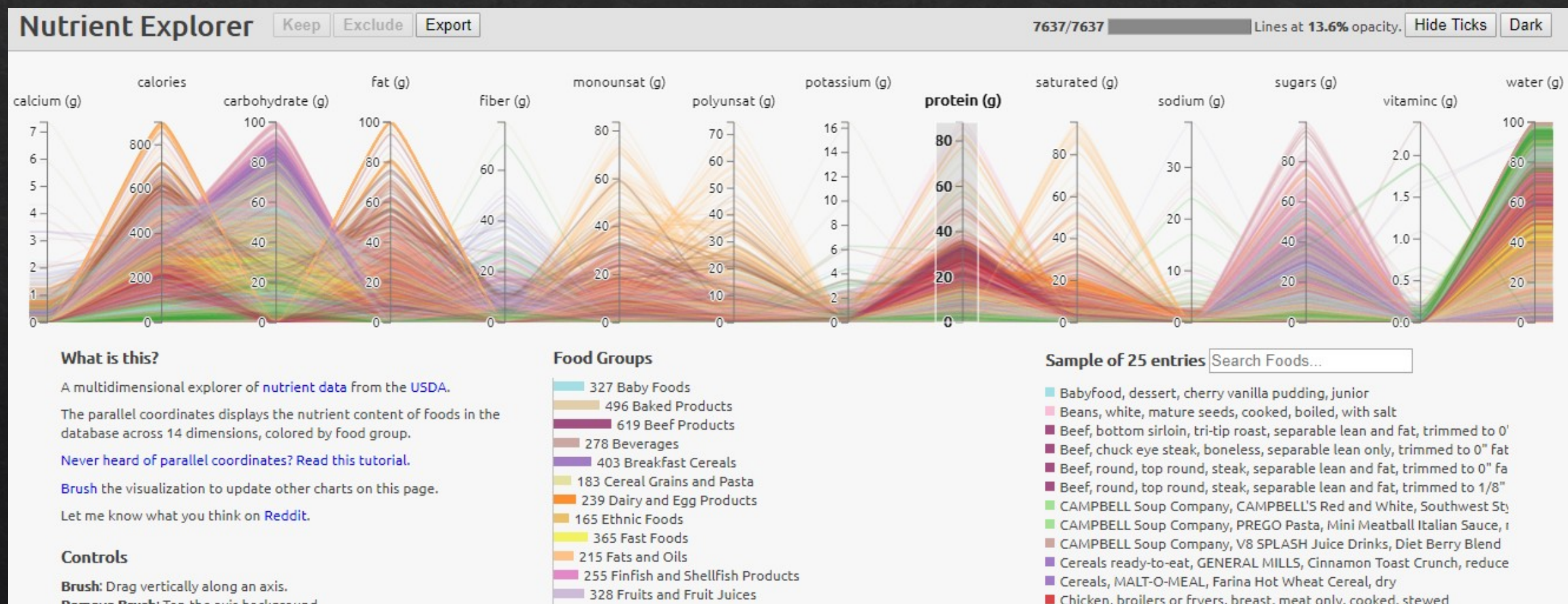
Number of dimensions on screen also needs to be below about a dozen

A few thousand records.

The data needs to be numerical.

# Example: Nutrient Explorer

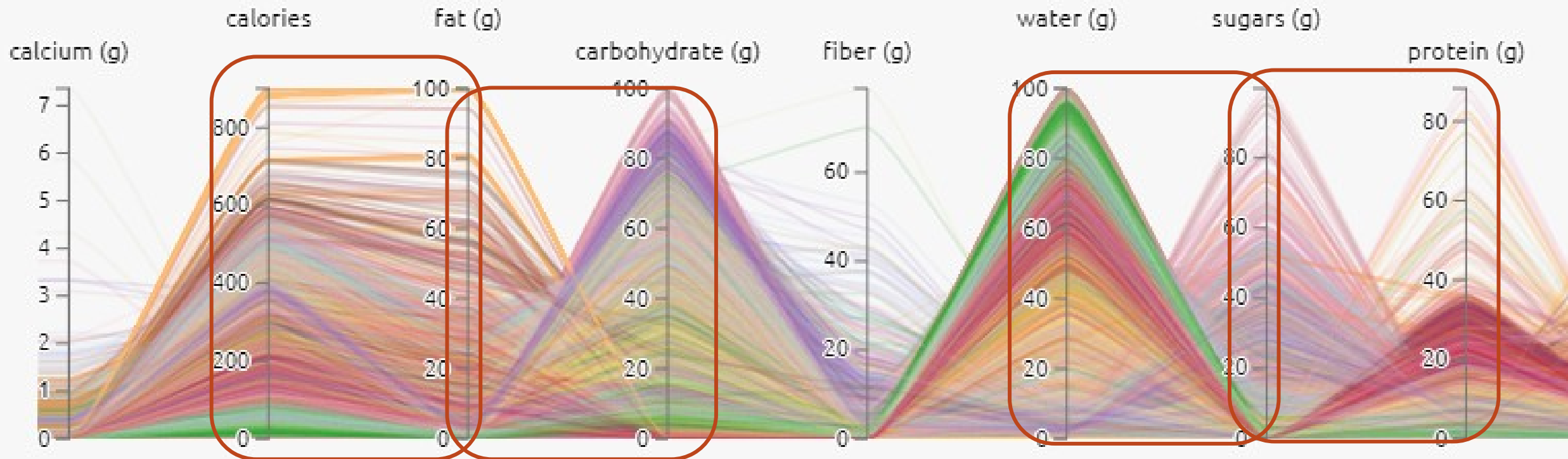
<https://gist.github.com/syntagmatic/c9fb69e425a3c07cfbd09169941fbf46>





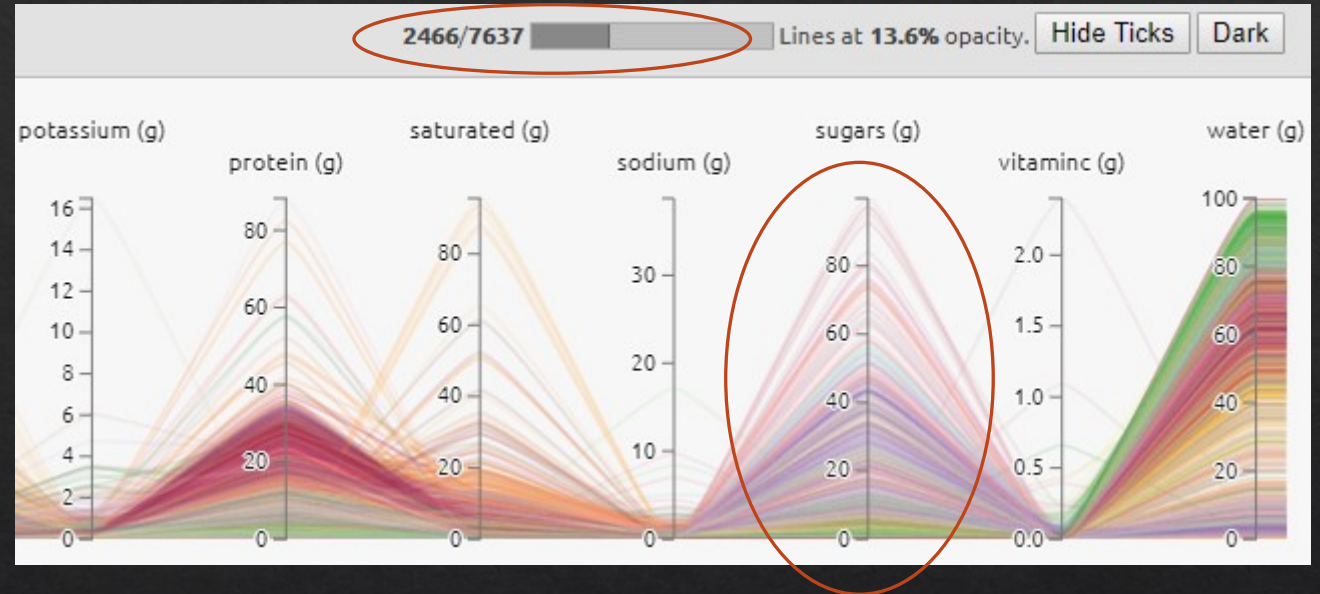
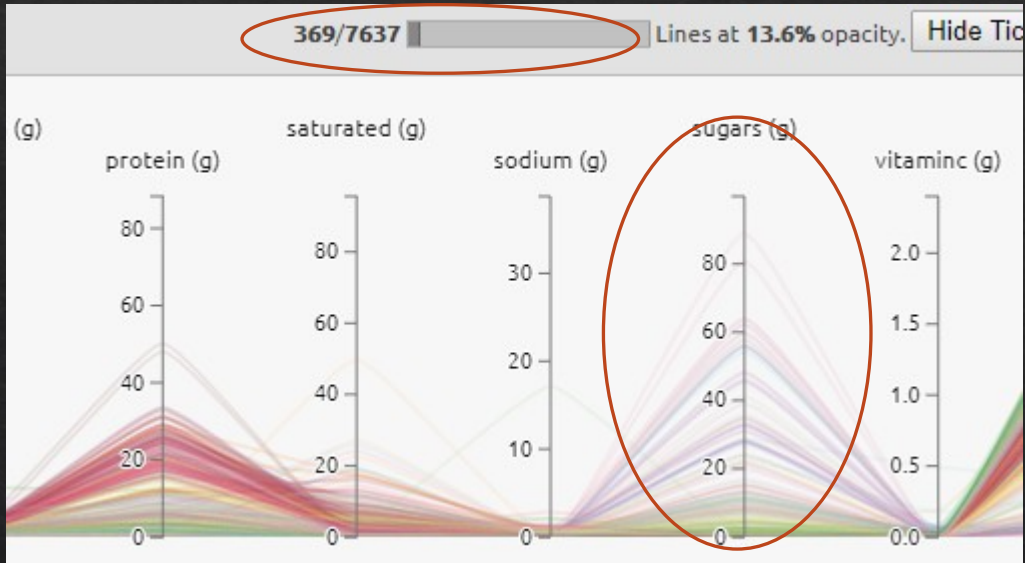
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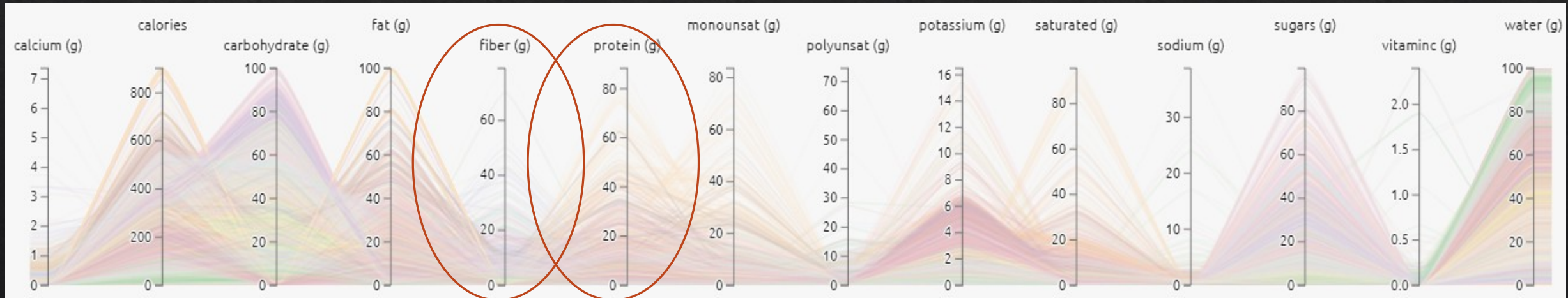
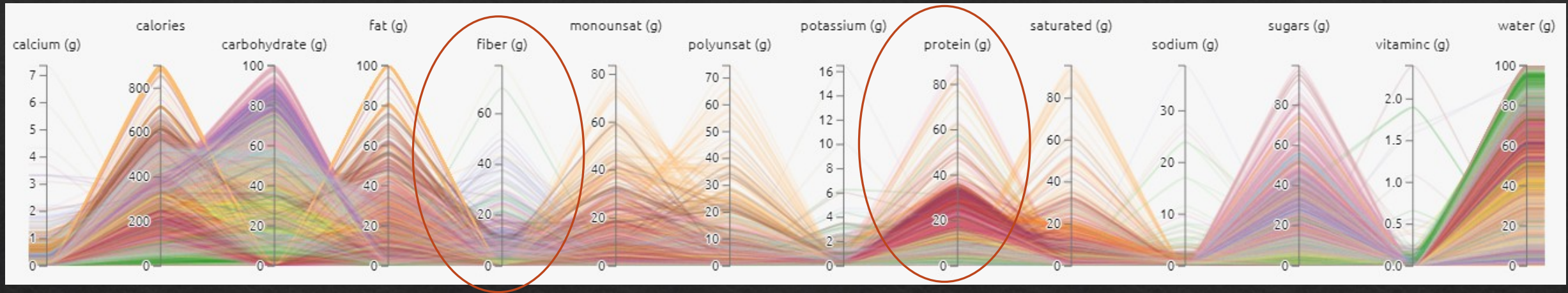


# Progressive Rendering



- Gives the user value
- Overkill if the dataset is small

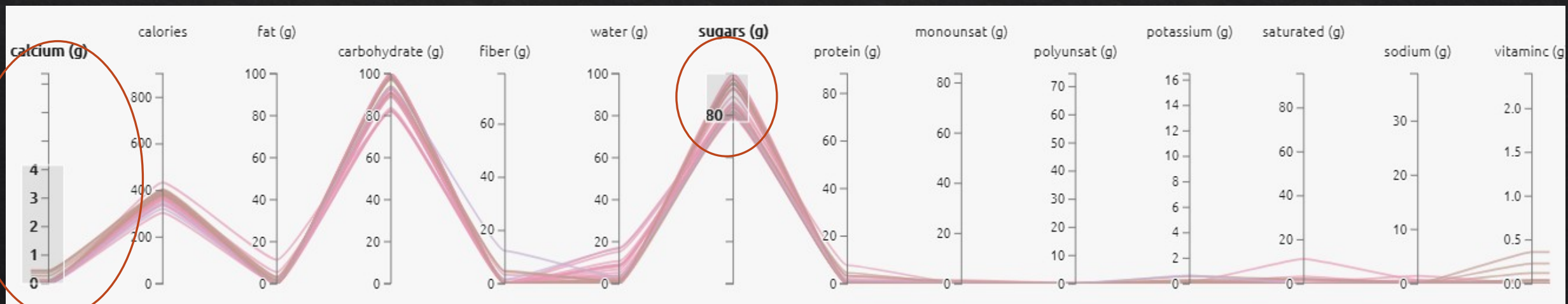
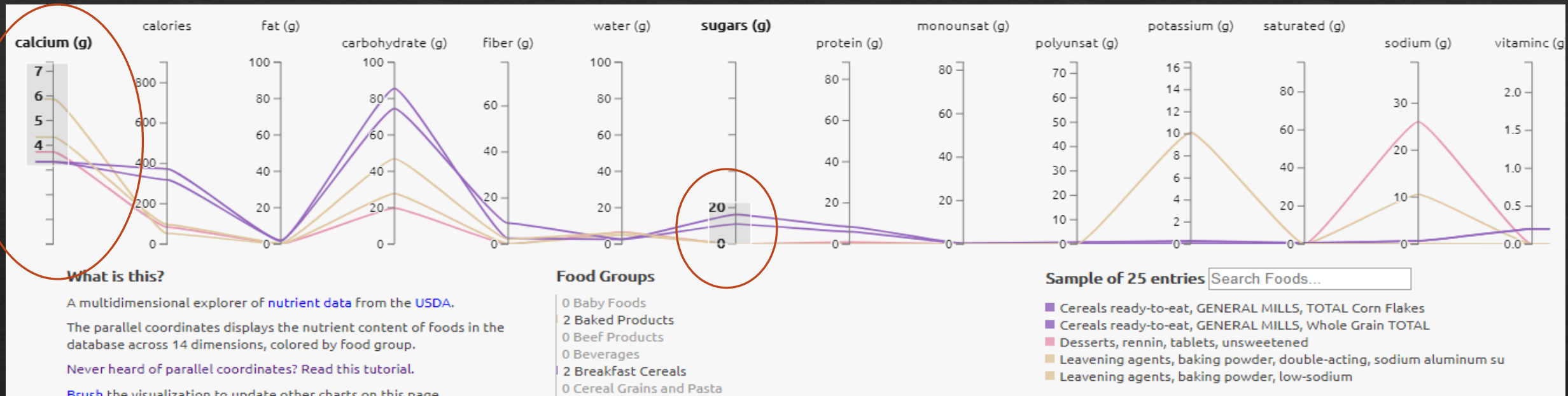
# Interaction: Dragging Dimensions



- Very Useful for Analyzing pairs of parameters

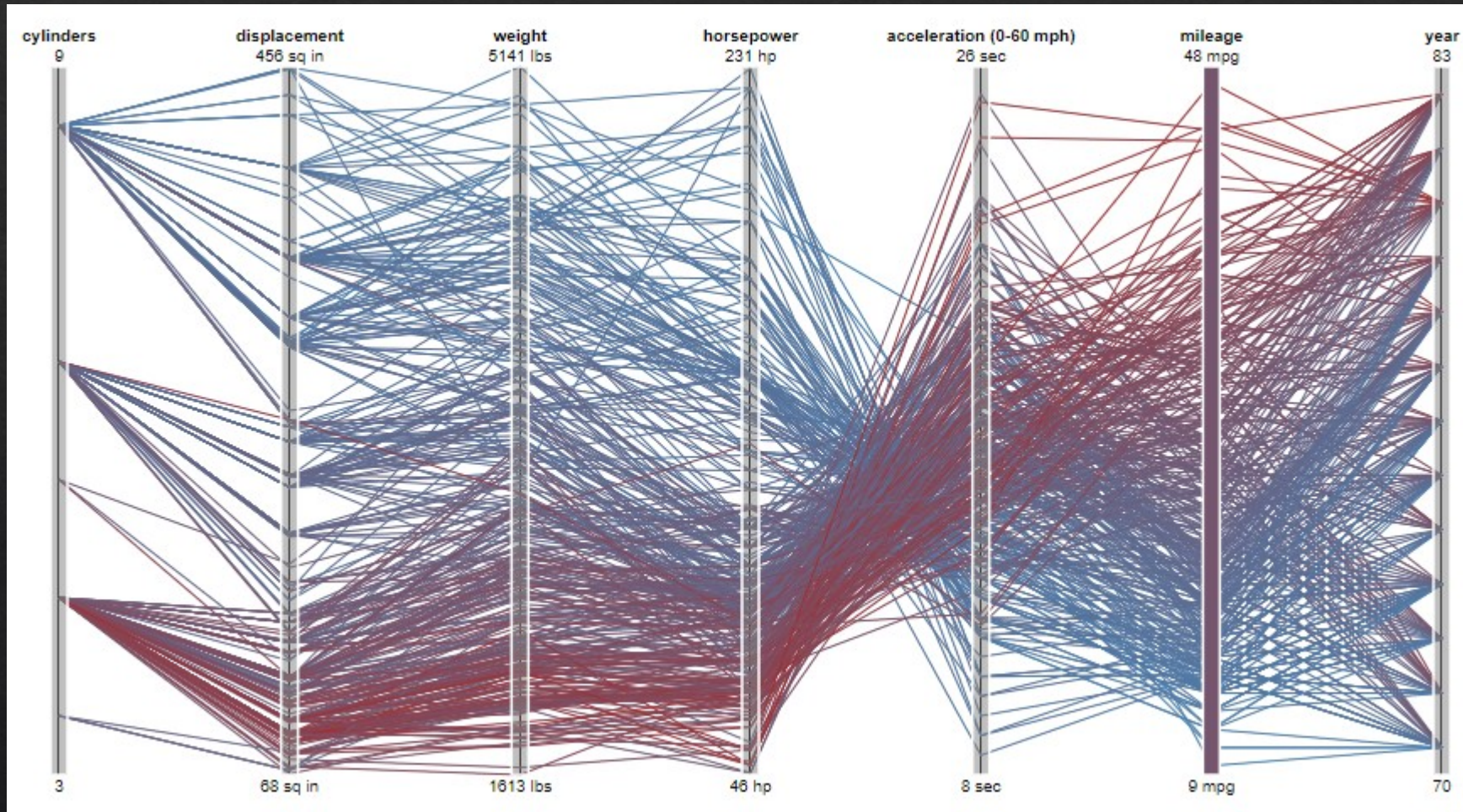


# Interaction: Brushing & Sliding





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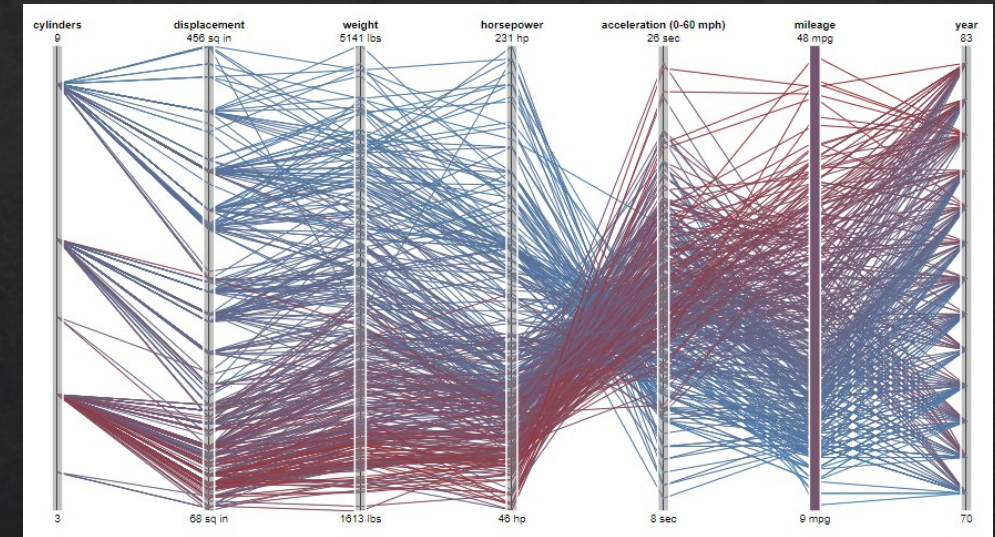
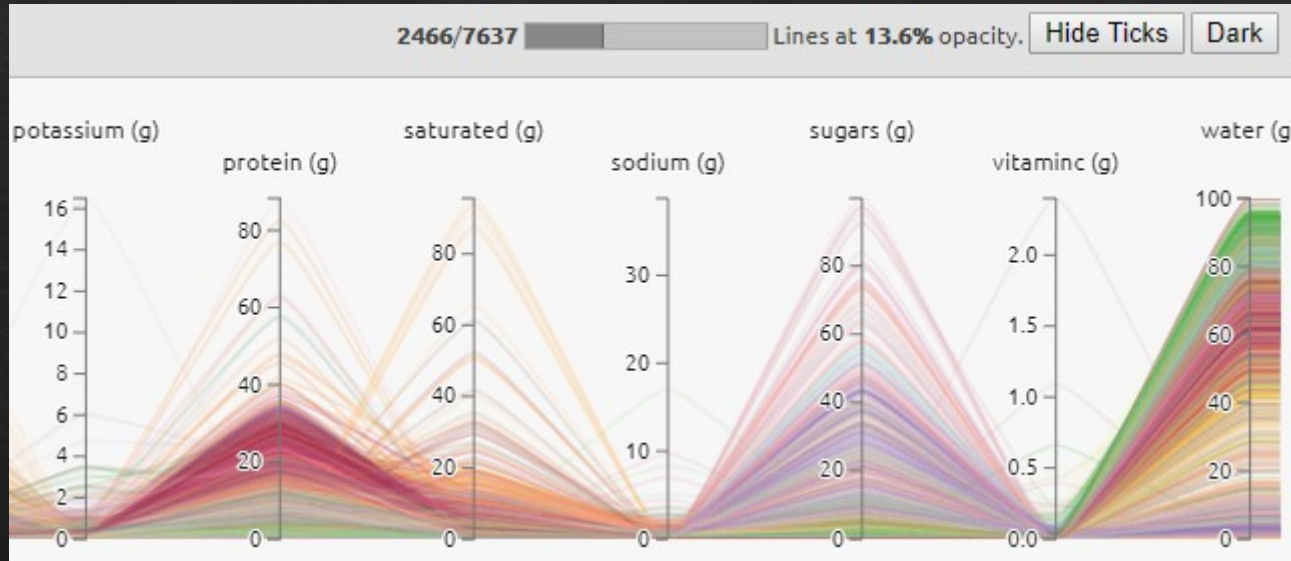


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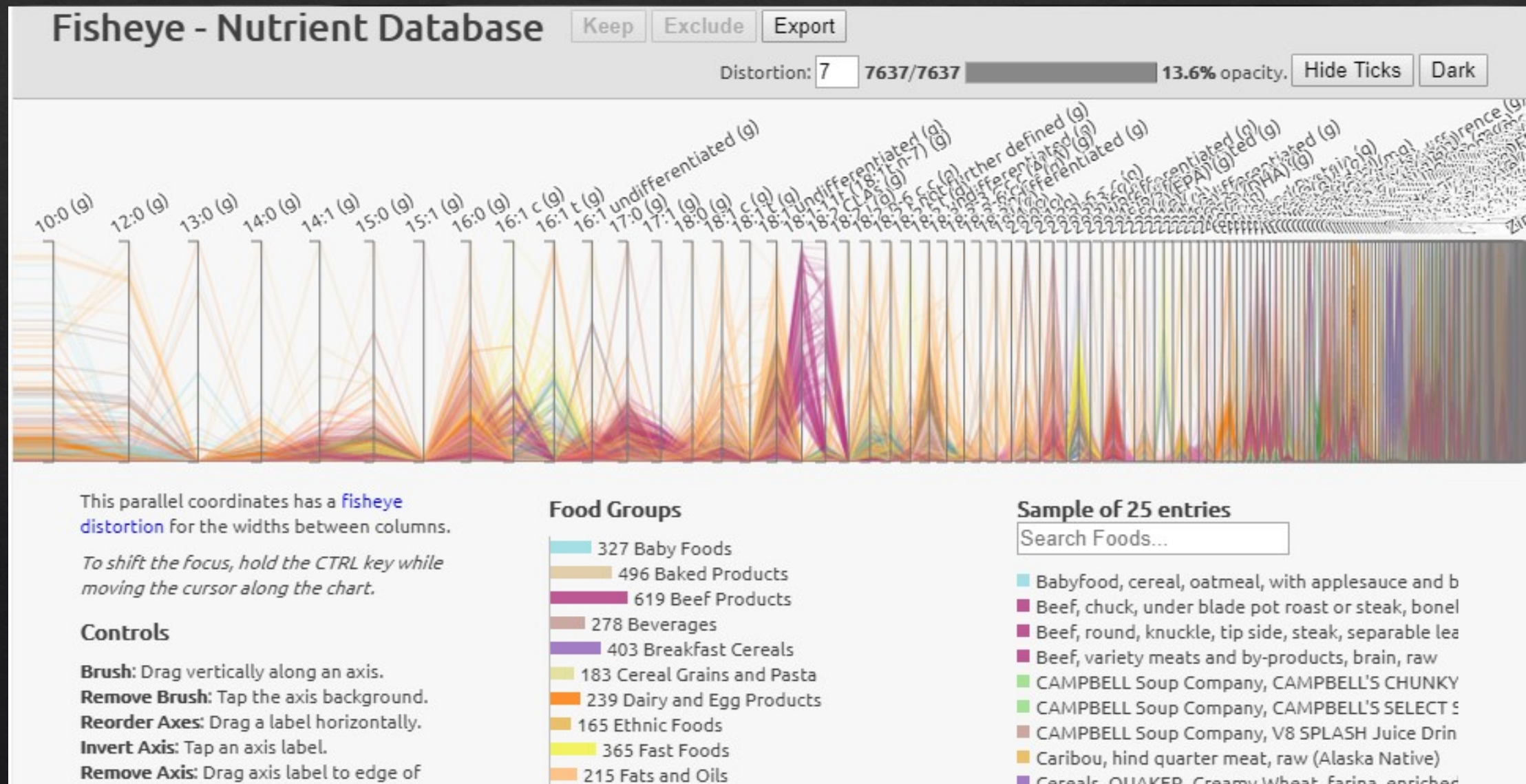


# Curve vs Straight-Line

## Which one you like? Why?



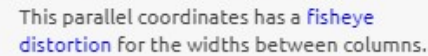
# Fisheye Interaction







Distortion:	7	7637/7637	<div></div>	13.6% opacity.	Hide Ticks	Dark
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### Controls

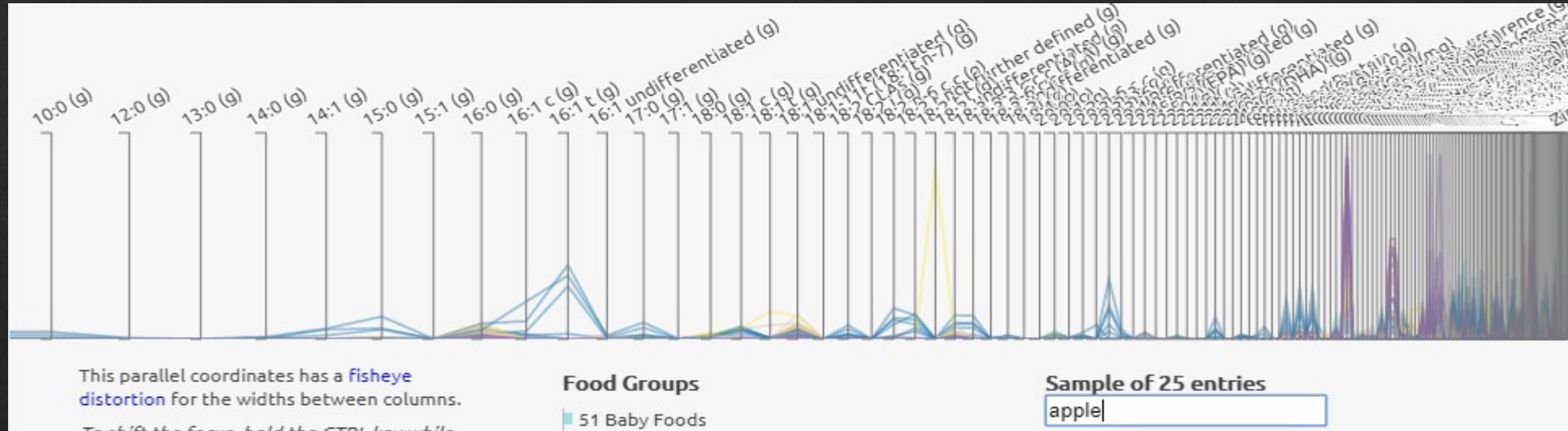
**Remove Axis:** Drag axis label to edge of

327	Baby Foods
496	Baked Products
619	Beef Products
278	Beverages
403	Breakfast Cereals
183	Cereal Grains and Pasta
239	Dairy and Egg Products
165	Ethnic Foods
365	Fast Foods
215	Fats and Oils

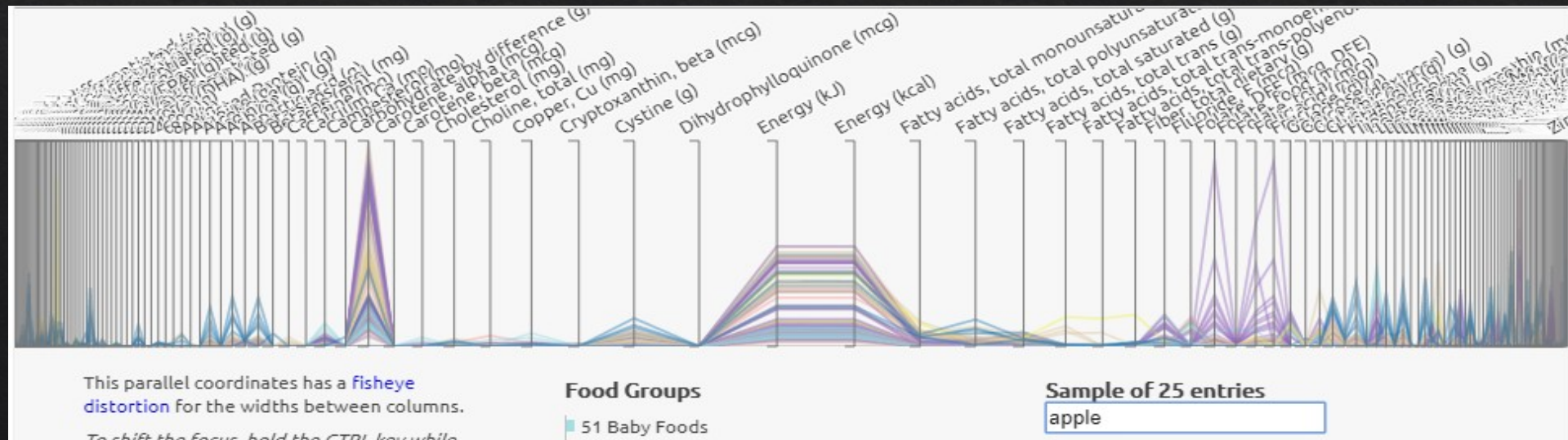
 Search Foods...

- Babyfood, cereal, oatmeal, with applesauce and b
- Beef, chuck, under blade pot roast or steak, bonel
- Beef, round, knuckle, tip side, steak, separable lea
- Beef, variety meats and by-products, brain, raw
- CAMPBELL Soup Company, CAMPBELL'S CHUNKY
- CAMPBELL Soup Company, CAMPBELL'S SELECT 5
- CAMPBELL Soup Company, V8 SPLASH Juice Drin
- Caribou, hind quarter meat, raw (Alaska Native)
- Cereals, QUAKER Creamy Wheat farina, enriched

# Fisheye Interaction







# Limitations

Lots of **over-plotting** can make it impossible to read

Number of **dimensions** on screen also needs to be **below about a dozen**

A **few thousand** records.

The data needs to be **numerical**.