



## Parallel Coordinates

### Recap & Voluntary User Study

My name, research group, one of my research topics: parallel coordinates.  
Currently working on a paper about cluster identification in parallel coordinates.

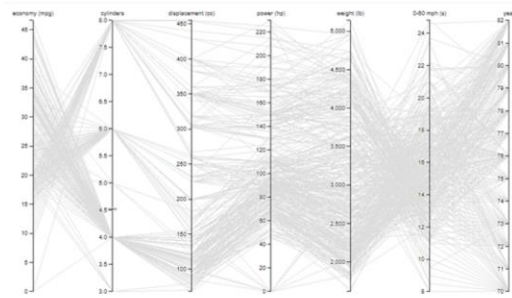
Today:

- Recap on parallel coordinates, comparison with scatter plots, and enhancements.
- Voluntary user study: good preparation for exam and supporting our research AND chocolate.

# Parallel Coordinates

	A	B	C	D	E	F	G	H
1	name	economy (mpg)	cylinders	displacement (in)	power (hp)	weight (lb)	0-60 mph (s)	year
2	AMC Ambassador Brougham	15	8	360	175	3620	15	75
3	AMC Ambassador DPL	15	8	360	190	3850	8.5	76
4	AMC Ambassador SST	17	8	360	150	3670	11.5	72
5	AMC Concord DL 8	26.2	8	252	90	3200	18.7	79
6	AMC Concord DL 8	18.1	8	258	120	3450	15.1	76
7	AMC Concord DL 8	20	8	252	90	3000	20.5	82
8	AMC Concord	19.4	8	252	90	3200	17.2	78
9	AMC Concord	16.4	8	252	90	3000	20.1	80
10	AMC Gremlin	19	8	252	100	2780	15	73
11	AMC Gremlin	19	8	252	100	2640	13	71
12	AMC Gremlin	20	8	252	100	2914	18	75
13	AMC Gremlin	21	8	198	90	2460	13	76
14	AMC Hornet Sportabout (Wagon)	18	8	258	130	2960	13.5	71
15	AMC Hornet	18	8	199	97	2796	15.5	70
16	AMC Hornet	18	8	252	100	2960	16	73
17	AMC Hornet	19	8	252	100	2960	18	76
18	AMC Hornet	22.5	6	252	90	3000	17.6	76
19	AMC Matador (Wagon)	14	8	304	150	4207	15.5	76
20	AMC Matador (Wagon)	15	8	304	150	4000	12.5	72
21	AMC Matador	14	8	304	150	3870	11.7	73
22	AMC Matador	15	8	258	135	3700	19	75
23	AMC Matador	15.5	8	304	120	3960	13.9	76
24	AMC Matador	18	6	258	120	3600	18	76
25	AMC Matador	18	6	252	100	3280	15.5	71
26	AMC Pacer DL	17.5	8	258	95	3100	17.8	76
27	AMC Pacer	19	8	252	90	3100	17	75
28	AMC Rebel SST (Wagon)	18	8	300	175	3800	11	70
29	AMC Rebel SST	18	8	300	150	3600	12	70
30	AMC Spirit DL	27.4	4	121	60	2670	10	79
31	Audi 100 LS	20	8	134	91	2380	14	75

cars dataset (about 400 rows)



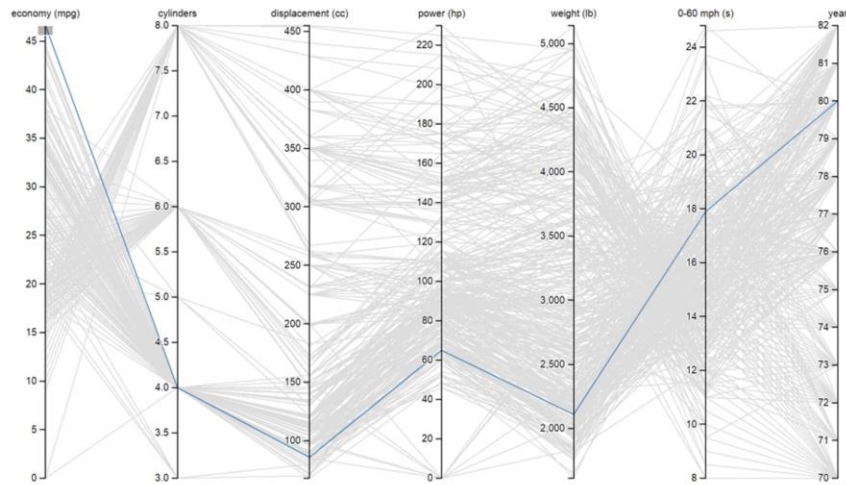
<https://bl.ocks.org/jasondavies/1341281>

[The students already worked with PCPs a couple of weeks before this session]  
Open question to audience: what are parallel coordinates and why should we use them?

Some important aspects:

- Every dimension (column in the left dataset) is represented by a single dimension
- Data records (row in the table) are represented by polylines, connecting the values on each dimension
- Individual scaling on every dimension possible
- One of the most popular techniques for multi- and high-dimensional data
- Advantage: we can trace records and patterns across a large number of dimensions

## Parallel Coordinates



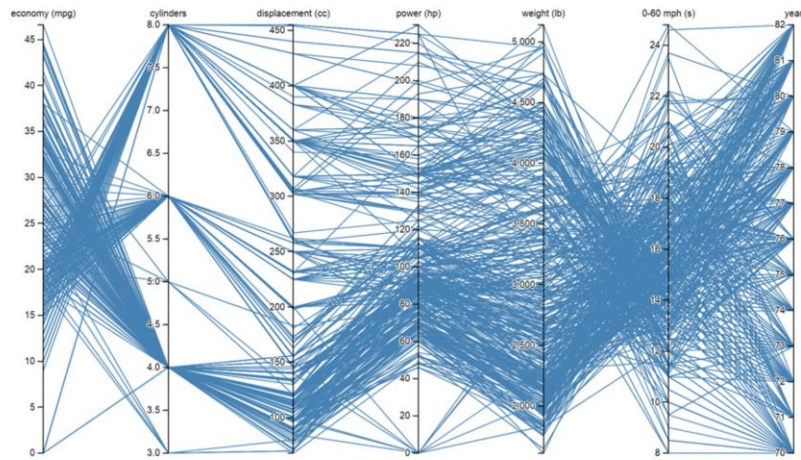
<https://bl.ocks.org/jasondavies/1341281>

Example of a single data record.

Discuss the type of car what we can see: high mpg, 4 cylinders, ...

What type of car could that be?

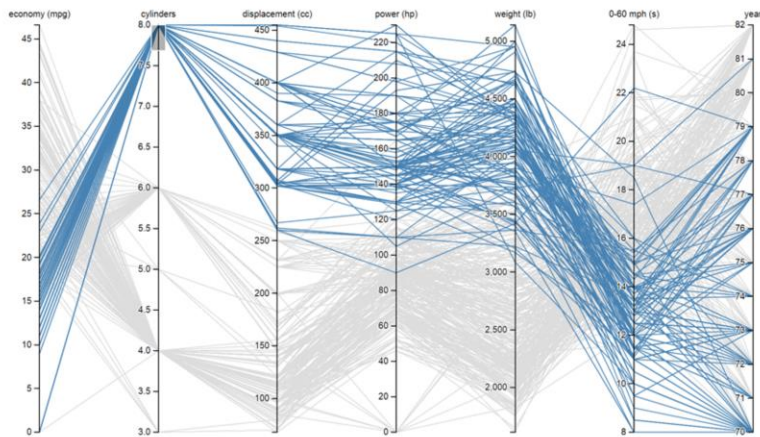
## Parallel Coordinates



<https://bl.ocks.org/jasondavies/1341281>

Here now a PCP with all cars.  
Which relations can we see?

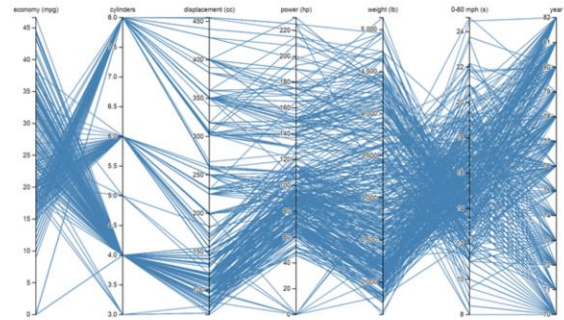
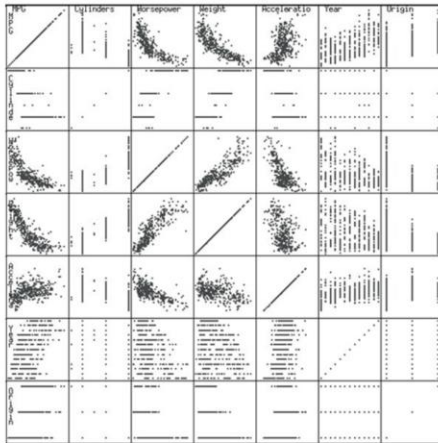
## Parallel Coordinates



<https://bl.ocks.org/jasondavies/1341281>

Parallel coordinates can support many different interaction techniques.  
Which concepts do you remember from the previous lecture?  
Examples: brushing (see example), changing axes ordering, removing outliers, ...

## Parallel Coordinates vs. Scatter Plot Matrix (SPLOM)



[https://images.slideplayer.com/3/794861/slides/slide\\_14.jpg](https://images.slideplayer.com/3/794861/slides/slide_14.jpg)  
<https://bl.ocks.org/jasondavies/1341281>

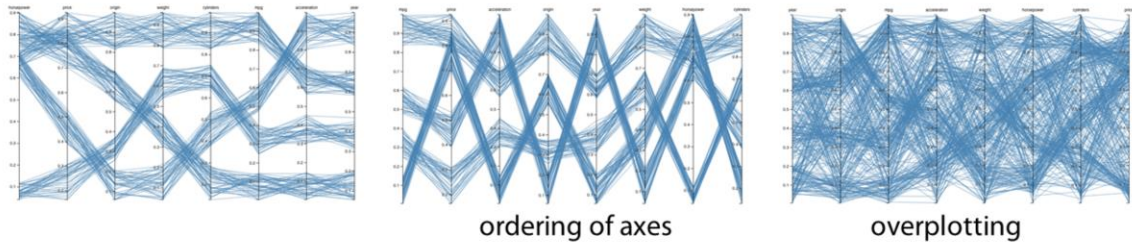
What is the main advantage of PCP compared to a scatter plot matrix?

-> We can compare more than two dimensions.

Advantages of SPLOM compared to PCP?

-> Often easier to understand for non-vis experts and less cluttered.

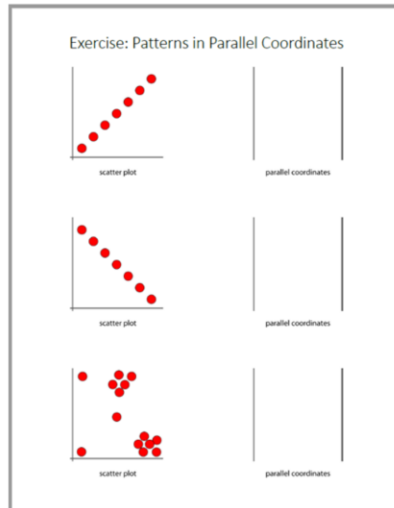
## Challenges in Parallel Coordinates



What are the main challenges when visualizing data with parallel coordinates

- Axes arrangement: both figures show the same dataset, but with a different ordering of the dimensions.
- Overplotting due to noise/clutter. Many lines are crossing and are on top of each other. It is more difficult to spot patterns in the data.

## Patterns in Parallel Coordinates

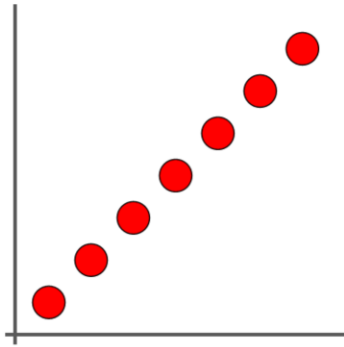


Exercise for the next 10 Minutes.

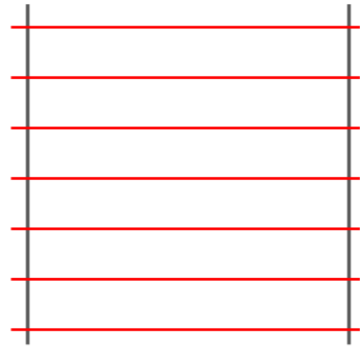
For each pattern in the scatter plot on the right, please draw the corresponding pattern in the parallel coordinates plot.



## Positive Correlation



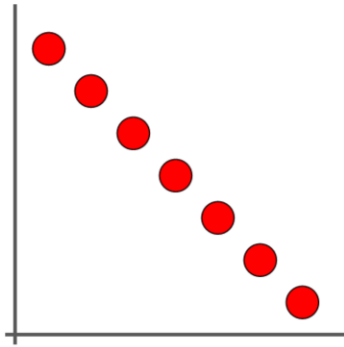
scatter plot



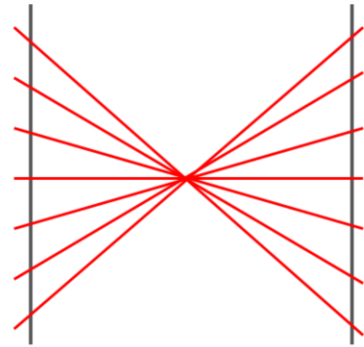
parallel coordinates

Solution: discuss results.

## Negative Correlation



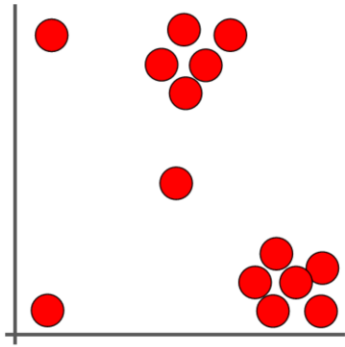
scatter plot



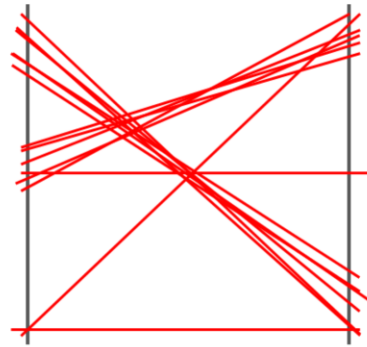
parallel coordinates

Solution: discuss results.

## Outlier, Noise and Clusters



scatter plot



parallel coordinates

Solution: discuss results.

## User Study: Identify Clusters in Parallel Coordinates

### Advantages of participation

- Chocolate ☺
- Practice for exam
- Support our research

We now invite everybody to participate in our user study.

Please use your own laptop

Topic: identify clusters in parallel coordinates

Estimated time for study: 30 minutes

Participation is voluntary. Everybody who does not like to participate is now allowed to leave the room.

Advantages of participation: chocolate, practice for exam, support our research (you would do me a huge favor)

We scatter the students across the room so that they are not able to talk to each other

Everybody receives the data protection form and need to read and sign it.

## Training

<http://subspace.dbvis.de/training>

- Browser: Chrome, Firefox, Safari
- Full screen (Windows: F11; Mac: Fn+F11)
- Screen size (parallel coordinates should be on one page)

We start with a training first

Please open the website with a browser of your choice

Full screen

Is everything displayed on your screen without scrolling? If not, please use the zoom feature of your browser

Please go through the tasks and let us know, if you encounter any questions or comments.

## Study

<http://subspace.dbvis.de/pcp>

- Full screen (Windows: F11; Mac: Fn+F11)
- Answer the questions to the best of your knowledge
  - no right or wrong answers
  - use your definition of a cluster
  - focus on accuracy

After all remaining questions have been answered: we start the study.  
We ensure that everybody is using full screen and that no scrolling is necessary.