

Learning Visualizations by Analogy

Promoting Visual Literacy through Visualization Morphing

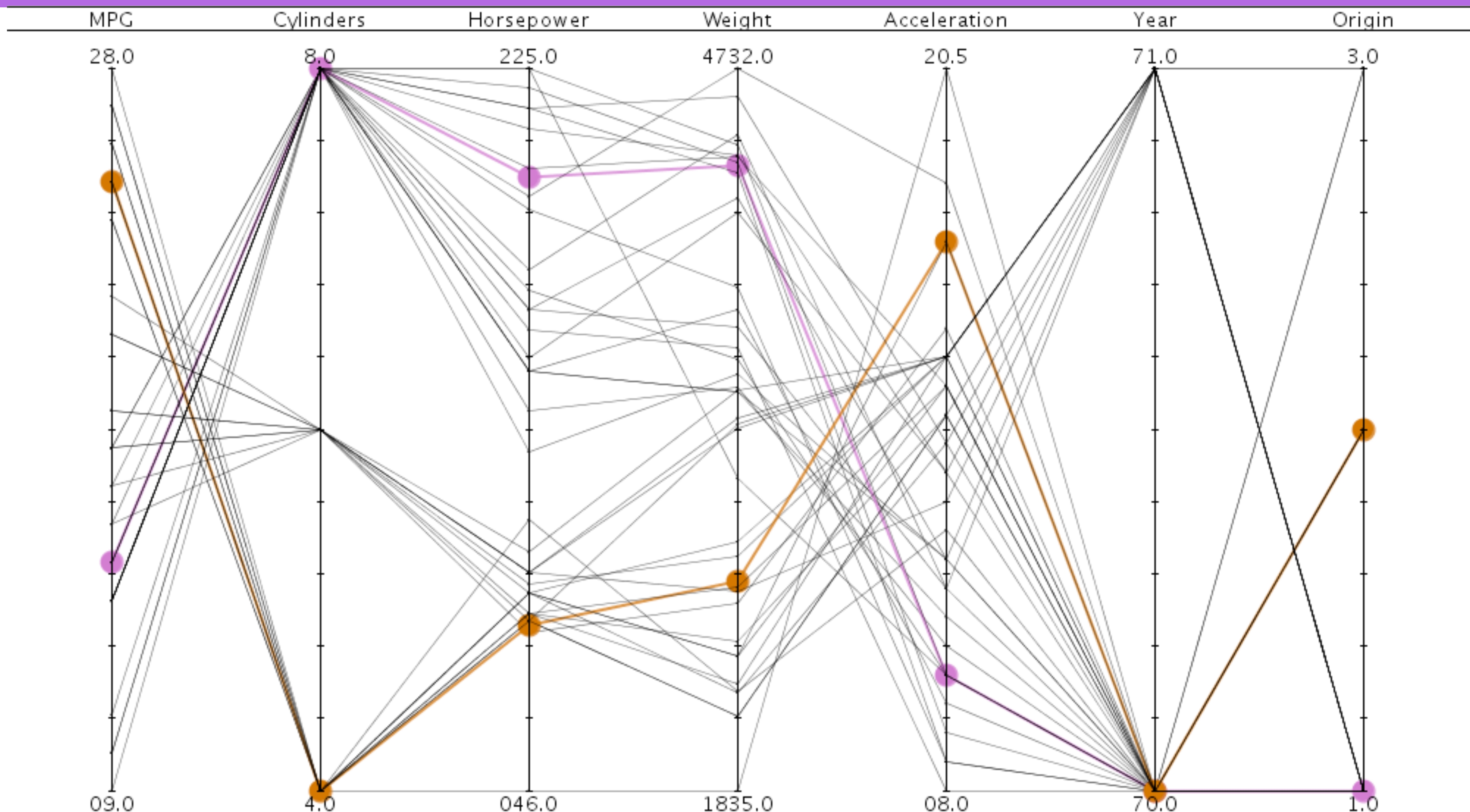
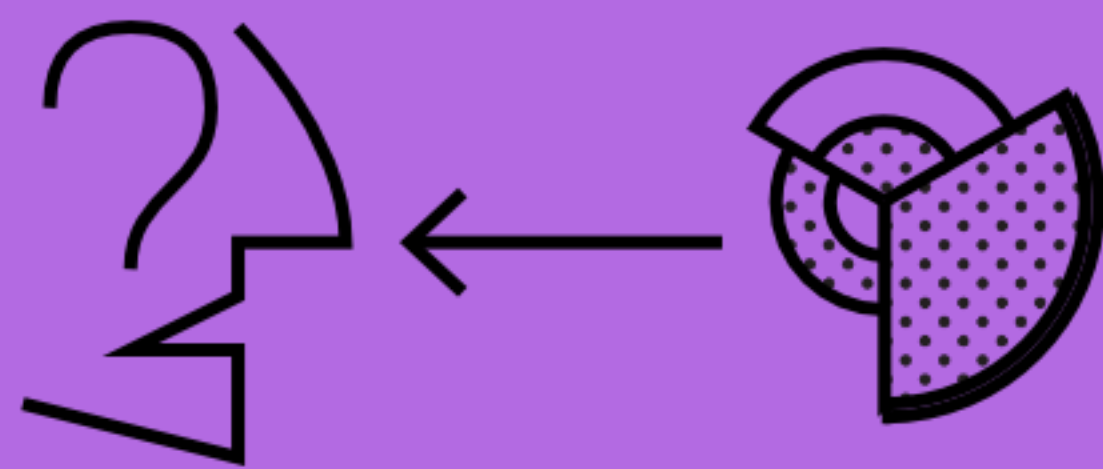
Puripant Ruchikachorn and Klaus Mueller

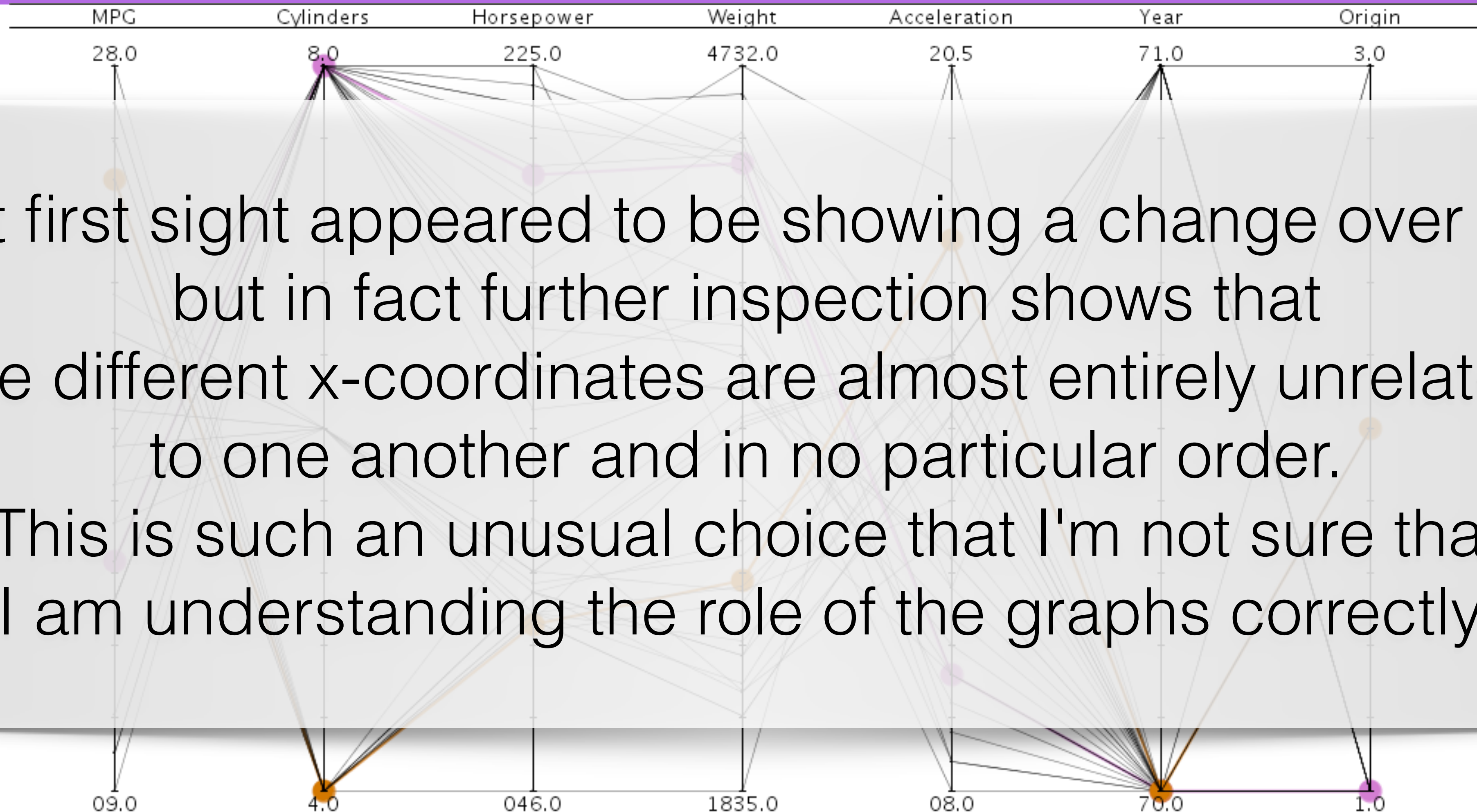
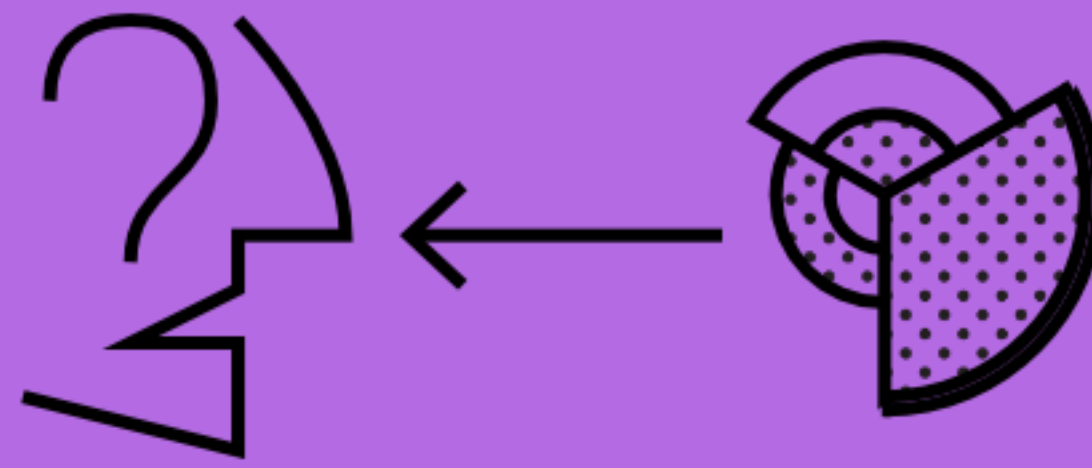


Stony Brook
University



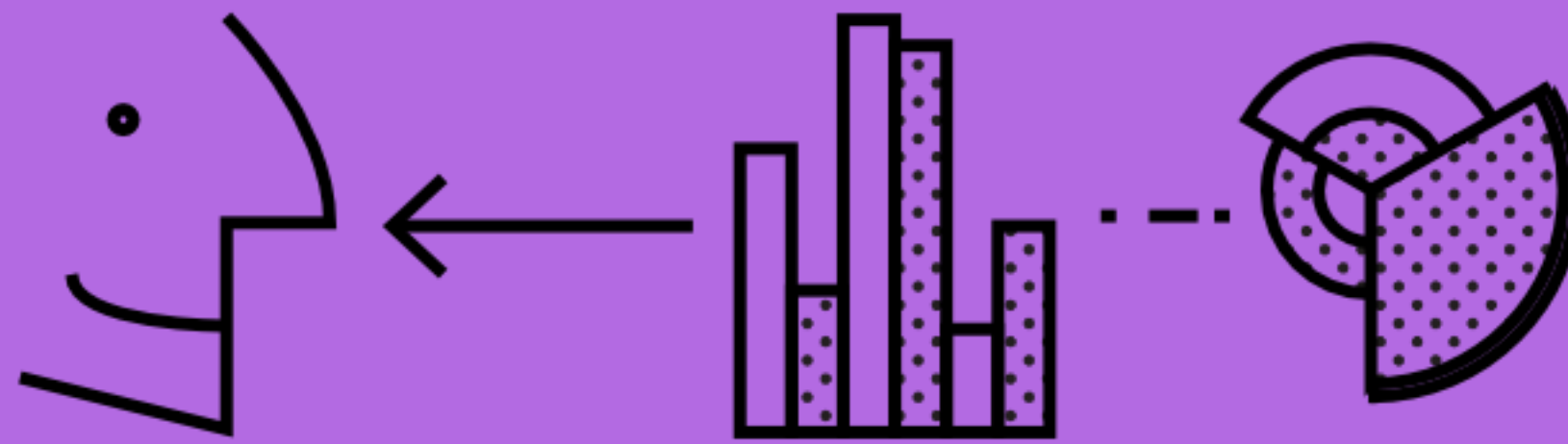
Korea
The State University
of New York



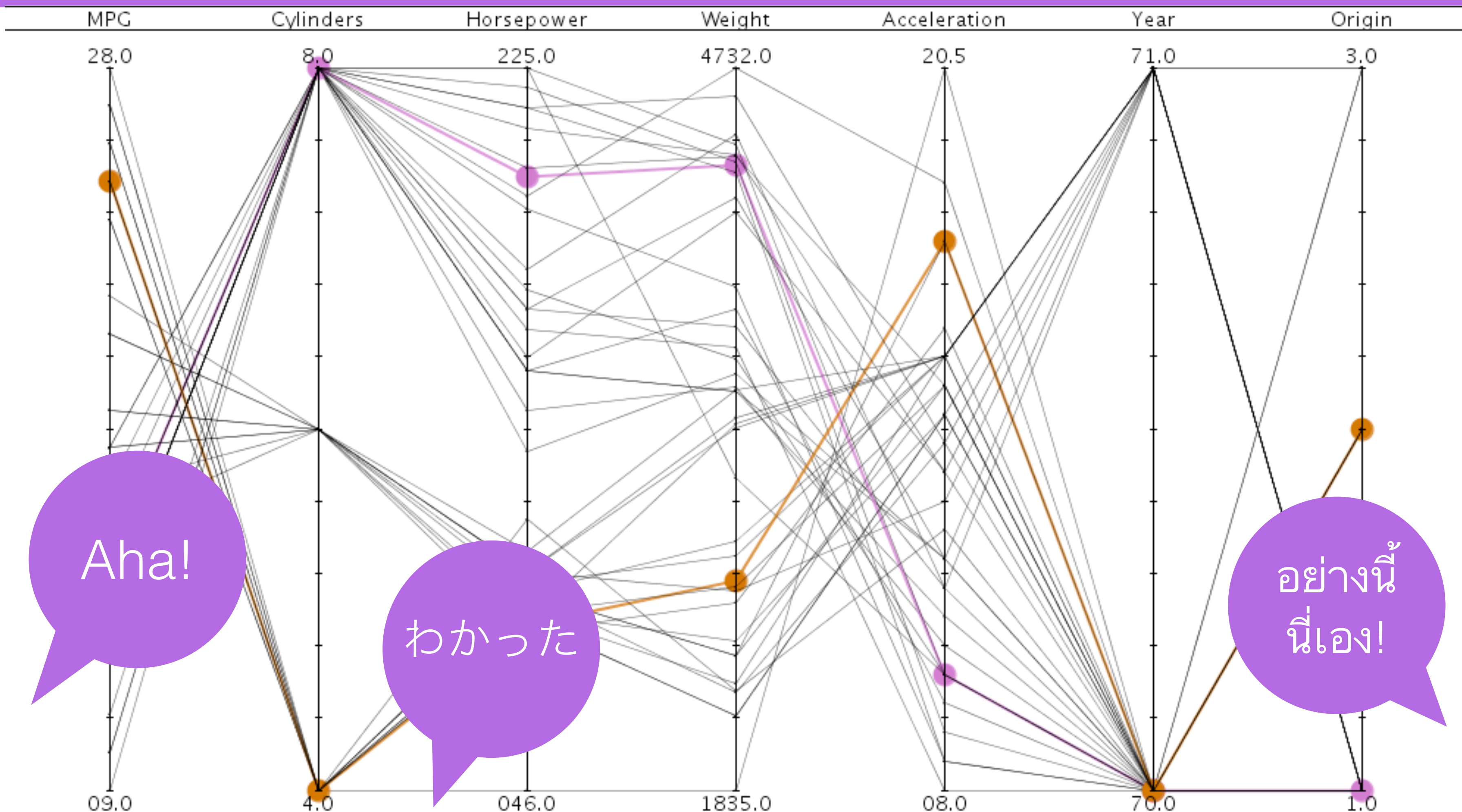
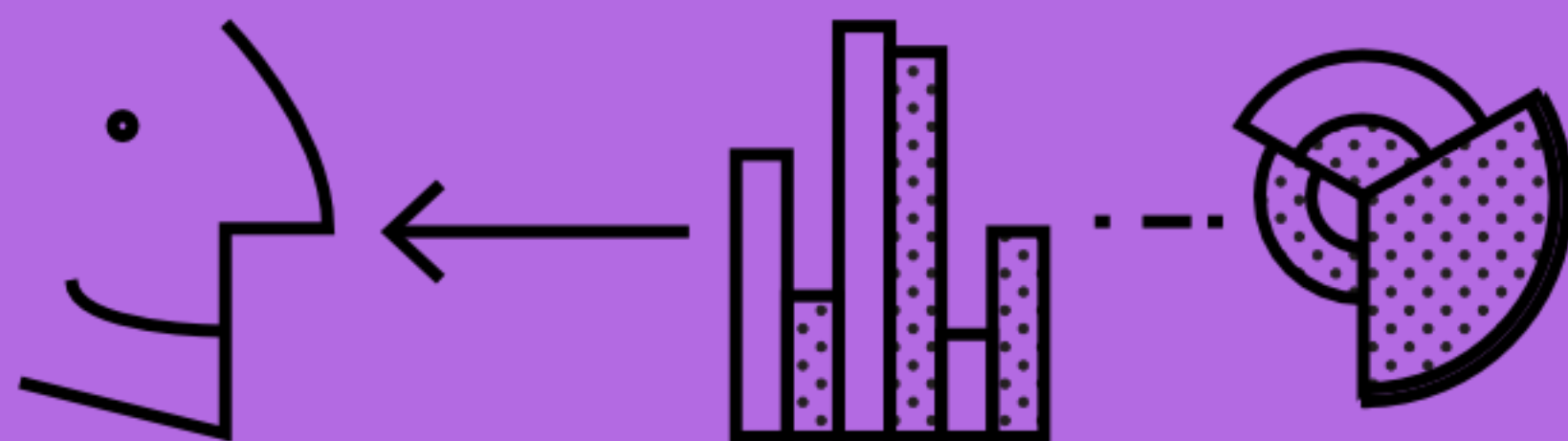


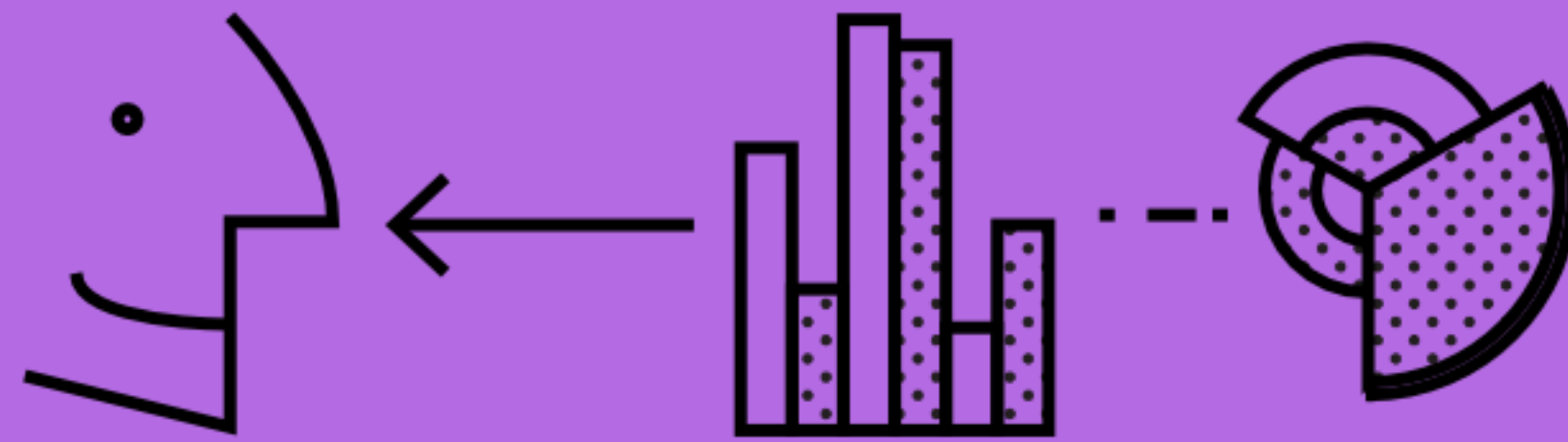
... at first sight appeared to be showing a change over time, but in fact further inspection shows that the different x-coordinates are almost entirely unrelated to one another and in no particular order.

This is such an unusual choice that I'm not sure that I am understanding the role of the graphs correctly.

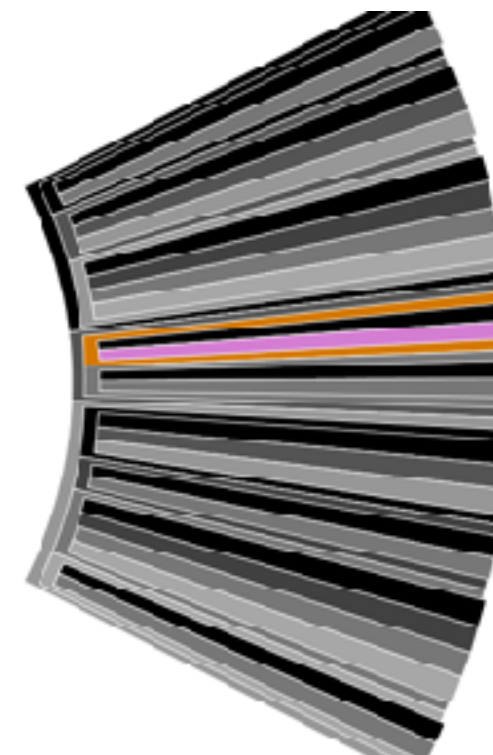
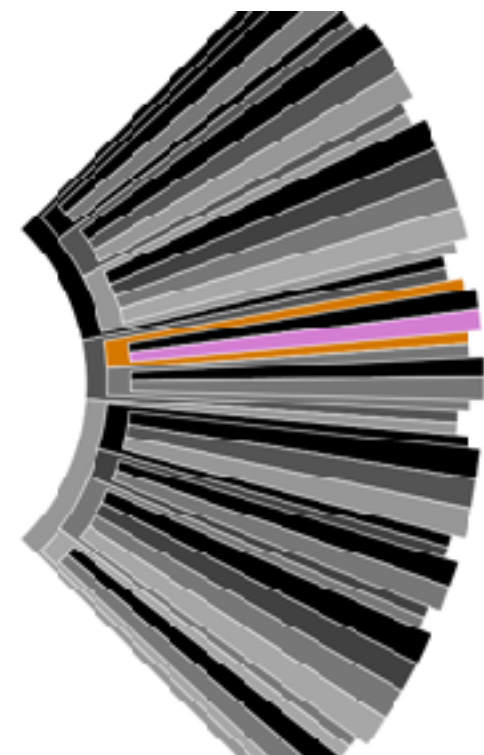
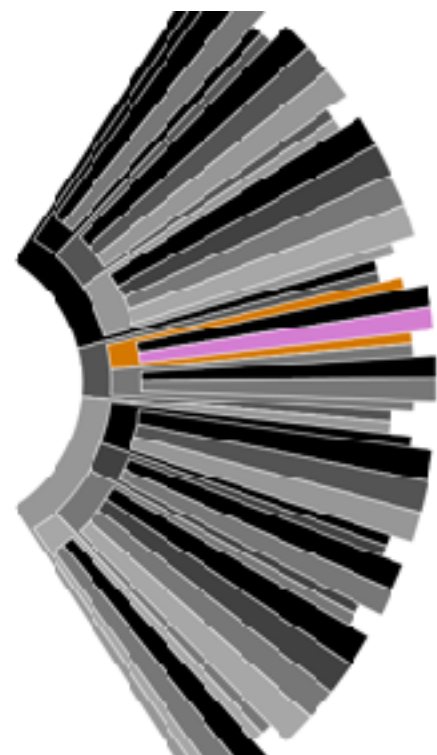
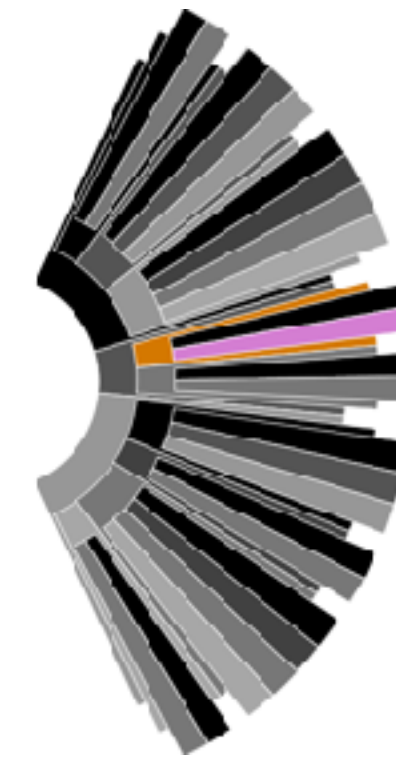
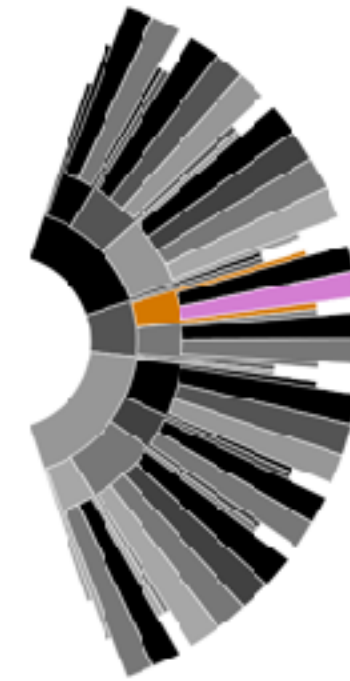
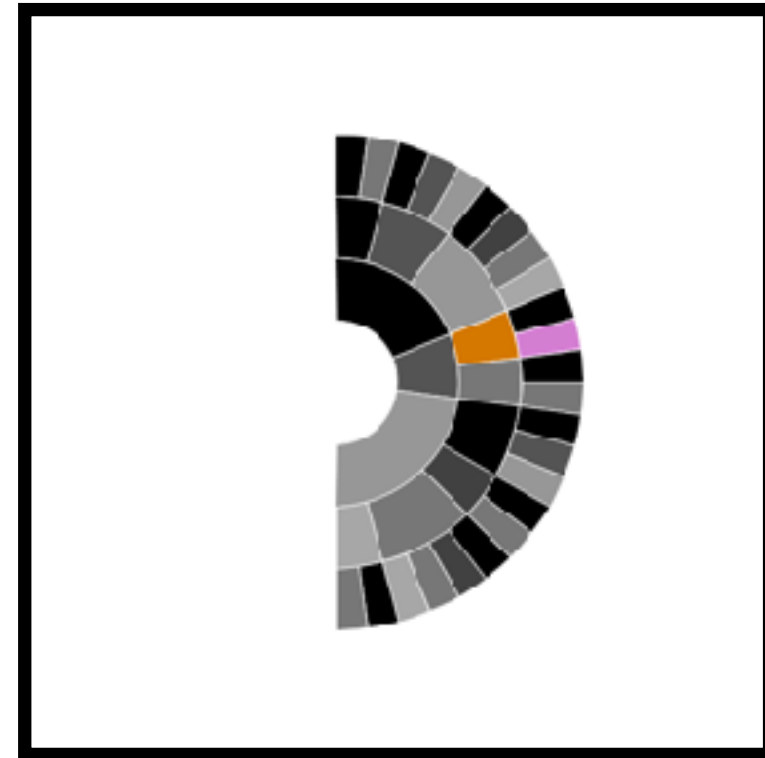


MPG	Cylinders	Horsepower	Weight	Acceleration	Year	Origin
18.0	8.0	130.0	3504.0	12.0	70.0	1.0
15.0	8.0	165.0	3693.0	11.5	70.0	1.0
18.0	8.0	150.0	3436.0	11.0	70.0	1.0
16.0	8.0	150.0	3433.0	12.0	70.0	1.0
17.0	8.0	140.0	3449.0	10.5	70.0	1.0
15.0	8.0	198.0	4341.0	10.0	70.0	1.0
14.0	8.0	220.0	4354.0	09.0	70.0	1.0
14.0	8.0	215.0	4312.0	08.5	70.0	1.0
14.0	8.0	225.0	4425.0	10.0	70.0	1.0
15.0	8.0	190.0	3850.0	08.5	70.0	1.0
15.0	8.0	170.0	3563.0	10.0	70.0	1.0
14.0	8.0	160.0	3609.0	08.0	70.0	1.0
15.0	8.0	150.0	3761.0	09.5	70.0	1.0
14.0	8.0	225.0	3086.0	10.0	70.0	1.0
24.0	4.0	095.0	2372.0	15.0	70.0	3.0
22.0	6.0	095.0	2833.0	15.5	70.0	1.0
18.0	6.0	097.0	2774.0	15.5	70.0	1.0
21.0	6.0	085.0	2587.0	16.0	70.0	1.0
27.0	4.0	088.0	2130.0	14.5	70.0	3.0
26.0	4.0	046.0	1835.0	20.5	70.0	2.0
25.0	4.0	087.0	2672.0	17.5	70.0	2.0
24.0	4.0	090.0	2430.0	14.5	70.0	2.0
25.0	4.0	095.0	2375.0	17.5	70.0	2.0
26.0	4.0	113.0	2234.0	12.5	70.0	2.0
21.0	6.0	090.0	2648.0	15.0	70.0	1.0
10.0	8.0	215.0	4615.0	14.0	70.0	1.0
10.0	8.0	200.0	4376.0	15.0	70.0	1.0
11.0	8.0	210.0	4382.0	13.5	70.0	1.0
09.0	8.0	193.0	4732.0	18.5	70.0	1.0
27.0	4.0	088.0	2130.0	14.5	71.0	3.0
28.0	4.0	090.0	2264.0	15.5	71.0	1.0
25.0	4.0	095.0	2228.0	14.0	71.0	3.0
19.0	6.0	100.0	2634.0	13.0	71.0	1.0
16.0	6.0	105.0	3439.0	15.5	71.0	1.0
17.0	6.0	100.0	3329.0	15.5	71.0	1.0
19.0	6.0	088.0	3302.0	15.5	71.0	1.0
18.0	6.0	100.0	3288.0	15.5	71.0	1.0
14.0	8.0	165.0	4209.0	12.0	71.0	1.0
14.0	8.0	175.0	4464.0	11.5	71.0	1.0
14.0	8.0	153.0	4154.0	12.5	71.0	1.0

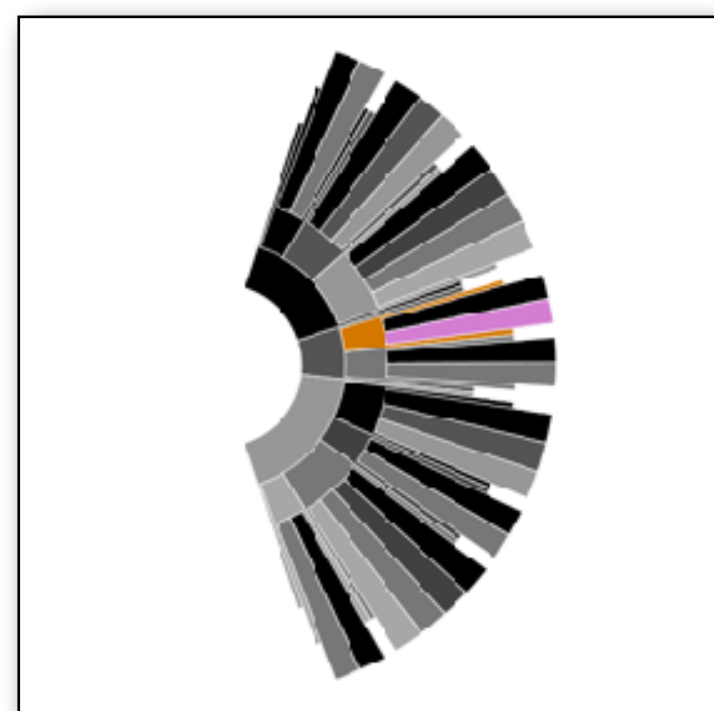
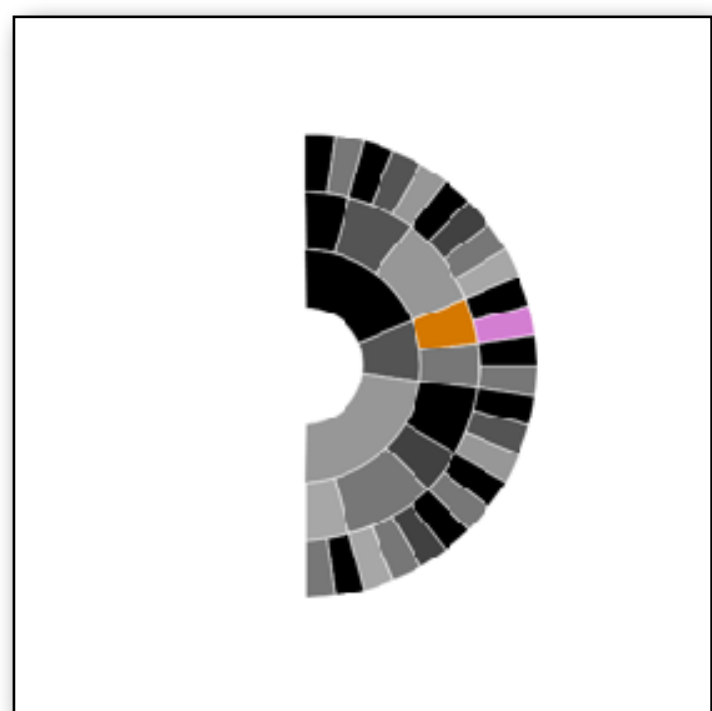
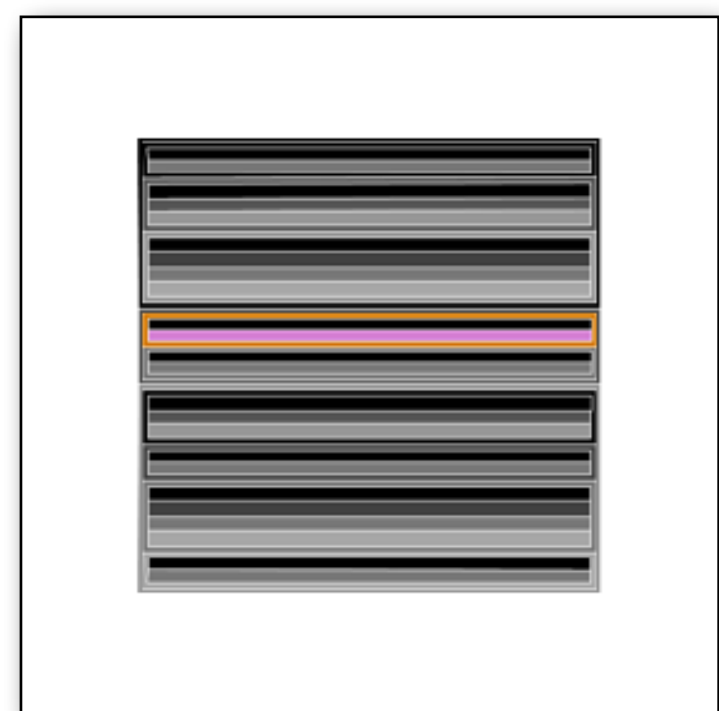




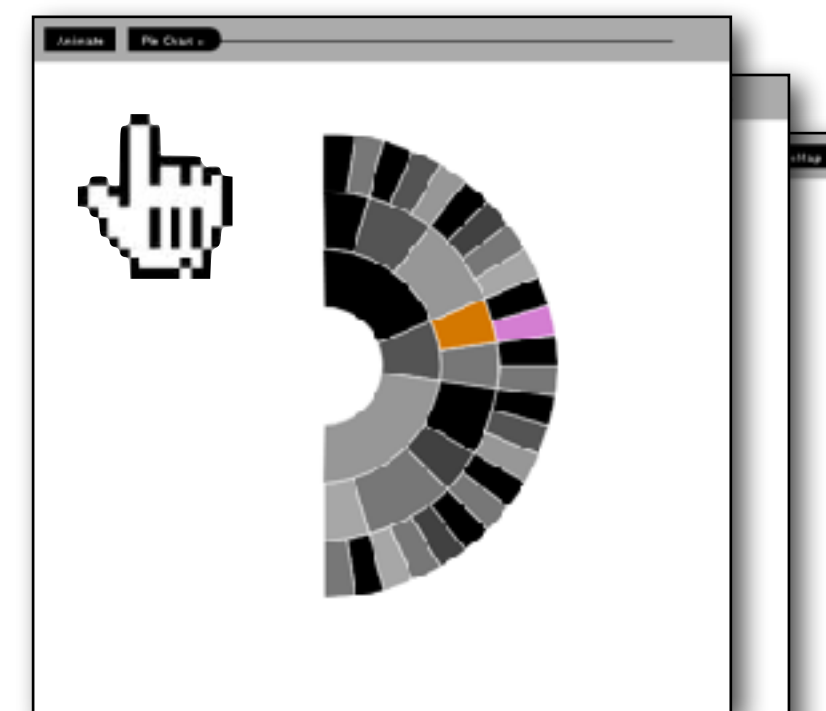
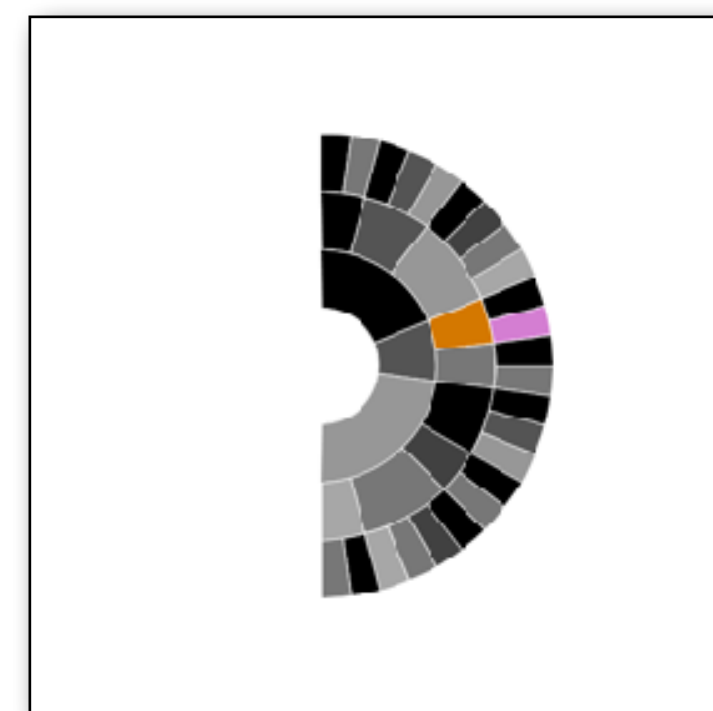
Source
Visualization

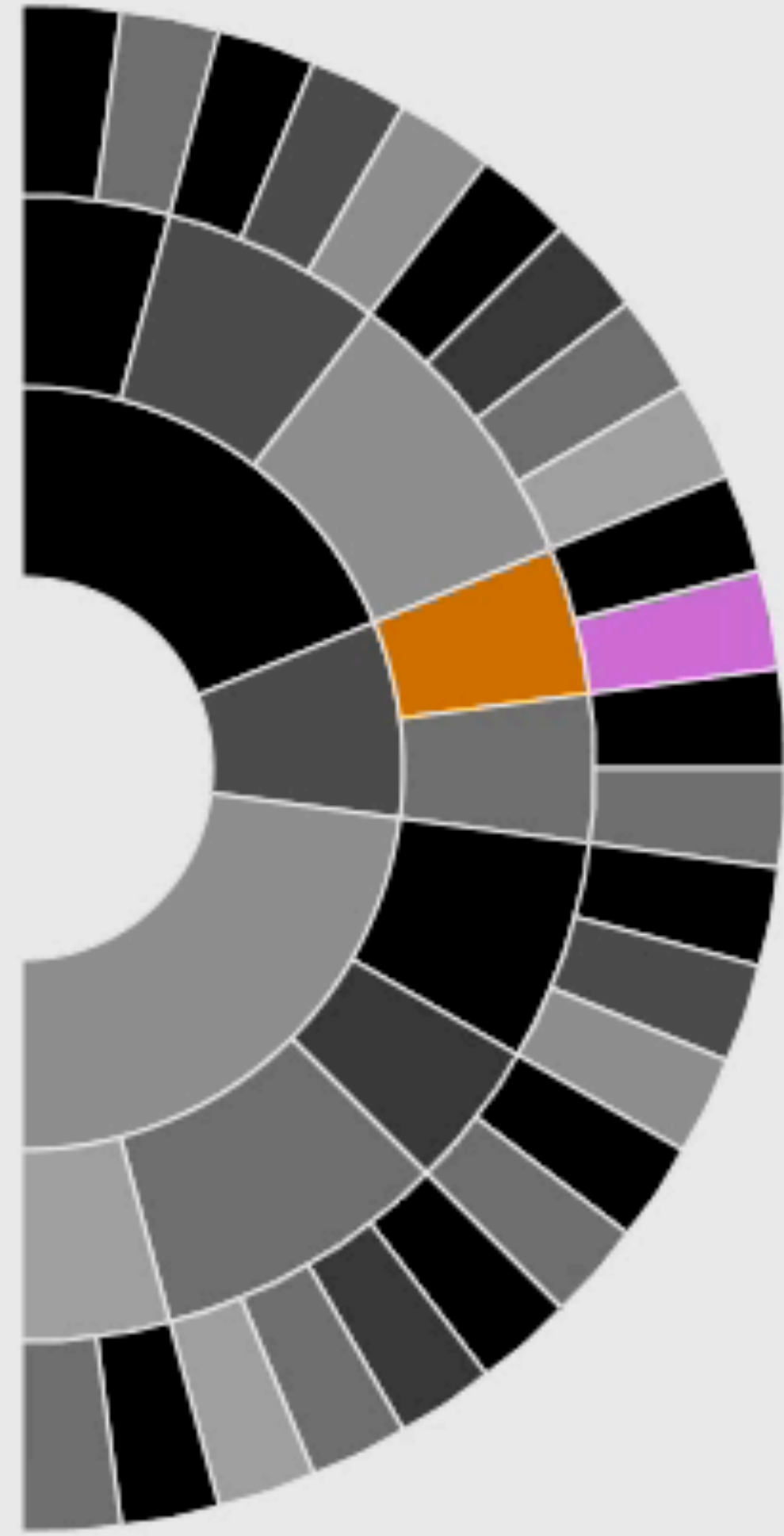


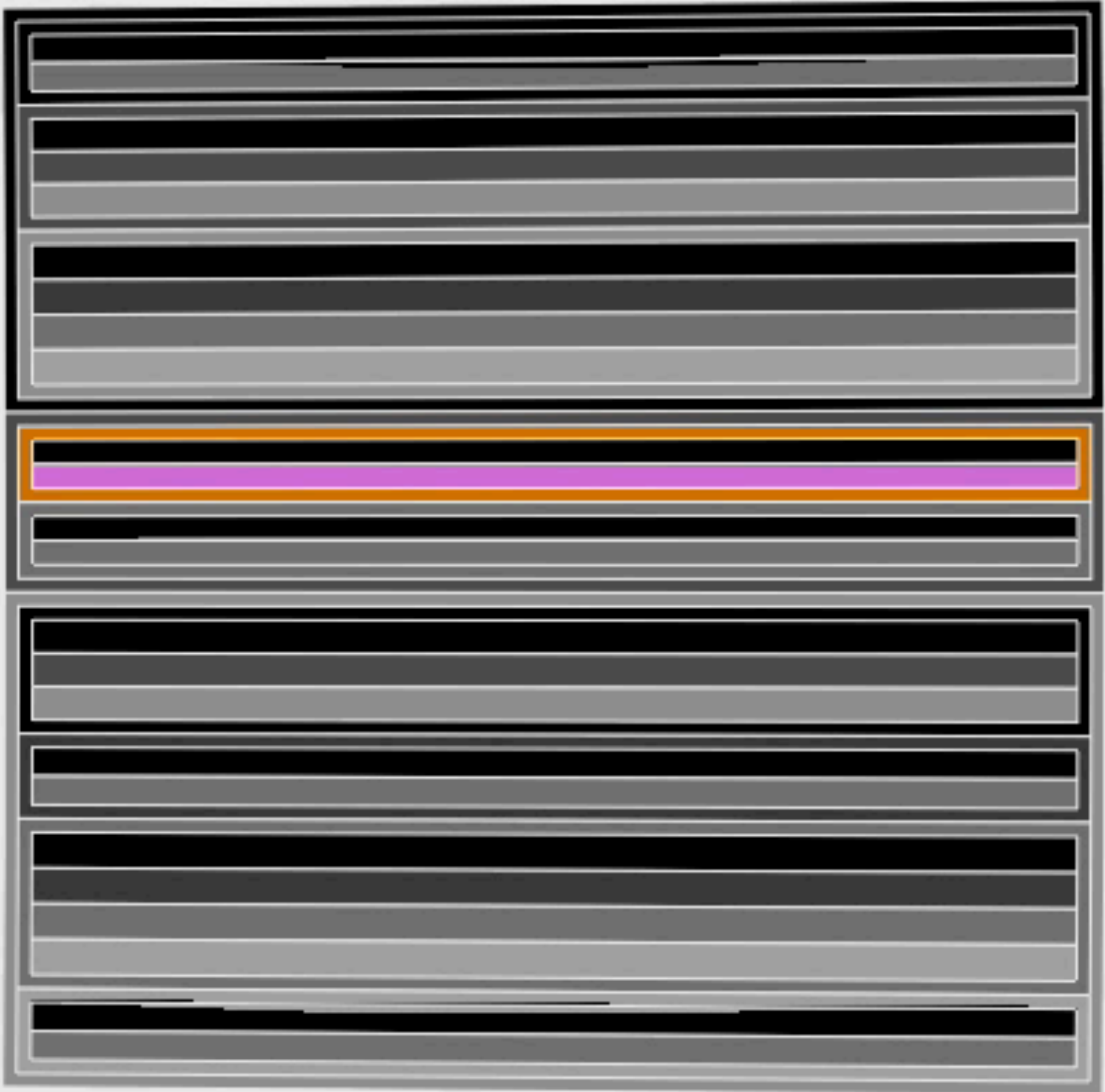
Target
Visualization



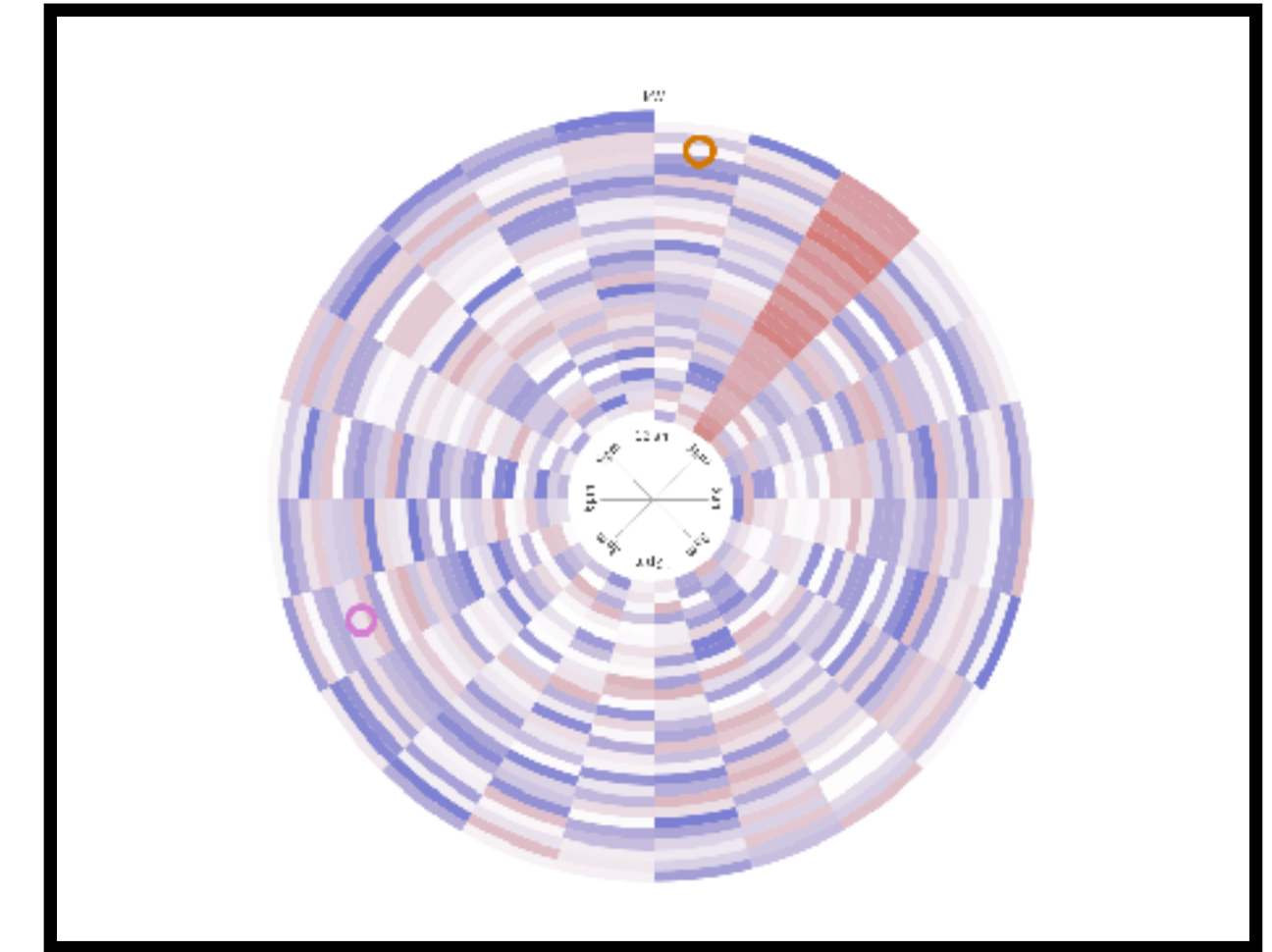
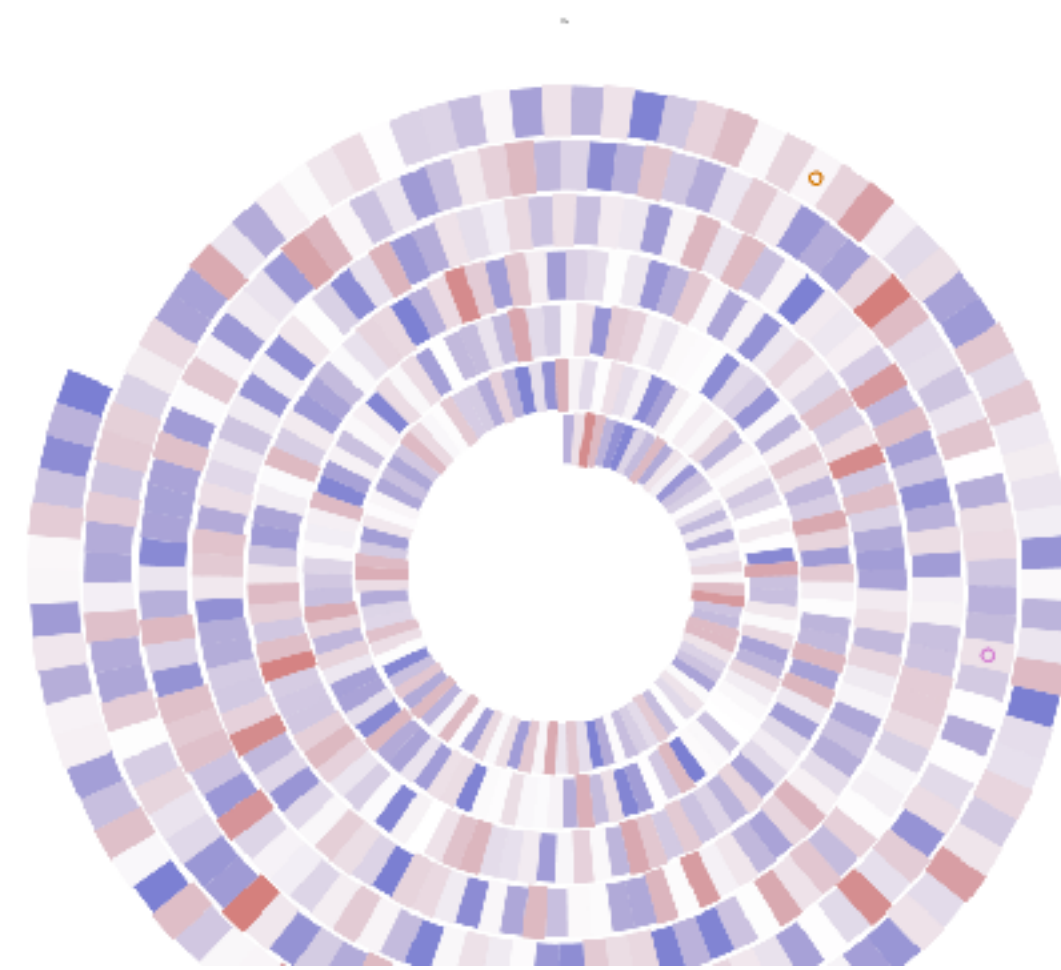
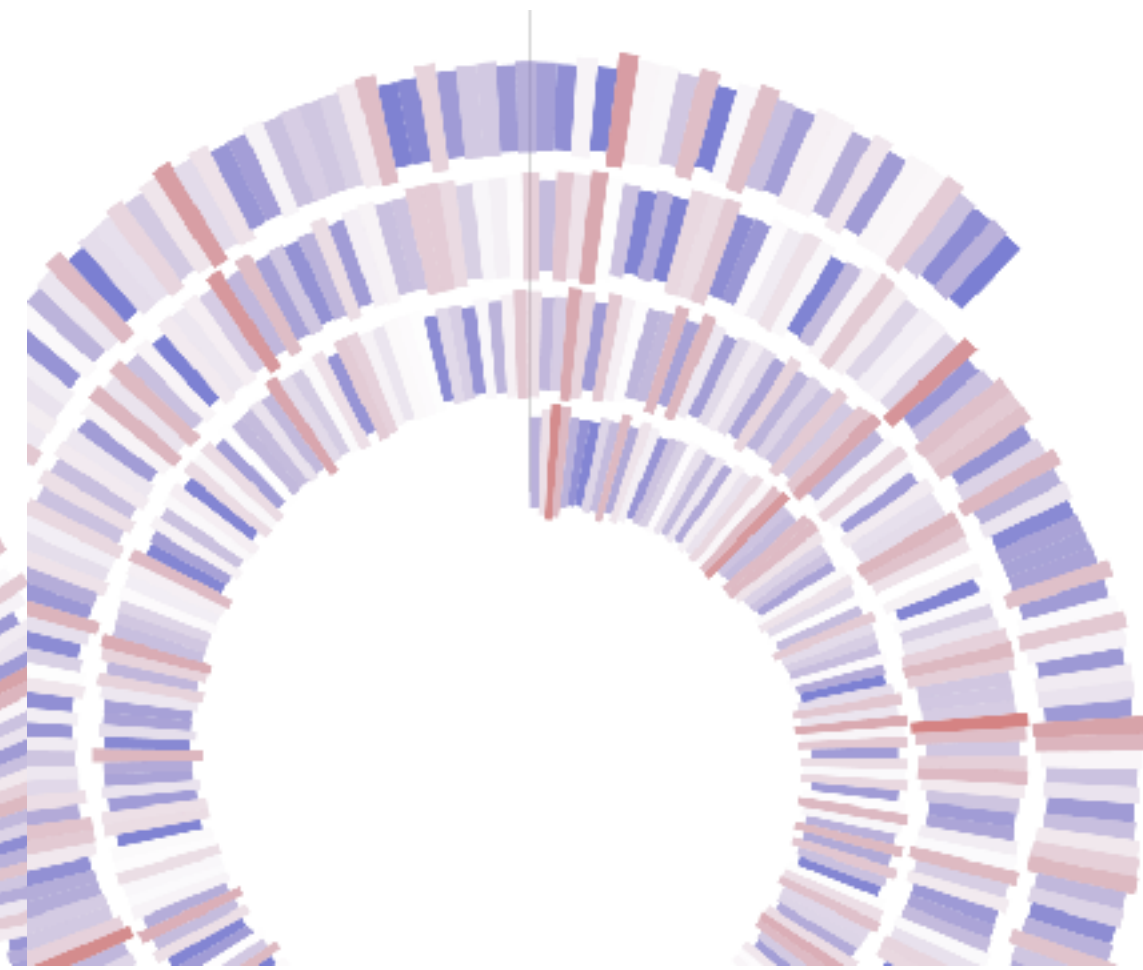
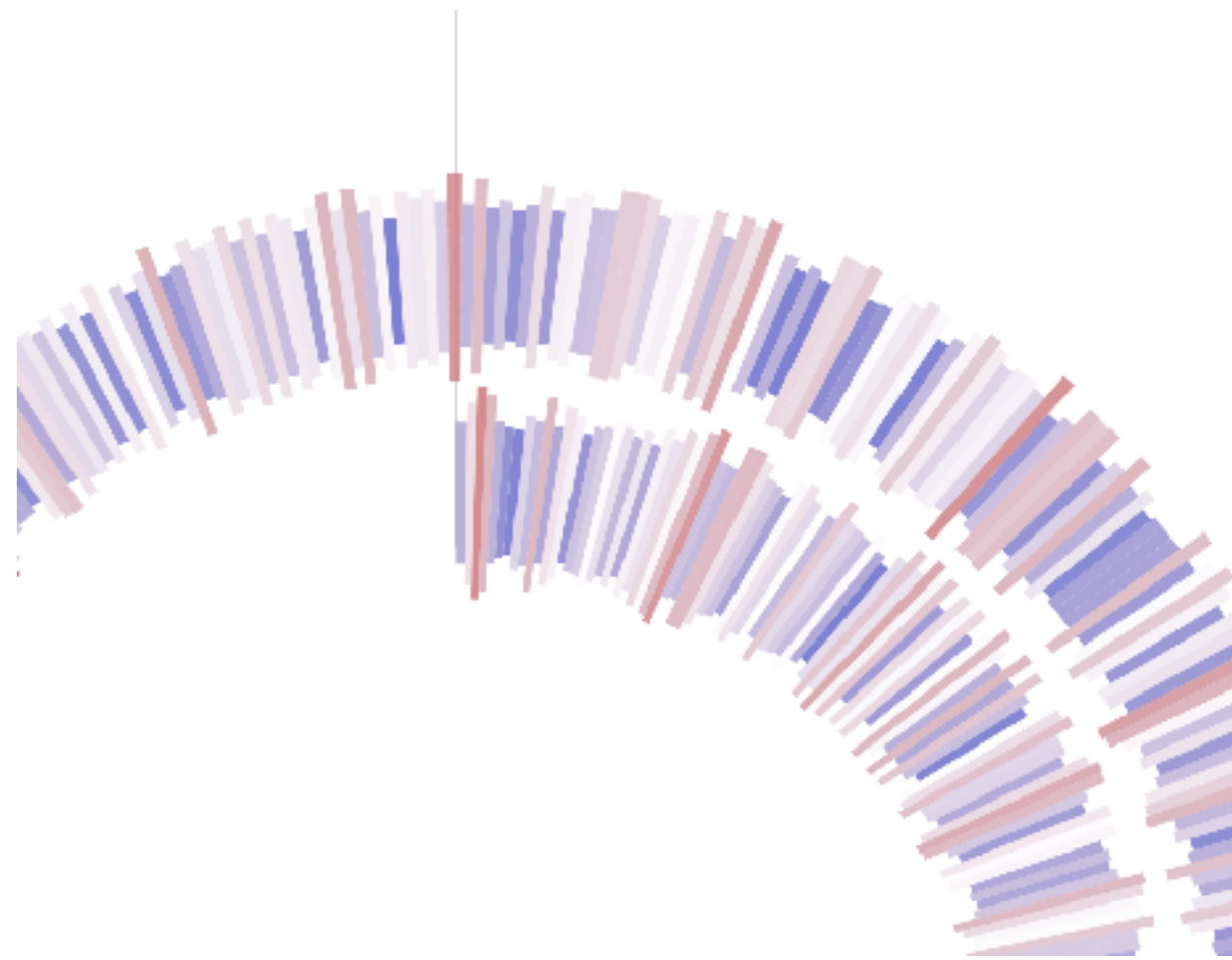
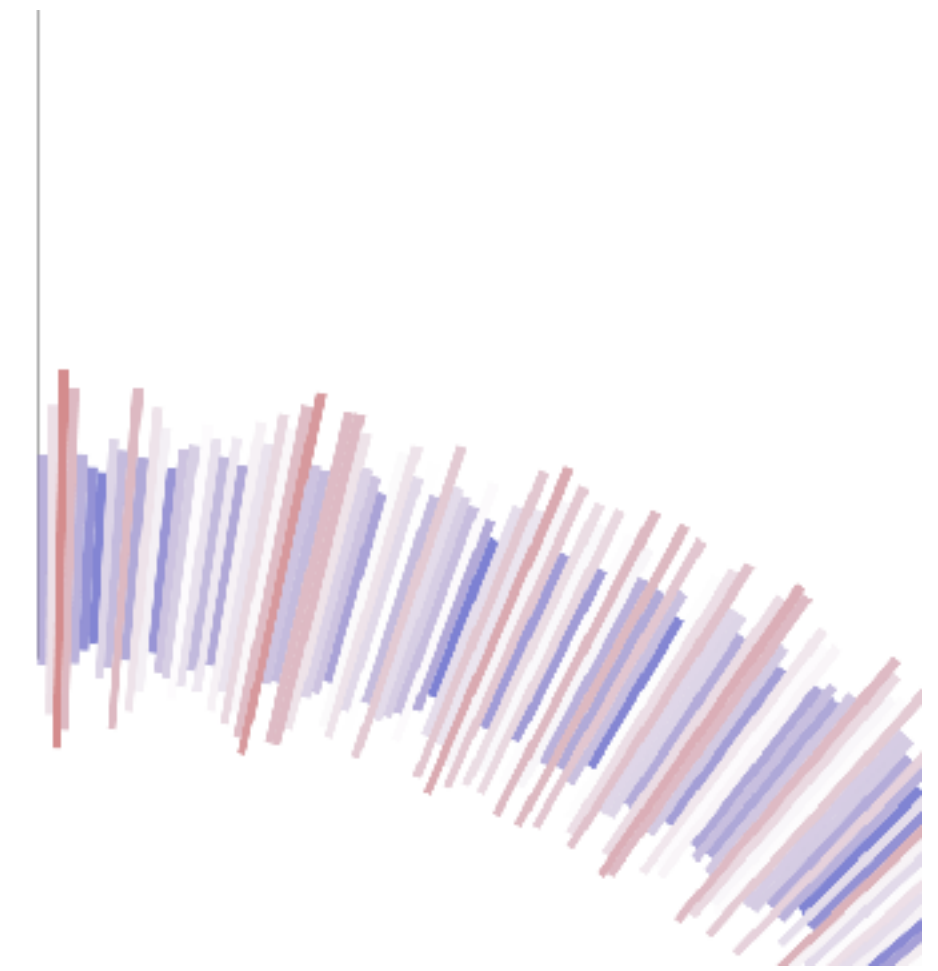
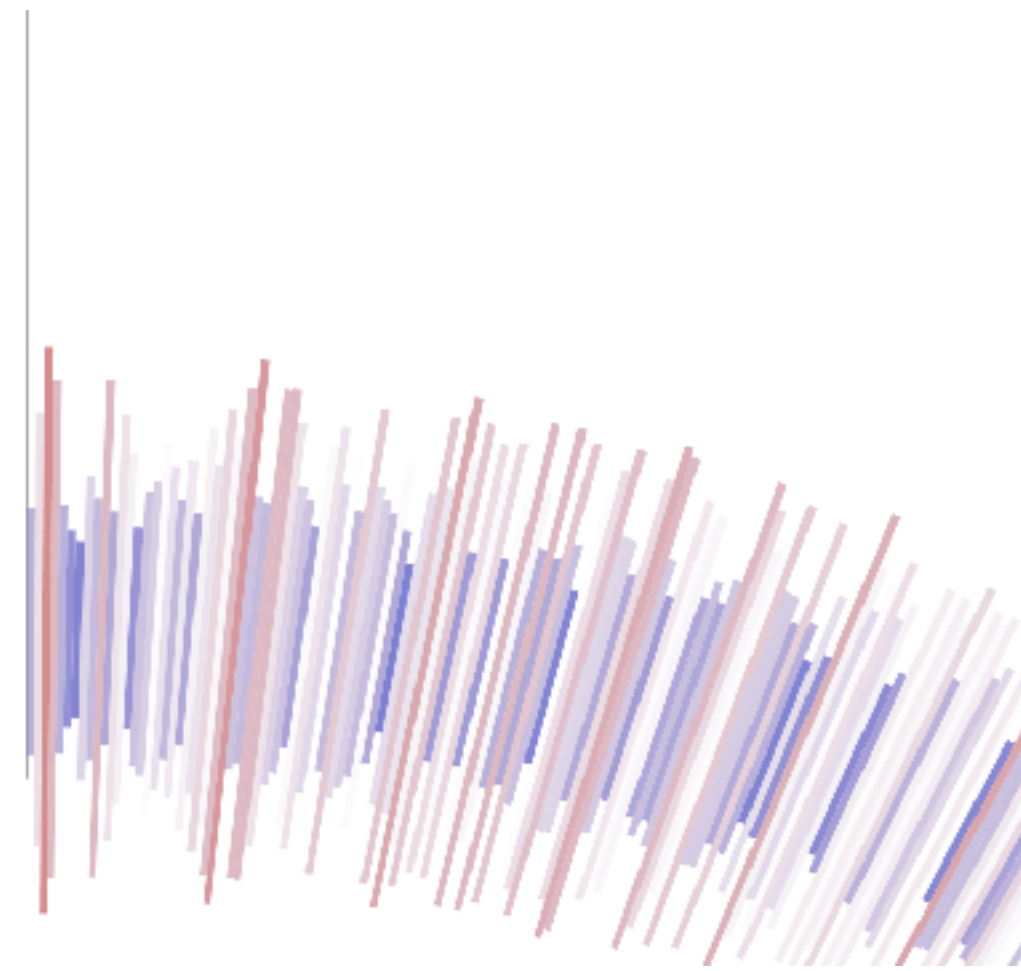
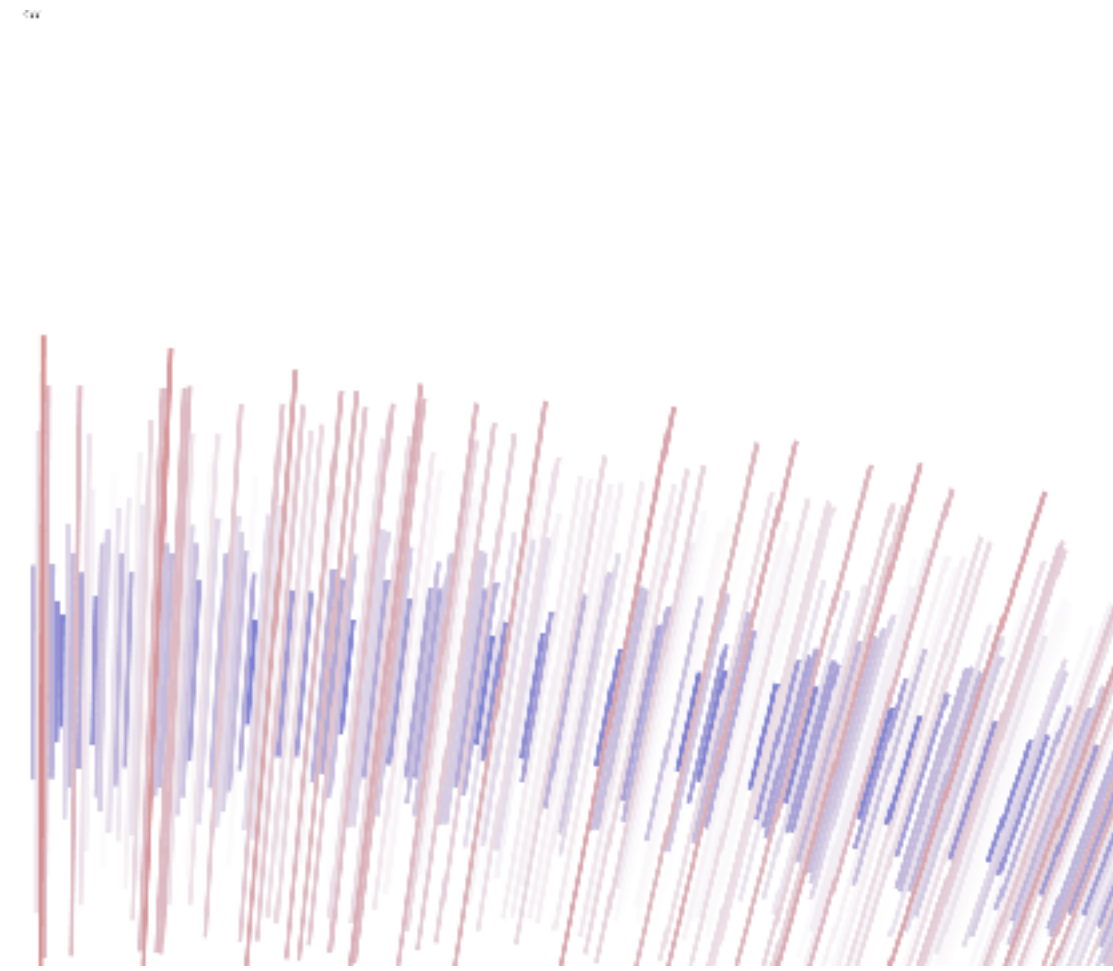
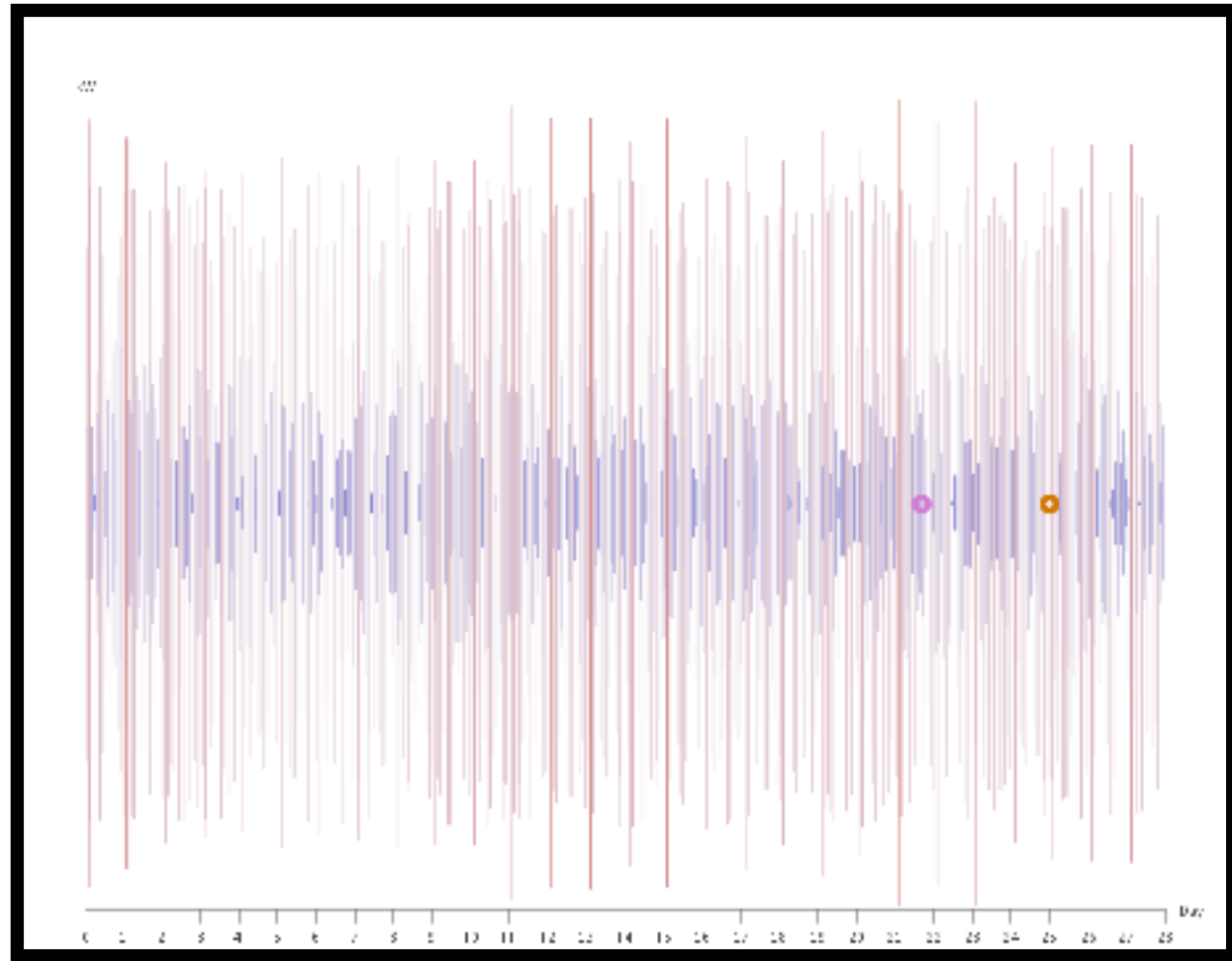
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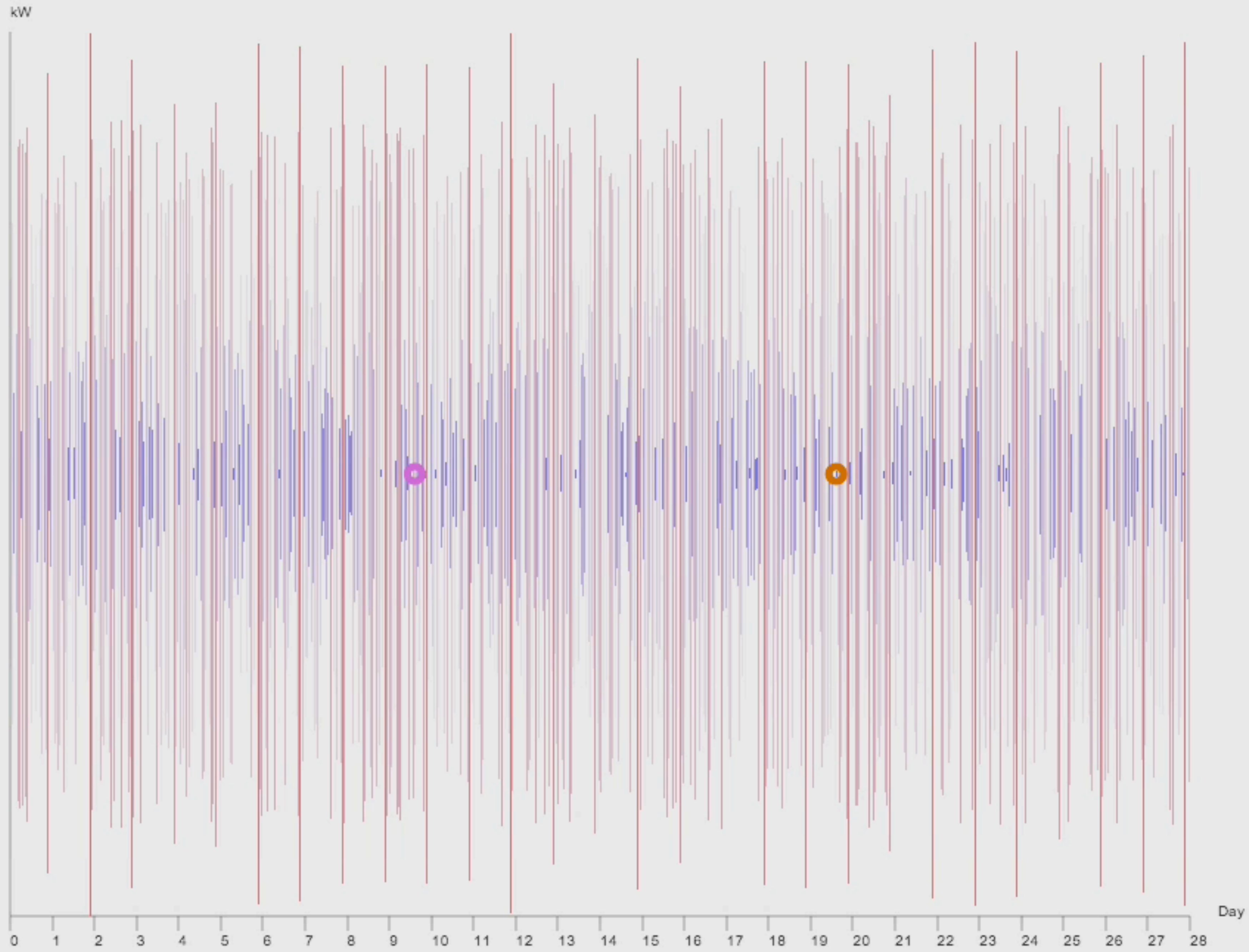
Linear Chart

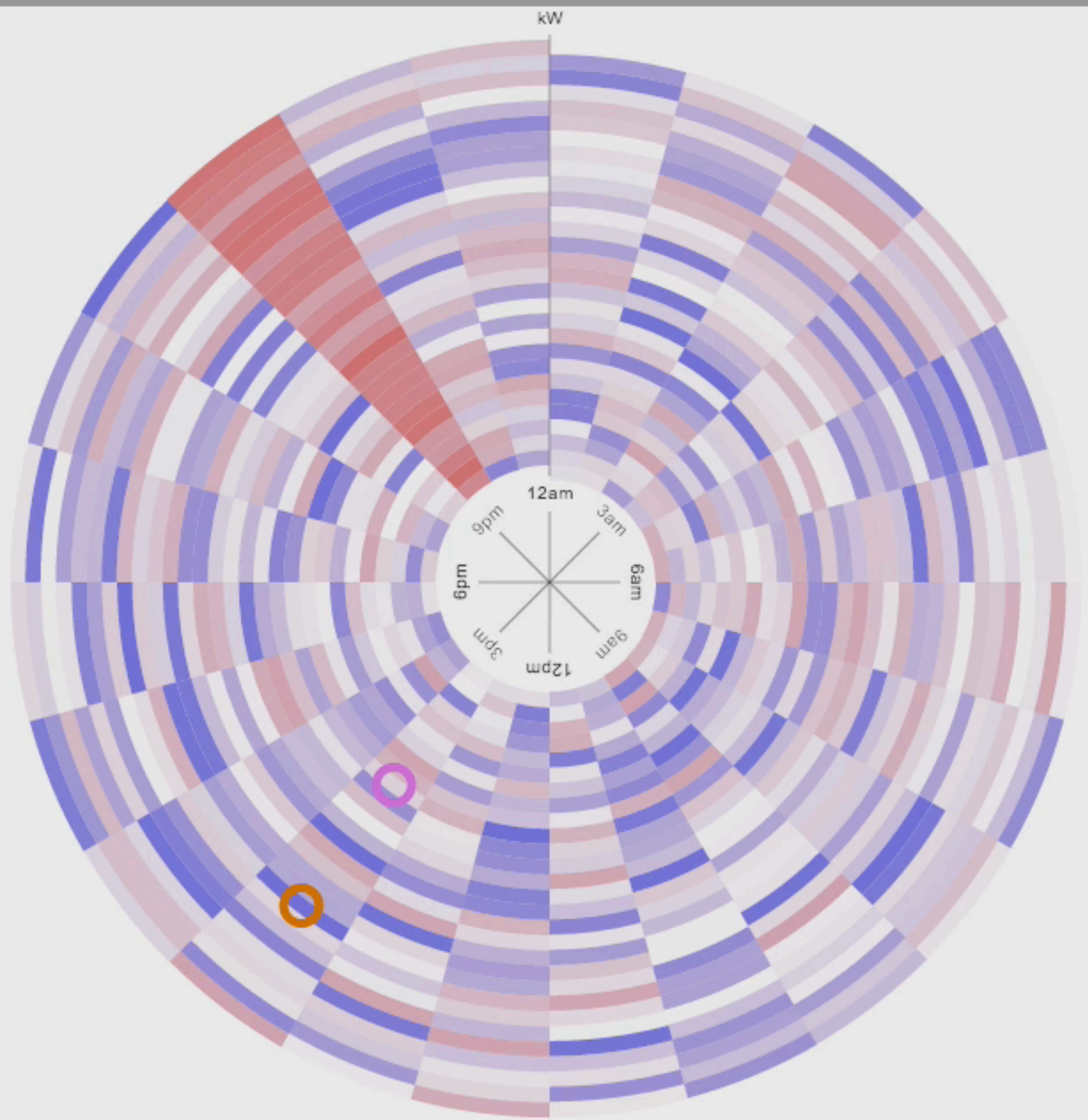


Spiral Chart

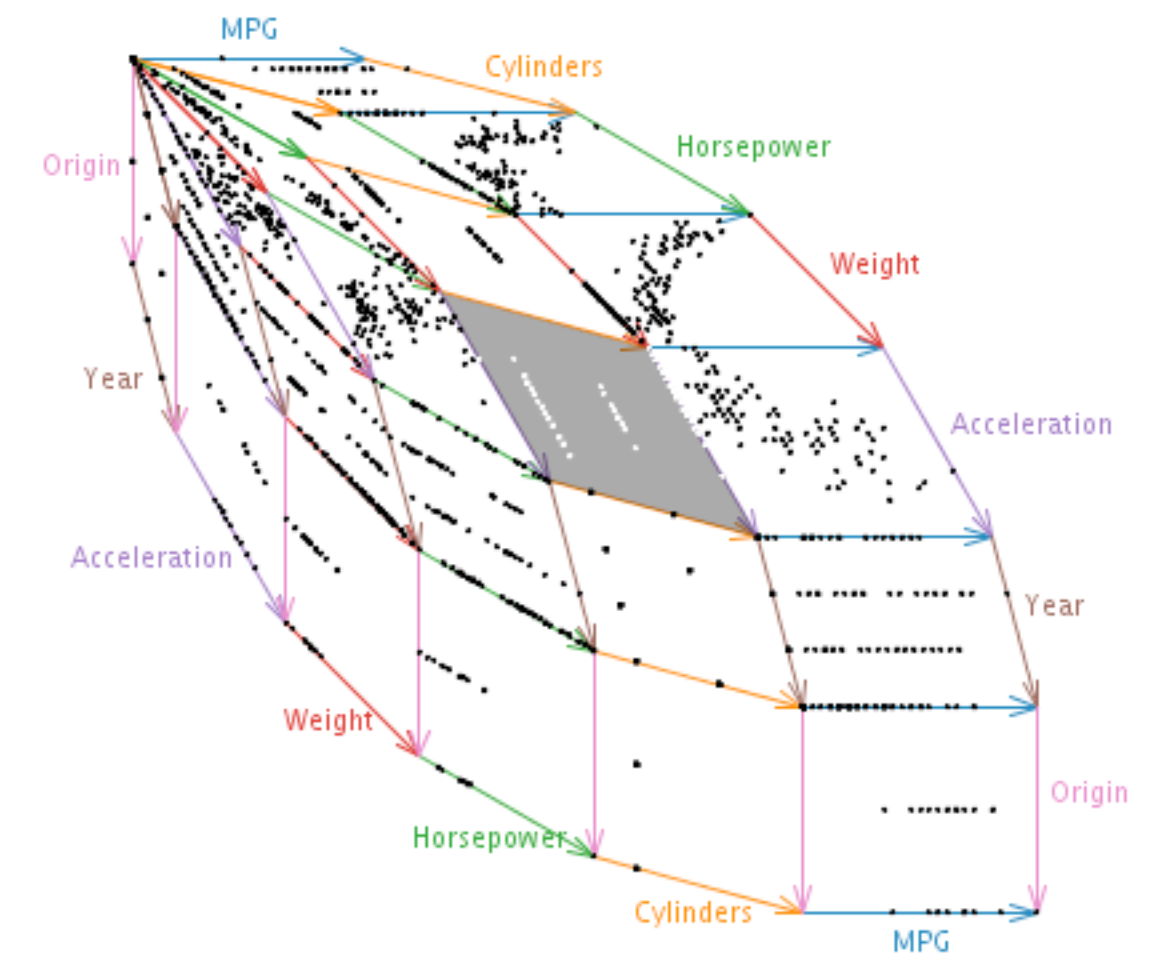
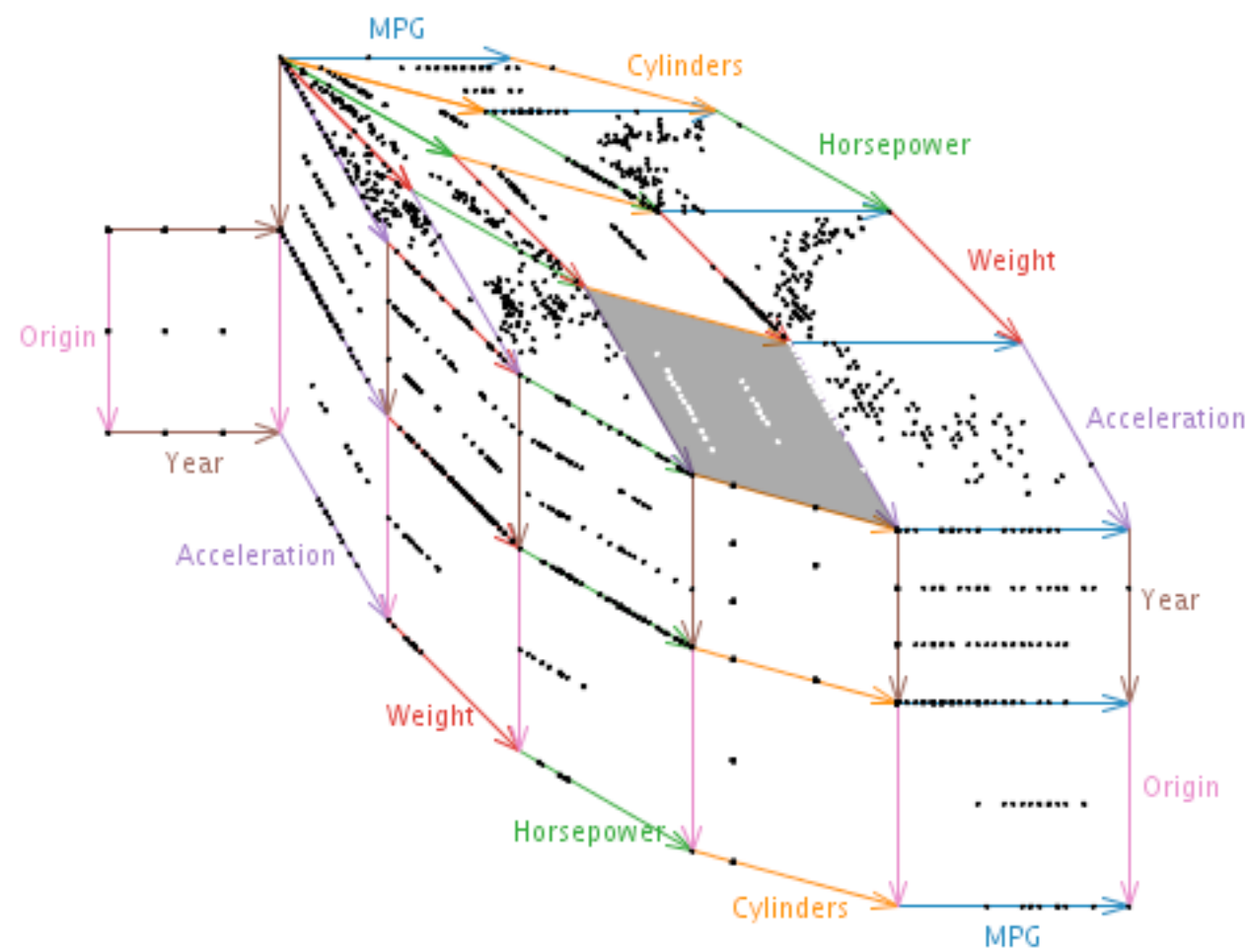
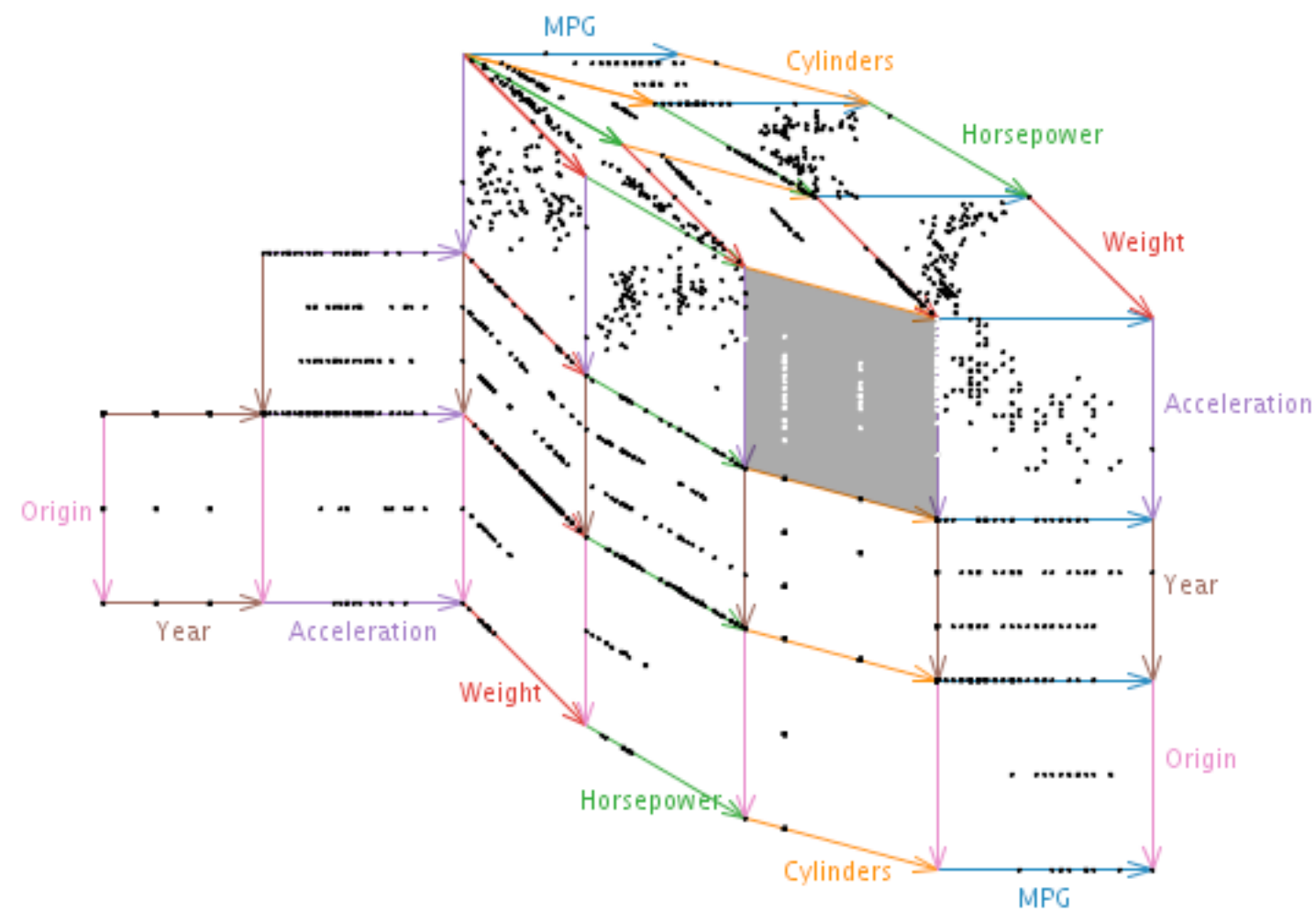
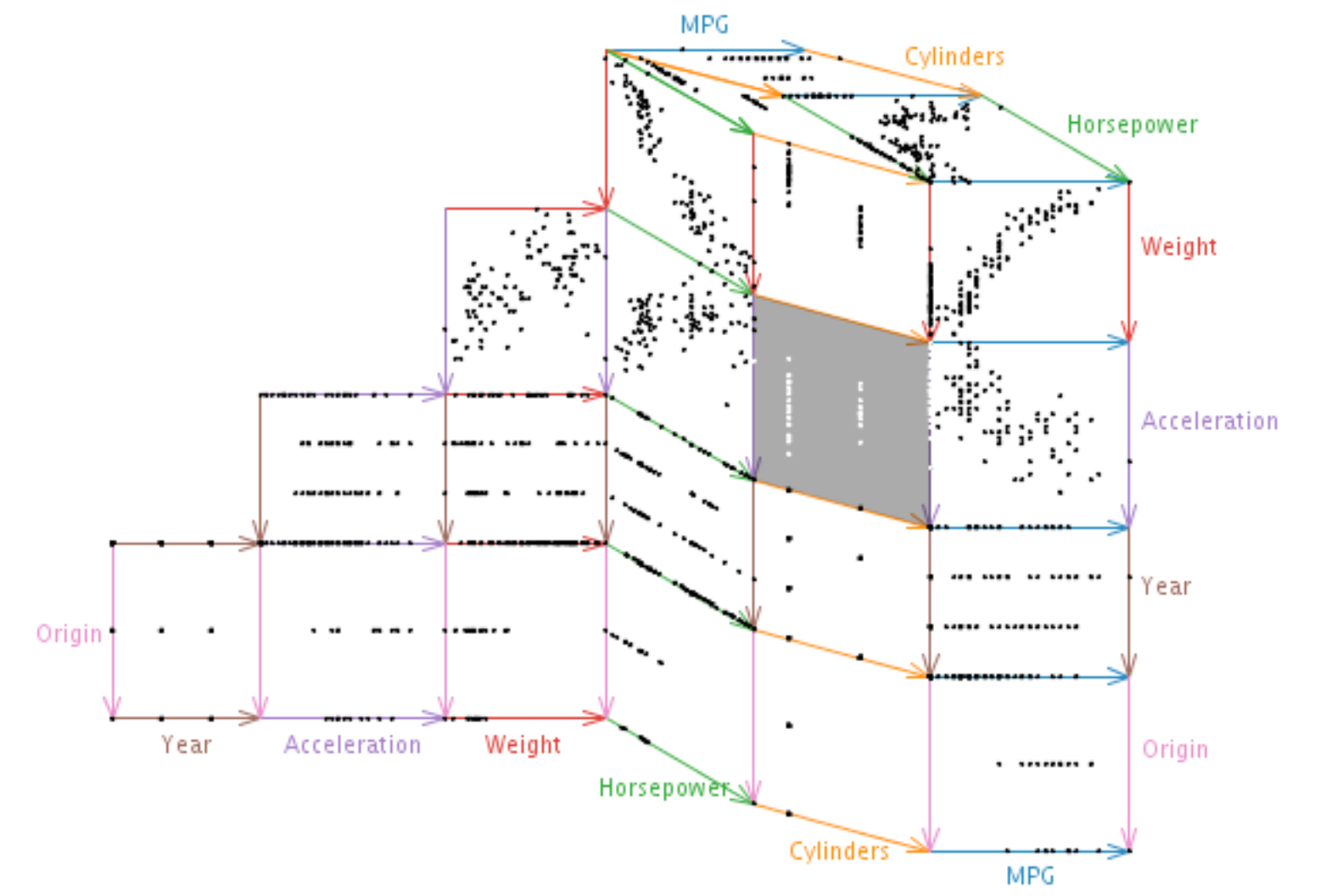
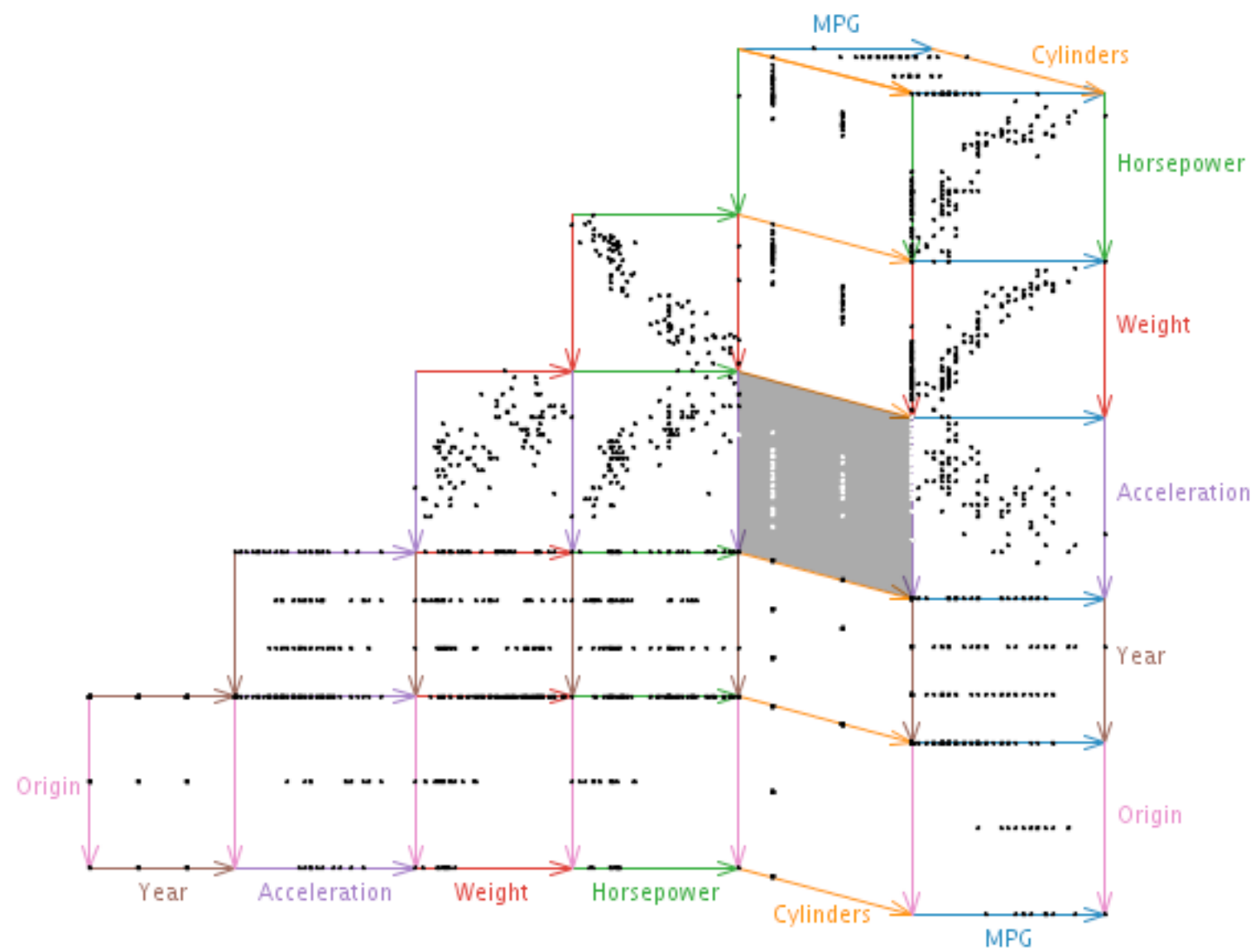
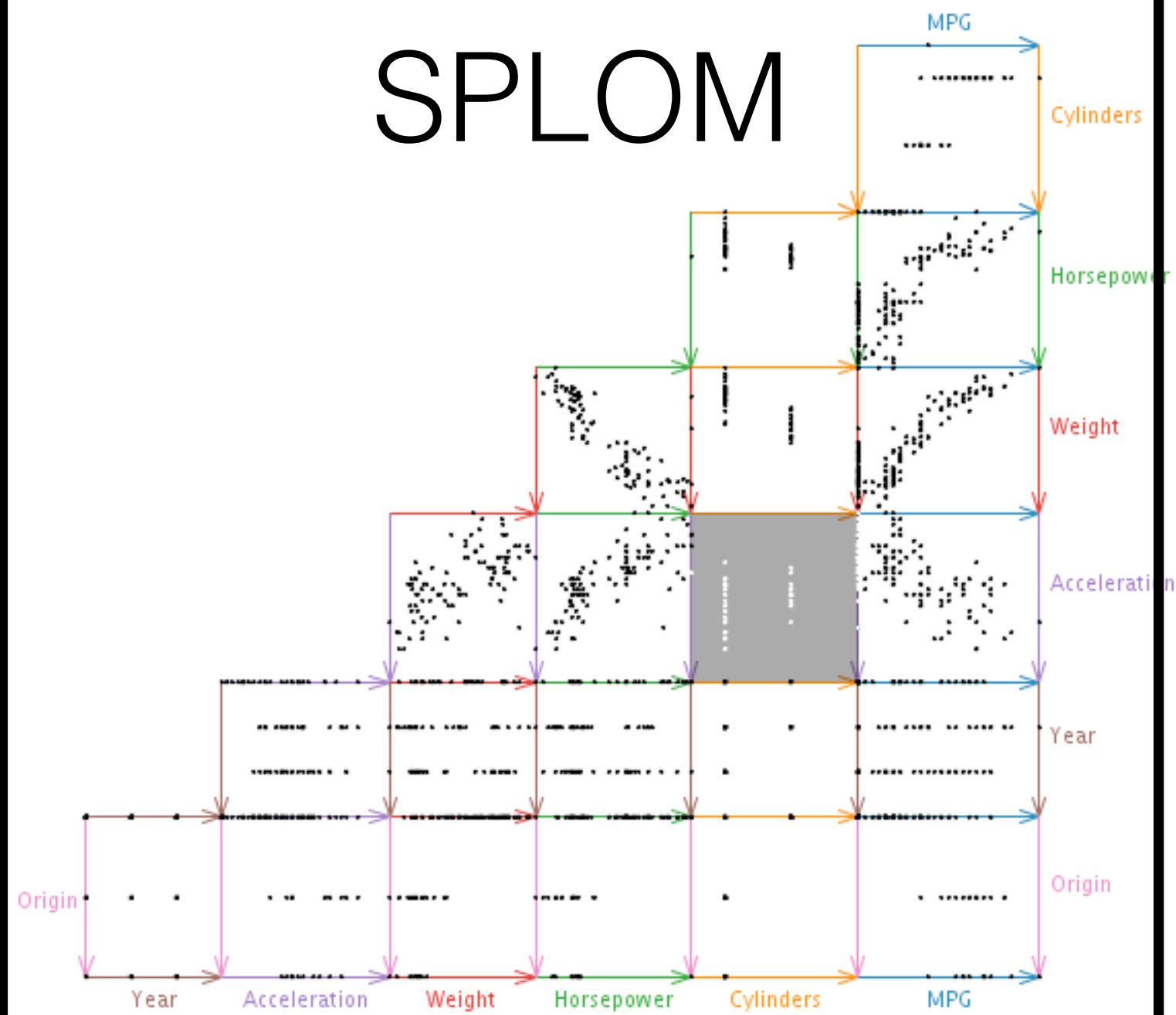
Animate

Linear >



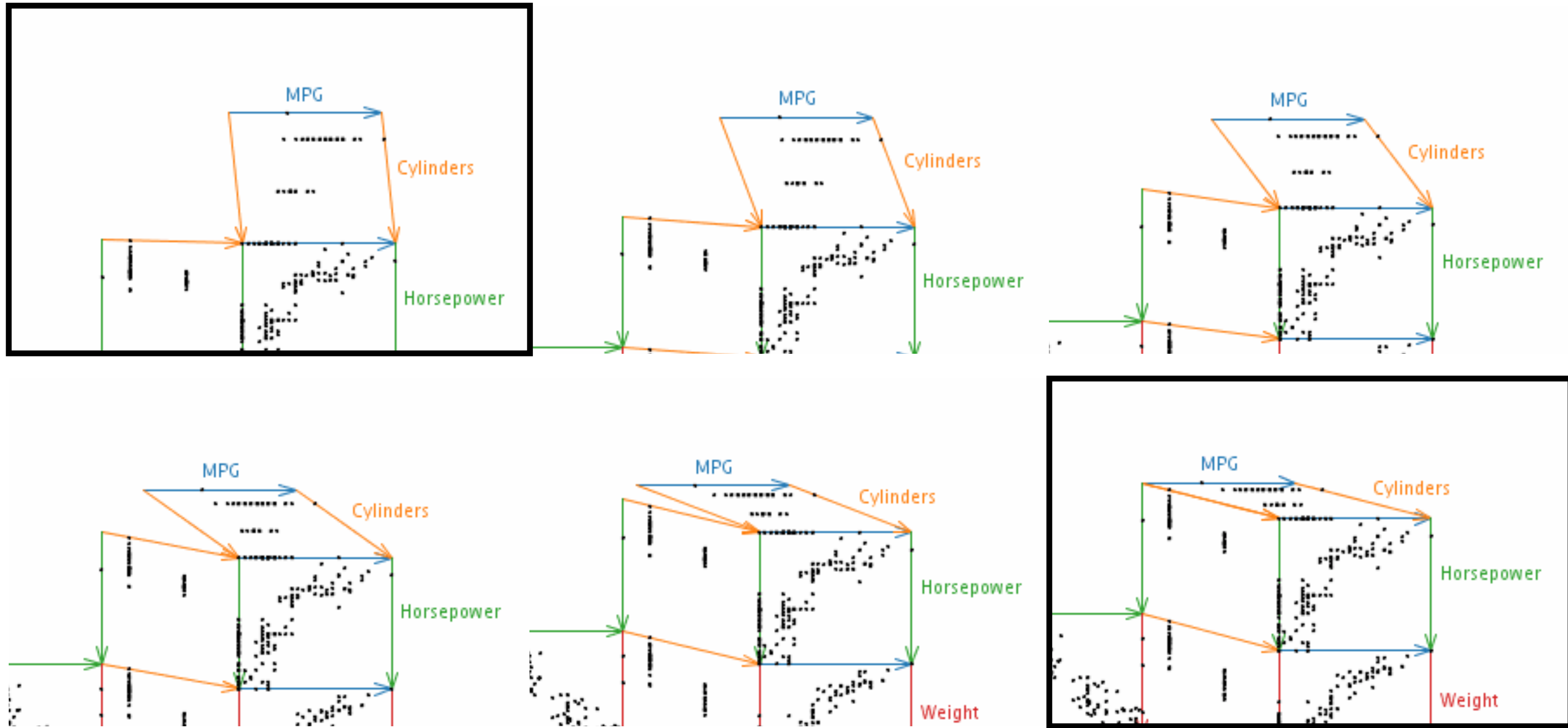


SPLOM



Hyperbox

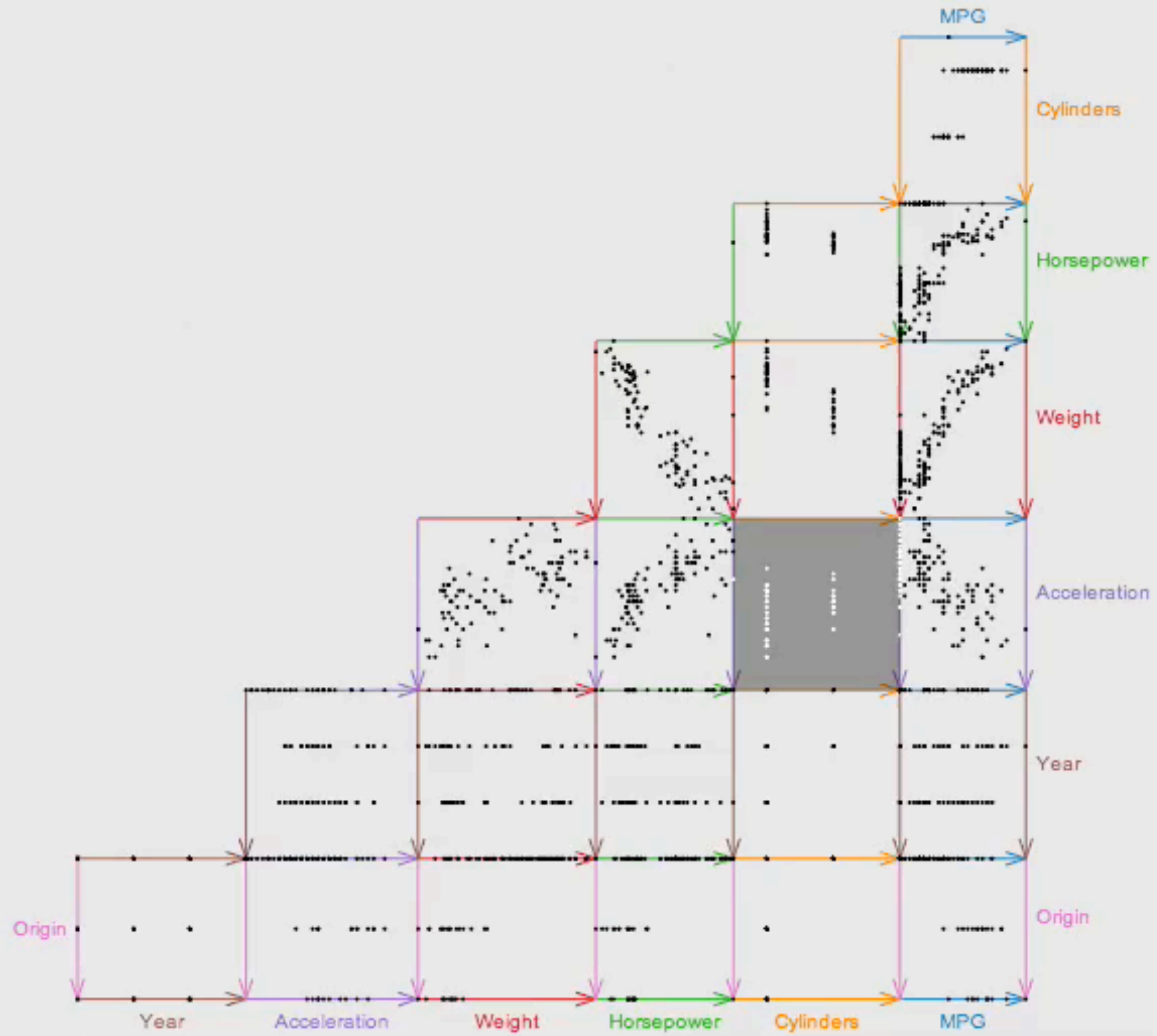
SPLOM

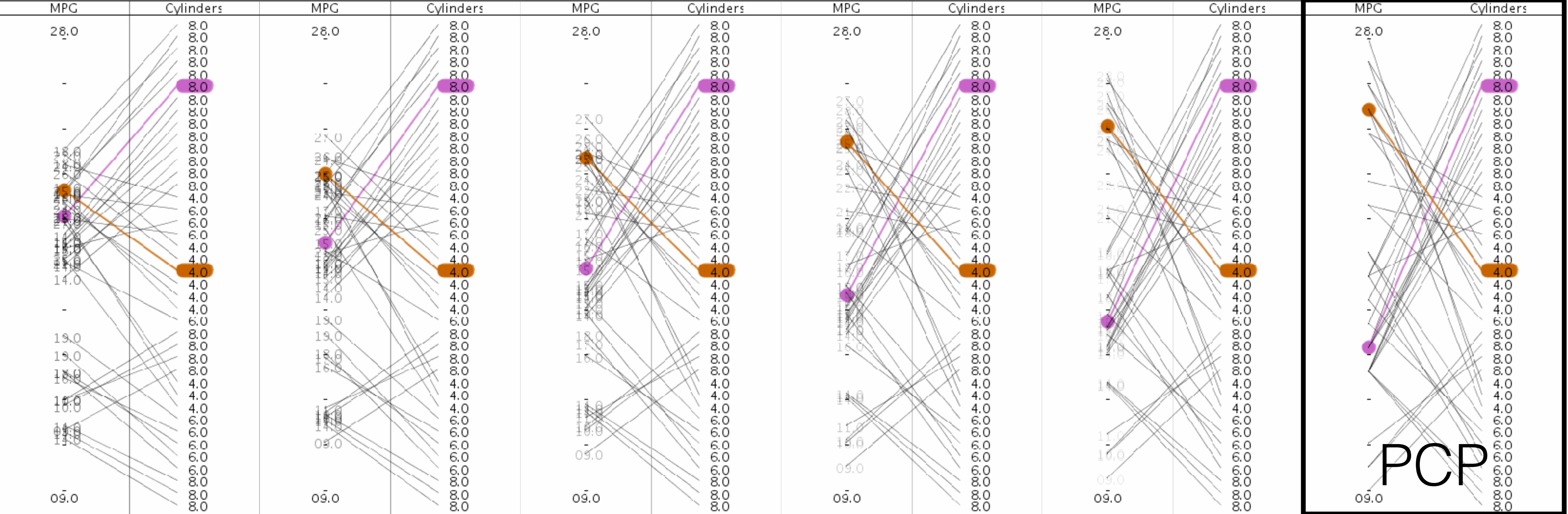
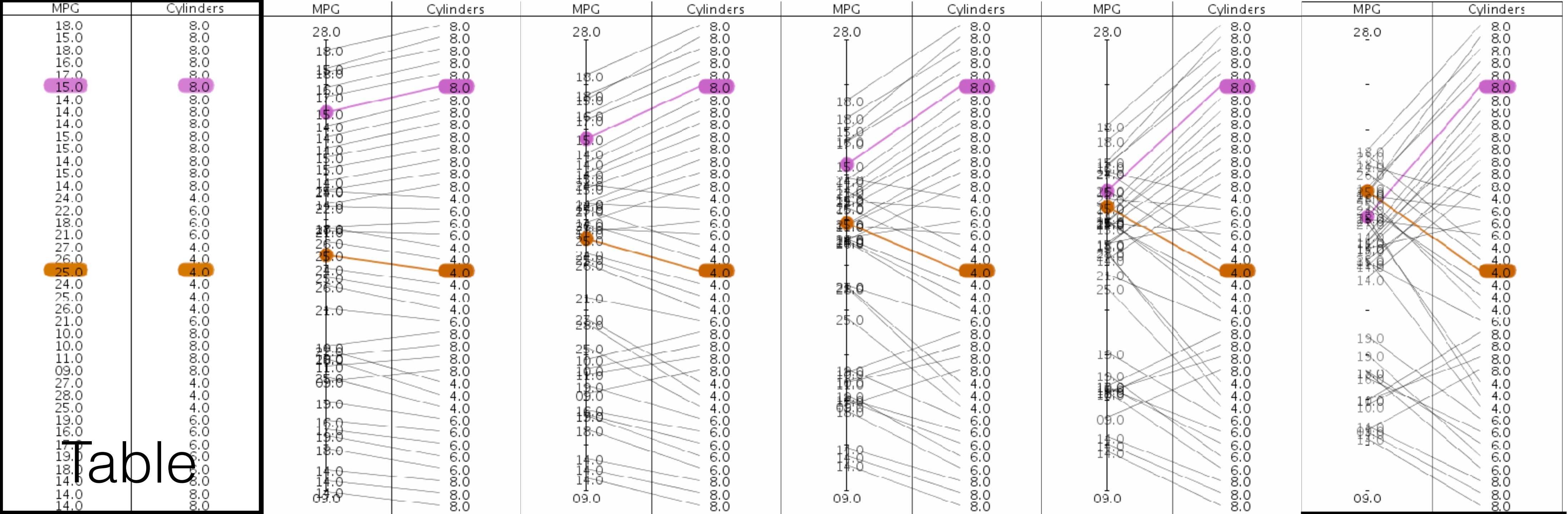


Hyperbox

Animate

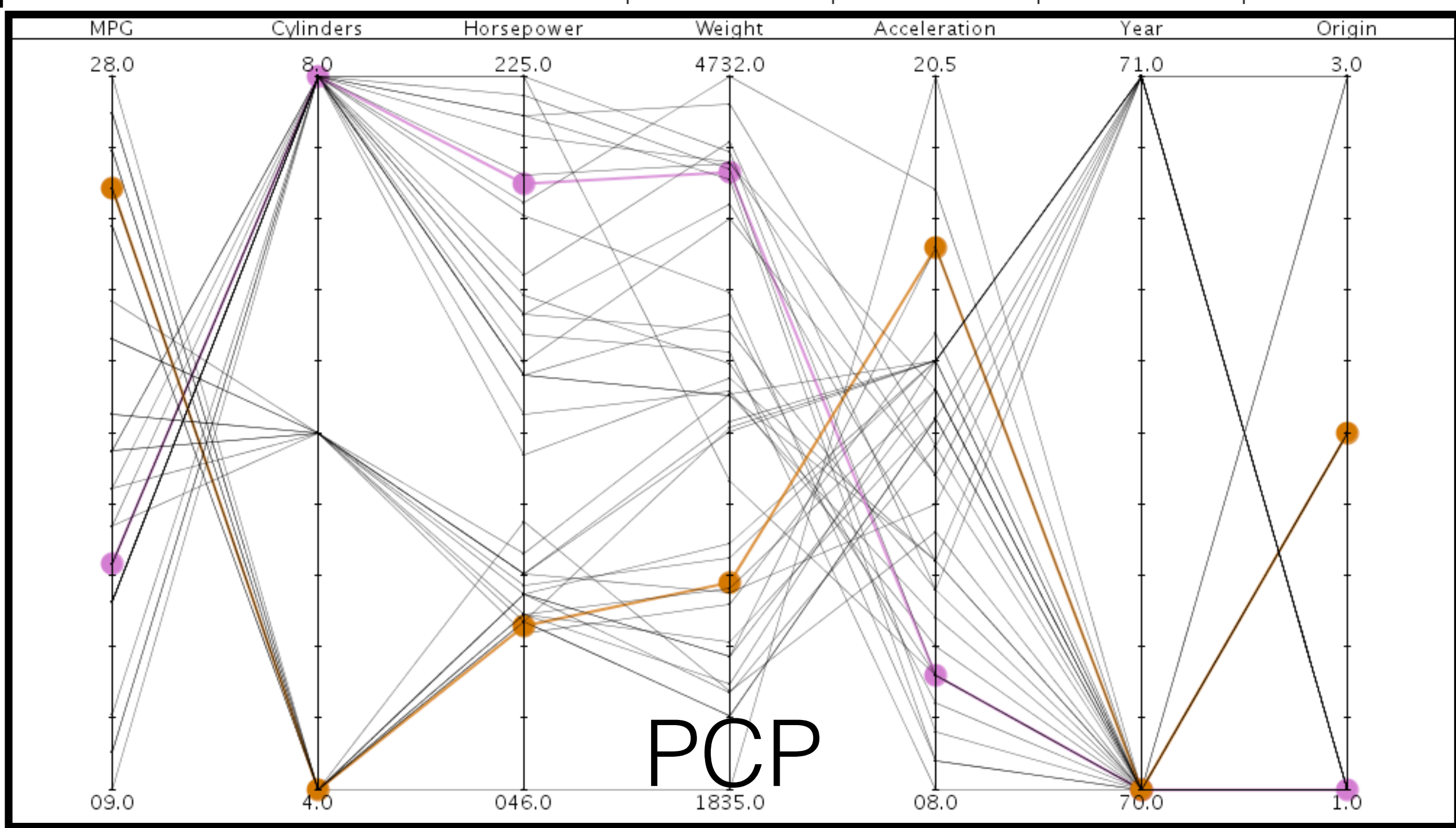
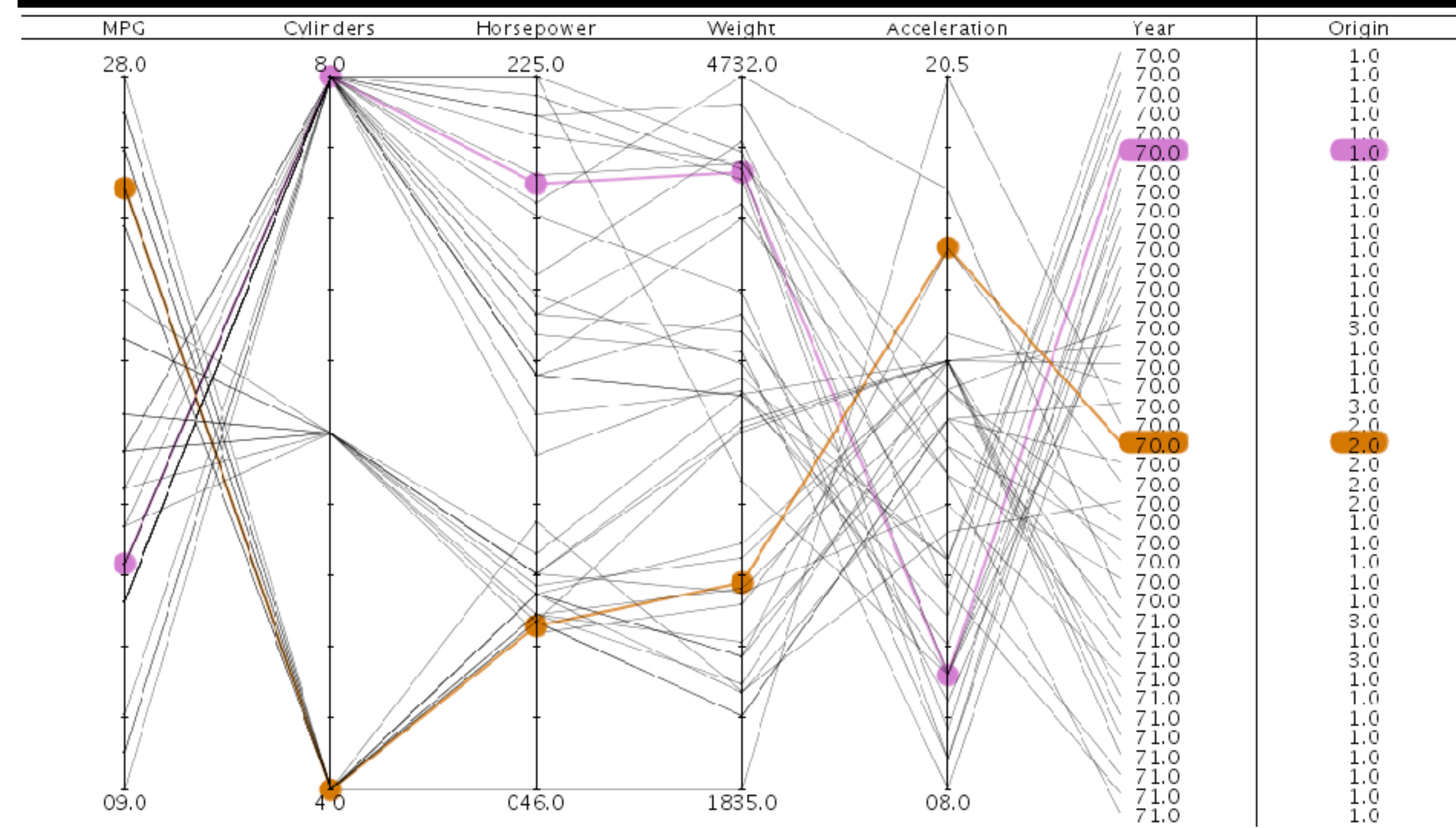
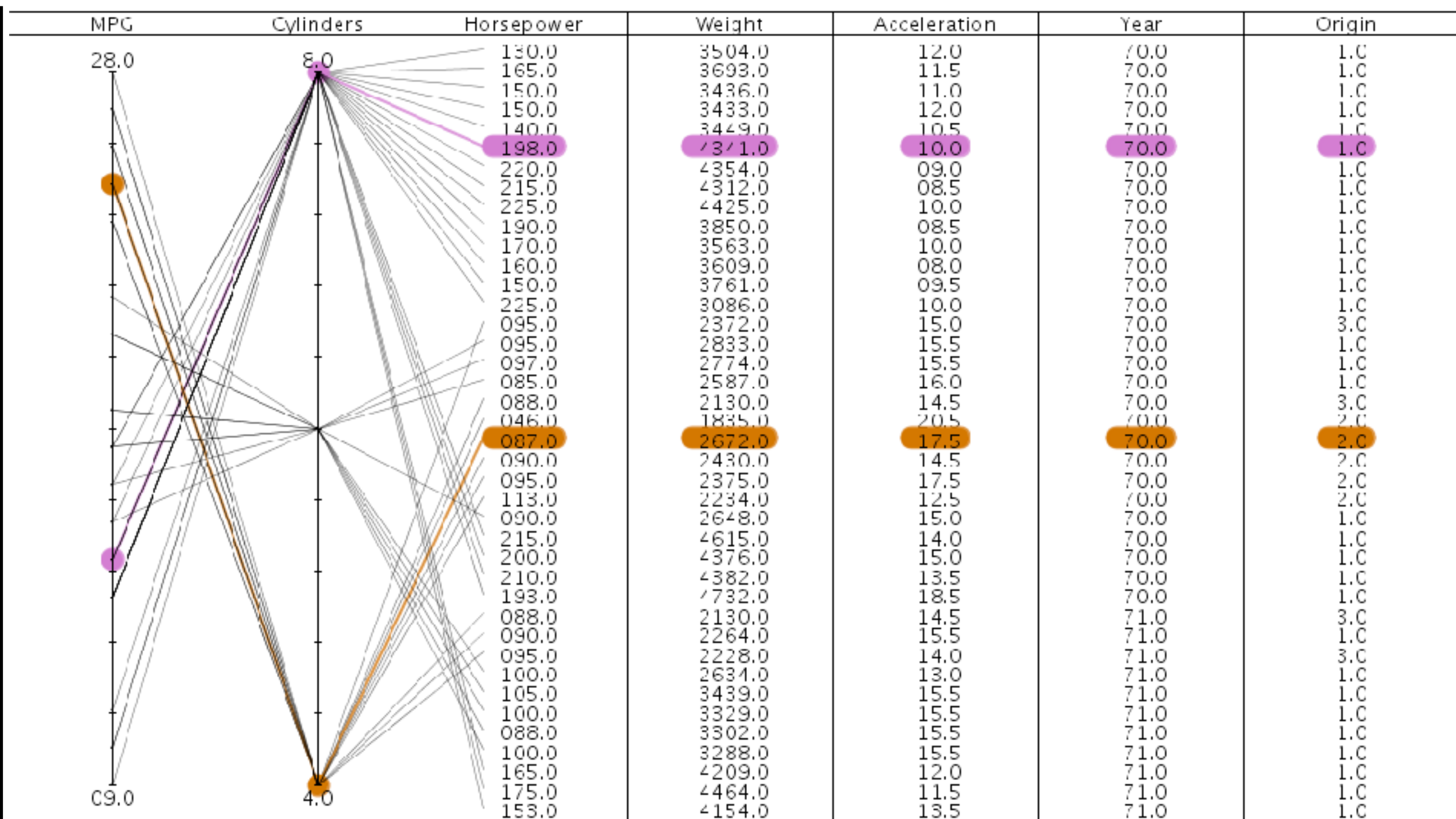
SPLM >





MPG	Cylinders	Horsepower	Weight	Acceleration	Year	Origin
18.0	8.0	130.0	3504.0	12.0	70.0	1.0
15.0	8.0	165.0	3693.0	11.5	70.0	1.0
18.0	8.0	150.0	3436.0	11.0	70.0	1.0
16.0	8.0	150.0	3433.0	12.0	70.0	1.0
17.0	8.0	140.0	3449.0	10.5	70.0	1.0
15.0	8.0	198.0	4341.0	10.0	70.0	1.0
14.0	8.0	220.0	4354.0	09.0	70.0	1.0
14.0	8.0	215.0	4312.0	08.5	70.0	1.0
14.0	8.0	225.0	4425.0	10.0	70.0	1.0
15.0	8.0	190.0	3850.0	08.5	70.0	1.0
15.0	8.0	170.0	3563.0	10.0	70.0	1.0
14.0	8.0	160.0	3609.0	08.0	70.0	1.0
15.0	8.0	150.0	3761.0	09.5	70.0	1.0
14.0	8.0	225.0	3086.0	10.0	70.0	1.0
24.0	4.0	095.0	2372.0	15.0	70.0	3.0
22.0	6.0	095.0	2833.0	15.5	70.0	1.0
18.0	6.0	097.0	2774.0	15.5	70.0	1.0
21.0	6.0	085.0	2587.0	16.0	70.0	1.0
27.0	4.0	088.0	2130.0	14.5	70.0	3.0
26.0	4.0	046.0	1835.0	20.5	70.0	2.0
25.0	4.0	087.0	2672.0	17.5	70.0	2.0
24.0	4.0	090.0	2430.0	14.5	70.0	2.0
25.0	4.0	095.0	2375.0	17.5	70.0	2.0
26.0	4.0	113.0	2234.0	12.5	70.0	2.0
21.0	6.0	090.0	2648.0	15.0	70.0	1.0
10.0	8.0	215.0	4615.0	14.0	70.0	1.0
10.0	8.0	200.0	4376.0	15.0	70.0	1.0
11.0	8.0	210.0	4382.0	13.5	70.0	1.0
09.0	8.0	193.0	4732.0	18.5	70.0	1.0
27.0	4.0	088.0	2130.0	14.5	71.0	3.0
28.0	4.0	090.0	2264.0	15.5	71.0	1.0
25.0	4.0	095.0	2228.0	14.0	71.0	3.0
19.0	6.0	100.0	2634.0	13.0	71.0	1.0
16.0	6.0	105.0	3439.0	15.5	71.0	1.0
17.0	6.0	100.0	3329.0	15.5	71.0	1.0
19.0	6.0	088.0	3329.0	15.5	71.0	1.0
18.0	6.0	100.0	3288.0	15.5	71.0	1.0
14.0	8.0	165.0	4209.0	12.0	71.0	1.0
14.0	8.0	175.0	4464.0	11.5	71.0	1.0
14.0	8.0	153.0	4154.0	13.5	71.0	1.0

Table



PCP

Animate

Data Table >

MPG	Cylinders	Horsepower	Weight	Acceleration	Year	Origin
18.0	8.0	130.0	3504.0	12.0	70.0	1.0
15.0	8.0	165.0	3693.0	11.5	70.0	1.0
18.0	8.0	150.0	3436.0	11.0	70.0	1.0
16.0	8.0	150.0	3433.0	12.0	70.0	1.0
17.0	8.0	140.0	3449.0	10.5	70.0	1.0
15.0	8.0	198.0	4341.0	10.0	70.0	1.0
14.0	8.0	220.0	4354.0	09.0	70.0	1.0
14.0	8.0	215.0	4312.0	08.5	70.0	1.0
14.0	8.0	225.0	4425.0	10.0	70.0	1.0
15.0	8.0	190.0	3850.0	08.5	70.0	1.0
15.0	8.0	170.0	3563.0	10.0	70.0	1.0
14.0	8.0	160.0	3609.0	08.0	70.0	1.0
15.0	8.0	150.0	3761.0	09.5	70.0	1.0
14.0	8.0	225.0	3086.0	10.0	70.0	1.0
24.0	4.0	095.0	2372.0	15.0	70.0	3.0
22.0	6.0	095.0	2833.0	15.5	70.0	1.0
18.0	6.0	097.0	2774.0	15.5	70.0	1.0
21.0	6.0	085.0	2587.0	16.0	70.0	1.0
27.0	4.0	088.0	2130.0	14.5	70.0	3.0
26.0	4.0	046.0	1835.0	20.5	70.0	2.0
25.0	4.0	087.0	2672.0	17.5	70.0	2.0
24.0	4.0	090.0	2430.0	14.5	70.0	2.0
25.0	4.0	095.0	2375.0	17.5	70.0	2.0
26.0	4.0	113.0	2234.0	12.5	70.0	2.0
21.0	6.0	090.0	2648.0	15.0	70.0	1.0
10.0	8.0	215.0	4615.0	14.0	70.0	1.0
10.0	8.0	200.0	4376.0	15.0	70.0	1.0
11.0	8.0	210.0	4382.0	13.5	70.0	1.0
09.0	8.0	193.0	4732.0	18.5	70.0	1.0
27.0	4.0	088.0	2130.0	14.5	71.0	3.0
28.0	4.0	090.0	2264.0	15.5	71.0	1.0
25.0	4.0	095.0	2228.0	14.0	71.0	3.0
19.0	6.0	100.0	2634.0	13.0	71.0	1.0
16.0	6.0	105.0	3439.0	15.5	71.0	1.0
17.0	6.0	100.0	3329.0	15.5	71.0	1.0
19.0	6.0	088.0	3302.0	15.5	71.0	1.0
18.0	6.0	100.0	3288.0	15.5	71.0	1.0
14.0	8.0	165.0	4209.0	12.0	71.0	1.0
14.0	8.0	175.0	4464.0	11.5	71.0	1.0
14.0	8.0	153.0	4154.0	13.5	71.0	1.0

1st dataset

Source Visualization



Morphs



Target Visualization



Visual Understanding Study



1st dataset

2nd dataset

Source Visualization

S_{1M}

Morphs

Target Visualization

T_1

T_{1M}

T_2

Visual Understanding Study

Data Understanding Study

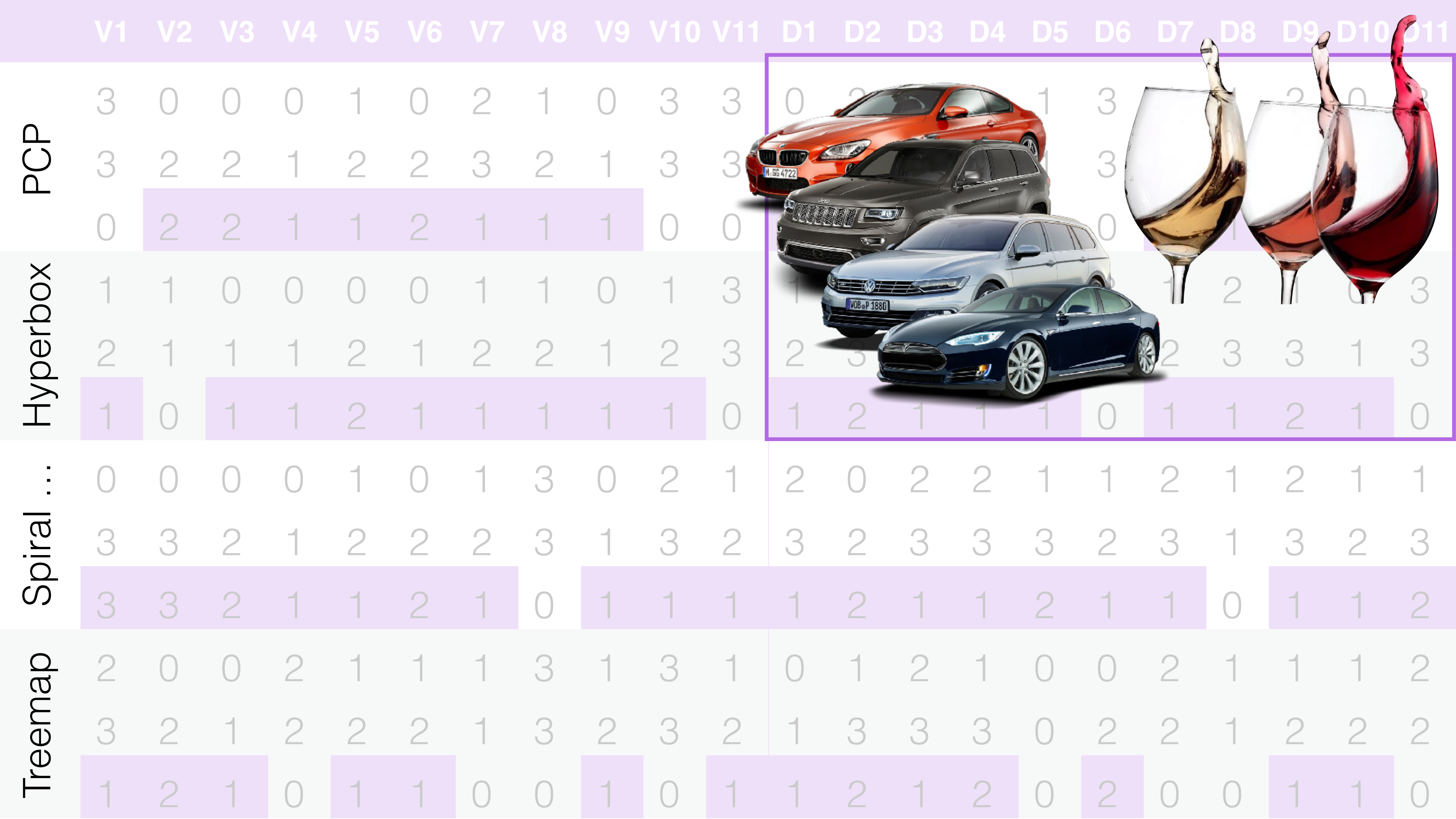
Target Vis	Visual Understanding Study	Data Understanding Study
PCP	<ol style="list-style-type: none"> 1. The MPG of the orange-highlighted car is roughly 40% of its range. 2. There is just one line at the top of the acceleration scale. 3. Heavier cars are faster. 	<ol style="list-style-type: none"> 1. The number of cylinders of the orange-highlighted car is 4, one fifth between 3 and 8. 2. Many cars have the same numbers of cylinders, mostly even numbers particularly 4 and 8. 3. Heavier cars have more cylinders and hence more horsepower and speed.
Hyperbox	~	~
Spiral ...	~	~
Treemap	~	~

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
PCP	3	0	0	0	1	0	2	1	0	3	3	0	2	3	1	1	3	1	1	2	0	3
	3	2	2	1	2	2	3	2	1	3	3	2	3	3	3	1	3	2	2	3	2	3
	0	2	2	1	1	2	1	1	1	0	0	2	1	0	2	0	0	1	1	1	2	0
Hyperbox	1	1	0	0	0	0	1	1	0	1	3	1	1	2	2	0	3	1	2	1	0	3
	2	1	1	1	2	1	2	2	1	2	3	2	3	3	3	1	3	2	3	3	1	3
	1	0	1	1	30 mins			1	1	1	0	1	2	1	1	60 mins		1	2	1	0	
Spiral ...	0	0	0	0	on average			3	0	2	1	2	0	2	2	on average		1	2	1	1	
	3	3	2	1	2	2	2	3	1	3	2	3	2	3	3	2	3	1	3	2	3	
	3	3	2	1	1	2	1	0	1	1	1	1	2	1	1	2	1	1	0	1	1	2
Treemap	2	0	0	2	1	1	1	3	1	3	1	0	1	2	1	0	0	2	1	1	1	2
	3	2	1	2	2	2	1	3	2	3	2	1	3	3	3	0	2	2	1	2	2	2
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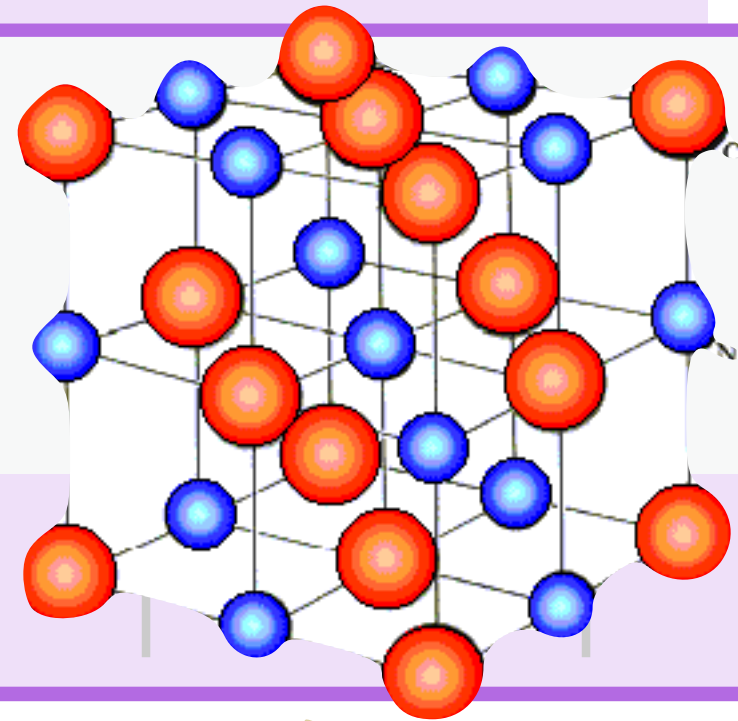
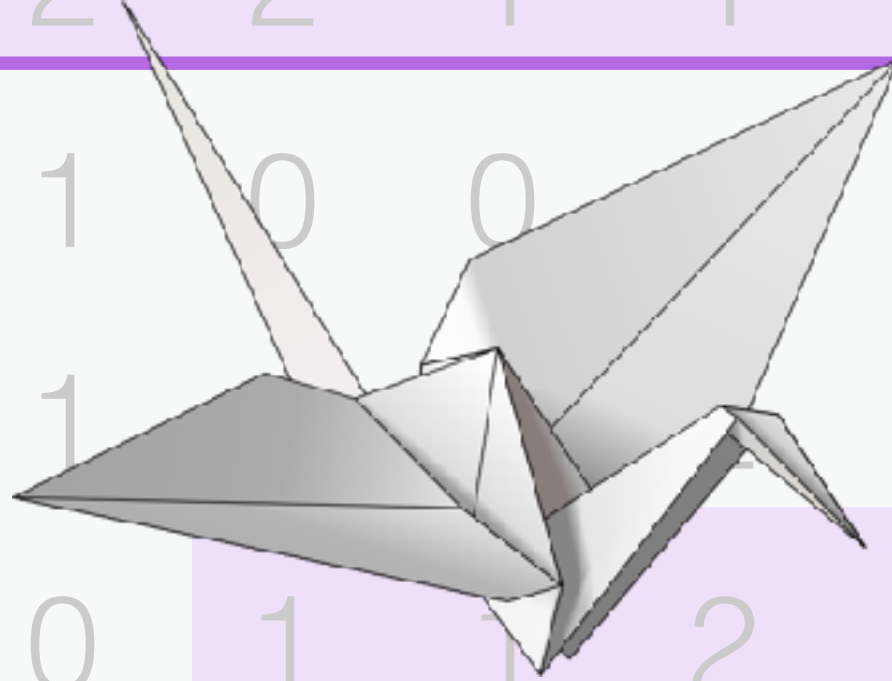
	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
PCP	3	0	0	0	1	0	2	1	0	3	3	0	2	3	1	1	3	1	1	2	0	3
	3	2	2	1	2	2	3	2	1	3	3	2	3	3	3	1	3	2	2	3	2	3
	0	2	2	1	1	2	1	1	1	0	0	2	1	0	2	0	0	1	1	1	2	0
Hyperbox	1	1	0	0	0	0	1	1	0	1	3	1	1	2	2	0	3	1	2	1	0	3
	2	1	1	1	2	1	2	2	1	2	3	2	3	3	3	1	3	2	3	3	1	3
	1	0	1	1	2	1	1	1	1	1	0	1	2	1	1	1	0	1	1	2	1	0
Spiral ∴	0	0	0	0	1	0	1	3	0	2	1	2	0	2	2	1	1	2	1	2	1	1
	3	3	2	1	2	2	2	3	1	3	2	3	2	3	3	3	2	3	1	3	2	3
	3	3	2	1	1	2	1	0	1	1	1	1	2	1	1	2	1	1	0	1	1	2
Treemap	2	0	0	2	1	1	1	3	1	3	1	0	1	2	1	0	0	2	1	1	1	2
	3	2	1	2	2	2	1	3	2	3	2	1	3	3	3	0	2	2	1	2	2	2
	1	2	1	0	1	1	0	0	1	0	1	1	2	1	2	0	2	0	0	1	1	0

	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
PCP	3	0	0	0	1	0	2	1	0	3	3	0	2	3	1	1	3	1	1	2	0	3
	3	2	2	1	2	2	3	2	1	3	3	2	3	3	3	1	3	2	2	3	2	3
	0	2	2	1	1	2	1	1	1	0	0	2	1	0	2	0	0	1	1	1	2	0
Hyperbox	1	1	0	0	0	0	1	1	0	1	3	1	1	2	2	0	3	1	2	1	0	3
	2	1	1	1	2	1	2	2	1	2	3	2	3	3	3	1	3	2	3	3	1	3
	1	0	1	1	2	1	1	1	1	1	0	1	2	1	1	1	0	1	1	2	1	0
Spiral ∴	0	0	0	0	1	0	1	3	0	2	1	2	0	2	2	1	1	2	1	2	1	1
	3	3	2	1	2	2	2	3	1	3	2	3	2	3	3	3	2	3	1	3	2	3
	3	3	2	1	1	2	1	0	1	1	1	1	2	1	1	2	1	1	0	1	1	2
Treemap	2	0	0	2	1	1	1	3	1	3	1	0	1	2	1	0	0	2	1	1	1	2
	3	2	1	2	2	2	1	3	2	3	2	1	3	3	3	0	2	2	1	2	2	2
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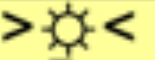


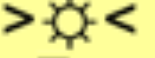




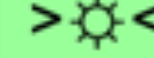
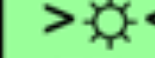














































	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
PCP	3	0	0	0	1	0	2	1	0	3	3	0	2	3	1	1	3	1	1	2	0	3
	3	2	2	1	2	2	3	2	1	3	3	2	3	3	3	1	3	2	2	3	2	3
	0	2	2	1	1	2	1	1	1	0	0	2	1	0	2	0	0	1	1	1	2	0
Hyperbox	1	1	0	0	0	0	1	1	0	1	3	1	1	2	2	0	3	1	2	1	0	3
	2	1	1	1	2	1	2	2	1	2	3	2	3	3	3	1	3	2	3	3	1	3
	1	0	1	1	2	1	1	1	1	1	0	1	2	1	1	1	0	1	1	2	1	0
Spiral ..	0	0	0	0	1	0	1	3	0	2	1	2	0	2	2	1	1	2	1	2	1	1
	3	3	2	1	2	2	2	3	1	3	2	3	2	3	3	3	2	3	1	3	2	3
	3	3	2	1	1	2	1	0	1	1	1	1	2	1	1	2	1	1	0	1	1	2
Treemap	2	0	0	2	1	1	1	3	1	3	1	0	1	2	1	0	0	2	1	1	1	2
	3	2	1	2	2	2	1	3	2	3	2	1	3	3	3	0	2	2	1	2	2	2
	1	2	1	0	1	1	0	0	1	0	1	1	2	1	2	0	2	0	0	1	1	0



	V1	V2	V3	V4	V5	V6	V7	V8	V9	V10	V11	D1	D2	D3	D4	D5	D6	D7	D8	D9	D10	D11
PCP	3	0	0	0	1	0	2	1	0	3	3	0	2	3	1	1	3	1	1	2	0	3
	3	2	2	1	2	2	3	2	1	3	3	2	3	3	3	1	3	2	2	3	2	3
	0	2	2	1	1	2	1	1	1	0	0	2	1	0	2	0	0	1	1	1	2	0
Hyperbox	1	1	0	0	0	0	0	0	0	1	3	1	1	2	2	0	3	1	2	1	0	3
	2	1	0	0	0	1	0	0	0	2	3	2	3	3	3	1	3	2	3	3	1	3
	1	0	1	1	2	1	1	1	1	1	0	1	2	1	1	1	0	1	1	2	1	0
Spiral ...	0	0	0	0	1	0	1	3	0	2	1	2	0	2	2	1	1	2	1	2	1	1
	3	3	0	0	0	2	0	0	1	3	2	3	2	3	3	3	2	3	1	3	2	3
	3	3	2	2	1	2	1	1	1	1	1	1	2	1	1	2	1	1	0	1	1	2
Treemap	2	0	0	0	1	1	0	0	0	3	1	0	1	2	1	0	0	2	1	1	1	2
	3	2	0	0	0	2	0	0	0	3	2	1	3	3	3	0	2	2	1	2	2	2
	1	2	0	0	0	1	0	0	0	0	1	1	2	1	2	0	2	0	0	1	1	0



A PERIODIC TABLE OF VISUALIZATION METHODS

 C continuum																 G graphic facilitation	
 Tb table	 Ca cartesian coordinates																 Ct cartoon
 Pi pie chart	 L line chart																 Ri rich picture
 B bar chart	 Ac area chart	 R radar chart cobweb	 Pa parallel coordinates	 Hy hyperbolic tree	 Cy cycle diagram	 T timeline	 Ve venn diagram	 Mi mindmap	 Sq square of oppositions	 Cc concentric circles	 Ar argument slide	 Sw swim lane diagram	 Gc gant chart	 Pm perspectives diagram	 D dilemma diagram	 Pr parameter ruler	 Kn knowledge map
 Hi histogram	 Sc scatterplot	 Sa sankey diagram	 In information lense	 E entity relationship diagram	 Pt petri net	 Fl flow chart	 Cl clustering	 Lc layer chart	 Py minto pyramid technique	 Ce cause-effect chains	 Tl toulmin map	 Dt decision tree	 Cp cpm critical path method	 Cf concept fan	 Co concept map	 Ic iceberg	 Lm learning map
 Tk tukey box plot	 Sp spectrogram	 Da data map	 Tp treemap	 Cn cone tree	 Sy system dyn./simulation	 Df data flow diagram	 Se semantic network	 So soft system modeling	 Sn synergy map	 Fo force field diagram	 Ib ibis argumentation map	 Pr process event chains	 Pe pert chart	 Ev evocative knowledge map	 V Vee diagram	 Hh heaven 'n' hell chart	 I infomural

Data Visualization
Visual representations of quantitative data in schematic form (either with or without axes)

Strategy Visualization
The systematic use of complementary visual representations in the analysis, development, formulation, communication, and implementation of strategies in organizations.

Information Visualization
The use of interactive visual representations of data to amplify cognition. This means that the data is transformed into an image, it is mapped to screen space. The image can be changed by users as they proceed working with it

Metaphor Visualization
Visual Metaphors position information graphically to organize and structure information. They also convey an insight about the represented information through the key characteristics of the metaphor that is employed

Concept Visualization
Methods to elaborate (mostly) qualitative concepts, ideas, plans, and analyses.

Compound Visualization
The complementary use of different graphic representation formats in one single schema or frame

 **Cy** **Process Visualization**

 **Hy** **Structure Visualization**

 **Overview**
 **Detail**

 **Detail AND Overview**



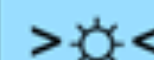
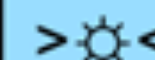


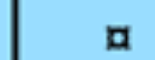





















 **Divergent thinking**

 **Convergent thinking**

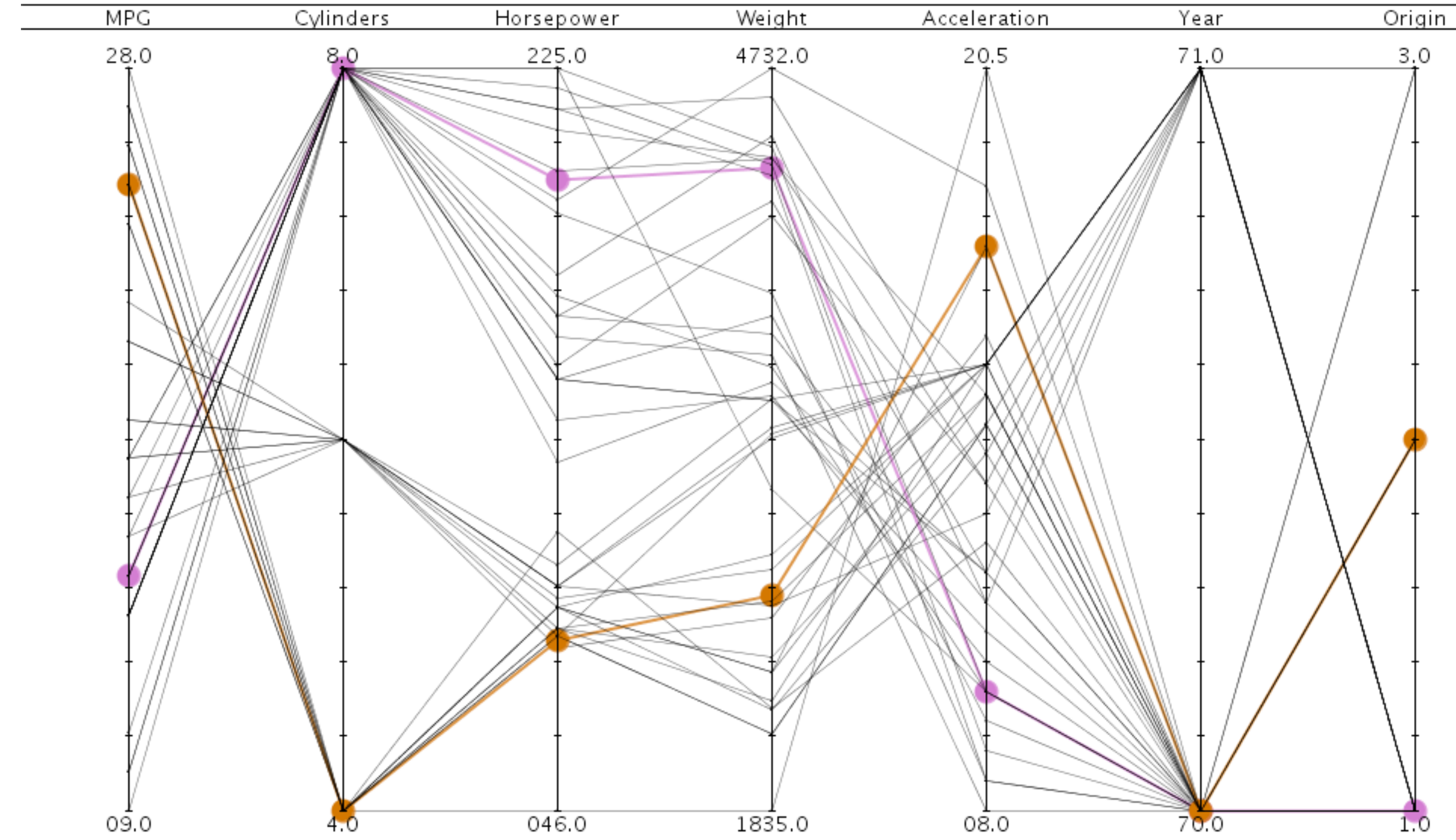
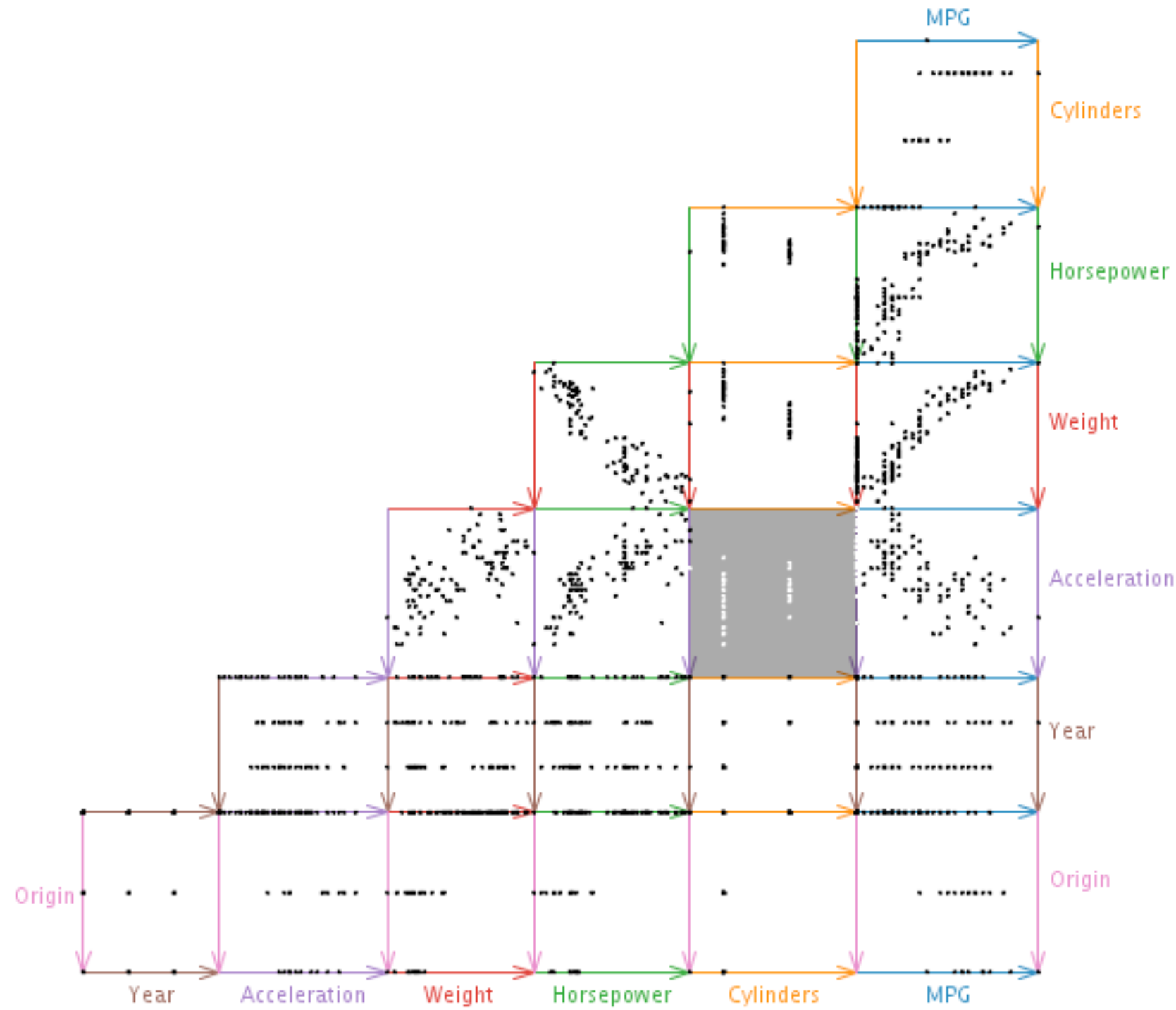
Note: Depending on your location and connection speed it can take some time to load a pop-up picture.

version 1.5

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 Su supply demand curve	 Pe performance charting	 St strategy map	 Oc organisation chart	 Ho house of quality	 Fd feedback diagram	 Ft failure tree	 Mq magic quadrant	 Ld life-cycle diagram	 Po porter's five forces	 S s-cycle	 Sm stakeholder map	 Is ishikawa diagram	 Tc technology roadmap
 Ed edgeworth box	 Pf portfolio diagram	 Sg strategic game board	 Mz mintzberg's organigraph	 Z zwicky's morphological box	 Ad affinity diagram	 De decision discovery diagram	 Bm bcg matrix	 Stc strategy canvas	 Vc value chain	 Hy hype-cycle	 Sr stakeholder rating map	 Ta taps	 Sd spray diagram

A PERIODIC TABLE OF VISUALIZATION METHODS



- Visualization**
- Overview**
 - Detail**
 - Detail AND Overview**
 - Divergent thinking**
 - Convergent thinking**

Su supply demand curve	Pe performance charting	St strategy map	Oc organisation chart	Ho house of quality	Fd feedback diagram	Ft failure tree	Mq magic quadrant	Ld life-cycle diagram	Po porter's five forces	S s-cycle	Sm stakeholder map	Is ishikawa diagram	Tc technology roadmap
Ed edgeworth box	Pf portfolio diagram	Sg strategic game board	Mz mintzberg's organigraph	Z zwicky's morphological box	Ad affinity diagram	De decision discovery diagram	Bm bcg matrix	Stc strategy canvas	Vc value chain	Hy hype-cycle	Sr stakeholder rating map	Ta taps	Sd spray diagram

Learning Visualizations by Analogy

Promoting Visual Literacy through Visualization Morphing

<http://tinyurl.com/VisAnalogy>

