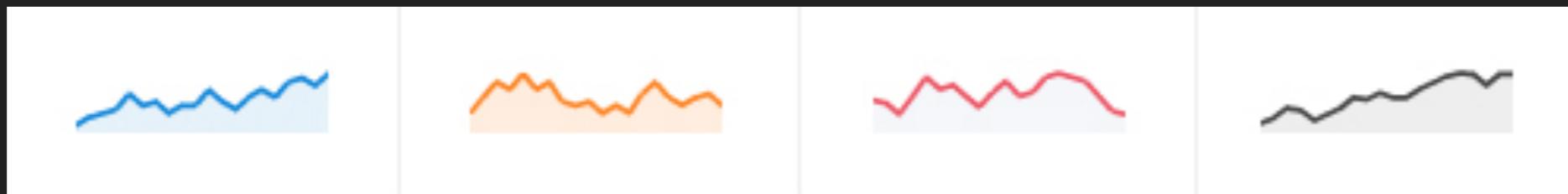


LECTURE 09

High-Dimensional Visualization

Univariate

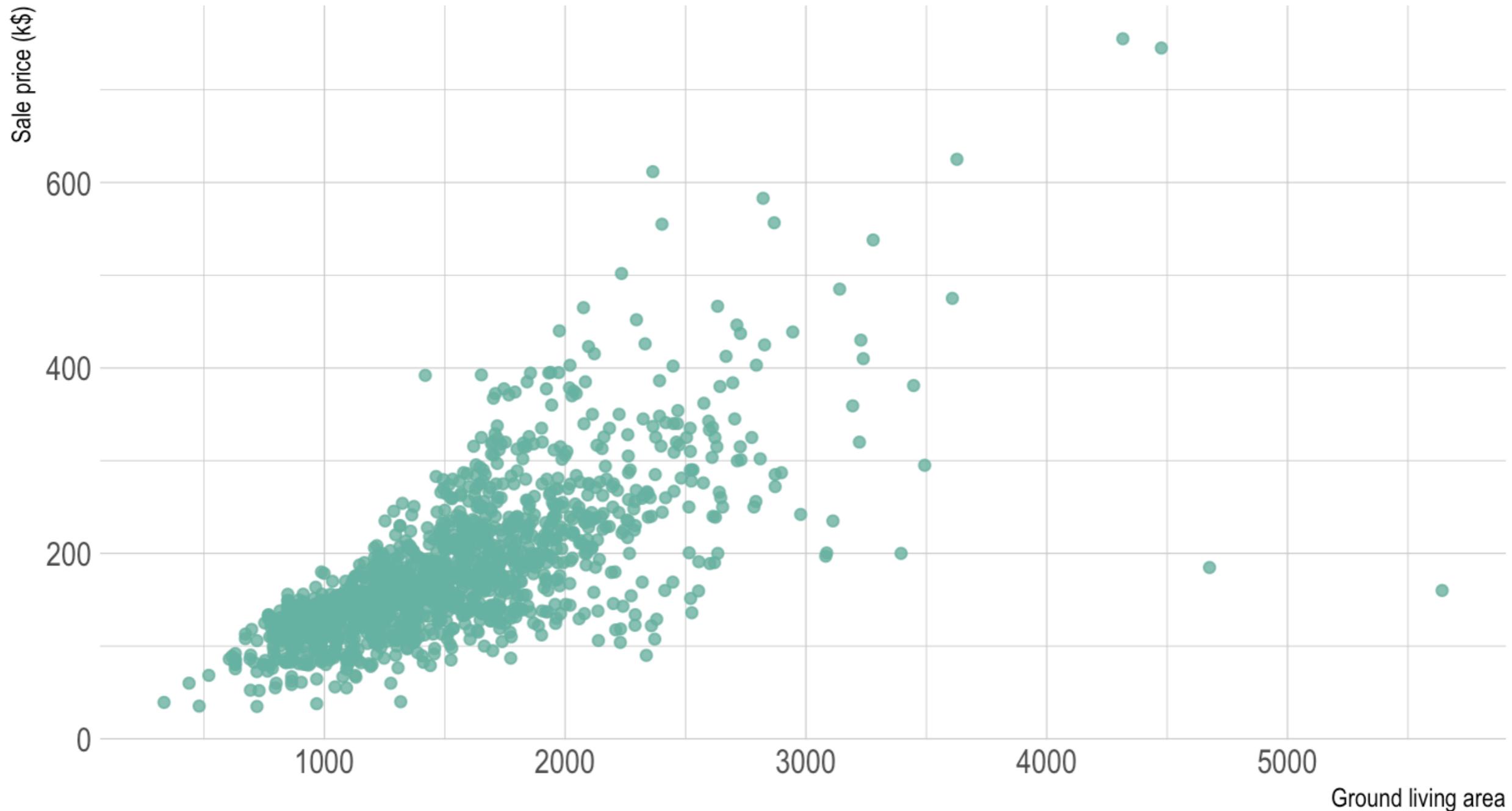


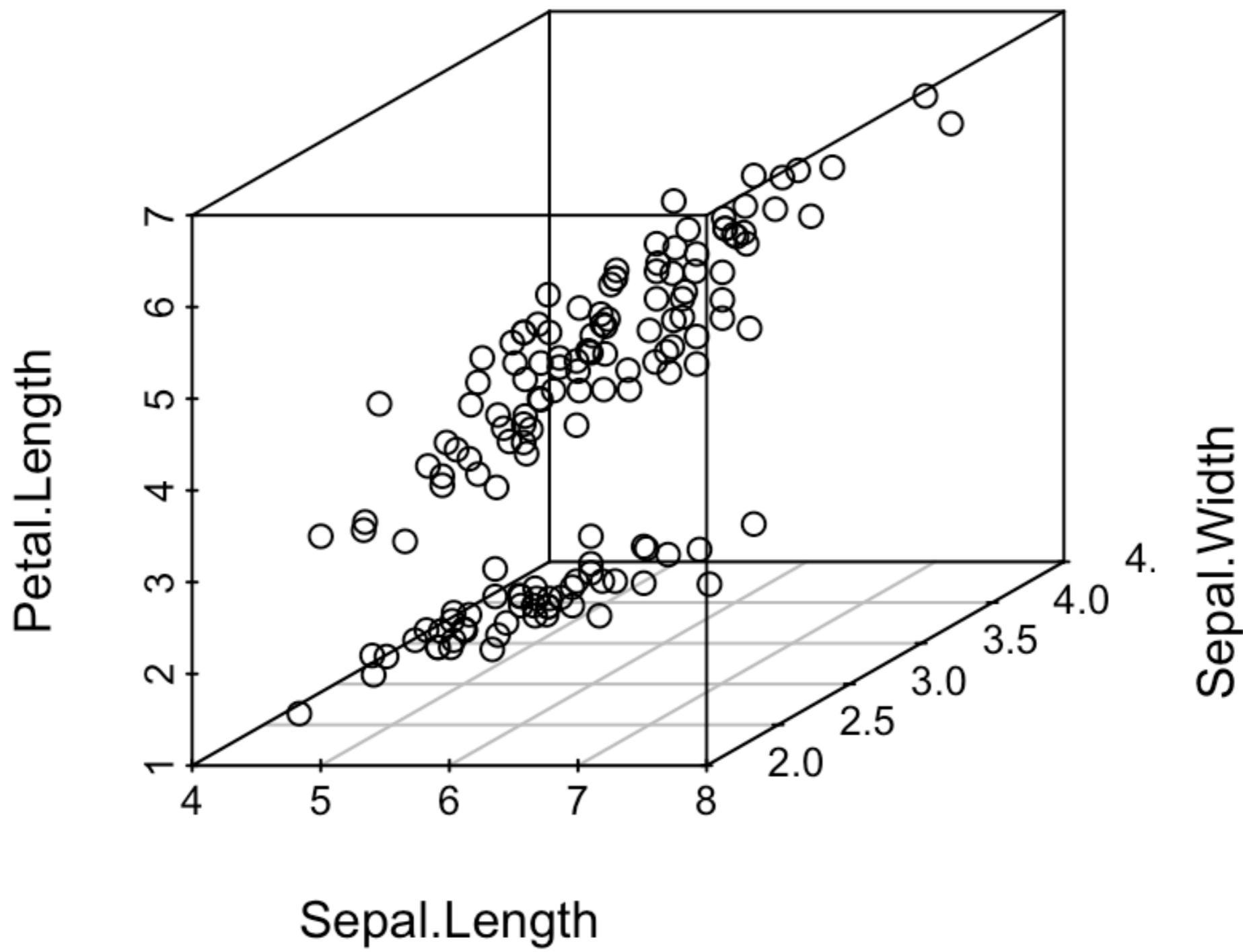
STOCK MARKET ANALYSIS - OCT 2018

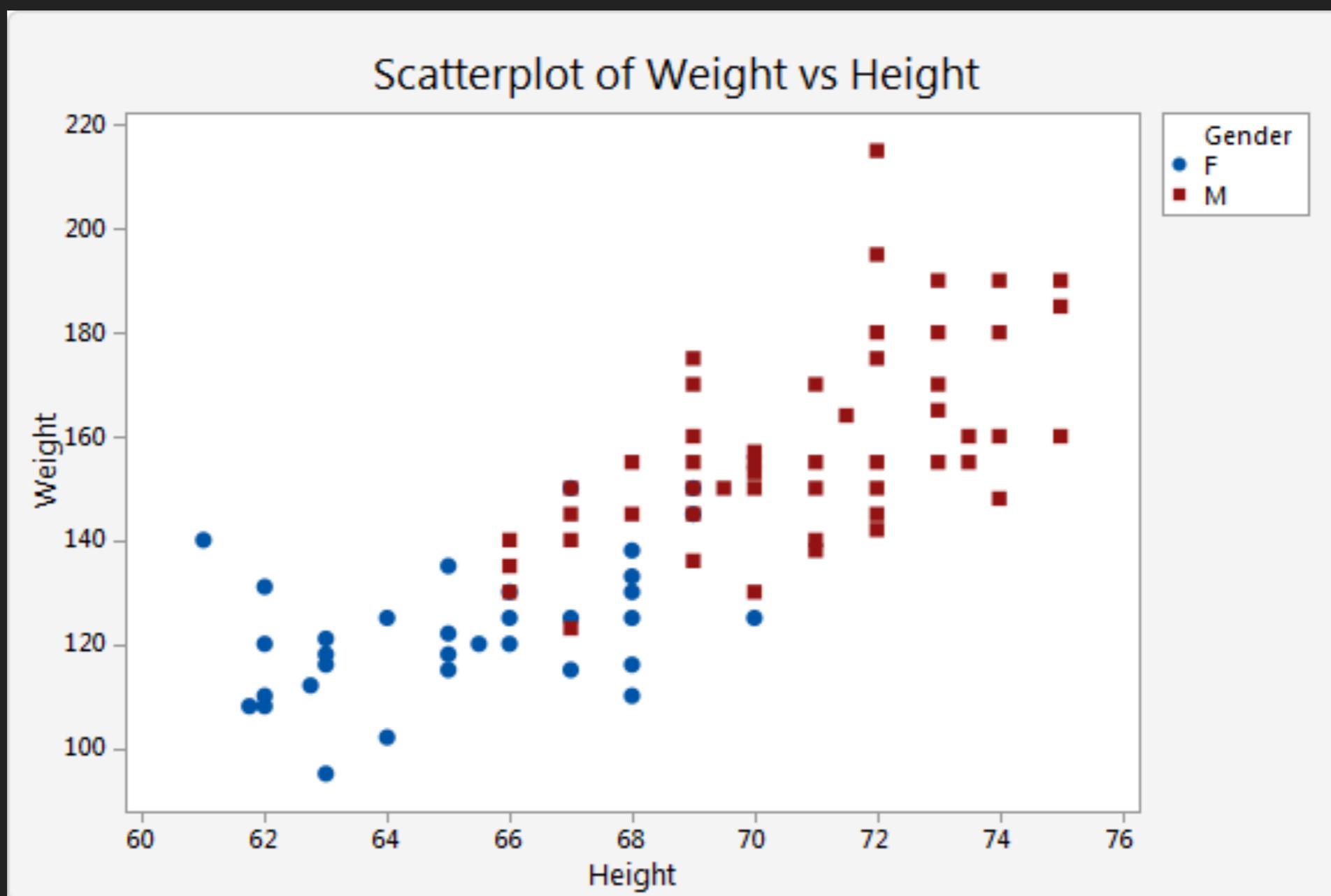
Company	Latest Week Volume	Prior Week Volume	Change	% Change	Volume Trend Last 31 days as of 31-10-2018
 G	16,356,600	8,707,400	7,649,200	87.85%	
 f	195,375,400	103,700,700	91,674,700	88.40%	
 Apple	198,068,600	174,145,400	23,923,200	13.74%	
 a	60,965,900	29,933,500	31,032,400	103.67%	
 DELL	6,393,500	8,870,600	2,477,100	27.92%	
 Microsoft	288,745,200	199,505,500	89,239,700	44.73%	
 hp	52,925,900	50,509,900	2,416,000	4.78%	
 intel	228,612,200	161,738,200	66,874,000	41.35%	

bivariate

Ground living area partially explains sale price of apartments





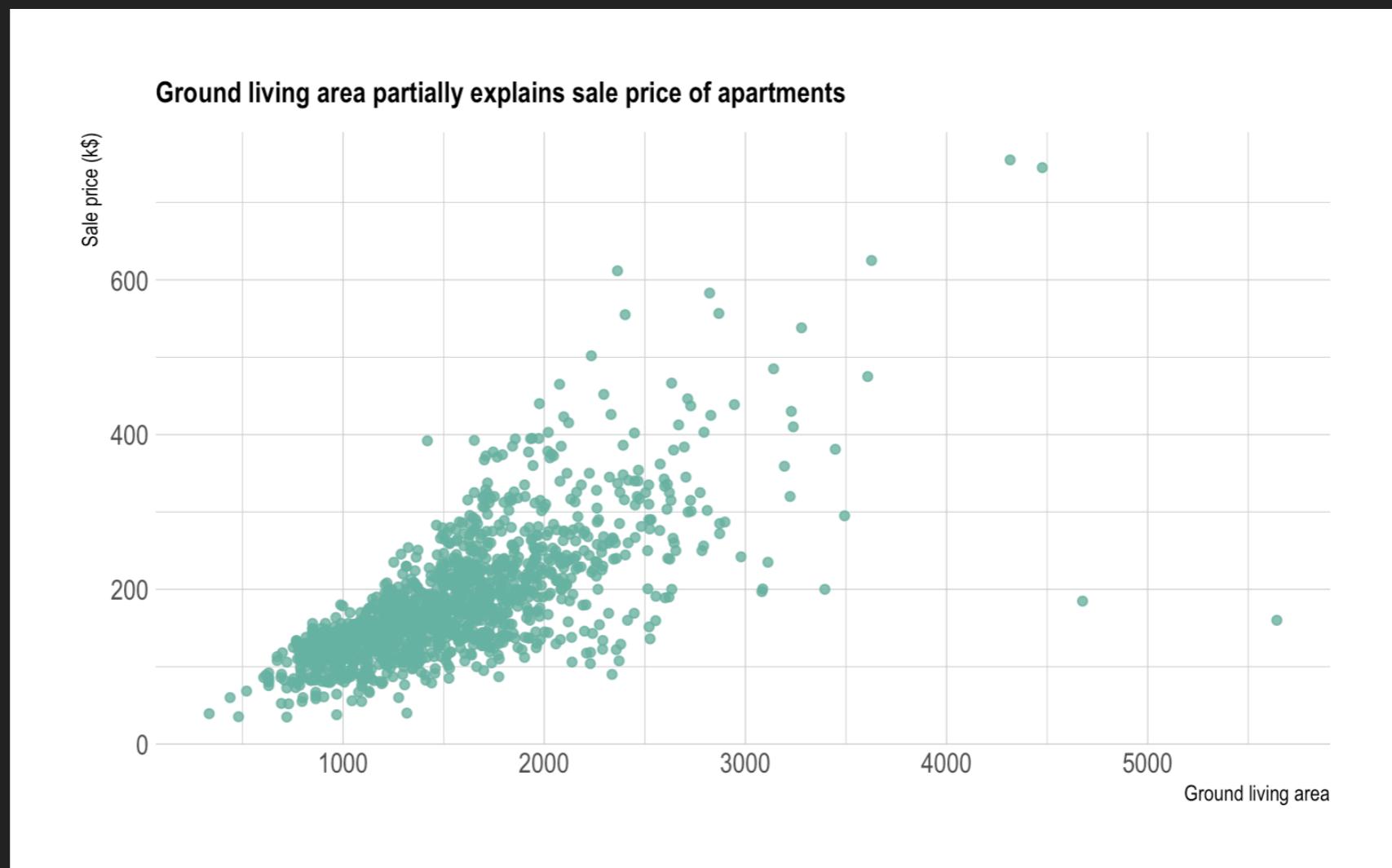


Multi-variate

Vehicle Name	Small/Sporty/ Compact/Large		Sports Car	SUV	Wagon	Minivan	Pickup	AWD	RWD	Retail Price	Dealer Cost	Engine Size (l)	Cyl	HP	City MPG	Hwy MPG	Wheel Base			Len	Width
	Sedan	Coupe															Weight	Front Wheel Base	Rear Wheel Base		
Toyota 4Runner SR5 V6	0	0	1	0	0	0	0	0	0	27710	24801	4	6	245	18	21	4035	110	189	74	
Toyota Avalon XL 4dr	1	0	0	0	0	0	0	0	0	26560	23693	3	6	210	21	29	3417	107	192	72	
Toyota Avalon XLS 4dr	1	0	0	0	0	0	0	0	0	30920	27271	3	6	210	21	29	3439	107	192	72	
Toyota Camry LE 4dr	1	0	0	0	0	0	0	0	0	19560	17558	2.4	4	157	24	33	3086	107	189	71	
Toyota Camry LE V6 4dr	1	0	0	0	0	0	0	0	0	22775	20325	3	6	210	21	29	3296	107	189	71	
Toyota Camry Solara SE 2dr	1	0	0	0	0	0	0	0	0	19635	17722	2.4	4	157	24	33	3175	107	193	72	
Toyota Camry Solara SE V6 2dr	1	0	0	0	0	0	0	0	0	21965	19819	3.3	6	225	20	29	3417	107	193	72	
Toyota Camry Solara SLE V6 2dr	1	0	0	0	0	0	0	0	0	26510	23908	3.3	6	225	20	29	3439	107	193	72	
Toyota Camry XLE V6 4dr	1	0	0	0	0	0	0	0	0	25920	23125	3	6	210	21	29	3362	107	189	71	
Toyota Celica GT-S 2dr	0	1	0	0	0	0	0	0	0	22570	20363	1.8	4	180	24	33	2500	102	171	68	
Toyota Corolla CE 4dr	1	0	0	0	0	0	0	0	0	14085	13065	1.8	4	130	32	40	2502	102	178	67	
Toyota Corolla LE 4dr	1	0	0	0	0	0	0	0	0	15295	13889	1.8	4	130	32	40	2524	102	178	67	
Toyota Corolla S 4dr	1	0	0	0	0	0	0	0	0	15030	13650	1.8	4	130	32	40	2524	102	178	67	
Toyota Echo 2dr auto	1	0	0	0	0	0	0	0	0	11560	10896	1.5	4	108	33	39	2085	93	163	65	
Toyota Echo 2dr manual	1	0	0	0	0	0	0	0	0	10760	10144	1.5	4	108	35	43	2035	93	163	65	
Toyota Echo 4dr	1	0	0	0	0	0	0	0	0	11290	10642	1.5	4	108	35	43	2055	93	163	65	
Toyota Highlander V6	0	0	1	0	0	0	0	1	0	27930	24915	3.3	6	230	18	24	3935	107	185	72	
Toyota Land Cruiser	0	0	1	0	0	0	0	1	0	54765	47986	4.7	8	325	13	17	5390	112	193	76	
Toyota Matrix XR	0	0	0	1	0	0	0	0	0	16695	15156	1.8	4	130	29	36	2679	102	171	70	
Toyota MR2 Spyder convertible 2dr	0	1	0	0	0	0	0	0	1	25130	22787	1.8	4	138	26	32	2195	97	153	67	
Toyota Prius 4dr (gas/electric)	1	0	0	0	0	0	0	0	0	20510	18926	1.5	4	110	59	51	2890	106	175	68	
Toyota RAV4	0	0	1	0	0	0	0	1	0	20290	18553	2.4	4	161	22	27	3119	98	167	68	
Toyota Sequoia SR5	0	0	1	0	0	0	0	1	0	35695	31827	4.7	8	240	14	17	5270	118	204	78	
Toyota Sienna CE	0	0	0	0	0	1	0	0	0	23495	21198	3.3	6	230	19	27	4120	119	200	77	
Toyota Sienna XLE Limited	0	0	0	0	0	1	0	0	0	28800	25690	3.3	6	230	19	27	4165	119	200	77	
Toyota Tacoma	0	0	0	0	0	0	1	0	1	12800	11879	2.4	4	142	22	27	2750	103	*	*	
Toyota Tundra Access Cab V6 SR5	0	0	0	0	0	0	1	1	0	25935	23520	3.4	6	190	14	17	4435	128	*	*	
Toyota Tundra Regular Cab V6	0	0	0	0	0	0	1	0	1	16495	14978	3.4	6	190	16	20	3925	128	*	*	

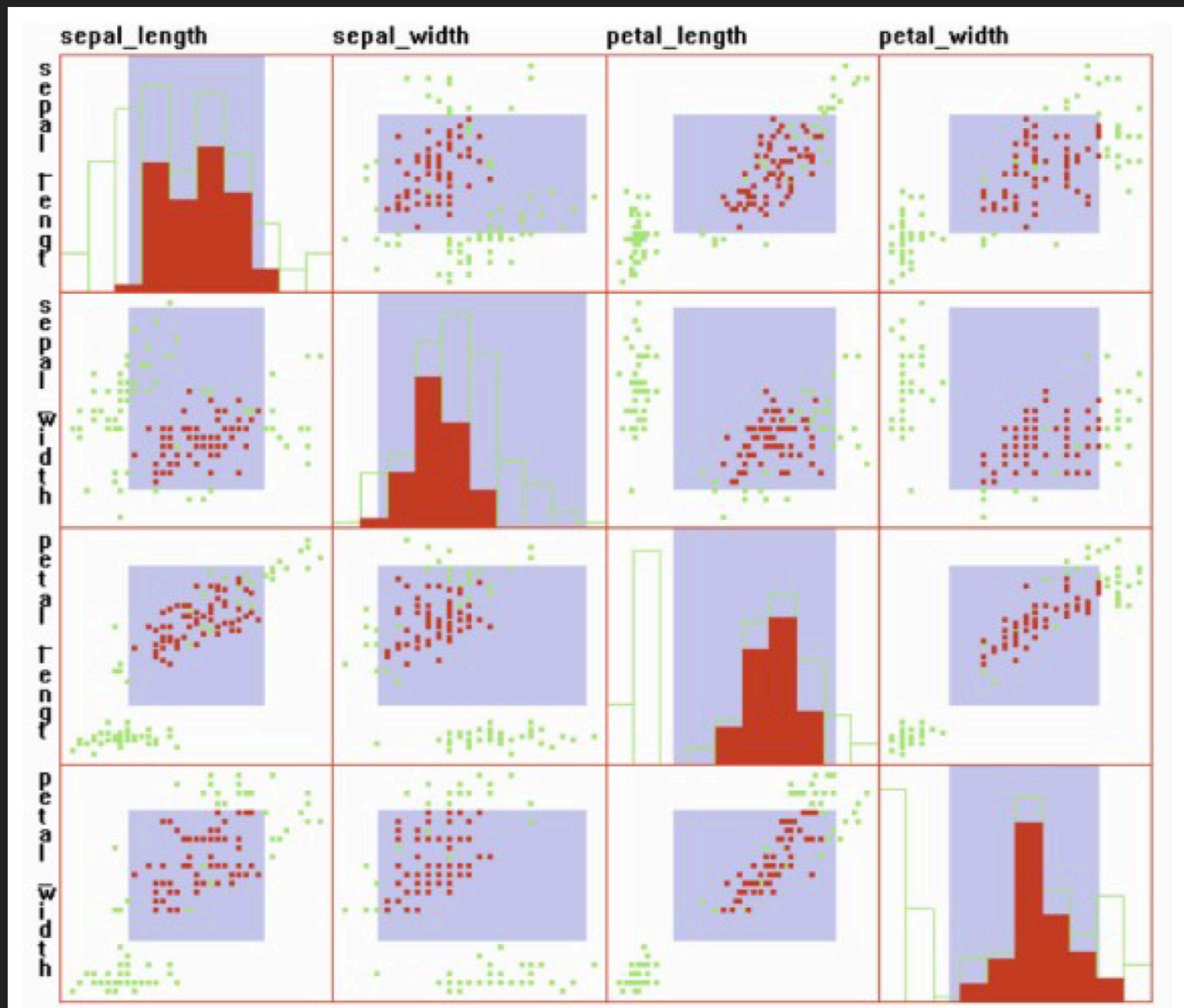
Point-Based Approaches

► Scatterplot



Point-Based Approaches (Cont.)

- ▶ Scatterplot Matrix
 - ▶ Pair-up scatterplot
 - ▶ Diagonal plot showing a histogram of each dimension



Multi-Dimensional Scaling

- ▶ Multi-dimensional scaling (MDS) is a method that represents measurements of similarity (or dissimilarity) among pairs of objects as distances between points of a **low-dimensional** multidimensional space

`sklearn.manifold.MDS¶`

```
class sklearn.manifold. MDS (n_components=2, metric=True, n_init=4, max_iter=300, verbose=0, eps=0.001,  
n_jobs=None, random_state=None, dissimilarity='euclidean')
```

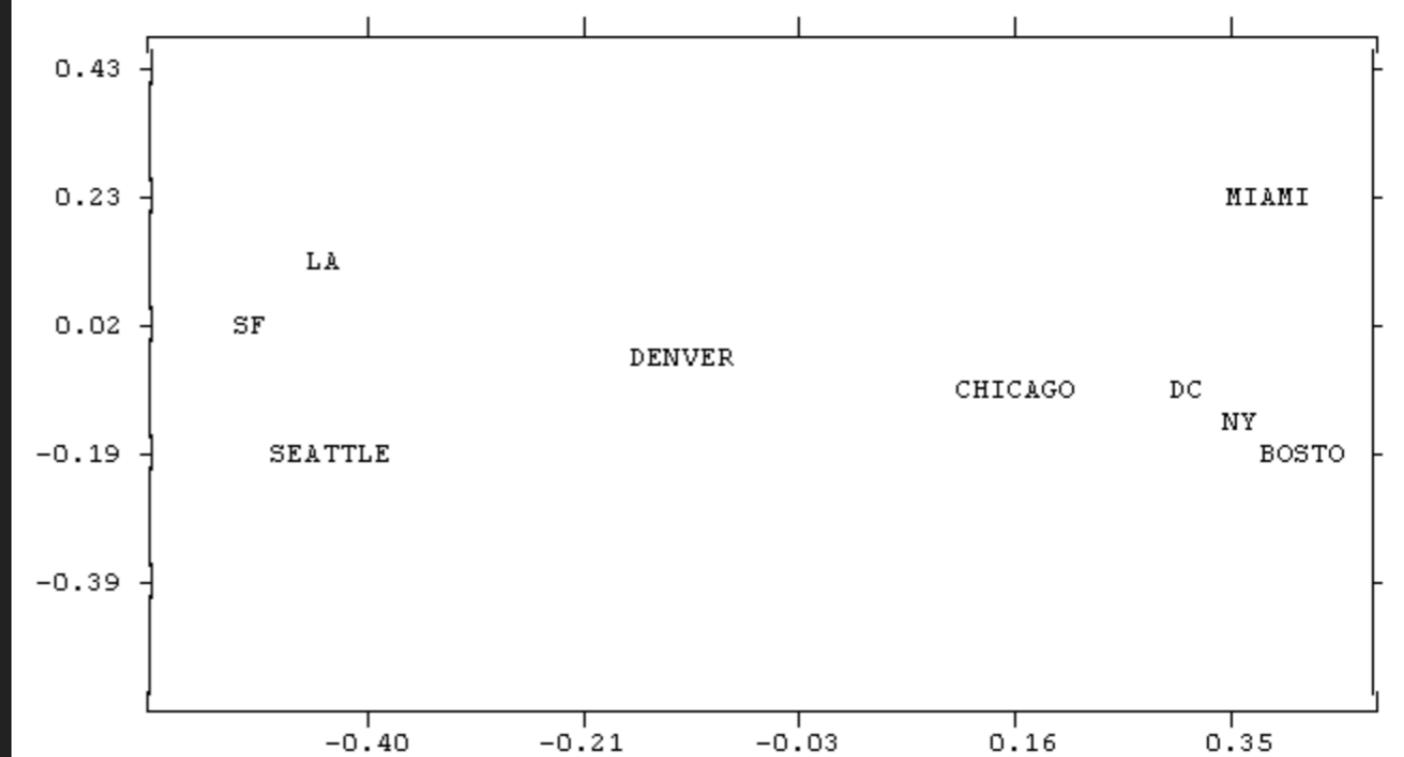
[source]

<https://scikit-learn.org/stable/modules/generated/sklearn.manifold.MDS.html>

MDS (Cont.)

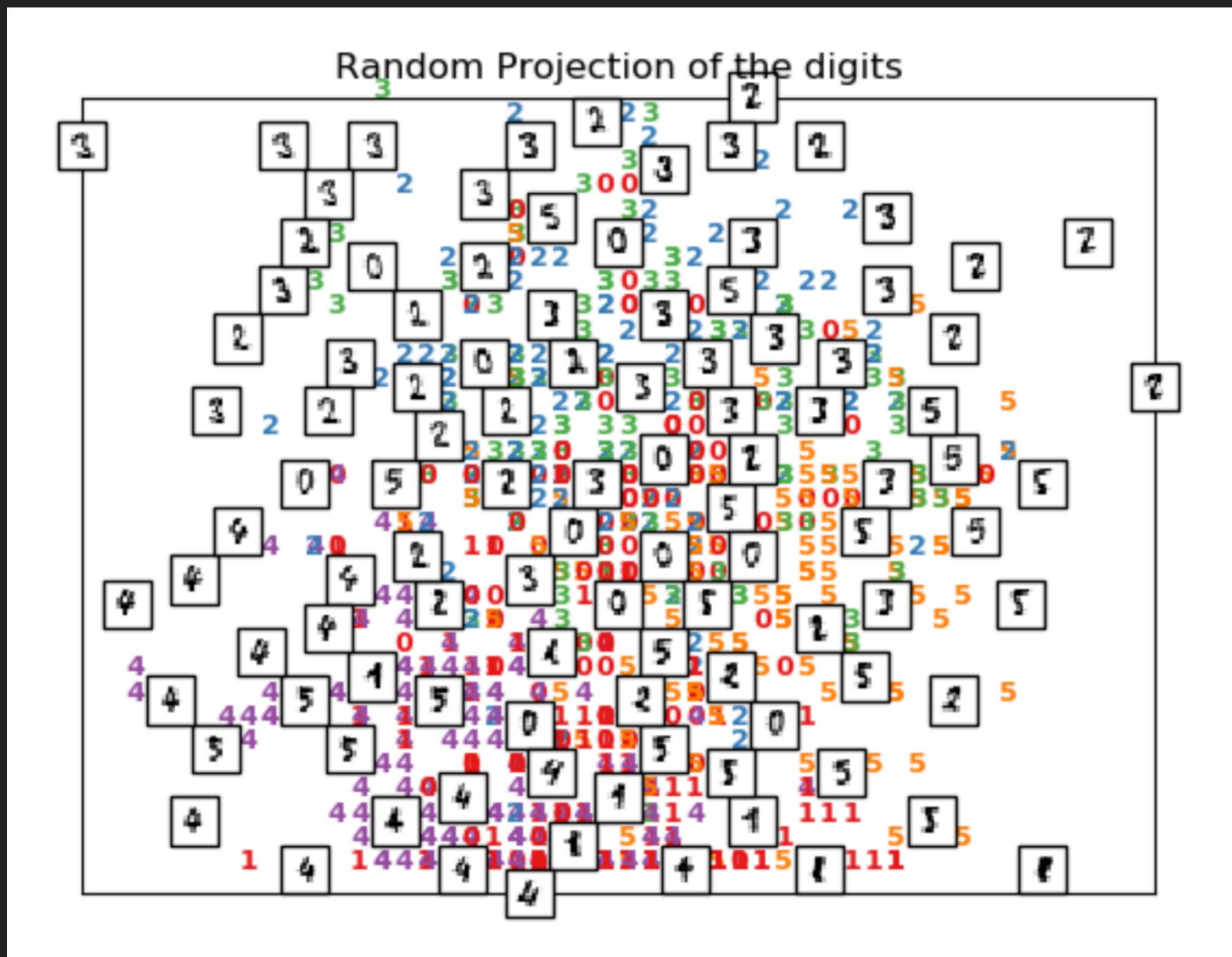
- Given the matrix of distances among cities

	1	2	3	4	5	6	7	8	9	
	BOST	NY	DC	MIAM	CHIC	SEAT	SF	LA	DENV	
1	BOSTON	0	206	429	1504	963	2976	3095	2979	1949
2	NY	206	0	233	1308	802	2815	2934	2786	1771
3	DC	429	233	0	1075	671	2684	2799	2631	1616
4	MIAMI	1504	1308	1075	0	1329	3273	3053	2687	2037
5	CHICAGO	963	802	671	1329	0	2013	2142	2054	996
6	SEATTLE	2976	2815	2684	3273	2013	0	808	1131	1307
7	SF	3095	2934	2799	3053	2142	808	0	379	1235
8	LA	2979	2786	2631	2687	2054	1131	379	0	1059
9	DENVER	1949	1771	1616	2037	996	1307	1235	1059	0

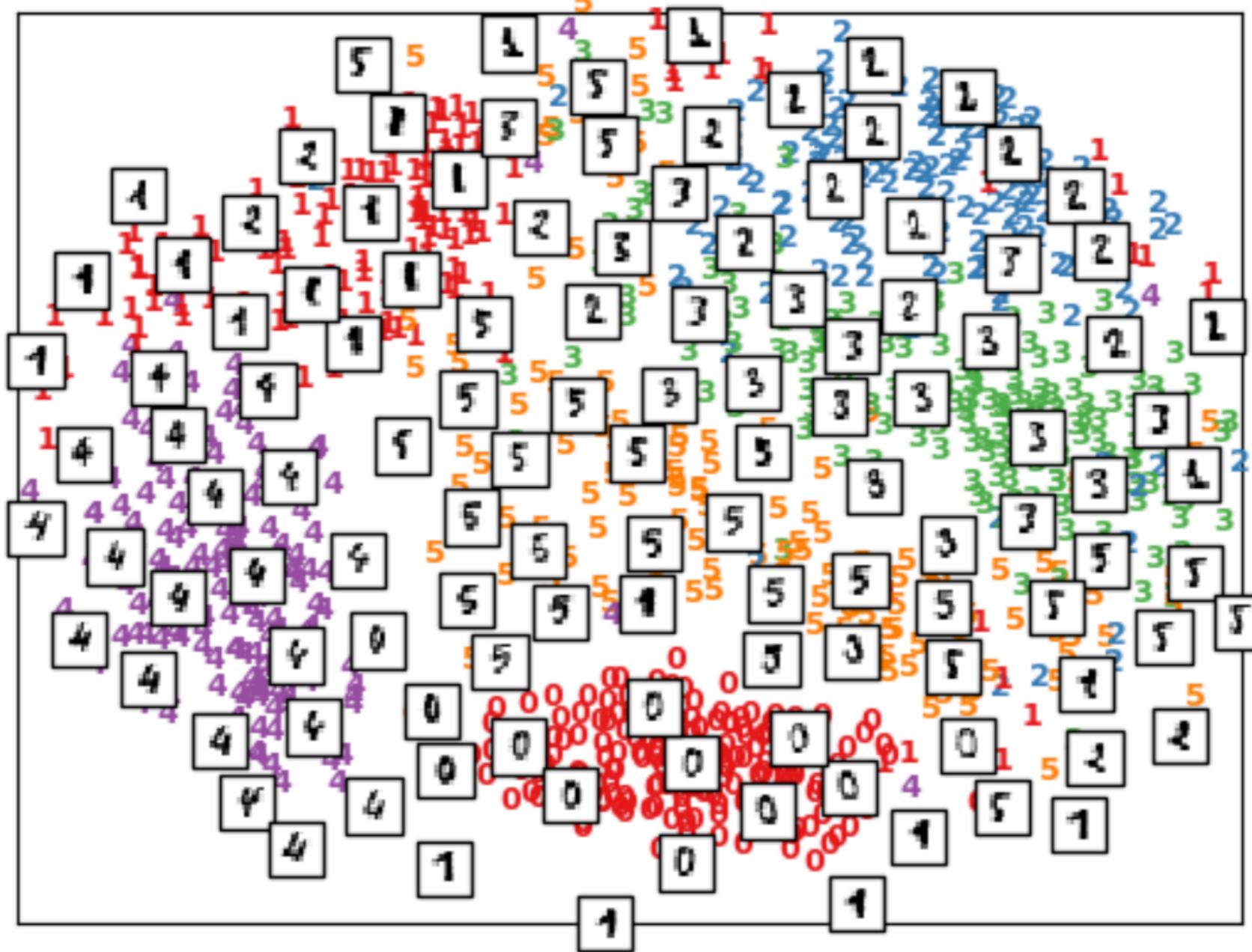


A selection from the 64-dimensional digits dataset

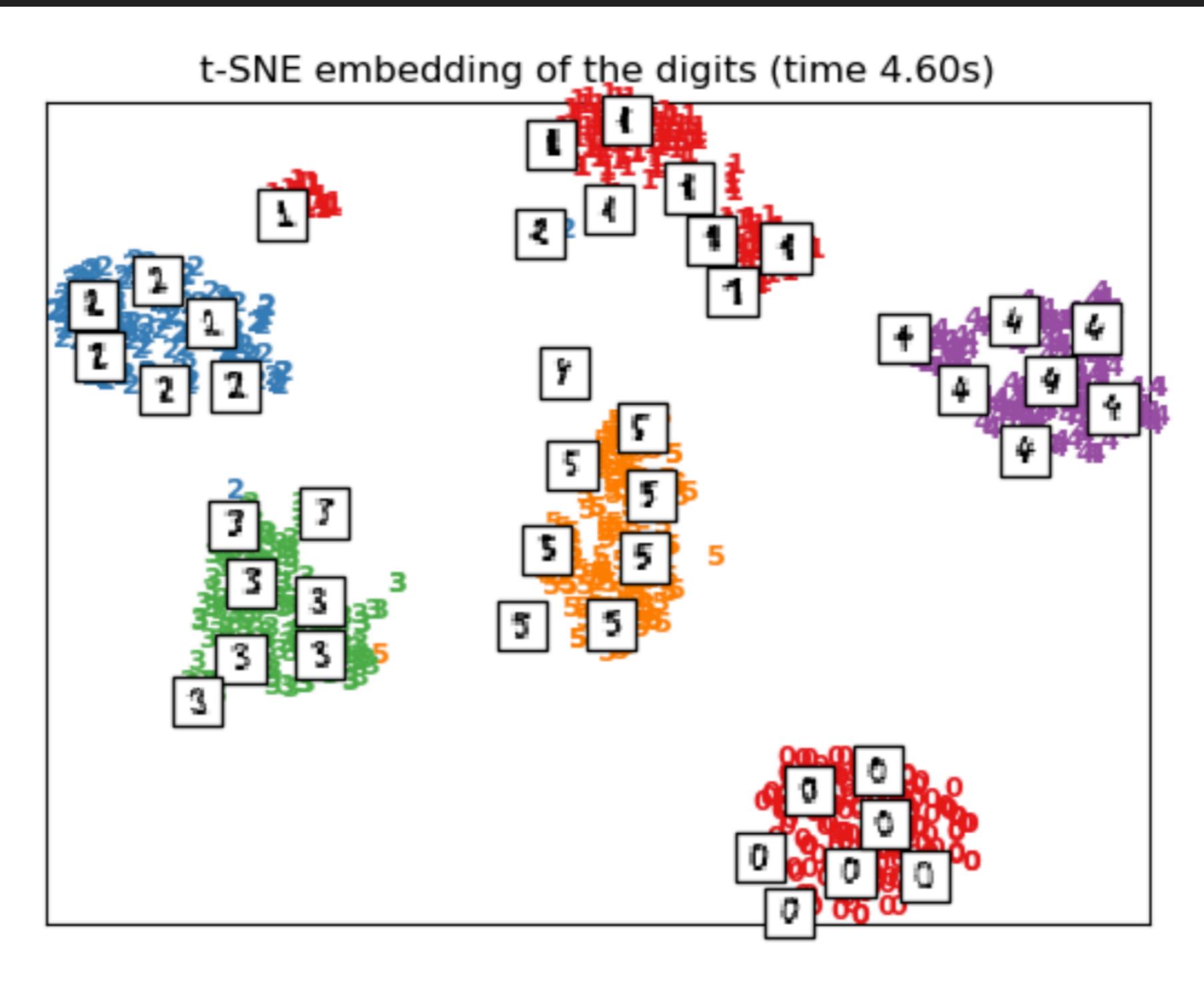
0	1	2	3	4	5	0	1	1	3	4	5	0	5
5	5	0	4	1	3	5	1	0	0	2	2	2	0
4	9	1	5	0	5	2	0	0	1	3	2	1	4
3	4	4	0	5	3	1	5	4	4	2	2	5	5
2	3	4	5	0	1	2	3	4	5	0	1	2	3
0	4	4	1	3	5	1	0	0	2	2	1	0	4
1	5	0	5	2	2	0	0	1	3	2	1	3	4
0	5	7	4	4	2	1	2	5	5	4	4	0	0
5	0	4	2	3	4	7	0	4	2	3	4	5	5
8	5	4	1	0	0	2	2	0	4	2	3	3	4
5	2	2	0	0	4	4	3	2	4	3	1	4	5
3	1	5	4	4	2	2	5	5	4	4	3	1	2
0	1	2	3	4	5	0	1	2	3	4	5	0	1
5	1	0	0	1	2	2	0	1	2	3	3	4	4
1	2	0	0	1	3	2	1	4	3	1	3	4	0
4	5	4	4	2	1	2	5	6	4	4	0	1	3
2	3	4	5	0	1	2	3	4	5	0	1	2	3
0	0	1	1	2	0	1	3	3	3	4	4	4	5
0	0	1	3	1	4	3	1	4	3	1	4	0	5
4	4	2	2	1	5	6	4	4	4	0	1	2	3



MDS embedding of the digits (time 2.48s)



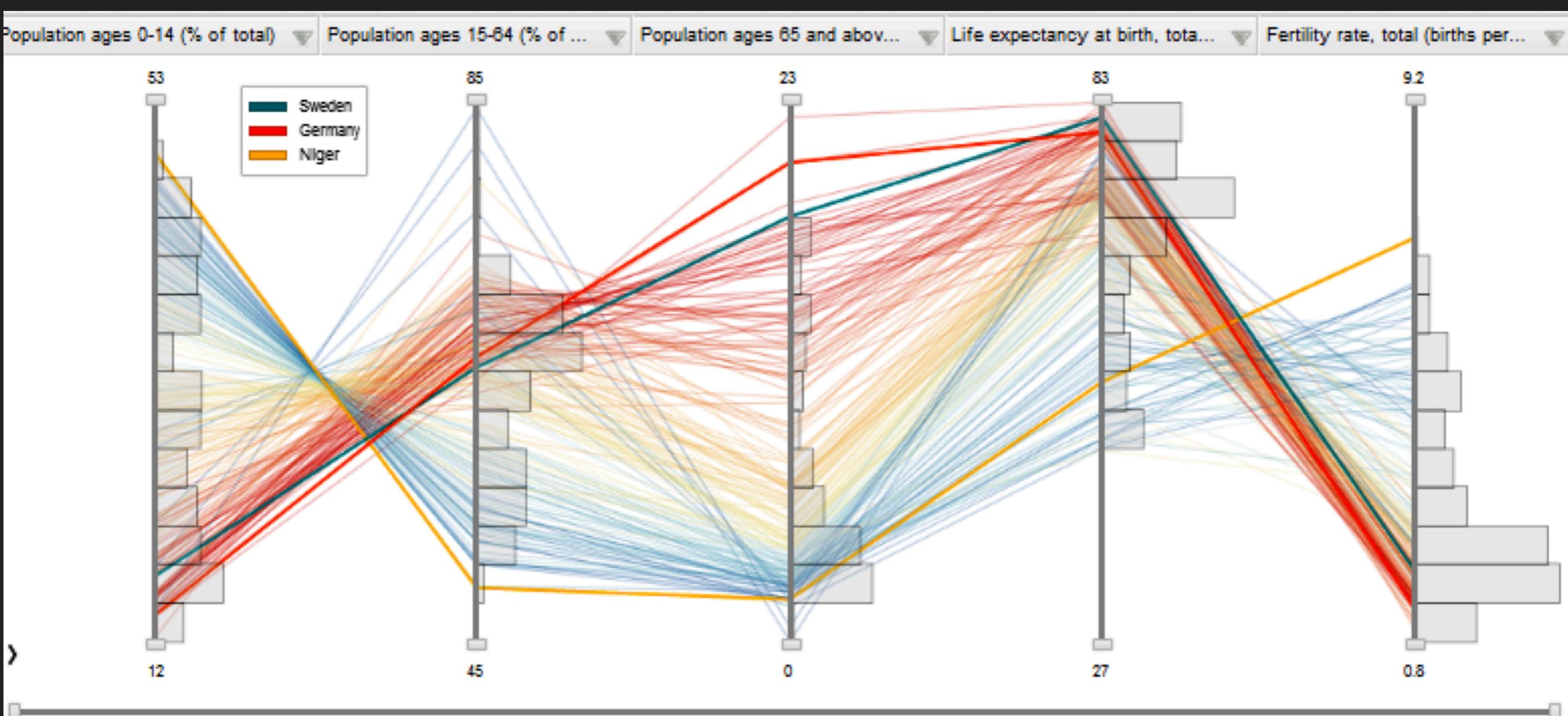
t-SNE embedding of the digits (time 4.60s)



https://scikit-learn.org/stable/auto_examples/manifold/plot_lle_digits.html#sphx-glr-auto-examples-manifold-plot-lle-digits-py

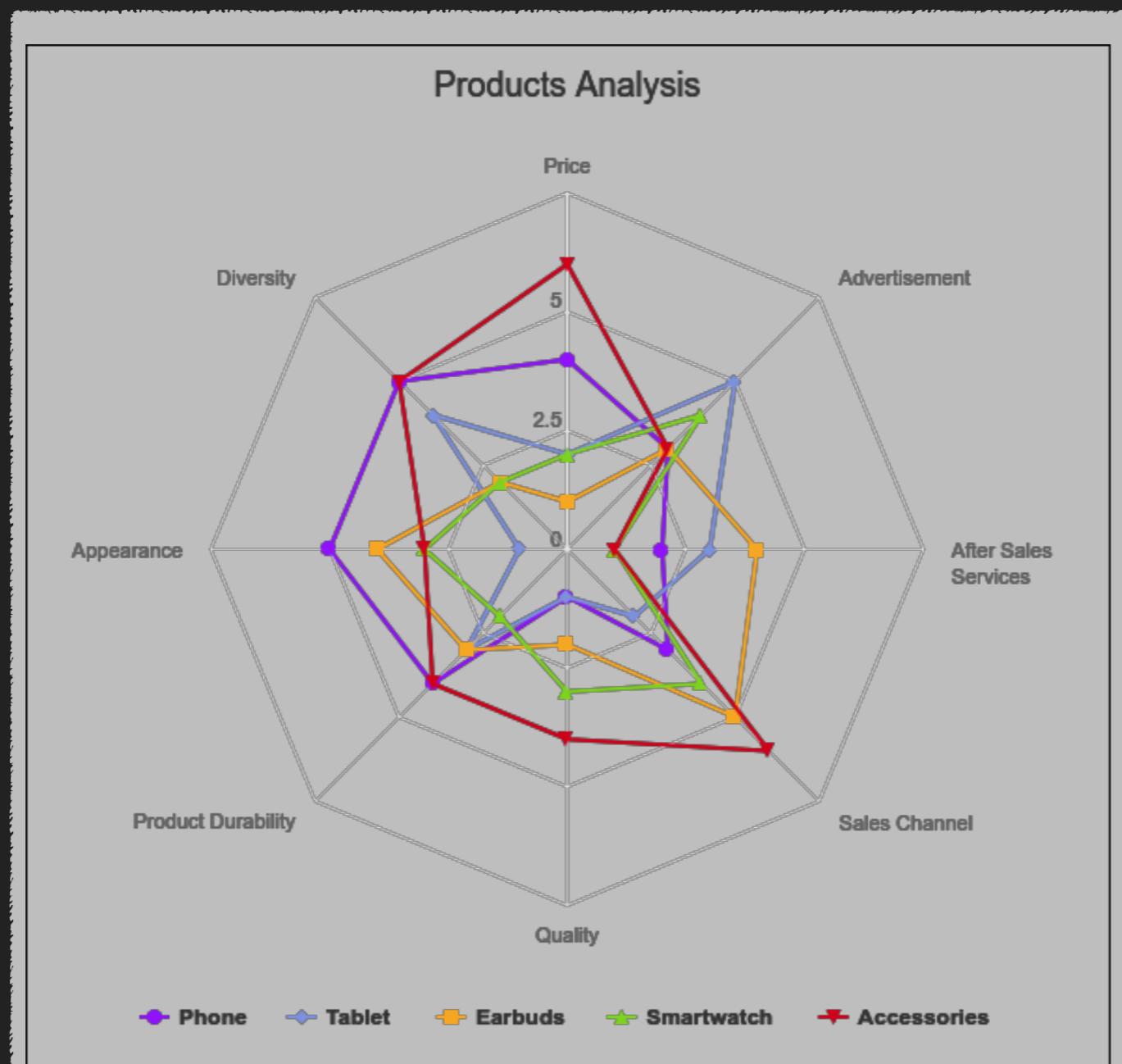
Line-Based Approaches

▶ Parallel Coordinates



Line-Based Approaches (Cont.)

► Radial Axis Coordinates

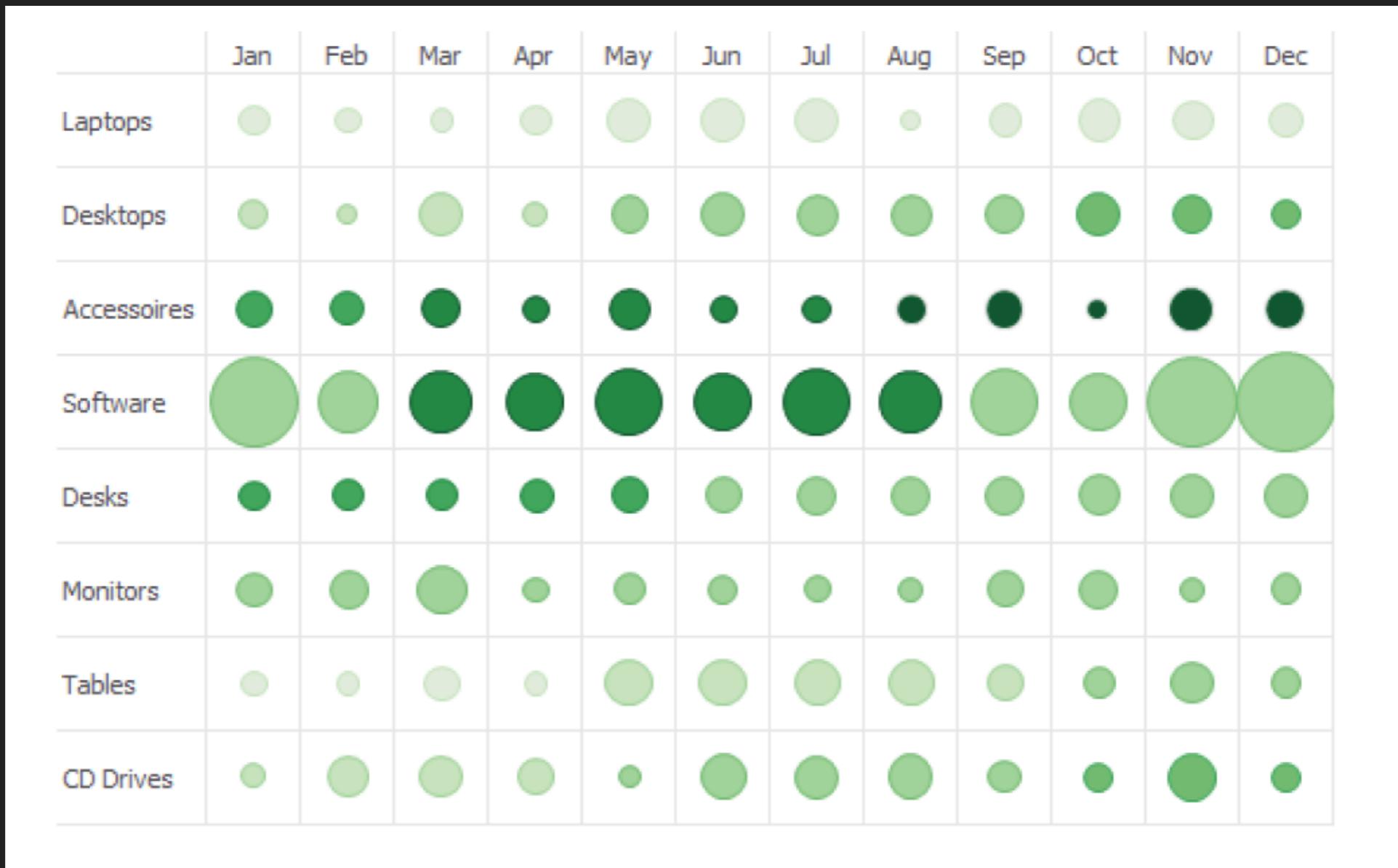


iVisDesigner

<https://donghaoren.org/ivisdesigner/>

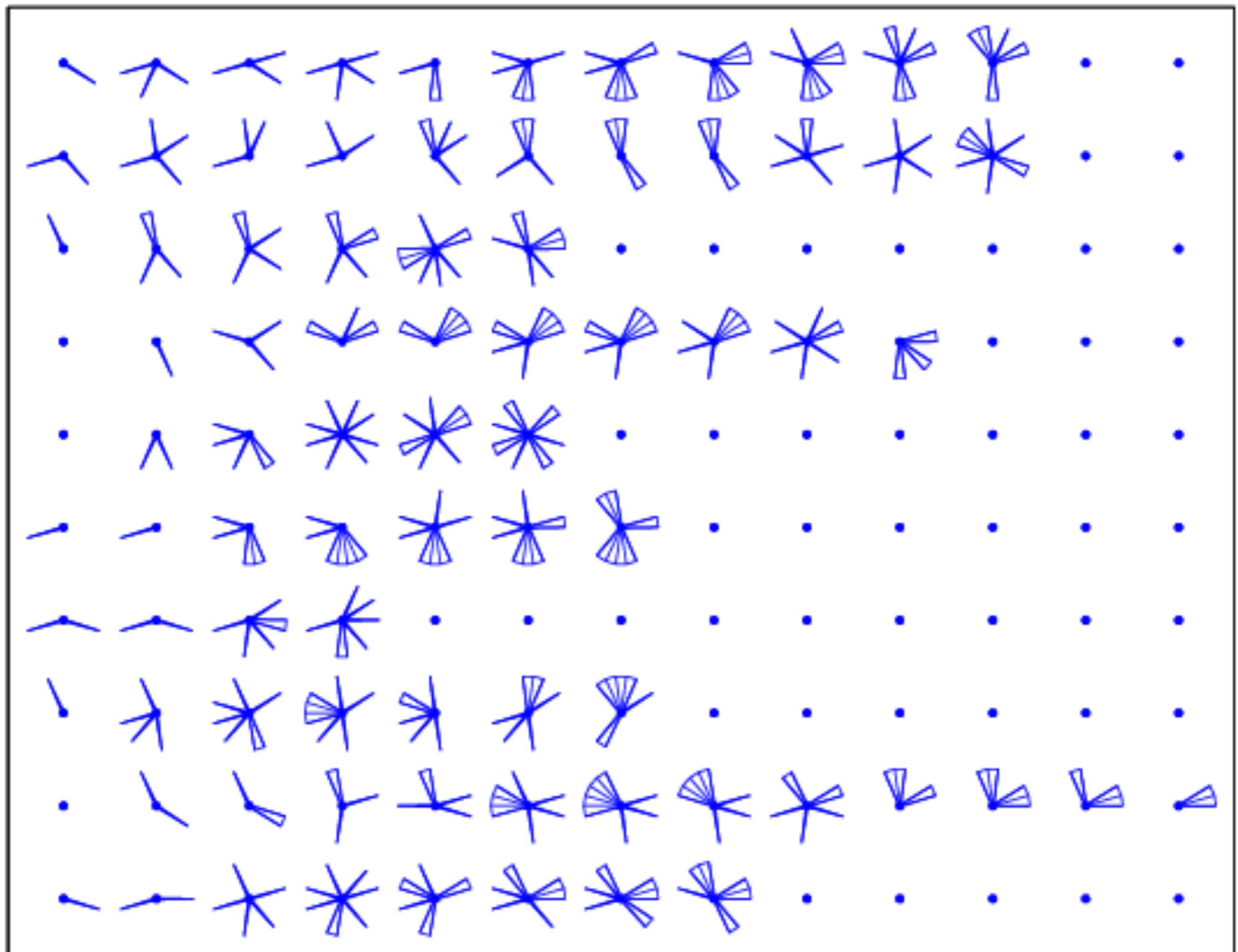
Tabular Display

System	Processor	RAM	Graphics	Gaming	
				graphics	Hard disk
Dell XPS 420	7.1	7.1	7.3	7.3	5.9
<i>Dell Studio XPS 1340</i>	6.0	5.9	5.9	4.7	5.8
Dell XPS 410 (Media Center)	5.9	5.5	5.8	6.4	5.9
HP Pavilion Elite m9300t (Media Center)	7.2	7.2	5.6	4.8	5.9
HP Pavilion Elite m9300t (desktop PC)	7.2	7.2	5.3	6.4	5.9
Apple Mac Mini (2009 model)	5.5	5.5	5.3	4.4	5.2
<i>Dell Latitude XT</i> (Tablet/multi-touch)	4.1	4.2	4.2	3.5	3.7
Dell Studio Hybrid	6.0	6.0	3.3	3.1	5.7
<i>Lenovo X300</i>	3.7	4.6	2.9	3.1	6.1
<i>Sony VAIO TZ2000</i>	3.9	4.0	2.0	3.0	4.0
<i>Italics indicate notebook</i>					

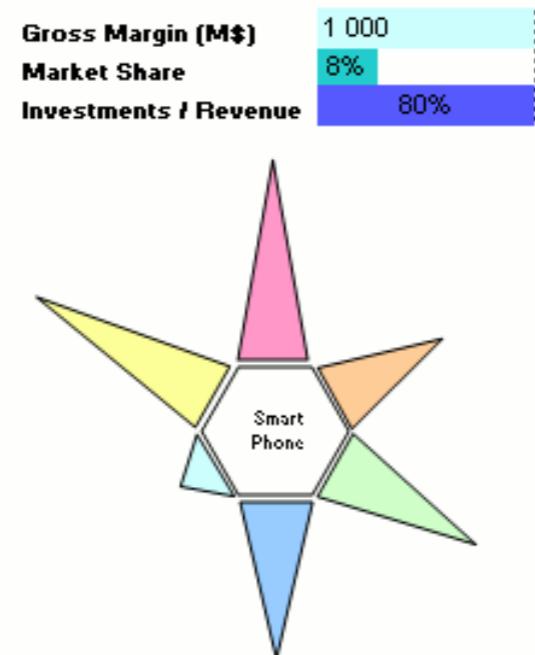
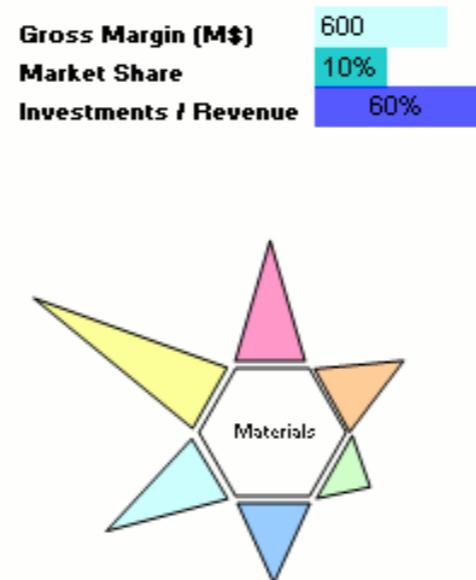
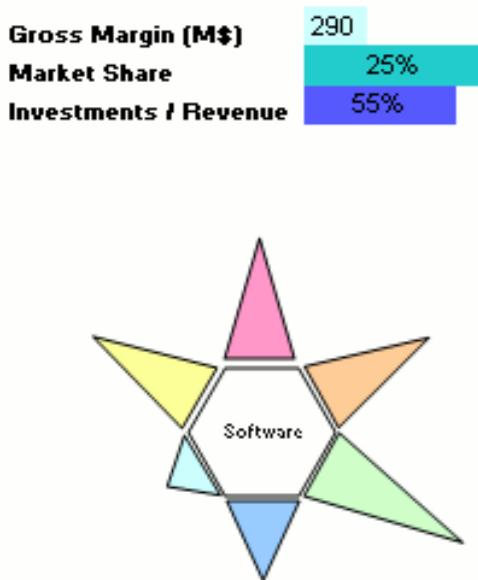


Glyphs And Icons

- ▶ A **glyph** is a visual representation of a piece of data or information where a graphical entity and its **attributes** are controlled by **one or more data attributes**.
- ▶



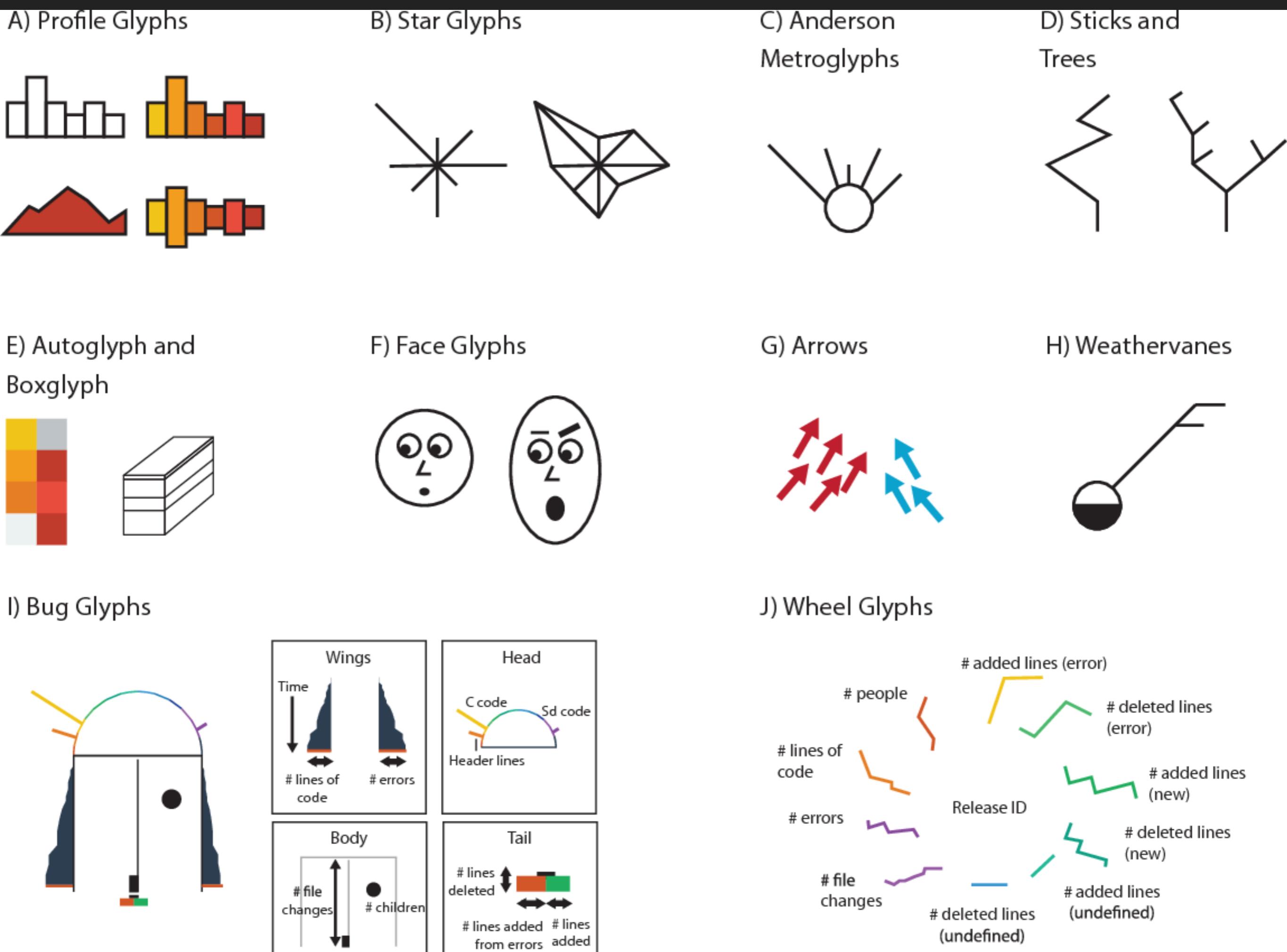
6 forces model applied to Smart Phone activities

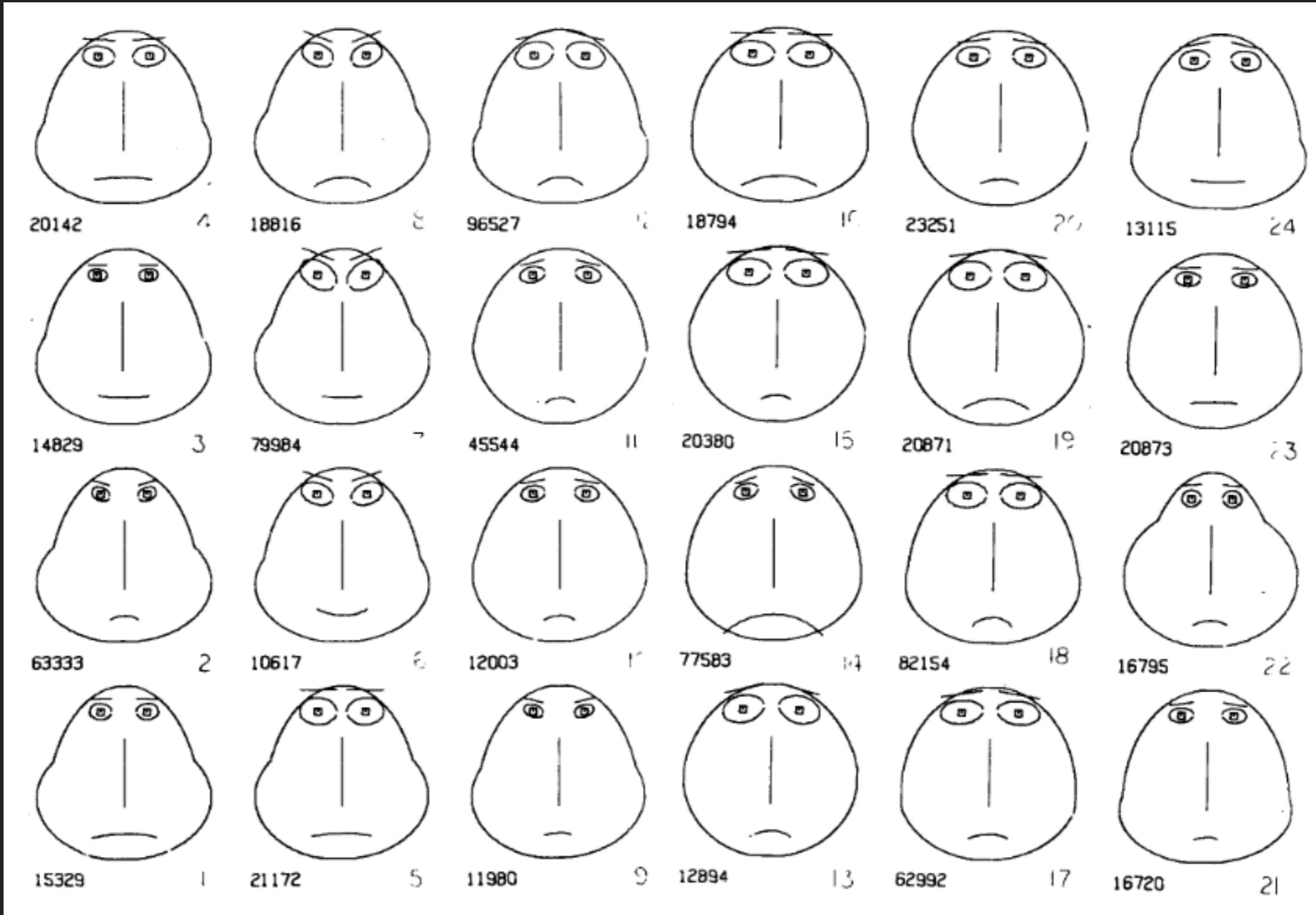


2008

	Software	Materials	SmartPhone
Intensity of Rivalry	Medium	Medium	Very strong
Substitutes	Medium	Low	Medium
Buyers	Strong	Very Low	Strong
Political Influence	Low	Low	Strong
Suppliers	Very Low	Medium	Very Low
Threat of New Entry	Medium	Very strong	Very strong

Gross Margin (M\$)	290	600	1 000
Market Share	25%	10%	8%
Investments / Revenue	55%	60%	80%





Chernoff Face

Small Multiples

- ▶ Sets of **thumbnail sized graphics** on same measures and scale.

