

CSE/ISE 332

INTRODUCTION TO VISUALIZATION

LAB #1

KLAUS MUELLER

COMPUTER SCIENCE DEPARTMENT
STONY BROOK UNIVERSITY

PURPOSE

Get a feel for data and where to find them

Get your hands dirty with JavaScript and D3.js
Code with Visual Studio with AI assistance

Online tutorials

- JavaScript: [W3Schools.com](https://www.w3schools.com) (see also intro slide deck)
- D3: [freeCodeCamp](https://freeCodeCamp.org), [D3 website](https://d3js.org/), [github](https://github.com) [makeBarChart](https://d3js.org/d3.js)

Take advantage of this opportunity to learn D3 **now**

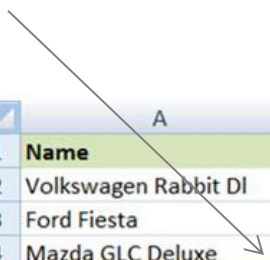
- you will need this later in the course

RECTANGULAR DATASET

One data item

The variables

→ the attributes or properties we measured



	A	B	C	D	E	F	G	H	I
1	Name	Country	Miles Per Gallon	Accceleration	Horsepower	weight	cylinders	year	price
2	Volkswagen Rabbit DI	Germany	43,1	21,5	48	1985	4	78	2400
3	Ford Fiesta	Germany	36,1	14,4	66	1800	4	78	1900
4	Mazda GLC Deluxe	Japan	32,8	19,4	52	1985	4	78	2200
5	Datsun B210 GX	Japan	39,4	18,6	70	2070	4	78	2725
6	Honda Civic CVCC	Japan	36,1	16,4	60	1800	4	78	2250
7	Oldsmobile Cutlass	USA	19,9	15,5	110	3365	8	78	3300
8	Dodge Diplomat	USA	19,4	13,2	140	3735	8	78	3125
9	Mercury Monarch	USA	20,2	12,8	139	3570	8	78	2850
10	Pontiac Phoenix	USA	19,2	19,2	105	3535	6	78	2800
11	Chevrolet Malibu	USA	20,5	18,2	95	3155	6	78	3275
12	Ford Fairmont A	USA	20,2	15,8	85	2965	6	78	2375
13	Ford Fairmont M	USA	25,1	15,4	88	2720	4	78	2275
14	Plymouth Volare	USA	20,5	17,2	100	3430	6	78	2700
15	AMC Concord	USA	19,4	17,2	90	3210	6	78	2300
16	Buick Century	USA	20,6	15,8	105	3380	6	78	3300
17	Mercury Zephyr	USA	20,8	16,7	85	3070	6	78	2425
18	Dodge Aspen	USA	18,6	18,7	110	3620	6	78	2700
19	AMC Concord D1	USA	18,1	15,1	120	3410	6	78	2425
20	Chevrolet MonteCarlo	USA	19,2	13,2	145	3425	8	78	3900
21	Buick RegalTurbo	USA	17,7	13,4	165	3445	6	78	4400
22	Ford Futura	Germany	18,1	11,2	139	3205	8	78	2525
23	Dodge Magnum XE	USA	17,5	13,7	140	4080	8	78	3000
24	Chevrolet Chevette	USA	30	16,5	68	2155	4	78	2100

The data items
→ the samples
(observations)
we obtained
from the
population of
all instances

RECTANGULAR DATASET

Also called the *Data Matrix*

Car performance metrics

or Survey question responses

or Patient characteristics

One data item

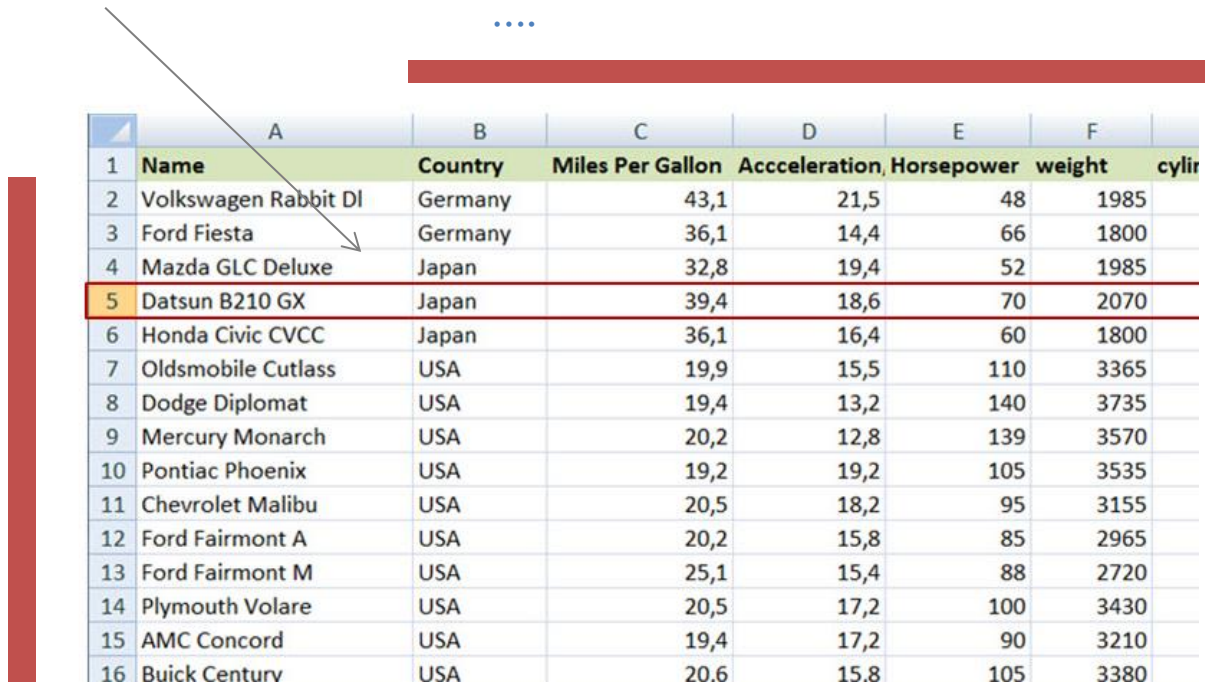
....

Car models

or Survey respondents

or Patients

....



The diagram illustrates a rectangular dataset matrix. A red vertical bar on the left represents the set of car models, and a red horizontal bar at the top represents the set of performance metrics. The intersection of these two sets is the data matrix, shown as a table. An arrow points from the text 'One data item' to a specific cell in the table (row 5, column 2).

	A	B	C	D	E	F	
1	Name	Country	Miles Per Gallon	Accceleration	Horsepower	weight	cylir
2	Volkswagen Rabbit DI	Germany	43,1	21,5	48	1985	
3	Ford Fiesta	Germany	36,1	14,4	66	1800	
4	Mazda GLC Deluxe	Japan	32,8	19,4	52	1985	
5	Datsun B210 GX	Japan	39,4	18,6	70	2070	
6	Honda Civic CVCC	Japan	36,1	16,4	60	1800	
7	Oldsmobile Cutlass	USA	19,9	15,5	110	3365	
8	Dodge Diplomat	USA	19,4	13,2	140	3735	
9	Mercury Monarch	USA	20,2	12,8	139	3570	
10	Pontiac Phoenix	USA	19,2	19,2	105	3535	
11	Chevrolet Malibu	USA	20,5	18,2	95	3155	
12	Ford Fairmont A	USA	20,2	15,8	85	2965	
13	Ford Fairmont M	USA	25,1	15,4	88	2720	
14	Plymouth Volare	USA	20,5	17,2	100	3430	
15	AMC Concord	USA	19,4	17,2	90	3210	
16	Buick Centurv	USA	20.6	15.8	105	3380	

SOME GOOD SOURCES FOR DATA

[Kaggle](#) – lots of data for data science

[NYC Open Data](#) – all kinds of data related to NYC operations

[Kaiser Foundation](#) – numerous data related to public health

[Data.gov](#) – open data site with US government data

[Forbes](#) – site with links to data sites

[Data Quest](#) – another site with links to data sites

[Quandl](#) – mostly financial and economics data

[Open Data Inception](#) – map w/data portals around the world

[World Bank](#) – collection of global development data

[UCI repository](#) – site that has been around for a long time

[Analytics Vidhya](#) – another site with many links to data sites

Wikipedia also has lots of data in tables

NOTES ON DATASET

Some advice

- avoid datasets where the majority of data is categorical (not overly exciting for binning, clustering, and so on)
- if an attribute is categorical it should have at least 6 categories
 - some important variables may have fewer levels, such as gender (OK)
- convert textual categories into numbers by assigning a numerical ID
- aim for datasets with more than 500 data points and 15 attributes
- if your dataset is larger, pick 500 sample points at random (for now)
- if you have too many attributes keep the ones of interest (prefer quantitative attributes)
- if the data set has text, images, video, logs, etc. convert them to numbers via appropriate mechanism as discussed in class (this would be an advanced task, so you may want to avoid data like this)
- produce a spreadsheet of rows (data items) and attributes (columns)

FUSE AT LEAST TWO DATASETS

Fusing data from two (or more) sources can yield interesting datasets

- you would have the same data points, just more attributes --> the attributes from both datasets
- goal: find two or more datasets that can that can bring deeper and more comprehensive insight, broadening the theme

Examples:

- a dataset with crime data for all US States + datasets with state-wise average incomes, education levels, or unemployment rates might provide interesting insights on the causes of certain crimes
- a dataset with the weather per day at a set of cities + a dataset that has the on-time performances per day for the airports in these cities may provide insight on the reasons for the time delays

EXAMPLE: FUSING DIFFERENT THEMATIC DATASETS

Address	Size	Bedrooms	Baths	Price	Zip Code	House listing data
5 Nut Str.	2,345 sqft	3	1	\$564k	11794	

Education by zip code	Zip Code	School Name	Avg. SAT	Class Size	Cost
	11794	Tree Top	1060	34	Public

Quality of life by zip code	Zip Code	Livability Score	Distance to Airport	Air Quality Score	Electricity Cost
	11794	63	45 miles	89	\$0.34/KW

Make sure that all data are from the same/similar year (when time matters)

Might need different keys for linking different thematic datasets

- for example zip code, state, county, and so on
- find associations for each in all tables and fuse
- duplicate information for coarse grained tables in finer-grained tables

ASSIGNMENT (1)

Get some CSV-based data (also see previous slides)

- ideally at around 500 data points or more
- at least 15 dimensions (fuse datasets to achieve this)
- good mix of numerical and categorical variables
- see “Notes on Datasets” slide (flip back a few slides)
- you can use this dataset for the final project, too

ASSIGNMENT (2)

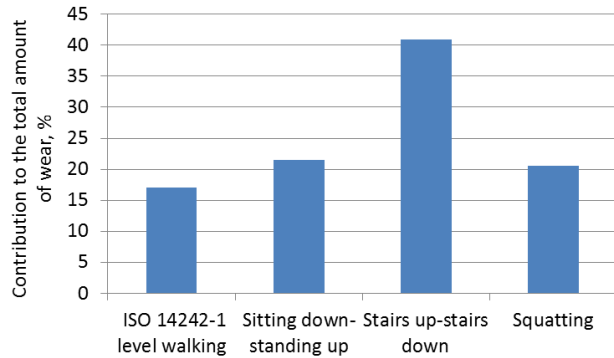
Your D3-based visual interface should be able to (10 pts each):

1. present a pull-down menu for users to select a variable, update chart
2. draw a **bar chart** if a categorical variable is selected
3. draw a **histogram** if a numerical variable is selected (bin it into a fixed range (equi-width) of your choice)
4. add a radio button that selects whether the chart is drawn upright or sideways (see example on the right)
5. produce a **scatterplot** of two selected variables (use a radio button to determine which of the two variable axes (x, y) is to be assigned to the variable chosen by the menu)

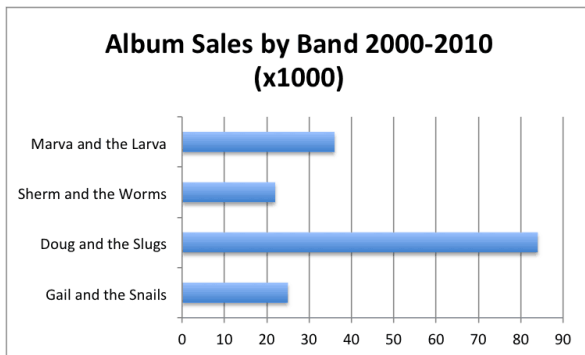
This is not a group project

See some examples on the next slide

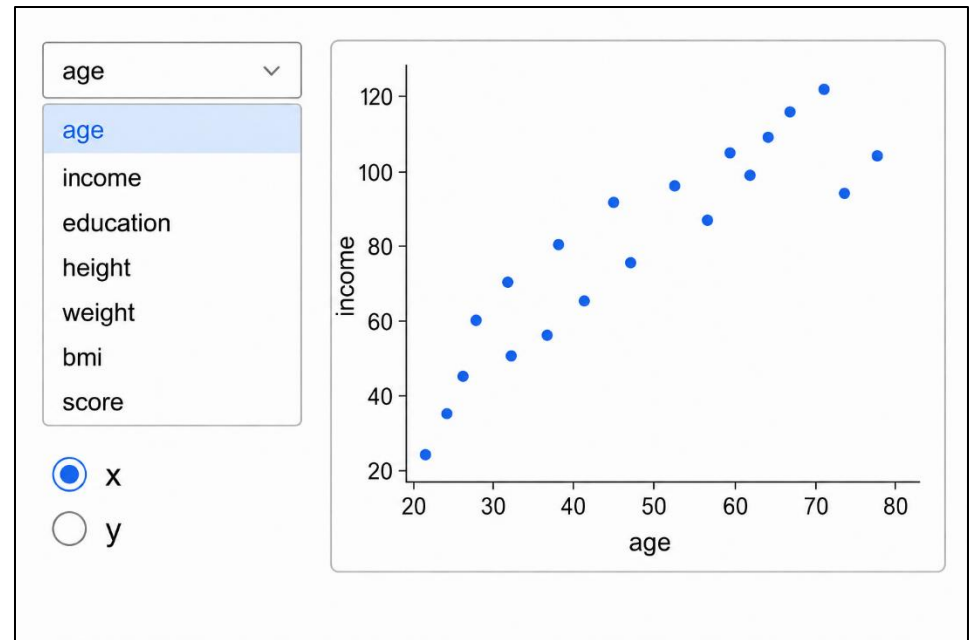
ASSIGNMENT EXAMPLES



Horizontal (upright) bar chart



Vertical (sideways) bar chart



Scatterplot with drop down menu and a radio button for axis selection (here x is selected to assign the 'age' variable to the x-axis)

ASSIGNMENT (3)

An additional 10 pts for a fused dataset (extra credit)

Don't forget to

- label the axes (variable names)
- label the x-axis (bin range midpoints or category label)
- label the y-axis (number of items)
- provide title

Due date is **Monday Sept 14** end of day

Submission on Brightspace

DELIVERABLES

Upload the following to Brightspace:

- voice-narrated video file that shows all features of your software in action
- report
 - name the source(s) of the dataset(s) with URL
 - describe the attributes
 - write why you thought these data are interesting
 - mention anything noteworthy about implementation (beyond the video)
- zip file with all source code
- one! excel sheet with the fused data

Grading

- TA will pick students at random for thorough code review sessions
- you better know your code !!!
- do not videotape someone else's program

SEEKING OUTSIDE HELP

Aka, cheating

Discussion with your classmates (but not others) is OK

Excessive cut and paste from any source is not OK

- any suspected activity of this kind will result in zero points
- also for the person providing the original
- two-strikes and out rule is in effect (including an academic misconduct report)
- this includes any feeble attempt to cover the tracks somehow

Stay honest and resist the temptation!

See AI policy next page

AI POLICY – DOCUMENT ALL AI CODE

In your submission, include:

- which AI tool(s) you used (if you used one)
- what they were used for (e.g., “initial D3 scaffold,” “event callbacks”)
- what you modified or added yourself
- short annotations are sufficient

Projects are not graded on code quality, rather they are graded on:

- visual design quality
- correctness and clarity
- interaction and analytic insight
- demonstrated understanding of visual analytics and its effective/creative use

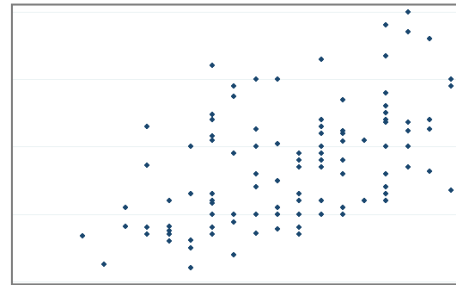
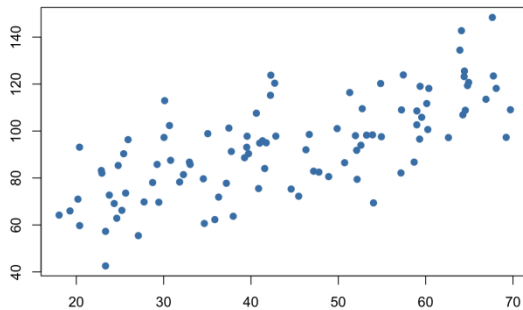
Using AI does not lower or raise your grade by itself

AI can help you write code faster — it cannot decide what a good visualization is

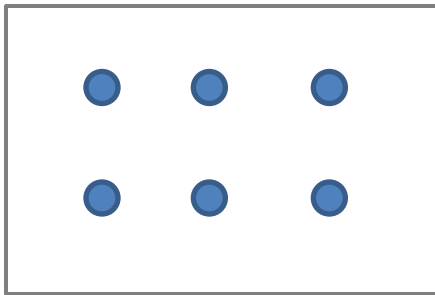
NOTES ON SCATTERPLOTS

You can plot both numerical and categorical variables

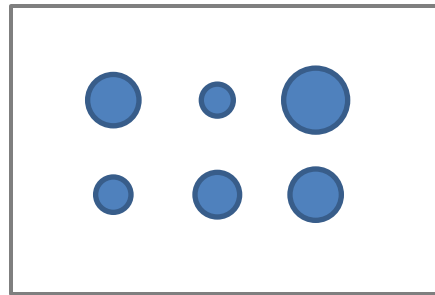
- when one or both variables are numerical this is straightforward



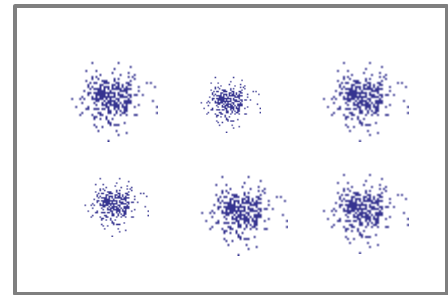
- when both variables are categorical you have three options



just overplot the points
so they look like one
point



scale disks in proportion
to the number of points
(more informative)

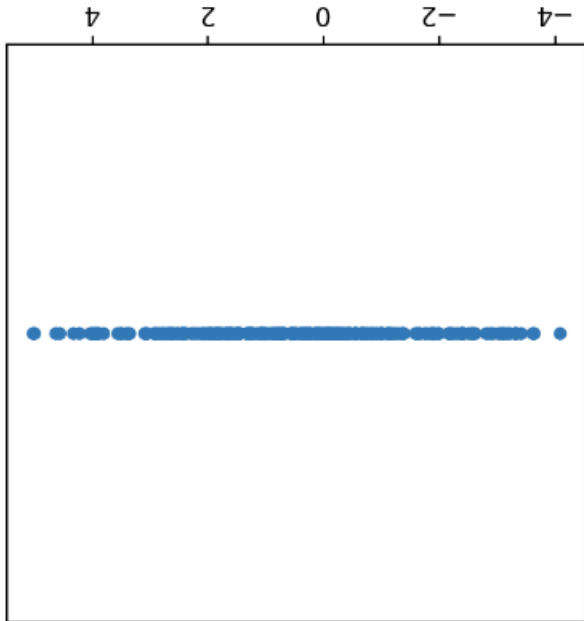


jitter each plotted point so a
cluster with more points
appears denser (more real)

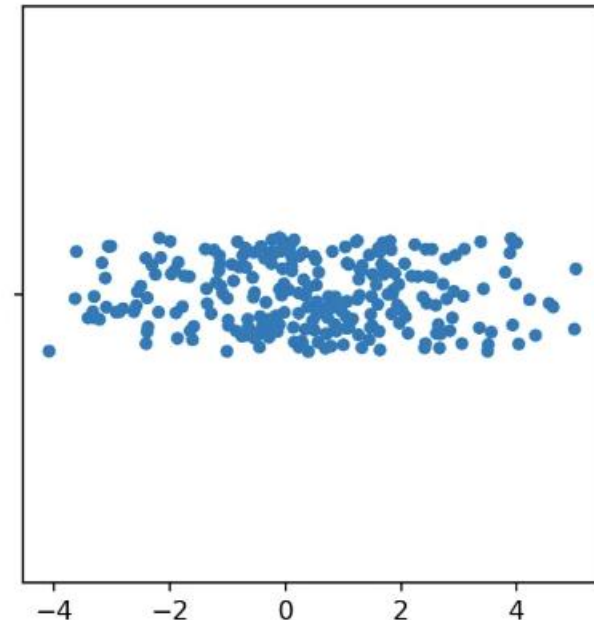
ONE MORE SCATTERPLOT HINT

When you have one numerical and one categorical variable

- use strip plots



what you would get



with jittering in the categorical

HISTOGRAM CALCULATIONS – BINNING

Determine bin size

- $\text{min}(\text{data})$ is optional, can also use 0 or some reasonable value
- $\text{max}(\text{data})$ is optional, can also use some reasonable value

$$\text{bin size} = \frac{\text{max}(\text{data}) - \text{min}(\text{data})}{\text{number of bins}}$$

Given a data value val increment (++) the bin value

- but first initialize bin val array to 0

$$\text{bin val array} \left[\left\lfloor \frac{\text{val} - \text{min}(\text{data})}{\text{bin size}} \right\rfloor \right] ++$$

HISTOGRAM CALCULATIONS – PLOTTING

Determine bin size on the screen

$$\text{bin size on screen} = \frac{\text{chart width}}{\text{number of bins}}$$

Center of a bar for bin with index *bin index*

$$\text{bar center on screen} = (\text{bin index} \cdot \text{bin size on screen}) + 0.5$$

Height of the bar for a bin with index *bin index*

$$\text{bar height}(\text{bin index}) = \text{bin val array}(\text{bin index}) \cdot \frac{\text{chart height}}{\max(\text{bin val array})}$$

Do not forget that the origin of a web page is the top left corner

