Intro to Data Visualization

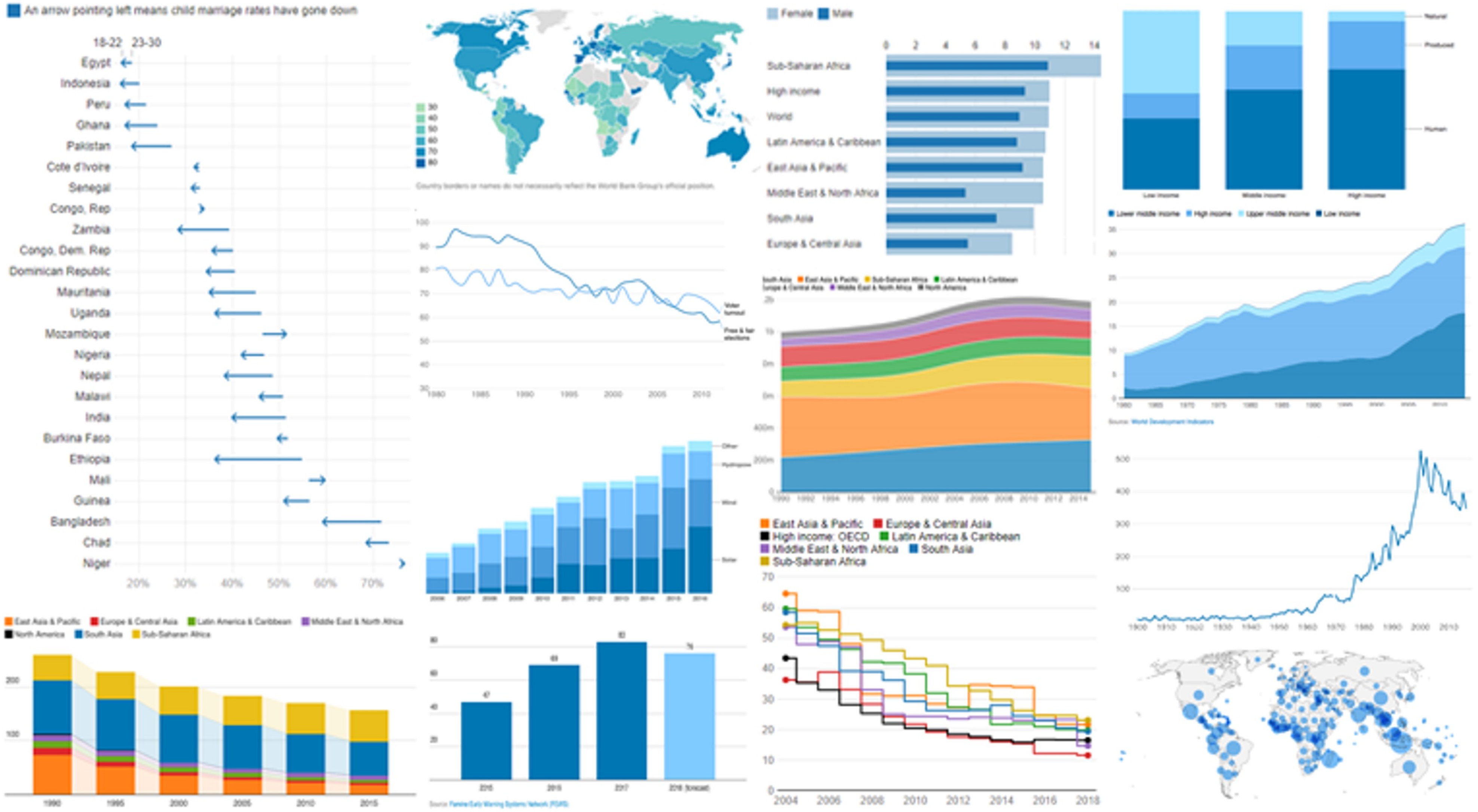
Data manipulation and plotting

Big data

Insights, predictions, products

https://sdtimes.com/data/big-data-go/

Data visualization



Modules

Pandas - reading data

Matplotlib - plotting data

What is Pandas ?

- *Pandas* is an open source, BSD-licensed library providing high-performance, easy-to-use data structures and data analysis tools for the Python programming language.

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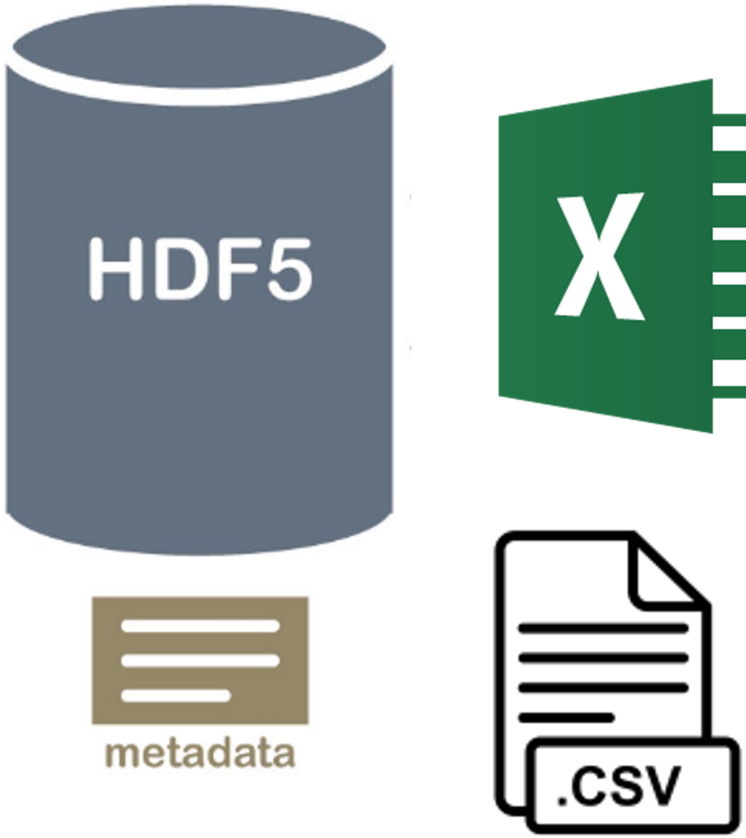
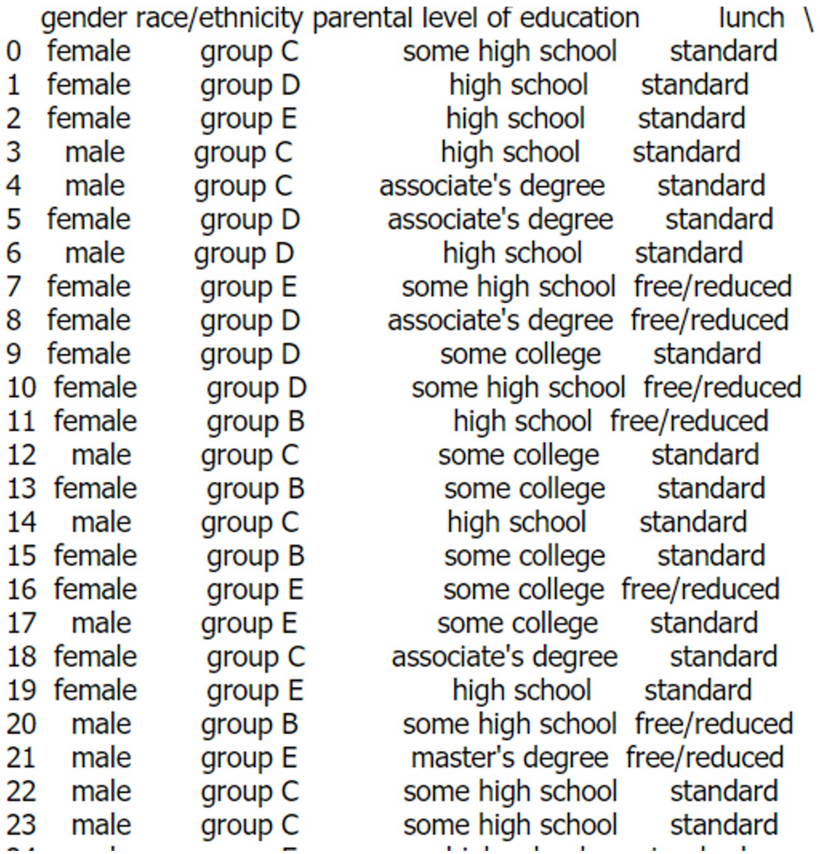
What does Pandas can do ?

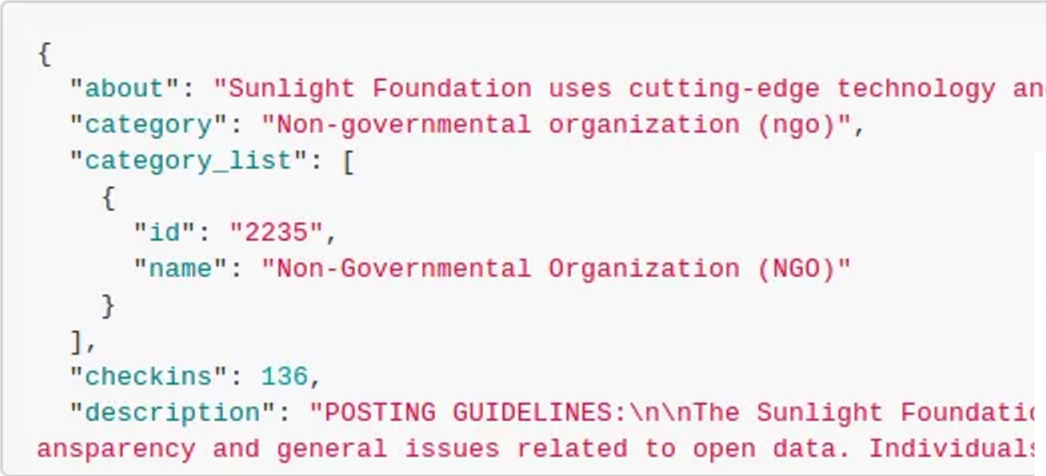
Reading data



Viewing data

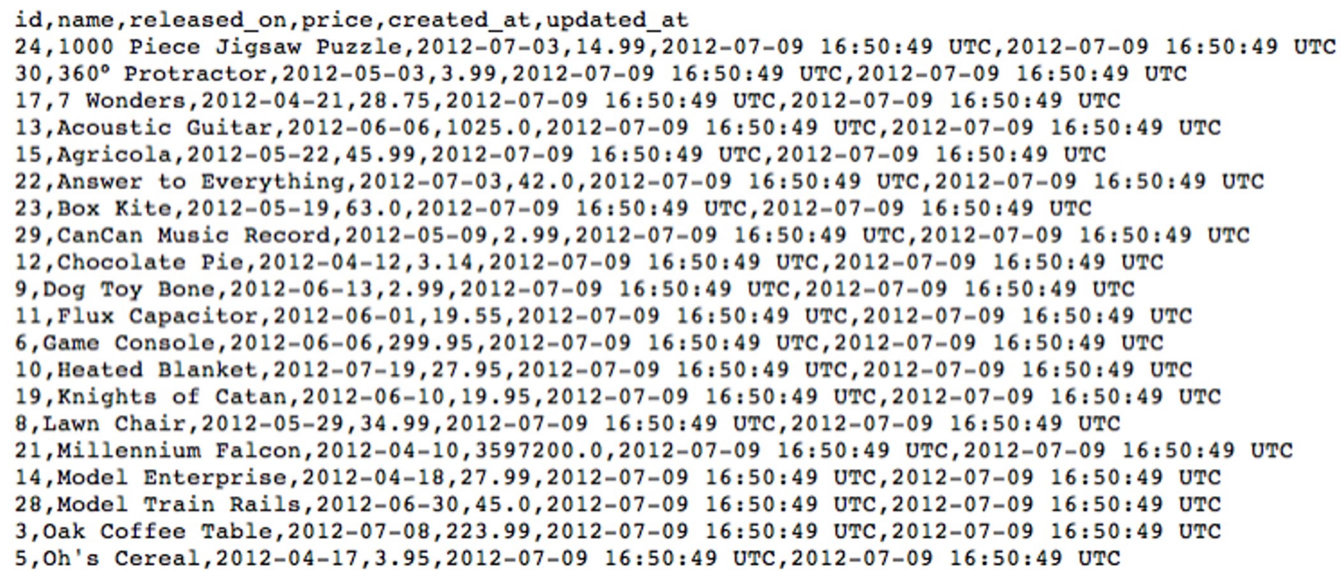


```
   gender race/ethnicity parental level of education         lunch  \
0  female        group C             some high school      standard
1  female        group D                  high school      standard
2  female        group E                  high school      standard
3    male        group C                  high school      standard
4    male        group C           associate's degree      standard
5  female        group D           associate's degree      standard
6    male        group D                  high school      standard
7  female        group E             some high school  free/reduced
8  female        group D           associate's degree  free/reduced
9  female        group D                 some college      standard
10  female        group D             some high school  free/reduced
11  female        group B                  high school  free/reduced
12    male        group C                 some college      standard
13  female        group B                 some college      standard
14    male        group C                  high school      standard
15  female        group B                 some college      standard
16  female        group E                 some college  free/reduced
17    male        group E                 some college      standard
18  female        group C           associate's degree      standard
19  female        group E                  high school      standard
20    male        group B             some high school  free/reduced
21    male        group E              master's degree  free/reduced
22    male        group C             some high school      standard
23    male        group C             some high school      standard
```



```
{
  "about": "Sunlight Foundation uses cutting-edge technology and ideas to make
  "category": "Non-governmental organization (ngo)",
  "category_list": [
    {
      "id": "2235",
      "name": "Non-Governmental Organization (NGO)"
    }
  ],
  "checkins": 136,
  "description": "POSTING GUIDELINES:\n\nThe Sunlight Foundati
ansparency and general issues related to open data. Individuals
```

json



```
id,name,released_on,price,created_at,updated_at
24,1000 Piece Jigsaw Puzzle,2012-07-03,14.99,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
30,360° Protractor,2012-05-03,3.99,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
17,7 Wonders,2012-04-21,28.75,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
13,Acoustic Guitar,2012-06-06,1025.0,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
15,Agricola,2012-05-22,45.99,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
22,Answer to Everything,2012-07-03,42.0,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
23,Box Kite,2012-05-19,63.0,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
29,CanCan Music Record,2012-05-09,2.99,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
12,Chocolate Pie,2012-04-12,3.14,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
9,Dog Toy Bone,2012-06-13,2.99,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
11,Flux Capacitor,2012-06-01,19.55,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
6,Game Console,2012-06-06,299.95,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
10,Heated Blanket,2012-07-19,27.95,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
19,Knights of Catan,2012-06-10,19.95,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
8,Lawn Chair,2012-05-29,34.99,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
21,Millennium Falcon,2012-04-10,3597200.0,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
14,Model Enterprise,2012-04-18,27.99,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
28,Model Train Rails,2012-06-30,45.0,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
3,Oak Coffee Table,2012-07-08,223.99,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
5,Oh's Cereal,2012-04-17,3.95,2012-07-09 16:50:49 UTC,2012-07-09 16:50:49 UTC
```

csv

https://sunlightfoundation.com/2014/03/11/making-json-as-simple-as-a-spreadsheet/
http://railscasts.com/episodes/362-exporting-csv-and-excel?view=asciicast

How to install Pandas

- Conda command: conda install -c anaconda pandas

- Pip command: pip install pandas

Some commands of Pandas

1. How to import Pandas.

Command : import pandas as pd

2. Reading a csv file.

Command : pd.read_csv(*filepath_or_buffer*)

filepath_or_buffer (String) = Path of a file.

Example: df = pd.read_csv("exams_100.csv")

Some commands of Pandas

3. Viewing the top n rows of a file

Command : df.head(n)

n (int) = number of rows to select. (Default is 5)

4. Viewing the bottom n rows of a file

Command : df.tail(n)

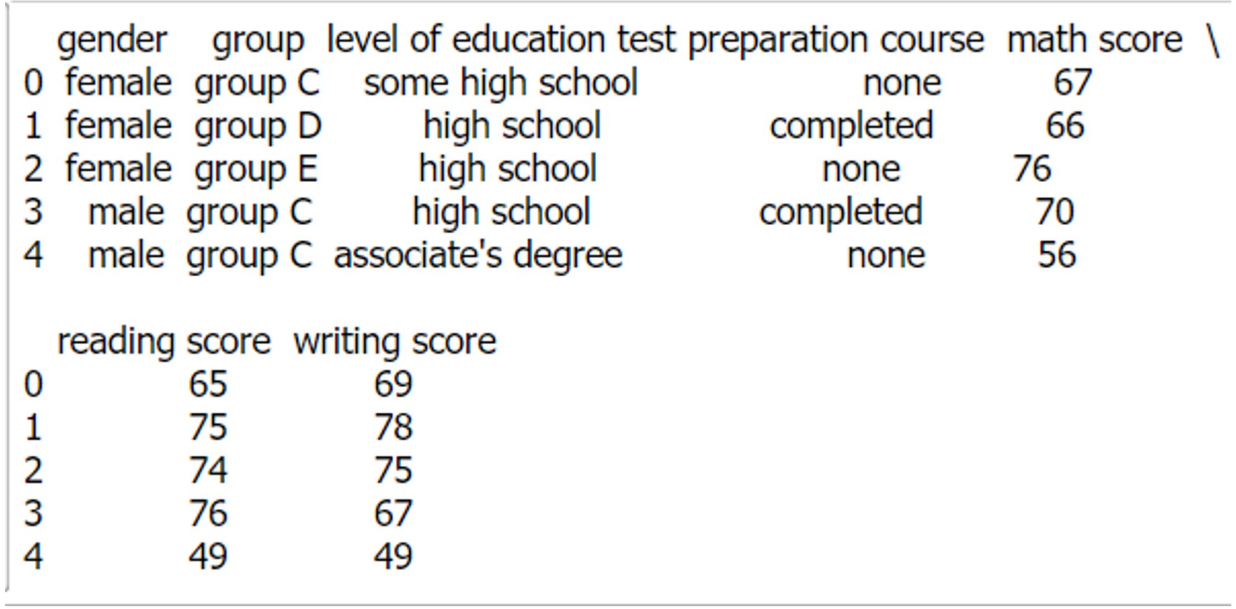
n (int) = number of rows to select. (Default is 5)

Example of reading data by pandas

```
Import pandas as pd

data = pd.read_csv(‘data.csv’)

print(data)
```



```
   gender   group  level of education test preparation course  math score  \
0  female  group C   some high school                    none          67
1  female  group D        high school               completed          66
2  female  group E        high school                    none          76
3    male  group C        high school               completed          70
4    male  group C  associate's degree                   none          56

   reading score  writing score
0             65             69
1             75             78
2             74             75
3             76             67
4             49             49
```

How to get data after reading it

We can look inside each column by its name

Example :

Dict Key

gender = data['gender’]

Returns : **DataFrame**

What is a DataFrame ? : a tabular data (with rows and columns).

Convert to list by mylist = list(gender)

What is Matplotlib

- Matplotlib is a Python 2D plotting library

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What does Matplotlib can do ?

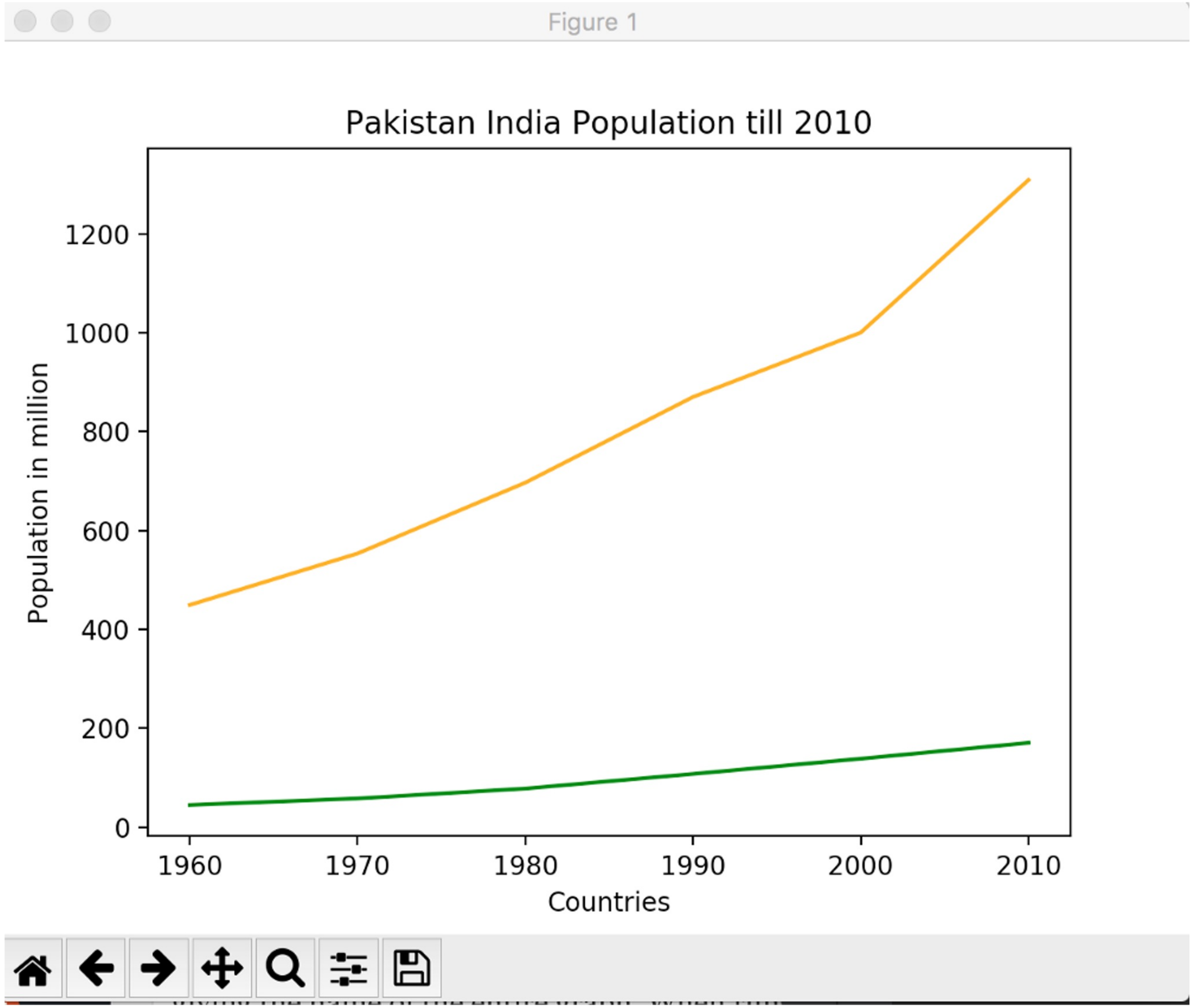
- Advantages of Matplotlib library
  - Large community
  - Many plot types supported
  - Easy to use with python

What does Matplotlib can do ?

- Some types of Matplotlib graphs
  - Line graph
  - Bar graph
  - Pie graph
  - etc

Line graph

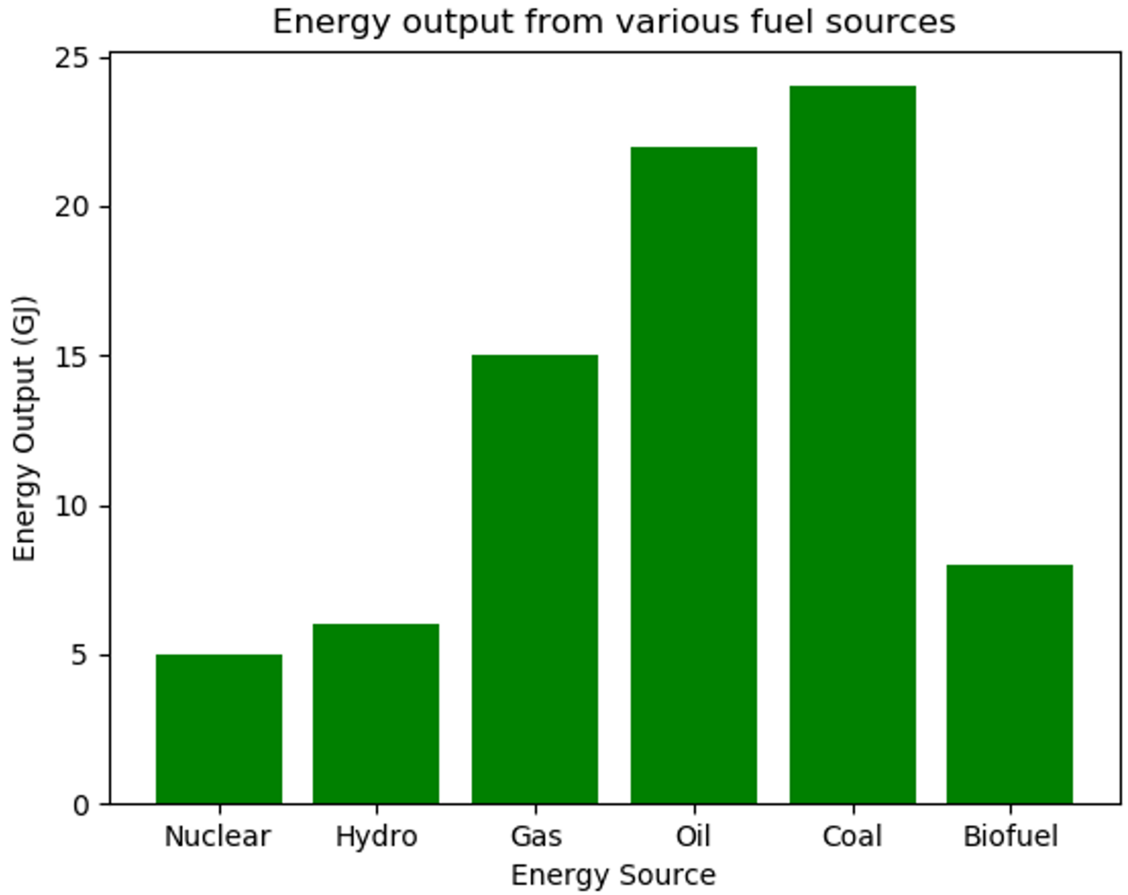
```
import matplotlib.pyplot as plt

year = [1960, 1970, 1980, 1990, 2000, 2010]
pop_pakistan = [44.91, 58.09, 78.07, 107.7,
138.5, 170.6]
pop_india =  [449.48, 553.57, 696.783,
870.133, 1000.4, 1309.1]
plt.plot(year, pop_pakistan, color='g')
plt.plot(year, pop_india, color='orange')
plt.xlabel('Countries')
plt.ylabel('Population in million')
plt.title('Pakistan India Population till 2010')
plt.show()
```



list comprehension!
What does enumerate(x) do?

Bar graph

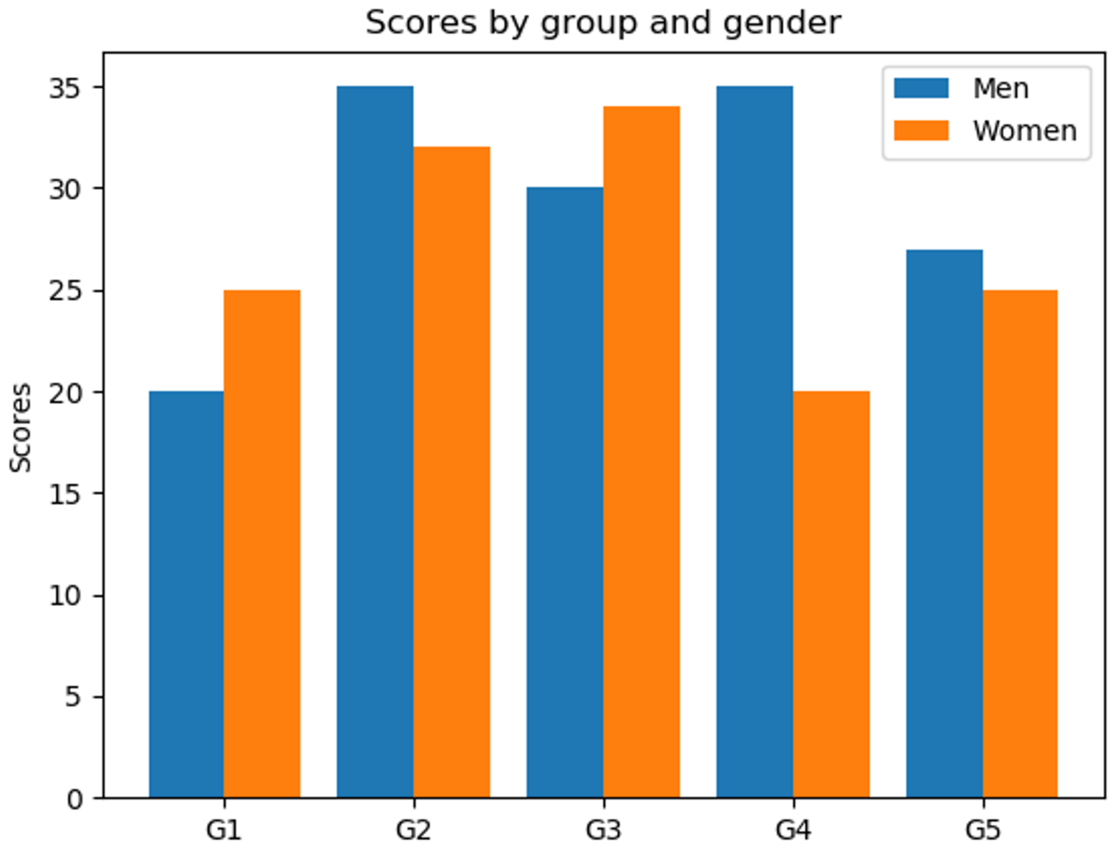
```
import matplotlib.pyplot as plt

x = ['Nuclear', 'Hydro', 'Gas', 'Oil', 'Coal',
'Biofuel']
energy = [5, 6, 15, 22, 24, 8]
x_pos = [idx for idx, val in enumerate(x)]
plt.bar(x_pos, energy, color='green')
plt.xlabel("Energy Source")
plt.ylabel("Energy Output (GJ)")
plt.title("Energy output from various fuel
sources")
plt.xticks(x_pos, x)
plt.show()
```



```
mylist = [‘a’,’b’,’c’]

for item in mylist

for id, item in enumerate(mylist)
```

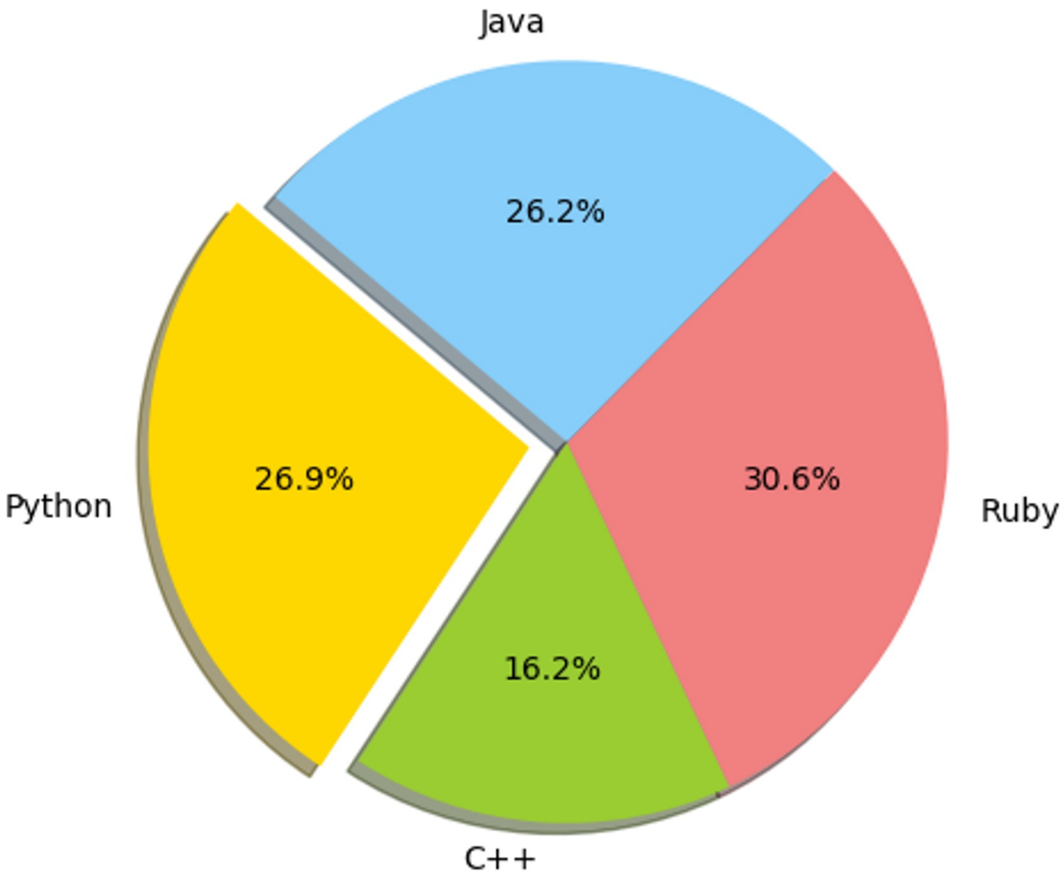
Bar graph with multiple plots

```
N = 5
men_means = (20, 35, 30, 35, 27)
women_means = (25, 32, 34, 20, 25)
width = 0.40

index_men = [idx for idx in range(N)]
index_women = [idx+0.40 for idx in range(N)]
index_number = [idx+0.40 / 2 for idx in range(N)]

plt.bar(index_men, men_means, width, label='Men')
plt.bar(index_women, women_means, width, label='Women')

plt.ylabel('Scores')
plt.title('Scores by group and gender')

plt.xticks(index_number, ('G1', 'G2', 'G3', 'G4', 'G5'))
plt.legend(loc='best')
plt.show()
```

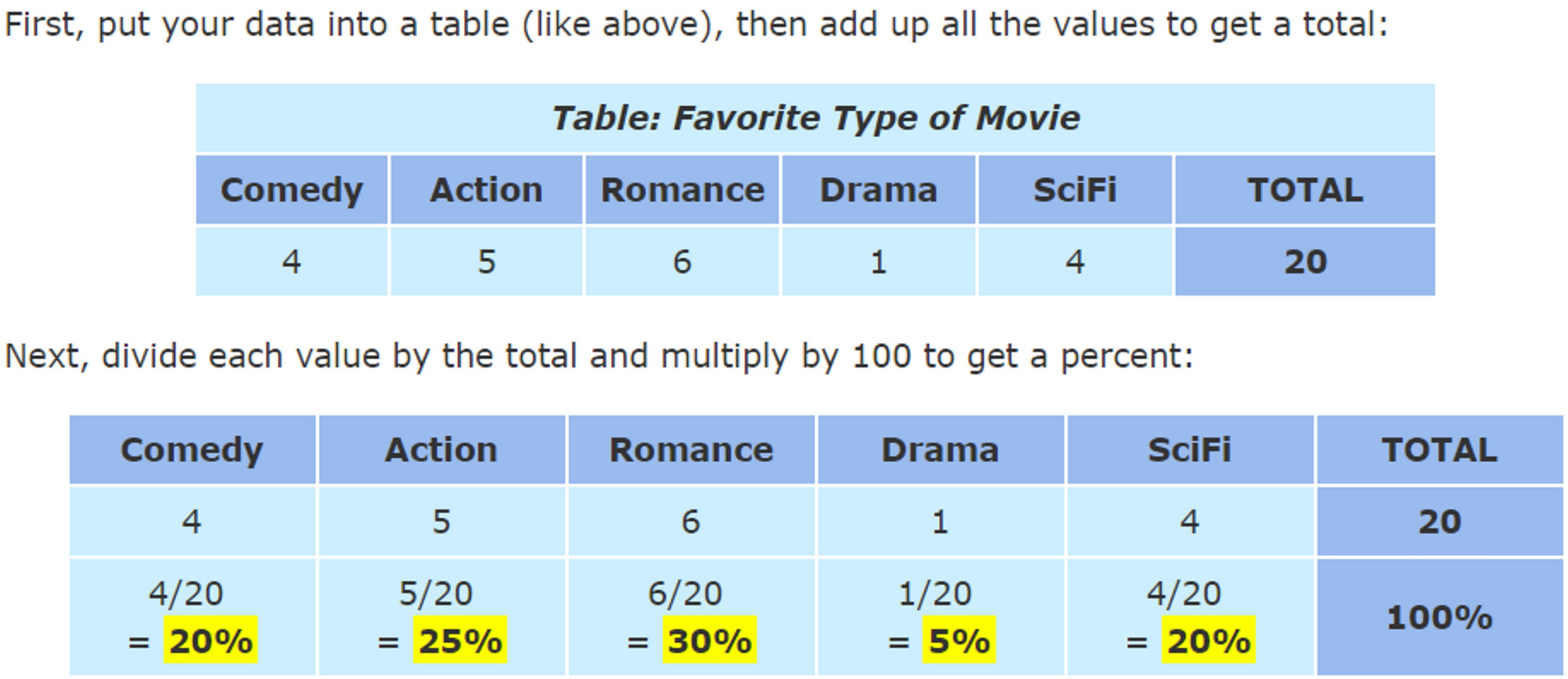


Pie graph

```
import matplotlib.pyplot as plt

# Data to plot
labels = 'Python', 'C++', 'Ruby', 'Java'
sizes = [215, 130, 245, 210]
colors = ['gold', 'yellowgreen', 'lightcoral',
'lightskyblue']
explode = (0.1, 0, 0, 0)  # explode 1st slice

# Plot
plt.pie(sizes, explode=explode,
labels=labels, colors=colors,
autopct='%1.1f%%', shadow=True,
startangle=140)

plt.show()
```



Pie graph calculation



First, put your data into a table (like above), then add up all the values to get a total:

Table: Favorite Type of Movie

Comedy	Action	Romance	Drama	SciFi	TOTAL
4	5	6	1	4	**20**

Next, divide each value by the total and multiply by 100 to get a percent:

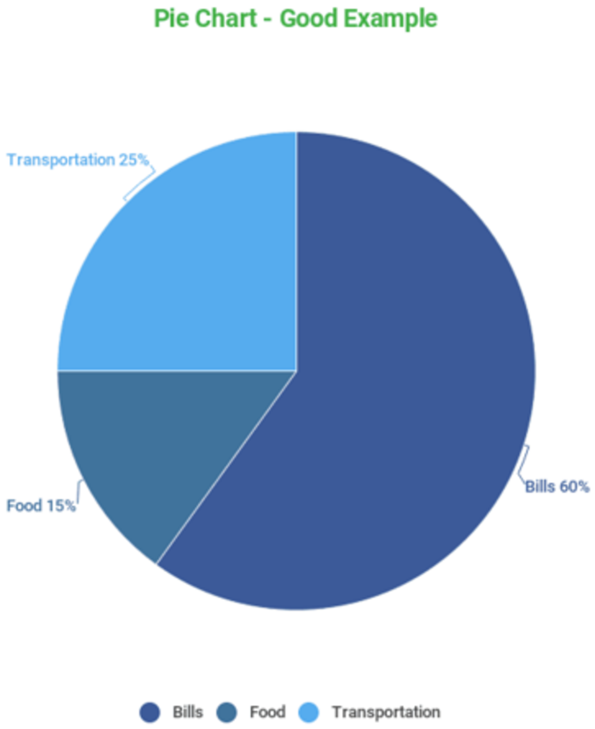
Comedy	Action	Romance	Drama	SciFi	TOTAL
4	5	6	1	4	**20**
4/20 = **20%**	5/20 = **25%**	6/20 = **30%**	1/20 = **5%**	4/20 = **20%**	**100%**

Credit: https://www.mathsisfun.com/data/pie-charts.html

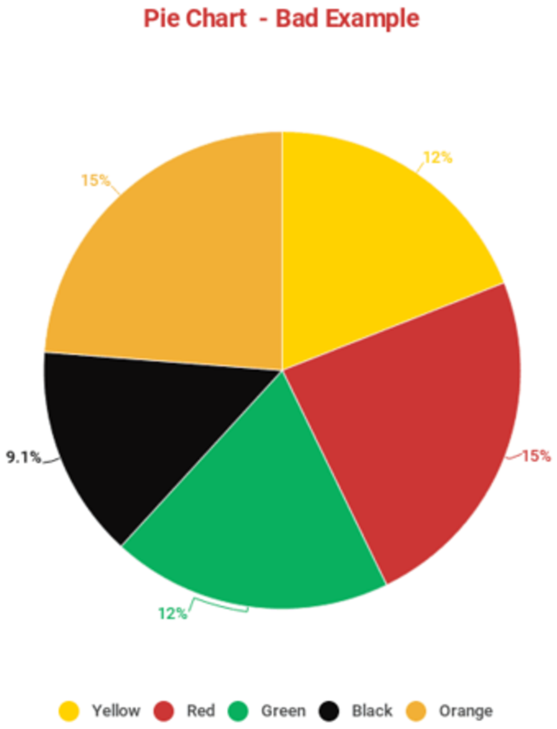
Which plot type?

Bar graph: Comparison

Line graph: Trend, time series



Pie Chart - Good Example



Pie Chart - Bad Example

Pie graph: proportion, clear difference, not more than 5 segments