esade

Intermediate Python & a Glimpse into AI applications

Class 3

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Index Class 3

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Topic 1: Recap

Recap Class 2: Pandas

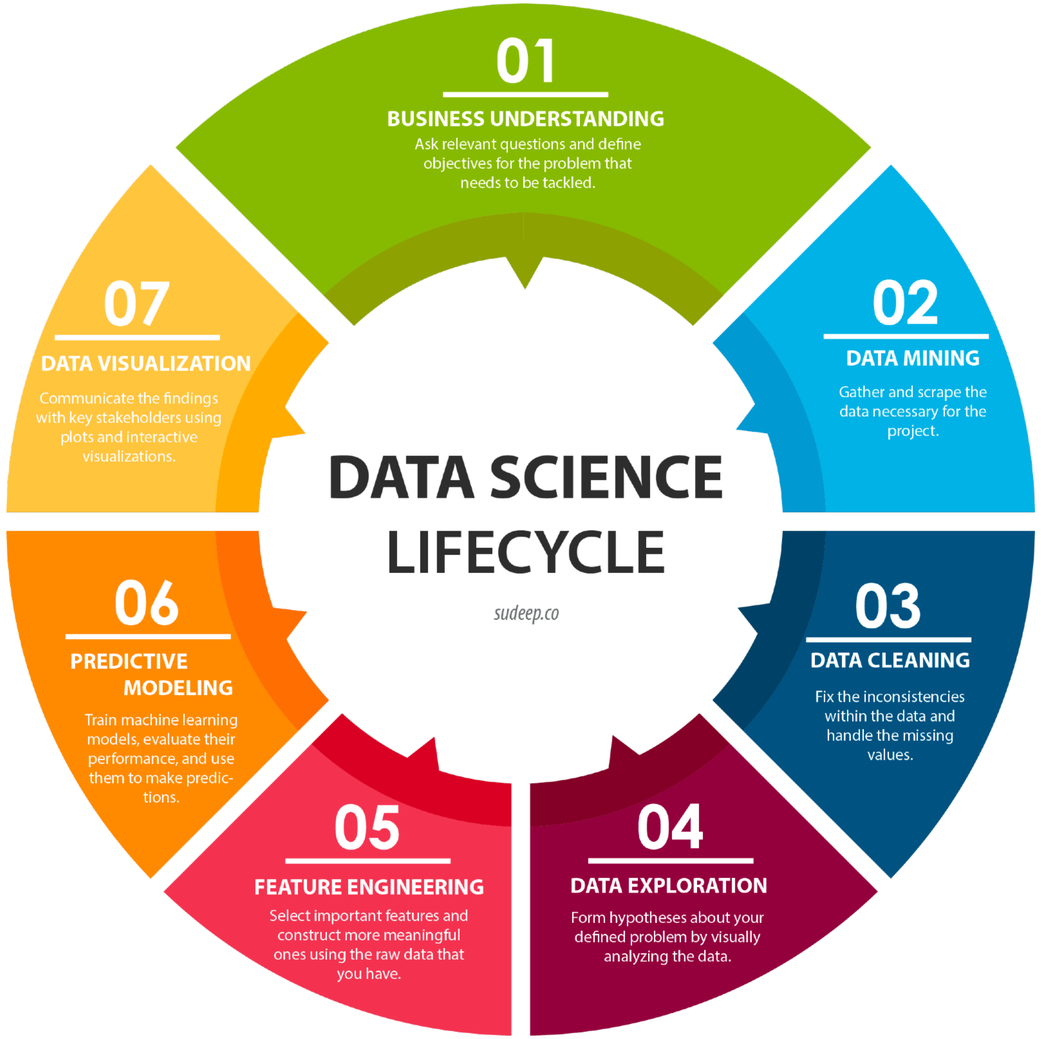
Groupby

Apply

Lambda

Groupby + Apply + Lambda

Recap Class 2: The Data Science Lifecycle



Recap Class 2: Data Cleaning

- Step 1: Remove irrelevant data
- Step 2: Deduplicate your data
- Step 3: Fix structural errors
- Step 4: Deal with missing data
- Step 5: Filter out data outliers
- Step 6: Validate your data

Recap Class 2: Comments Exercises

- Be careful when you use drop(). If you run that cell twice it will give you an error.

```
/usr/local/lib/python3.8/dist-packages/pandas/core/indexes/base.py in drop(self, labels, errors)
   6015         if mask.any():
   6016             if errors != "ignore":
-> 6017                 raise KeyError(f"{labels[mask]} not found in axis")
   6018             indexer = indexer[~mask]
   6019         return self.delete(indexer)

KeyError: "['address'] not found in axis"
```

Try to understand the errors that pop out

Recap Class 2: Comments Exercises

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```

Try to understand the errors that pop out

Example of me yesterday and my code

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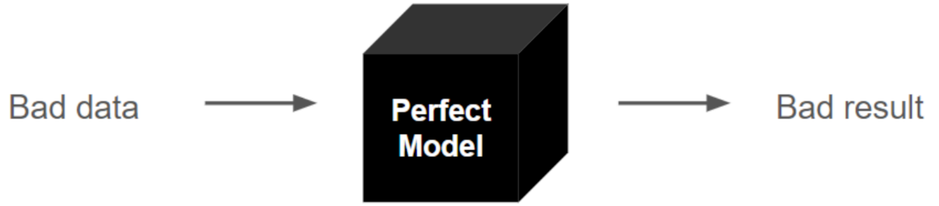
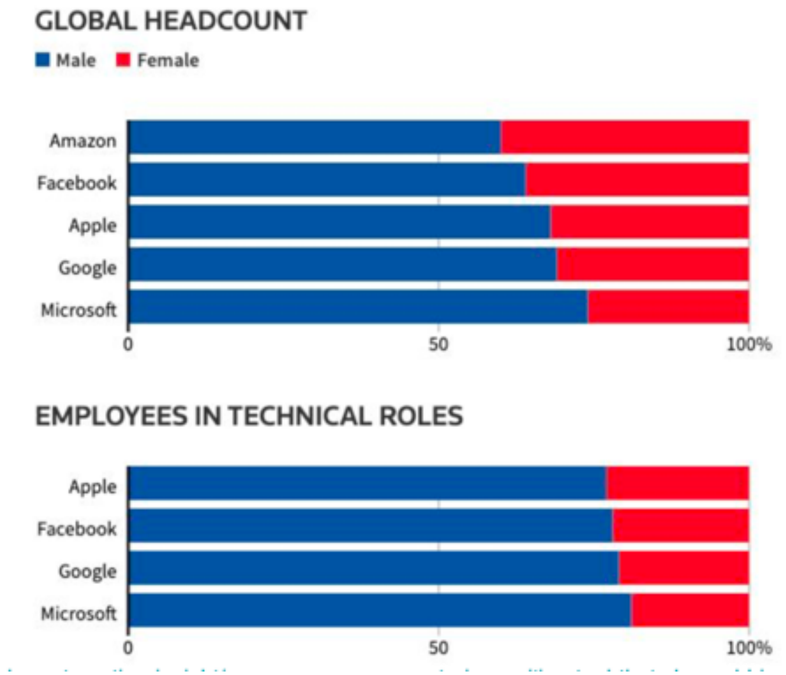
Topic 2: Data Preparation - Data Exploration

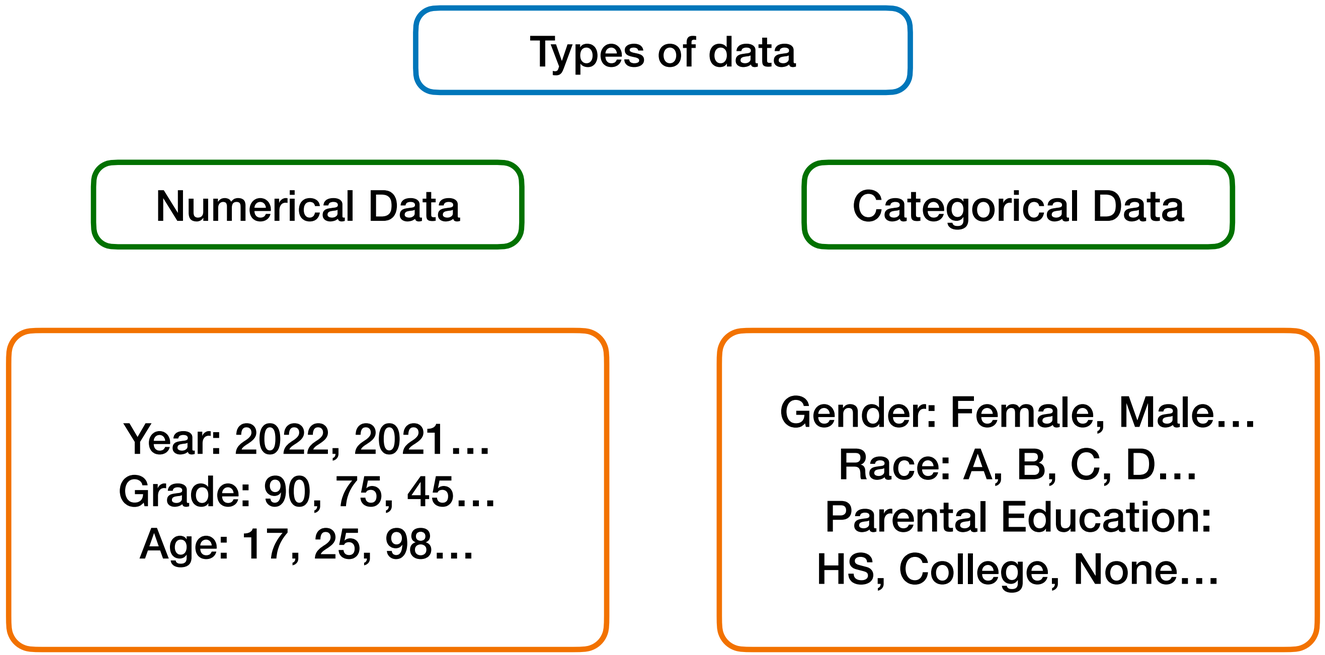
Data Exploration - Exploratory data analysis (EDA)



- A process where users look at and understand their data with statistical and visualization methods.
- Identify patterns and problems in the dataset
- Decide which model or algorithm to use in subsequent steps.



Preliminary data processing



Preliminary data processing

- Changes to the types of data of a column, i.e.:
    - Numerical to a string: int —> str
    - String to a date time: str —> datetime

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 962 entries, 0 to 1009
Data columns (total 11 columns):
 #   Column                       Non-Null Count  Dtype
---  ------                       --------------  -----
 0   gender                       962 non-null    object
 1   race/ethnicity               962 non-null    object
 2   parental level of education  962 non-null    object
 3   lunch                        962 non-null    object
 4   test preparation course      962 non-null    object
 5   math score                   962 non-null    int64
 6   reading score                962 non-null    int64
 7   writing score                962 non-null    int64
 8   id_student                   962 non-null    int64
 9   Year                         962 non-null    int64
 10  Age                          962 non-null    float64
dtypes: float64(1), int64(5), object(5)
memory usage: 90.2+ KB
```

Exercise

- Change the data type of the id_student column from int to str

EDA steps

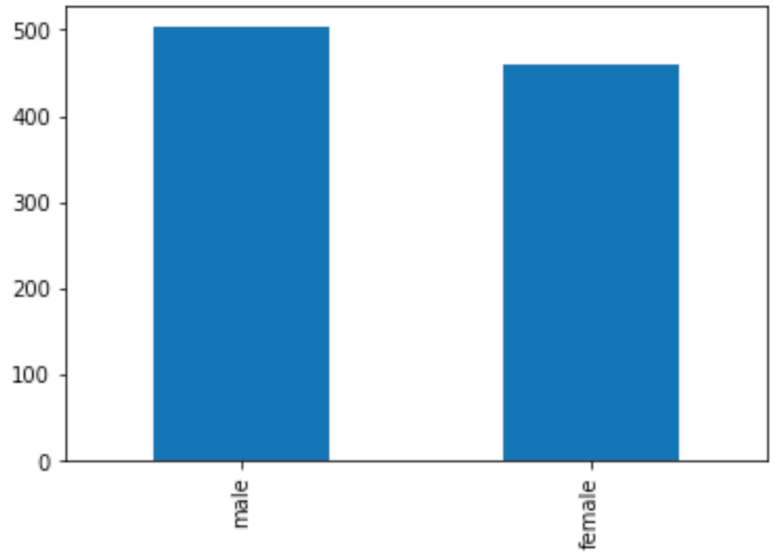
- Categorical EDA
- Numerical EDA
    - Univariate analysis
    - Bivariate analysis (Categorical + Numerical)
    - Multivariate analysis

Categorical EDA

- Initial step: Explore group counts of categorical columns

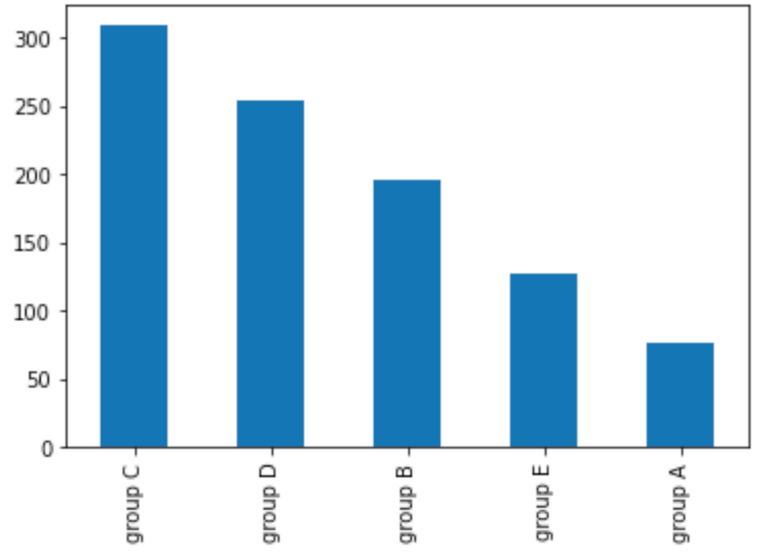
```
df['gender'].value_counts().plot(kind='bar')
```

```
<AxesSubplot:>
```




```
df['race/ethnicity'].value_counts().plot(kind='bar')
```

```
<AxesSubplot:>
```



Exercise

- Get a bar plot showing the number of students who completed the test preparation course and those who did not.

Numerical EDA

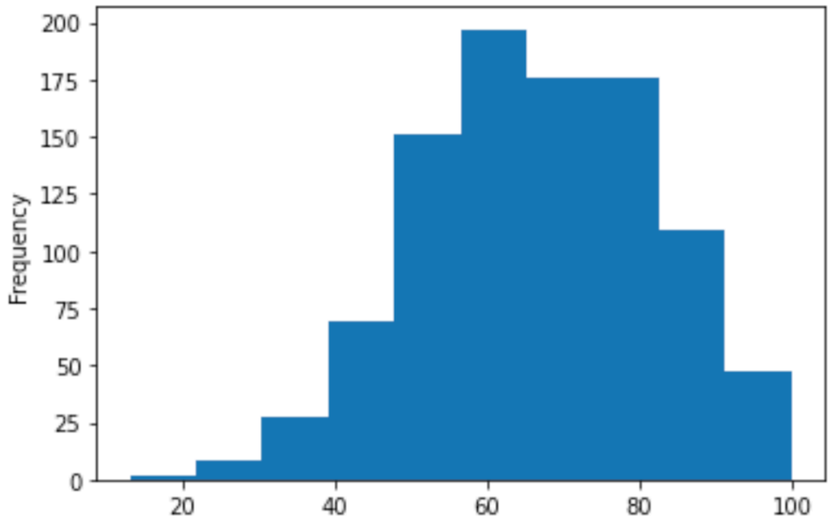
- How is the numerical data distributed?
- Can we find anything interesting?

```
df.describe()
```

	math score	reading score
count	962.000000	962.000000
mean	66.426195	68.943867
std	15.396706	14.768592
min	13.000000	27.000000
25%	55.250000	59.000000
50%	67.000000	70.000000
75%	77.000000	79.000000
max	100.000000	100.000000

```
df['math score'].plot(kind='hist')
```

```
<AxesSubplot:ylabel='Frequency'>
```



Exercise

- Plot the histogram of the reading and writing scores. Do you see anything interesting?

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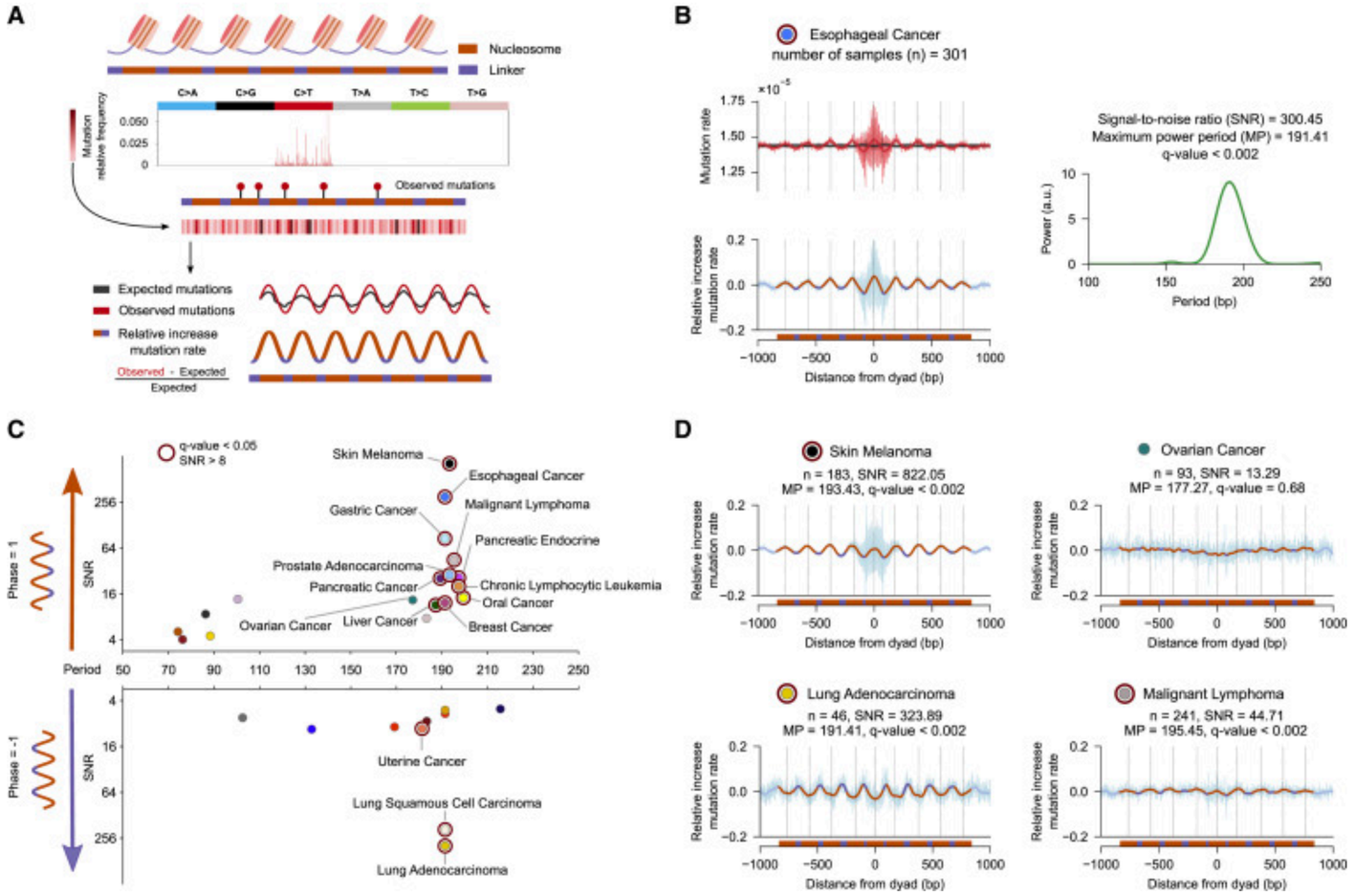
Topic 3: Matplotlib & Seaborn

Matplotlib & Seaborn



- Both are Python libraries to produce figures
- To explore the data —> visualizations of your results are needed
- Seaborn is built on top of matplotlib. It provides an easy-to-use interface for drawing attractive and informative graphics (Also from pandas dataframes)

Matplotlib & Seaborn

Matplotlib building blocks

Load Libraries

```
import matplotlib.pyplot as plt
import seaborn as sns
```

Fully customizable

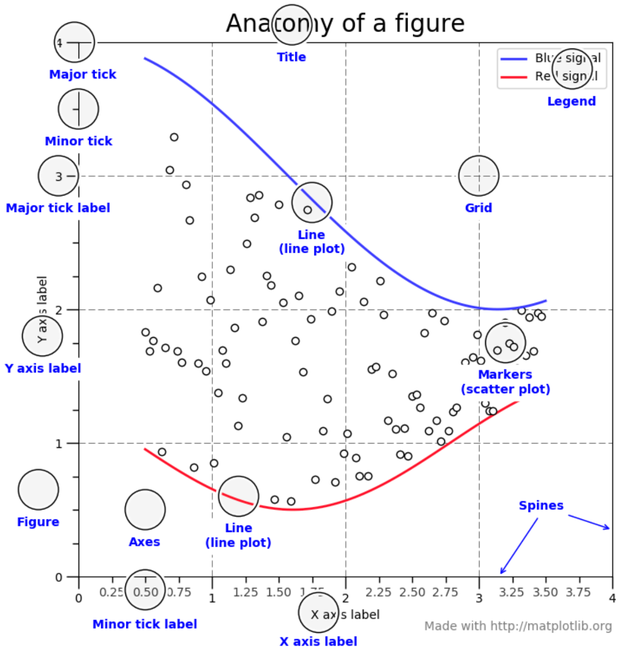


Figure structure

```
#Start Figure
fig, ax = plt.subplots(figsize=(5, 5))

#Body of the figure to build and the data to use
sns.barplot(x=to_plot['gender'], y=to_plot['index'],
            palette=['#08519c', '#f03b20'])

#Change Axes
ax.set_xlabel("Gender", fontsize=12)
ax.set_ylabel("", fontsize=12)
ax.set_yticklabels(['Male', 'Female'])
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

# Add Numbers to plot
for index, row in to_plot.iterrows():
    ax.text(row.gender + 25, index, row.gender,
             color='black', ha="center", fontsize=12)

## Add legend
custom_lines = []
for el in [('Male', '#08519c'), ('Female', '#f03b20')]:
    custom_lines.append(
        plt.plot([],[], marker="o", ms=8, ls="", mec='black',
        mew=0, color=el[1], label=el[0])[0]
    )
ax.legend(
    bbox_to_anchor=(0., 1.05, 1., .102),
    handles=custom_lines, loc='upper center',
    facecolor='white', ncol=1, fontsize=10, frameon=False
    )
#Save or show
plt.show()
```

Code for figure

```
#Start Figure
fig, ax = plt.subplots(figsize=(5, 5))

#Body of the figure to build and the data to use
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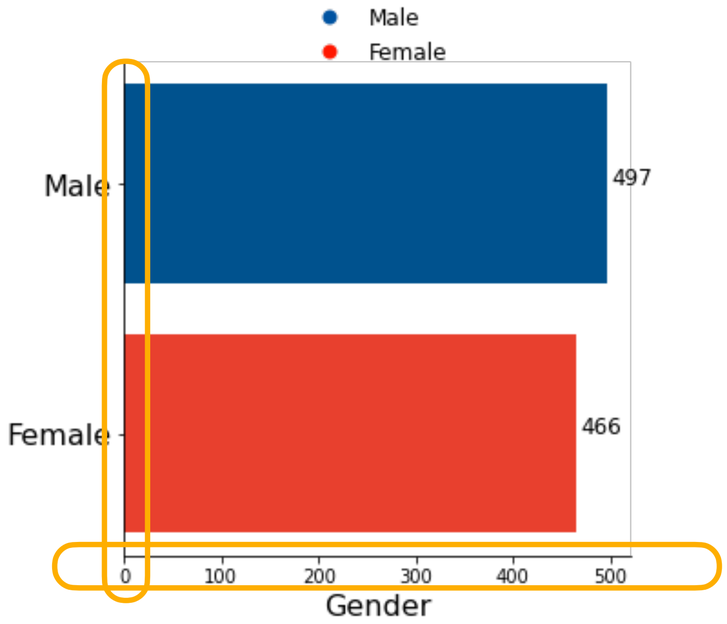

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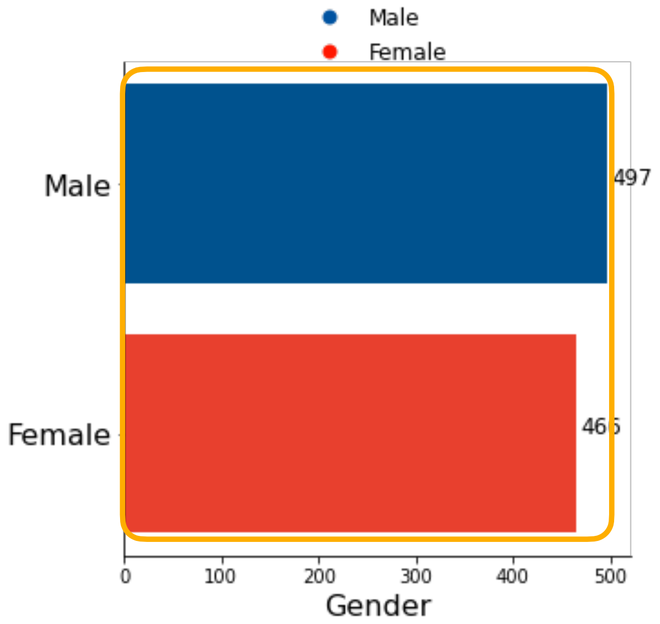

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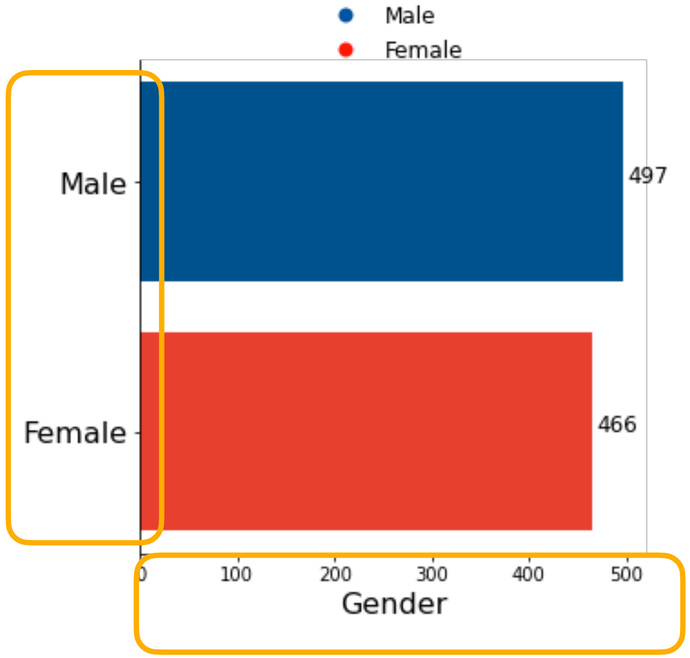

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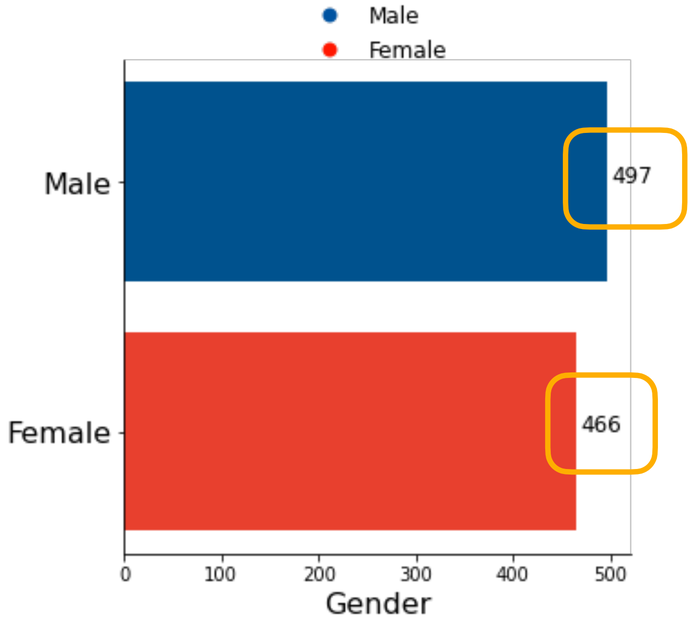

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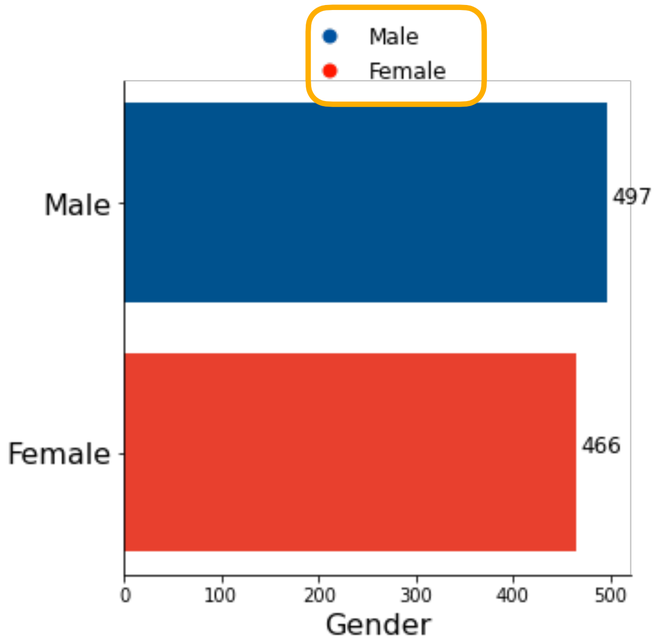

Code for figure

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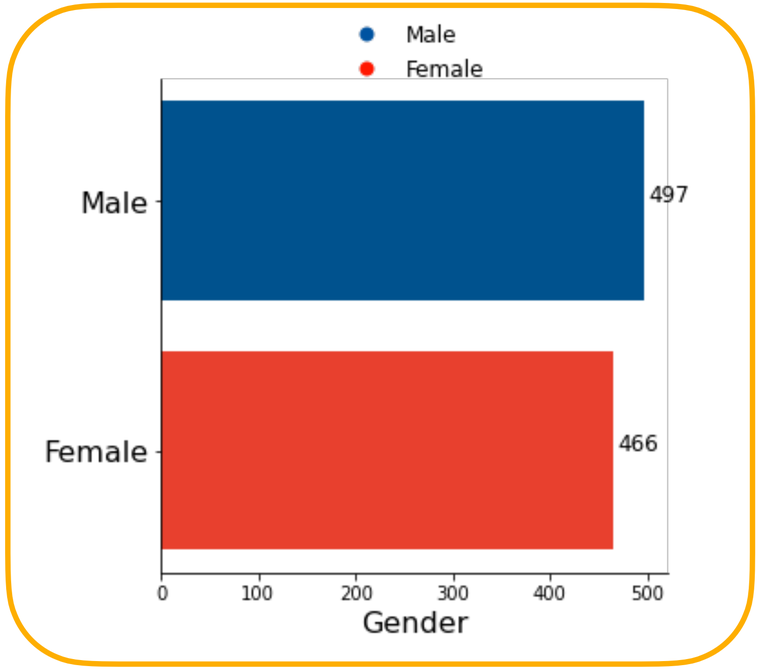
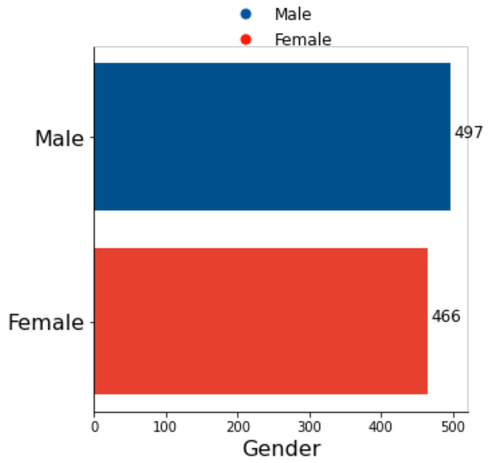


Barplot

- Graph that presents categorical data with rectangular bars with heights or lengths proportional to the values that they represent

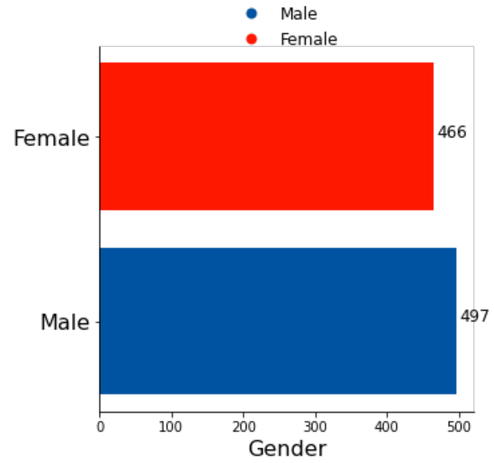
seaborn

```
#Body of the figure to build and the data to use
sns.barplot(x=to_plot['gender'], y=to_plot['index'],
            palette=['#08519c', '#f03b20'])
```



matplotlib

```
#Body of the figure to build and the data to use
plt.barh(width=to_plot['gender'], y=to_plot['index'],
         color=['#08519c', '#f03b20'])
```

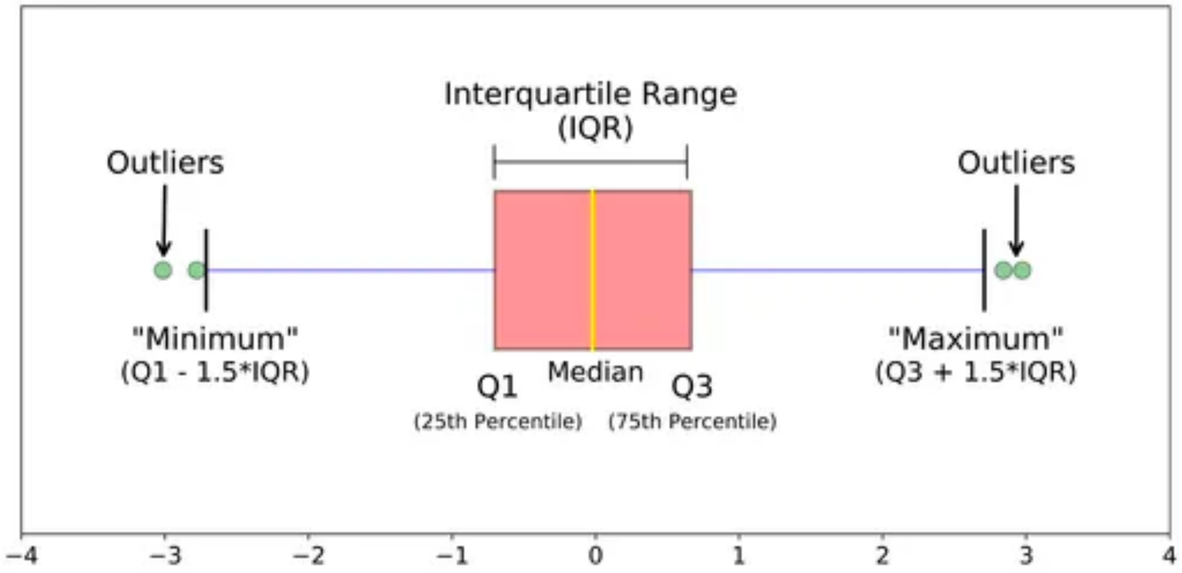


Exercise

- Write the barpot Python code for a categorical column that is not gender

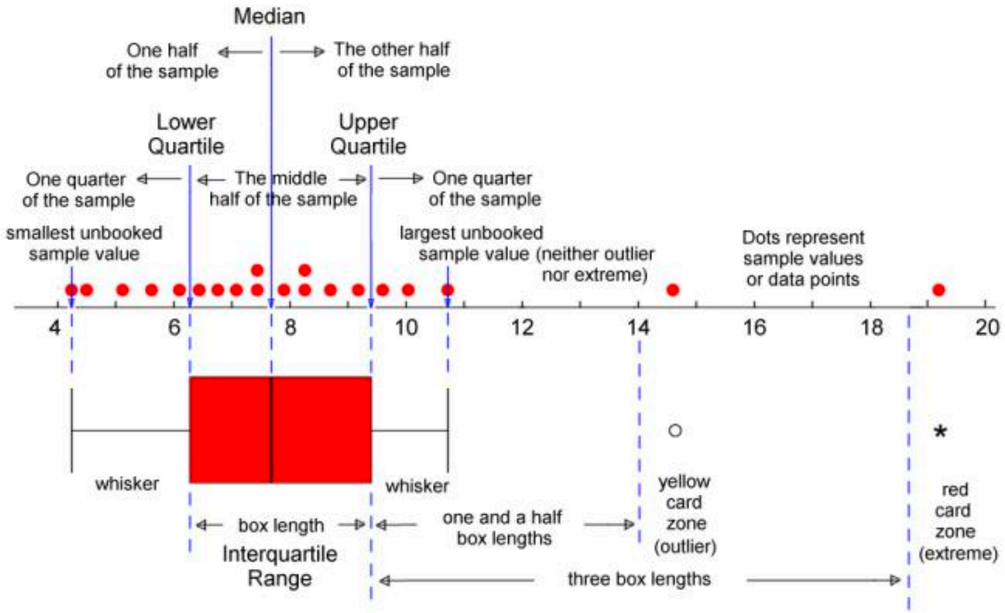
Boxplot

- A standardized way of displaying the distribution of data based on a five-number summary (“minimum”, first quartile [Q1], median, third quartile [Q3], and “maximum”)
- Graphically demonstrates the locality, spread, and skewness groups of numerical data through their quartiles



Boxplot Calculation

Interpretation



Boxplot Calculation

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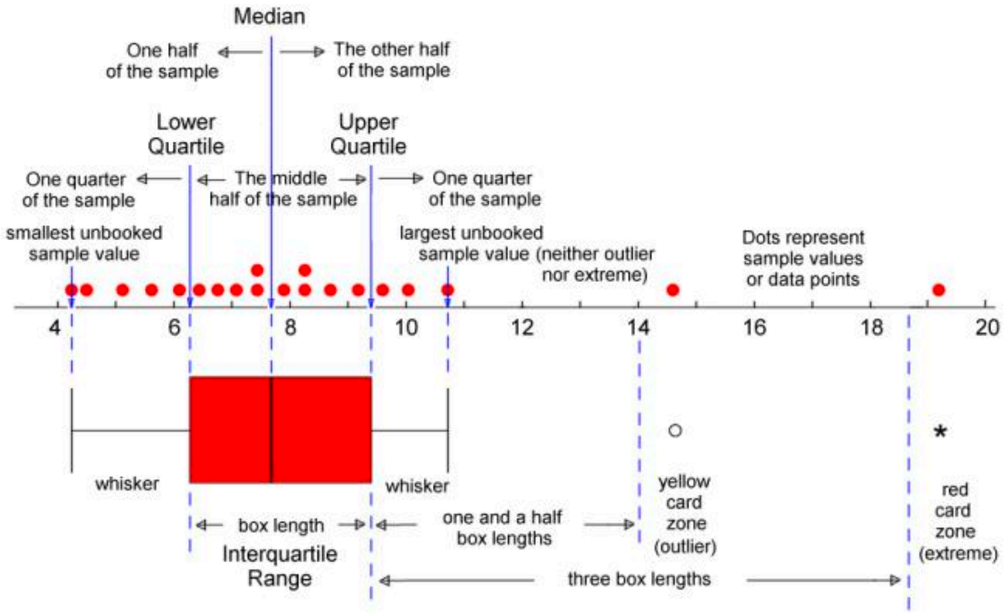

Data

	math score
count	963.000000
mean	66.234683
std	15.250540
min	13.000000
25%	56.000000
50%	66.000000
75%	77.000000
max	100.000000

Boxplot Calculation

Interpretation

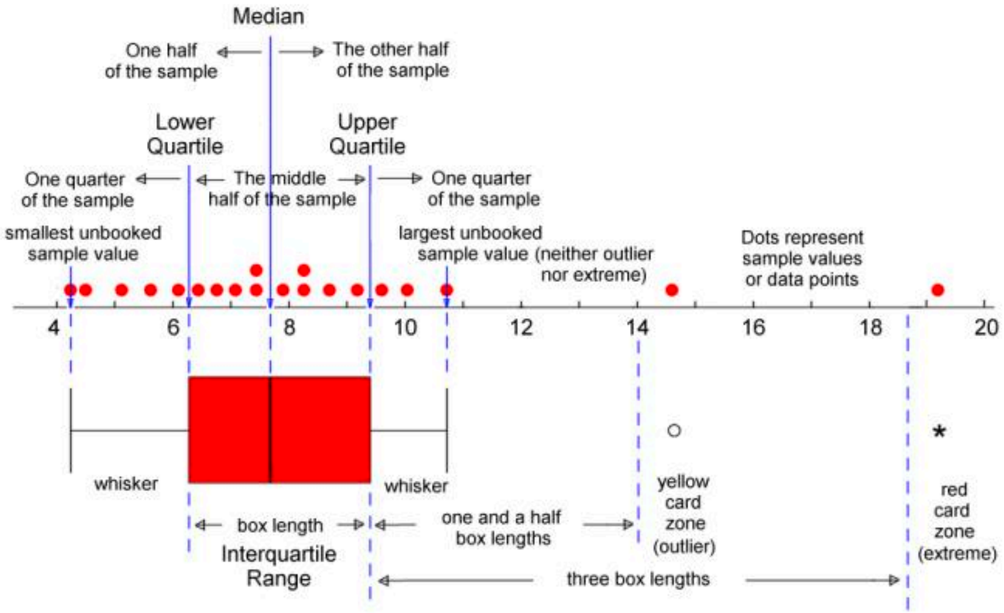

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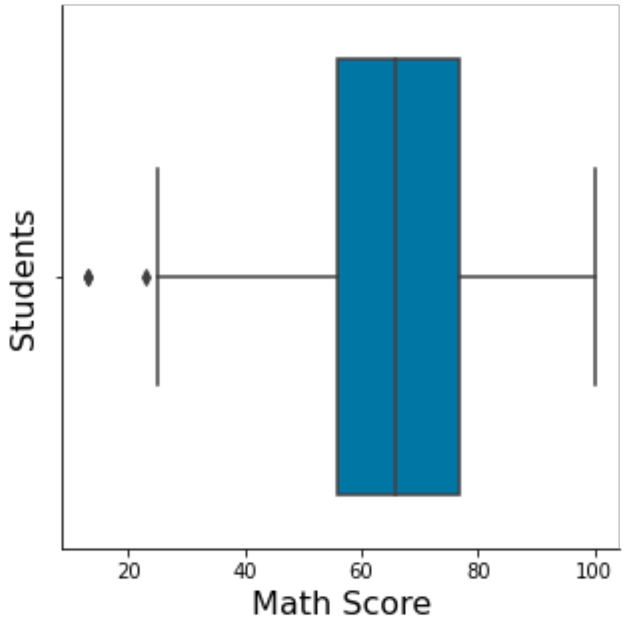
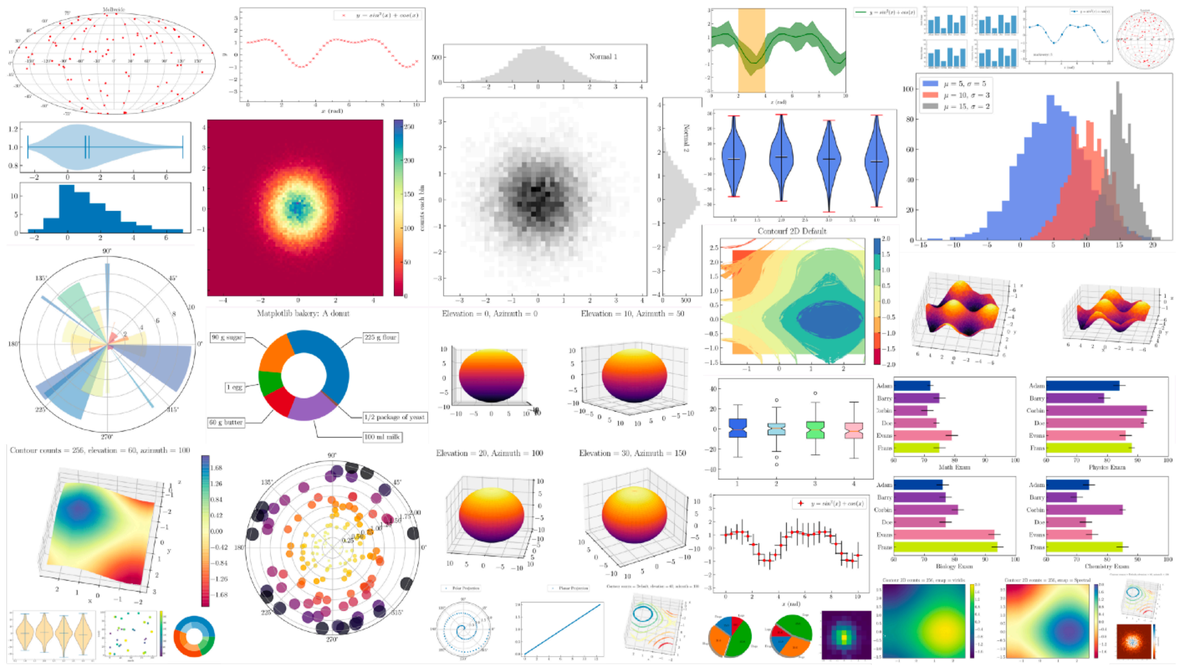
Figure Result



Exercise

- Write the boxplot Python code for the writing score column

There are infinite plot types that you can look into and use



https://matplotlib.org/stable/gallery/index.html

- Important to know how to use some of them quickly to explore your data:
    - Barplots and Boxplots mainly. Also, violin plots, scatter plots, etc…
- Plotting figures is an art and is crucial for communicating your results
- It is a time-consuming process. Go simple and improve when you want to show something

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Topic 4: Data Exploration & Visualization

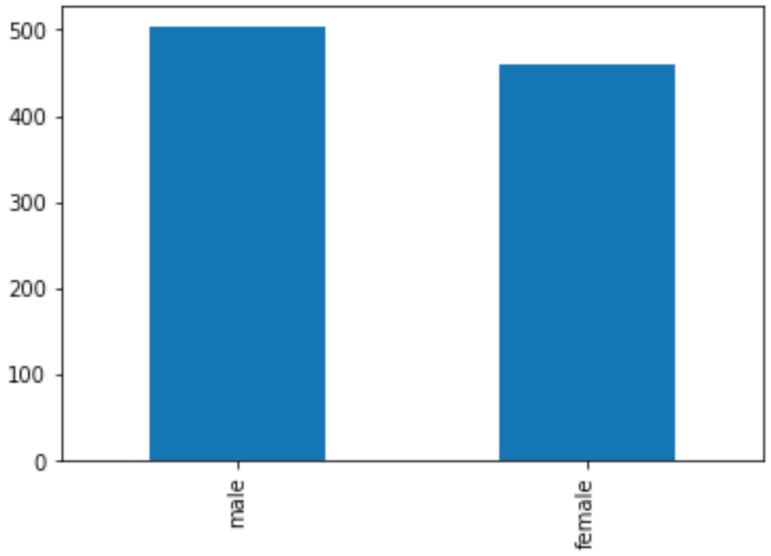
EDA steps

- Categorical EDA
- Numerical EDA
    - Univariate analysis
    - Bivariate analysis (Categorical + Numerical)
    - Multivariate analysis

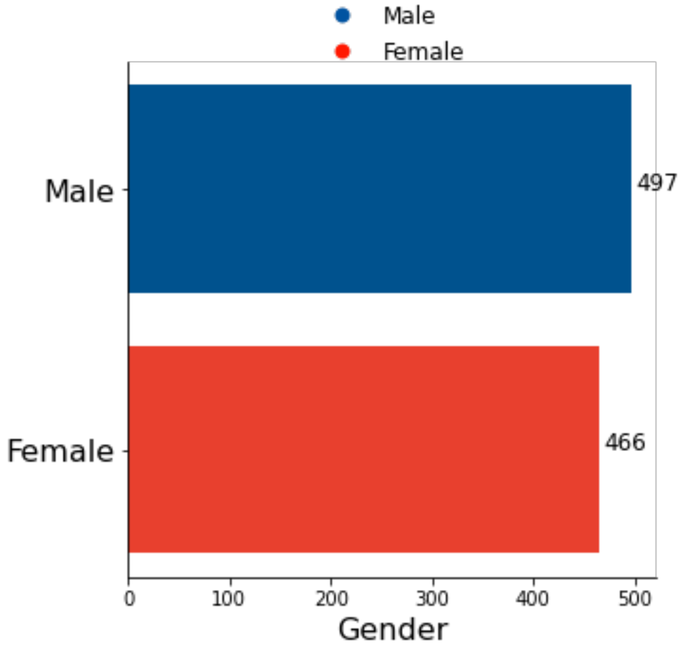
Categorical EDA

- Improve our plots: give them color, change axis names, etc…

Ugly but little code



More informative but time-consuming

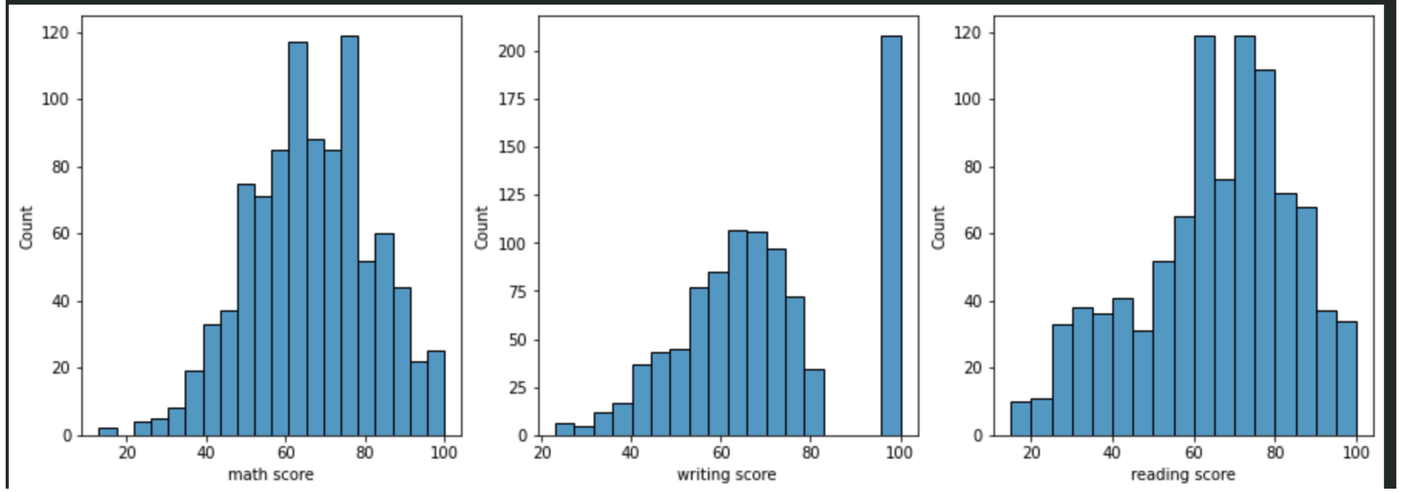


Numerical EDA - Univariate Analysis

- Study of single variables of the data by analysing the data distributions —> Histograms & Boxplots
- Is my data normally distributed? Can I identify unseen outliers?

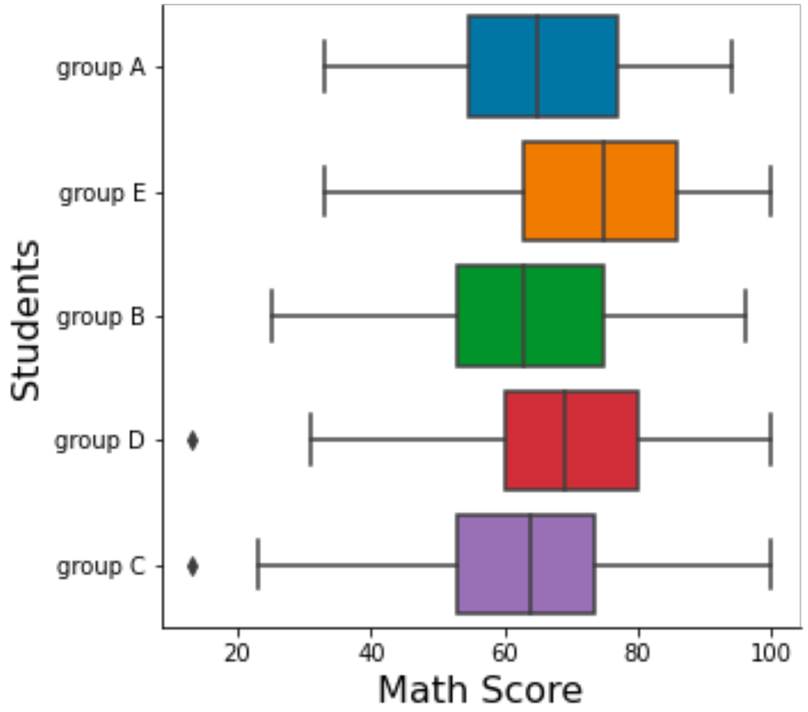
```
#Start Figure
fig, (ax1, ax2, ax3) = plt.subplots(nrows=1, ncols=3, figsize=(15, 5))

#Body of the figure to build and the data to use
sns.histplot(x=df['math score'], ax=ax1)
sns.histplot(x=df['writing score'], ax=ax2)
sns.histplot(x=df['reading score'], ax=ax3)

#Save or show
plt.show()
```

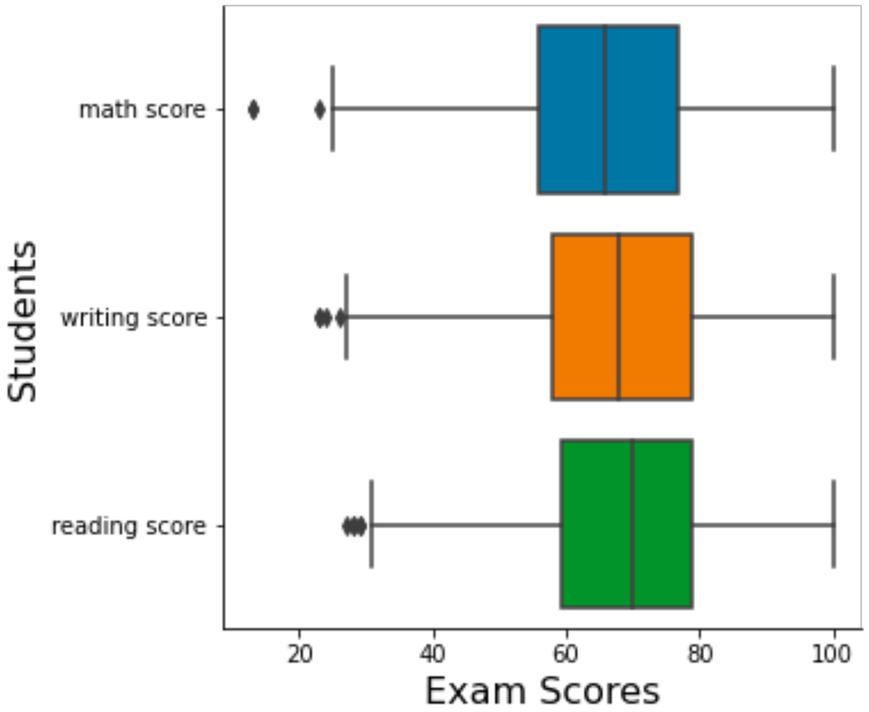
✓ 0.2s



Numerical EDA - Bivariate Analysis (Categorical + Numerical)

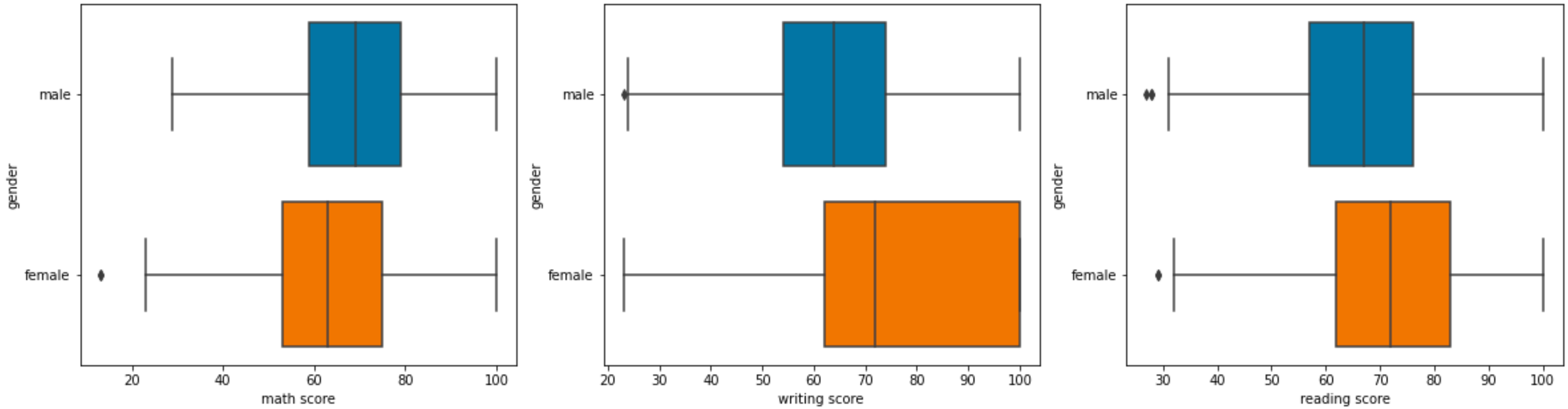
- Combination of variables through boxplots





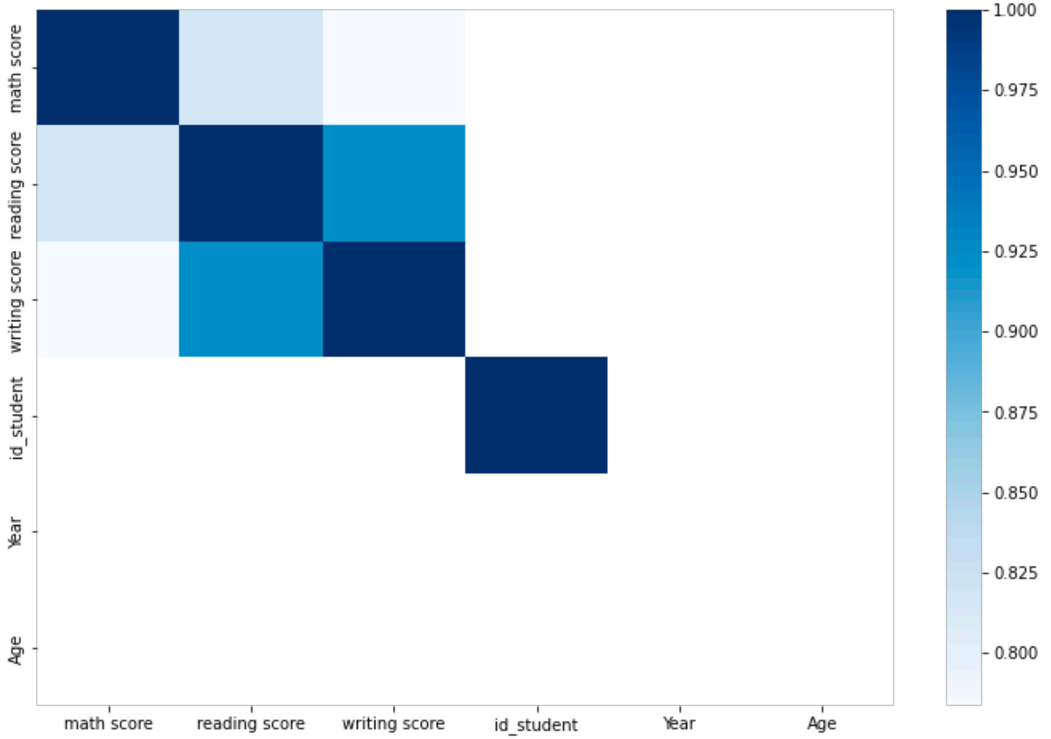
Exercise

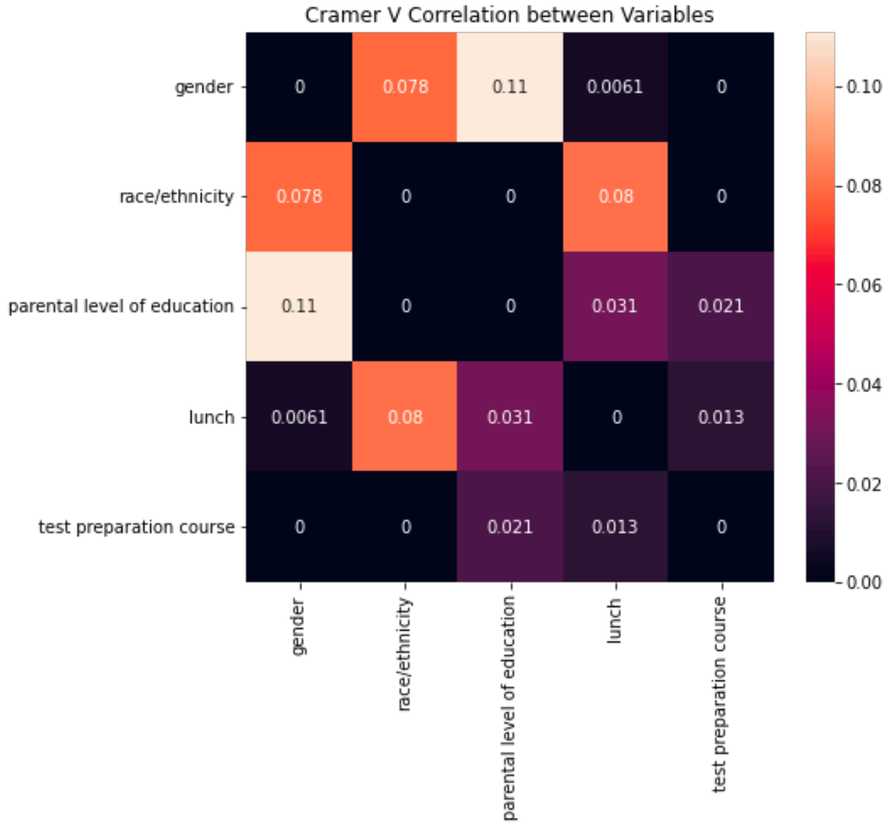
- Can you get the plot below (They can be separated as well)?



Numerical EDA - Multivariate Analysis

- Correlation plots to see how all numerical or categorical variables are related
- This helps identify possible correlations in the data that made affect downstream models. We will come back to this





Additional Assignment: Use case with our data

- A school wants to hire us to see whether we are able to understand some problems they believe they are facing.
- Something is going wrong with the performance of the students but they are not able to figure it out and give reasons to it.
- Some parents are very disappointed with the grades of their kids and have complained continuously to the board of the school.
- Our company is low on budget and we accept the deal even if it is risky, stressful and the money won't cover much of our runaway either but we take what we get.

Can you spot which students are suffering from the problem, in which subject, and how it may be solved?

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