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Intermediate Python & a Glimpse into AI applications

Class 3

Pepe Bonet Giner

13th January 2023

Index Class 3

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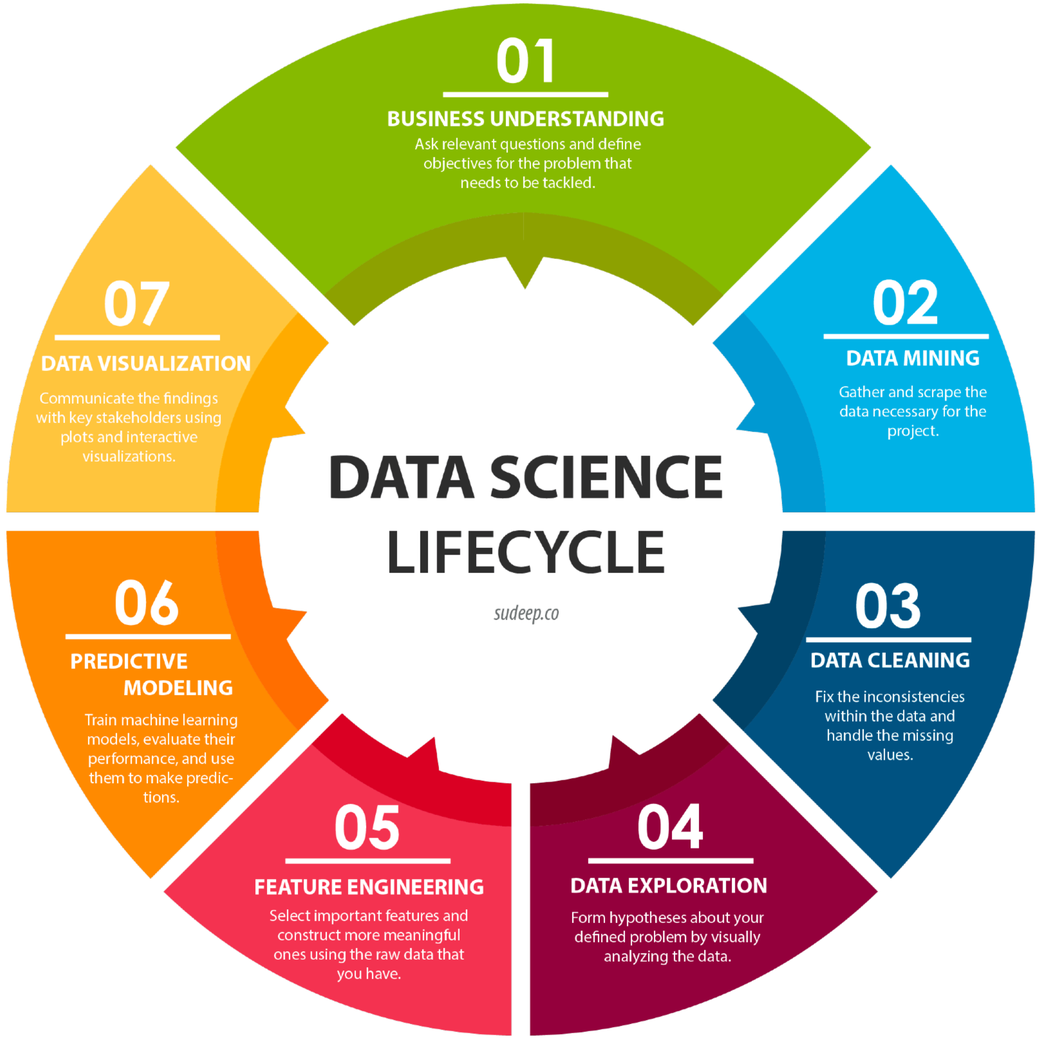
Topic 1: Recap

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

Data Exploration: EDA steps

- A process where users look at and understand their data with statistical and visualization methods
- Preliminary Data Processing
- Categorical EDA
- Numerical EDA

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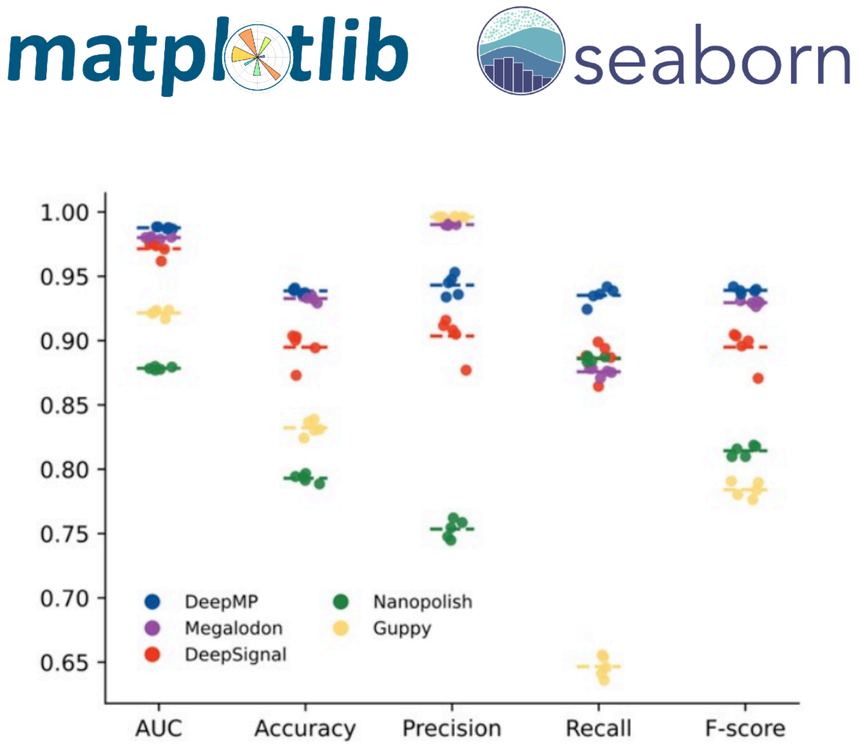
Topic 2: Matplotlib & Seaborn

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 building blocks

Load Libraries

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

Fully customizable

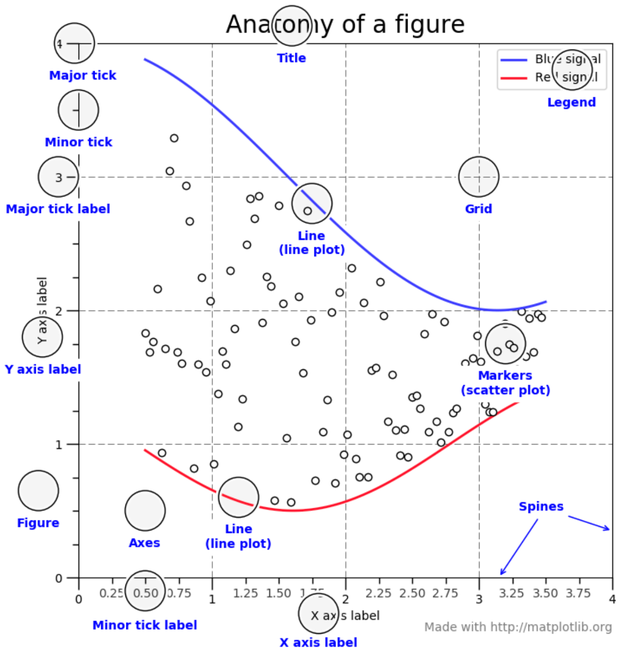


Figure structure

```
#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()
```

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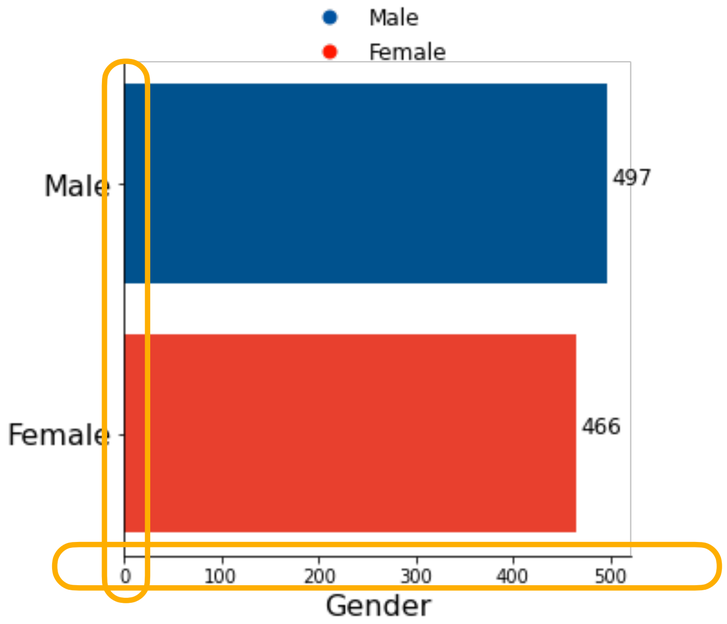

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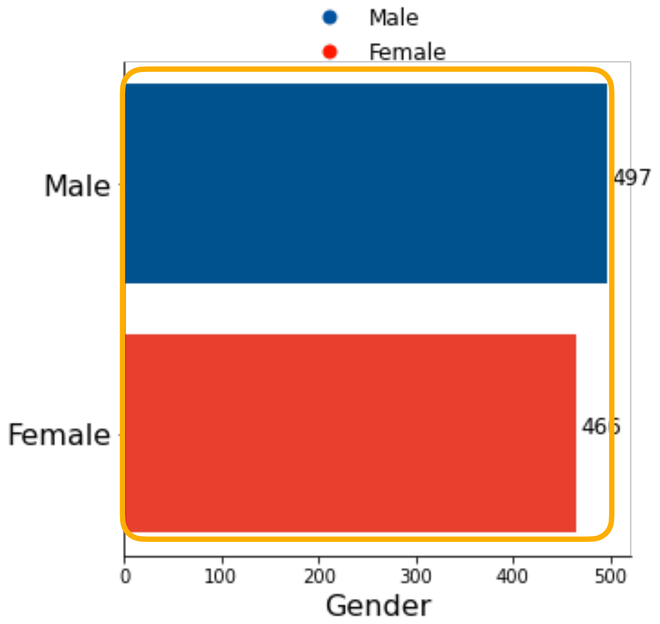

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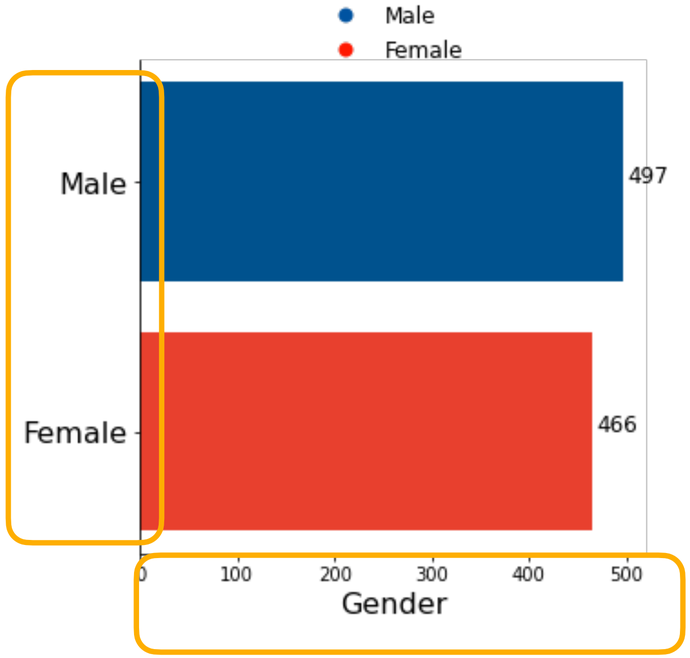

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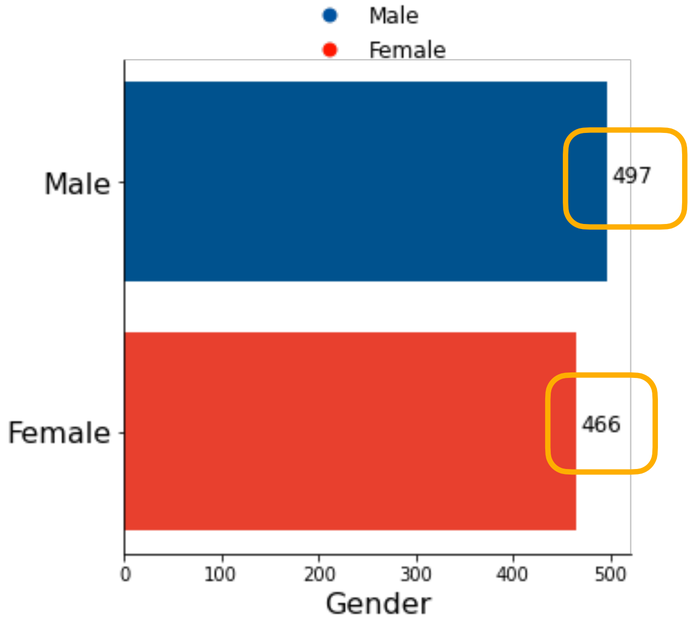

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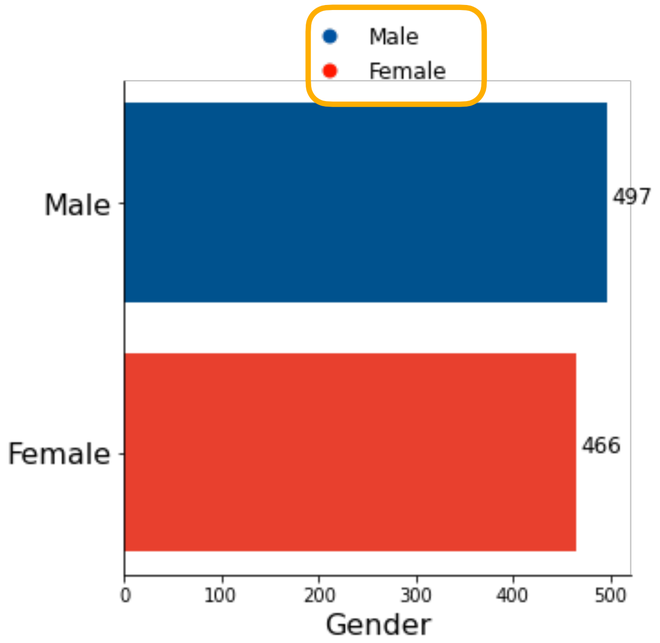

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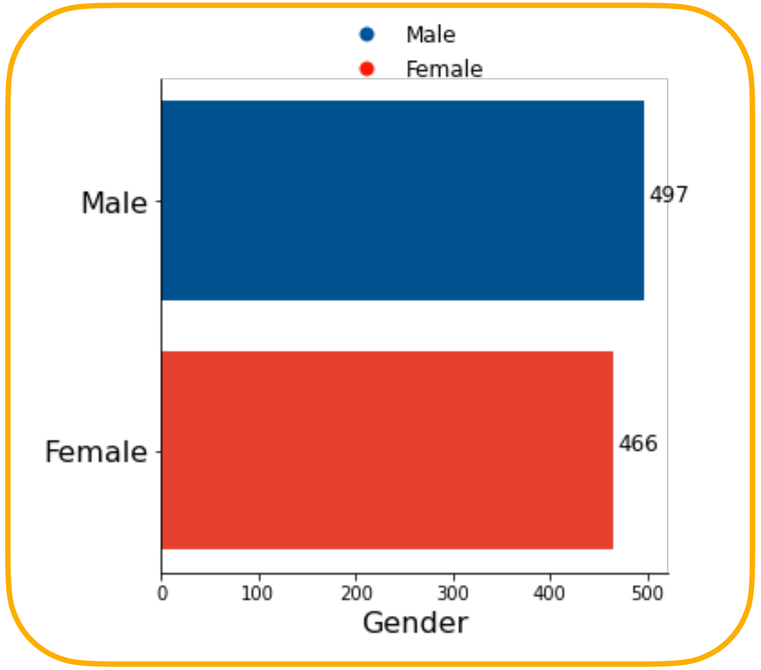
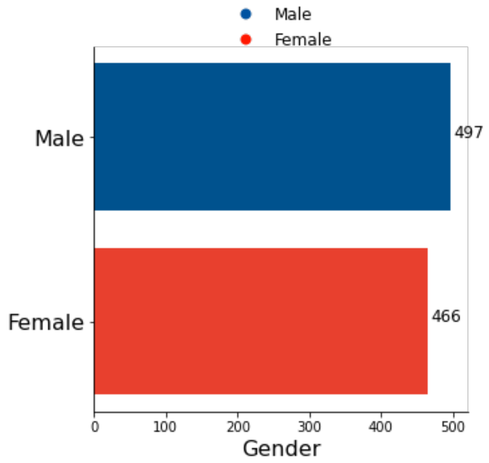


Barplot

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

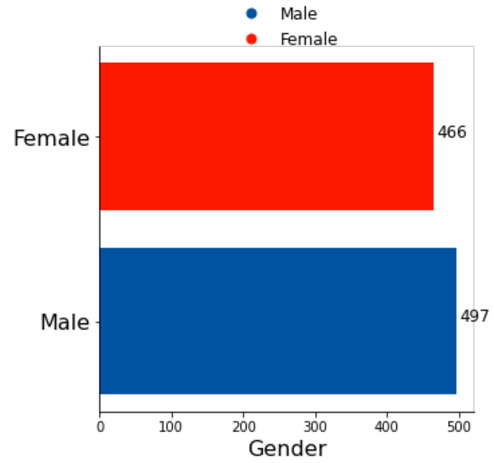
seaborn

```
#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'])
```

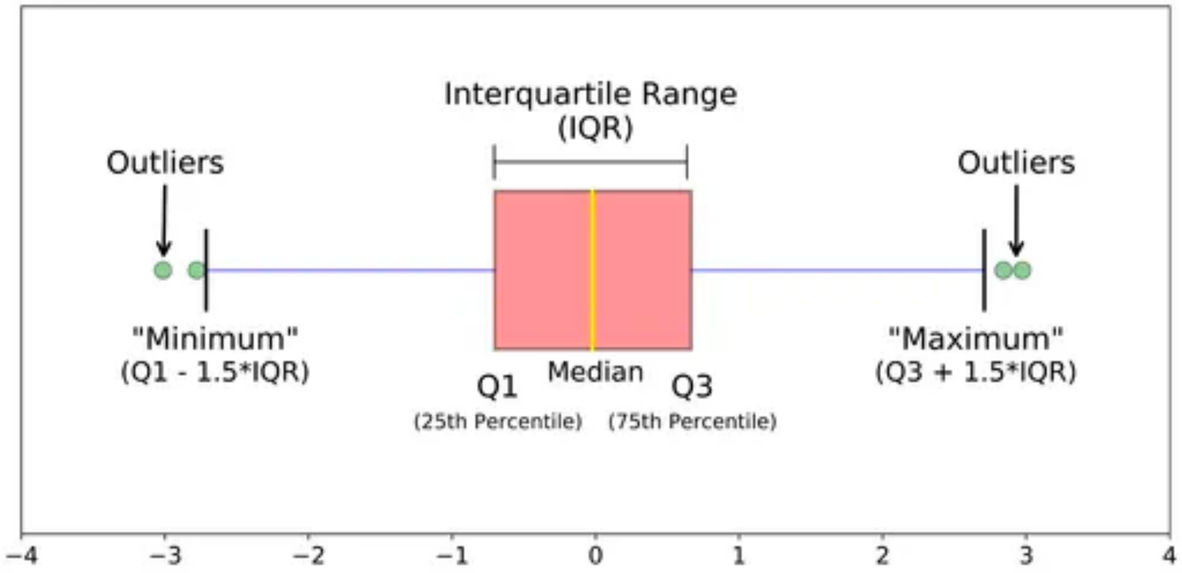


Exercise

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

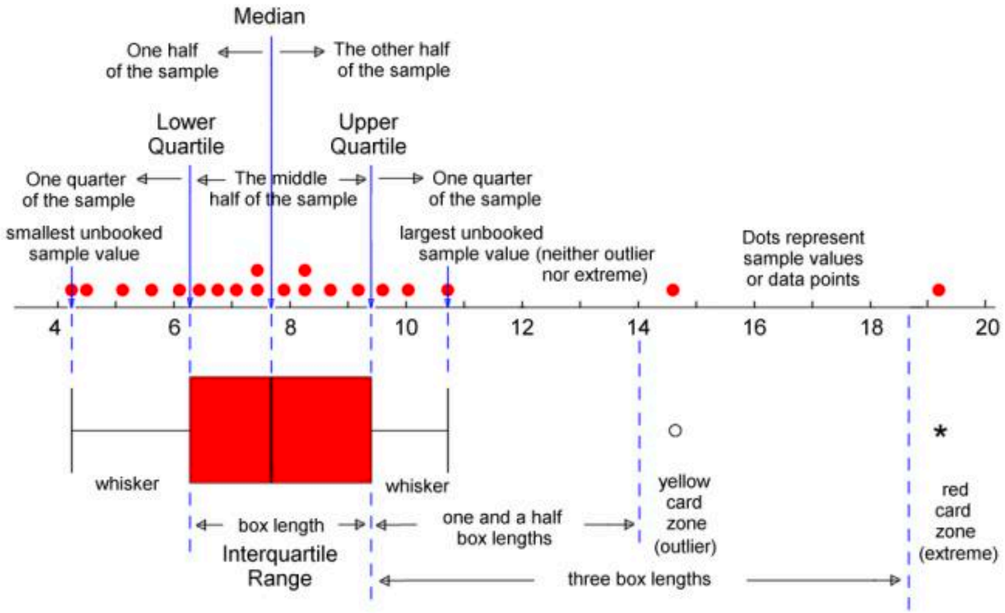
Boxplot

- 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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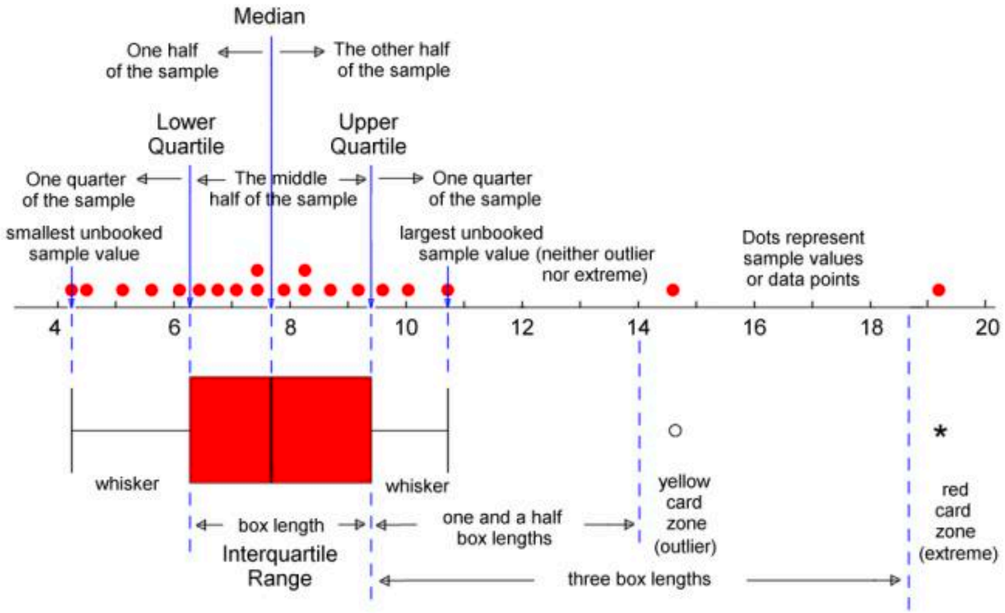
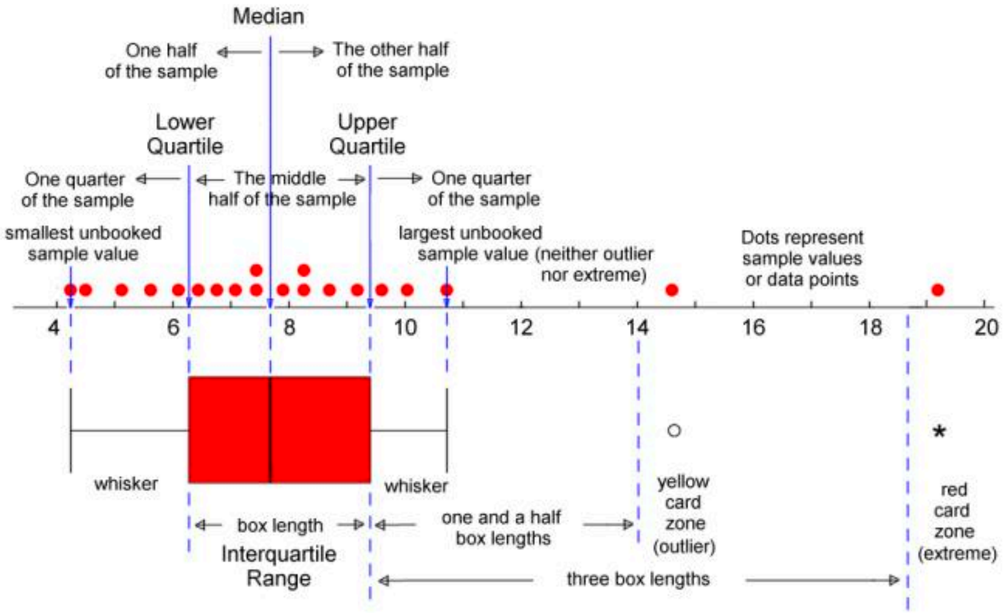


Data

	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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count	963.000000
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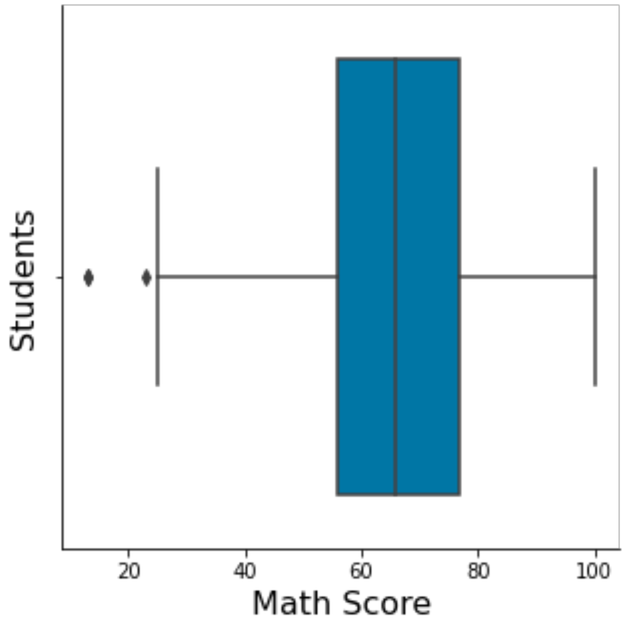
max	100.000000

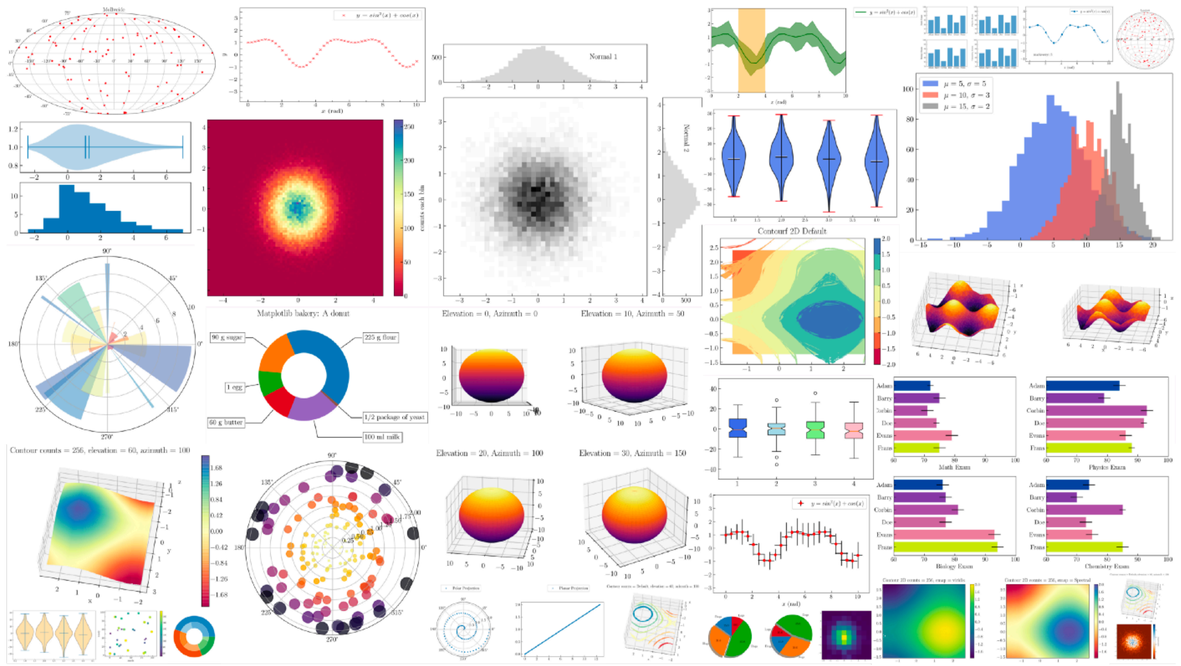
Figure Result



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 3: Data Exploration & Visualization

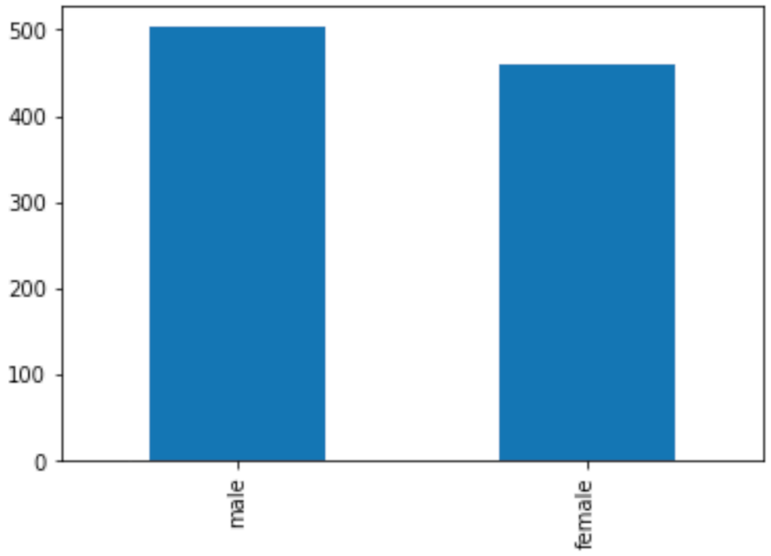
EDA steps

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

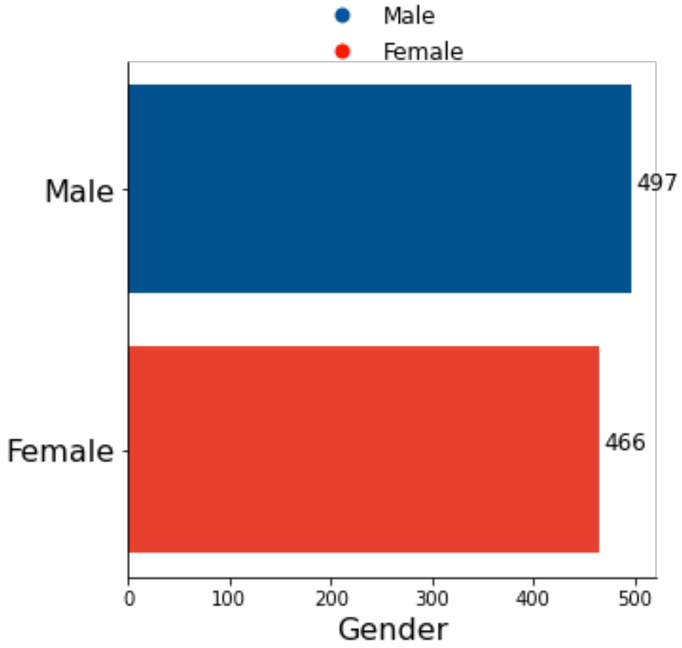
Categorical EDA

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

Ugly but little code



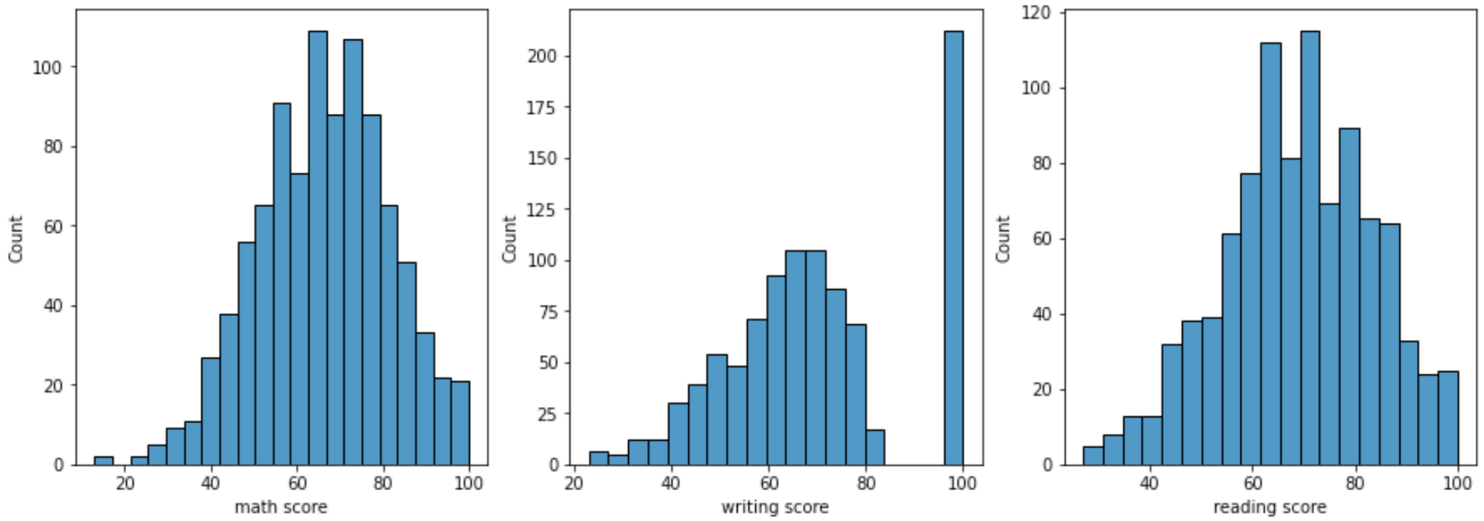
More informative but time-consuming



Numerical EDA - Univariate Analysis

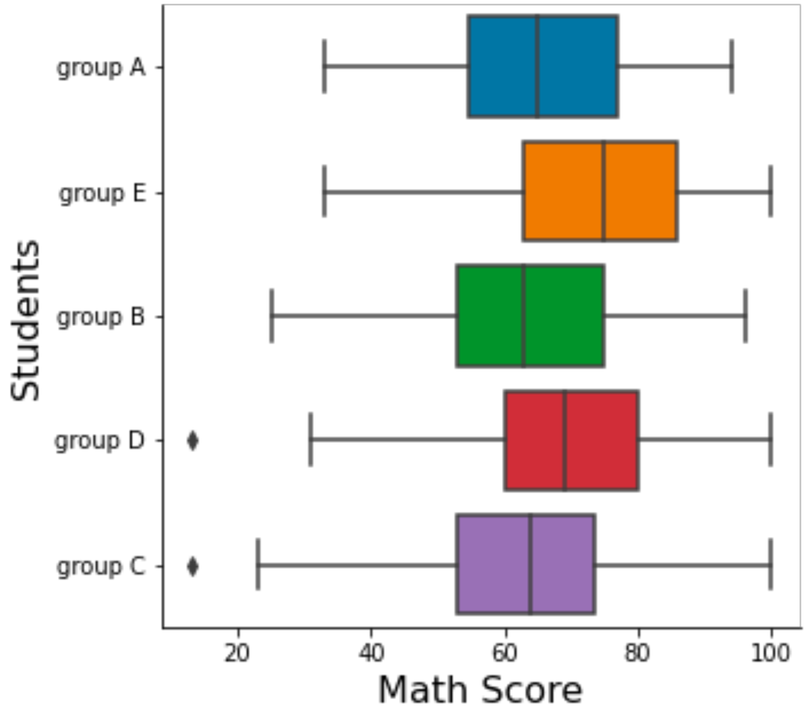
- Study of single variables of the data by analysing the data distributions —> Histograms & Boxplots
- Is my data normally distributed? Can I identify unseen outliers?

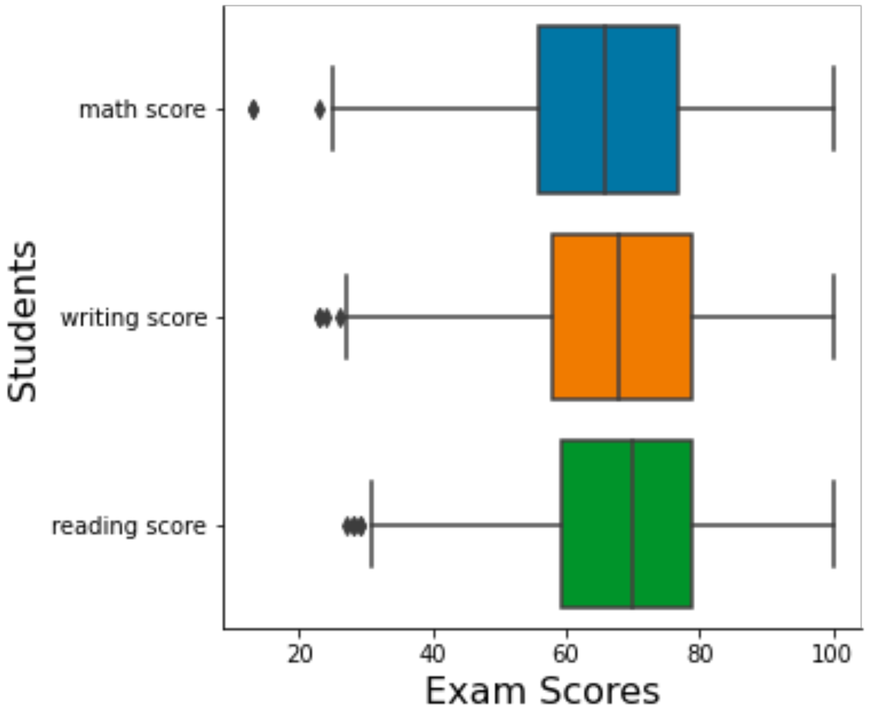
```
#Start Figure
fig, (ax1, ax2, ax3) = plt.subplots(nrows=1, ncols=3, figsize=(15, 5))

#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()
```



Numerical EDA - Bivariate Analysis (Categorical + Numerical)

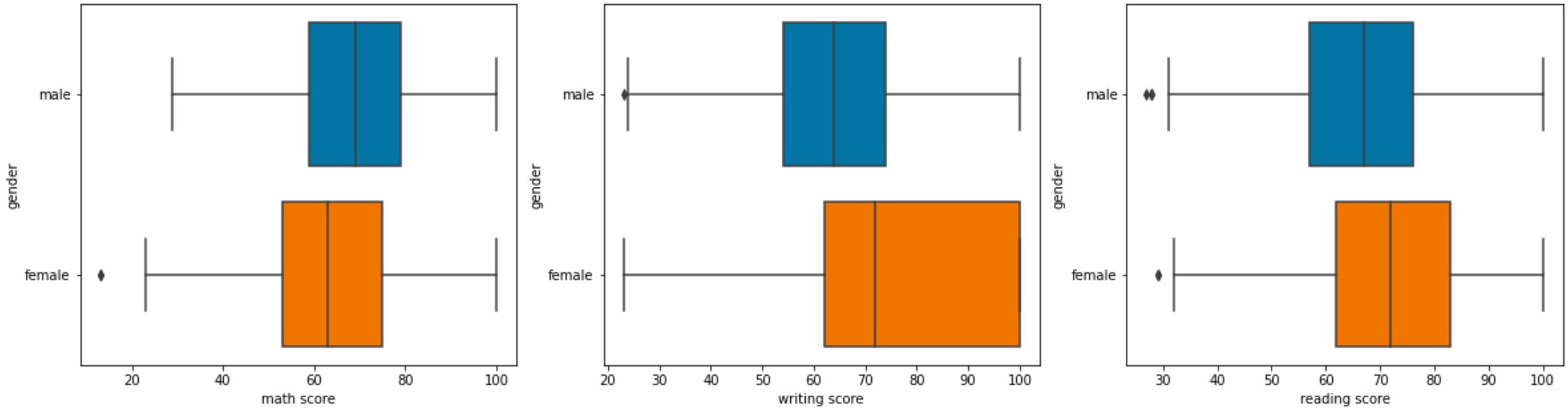
- Combination of variables through boxplots





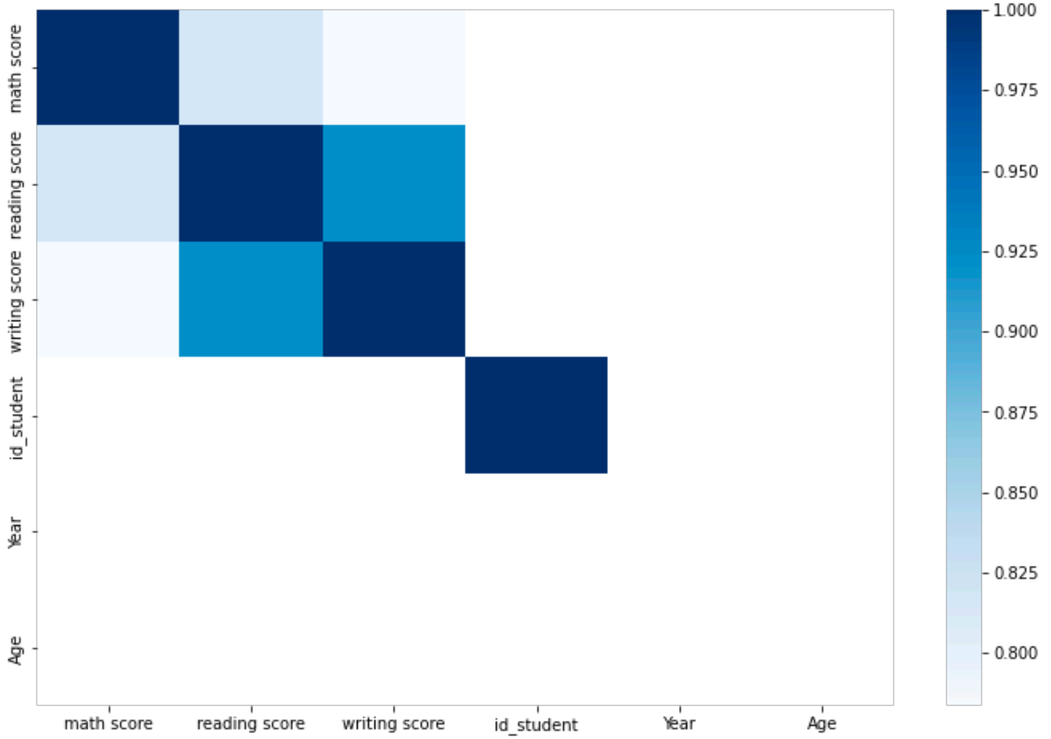
Exercise

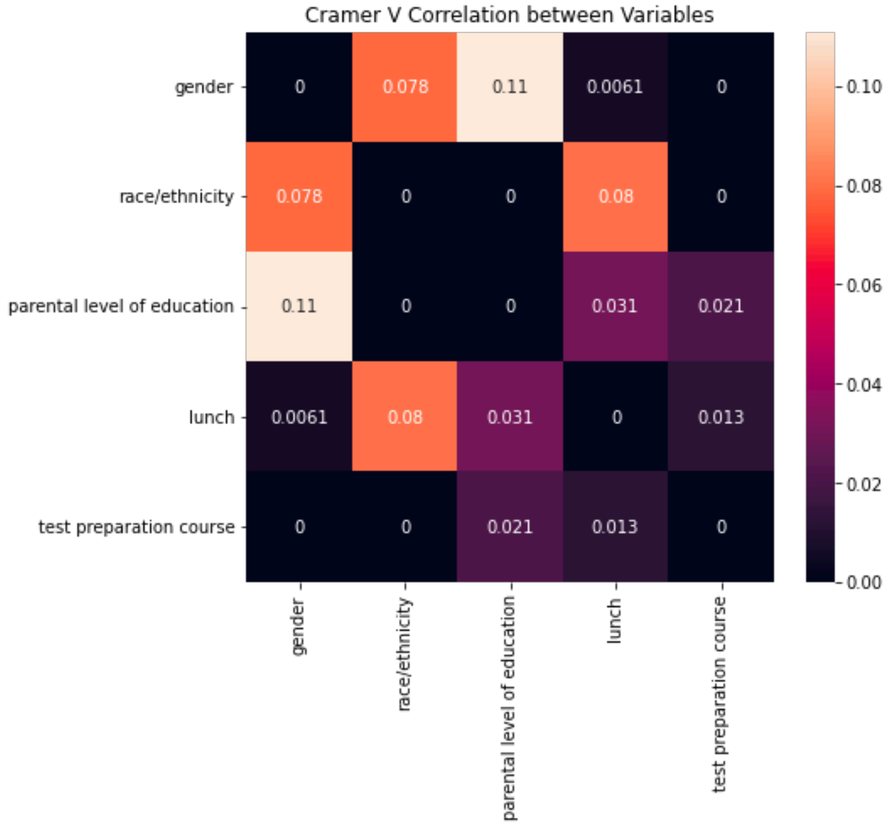
- Can you get the plot below (They can be separated as well)?



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





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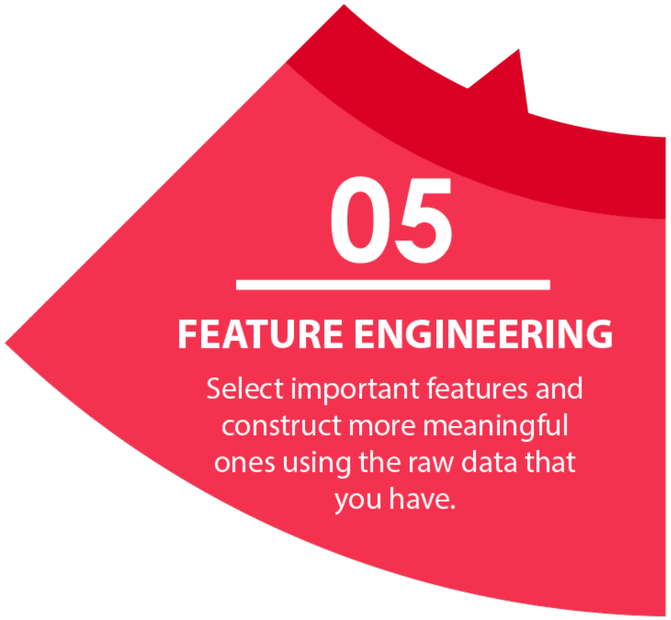
Topic 4: Feature Engineering

Feature engineering



- Is the process of using domain knowledge to extract features (characteristics, properties, attributes) from raw data
- Examples of current projects:
  - Chatbot: #TimesAsking4help, #Words
  - Universities: #PassedSubjects, GradeMean

Feature engineering

Transform the parental level of education

```
df['parental level of education'].value_counts()
```

```
some college          219
associate's degree    196
high school           194
some high school      180
bachelor's degree     107
master's degree        67
Name: parental level of education, dtype: int64
```

```
new_col = []
for el in df['parental level of education'].tolist():
    if el in ["master's degree", "bachelor's degree", "some college"]:
        new_col.append('went to college')
    else:
        new_col.append('no college')
df['Education'] = new_col
```

Feature engineering

Transform the parental level of education

```
df['parental level of education'].value_counts()
```

```
some college          219
associate's degree    196
high school           194
some high school      180
bachelor's degree     107
master's degree        67
Name: parental level of education, dtype: int64
```

```
new_col = []
for el in df['parental level of education'].tolist():
    if el in ["master's degree", "bachelor's degree", "some college"]:
        new_col.append('went to college')
    else:
        new_col.append('no college')
df['Education'] = new_col
```

BMI Calculation

```
df['height'] = 1.70
df['weight'] = 70
```

```
df['BMI'] =  round(df['weight'] / (df['height'] * df['height']), 2)
```

```
df.drop(['height', 'weight'], axis=1, inplace=True)
```

Exercise

- Add a new feature (column) to the dataset named *scores mean* that represents the mean of all three grades (math, writing and reading)

esade

Documentation

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