



ENG 346

Data Structures and Algorithms for Artificial Intelligence

Data Visualizations

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Visualization Libraries

- Matplotlib
- Seaborn
- Plotly
- Ggplot
- ...

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Types of Features



- Numerical: Values with numeric types (int, float, etc.).
 - Examples: age, salary, height.
- Categorical Features: Features that can take one of a limited number of values.
 - Examples: gender (male, female), color (red, blue, green).
- Ordinal Features: Categorical features that have a clear ordering.
 - Examples: T-shirt size (S, M, L, XL).
- Binary Features: A special case of categorical features with only two categories.
 - Examples: is_smoker (yes, no), has_subscription (true, false).
- Text Features: Features that contain textual data.

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Types of Plots



- Line Charts: Display trends.
- Scatter Plots: Investigate relationships between two variables.
- Bar Charts: Summarize categorical data and compare different categories.
- Pie Charts: Illustrate proportions of a whole for categorical variables.
- Histograms: Explore the distribution of individual variables.
- Box Plots : Show the distribution and skewness of data, identify outliers.
- Heatmaps: Visualize correlation matrices to understand relationships between variables.
- Violin Plots: Similar to box plots but also display the probability density of the data.
- Density Plots: Visualize the distribution of a single variable.

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imports

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline # for Notebooks
```



1st cycle of 1st unit

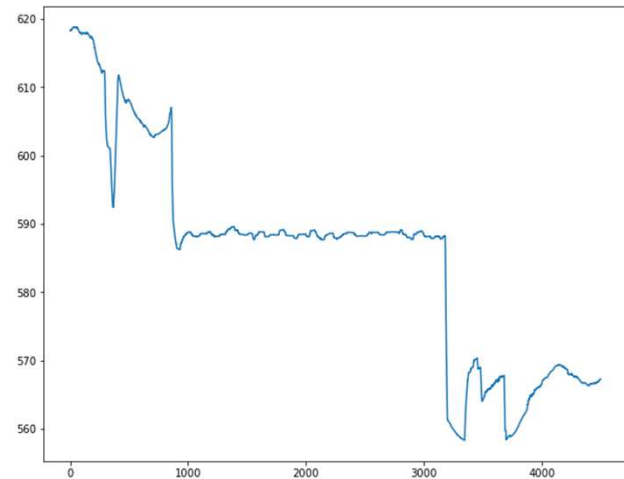
```
u1c1_df = df_X_s.loc[(df_A.unit == 1) & (df_A.cycle == 1)].reindex()
```



Line Plots

`plt.plot(x, y, ...)`

Example: `plt.plot(u1c1_df.T24)`

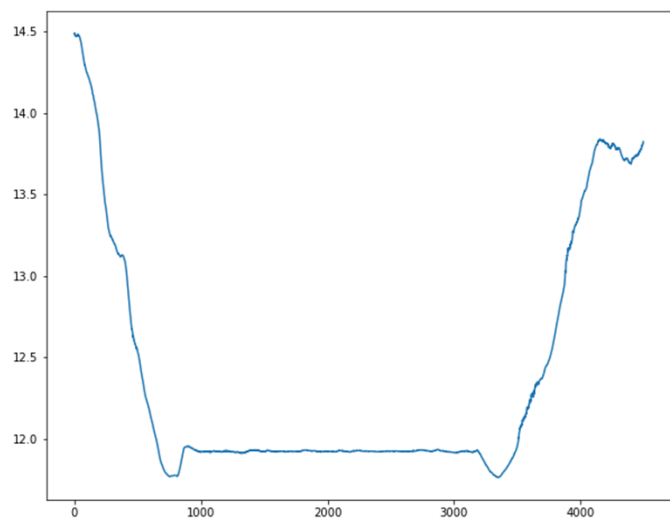


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Line Plots – continued

`plt.plot(u1c1_df.P2)`



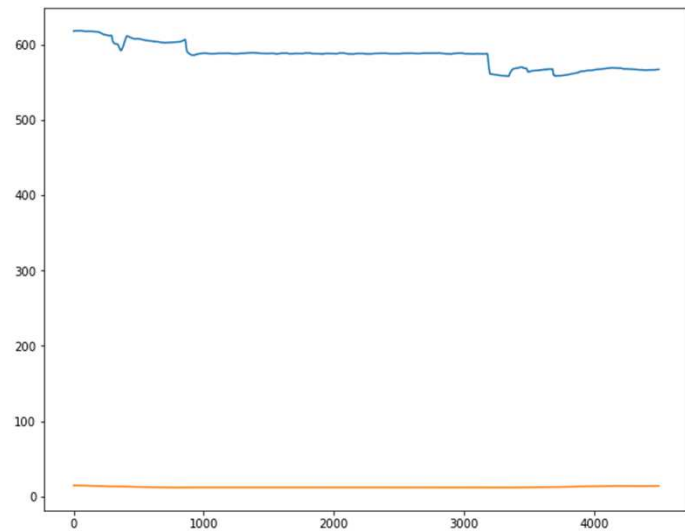
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Line Plots – continued



```
plt.plot(u1c1_df.T24)
plt.plot(u1c1_df.P2)
```



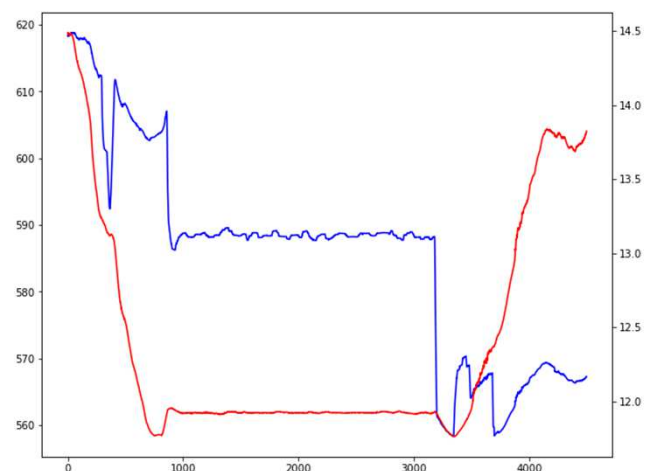
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Line Plots – continued



```
fig, ax1 = plt.subplots()
ax2 = ax1.twinx() # instantiate a second axes that shares the same x-axis
ax1.plot(u1c1_df.T24, color='blue')
ax2.plot(u1c1_df.P2, color='red')
```



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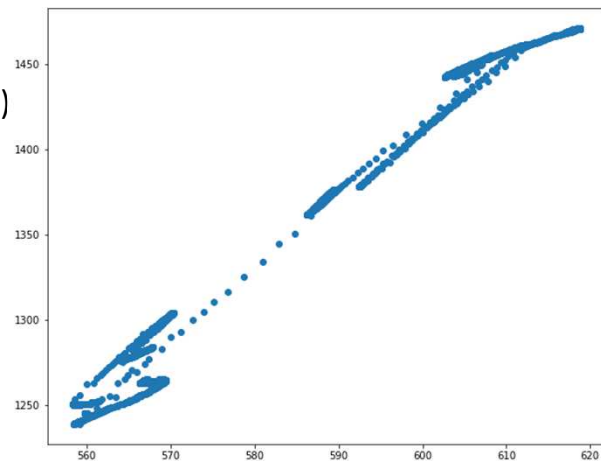
Scatter Plots



`plt.scatter(x, y, ...)`

Example:

`plt.scatter(u1c1_df.T24, u1c1_df.T30)`



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Bar Charts



`plt.bar()`

Example:

`fig, ax = plt.subplots()`

`fruits = ['apple', 'blueberry', 'cherry', 'orange']`

`counts = [40, 100, 30, 55]`

`bar_labels = ['red', 'blue', '_red', 'orange']`

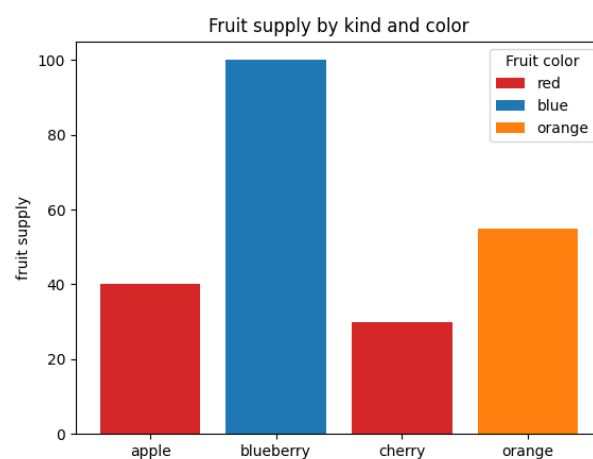
`bar_colors = ['tab:red', 'tab:blue', 'tab:red', 'tab:orange']`

`ax.bar(fruits, counts, label=bar_labels, color=bar_colors)`

`ax.set_ylabel('fruit supply')`

`ax.set_title('Fruit supply by kind and color')`

`ax.legend(title='Fruit color')`



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Pie Charts

`plt.pie()`

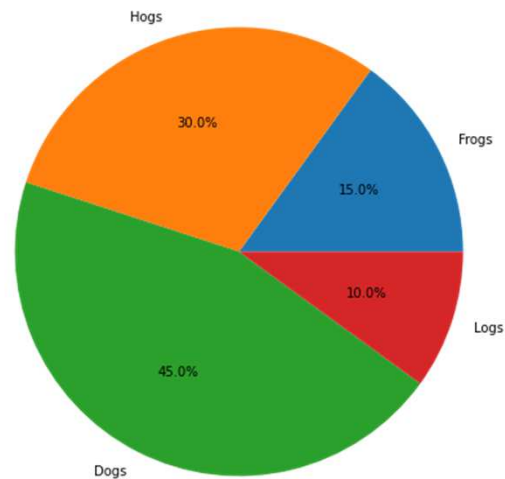
Example:

`labels = 'Frogs', 'Hogs', 'Dogs', 'Logs'`

`sizes = [15, 30, 45, 10]`

`fig, ax = plt.subplots(figsize=(10,8))`

`ax.pie(sizes, labels=labels, autopct='%1.1f%%')`



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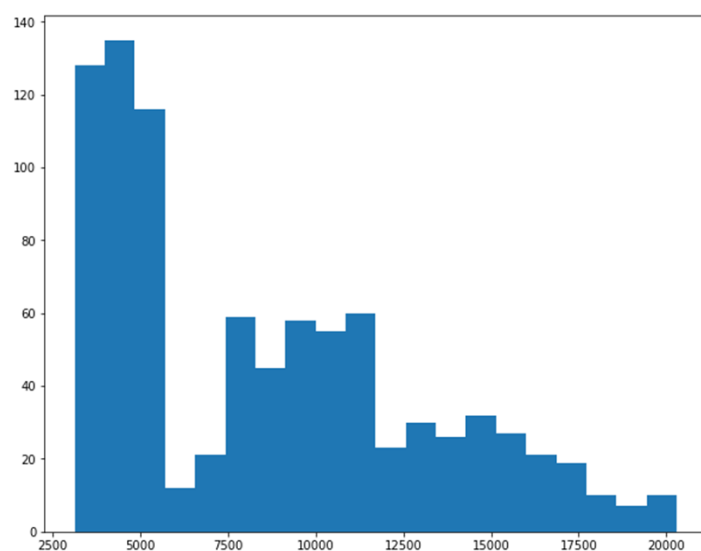
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Histogram

`plt.hist()`

Example:

`plt.hist(ux_cycles, bins=20)`



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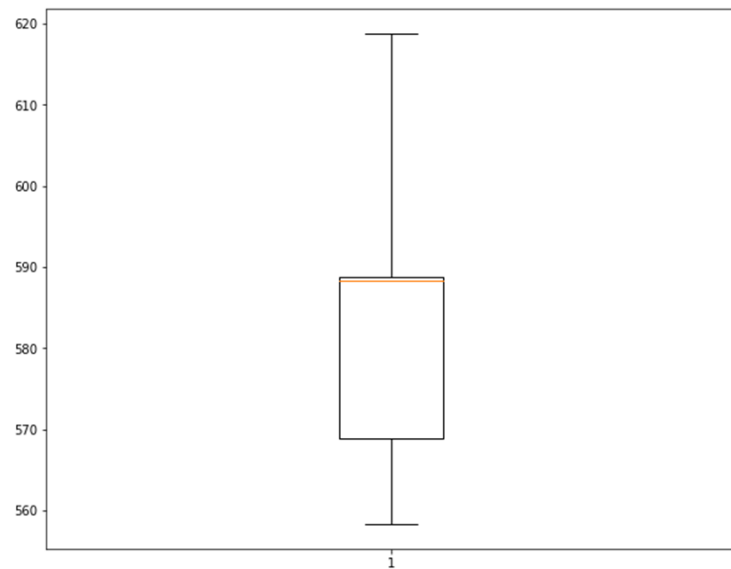
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Box Plots

`plt.boxplot()`

Example:

`plt.boxplot(u1c1_df.T24)`

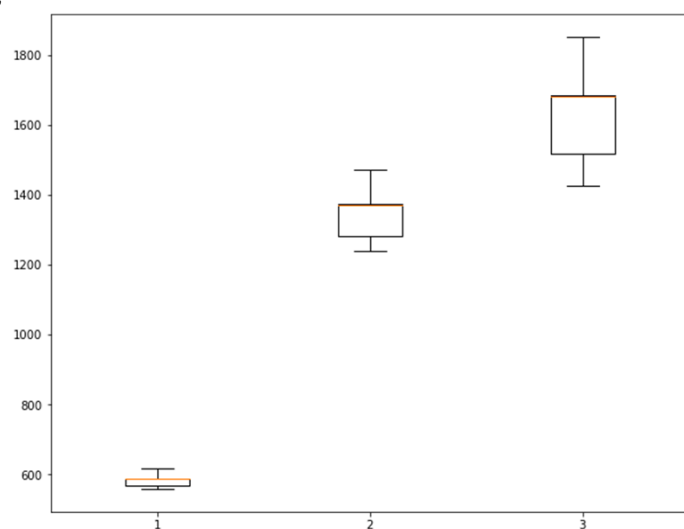


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Box Plots – continued

`plt.boxplot(u1c1_df[["T24", "T30", "T48"]])`



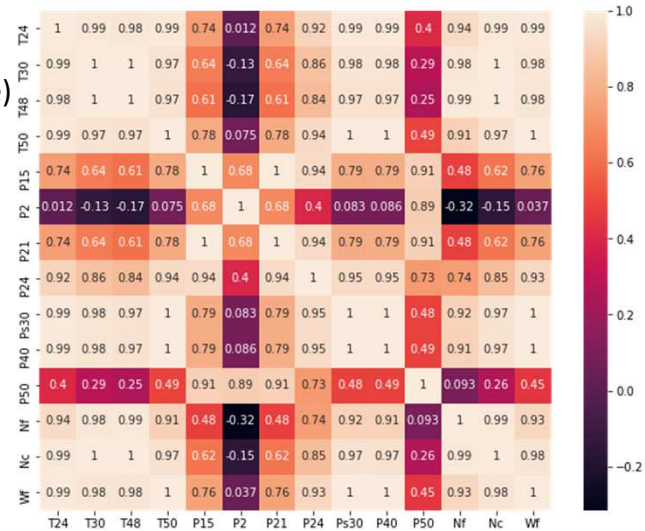
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Heatmaps

`sns.heatmap()`

`sns.heatmap(u1c1_df.corr(), annot=True)`



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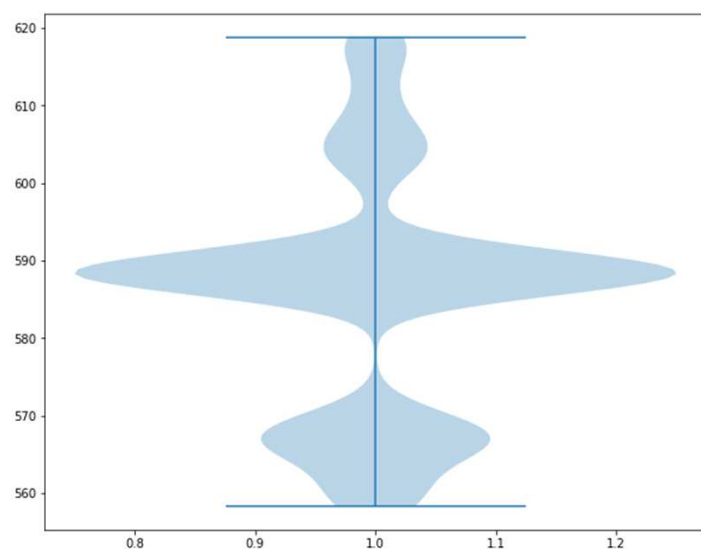
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Violin Plots

`plt.violinplot()`

Example:

`plt.violinplot(u1c1_df.T24)`



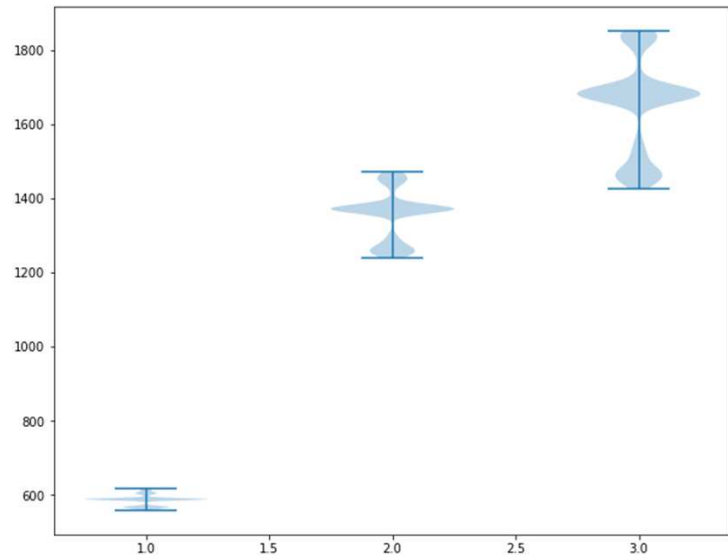
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Violin Plots – continued



```
plt.violinplot(u1c1_df[["T24",  
"T30", "T48"]])
```



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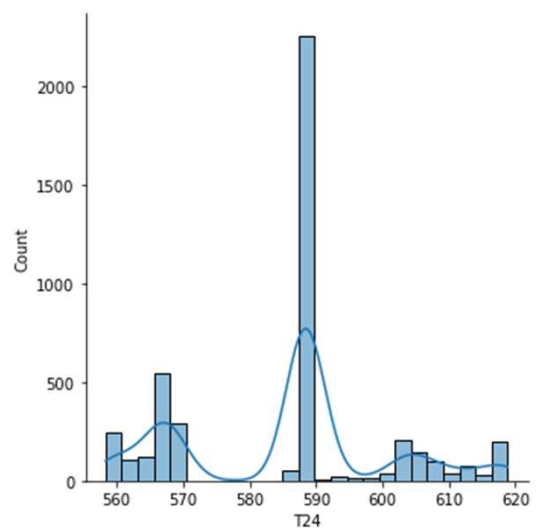
Density Plots



```
sns.distplot()
```

Example:

```
sns.distplot(u1c1_df.T24, kde=True)
```



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