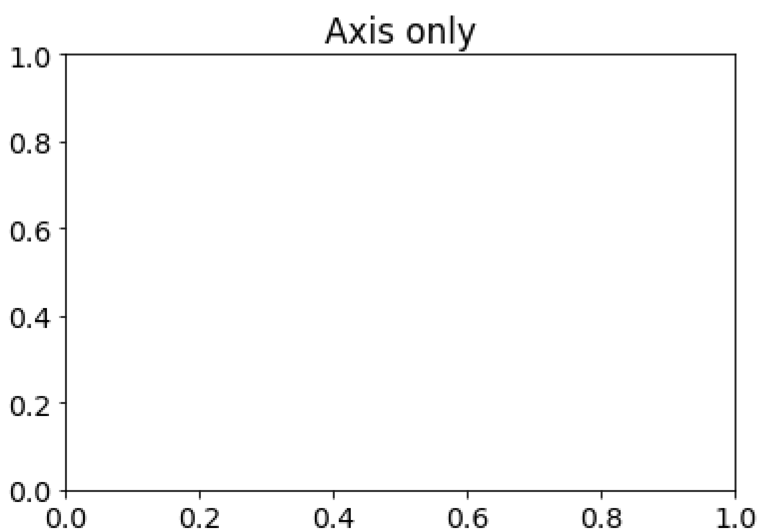
CAS CS 365

Lab 1

```
import matplotlib as mpl
import matplotlib.pyplot as plt
plt.rcParams.update({'font.size': 18})

import numpy as np
import pandas as pd
from sklearn import datasets
```

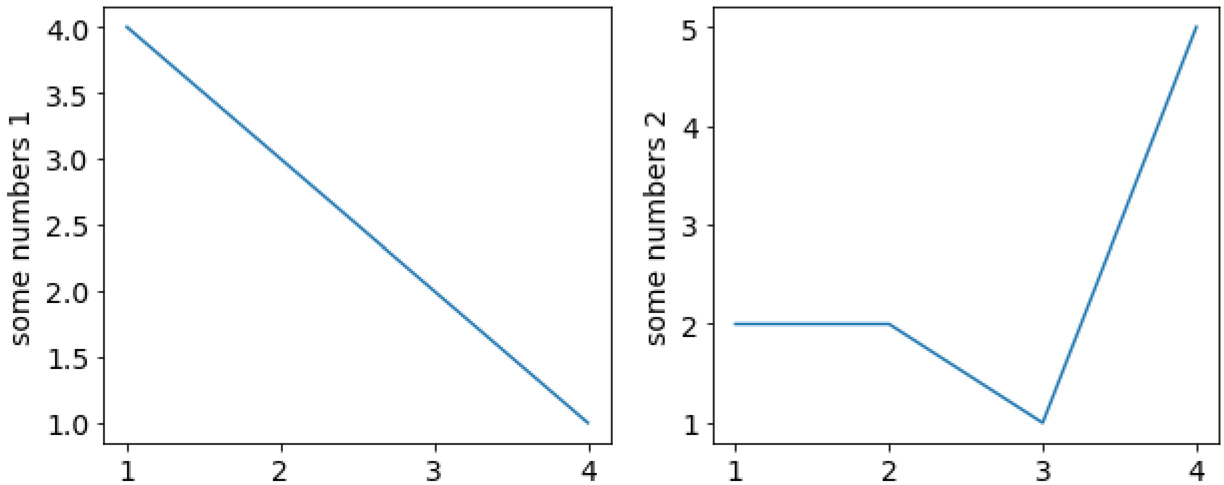
Basic plot

```
fig, ax = plt.subplots()  # Create a figure containing a single axes.
ax.set_title('Axis only')
plt.show()
```




```
plt.figure(figsize=(10,4)) # Set figure size

plt.subplot(1,2,1)  # Create a figure containing two axes. Focusing on the first axes
plt.plot([1, 2, 3, 4], [4, 3, 2, 1]);  # Plot some data on the axes.
plt.ylabel('some numbers 1') # Set label on y axis

plt.subplot(1,2,2)  # Focusing on the second axes
plt.plot([1, 2, 3, 4], [2, 2, 1, 5]);  # Plot some data on the axes.
plt.ylabel('some numbers 2')
```

```
plt.show()
```



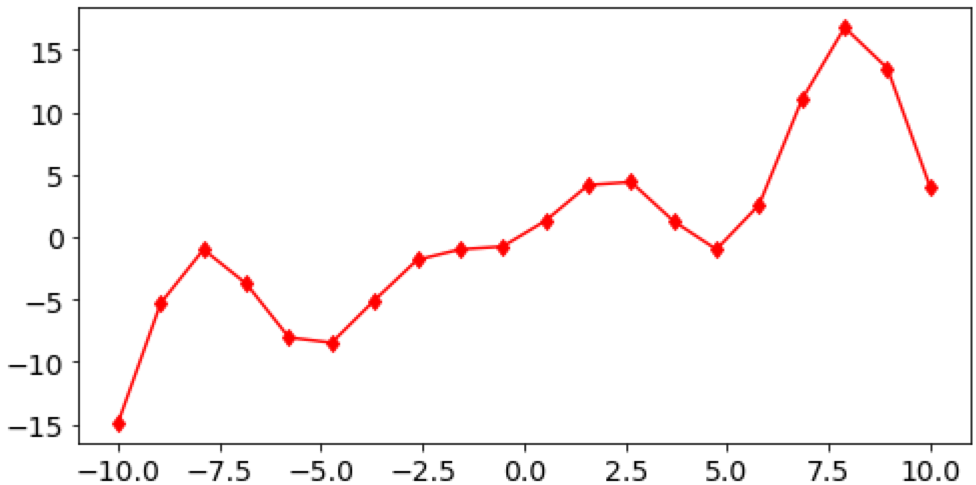
Plot functions.

Below is an example of

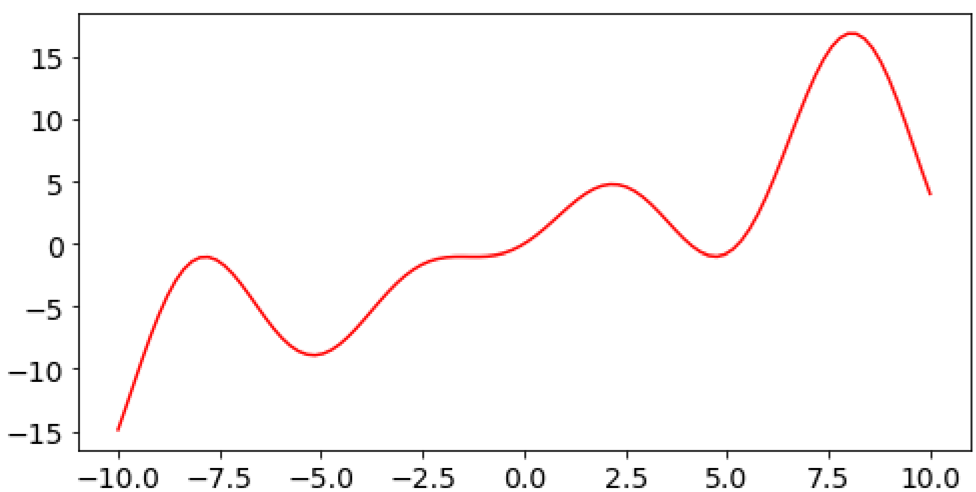
$\sin(x)+x+x \cdot \sin(x)$

.

```
def f(x):
    return np.sin(x) + x + x * np.sin(x)

plt.figure(figsize=(8,4))

x = np.linspace(-10, 10, 20)  # Generate an array of 20 numbers ranging from -10 to 10

plt.plot(x, f(x), color='red', marker='d')  # Plot with red color and diamond markers.

plt.show()
```




```
plt.figure(figsize=(8,4))

# Increase the precision of the array. Now it contains 100 numbers within the same range.
x = np.linspace(-10, 10, 100)

plt.plot(x, f(x), color='red')

plt.show()
```



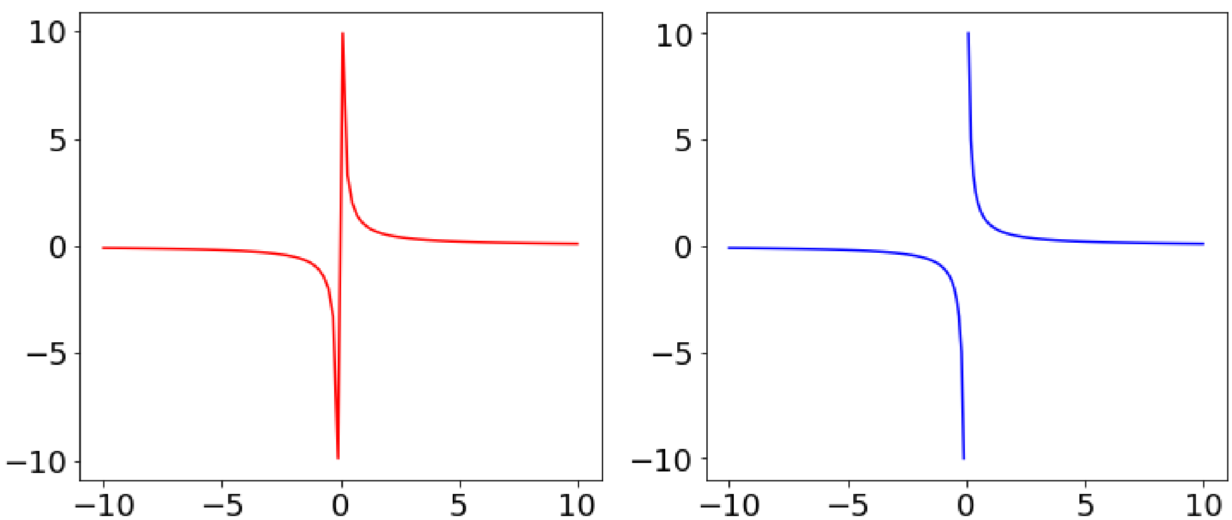
Plot

y=1/x

. Same approach does not work here, as the function value "jump" after x=0.

```
def f(x):
   return 1.0/x
```

```
plt.figure(figsize=(12,5))
plt.subplot(1,2,1)

x = np.linspace(-10, 10, 100)
plt.plot(x, f(x), color='red')

plt.subplot(1,2,2)

x = np.linspace(-10, -0.1, 100)
plt.plot(x, f(x), color='blue')

x = np.linspace(0.1, 10, 100)
plt.plot(x, f(x), color='blue')

plt.show()
```



In [ ]:

Iris Dataset

```
plt.rcParams.update({'font.size': 14})  # Decrease the plot font size


iris = datasets.load_iris() #Loading the dataset


Out[16]: dict_keys(['data', 'target', 'frame', 'target_names', 'DESCR', 'feature_names', 'filename'])

# Converting it into Dataframe
iris = pd.DataFrame(
```

```
data= np.c_[iris['data'], iris['target']],
columns= iris['feature_names'] + ['target']
)
```

Pandas.Dataframe is a class that stores "Two-dimensional, size-mutable, potentially heterogeneous tabular data". It can be considered as SQL Tables in Python.

```
iris.shape
```

Out[24]: (150, 5)

```
iris.head(10)
```

Out[25]:

	sepal length (cm)	sepal width (cm)	petal length (cm)	petal width (cm)	target
0	5.1	3.5	1.4	0.2	0.0
1	4.9	3.0	1.4	0.2	0.0
2	4.7	3.2	1.3	0.2	0.0
3	4.6	3.1	1.5	0.2	0.0
4	5.0	3.6	1.4	0.2	0.0
5	5.4	3.9	1.7	0.4	0.0
6	4.6	3.4	1.4	0.3	0.0
7	5.0	3.4	1.5	0.2	0.0
8	4.4	2.9	1.4	0.2	0.0

9	4.9	3.1	1.5	0.1	0.0

iris.groupby('target').size()

Out[45]:
target
0.0   50
1.0   50
2.0   50
dtype: int64

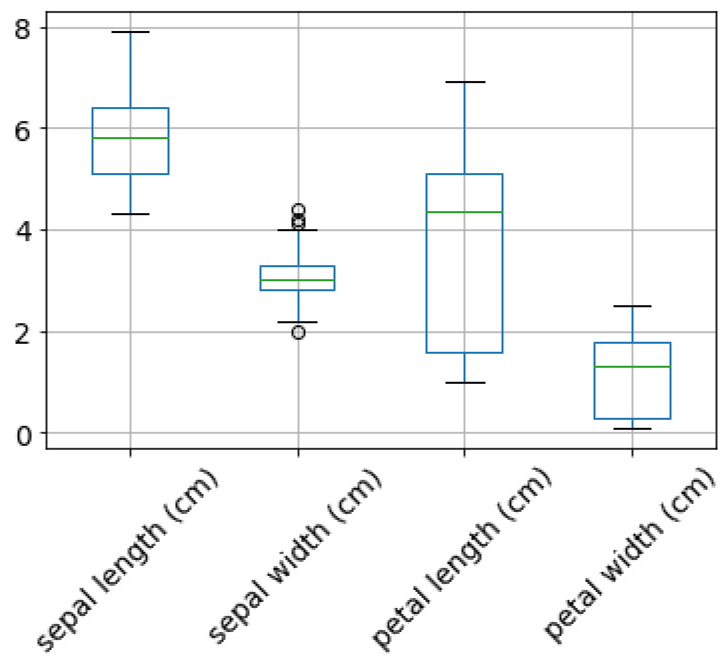
iris.describe()

Out[21]:

	sepal length (cm)	sepal width (cm)	petal length (cm)	petal width (cm)	target
count	150.000000	150.000000	150.000000	150.000000	150.000000
mean	5.843333	3.057333	3.758000	1.199333	1.000000
std	0.828066	0.435866	1.765298	0.762238	0.819232
min	4.300000	2.000000	1.000000	0.100000	0.000000
25%	5.100000	2.800000	1.600000	0.300000	0.000000
50%	5.800000	3.000000	4.350000	1.300000	1.000000
75%	6.400000	3.300000	5.100000	1.800000	2.000000
max	7.900000	4.400000	6.900000	2.500000	2.000000

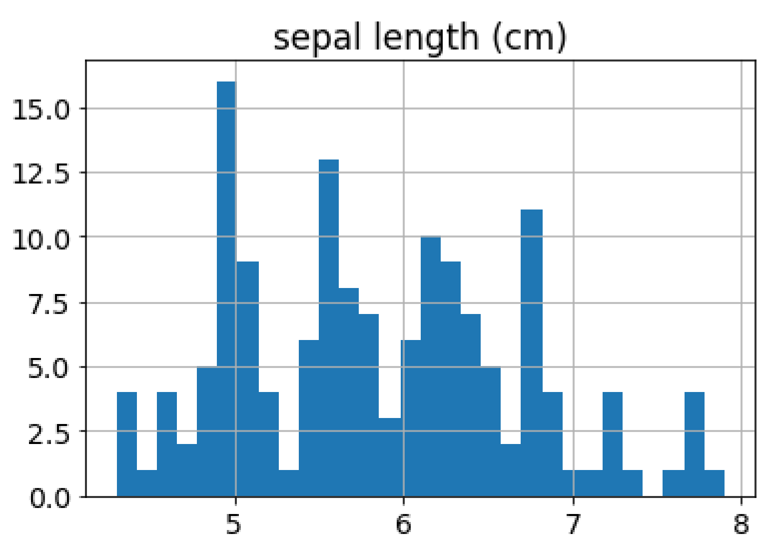
Median, First Quantile, Third Quantile, Whiskers, Maximum, Minimm, and Outliers.

```
iris.drop('target',axis=1).boxplot(rot=45)
plt.show()
```



Focus on one feature: sepal length.

```
iris.hist('sepal length (cm)', bins=30)
plt.show()
```

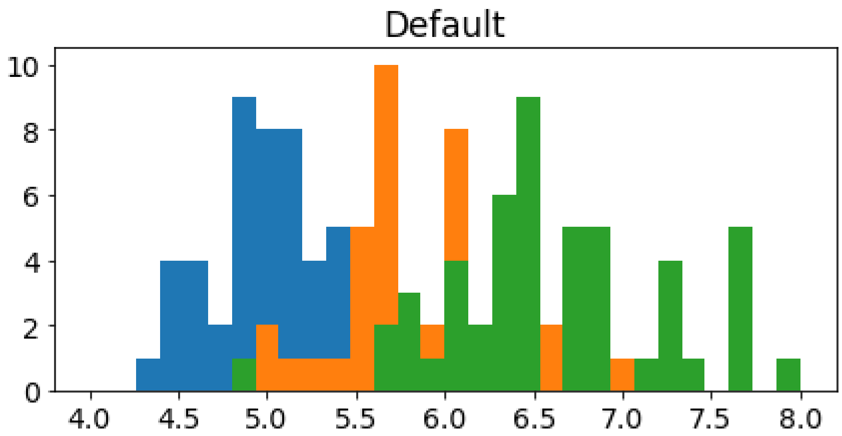


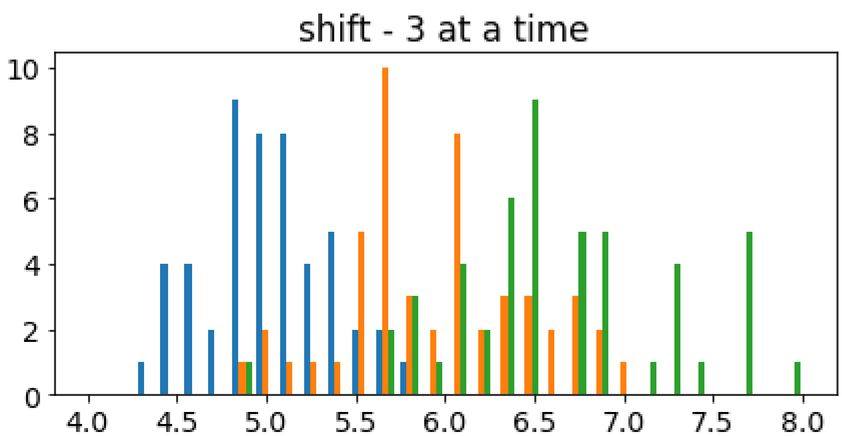
Initialize three dataframes with different target values

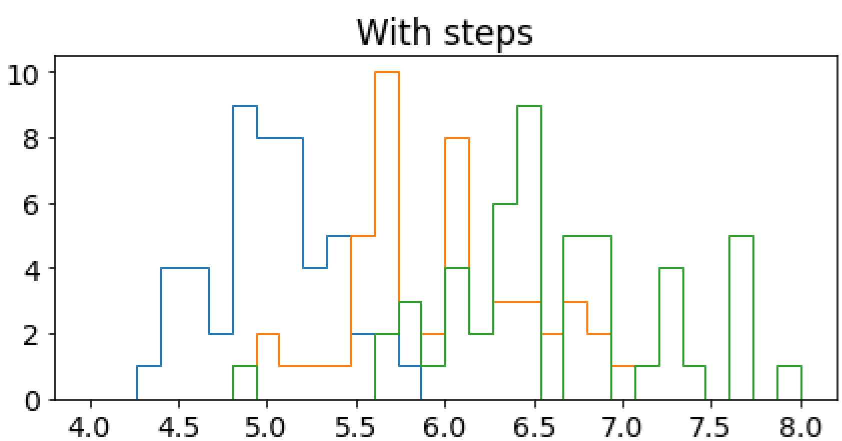
```
type0_df = iris[iris['target']==0.0]
type1_df = iris[iris['target']==1.0]
type2_df = iris[iris['target']==2.0]
```

Visualize sepal length of different iris types via histograms

```
plt.figure(figsize=(7,12))

common_params = dict(bins=30,
                range=(4, 8))
a = type0_df['sepal length (cm)'].values
b = type1_df['sepal length (cm)'].values
c = type2_df['sepal length (cm)'].values

plt.subplots_adjust(hspace=.4)
plt.subplot(311)
plt.title('Default')
plt.hist(a, **common_params)
plt.hist(b, **common_params)
plt.hist(c, **common_params)
plt.subplot(312)
plt.title('shift - 3 at a time')
plt.hist((a, b, c), **common_params)
plt.subplot(313)
common_params['histtype'] = 'step'
plt.title('With steps')
plt.hist(a, **common_params)
plt.hist(b, **common_params)
plt.hist(c, **common_params)
plt.show()
```







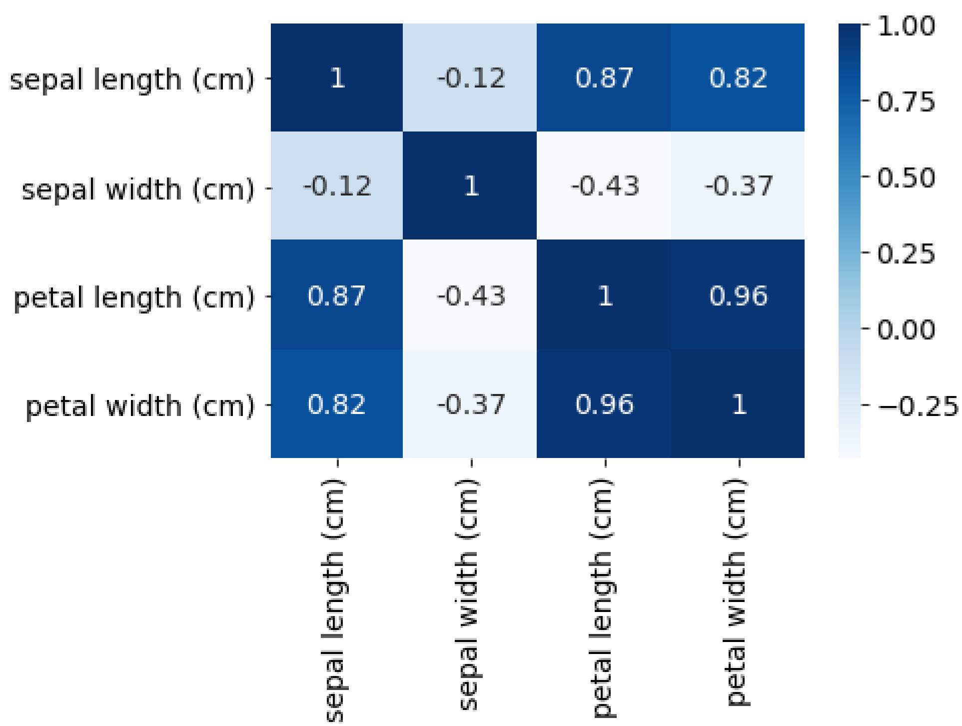
Correlation between features

```
iris.drop('target',axis=1).corr()
```

Out[61]:

	sepal length (cm)	sepal width (cm)	petal length (cm)	petal width (cm)
sepal length (cm)	1.000000	-0.117570	0.871754	0.817941
sepal width (cm)	-0.117570	1.000000	-0.428440	-0.366126
petal length (cm)	0.871754	-0.428440	1.000000	0.962865
petal width (cm)	0.817941	-0.366126	0.962865	1.000000

```
import seaborn
corr = iris.drop('target',axis=1).corr()
seaborn.heatmap(corr, cmap="Blues", annot=True)
plt.show()
```



Scatter plot to visualize samples with two features, i.e., petal length and width.

```
fig, ax = plt.subplots()
fig.set_size_inches(10, 6) # adjusting the length and width of plot

# lables and scatter points
ax.scatter(type0_df['petal length (cm)'], type0_df['petal width (cm)'], label="T0", facecolor="blue")
ax.scatter(type1_df['petal length (cm)'], type1_df['petal width (cm)'], label="T1", facecolor="green")
ax.scatter(type2_df['petal length (cm)'], type2_df['petal width (cm)'], label="T2", facecolor="red")


ax.set_xlabel("petal length (cm)")
ax.set_ylabel("petal width (cm)")
ax.grid()
ax.set_title("Iris petals")
ax.legend()

plt.show()
```