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Assignment No 1 : Data wrangling 1

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1. Import Required Libraries

In [1]:
```
import pandas as pd
import numpy as np
```

2. Locate open source data from web

Dataset link : https://www.kaggle.com/c/titanic/data (https://www.kaggle.com/c/titanic/data)

3. Load the dataset into Pandas Dataframe

In [2]:
```
df = pd.read_csv("train.csv")
```

In [3]:
```
df
```

Out[3]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500
...	...	...	...	...	...	...	...	...	...	...
886	887	0	2	Montvila, Rev. Juozas	male	27.0	0	0	211536	13.0000
887	888	1	1	Graham, Miss. Margaret Edith	female	19.0	0	0	112053	30.0000
888	889	0	3	Johnston, Miss. Catherine Helen "Carrie"	female	NaN	1	2	W./C. 6607	23.4500
889	890	1	1	Behr, Mr. Karl Howell	male	26.0	0	0	111369	30.0000
890	891	0	3	Dooley, Mr.	male	32.0	0	0	370376	7.7500

4. Data Preprocessing

In [4]:
```
# check dimensions of dataframe
df.shape
```

Out[4]:
```
(891, 12)
```

In [5]:
```
# check the columns present
df.columns
```

Out[5]:
```
Index(['PassengerId', 'Survived', 'Pclass', 'Name', 'Sex', 'Age', 'SibSp',
       'Parch', 'Ticket', 'Fare', 'Cabin', 'Embarked'],
      dtype='object')
```

In [6]:
```
# check total size (rows * columns)
df.size
```

Out[6]:
```
10692
```

In [7]:
```
# check datatypes of each column
df.dtypes
```

Out[7]:

```
PassengerId      int64
Survived         int64
Pclass           int64
Name            object
Sex             object
```

In [8]:
```
#check for missing values
df.isnull().sum()
```

Out[8]:
```
PassengerId      0
Survived         0
Pclass           0
Name             0
Sex              0
Age            177
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin          687
Embarked         2
dtype: int64
```

In [9]:
```
# check initial statistics
df.describe()
```

Out[9]:

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare
count	891.000000	891.000000	891.000000	714.000000	891.000000	891.000000	891.000000
mean	446.000000	0.383838	2.308642	29.699118	0.523008	0.381594	32.204208
std	257.353842	0.486592	0.836071	14.526497	1.102743	0.806057	49.693429
min	1.000000	0.000000	1.000000	0.420000	0.000000	0.000000	0.000000
25%	223.500000	0.000000	2.000000	20.125000	0.000000	0.000000	7.910400
50%	446.000000	0.000000	3.000000	28.000000	0.000000	0.000000	14.454200
75%	668.500000	1.000000	3.000000	38.000000	1.000000	0.000000	31.000000
max	891.000000	1.000000	3.000000	80.000000	8.000000	6.000000	512.329200

In [10]:
```
# Print information about the dataframe
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   PassengerId  891 non-null    int64
 1   Survived     891 non-null    int64
```

5. Data Formatting and Data Normalization

In [11]:
```
# Handling missing values
# 1. fillna() : method which we can use replace null(NaN) values with some oth
# or we can perform forward fill(ffill), backward fill(bfill).

# 2. interpolate() : performs linear interpolation(by default but you can chan
# and replaces the null with the result.

# 3. dropna() : It will drop all the rows that have NaN values. but using this
```

In [12]:
```
df["Cabin"] = df["Cabin"].replace(to_replace=np.nan, value="unknown")
df
```

Out[12]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500
...	...	...	...	...	...	...	...	...	...	...
886	887	0	2	Montvila, Rev. Juozas	male	27.0	0	0	211536	13.0000
887	888	1	1	Graham, Miss. Margaret Edith	female	19.0	0	0	112053	30.0000

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
888	889	0	3	Johnston, Miss. Catherine Helen "Carrie"	female	NaN	1	2	W./C. 6607	23.4500
889	890	1	1	Behr, Mr. Karl Howell	male	26.0	0	0	111369	30.0000
890	891	0	3	Dooley, Mr. Patrick	male	32.0	0	0	370376	7.7500

In [13]:
```
df["Age"] = df["Age"].interpolate()
df
```

Out[13]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500
...	...	...	...	...	...	...	...	...	...	...
886	887	0	2	Montvila, Rev. Juozas	male	27.0	0	0	211536	13.0000
887	888	1	1	Graham, Miss. Margaret Edith	female	19.0	0	0	112053	30.0000
888	889	0	3	Johnston, Miss. Catherine Helen "Carrie"	female	22.5	1	2	W./C. 6607	23.4500
889	890	1	1	Behr, Mr. Karl Howell	male	26.0	0	0	111369	30.0000

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
890	891	0	3	Dooley, Mr.	male	32.0	0	0	370376	7.7500

```
In [14]: df["Embarked"].fillna(method="ffill",inplace=True)
```

```
In [15]: df
```

Out[15]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500
...	...	...	...	...	...	...	...	...	...	...
886	887	0	2	Montvila, Rev. Juozas	male	27.0	0	0	211536	13.0000
887	888	1	1	Graham, Miss. Margaret Edith	female	19.0	0	0	112053	30.0000
888	889	0	3	Johnston, Miss. Catherine Helen "Carrie"	female	22.5	1	2	W./C. 6607	23.4500
889	890	1	1	Behr, Mr. Karl Howell	male	26.0	0	0	111369	30.0000
890	891	0	3	Dooley, Mr. Patrick	male	32.0	0	0	370376	7.7500

891 rows × 12 columns

```
In [16]: df.isnull().sum()
```

```
Out[16]: PassengerId    0
         Survived       0
         Pclass         0
         Name           0
         Sex            0
         Age            0
         SibSp          0
         Parch          0
         Ticket         0
         Fare           0
         Cabin          0
         Embarked       0
         dtype: int64
```

```
In [17]: # Changing Datatypes
         df.dtypes
```

```
Out[17]: PassengerId      int64
         Survived         int64
         Pclass           int64
         Name            object
         Sex             object
         Age            float64
         SibSp            int64
         Parch            int64
         Ticket          object
         Fare           float64
         Cabin           object
         Embarked        object
         dtype: object
```

```
In [18]: df["Age"] = df["Age"].astype('int64')
```

```
In [19]: df.dtypes
```

```
Out[19]: PassengerId      int64
         Survived         int64
         Pclass           int64
         Name            object
         Sex             object
         Age              int64
         SibSp            int64
         Parch            int64
         Ticket          object
         Fare           float64
         Cabin           object
         Embarked        object
         dtype: object
```

6. Turning categorical variables into quantitive

In [20]:
```
quantitative_data = pd.get_dummies(df.Embarked,prefix = 'Embarked')
```

In [21]:
```
quantitative_data
```

Out[21]:

	Embarked_C	Embarked_Q	Embarked_S
0	0	0	1
1	1	0	0
2	0	0	1
3	0	0	1
4	0	0	1
...	...	...	...
886	0	0	1
887	0	0	1
888	0	0	1
889	1	0	0
890	0	1	0

891 rows × 3 columns

In [22]:
```
df = df.join(quantitative_data)
df
```

Out[22]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
0	1	0	3	Braund, Mr. Owen Harris	male	22	1	0	A/5 21171	7.2500
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38	1	0	PC 17599	71.2833
2	3	1	3	Heikkinen, Miss. Laina	female	26	0	0	STON/O2. 3101282	7.9250
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35	1	0	113803	53.1000
4	5	0	3	Allen, Mr. William Henry	male	35	0	0	373450	8.0500
...	...	...	...	...	...	...	...	...	...	...

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
886	887	0	2	Montvila, Rev. Juozas	male	27	0	0	211536	13.0000
887	888	1	1	Graham, Miss. Margaret Edith	female	19	0	0	112053	30.0000
888	889	0	3	Johnston, Miss. Catherine Helen "Carrie"	female	22	1	2	W./C. 6607	23.4500
889	890	1	1	Behr, Mr. Karl Howell	male	26	0	0	111369	30.0000
				Dooley,						

In [23]:
```
df.drop(['Embarked'],axis = 1,inplace = True)
df
```

Out[23]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
0	1	0	3	Braund, Mr. Owen Harris	male	22	1	0	A/5 21171	7.2500
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38	1	0	PC 17599	71.2833
2	3	1	3	Heikkinen, Miss. Laina	female	26	0	0	STON/O2. 3101282	7.9250
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35	1	0	113803	53.1000
4	5	0	3	Allen, Mr. William Henry	male	35	0	0	373450	8.0500
...	...	...	...	...	...	...	...	...	...	...
886	887	0	2	Montvila, Rev. Juozas	male	27	0	0	211536	13.0000
887	888	1	1	Graham, Miss. Margaret Edith	female	19	0	0	112053	30.0000

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
888	889	0	3	Johnston, Miss. Catherine Helen "Carrie"	female	22	1	2	W./C. 6607	23.4500
889	890	1	1	Behr, Mr. Karl Howell	male	26	0	0	111369	30.0000

In [24]:
```
quantitative_sex = pd.get_dummies(df.Sex,prefix = 'Sex')
quantitative_sex
```

Out[24]:

	Sex_female	Sex_male
0	0	1
1	1	0
2	1	0
3	1	0
4	0	1
...	...	...
886	0	1
887	1	0
888	1	0
889	0	1
890	0	1

891 rows × 2 columns

In [25]:
```
df = df.join(quantitative_sex)
df
```

Out[25]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
0	1	0	3	Braund, Mr. Owen Harris	male	22	1	0	A/5 21171	7.2500
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38	1	0	PC 17599	71.2833
2	3	1	3	Heikkinen, Miss. Laina	female	26	0	0	STON/O2. 3101282	7.9250

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35	1	0	113803	53.1000
4	5	0	3	Allen, Mr. William Henry	male	35	0	0	373450	8.0500
...	...	...	...	...	...	...	...	...	...	...
886	887	0	2	Montvila, Rev. Juozas	male	27	0	0	211536	13.0000
887	888	1	1	Graham, Miss. Margaret Edith	female	19	0	0	112053	30.0000
888	889	0	3	Johnston, Miss. Catherine Helen "Carrie"	female	22	1	2	W./C. 6607	23.4500
889	890	1	1	Behr, Mr. Karl Howell	male	26	0	0	111369	30.0000

In [26]:
```
df.drop(['Sex'],axis = 1,inplace = True)
df
```

Out[26]:

	PassengerId	Survived	Pclass	Name	Age	SibSp	Parch	Ticket	Fare	Cabin
0	1	0	3	Braund, Mr. Owen Harris	22	1	0	A/5 21171	7.2500	unknown
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	38	1	0	PC 17599	71.2833	C85
2	3	1	3	Heikkinen, Miss. Laina	26	0	0	STON/O2. 3101282	7.9250	unknown
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	35	1	0	113803	53.1000	C123
4	5	0	3	Allen, Mr. William Henry	35	0	0	373450	8.0500	unknown
...	...	...	...	...	...	...	...	...	...	...

	PassengerId	Survived	Pclass	Name	Age	SibSp	Parch	Ticket	Fare	Cabin
886	887	0	2	Montvila, Rev. Juozas	27	0	0	211536	13.0000	unknown
887	888	1	1	Graham, Miss. Margaret Edith	19	0	0	112053	30.0000	B42
888	889	0	3	Johnston, Miss. Catherine Helen "Carrie"	22	1	2	W./C. 6607	23.4500	unknown
889	890	1	1	Behr, Mr. Karl Howell	26	0	0	111369	30.0000	C148
890	891	0	3	Dooley, Mr.	32	0	0	370376	7.7500	unknown

Assignment No 2 : Data Wrangling 2

---

1. Import Required Libraries

In [1]:
```
import pandas as pd
import numpy as np
```

2. Load the dataset into dataframe

In [2]:
```
df = pd.read_csv('StudentPerformance.csv')
```

In [3]:
```
df
```

Out[3]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
0	71.0	78	65.0	99.0	2018.0	
1	63.0	86	71.0	100.0	NaN	
2	71.0	92	64.0	76.0	2021.0	
3	77.0	95	68.0	84.0	2021.0	
4	63.0	81	70.0	76.0	2021.0	
5	NaN	92	NaN	89.0	2020.0	
6	66.0	75	67.0	93.0	2019.0	
7	50.0	100	68.0	200.0	2015.0	
8	60.0	90	61.0	87.0	2021.0	
9	64.0	89	72.0	80.0	2019.0	
10	63.0	81	62.0	95.0	2021.0	
11	66.0	95	77.0	90.0	2020.0	
12	60.0	88	73.0	91.0	2020.0	
13	72.0	80	69.0	98.0	2021.0	
14	60.0	76	NaN	82.0	2020.0	
15	69.0	83	69.0	NaN	2019.0	
16	72.0	80	20.0	75.0	2021.0	
17	90.0	95	66.0	85.0	2002.0	
18	70.0	89	73.0	90.0	2020.0	

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
19	66.0	91	77.0	100.0	2020.0	
20	61.0	75	74.0	76.0	NaN	
21	NaN	77	79.0	82.0	2018.0	
22	65.0	95	60.0	100.0	2021.0	
23	63.0	86	78.0	82.0	2019.0	
24	78.0	95	66.0	NaN	2019.0	
25	71.0	84	72.0	89.0	2018.0	
26	78.0	78	73.0	87.0	2018.0	
27	67.0	79	67.0	89.0	2018.0	
28	75.0	79	NaN	97.0	2020.0	

Check the dimensions of dataframe

In [4]:
```
df.shape
```

Out[4]:
```
(30, 6)
```

Check the number of null values in each column

In [5]:
```
df.isnull().sum()
```

Out[5]:
```
math_score              2
reading_score           0
writing_score           3
placement_score         2
club_join_date          2
placement_offer_count   1
dtype: int64
```

In [6]:
```
df.isnull()
```

Out[6]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
0	False	False	False	False	False	
1	False	False	False	False	True	
2	False	False	False	False	False	
3	False	False	False	False	False	
4	False	False	False	False	False	
5	True	False	True	False	False	
6	False	False	False	False	False	
7	False	False	False	False	False	

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
8	False	False	False	False	False	
9	False	False	False	False	False	
10	False	False	False	False	False	
11	False	False	False	False	False	
12	False	False	False	False	False	
13	False	False	False	False	False	
14	False	False	True	False	False	
15	False	False	False	True	False	
16	False	False	False	False	False	
17	False	False	False	False	False	
18	False	False	False	False	False	
19	False	False	False	False	False	
20	False	False	False	False	True	
21	True	False	False	False	False	
22	False	False	False	False	False	
23	False	False	False	False	False	
24	False	False	False	True	False	
25	False	False	False	False	False	
26	False	False	False	False	False	
27	False	False	False	False	False	
28	False	False	True	False	False	

Handling missing/null values

In [7]:
```
df['math_score']=df['math_score'].interpolate()
df
```

Out[7]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
0	71.0	78	65.0	99.0	2018.0	
1	63.0	86	71.0	100.0	NaN	
2	71.0	92	64.0	76.0	2021.0	
3	77.0	95	68.0	84.0	2021.0	
4	63.0	81	70.0	76.0	2021.0	
5	64.5	92	NaN	89.0	2020.0	
6	66.0	75	67.0	93.0	2019.0	
7	50.0	100	68.0	200.0	2015.0	

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
8	60.0	90	61.0	87.0	2021.0	
9	64.0	89	72.0	80.0	2019.0	
10	63.0	81	62.0	95.0	2021.0	
11	66.0	95	77.0	90.0	2020.0	
12	60.0	88	73.0	91.0	2020.0	
13	72.0	80	69.0	98.0	2021.0	
14	60.0	76	NaN	82.0	2020.0	
15	69.0	83	69.0	NaN	2019.0	
16	72.0	80	20.0	75.0	2021.0	
17	90.0	95	66.0	85.0	2002.0	
18	70.0	89	73.0	90.0	2020.0	
19	66.0	91	77.0	100.0	2020.0	
20	61.0	75	74.0	76.0	NaN	
21	63.0	77	79.0	82.0	2018.0	
22	65.0	95	60.0	100.0	2021.0	
23	63.0	86	78.0	82.0	2019.0	
24	78.0	95	66.0	NaN	2019.0	
25	71.0	84	72.0	89.0	2018.0	
26	78.0	78	73.0	87.0	2018.0	
27	67.0	79	67.0	89.0	2018.0	

In [8]:
```
df.isnull().sum()
```

Out[8]:
```
math_score            0
reading_score         0
writing_score         3
placement_score       2
club_join_date        2
placement_offer_count 1
dtype: int64
```

In [9]:
```
df['writing_score'] = df['writing_score'].fillna(method='ffill')
df
```

Out[9]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
0	71.0	78	65.0	99.0	2018.0	
1	63.0	86	71.0	100.0	NaN	
2	71.0	92	64.0	76.0	2021.0	
3	77.0	95	68.0	84.0	2021.0	
4	63.0	81	70.0	76.0	2021.0	

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
5	64.5	92	70.0	89.0	2020.0	
6	66.0	75	67.0	93.0	2019.0	
7	50.0	100	68.0	200.0	2015.0	
8	60.0	90	61.0	87.0	2021.0	
9	64.0	89	72.0	80.0	2019.0	
10	63.0	81	62.0	95.0	2021.0	
11	66.0	95	77.0	90.0	2020.0	
12	60.0	88	73.0	91.0	2020.0	
13	72.0	80	69.0	98.0	2021.0	
14	60.0	76	69.0	82.0	2020.0	
15	69.0	83	69.0	NaN	2019.0	
16	72.0	80	20.0	75.0	2021.0	
17	90.0	95	66.0	85.0	2002.0	
18	70.0	89	73.0	90.0	2020.0	
19	66.0	91	77.0	100.0	2020.0	
20	61.0	75	74.0	76.0	NaN	
21	63.0	77	79.0	82.0	2018.0	
22	65.0	95	60.0	100.0	2021.0	
23	63.0	86	78.0	82.0	2019.0	
24	78.0	95	66.0	NaN	2019.0	
25	71.0	84	72.0	89.0	2018.0	
26	78.0	78	73.0	87.0	2018.0	
27	67.0	79	67.0	89.0	2018.0	
28	75.0	79	67.0	97.0	2020.0	

In [10]:
```
df.isnull().sum()
```

Out[10]:
```
math_score              0
reading_score           0
writing_score           0
placement_score         2
club_join_date          2
placement_offer_count   1
dtype: int64
```

In [11]:
```
df['placement_score'] = df['placement_score'].fillna(method='bfill')
df
```

Out[11]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
0	71.0	78	65.0	99.0	2018.0	
1	63.0	86	71.0	100.0	NaN	

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
2	71.0	92	64.0	76.0	2021.0	
3	77.0	95	68.0	84.0	2021.0	
4	63.0	81	70.0	76.0	2021.0	
5	64.5	92	70.0	89.0	2020.0	
6	66.0	75	67.0	93.0	2019.0	
7	50.0	100	68.0	200.0	2015.0	
8	60.0	90	61.0	87.0	2021.0	
9	64.0	89	72.0	80.0	2019.0	
10	63.0	81	62.0	95.0	2021.0	
11	66.0	95	77.0	90.0	2020.0	
12	60.0	88	73.0	91.0	2020.0	
13	72.0	80	69.0	98.0	2021.0	
14	60.0	76	69.0	82.0	2020.0	
15	69.0	83	69.0	75.0	2019.0	
16	72.0	80	20.0	75.0	2021.0	
17	90.0	95	66.0	85.0	2002.0	
18	70.0	89	73.0	90.0	2020.0	
19	66.0	91	77.0	100.0	2020.0	
20	61.0	75	74.0	76.0	NaN	
21	63.0	77	79.0	82.0	2018.0	
22	65.0	95	60.0	100.0	2021.0	
23	63.0	86	78.0	82.0	2019.0	
24	78.0	95	66.0	89.0	2019.0	
25	71.0	84	72.0	89.0	2018.0	
26	78.0	78	73.0	87.0	2018.0	
27	67.0	79	67.0	89.0	2018.0	
28	75.0	79	67.0	97.0	2020.0	

In [12]:
```
df.isnull().sum()
```

Out[12]:
```
math_score              0
reading_score           0
writing_score           0
placement_score         0
club_join_date          2
placement_offer_count   1
dtype: int64
```

In [13]:
```
df['club_join_date'] = df['club_join_date'].replace(to_replace=np.nan,value='2
df
```

Out[13]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
0	71.0	78	65.0	99.0	2018	
1	63.0	86	71.0	100.0	2019	
2	71.0	92	64.0	76.0	2021	
3	77.0	95	68.0	84.0	2021	
4	63.0	81	70.0	76.0	2021	
5	64.5	92	70.0	89.0	2020	
6	66.0	75	67.0	93.0	2019	
7	50.0	100	68.0	200.0	2015	
8	60.0	90	61.0	87.0	2021	
9	64.0	89	72.0	80.0	2019	
10	63.0	81	62.0	95.0	2021	
11	66.0	95	77.0	90.0	2020	
12	60.0	88	73.0	91.0	2020	
13	72.0	80	69.0	98.0	2021	
14	60.0	76	69.0	82.0	2020	
15	69.0	83	69.0	75.0	2019	
16	72.0	80	20.0	75.0	2021	
17	90.0	95	66.0	85.0	2002	
18	70.0	89	73.0	90.0	2020	
19	66.0	91	77.0	100.0	2020	
20	61.0	75	74.0	76.0	2019	
21	63.0	77	79.0	82.0	2018	
22	65.0	95	60.0	100.0	2021	
23	63.0	86	78.0	82.0	2019	
24	78.0	95	66.0	89.0	2019	
25	71.0	84	72.0	89.0	2018	
26	78.0	78	73.0	87.0	2018	
27	67.0	79	67.0	89.0	2018	
28	75.0	79	67.0	97.0	2020	
29	73.0	78	61.0	75.0	2020	

In [14]:
```
df.isnull().sum()
```

Out[14]:

```
math_score                0
reading score             0
```

In [15]:
```
df['placement_offer_count']=df['placement_offer_count'].fillna('1')
df
```

Out[15]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
0	71.0	78	65.0	99.0	2018	
1	63.0	86	71.0	100.0	2019	
2	71.0	92	64.0	76.0	2021	
3	77.0	95	68.0	84.0	2021	
4	63.0	81	70.0	76.0	2021	
5	64.5	92	70.0	89.0	2020	
6	66.0	75	67.0	93.0	2019	
7	50.0	100	68.0	200.0	2015	
8	60.0	90	61.0	87.0	2021	
9	64.0	89	72.0	80.0	2019	
10	63.0	81	62.0	95.0	2021	
11	66.0	95	77.0	90.0	2020	
12	60.0	88	73.0	91.0	2020	
13	72.0	80	69.0	98.0	2021	
14	60.0	76	69.0	82.0	2020	
15	69.0	83	69.0	75.0	2019	
16	72.0	80	20.0	75.0	2021	
17	90.0	95	66.0	85.0	2002	
18	70.0	89	73.0	90.0	2020	
19	66.0	91	77.0	100.0	2020	
20	61.0	75	74.0	76.0	2019	
21	63.0	77	79.0	82.0	2018	
22	65.0	95	60.0	100.0	2021	
23	63.0	86	78.0	82.0	2019	
24	78.0	95	66.0	89.0	2019	
25	71.0	84	72.0	89.0	2018	
26	78.0	78	73.0	87.0	2018	
27	67.0	79	67.0	89.0	2018	
28	75.0	79	67.0	97.0	2020	
29	73.0	78	61.0	75.0	2020	

In [16]:
```
df.isnull().sum()
```

Out[16]:
```
math_score              0
reading_score           0
writing_score           0
placement_score         0
club_join_date          0
placement_offer_count   0
dtype: int64
```

Check the data types and convert into appropriate types

In [17]:
```
df.dtypes
```

Out[17]:
```
math_score              float64
reading_score             int64
writing_score           float64
placement_score         float64
club_join_date           object
placement_offer_count    object
dtype: object
```

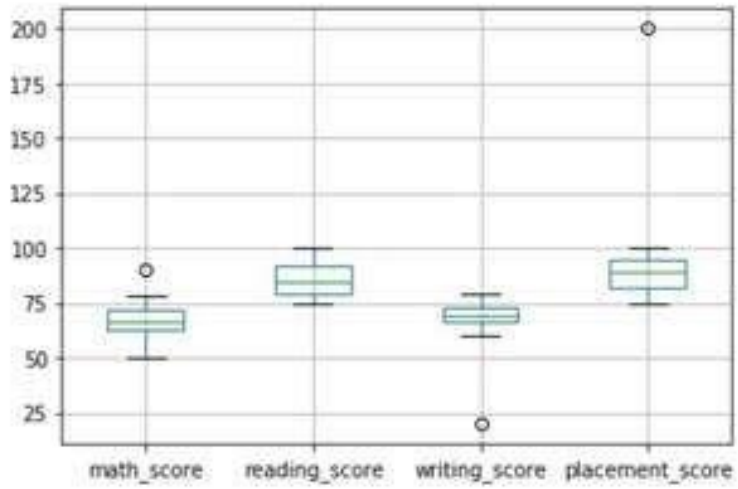
In [18]:
```
df['math_score']=df['math_score'].astype('int64')
df['reading_score']=df['reading_score'].astype('int64')
df['writing_score']=df['writing_score'].astype('int64')
df['placement_score']=df['placement_score'].astype('int64')
df['club_join_date']=df['club_join_date'].astype('int64')
df['placement_offer_count']=df['placement_offer_count'].astype('int64')
df.dtypes
```

Out[18]:
```
math_score              int64
reading_score           int64
writing_score           int64
placement_score         int64
club_join_date          int64
placement_offer_count   int64
dtype: object
```

Check for outliers

In [19]:
```
columns = ['math_score','reading_score','writing_score','placement_score']
df.boxplot(columns)
```

Out[19]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x5d9471ffc8>
```



In [20]:
```
np.where(df['math_score'] < 60)
```

Out[20]:
```
(array([7], dtype=int64),)
```

In [21]:
```
np.where(df['math_score'] > 80)
```

Out[21]:
```
(array([17], dtype=int64),)
```

In [22]:
```
np.where(df['reading_score'] < 75)
```

Out[22]:
```
(array([], dtype=int64),)
```

In [23]:
```
np.where(df['reading_score'] > 95)
```

Out[23]:
```
(array([7], dtype=int64),)
```

In [24]:
```
np.where(df['writing_score'] < 60)
```

Out[24]:
```
(array([16], dtype=int64),)
```

In [25]:
```
np.where(df['writing_score'] > 80)
```

Out[25]:
```
(array([], dtype=int64),)
```

In [26]:
```
np.where(df['placement_score'] < 75)
```

Out[26]:
```
(array([], dtype=int64),)
```

In [27]:
```
np.where(df['placement_score'] > 100)
```

Out[27]:
```
(array([7], dtype=int64),)
```

In [28]:
```
np.where((df['placement_score'] < 75) & (df['placement_offer_count'] > 1))
```

Out[28]:
```
(array([], dtype=int64),)
```

In [29]:
```
np.where(((df['placement_score'] > 75) & (df['placement_score'] <= 85))
         & ((df['placement_offer_count'] > 2) | (df['placement_offer_count'] <
```

Out[29]:
```
(array([17, 21], dtype=int64),)
```

In [30]:
```
np.where((df['placement_score'] > 85) & (df['placement_offer_count'] < 3))
```

Out[30]:
```
(array([10, 24], dtype=int64),)
```

In [31]:
```
# The above results gives us the rows with the outliers
# There are different methods that can be used for outlier detection and remov
# 1. Percentile
# 2. Standard Deviation
# 3. Z score
```

Outlier detection

In [32]:
```
df[(df['math_score'] < 60) | (df['math_score'] > 80)]
```

Out[32]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
7	50	100	68	200	2015	
17	90	95	66	85	2002	

In [33]:
```
df[(df['reading_score'] < 75) | (df['reading_score'] > 95)]
```

Out[33]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_c
7	50	100	68	200	2015	

In [34]:
```
df[(df['writing_score'] < 60) | (df['writing_score'] > 80)]
```

Out[34]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
16	72	80	20	75	2021	

In [35]:
```
df[(df['placement_score'] < 75) | (df['placement_score'] > 100)]
```

Out[35]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_c
7	50	100	68	200	2015	

In [36]:
```
df[(df['club_join_date'] < 2018) | (df['club_join_date'] > 2021)]
```

Out[36]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
7	50	100	68	200	2015	

math_score reading_score writing_score placement_score club_join_date placement_offer

In [37]:
```
df[(df['placement_score'] < 75) & (df['placement_offer_count'] > 1)]
```

Out[37]:

math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_co

In [38]:
```
df[((df['placement_score'] > 75) & (df['placement_score'] <= 85))
   & ((df['placement_offer_count'] > 2) | (df['placement_offer_count'] < 2))]
```

Out[38]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
17	90	95	66	85	2002	
21	63	77	79	82	2018	

In [39]:
```
df[((df['placement_score'] > 85) & (df['placement_offer_count'] < 3))]
```

Out[39]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
10	63	81	62	95	2021	
24	78	95	66	89	2019	

Outlier Removal

In [40]:
```
new_df1 = df[
    ((df.math_score >= 60) & (df.math_score <= 80)) &
    ((df.reading_score >= 75) & (df.reading_score <= 95)) &
    ((df.writing_score >= 60) & (df.writing_score <= 80)) &
    ((df.placement_score >= 75) & (df.placement_score <= 100)) &
    ((df.club_join_date >= 2018) & (df.club_join_date <= 2021))]
```

In [41]:
```
new_df1
```

Out[41]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
0	71	78	65	99	2018	
1	63	86	71	100	2019	
2	71	92	64	76	2021	
3	77	95	68	84	2021	
4	63	81	70	76	2021	
5	64	92	70	89	2020	
6	66	75	67	93	2019	
8	60	90	61	87	2021	
9	64	89	72	80	2019	
10	63	81	62	95	2021	
11	66	95	77	90	2020	
12	60	88	73	91	2020	

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
13	72	80	69	98	2021	
14	60	76	69	82	2020	
15	69	83	69	75	2019	
18	70	89	73	90	2020	
19	66	91	77	100	2020	
20	61	75	74	76	2019	
21	63	77	79	82	2018	
22	65	95	60	100	2021	
23	63	86	78	82	2019	
24	78	95	66	89	2019	
25	71	84	72	89	2018	
26	78	78	73	87	2018	
27	67	79	67	89	2018	
28	75	79	67	97	2020	

In [42]:
```
new_df1[(new_df1['placement_score'] < 75) & (new_df1['placement_offer_count']
```

Out[42]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_co

In [43]:
```
new_df1[((new_df1['placement_score'] >= 75) & (new_df1['placement_score'] <= 8
  & ((new_df1['placement_offer_count'] > 2) | (new_df1['placement_offer_count
```

Out[43]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
15	69	83	69	75	2019	
21	63	77	79	82	2018	

In [44]:
```
new_df1[((new_df1['placement_score'] > 85) & (new_df1['placement_offer_count']
```

Out[44]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
10	63	81	62	95	2021	
24	78	95	66	89	2019	

In [45]:
```
new_df2 = new_df1[
    ((new_df1.placement_score < 75) & (new_df1.placement_offer_count==1)) |
    (((new_df1.placement_score >= 75) & (new_df1.placement_score <= 85)) & (ne
    ((new_df1.placement_score > 85) & (new_df1.placement_offer_count==3))]
```

In [46]:
```
new_df2
```

Out[46]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
0	71	78	65	99	2018	
1	63	86	71	100	2019	

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_
2	71	92	64	76	2021	
3	77	95	68	84	2021	
4	63	81	70	76	2021	
5	64	92	70	89	2020	
6	66	75	67	93	2019	
8	60	90	61	87	2021	
9	64	89	72	80	2019	
11	66	95	77	90	2020	
12	60	88	73	91	2020	
13	72	80	69	98	2021	
14	60	76	69	82	2020	
18	70	89	73	90	2020	
19	66	91	77	100	2020	
20	61	75	74	76	2019	
22	65	95	60	100	2021	
23	63	86	78	82	2019	
25	71	84	72	89	2018	
26	78	78	73	87	2018	
27	67	79	67	89	2018	
28	75	79	67	97	2020	

In [47]:
```
new_df2.shape
```

Out[47]:
```
(23, 6)
```

Check if the outliers are completely removed

In [48]:
```
new_df2[(new_df2['math_score'] < 60) | (new_df2['math_score'] > 80)]
```

Out[48]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_co

In [49]:
```
new_df2[(new_df2['reading_score'] < 75) | (new_df2['reading_score'] > 95)]
```

Out[49]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_co

In [50]:
```
new_df2[(new_df2['writing_score'] < 60) | (new_df2['writing_score'] > 80)]
```

Out[50]:

	math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_co

In [51]:
```
new_df2[(new_df2['placement_score'] < 75) | (new_df2['placement_score'] > 100)
```

Out[51]:

math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_co

In [52]:
```
new_df2[(new_df2['club_join_date'] < 2018) | (new_df2['club_join_date'] > 2021
```

Out[52]:

math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_co

In [53]:
```
new_df2[(new_df2['placement_score'] < 75) & (new_df2['placement_offer_count']
```

Out[53]:

math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_co

In [54]:
```
new_df2[((new_df2['placement_score'] > 75) & (new_df2['placement_score'] <= 85
   & ((new_df2['placement_offer_count'] > 2) | (new_df2['placement_offer_count
```

Out[54]:

math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_co

In [55]:
```
new_df2[((new_df2['placement_score'] > 85) & (new_df2['placement_offer_count']
```

Out[55]:

math_score	reading_score	writing_score	placement_score	club_join_date	placement_offer_co

Data transformation and Normalization

In [56]:
```
from sklearn.preprocessing import MinMaxScaler
scaling = MinMaxScaler()
scaling.fit_transform(new_df2[['math_score','reading_score','writing_score','p
```

Out[56]:
```
array([[0.61111111, 0.15      , 0.27777778, 0.96      ],
       [0.16666667, 0.55      , 0.61111111, 1.        ],
       [0.61111111, 0.85      , 0.22222222, 0.04      ],
       [0.94444444, 1.        , 0.44444444, 0.36      ],
       [0.16666667, 0.3       , 0.55555556, 0.04      ],
       [0.22222222, 0.85      , 0.55555556, 0.56      ],
       [0.33333333, 0.        , 0.38888889, 0.72      ],
       [0.        , 0.75      , 0.05555556, 0.48      ],
       [0.22222222, 0.7       , 0.66666667, 0.2       ],
       [0.33333333, 1.        , 0.94444444, 0.6       ],
       [0.        , 0.65      , 0.72222222, 0.64      ],
       [0.66666667, 0.25      , 0.5       , 0.92      ],
       [0.        , 0.05      , 0.5       , 0.28      ],
       [0.55555556, 0.7       , 0.72222222, 0.6       ],
       [0.33333333, 0.8       , 0.94444444, 1.        ],
       [0.05555556, 0.        , 0.77777778, 0.04      ],
       [0.27777778, 1.        , 0.        , 1.        ],
       [0.16666667, 0.55      , 1.        , 0.28      ],
       [0.61111111, 0.45      , 0.66666667, 0.56      ],
       [1.        , 0.15      , 0.72222222, 0.48      ],
       [0.38888889, 0.2       , 0.38888889, 0.56      ],
       [0.83333333, 0.2       , 0.38888889, 0.88      ],
       [0.72222222, 0.15      , 0.05555556, 0.        ]])
```

Assignment No 3 : Descriptive Statistics - Measures of Central Tendency and Variability

---

Import Required Libraries

In [1]:
```
import pandas as pd
import numpy as np
```

Read csv into Dataframe

In [2]:
```
df = pd.read_csv('iris.csv')
```

In [3]:
```
df
```

Out[3]:

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
0	1	5.1	3.5	1.4	0.2	Iris-setosa
1	2	4.9	3.0	1.4	0.2	Iris-setosa
2	3	4.7	3.2	1.3	0.2	Iris-setosa
3	4	4.6	3.1	1.5	0.2	Iris-setosa
4	5	5.0	3.6	1.4	0.2	Iris-setosa
...	...	...	...	...	...	...
145	146	6.7	3.0	5.2	2.3	Iris-virginica
146	147	6.3	2.5	5.0	1.9	Iris-virginica
147	148	6.5	3.0	5.2	2.0	Iris-virginica
148	149	6.2	3.4	5.4	2.3	Iris-virginica
149	150	5.9	3.0	5.1	1.8	Iris-virginica

150 rows × 6 columns

Data Preprocessing

In [4]:
```
df.shape
```

Out[4]:
```
(150, 6)
```

In [5]:
```
df.isnull().sum()
```

Out[5]:
```
Id               0
SepalLengthCm    0
SepalWidthCm     0
PetalLengthCm    0
PetalWidthCm     0
Species          0
dtype: int64
```

In [6]:
```
df.dtypes
```

Out[6]:
```
Id                int64
SepalLengthCm    float64
SepalWidthCm     float64
PetalLengthCm    float64
PetalWidthCm     float64
Species           object
dtype: object
```

In [7]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 6 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Id             150 non-null    int64
 1   SepalLengthCm  150 non-null    float64
 2   SepalWidthCm   150 non-null    float64
 3   PetalLengthCm  150 non-null    float64
 4   PetalWidthCm   150 non-null    float64
 5   Species        150 non-null    object
dtypes: float64(4), int64(1), object(1)
memory usage: 7.2+ KB
```

In [8]:
```
df.drop(columns = 'Id', inplace = True)
df
```

Out[8]:

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
0	5.1	3.5	1.4	0.2	Iris-setosa
1	4.9	3.0	1.4	0.2	Iris-setosa
2	4.7	3.2	1.3	0.2	Iris-setosa
3	4.6	3.1	1.5	0.2	Iris-setosa
4	5.0	3.6	1.4	0.2	Iris-setosa
...	...	...	...	...	...
145	6.7	3.0	5.2	2.3	Iris-virginica
146	6.3	2.5	5.0	1.9	Iris-virginica
147	6.5	3.0	5.2	2.0	Iris-virginica

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
148	6.2	3.4	5.4	2.3	Iris-virginica
149	5.9	3.0	5.1	1.8	Iris-virginica

In [9]:
```
df.describe()
```

Out[9]:

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm
count	150.000000	150.000000	150.000000	150.000000
mean	5.843333	3.054000	3.758667	1.198667
std	0.828066	0.433594	1.764420	0.763161
min	4.300000	2.000000	1.000000	0.100000
25%	5.100000	2.800000	1.600000	0.300000
50%	5.800000	3.000000	4.350000	1.300000
75%	6.400000	3.300000	5.100000	1.800000
max	7.900000	4.400000	6.900000	2.500000

Calculation of Mean for each Feature

In [10]:
```
np.mean(df['SepalLengthCm'])
```

Out[10]:
```
5.843333333333335
```

In [11]:
```
np.mean(df['SepalWidthCm'])
```

Out[11]:
```
3.0540000000000007
```

In [12]:
```
np.mean(df['PetalLengthCm'])
```

Out[12]:
```
3.7586666666666693
```

In [13]:
```
np.mean(df['PetalWidthCm'])
```

Out[13]:
```
1.1986666666666672
```

In [14]:
```
np.mean(df)
```

Out[14]:
```
SepalLengthCm    5.843333
SepalWidthCm     3.054000
PetalLengthCm    3.758667
PetalWidthCm     1.198667
dtype: float64
```

Calculation of Standard Deviation for each feature

In [15]:
```
np.std(df)
```

Out[15]:

```
SepalLengthCm    0.825301
SepalWidthCm     0.432147
PetalLengthCm    1.758529
PetalWidthCm     0.760613
```

Calculating minimum value

In [16]:
```
np.min(df)
```

Out[16]:
```
SepalLengthCm            4.3
SepalWidthCm               2
PetalLengthCm              1
PetalWidthCm             0.1
Species          Iris-setosa
dtype: object
```

Calculating maximum value

In [17]:
```
np.max(df)
```

Out[17]:
```
SepalLengthCm               7.9
SepalWidthCm                4.4
PetalLengthCm               6.9
PetalWidthCm                2.5
Species          Iris-virginica
dtype: object
```

Calculating 1st quantile (25th percentile)

In [18]:
```
df.quantile(0.25)
```

Out[18]:
```
SepalLengthCm    5.1
SepalWidthCm     2.8
PetalLengthCm    1.6
PetalWidthCm     0.3
Name: 0.25, dtype: float64
```

Calculating 2nd quantile (50th percentile)

In [19]:
```
df.quantile(0.50)
```

Out[19]:
```
SepalLengthCm    5.80
SepalWidthCm     3.00
PetalLengthCm    4.35
PetalWidthCm     1.30
Name: 0.5, dtype: float64
```

Calculating 3rd quantile (75th percentile)

In [20]:
```
df.quantile(0.75)
```

Out[20]:

```
SepalLengthCm    6.4
SepalWidthCm     3.3
PetalLengthCm    5.1
PetalWidthCm     1.8
```

Assignment No 4 : Data Analytics 1

Reading Required Dataset

In [1]:
```
from sklearn.datasets import load_boston
boston = load_boston()
```

In [2]:
```
print(boston)
```

```
{'data': array([[6.3200e-03, 1.8000e+01, 2.3100e+00, ..., 1.5300e+01, 3.9690
e+02,
        4.9800e+00],
       [2.7310e-02, 0.0000e+00, 7.0700e+00, ..., 1.7800e+01, 3.9690e+02,
        9.1400e+00],
       [2.7290e-02, 0.0000e+00, 7.0700e+00, ..., 1.7800e+01, 3.9283e+02,
        4.0300e+00],
       ...,
       [6.0760e-02, 0.0000e+00, 1.1930e+01, ..., 2.1000e+01, 3.9690e+02,
        5.6400e+00],
       [1.0959e-01, 0.0000e+00, 1.1930e+01, ..., 2.1000e+01, 3.9345e+02,
        6.4800e+00],
       [4.7410e-02, 0.0000e+00, 1.1930e+01, ..., 2.1000e+01, 3.9690e+02,
        7.8800e+00]]), 'target': array([24. , 21.6, 34.7, 33.4, 36.2, 28.7, 2
2.9, 27.1, 16.5, 18.9, 15. ,
       18.9, 21.7, 20.4, 18.2, 19.9, 23.1, 17.5, 20.2, 18.2, 13.6, 19.6,
       15.2, 14.5, 15.6, 13.9, 16.6, 14.8, 18.4, 21. , 12.7, 14.5, 13.2,
       13.1, 13.5, 18.9, 20. , 21. , 24.7, 30.8, 34.9, 26.6, 25.3, 24.7,
       21.2, 19.3, 20. , 16.6, 14.4, 19.4, 19.7, 20.5, 25. , 23.4, 18.9,
       35.4, 24.7, 31.6, 23.3, 19.6, 18.7, 16. , 22.2, 25. , 33. , 23.5,
       19.4, 22. , 17.4, 20.9, 24.2, 21.7, 22.8, 23.4, 24.1, 21.4, 20. ,
       20.8, 21.2, 20.3, 28. , 23.9, 24.8, 22.9, 23.9, 26.6, 22.5, 22.2,
       23.6, 28.7, 22.6, 22. , 22.9, 25. , 20.6, 28.4, 21.4, 38.7, 43.8,
       33.2, 27.5, 26.5, 18.6, 19.3, 20.1, 19.5, 19.5, 20.4, 19.8, 19.4,
       21.7, 22.8, 18.8, 18.7, 18.5, 18.3, 21.2, 19.2, 20.4, 19.3, 22. ,
       20.3, 20.5, 17.3, 18.8, 21.4, 15.7, 16.2, 18. , 14.3, 19.2, 19.6,
       23. , 18.4, 15.6, 18.1, 17.4, 17.1, 13.3, 17.8, 14. , 14.4, 13.4,
       15.6, 11.8, 13.8, 15.6, 14.6, 17.8, 15.4, 21.5, 19.6, 15.3, 19.4,
       17. , 15.6, 13.1, 41.3, 24.3, 23.3, 27. , 50. , 50. , 50. , 22.7,
       25. , 50. , 23.8, 23.8, 22.3, 17.4, 19.1, 23.1, 23.6, 22.6, 29.4,
       23.2, 24.6, 29.9, 37.2, 39.8, 36.2, 37.9, 32.5, 26.4, 29.6, 50. ,
       32. , 29.8, 34.9, 37. , 30.5, 36.4, 31.1, 29.1, 50. , 33.3, 30.3,
       34.6, 34.9, 32.9, 24.1, 42.3, 48.5, 50. , 22.6, 24.4, 22.5, 24.4,
       20. , 21.7, 19.3, 22.4, 28.1, 23.7, 25. , 23.3, 28.7, 21.5, 23. ,
       26.7, 21.7, 27.5, 30.1, 44.8, 50. , 37.6, 31.6, 46.7, 31.5, 24.3,
       31.7, 41.7, 48.3, 29. , 24. , 25.1, 31.5, 23.7, 23.3, 22. , 20.1,
       22.2, 23.7, 17.6, 18.5, 24.3, 20.5, 24.5, 26.2, 24.4, 24.8, 29.6,
       42.8, 21.9, 20.9, 44. , 50. , 36. , 30.1, 33.8, 43.1, 48.8, 31. ,
       36.5, 22.8, 30.7, 50. , 43.5, 20.7, 21.1, 25.2, 24.4, 35.2, 32.4,
       32. , 33.2, 33.1, 29.1, 35.1, 45.4, 35.4, 46. , 50. , 32.2, 22. ,
       20.1, 23.2, 22.3, 24.8, 28.5, 37.3, 27.9, 23.9, 21.7, 28.6, 27.1,
       20.3, 22.5, 29. , 24.8, 22. , 26.4, 33.1, 36.1, 28.4, 33.4, 28.2,
       22.8, 20.3, 16.1, 22.1, 19.4, 21.6, 23.8, 16.2, 17.8, 19.8, 23.1,
       21. , 23.8, 23.1, 20.4, 18.5, 25. , 24.6, 23. , 22.2, 19.3, 22.6,
       19.8, 17.1, 19.4, 22.2, 20.7, 21.1, 19.5, 18.5, 20.6, 19. , 18.7,
       32.7, 16.5, 23.9, 31.2, 17.5, 17.2, 23.1, 24.5, 26.6, 22.9, 24.1,
       18.6, 30.1, 18.2, 20.6, 17.8, 21.7, 22.7, 22.6, 25. , 19.9, 20.8,
       16.8, 21.9, 27.5, 21.9, 23.1, 50. , 50. , 50. , 50. , 50. , 13.8,
       13.8, 15. , 13.9, 13.3, 13.1, 10.2, 10.4, 10.9, 11.3, 12.3,  8.8,
        7.2, 10.5,  7.4, 10.2, 11.5, 15.1, 23.2,  9.7, 13.8, 12.7, 13.1,
       12.5,  8.5,  5. ,  6.3,  5.6,  7.2, 12.1,  8.3,  8.5,  5. , 11.9,
       27.9, 17.2, 27.5, 15. , 17.2, 17.9, 16.3,  7. ,  7.2,  7.5, 10.4,
        8.8,  8.4, 16.7, 14.2, 20.8, 13.4, 11.7,  8.3, 10.2, 10.9, 11. ,
        9.5, 14.5, 14.1, 16.1, 14.3, 11.7, 13.4,  9.6,  8.7,  8.4, 12.8,
       10.5, 17.1, 18.4, 15.4, 10.8, 11.8, 14.9, 12.6, 14.1, 13. , 13.4,
       15.2, 16.1, 17.8, 14.9, 14.1, 12.7, 13.5, 14.9, 20. , 16.4, 17.7,
```

```
19.5, 20.2, 21.4, 19.9, 19. , 19.1, 19.1, 20.1, 19.9, 19.6, 23.2,
29.8, 13.8, 13.3, 16.7, 12. , 14.6, 21.4, 23. , 23.7, 25. , 21.8,
```

Importing Required Libraries

In [3]:
```
import pandas as pd
import numpy as np
from sklearn import linear_model
from sklearn.model_selection import train_test_split
```

Creating Dataframe

In [4]:
```
df_x = pd.DataFrame(boston.data, columns=boston.feature_names)
```

In [5]:
```
df_y = pd.DataFrame(boston.target)
```

In [6]:
```
df_x
```

Out[6]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	DIS	RAD	TAX	PTRATIO	B	LS
0	0.00632	18.0	2.31	0.0	0.538	6.575	65.2	4.0900	1.0	296.0	15.3	396.90	
1	0.02731	0.0	7.07	0.0	0.469	6.421	78.9	4.9671	2.0	242.0	17.8	396.90	
2	0.02729	0.0	7.07	0.0	0.469	7.185	61.1	4.9671	2.0	242.0	17.8	392.83	
3	0.03237	0.0	2.18	0.0	0.458	6.998	45.8	6.0622	3.0	222.0	18.7	394.63	
4	0.06905	0.0	2.18	0.0	0.458	7.147	54.2	6.0622	3.0	222.0	18.7	396.90	
...	...	...	...	...	...	...	...	...	...	...	...	...	
501	0.06263	0.0	11.93	0.0	0.573	6.593	69.1	2.4786	1.0	273.0	21.0	391.99	
502	0.04527	0.0	11.93	0.0	0.573	6.120	76.7	2.2875	1.0	273.0	21.0	396.90	
503	0.06076	0.0	11.93	0.0	0.573	6.976	91.0	2.1675	1.0	273.0	21.0	396.90	
504	0.10959	0.0	11.93	0.0	0.573	6.794	89.3	2.3889	1.0	273.0	21.0	393.45	
505	0.04741	0.0	11.93	0.0	0.573	6.030	80.8	2.5050	1.0	273.0	21.0	396.90	

506 rows × 13 columns

In [8]:
```
df_y
```

Out[8]:

	0
0	24.0
1	21.6
2	34.7
3	33.4
4	36.2
...	...
501	22.4

	0
502	20.6
503	23.9
504	22.0
505	11.9

In [9]:
```
df_x.describe()
```

Out[9]:

	CRIM	ZN	INDUS	CHAS	NOX	RM	AGE	
count	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000	506.000000	506.
mean	3.613524	11.363636	11.136779	0.069170	0.554695	6.284634	68.574901	3.
std	8.601545	23.322453	6.860353	0.253994	0.115878	0.702617	28.148861	2.
min	0.006320	0.000000	0.460000	0.000000	0.385000	3.561000	2.900000	1.
25%	0.082045	0.000000	5.190000	0.000000	0.449000	5.885500	45.025000	2.
50%	0.256510	0.000000	9.690000	0.000000	0.538000	6.208500	77.500000	3.
75%	3.677083	12.500000	18.100000	0.000000	0.624000	6.623500	94.075000	5.
max	88.976200	100.000000	27.740000	1.000000	0.871000	8.780000	100.000000	12.

In [10]:
```
df_y.describe()
```

Out[10]:

	0
count	506.000000
mean	22.532806
std	9.197104
min	5.000000
25%	17.025000
50%	21.200000
75%	25.000000
max	50.000000

In [11]:
```
df_x.shape
```

Out[11]:
```
(506, 13)
```

In [12]:
```
df_x.columns
```

Out[12]:
```
Index(['CRIM', 'ZN', 'INDUS', 'CHAS', 'NOX', 'RM', 'AGE', 'DIS', 'RAD', 'TAX
',
       'PTRATIO', 'B', 'LSTAT'],
      dtype='object')
```

```
# Initializing the linear regression Model
```

In [13]:
```
reg = linear_model.LinearRegression()
```

Splitting Data into 70% training and 30% testing

In [14]:
```
x_train, x_test, y_train, y_test = train_test_split(df_x, df_y, test_size=0.3,
```

Train the model

In [15]:
```
reg.fit(x_train, y_train)
```

Out[15]:
```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=Fals
e)
```

In [16]:
```
#print the coefficient/ weights for each feature/column
#f(x) = mx + c =y where m is the coefficient

print(reg.coef_)
```

```
[[-1.33470103e-01  3.58089136e-02  4.95226452e-02  3.11983512e+00
  -1.54170609e+01  4.05719923e+00 -1.08208352e-02 -1.38599824e+00
   2.42727340e-01 -8.70223437e-03 -9.10685208e-01  1.17941159e-02
  -5.47113313e-01]]
```

Prediction

In [17]:
```
#print prediction for model
y_pred = reg.predict(x_test)
print(y_pred)
```

```
[[28.64896005]
 [36.49501384]
 [15.4111932 ]
 [25.40321303]
 [18.85527988]
 [23.14668944]
 [17.3921241 ]
 [14.07859899]
 [23.03692679]
 [20.59943345]
 [24.82286159]
 [18.53057049]
 [-6.86543527]
 [21.80172334]
 [19.22571177]
 [26.19191985]
 [20.27733882]
 [ 5.61596432]
 [40.44887974]
```

In [18]:
```
print(y_test)
```

```
        0
173  23.6
274  32.4
491  13.6
72   22.8
452  16.1
..    ...
441  17.1
23   14.5
225  50.0
433  14.3
447  12.6
```

In [21]:
```
#check the model accuracy using mean squared error
print(np.mean((y_pred-y_test)**2))
```

```
0    21.517444
dtype: float64
```

In [20]:
```
from sklearn.metrics import mean_squared_error
print(mean_squared_error(y_test,y_pred))
```

```
21.517444231176995
```

Assignment No 5 : Data Analytics 2

Importing Required Libraries

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
```

Read csv into dataframe

In [2]:
```
df = pd.read_csv('Social_Network_Ads.csv')
```

In [3]:
```
df
```

Out[3]:

	User ID	Gender	Age	EstimatedSalary	Purchased
0	15624510	Male	19	19000	0
1	15810944	Male	35	20000	0
2	15668575	Female	26	43000	0
3	15603246	Female	27	57000	0
4	15804002	Male	19	76000	0
...	...	...	...	...	...
395	15691863	Female	46	41000	1
396	15706071	Male	51	23000	1
397	15654296	Female	50	20000	1
398	15755018	Male	36	33000	0
399	15594041	Female	49	36000	1

400 rows × 5 columns

Data preprocessing

In [5]:
```
df.shape
```

Out[5]:
```
(400, 5)
```

In [6]:
```
df.columns
```

Out[6]:
```
Index(['User ID', 'Gender', 'Age', 'EstimatedSalary', 'Purchased'], dtype='ob
ject')
```

In [7]:
```
df.dtypes
```

Out[7]:
```
User ID             int64
Gender             object
Age                 int64
EstimatedSalary     int64
Purchased           int64
dtype: object
```

In [8]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 400 entries, 0 to 399
Data columns (total 5 columns):
 #   Column           Non-Null Count  Dtype
---  ------           --------------  -----
 0   User ID          400 non-null    int64
 1   Gender           400 non-null    object
 2   Age              400 non-null    int64
 3   EstimatedSalary  400 non-null    int64
 4   Purchased        400 non-null    int64
dtypes: int64(4), object(1)
memory usage: 15.8+ KB
```

In [9]:
```
df.describe()
```

Out[9]:

	User ID	Age	EstimatedSalary	Purchased
count	4.000000e+02	400.000000	400.000000	400.000000
mean	1.569154e+07	37.655000	69742.500000	0.357500
std	7.165832e+04	10.482877	34096.960282	0.479864
min	1.556669e+07	18.000000	15000.000000	0.000000
25%	1.562676e+07	29.750000	43000.000000	0.000000
50%	1.569434e+07	37.000000	70000.000000	0.000000
75%	1.575036e+07	46.000000	88000.000000	1.000000
max	1.581524e+07	60.000000	150000.000000	1.000000

In [10]:
```
x = df.iloc[:, [2, 3]].values
```

In [11]:
```
x
```

Out[11]:

```
array([[    19,  19000],
       [    35,  20000],
       [    26,  43000],
       [    27,  57000],
       [    19,  76000],
       [    27,  58000],
       [    27,  84000],
       [    32, 150000],
       [    25,  33000],
       [    35,  65000],
       [    26,  80000],
       [    26,  52000],
       [    20,  86000],
       [    32,  18000],
```

In [12]:
```
y = df.iloc[:, 4].values
```

In [13]:
```
y
```

Out[13]:
```
array([0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 1, 0, 1, 1, 0, 0, 0, 1, 0, 0, 0, 1,
       0, 1, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 1, 1, 0, 1, 0, 0, 0, 1, 1, 0,
       1, 1, 0, 1, 0, 1, 0, 1, 0, 0, 1, 1, 0, 1, 0, 0, 1, 1, 0, 1, 1, 0,
       1, 1, 0, 0, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 0, 1,
       0, 1, 0, 1, 1, 1, 1, 0, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 0, 0, 0, 1,
       1, 0, 0, 1, 0, 1, 0, 1, 1, 0, 1, 0, 1, 1, 0, 1, 1, 0, 0, 0, 1, 1,
       0, 1, 0, 0, 1, 0, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 1, 1, 0, 0, 1, 0,
       1, 0, 1, 1, 1, 0, 1, 0, 1, 1, 1, 0, 1, 1, 1, 1, 0, 1, 1, 1, 0, 1,
       0, 1, 0, 0, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1, 1, 1, 1, 1, 1, 0, 1,
       1, 1, 0, 1], dtype=int64)
```

Spliting Data into 75% training and 25% testing data

In [14]:
```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size = 0.25, ra
```

In [15]:
```
x_train
```

Out[15]:

```
array([[    44,  39000],
       [    32, 120000],
       [    38,  50000],
       [    32, 135000],
       [    52,  21000],
       [    53, 104000],
       [    39,  42000],
       [    38,  61000],
       [    36,  50000],
       [    36,  63000],
       [    35,  25000],
       [    35,  50000],
```

In [16]:
```
x_train.shape
```

Out[16]:
```
(300, 2)
```

In [17]:
```
y_train
```

Out[17]:
```
array([0, 1, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 1, 0, 1, 0, 0, 1, 0, 1,
       0, 1, 0, 0, 1, 1, 1, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0,
       0, 1, 1, 1, 1, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0, 0,
       0, 1, 1, 0, 0, 1, 0, 1, 1, 1, 0, 0, 1, 1, 0, 0, 1, 1, 0, 1, 0, 0,
       1, 1, 0, 1, 1, 1, 0, 0, 0, 0, 0, 1, 0, 0, 1, 1, 1, 1, 1, 0, 1, 1,
       0, 1, 0, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 0, 0, 1, 0,
       1, 1, 0, 1, 0, 0, 0, 0, 1, 0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 1, 0,
       0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 0,
       1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 1, 0, 1, 0, 0, 1,
       0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1, 0, 0, 0,
       0, 0, 0, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0, 1, 0, 1, 0, 1, 0, 0, 0,
       1, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1,
       1, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0,
       0, 1, 1, 1, 1, 0, 0, 0, 0, 1, 0, 0, 0, 0], dtype=int64)
```

In [18]:
```
y_train.shape
```

Out[18]:
```
(300,)
```

In [19]:
```
x_test
```

Out[19]:

```
array([[    30,  87000],
       [    38,  50000],
       [    35,  75000],
       [    30,  79000],
       [    35,  50000],
       [    27,  20000],
       [    31,  15000],
       [    36, 144000],
       [    18,  68000],
       [    47,  43000],
       [    30,  49000],
       [    28,  55000],
       [    37,  55000],
       [    39,  77000],
       [    20,  86000],
       [    32, 117000],
       [    37,  77000],
       [    19,  85000],
       [    55, 130000],
       [    35,  22000],
       [    35,  47000],
       [    47, 144000],
       [    41,  51000],
       [    47, 105000],
       [    23,  28000],
       [    49, 141000],
       [    28,  87000],
       [    29,  80000],
       [    37,  62000],
       [    32,  86000],
       [    21,  88000],
       [    37,  79000],
       [    57,  60000],
       [    37,  53000],
       [    24,  58000],
       [    18,  52000],
       [    22,  81000],
       [    34,  43000],
       [    31,  34000],
       [    49,  36000],
       [    27,  88000],
       [    41,  52000],
       [    27,  84000],
       [    35,  20000],
       [    43, 112000],
       [    27,  58000],
       [    37,  80000],
       [    52,  90000],
       [    26,  30000],
       [    49,  86000],
       [    57, 122000],
       [    34,  25000],
       [    35,  57000],
       [    34, 115000],
       [    59,  88000],
       [    45,  32000],
```

```
[    29,  83000],
[    26,  80000],
[    49,  28000],
[    23,  20000],
[    32,  18000],
[    60,  42000],
[    19,  76000],
[    36,  99000],
[    19,  26000],
[    60,  83000],
[    24,  89000],
[    27,  58000],
[    40,  47000],
[    42,  70000],
[    32, 150000],
[    35,  77000],
[    22,  63000],
[    45,  22000],
[    27,  89000],
[    18,  82000],
[    42,  79000],
[    40,  60000],
[    53,  34000],
[    47, 107000],
[    58, 144000],
[    59,  83000],
[    24,  55000],
```

In [20]:
```
x_test.shape
```

Out[20]:
```
(100, 2)
```

In [21]:
```
y_test
```

Out[21]:
```
array([0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1,
       0, 1, 0, 1, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0,
       1, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1,
       0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1, 0, 1,
       1, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 1], dtype=int64)
```

In [22]:
```
y_test.shape
```

Out[22]:
```
(100,)
```

Data Standardization

In [23]:
```
from sklearn.preprocessing import StandardScaler
sc_x = StandardScaler()
x_train = sc_x.fit_transform(x_train)
x_test = sc_x.fit_transform(x_test)
```

In [24]:
```
x_train
```

Out[24]:

```
array([[ 0.58164944, -0.88670699],
       [-0.60673761,  1.46173768],
       [-0.01254409, -0.5677824 ],
       [-0.60673761,  1.89663484],
       [ 1.37390747, -1.40858358],
       [ 1.47293972,  0.99784738],
       [ 0.08648817, -0.79972756],
       [-0.01254409, -0.24885782],
       [-0.21060859, -0.5677824 ],
       [-0.21060859, -0.19087153],
       [-0.30964085, -1.29261101],
       [-0.30964085, -0.5677824 ],
       [ 0.38358493,  0.09905991],
       [ 0.8787462 , -0.59677555],
       [ 2.06713324, -1.17663843],
       [ 1.07681071, -0.13288524],
       [ 0.68068169,  1.78066227],
       [-0.70576986,  0.56295021],
```

In [25]:
```
x_test
```

Out[25]:

```
array([[-0.54748976,  0.5130727 ],
       [ 0.15442019, -0.61825566],
       [-0.10879604,  0.14615539],
       [-0.54748976,  0.26846116],
       [-0.10879604, -0.61825566],
       [-0.81070599, -1.53554892],
       [-0.45975102, -1.68843113],
       [-0.0210573 ,  2.25592989],
       [-1.60035469, -0.0678797 ],
       [ 0.94406888, -0.83229075],
       [-0.54748976, -0.6488321 ],
       [-0.72296725, -0.46537345],
       [ 0.06668145, -0.46537345],
       [ 0.24215893,  0.20730828],
       [-1.4248772 ,  0.48249625],
       [-0.37201227,  1.43036596],
       [ 0.06668145,  0.20730828],
       [-1.51261594,  0.45191981],
       [ 1.64597884,  1.8278597 ],
       [-0.10879604, -1.47439603],
       [-0.10879604, -0.70998498],
       [ 0.94406888,  2.25592989],
       [ 0.41763642, -0.58767922],
       [ 0.94406888,  1.06344865],
       [-1.16166097, -1.29093738],
       [ 1.11954637,  2.16420057],
       [-0.72296725,  0.5130727 ],
       [-0.63522851,  0.2990376 ],
       [ 0.06668145, -0.25133835],
       [-0.37201227,  0.48249625],
       [-1.33713846,  0.54364914],
       [ 0.06668145,  0.26846116],
       [ 1.82145632, -0.31249124],
       [ 0.06668145, -0.52652633],
       [-1.07392223, -0.37364412],
       [-1.60035469, -0.55710277],
       [-1.24939971,  0.32961404],
       [-0.19653479, -0.83229075],
       [-0.45975102, -1.10747873],
       [ 1.11954637, -1.04632585],
       [-0.81070599,  0.54364914],
       [ 0.41763642, -0.55710277],
       [-0.81070599,  0.42134337],
       [-0.10879604, -1.53554892],
       [ 0.59311391,  1.27748375],
       [-0.81070599, -0.37364412],
       [ 0.06668145,  0.2990376 ],
       [ 1.3827626 ,  0.60480202],
       [-0.89844474, -1.2297845 ],
       [ 1.11954637,  0.48249625],
       [ 1.82145632,  1.58324817],
       [-0.19653479, -1.38266671],
       [-0.10879604, -0.40422056],
       [-0.19653479,  1.36921307],
       [ 1.99693381,  0.54364914],
       [ 0.7685914 , -1.16863161],
```

```
[-0.63522851,  0.39076693],
[-0.89844474,  0.2990376 ],
[ 1.11954637, -1.29093738],
[-1.16166097, -1.53554892],
[-0.37201227, -1.5967018 ],
[ 2.08467255, -0.86286719],
[-1.51261594,  0.17673183],
[-0.0210573 ,  0.87999   ],
```

Initializing logistic Regression model and training the model

In [26]:
```
from sklearn.linear_model import LogisticRegression
classifier = LogisticRegression(random_state = 0)
classifier.fit(x_train, y_train)
```

Out[26]:
```
LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                   intercept_scaling=1, l1_ratio=None, max_iter=100,
                   multi_class='auto', n_jobs=None, penalty='l2',
                   random_state=0, solver='lbfgs', tol=0.0001, verbose=0,
                   warm_start=False)
```

Prediction

In [29]:
```
y_pred = classifier.predict(x_test)
```

In [30]:
```
y_pred
```

Out[30]:
```
array([0, 0, 0, 0, 0, 0, 0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1,
       0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0,
       1, 0, 0, 1, 0, 1, 1, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 1,
       0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 1, 0, 1, 1, 1, 1, 0, 0, 1, 1, 0, 1,
       0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1], dtype=int64)
```

In [31]:
```
y_test
```

Out[31]:
```
array([0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 1, 0, 0, 1,
       0, 1, 0, 1, 0, 0, 0, 0, 0, 0, 1, 1, 0, 0, 0, 0, 0, 0, 1, 0, 0, 0, 0,
       1, 0, 0, 1, 0, 1, 1, 0, 0, 0, 1, 1, 0, 0, 1, 0, 0, 1, 0, 1, 0, 1,
       0, 0, 0, 0, 1, 0, 0, 1, 0, 0, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1, 0, 1,
       1, 0, 0, 1, 0, 0, 0, 1, 0, 1, 1, 1], dtype=int64)
```

Confusion Matrix

In [32]:
```
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
cm
```

Out[32]:
```
array([[63,  5],
       [ 8, 24]], dtype=int64)
```

In [ ]:
```
#The confusion matrix tells us that there were 87 correct predictions and 13 i
```

Calculating accuracy of model

In [34]:
```
from sklearn.metrics import accuracy_score
accuracy = accuracy_score(y_test, y_pred) * 100
accuracy
```

Out[34]: 87.0

True Positive : Actually True, Predicted True

In [48]:
```
tp = cm[0,[0]]
print('True Positive : ',tp)
```

```
True Positive :  [63]
```

False Positive : Actually False, Predicted True

In [49]:
```
fp = cm[0, [1]]
print('False Positive : ',fp)
```

```
False Positive :  [5]
```

False Negative : Actually True, Predicted False

In [50]:
```
fn = cm[1, [0]]
print('False Negative : ',fn)
```

```
False Negative :  [8]
```

True Negative : Actually False, Predicted False

In [51]:
```
tn = cm[1, [1]]
print('True Negative : ',tn)
```

```
True Negative :  [24]
```

Accuracy

In [47]:
```
accuracy_cm = ((tp + tn)/(tp + fp + fn + tn))
print('Accuracy : ',accuracy_cm*100)
```

```
Accuracy :  [87.]
```

Error Rate

In [54]:
```
error_rate_cm = ((fp + fn)/(tp + fp + fn + tn))
print('Error Rate : ', error_rate_cm*100)
```

```
Error Rate :  [13.]
```

Precision

In [56]:
```
precision_cm = (tp / (tp + fp))
print('Precision : ',precision_cm*100)
```

```
Precision :  [92.64705882]
```

Recall

In [59]:
```
#recall is also called sensitivity
recall_cm = (tp / (tp + fn))
print('Sensitivity : ', recall_cm*100)
```

```
Sensitivity :  [88.73239437]
```

Specificity

In [62]:
```
specificity_cm = (tn / (tn + fp))
print('Specificity : ', specificity_cm*100)
```

```
Specificity :  [82.75862069]
```

Assignment No 6 : Data Analytics 3

Importing Required Libraries

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
```

Reading csv into dataframe

In [2]:
```
df = pd.read_csv('iris.csv')
```

In [3]:
```
df
```

Out[3]:

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
0	1	5.1	3.5	1.4	0.2	Iris-setosa
1	2	4.9	3.0	1.4	0.2	Iris-setosa
2	3	4.7	3.2	1.3	0.2	Iris-setosa
3	4	4.6	3.1	1.5	0.2	Iris-setosa
4	5	5.0	3.6	1.4	0.2	Iris-setosa
...	...	...	...	...	...	...
145	146	6.7	3.0	5.2	2.3	Iris-virginica
146	147	6.3	2.5	5.0	1.9	Iris-virginica
147	148	6.5	3.0	5.2	2.0	Iris-virginica
148	149	6.2	3.4	5.4	2.3	Iris-virginica
149	150	5.9	3.0	5.1	1.8	Iris-virginica

150 rows × 6 columns

Data preprocessing

In [4]:
```
df.shape
```

Out[4]:
```
(150, 6)
```

In [5]:
```
df.columns
```

Out[5]:
```
Index(['Id', 'SepalLengthCm', 'SepalWidthCm', 'PetalLengthCm', 'PetalWidthCm
',
       'Species'],
      dtype='object')
```

In [6]:
```
df.dtypes
```

Out[6]:
```
Id                int64
SepalLengthCm    float64
SepalWidthCm     float64
PetalLengthCm    float64
PetalWidthCm     float64
Species           object
dtype: object
```

In [7]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 6 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Id             150 non-null    int64
 1   SepalLengthCm  150 non-null    float64
 2   SepalWidthCm   150 non-null    float64
 3   PetalLengthCm  150 non-null    float64
 4   PetalWidthCm   150 non-null    float64
 5   Species        150 non-null    object
dtypes: float64(4), int64(1), object(1)
memory usage: 7.2+ KB
```

In [8]:
```
df.describe()
```

Out[8]:

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm
count	150.000000	150.000000	150.000000	150.000000	150.000000
mean	75.500000	5.843333	3.054000	3.758667	1.198667
std	43.445368	0.828066	0.433594	1.764420	0.763161
min	1.000000	4.300000	2.000000	1.000000	0.100000
25%	38.250000	5.100000	2.800000	1.600000	0.300000
50%	75.500000	5.800000	3.000000	4.350000	1.300000
75%	112.750000	6.400000	3.300000	5.100000	1.800000
max	150.000000	7.900000	4.400000	6.900000	2.500000

In [9]:
```
df.isnull()
```

Out[9]:

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
0	False	False	False	False	False	False

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
1	False	False	False	False	False	False
2	False	False	False	False	False	False
3	False	False	False	False	False	False
4	False	False	False	False	False	False
...	...	...	...	...	...	...
145	False	False	False	False	False	False
146	False	False	False	False	False	False
147	False	False	False	False	False	False
148	False	False	False	False	False	False
149	False	False	False	False	False	False

In [10]:
```
df.isnull().sum()
```

Out[10]:
```
Id               0
SepalLengthCm    0
SepalWidthCm     0
PetalLengthCm    0
PetalWidthCm     0
Species          0
dtype: int64
```

In [11]:
```
df.drop(columns="Id", inplace=True)
df.head()
```

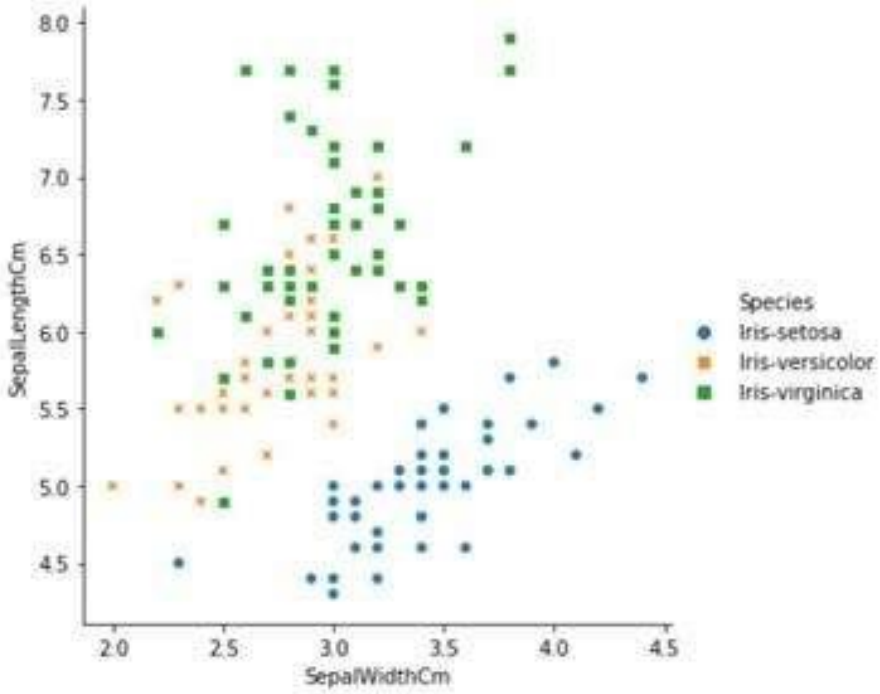
Out[11]:

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
0	5.1	3.5	1.4	0.2	Iris-setosa
1	4.9	3.0	1.4	0.2	Iris-setosa
2	4.7	3.2	1.3	0.2	Iris-setosa
3	4.6	3.1	1.5	0.2	Iris-setosa
4	5.0	3.6	1.4	0.2	Iris-setosa

Data Visualization

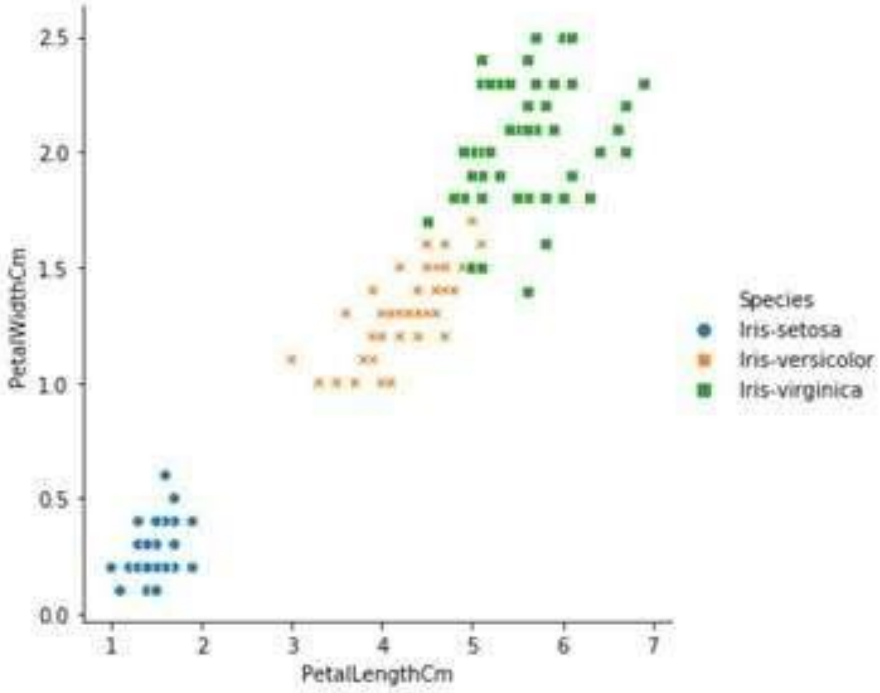
```
In [12]: sns.relplot(data = df, x = 'SepalWidthCm', y = 'SepalLengthCm', hue = 'Species
```

```
Out[12]: <seaborn.axisgrid.FacetGrid at 0x26edcc3cc8>
```



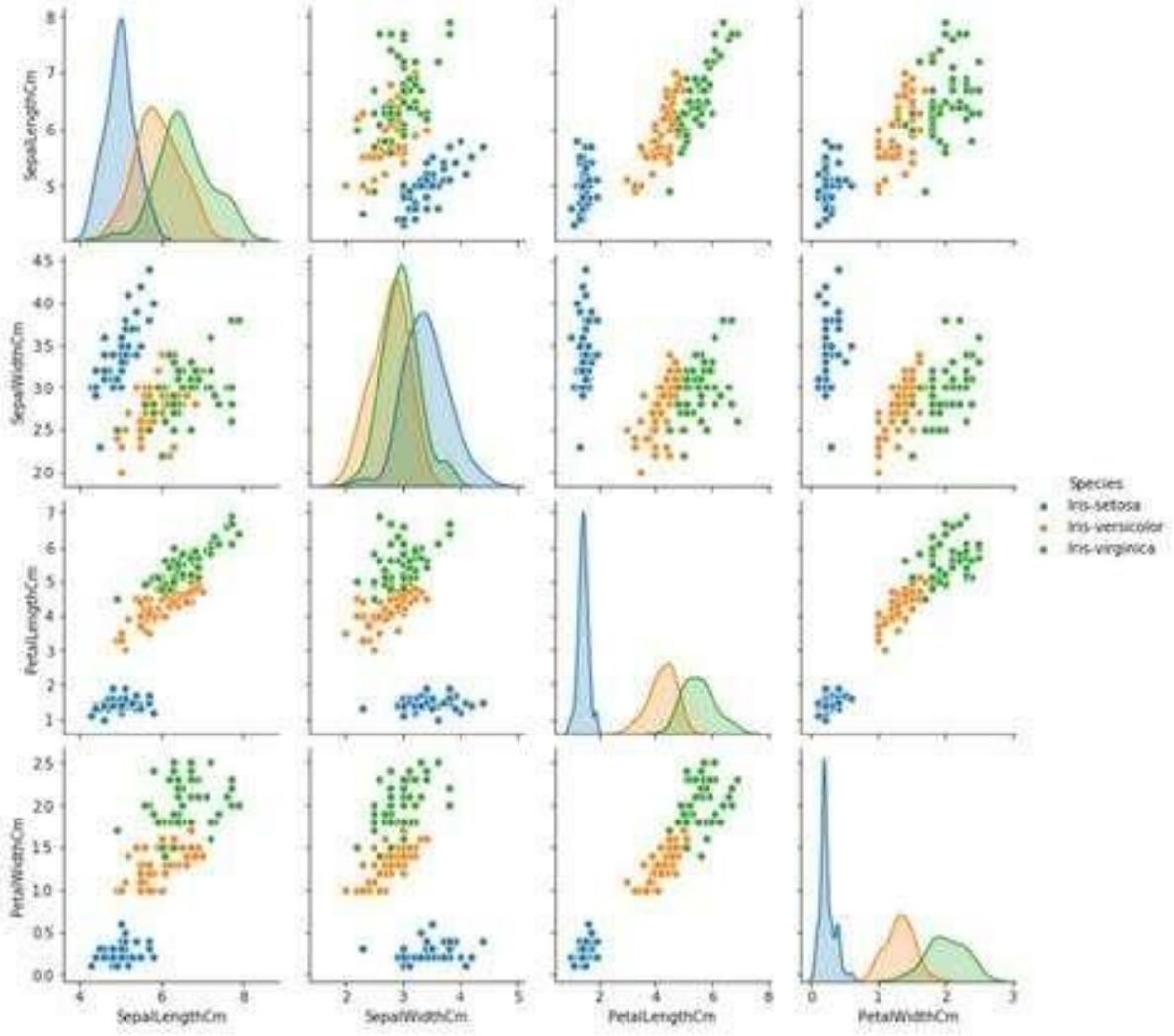

```
In [13]: sns.relplot(data = df, x = 'PetalLengthCm', y = 'PetalWidthCm', hue = 'Species
```

```
Out[13]: <seaborn.axisgrid.FacetGrid at 0x26f0e53ac8>
```



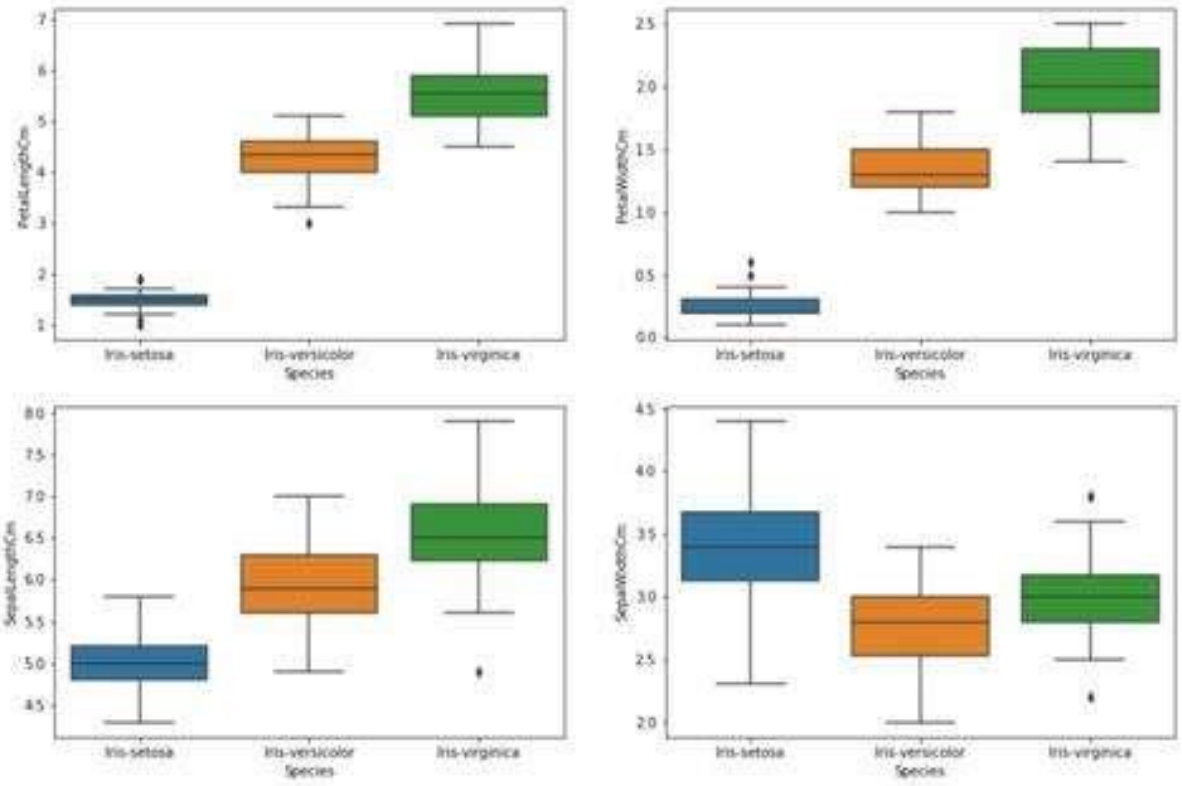
In [14]:
```
sns.pairplot(df, hue = 'Species')
```

Out[14]:
```
<seaborn.axisgrid.PairGrid at 0x26f0ec9248>
```



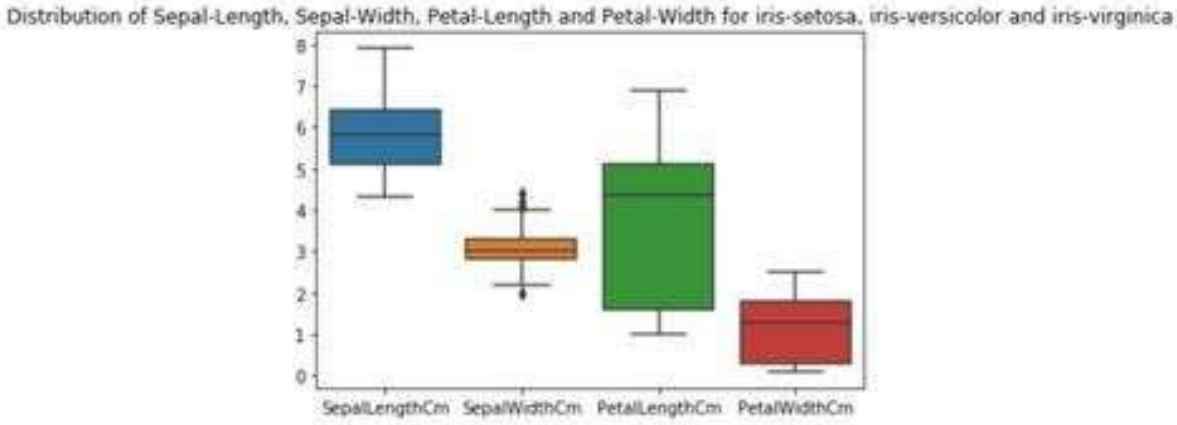
In [15]:
```
plt.figure(figsize = (15, 10))
plt.subplot(2, 2, 1)
sns.boxplot(data = df, x = 'Species', y = 'PetalLengthCm')

plt.subplot(2, 2, 2)
sns.boxplot(data = df, x = 'Species', y = 'PetalWidthCm')

plt.subplot(2, 2, 3)
sns.boxplot(data = df, x = 'Species', y = 'SepalLengthCm')

plt.subplot(2, 2, 4)
sns.boxplot(data = df, x = 'Species', y = 'SepalWidthCm')
```

Out[15]: <matplotlib.axes._subplots.AxesSubplot at 0x26ef631688>



In [16]:
```
sns.boxplot(data = df).set_title("Distribution of Sepal-Length, Sepal-Width, P
```

Out[16]:
```
Text(0.5, 1.0, 'Distribution of Sepal-Length, Sepal-Width, Petal-Length and P
etal-Width for iris-setosa, iris-versicolor and iris-virginica')
```



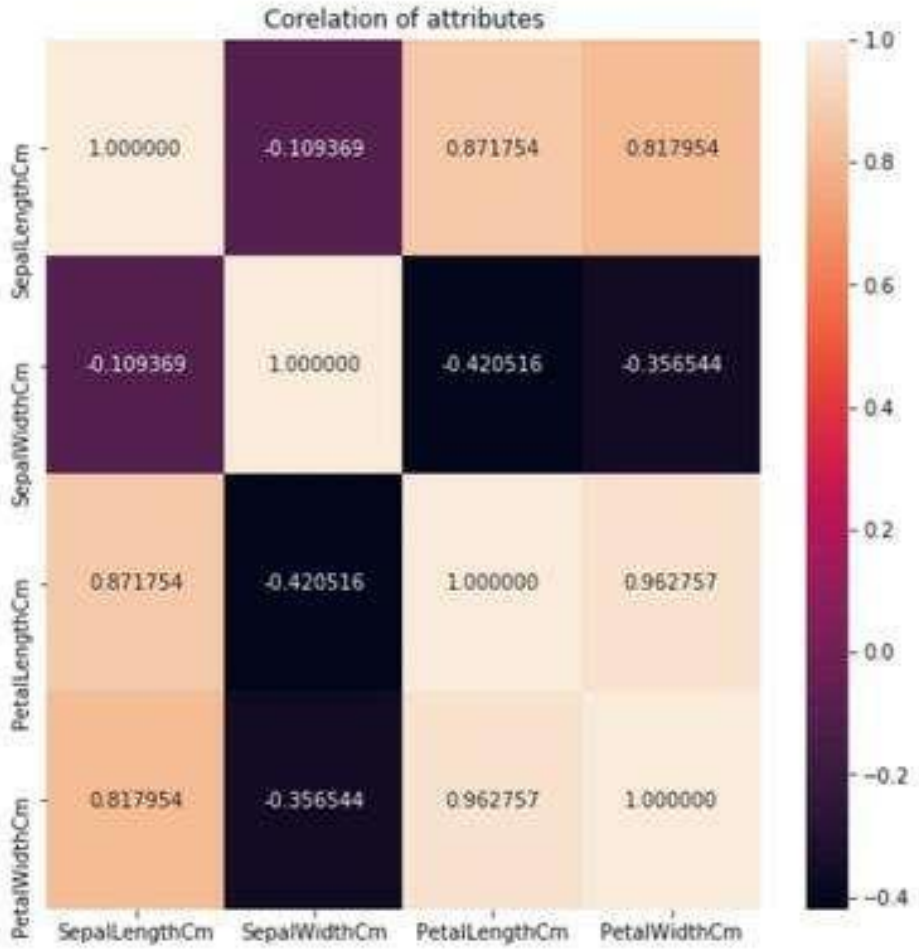
In [17]:
```
df.corr()
```

Out[17]:

	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm
SepalLengthCm	1.000000	-0.109369	0.871754	0.817954
SepalWidthCm	-0.109369	1.000000	-0.420516	-0.356544
PetalLengthCm	0.871754	-0.420516	1.000000	0.962757
PetalWidthCm	0.817954	-0.356544	0.962757	1.000000

In [18]:
```
plt.subplots(figsize = (8,8))
sns.heatmap(df.corr(), annot = True, fmt = "f").set_title("Corelation of attri
```

Out[18]: Text(0.5, 1, 'Corelation of attributes')



In [19]:
```
x = df.iloc[:, 0:4].values
x
```

Out[19]:

```
array([[5.1, 3.5, 1.4, 0.2]
```

In [20]:
```python
y = df.iloc[:, 4].values
y
```

Out[20]:
```
array(['Iris-setosa', 'Iris-setosa', 'Iris-setosa', 'Iris-setosa',
       'Iris-setosa', 'Iris-setosa', 'Iris-setosa', 'Iris-setosa',
       'Iris-setosa', 'Iris-setosa', 'Iris-setosa', 'Iris-setosa',
       'Iris-setosa', 'Iris-setosa', 'Iris-setosa', 'Iris-setosa',
       'Iris-setosa', 'Iris-setosa', 'Iris-setosa', 'Iris-setosa',
       'Iris-setosa', 'Iris-setosa', 'Iris-setosa', 'Iris-setosa',
       'Iris-setosa', 'Iris-setosa', 'Iris-setosa', 'Iris-setosa',
       'Iris-setosa', 'Iris-setosa', 'Iris-setosa', 'Iris-setosa',
       'Iris-setosa', 'Iris-setosa', 'Iris-setosa', 'Iris-setosa',
       'Iris-setosa', 'Iris-setosa', 'Iris-setosa', 'Iris-setosa',
       'Iris-setosa', 'Iris-setosa', 'Iris-setosa', 'Iris-setosa',
       'Iris-setosa', 'Iris-setosa', 'Iris-setosa', 'Iris-setosa',
       'Iris-setosa', 'Iris-setosa', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-versicolor', 'Iris-versicolor', 'Iris-versicolor',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica', 'Iris-virginica',
       'Iris-virginica', 'Iris-virginica'], dtype=object)
```

Label Encoding

In [21]:
```python
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
```

```
y = le.fit_transform(y)
y
```

Out[21]:
```
array([0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0,
       0, 0, 0, 0, 0, 0, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1,
       1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2,
       2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2, 2])
```

Splitting data into 70% training and 30% testing

In [22]:
```
from sklearn.model_selection import train_test_split
x_train, x_test, y_train, y_test = train_test_split(x, y, test_size = 0.3, ran
```

In [23]:
```
x_train
```

Out[23]:

```
array([[5. , 2. , 3.5, 1. ],
       [6.5, 3. , 5.5, 1.8],
       [6.7, 3.3, 5.7, 2.5],
       [6. , 2.2, 5. , 1.5],
       [6.7, 2.5, 5.8, 1.8],
       [5.6, 2.5, 3.9, 1.1],
       [7.7, 3. , 6.1, 2.3],
       [6.3, 3.3, 4.7, 1.6],
       [5.5, 2.4, 3.8, 1.1],
       [6.3, 2.7, 4.9, 1.8],
       [6.3, 2.8, 5.1, 1.5],
       [4.9, 2.5, 4.5, 1.7],
       [6.3, 2.5, 5. , 1.9],
       [7. , 3.2, 4.7, 1.4],
       [6.5, 3. , 5.2, 2. ],
       [6. , 3.4, 4.5, 1.6],
       [4.8, 3.1, 1.6, 0.2],
       [5.8, 2.7, 5.1, 1.9],
       [5.6, 2.7, 4.2, 1.3],
       [5.6, 2.9, 3.6, 1.3],
       [5.5, 2.5, 4. , 1.3],
       [6.1, 3. , 4.6, 1.4],
       [7.2, 3.2, 6. , 1.8],
       [5.3, 3.7, 1.5, 0.2],
       [4.3, 3. , 1.1, 0.1],
       [6.4, 2.7, 5.3, 1.9],
       [5.7, 3. , 4.2, 1.2],
       [5.4, 3.4, 1.7, 0.2],
       [5.7, 4.4, 1.5, 0.4],
       [6.9, 3.1, 4.9, 1.5],
       [4.6, 3.1, 1.5, 0.2],
       [5.9, 3. , 5.1, 1.8],
       [5.1, 2.5, 3. , 1.1],
       [4.6, 3.4, 1.4, 0.3],
       [6.2, 2.2, 4.5, 1.5],
       [7.2, 3.6, 6.1, 2.5],
       [5.7, 2.9, 4.2, 1.3],
       [4.8, 3. , 1.4, 0.1],
       [7.1, 3. , 5.9, 2.1],
       [6.9, 3.2, 5.7, 2.3],
       [6.5, 3. , 5.8, 2.2],
       [6.4, 2.8, 5.6, 2.1],
       [5.1, 3.8, 1.6, 0.2],
       [4.8, 3.4, 1.6, 0.2],
       [6.5, 3.2, 5.1, 2. ],
       [6.7, 3.3, 5.7, 2.1],
       [4.5, 2.3, 1.3, 0.3],
       [6.2, 3.4, 5.4, 2.3],
       [4.9, 3. , 1.4, 0.2],
       [5.7, 2.5, 5. , 2. ],
       [6.9, 3.1, 5.4, 2.1],
       [4.4, 3.2, 1.3, 0.2],
       [5. , 3.6, 1.4, 0.2],
       [7.2, 3. , 5.8, 1.6],
       [5.1, 3.5, 1.4, 0.3],
       [4.4, 3. , 1.3, 0.2],
```

```
[5.4, 3.9, 1.7, 0.4],
[5.5, 2.3, 4. , 1.3],
[6.8, 3.2, 5.9, 2.3],
[7.6, 3. , 6.6, 2.1],
[5.1, 3.5, 1.4, 0.2],
[4.9, 3.1, 1.5, 0.1],
[5.2, 3.4, 1.4, 0.2],
[5.7, 2.8, 4.5, 1.3],
[6.6, 3. , 4.4, 1.4],
[5. , 3.2, 1.2, 0.2],
[5.1, 3.3, 1.7, 0.5],
```

In [24]:
```
x_train.shape
```

Out[24]:
```
(105, 4)
```

In [25]:
```
x_test
```

Out[25]:

```
array([[5.8, 2.8, 5.1, 2.4],
       [6. , 2.2, 4. , 1. ],
       [5.5, 4.2, 1.4, 0.2],
       [7.3, 2.9, 6.3, 1.8],
       [5. , 3.4, 1.5, 0.2],
       [6.3, 3.3, 6. , 2.5],
       [5. , 3.5, 1.3, 0.3],
```

In [26]:
```
x_test.shape
```

Out[26]:
```
(45, 4)
```

In [27]:
```
y_train
```

Out[27]:
```
array([1, 2, 2, 2, 2, 1, 2, 1, 1, 2, 2, 2, 2, 1, 2, 1, 0, 2, 1, 1, 1, 1,
       2, 0, 0, 2, 1, 0, 0, 1, 0, 2, 1, 0, 1, 2, 1, 0, 2, 2, 2, 2, 0, 0,
       2, 2, 0, 2, 0, 2, 2, 0, 0, 2, 0, 0, 0, 1, 2, 2, 0, 0, 0, 1, 1, 0,
       0, 1, 0, 2, 1, 2, 1, 0, 2, 0, 2, 0, 0, 2, 0, 2, 1, 1, 1, 2, 2, 1,
       1, 0, 1, 2, 2, 0, 1, 1, 1, 1, 0, 0, 0, 2, 1, 2, 0])
```

In [28]:
```
y_train.shape
```

Out[28]:
```
(105,)
```

In [29]:
```
y_test
```

Out[29]:
```
array([2, 1, 0, 2, 0, 2, 0, 1, 1, 1, 2, 1, 1, 1, 1, 0, 1, 1, 0, 0, 2, 1,
       0, 0, 2, 0, 0, 1, 1, 0, 2, 1, 0, 2, 2, 1, 0, 1, 1, 1, 2, 0, 2, 0,
       0])
```

In [30]:
```
y_test.shape
```

Out[30]:
```
(45,)
```

Initializing Naive Bayes Model and training it

In [31]:
```
from sklearn.naive_bayes import GaussianNB
model = GaussianNB()
model.fit(x_train, y_train)
```

Out[31]:
```
GaussianNB(priors=None, var_smoothing=1e-09)
```

Prediction

In [32]:
```
prediction = model.predict(x_test)
```

In [33]:
```
prediction
```

Out[33]:
```
array([2, 1, 0, 2, 0, 2, 0, 1, 1, 1, 2, 1, 1, 1, 1, 0, 1, 1, 0, 0, 2, 1,
       0, 0, 2, 0, 0, 1, 1, 0, 2, 1, 0, 2, 2, 1, 0, 1, 1, 1, 2, 0, 2, 0,
       0])
```

In [34]:
```
y_test
```

Out[34]:
```
array([2, 1, 0, 2, 0, 2, 0, 1, 1, 1, 2, 1, 1, 1, 1, 0, 1, 1, 0, 0, 2, 1,
       0, 0, 2, 0, 0, 1, 1, 0, 2, 1, 0, 2, 2, 1, 0, 1, 1, 1, 2, 0, 2, 0,
       0])
```

Confusion Matrix

In [35]:
```
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, prediction)
cm
```

Out[35]:
```
array([[16,  0,  0],
       [ 0, 18,  0],
       [ 0,  0, 11]], dtype=int64)
```

Accuarcy

In [36]:
```
from sklearn.metrics import accuracy_score
accuracy = accuracy_score(y_test, prediction) * 100
accuracy
```

Out[36]:
```
100.0
```

Precision

In [43]:
```
from sklearn.metrics import precision_score
precision = precision_score(y_test, prediction, average = 'micro') *100
precision
```

Out[43]:
```
100.0
```

Recall

In [44]:
```
from sklearn.metrics import recall_score
recall = recall_score(y_test, prediction, average = 'micro') * 100
recall
```

Out[44]:
```
100.0
```

Assignment No 7

In [14]:
```
from textblob import TextBlob
import nltk
```

In [4]:
```
b = TextBlob("I havv good spelling")
```

In [5]:
```
b.correct()
```

Out[5]:
```
TextBlob("I have good spelling")
```

In [22]:
```
import nltk
nltk.download('punkt')
b1 = TextBlob("Beautiful is better than ugly."
              "Explicit is better than implicit."
              "Simple is better than complex.")
b1.words
```

```
[nltk_data] Downloading package punkt to
[nltk_data]     C:\Users\ADMIN\AppData\Roaming\nltk_data...
[nltk_data]   Package punkt is already up-to-date!
```

Out[22]:
```
WordList(['Beautiful', 'is', 'better', 'than', 'ugly.Explicit', 'is', 'better
', 'than', 'implicit.Simple', 'is', 'better', 'than', 'complex'])
```

In [23]:
```
b1.sentences
```

Out[23]:
```
[Sentence("Beautiful is better than ugly.Explicit is better than implicit.Sim
ple is better than complex.")]
```

In [24]:
```
sentence = TextBlob("Use 4 spaces per indentation level")
sentence.words
```

Out[24]:
```
WordList(['Use', '4', 'spaces', 'per', 'indentation', 'level'])
```

In [27]:
```
sentence.words[2].singularize()
```

Out[27]:
```
'space'
```

In [28]:
```
sentence.words[5].pluralize()
```

Out[28]:
```
'levels'
```

In [30]:
```
animals = TextBlob("cat dog octopus")
animals.words
```

Out[30]:
```
WordList(['cat', 'dog', 'octopus'])
```

In [31]:
```
animals.words.pluralize()
```

Out[31]:
```
WordList(['cats', 'dogs', 'octopodes'])
```

In [32]:
```
sen = TextBlob("We are no longer the knights who say Ni." "We are now the knig
sen.word_counts['ekki']
```

Out[32]:
```
3
```

In [33]:
```
sen.words.count('ekki')
```

Out[33]:
```
3
```

In [34]:
```
sen.words.count('ekki', case_sensitive=True)
```

Out[34]:
```
2
```

In [35]:
```
b = TextBlob("And now for something completely different.")
print(b.parse())
```

```
And/CC/O/O now/RB/B-ADVP/O for/IN/B-PP/B-PNP something/NN/B-NP/I-PNP complete
ly/RB/B-ADJP/O different/JJ/I-ADJP/O ././O/O
```

In [36]:
```
b1[0:19]
TextBlob("Beautiful is better")
```

Out[36]:
```
TextBlob("Beautiful is better")
```

In [37]:
```
b1.upper()
```

Out[37]:
```
TextBlob("BEAUTIFUL IS BETTER THAN UGLY.EXPLICIT IS BETTER THAN IMPLICIT.SIMP
LE IS BETTER THAN COMPLEX.")
```

In [39]:
```
b1.find("Simple")
```

Out[39]:
```
63
```

In [40]:
```
apple_blob = TextBlob('apples')
banana_blob = TextBlob('bananas')
apple_blob < banana_blob
```

Out[40]:
```
True
```

In [41]:
```
blob = TextBlob("Now is better then never.")
blob.ngrams(n=3)
```

Out[41]:
```
[WordList(['Now', 'is', 'better']),
 WordList(['is', 'better', 'then']),
 WordList(['better', 'then', 'never'])]
```

In [42]:
```
import nltk
from nltk import tokenize
from nltk.tokenize import sent_tokenize
text = """ Good Day everyone, how are you all today? Its fun learning data ana
text
```

Out[42]:
```
' Good Day everyone, how are you all today? Its fun learning data analysis. H
ope you all are practicing well.'
```

In [43]:
```
tokenized_text = sent_tokenize(text)
```

In [45]:
```
print(tokenized_text)
```

```
[' Good Day everyone, how are you all today?', 'Its fun learning data analysi
s.', 'Hope you all are practicing well.']
```

In [47]:
```
from nltk.tokenize import word_tokenize
tokenizer_word = word_tokenize(text)
print(tokenizer_word)
```

```
['Good', 'Day', 'everyone', ',', 'how', 'are', 'you', 'all', 'today', '?', 'I
ts', 'fun', 'learning', 'data', 'analysis', '.', 'Hope', 'you', 'all', 'are',
'practicing', 'well', '.']
```

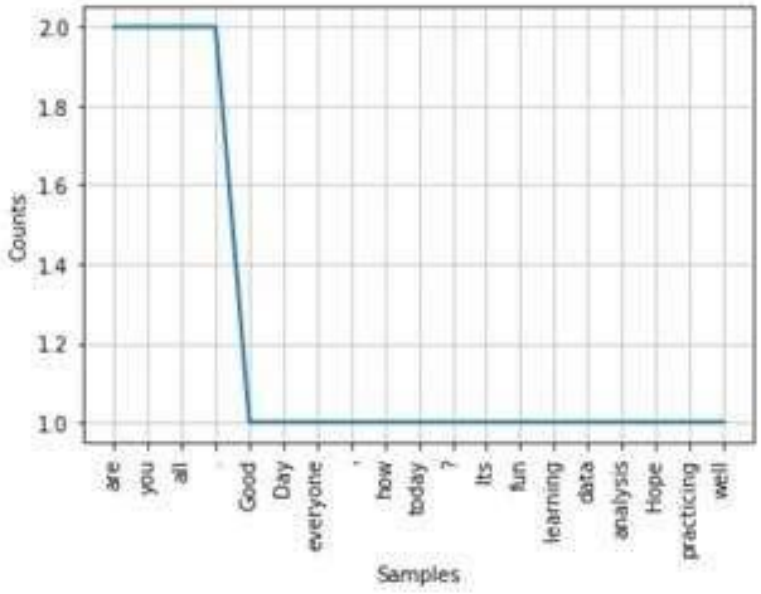
In [48]:
```
from nltk.probability import FreqDist
fdist = FreqDist(tokenizer_word)
print(fdist)
```

```
<FreqDist with 19 samples and 23 outcomes>
```

In [49]:
```
fdist.most_common(4)
```

Out[49]:
```
[('are', 2), ('you', 2), ('all', 2), ('.', 2)]
```

In [50]:
```
import matplotlib.pyplot as plt
fdist.plot(30,cumulative=False)
plt.show()
```



In [52]:
```
nltk.download('stopwords')
```

```
[nltk_data] Downloading package stopwords to
[nltk_data]     C:\Users\ADMIN\AppData\Roaming\nltk_data...
[nltk_data]   Unzipping corpora\stopwords.zip.
```

Out[52]:
```
True
```

In [57]:
```
from nltk.corpus import stopwords
stop_words = set(stopwords.words("english"))
print(stop_words)
```

```
{'wasn', 'how', 'herself', 'couldn', 'up', 'during', 'itself', 'than', 't', '
can', 'was', 'mustn', 'yours', 'did', 'didn', 'my', 'at', 'he', 'again', "wou
ldn't", 'myself', "isn't", 'it', "you'll", 'whom', 'any', "you're", "couldn'
t", 'shouldn', 'all', 'its', 'just', "hasn't", 'won', 'o', "mightn't", 'which
', 'hasn', 'that', 'theirs', 'over', 'i', 'such', 'am', 'until', 'on', 'throu
gh', 's', 'about', 'being', "mustn't", 'under', 'same', 'has', "should've", '
each', 'we', 'them', 'were', 'nor', 'here', "shan't", 'does', 'below', 'why',
'her', 'mightn', 'be', "it's", 'of', 'above', 'aren', 'doesn', 'by', 'wouldn
', 'then', 'him', "she's", 'while', 'with', 'for', 'their', 'to', 'out', 'if
', 'don', 'ourselves', 'in', 'themselves', 'ours', 'his', 'off', "wasn't", 't
he', 'very', 'so', 'are', 'what', 'from', 'there', 'will', 'yourselves', "tha
t'll", 'she', 'some', 'between', "aren't", 'shan', 'who', 'few', 'before', 'w
eren', 'this', 'because', 'both', 'd', 'hers', 'll', 'but', "won't", "don't",
'is', 'and', 'where', 'too', "shouldn't", 'ma', 'these', "hadn't", 'you', "yo
u've", 'down', "needn't", 'or', 'have', 'after', 'only', 'ain', 'own', 'once
', "you'd", 've', 'against', 'y', 'as', 'had', 'haven', 'more', "haven't", 'f
urther', 'no', 'those', "weren't", 'should', 'been', 'when', 'your', 'me', 'a
n', 'having', 'isn', 'm', 'doing', "doesn't", 'our', 'do', "didn't", 're', 'h
adn', 'they', 'into', 'not', 'himself', 'needn', 'most', 'other', 'now', 'a',
'yourself'}
```

In [60]:
```
filtered_sent=[]
for w in tokenizer_word:
    if w not in stop_words:
        filtered_sent.append(w)

print("Tokenized sentence : ",tokenizer_word)
print("Filtered sentence : ", filtered_sent)
```

```
Tokenized sentence :  ['Good', 'Day', 'everyone', ',', 'how', 'are', 'you', '
all', 'today', '?', 'Its', 'fun', 'learning', 'data', 'analysis', '.', 'Hope
', 'you', 'all', 'are', 'practicing', 'well', '.']
Filtered sentence :  ['Good', 'Day', 'everyone', ',', 'today', '?', 'Its', 'f
un', 'learning', 'data', 'analysis', '.', 'Hope', 'practicing', 'well', '.']
```

In [61]:
```
from nltk.stem import PorterStemmer
from nltk.tokenize import sent_tokenize, word_tokenize
ps = PorterStemmer()
stemmed_words = []
for w in filtered_sent:
    stemmed_words.append(ps.stem(w))
print("Filtered Sentence : ", filtered_sent)
print("Stemmed Sentence : ", stemmed_words)
```

```
Filtered Sentence :  ['Good', 'Day', 'everyone', ',', 'today', '?', 'Its', 'f
un', 'learning', 'data', 'analysis', '.', 'Hope', 'practicing', 'well', '.']
Stemmed Sentence :  ['good', 'day', 'everyon', ',', 'today', '?', 'it', 'fun
', 'learn', 'data', 'analysi', '.', 'hope', 'practic', 'well', '.']
```

In [62]:
```
nltk.download('wordnet')
```

```
[nltk_data] Downloading package wordnet to
[nltk_data]     C:\Users\ADMIN\AppData\Roaming\nltk_data...
[nltk_data]   Unzipping corpora\wordnet.zip.
```

Out[62]:
```
True
```

In [64]:
```
from nltk.stem.wordnet import WordNetLemmatizer
lem = WordNetLemmatizer()
from nltk.stem.porter import PorterStemmer
stem = PorterStemmer()
word = "flying"
print("Lemmatizer Word : ", lem.lemmatize(word, "v"))
print("Stemmed Word : ", stem.stem(word))
```

```
Lemmatizer Word :  fly
Stemmed Word :  fli
```

In [65]:
```
sent = "Albert Einstien was born in Ulm, Germany in 1879."
tokens = nltk.word_tokenize(sent)
print(tokens)
```

```
['Albert', 'Einstien', 'was', 'born', 'in', 'Ulm', ',', 'Germany', 'in', '187
9', '.']
```

In [66]:
```
nltk.download('averaged_perceptron_tagger')
```

```
[nltk_data] Downloading package averaged_perceptron_tagger to
[nltk_data]     C:\Users\ADMIN\AppData\Roaming\nltk_data...
[nltk_data]   Unzipping taggers\averaged_perceptron_tagger.zip.
```

Out[66]:
```
True
```

In [67]:
```
nltk.pos_tag(tokens)
```

Out[67]:
```
[('Albert', 'NNP'),
 ('Einstien', 'NNP'),
 ('was', 'VBD'),
 ('born', 'VBN'),
 ('in', 'IN'),
 ('Ulm', 'NNP'),
 (',', ','),
 ('Germany', 'NNP'),
 ('in', 'IN'),
 ('1879', 'CD'),
 ('.', '.')]
```

In [68]:
```
from collections import Counter
sentence = "Texas A&M University is located in Texas"
term_frequency = Counter(sentence.split())
```

In [69]:
```
term_frequency
```

Out[69]:
```
Counter({'Texas': 2,
         'A&M': 1,
         'University': 1,
         'is': 1,
         'located': 1,
         'in': 1})
```

Assignment No 8 : Data Visualization 1

Import Required Libraries

In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
```

Reading csv into data frame

In [2]:
```
df = pd.read_csv('train.csv')
df
```

Out[2]:

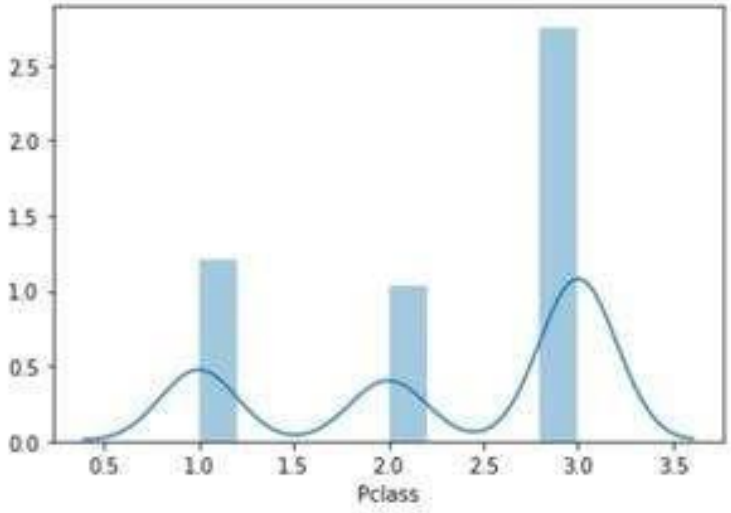
	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500
...	...	...	...	...	...	...	...	...	...	...
886	887	0	2	Montvila, Rev. Juozas	male	27.0	0	0	211536	13.0000
887	888	1	1	Graham, Miss. Margaret Edith	female	19.0	0	0	112053	30.0000

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
888	889	0	3	Johnston, Miss. Catherine Helen "Carrie"	female	NaN	1	2	W./C. 6607	23.4500
889	890	1	1	Behr, Mr. Karl Howell	male	26.0	0	0	111369	30.0000
890	891	0	3	Dooley, Mr. Patrick	male	32.0	0	0	370376	7.7500

Data Visualization

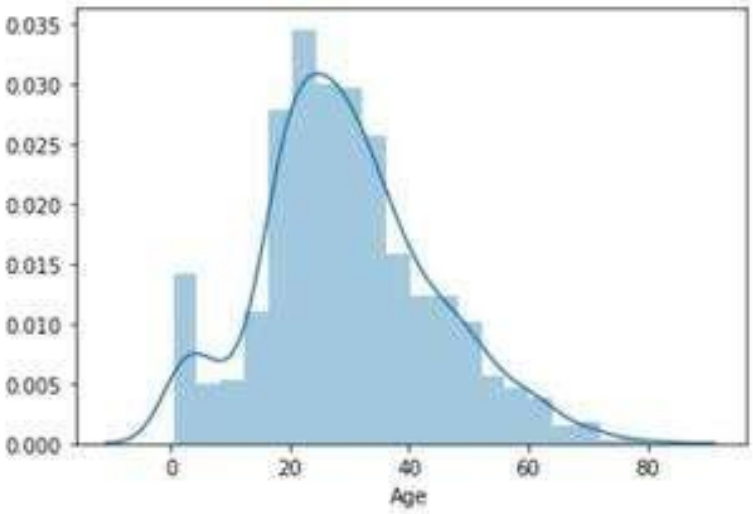
In [3]:
```
import seaborn as sns
sns.distplot(df['Pclass'])
```

Out[3]: <matplotlib.axes._subplots.AxesSubplot at 0x4f90eff688>



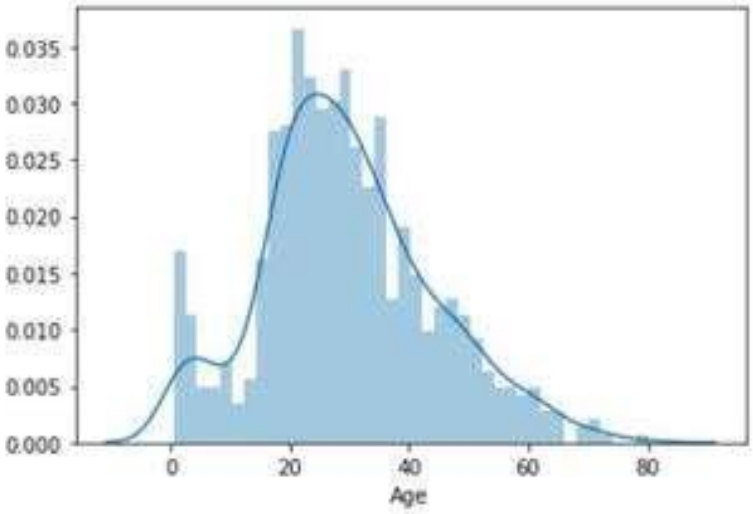
In [4]:
```
sns.distplot(df['Age'])
```

Out[4]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x4f914a8b08>
```



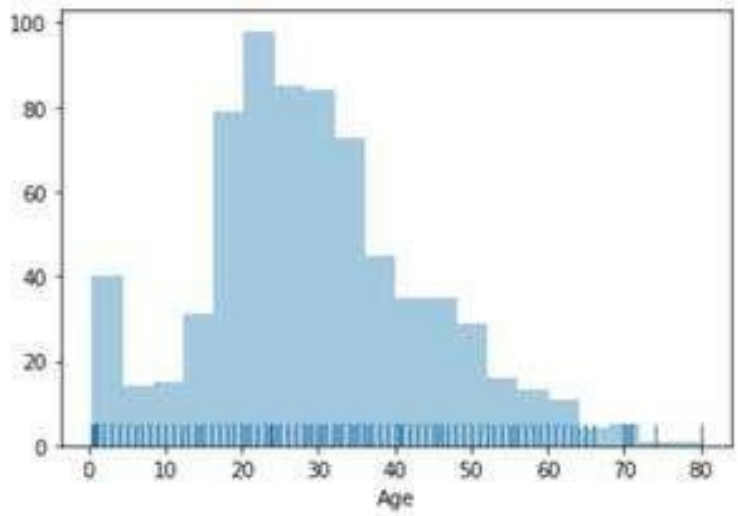
In [5]:
```
sns.distplot(df['Age'], bins=40)
```

Out[5]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x4f91918cc8>
```



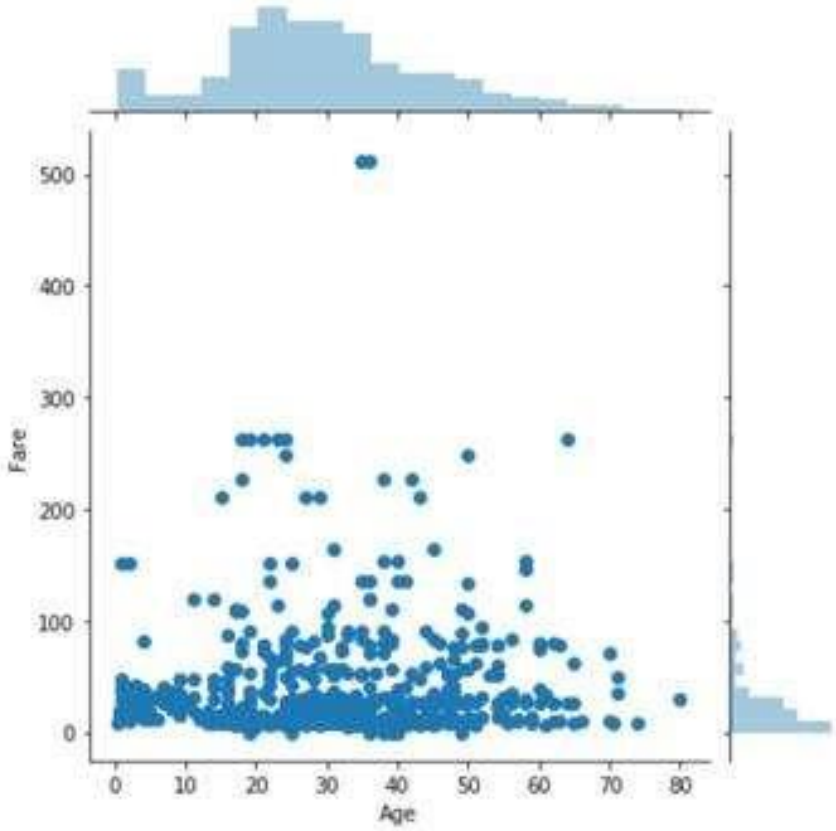
In [6]:
```
sns.distplot(df['Age'], bins=20, kde=False, rug=True)
```

Out[6]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x4f914b4b88>
```



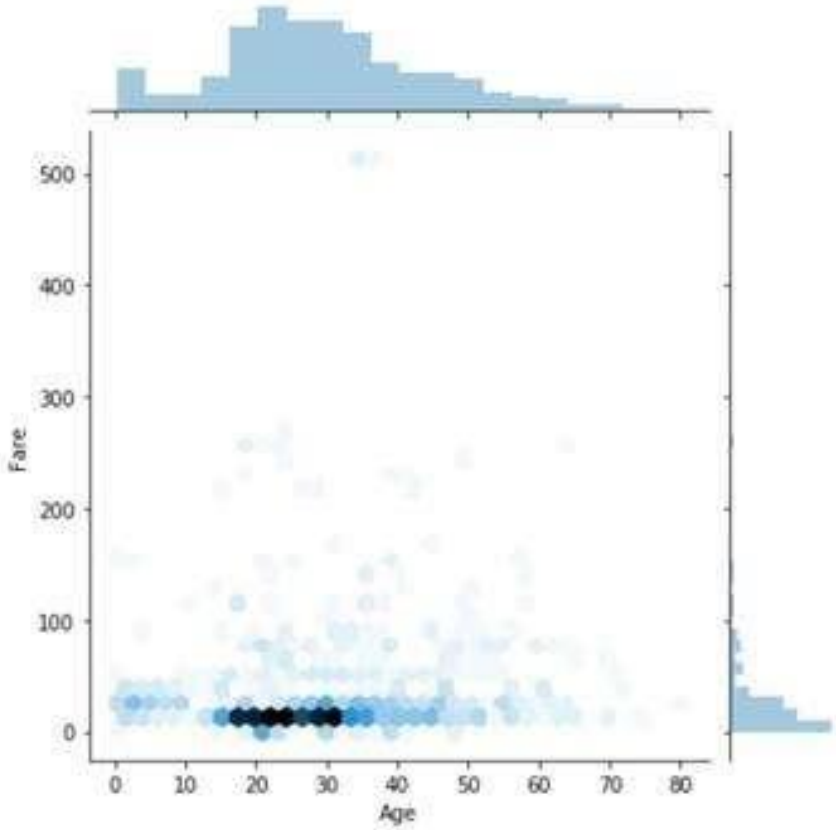
In [7]:
```
sns.jointplot(x = df['Age'], y = df['Fare'], kind = 'scatter')
```

Out[7]:
```
<seaborn.axisgrid.JointGrid at 0x4f91b27388>
```



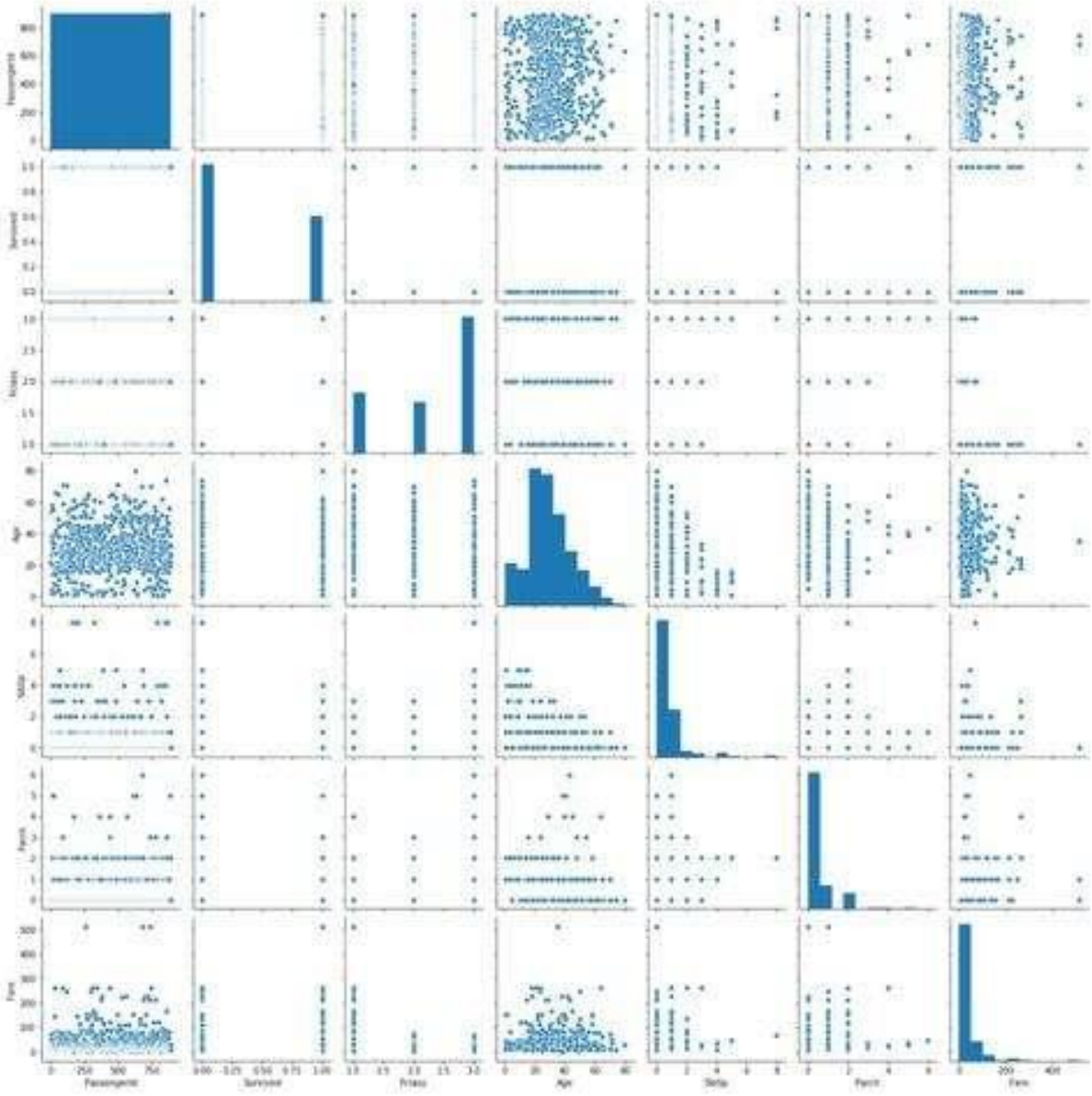
In [8]:
```
sns.jointplot(x = df['Age'], y = df['Fare'], kind = 'hex')
```

Out[8]:
```
<seaborn.axisgrid.JointGrid at 0x4f91cca788>
```



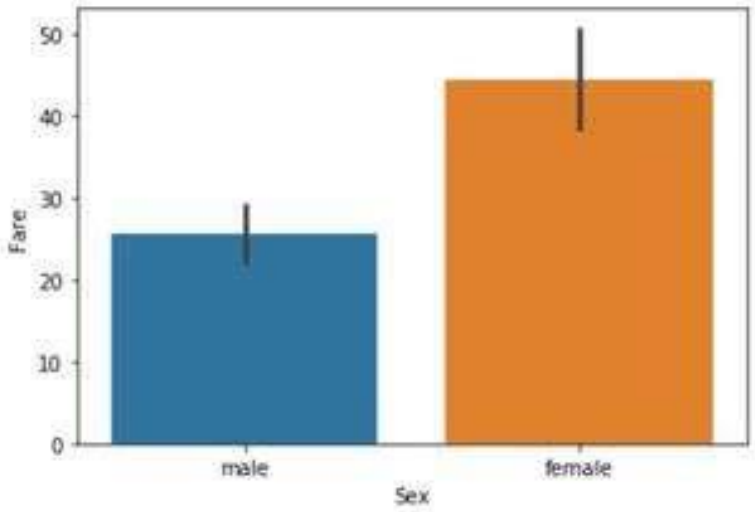
In [9]:
```
sns.pairplot(df)
```

Out[9]:
```
<seaborn.axisgrid.PairGrid at 0x4f91ccff88>
```



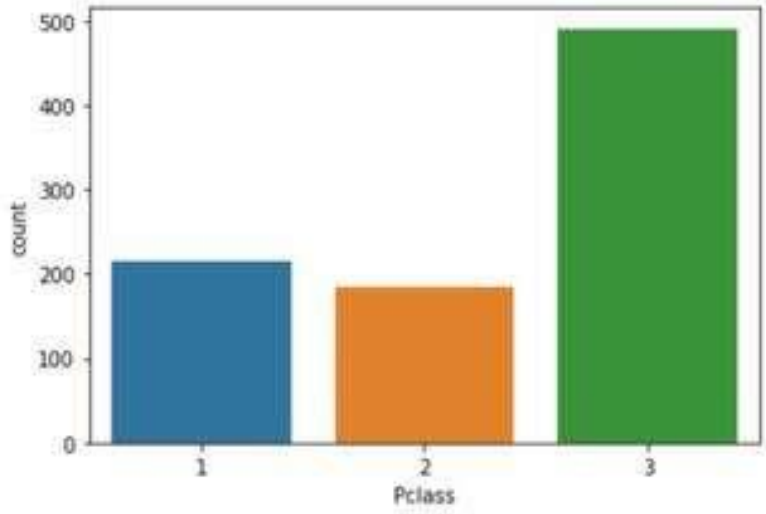
In [10]:
```
sns.barplot(x = df['Sex'], y = df['Fare'])
```

Out[10]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x4f94808a48>
```



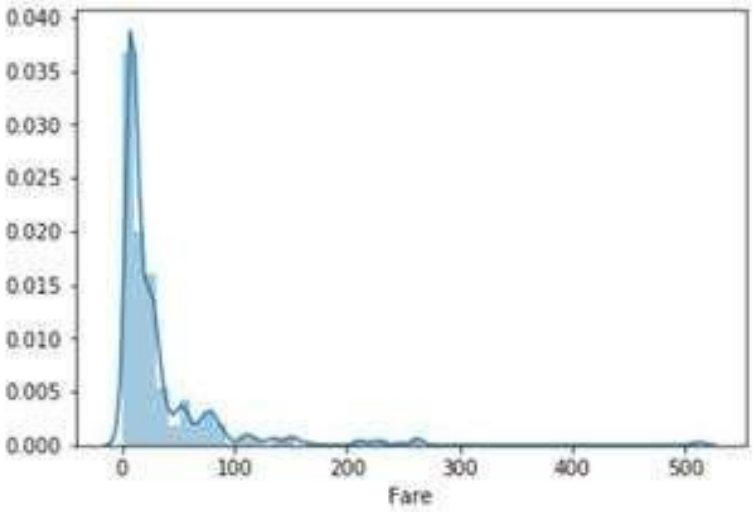
In [11]:
```
sns.countplot(df['Pclass'])
```

Out[11]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x4f91514648>
```



In [24]:
```
sns.distplot(df['Fare'], hist = True)
```

Out[24]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x4f955c6a48>
```



Assignment No 9 : Data Visualization 2

Import required Libraries

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
```

Read csv into dataframe

In [2]:
```
df = pd.read_csv('train.csv')
```

In [3]:
```
df
```

Out[3]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500
...	...	...	...	...	...	...	...	...	...	...
886	887	0	2	Montvila, Rev. Juozas	male	27.0	0	0	211536	13.0000

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare
887	888	1	1	Graham, Miss. Margaret Edith	female	19.0	0	0	112053	30.0000
888	889	0	3	Johnston, Miss. Catherine Helen "Carrie"	female	NaN	1	2	W./C. 6607	23.4500
889	890	1	1	Behr, Mr. Karl Howell	male	26.0	0	0	111369	30.0000
				Dooley,						

Data preprocessing

In [4]:
```
df.shape
```

Out[4]:
```
(891, 12)
```

In [5]:
```
df.columns
```

Out[5]:
```
Index(['PassengerId', 'Survived', 'Pclass', 'Name', 'Sex', 'Age', 'SibSp',
       'Parch', 'Ticket', 'Fare', 'Cabin', 'Embarked'],
      dtype='object')
```

In [6]:
```
df.dtypes
```

Out[6]:
```
PassengerId      int64
Survived         int64
Pclass           int64
Name            object
Sex             object
Age            float64
SibSp            int64
Parch            int64
Ticket          object
Fare           float64
Cabin           object
Embarked        object
dtype: object
```

In [7]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
 #   Column       Non-Null Count  Dtype
---  ------       --------------  -----
 0   PassengerId  891 non-null    int64
 1   Survived     891 non-null    int64
 2   Pclass       891 non-null    int64
 3   Name         891 non-null    object
 4   Sex          891 non-null    object
```

In [8]:
```
df.isnull()
```

Out[8]:

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	En
0	False	False	False	False	False	False	False	False	False	False	True	
1	False	False	False	False	False	False	False	False	False	False	False	
2	False	False	False	False	False	False	False	False	False	False	True	
3	False	False	False	False	False	False	False	False	False	False	False	
4	False	False	False	False	False	False	False	False	False	False	True	
...	...	...	...	...	...	...	...	...	...	...	...	
886	False	False	False	False	False	False	False	False	False	False	True	
887	False	False	False	False	False	False	False	False	False	False	False	
888	False	False	False	False	False	True	False	False	False	False	True	
889	False	False	False	False	False	False	False	False	False	False	False	
890	False	False	False	False	False	False	False	False	False	False	True	

891 rows × 12 columns

In [9]:
```
df.isnull().sum()
```

Out[9]:
```
PassengerId      0
Survived         0
Pclass           0
Name             0
Sex              0
Age            177
SibSp            0
Parch            0
Ticket           0
Fare             0
Cabin          687
Embarked         2
dtype: int64
```

In [10]:
```
df.describe()
```

Out[10]:

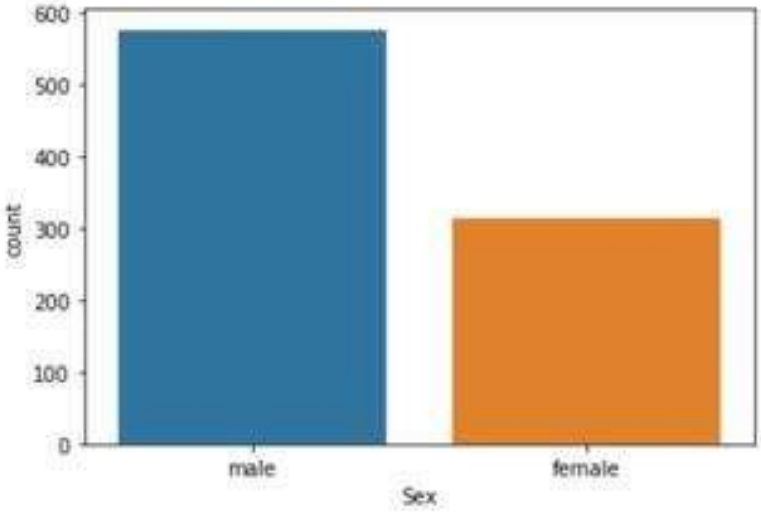
	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare
count	891.000000	891.000000	891.000000	714.000000	891.000000	891.000000	891.000000

	PassengerId	Survived	Pclass	Age	SibSp	Parch	Fare
mean	446.000000	0.383838	2.308642	29.699118	0.523008	0.381594	32.204208
std	257.353842	0.486592	0.836071	14.526497	1.102743	0.806057	49.693429
min	1.000000	0.000000	1.000000	0.420000	0.000000	0.000000	0.000000
25%	223.500000	0.000000	2.000000	20.125000	0.000000	0.000000	7.910400
50%	446.000000	0.000000	3.000000	28.000000	0.000000	0.000000	14.454200

Data Visualization

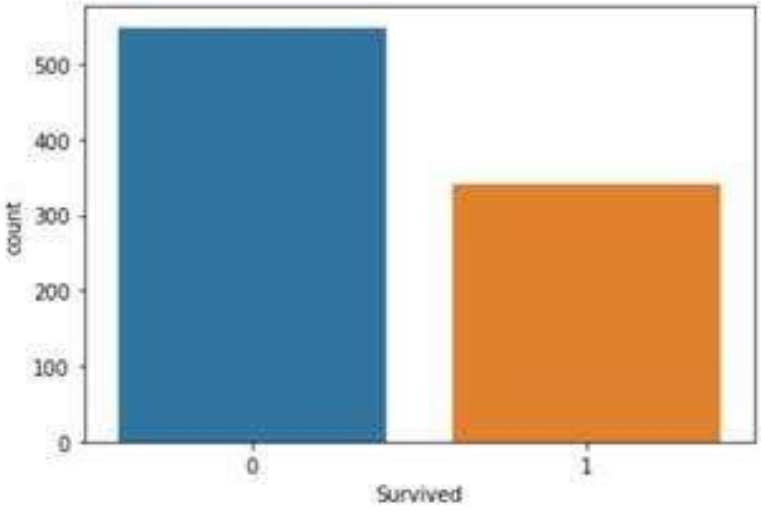
In [12]:
```
sns.countplot(df['Sex'])
```

Out[12]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x8345203508>
```



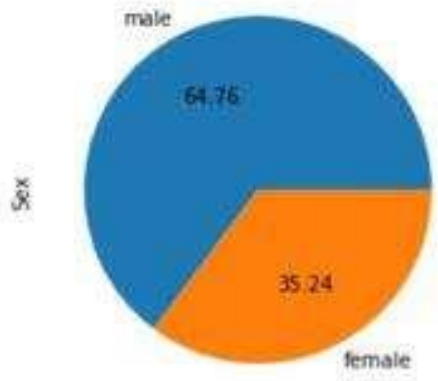
In [13]:
```
sns.countplot(df['Survived'])
```

Out[13]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x8345288b88>
```



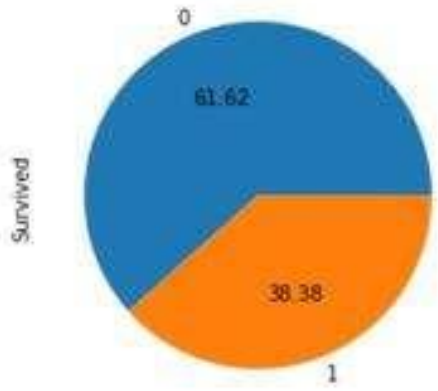
```
In [15]: df['Sex'].value_counts().plot(kind = 'pie', autopct = '%.2f')
```

```
Out[15]: <matplotlib.axes._subplots.AxesSubplot at 0x8345593d08>
```



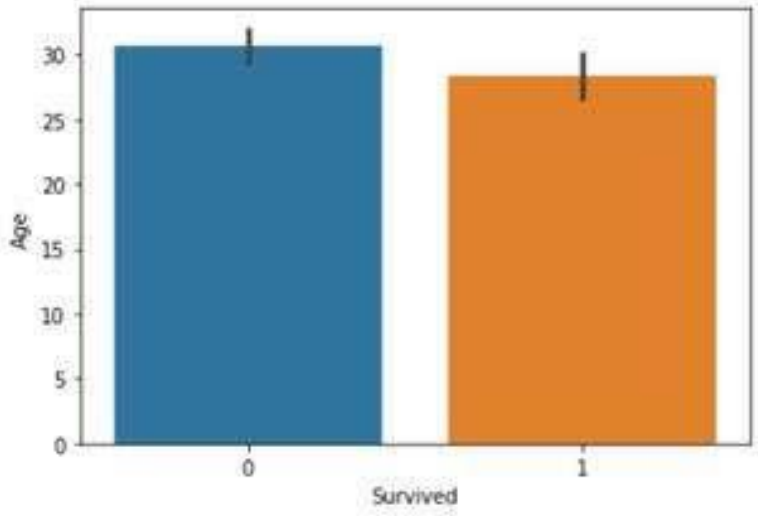

```
In [16]: df['Survived'].value_counts().plot(kind = 'pie', autopct = '%.2f')
```

```
Out[16]: <matplotlib.axes._subplots.AxesSubplot at 0x83455b8ec8>
```



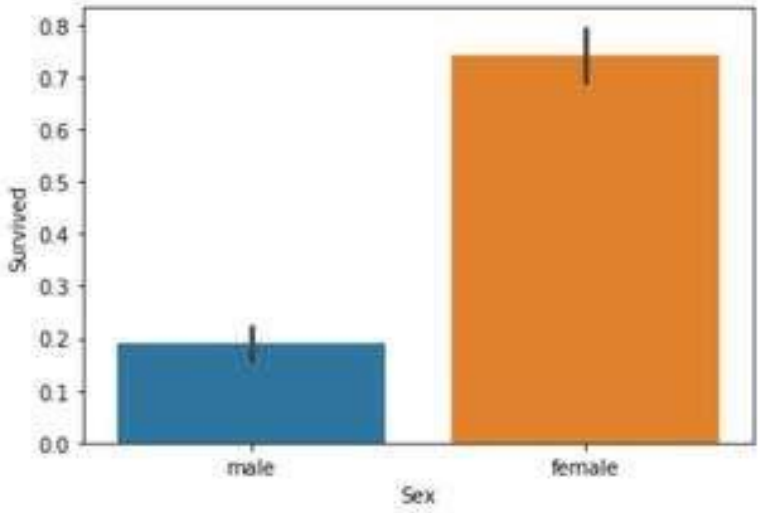

```
In [17]: sns.barplot(df['Survived'], df['Age'])
```

```
Out[17]: <matplotlib.axes._subplots.AxesSubplot at 0x8345bd2788>
```



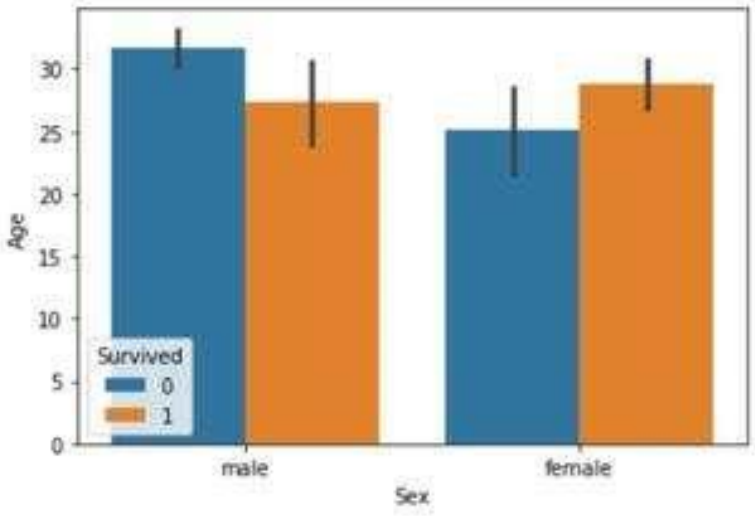
In [19]:
```
sns.barplot(df['Sex'], df['Survived'])
```

Out[19]: <matplotlib.axes._subplots.AxesSubplot at 0x8345bcda08>



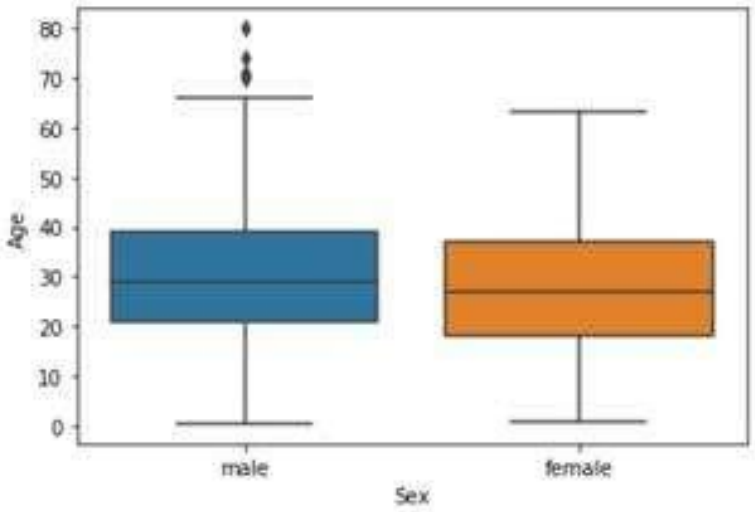
In [20]:
```
sns.barplot(df['Sex'],df['Age'], hue = df['Survived'])
```

Out[20]: <matplotlib.axes._subplots.AxesSubplot at 0x8345cf55c8>



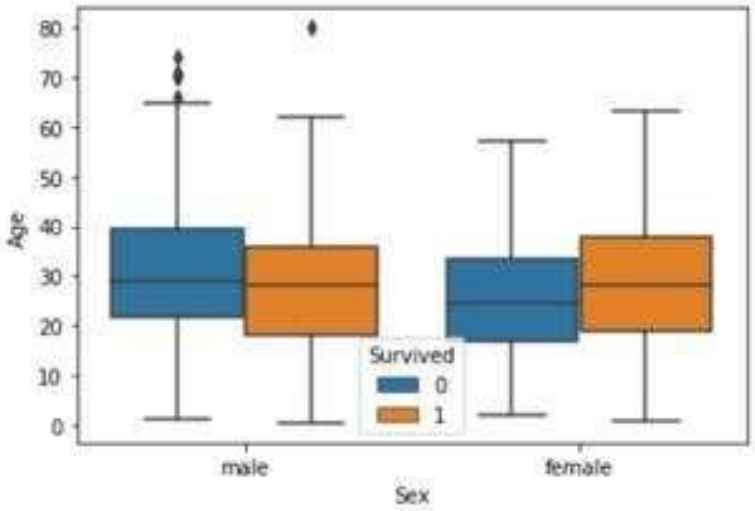
In [21]:
```
sns.boxplot(df['Sex'], df['Age'])
```

Out[21]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x8345d66c48>
```



In [4]:
```
sns.boxplot(df['Sex'], df['Age'], df['Survived'])
```

Out[4]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x44b8ecf788>
```



In [24]:
```
pd.crosstab(df['Sex'], df['Survived'])
```

Out[24]:

Survived	0	1
Sex		
female	81	233
male	468	109

In [25]:
```
pd.crosstab(df['Age'], df['Survived'])
```

Out[25]:

Survived	0	1
Age		

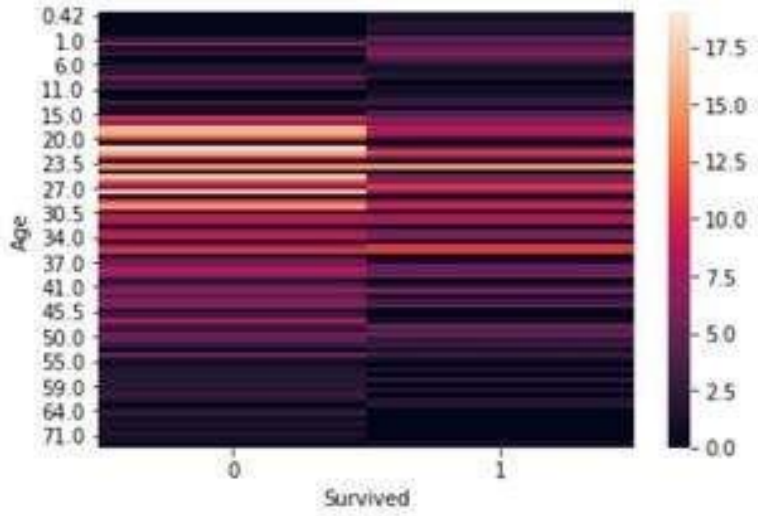
Survived	0	1
Age		
0.42	0	1
0.67	0	1
0.75	0	2
0.83	0	2
0.92	0	1
...	...	...
70.00	2	0
70.50	1	0
71.00	2	0
74.00	1	0

In [26]:
```
sns.heatmap(pd.crosstab(df['Sex'], df['Survived']))
```

Out[26]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x8345eaa848>
```

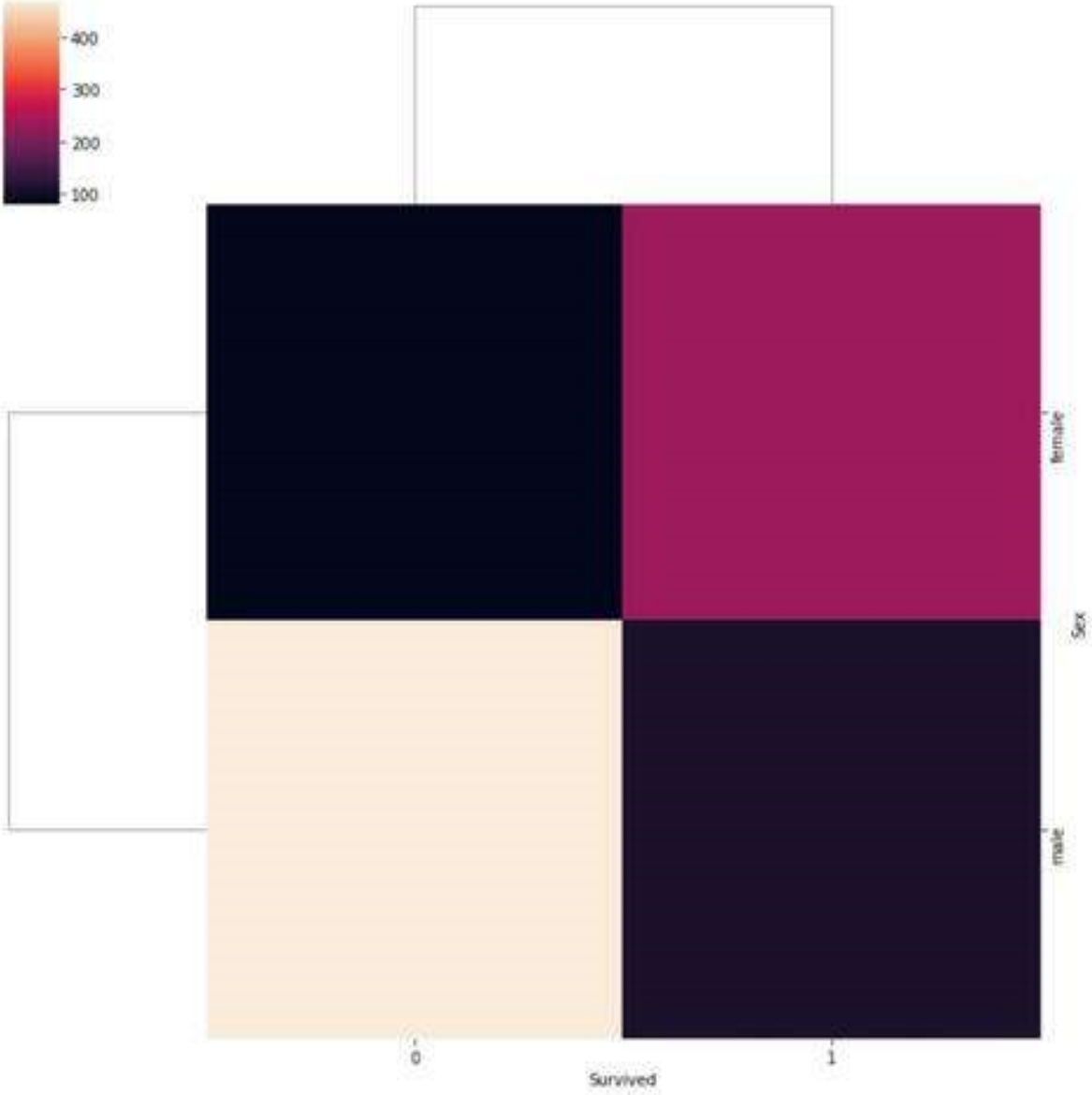
In [27]:
```
sns.heatmap(pd.crosstab(df['Age'], df['Survived']))
```

Out[27]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x8346973308>
```



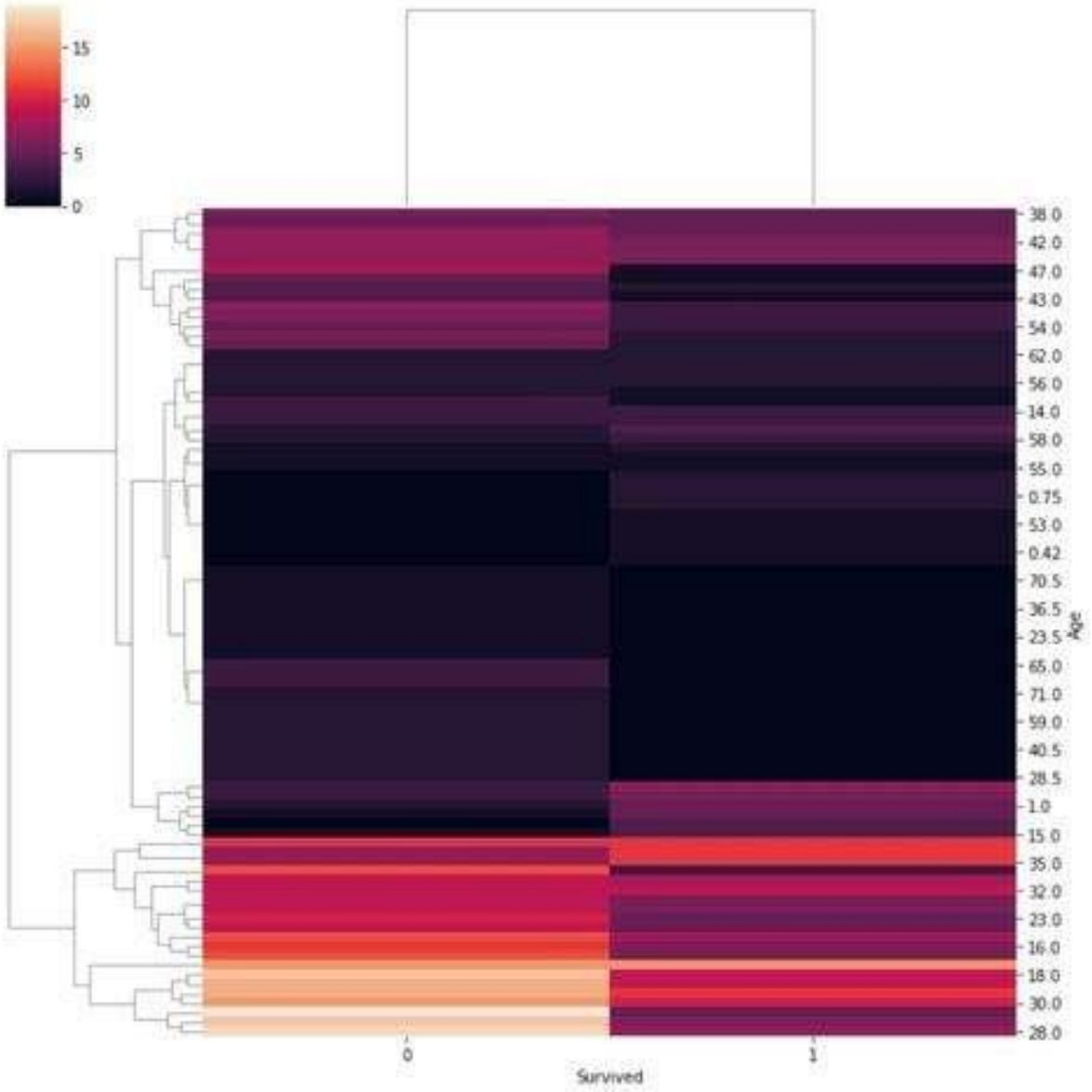
```
In [28]: sns.clustermap(pd.crosstab(df['Sex'], df['Survived']))b
```

```
Out[28]: <seaborn.matrix.ClusterGrid at 0x8345c8bd48>
```



```
In [29]: sns.clustermap(pd.crosstab(df['Age'], df['Survived']))
```

```
Out[29]: <seaborn.matrix.ClusterGrid at 0x83469736c8>
```



Assignment No 10 : Data Visualization 3

Importing Required Libraries

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import seaborn as sns
```

Reading csv into Dataframe

In [2]:
```
df = pd.read_csv('iris.csv')
df
```

Out[2]:

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm	Species
0	1	5.1	3.5	1.4	0.2	Iris-setosa
1	2	4.9	3.0	1.4	0.2	Iris-setosa
2	3	4.7	3.2	1.3	0.2	Iris-setosa
3	4	4.6	3.1	1.5	0.2	Iris-setosa
4	5	5.0	3.6	1.4	0.2	Iris-setosa
...	...	...	...	...	...	...
145	146	6.7	3.0	5.2	2.3	Iris-virginica
146	147	6.3	2.5	5.0	1.9	Iris-virginica
147	148	6.5	3.0	5.2	2.0	Iris-virginica
148	149	6.2	3.4	5.4	2.3	Iris-virginica
149	150	5.9	3.0	5.1	1.8	Iris-virginica

150 rows × 6 columns

Data preprocessing

In [3]:
```
df.shape
```

Out[3]:
```
(150, 6)
```

In [4]:
```
df.columns
```

Out[4]:

```
Index(['Id', 'SepalLengthCm', 'SepalWidthCm', 'PetalLengthCm', 'PetalWidthCm
',
       'Species'],
```

In [5]:
```
df.dtypes
```

Out[5]:
```
Id                int64
SepalLengthCm    float64
SepalWidthCm     float64
PetalLengthCm    float64
PetalWidthCm     float64
Species           object
dtype: object
```

In [6]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 150 entries, 0 to 149
Data columns (total 6 columns):
 #   Column         Non-Null Count  Dtype
---  ------         --------------  -----
 0   Id             150 non-null    int64
 1   SepalLengthCm  150 non-null    float64
 2   SepalWidthCm   150 non-null    float64
 3   PetalLengthCm  150 non-null    float64
 4   PetalWidthCm   150 non-null    float64
 5   Species        150 non-null    object
dtypes: float64(4), int64(1), object(1)
memory usage: 7.2+ KB
```

In [7]:
```
df.describe()
```

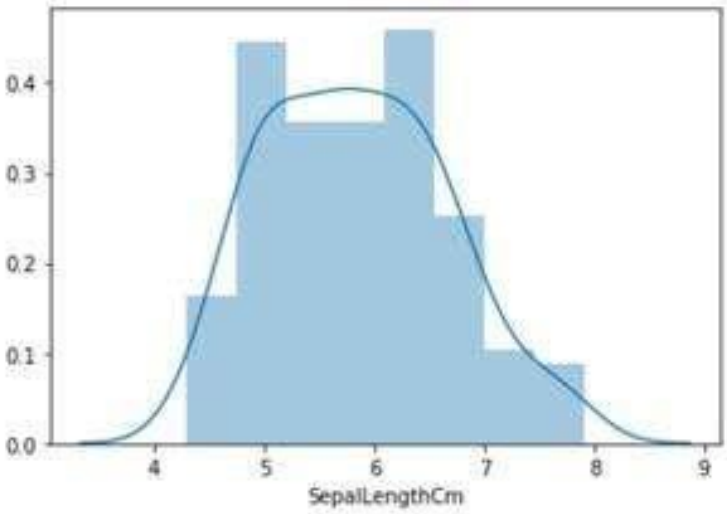
Out[7]:

	Id	SepalLengthCm	SepalWidthCm	PetalLengthCm	PetalWidthCm
count	150.000000	150.000000	150.000000	150.000000	150.000000
mean	75.500000	5.843333	3.054000	3.758667	1.198667
std	43.445368	0.828066	0.433594	1.764420	0.763161
min	1.000000	4.300000	2.000000	1.000000	0.100000
25%	38.250000	5.100000	2.800000	1.600000	0.300000
50%	75.500000	5.800000	3.000000	4.350000	1.300000
75%	112.750000	6.400000	3.300000	5.100000	1.800000
max	150.000000	7.900000	4.400000	6.900000	2.500000

Data Visualization

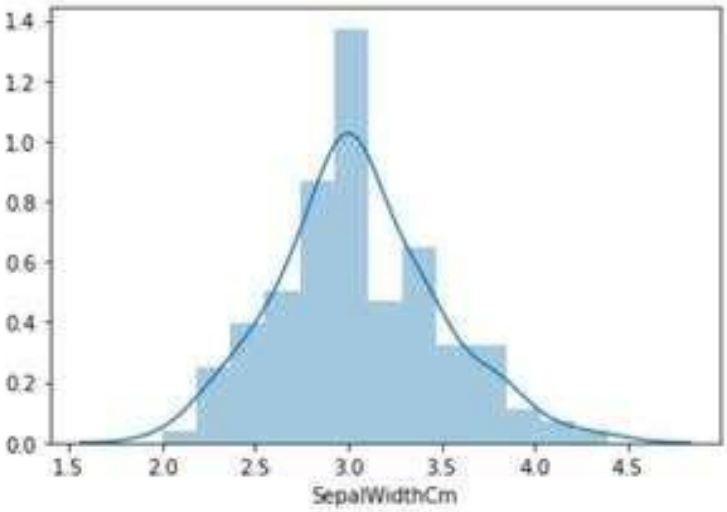
In [9]:
```
sns.distplot(df['SepalLengthCm'])
```

Out[9]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x491aa5fec8>
```



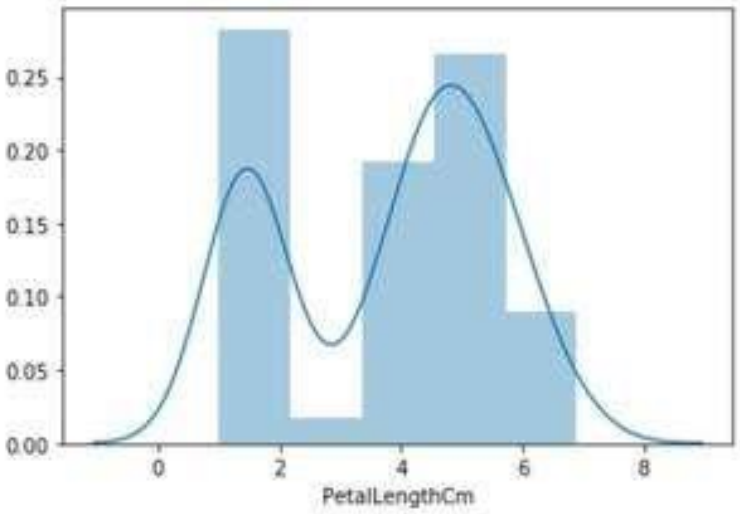
In [10]:
```
sns.distplot(df['SepalWidthCm'])
```

Out[10]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x4919d7a808>
```



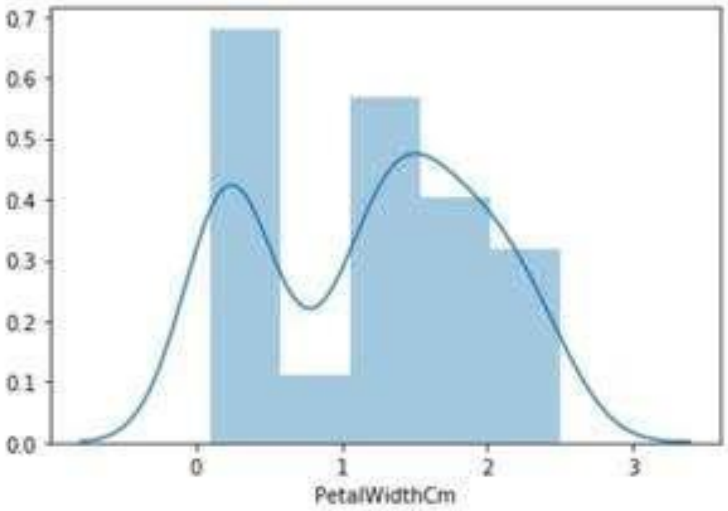
In [11]:
```
sns.distplot(df['PetalLengthCm'])
```

Out[11]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x491ad8f0c8>
```



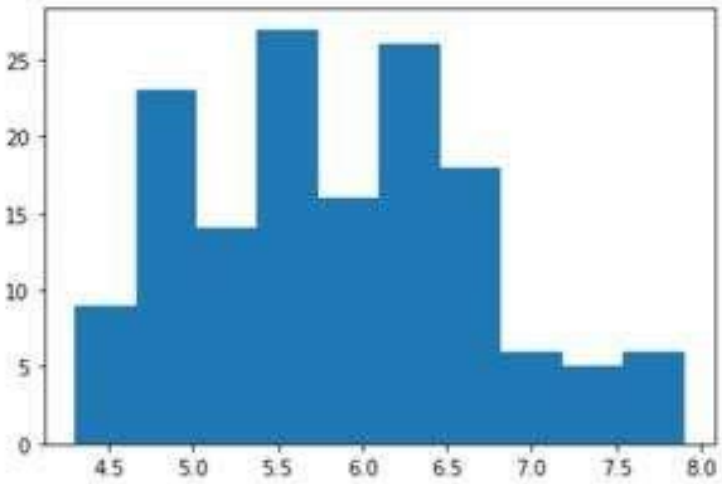
In [18]:
```
sns.distplot(df['PetalWidthCm'])
```

Out[18]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x49203185c8>
```



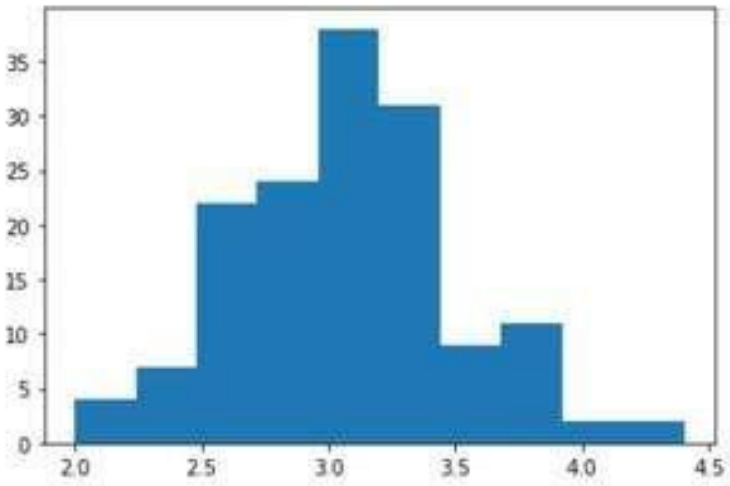
In [13]:
```
plt.hist(df['SepalLengthCm'])
```

Out[13]:
```
(array([ 9., 23., 14., 27., 16., 26., 18.,  6.,  5.,  6.]),
 array([4.3 , 4.66, 5.02, 5.38, 5.74, 6.1 , 6.46, 6.82, 7.18, 7.54, 7.9 ]),
 <a list of 10 Patch objects>)
```



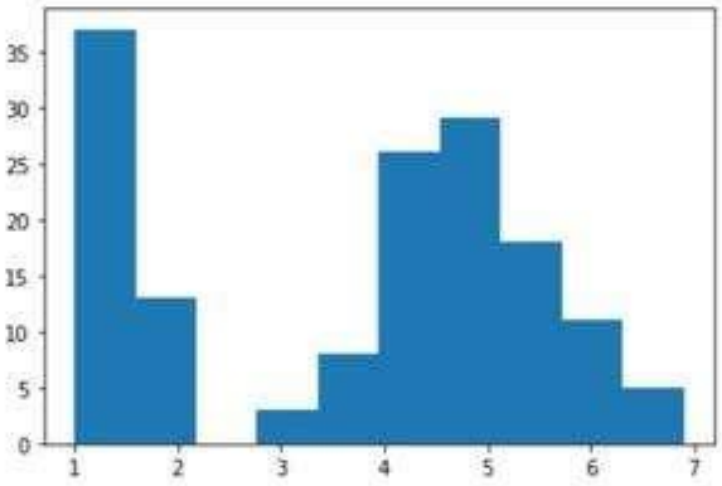
In [14]:
```
plt.hist(df['SepalWidthCm'])
```

Out[14]:
```
(array([ 4.,  7., 22., 24., 38., 31.,  9., 11.,  2.,  2.]),
 array([2.  , 2.24, 2.48, 2.72, 2.96, 3.2 , 3.44, 3.68, 3.92, 4.16, 4.4 ]),
 <a list of 10 Patch objects>)
```



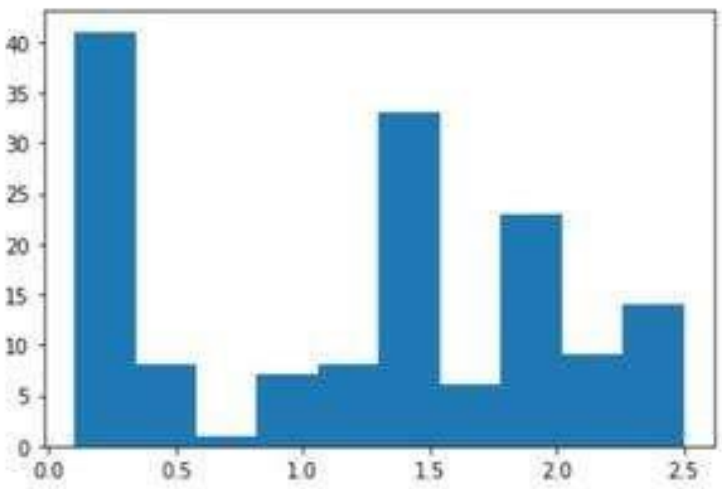
In [15]:
```
plt.hist(df['PetalLengthCm'])
```

Out[15]:
```
(array([37., 13.,  0.,  3.,  8., 26., 29., 18., 11.,  5.]),
 array([1.  , 1.59, 2.18, 2.77, 3.36, 3.95, 4.54, 5.13, 5.72, 6.31, 6.9 ]),
 <a list of 10 Patch objects>)
```



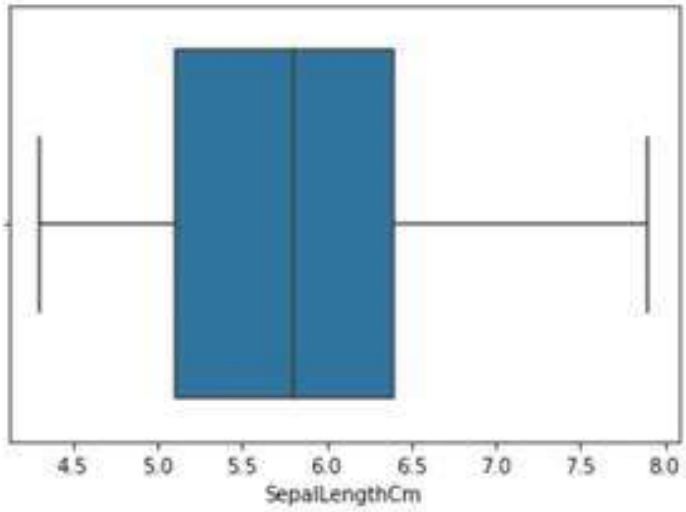
In [16]:
```
plt.hist(df['PetalWidthCm'])
```

Out[16]:
```
(array([41.,  8.,  1.,  7.,  8., 33.,  6., 23.,  9., 14.]),
 array([0.1 , 0.34, 0.58, 0.82, 1.06, 1.3 , 1.54, 1.78, 2.02, 2.26, 2.5 ]),
 <a list of 10 Patch objects>)
```



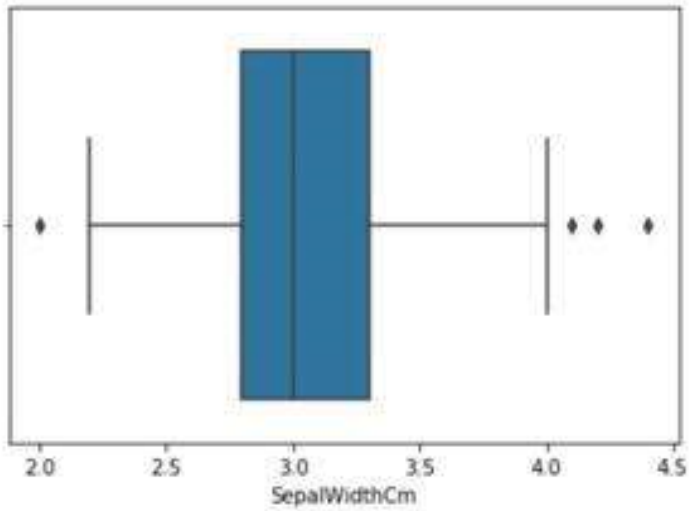
In [19]:
```
sns.boxplot(df['SepalLengthCm'])
```

Out[19]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x492033df88>
```



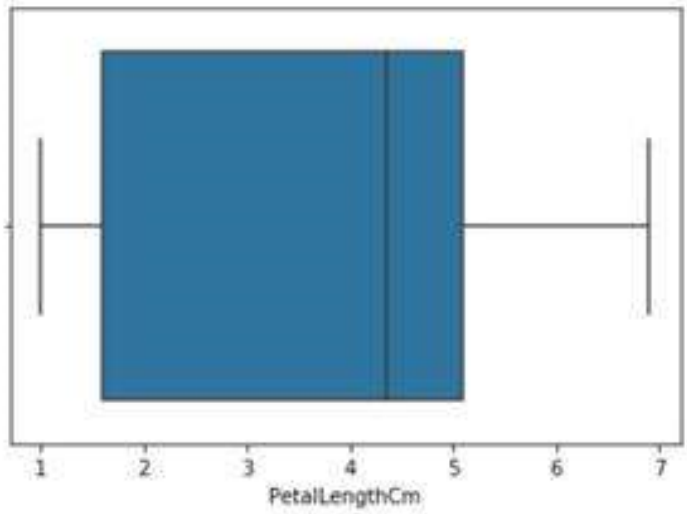
In [20]:
```
sns.boxplot(df['SepalWidthCm'])
```

Out[20]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x49203d7d48>
```



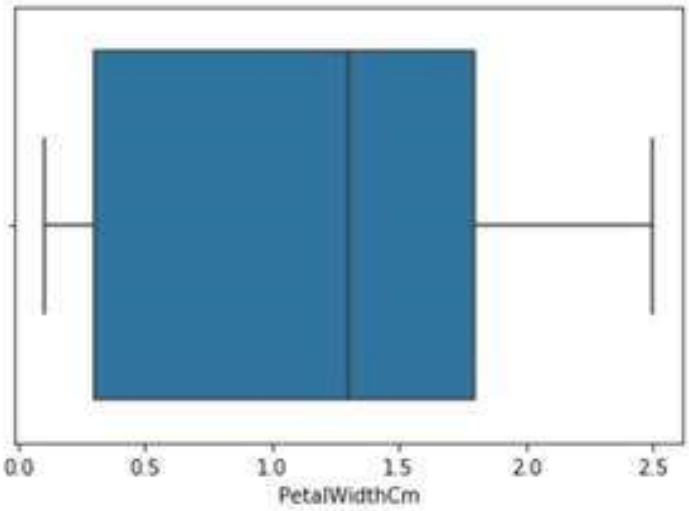
In [21]:
```
sns.boxplot(df['PetalLengthCm'])
```

Out[21]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x492043fe88>
```



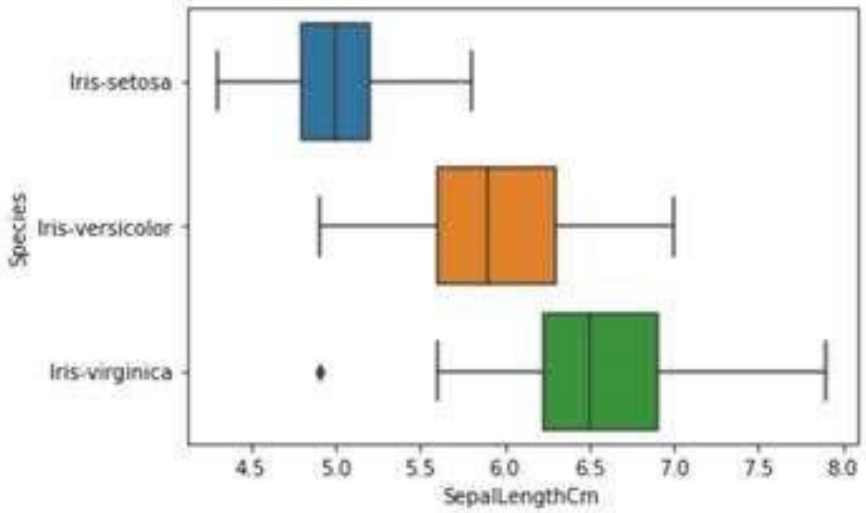
In [22]:
```
sns.boxplot(df['PetalWidthCm'])
```

Out[22]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x492047cf88>
```



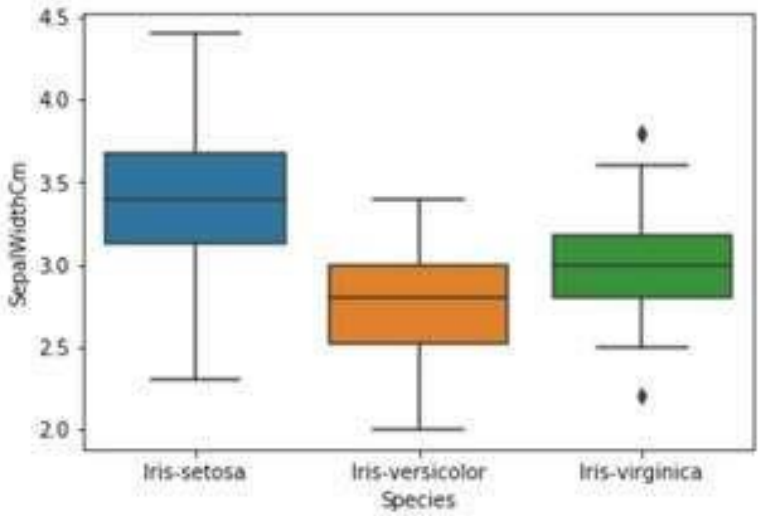
In [27]:
```
sns.boxplot(data = df, x = df['SepalLengthCm'], y = df['Species'])
```

Out[27]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x49206243c8>
```



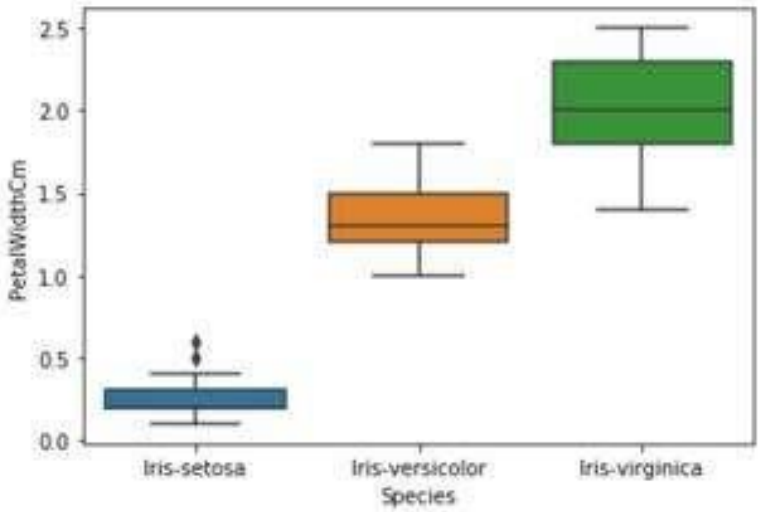
In [28]:
```
sns.boxplot(data = df, x = df['Species'], y = df['SepalWidthCm'])
```

Out[28]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x49206b7688>
```



In [29]:
```
sns.boxplot(data = df, x = df['Species'], y = df['PetalWidthCm'])
```

Out[29]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x49207549c8>
```



In [30]:
```
sns.boxplot(data = df, x = df['Species'], y = df['PetalLengthCm'])
```

Out[30]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x49207d9ac8>
```