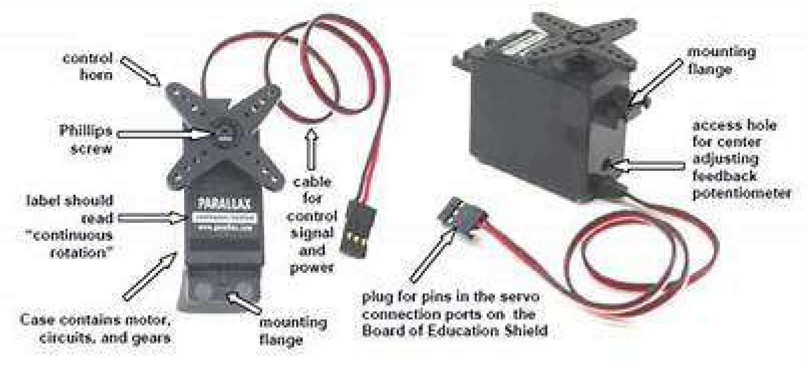
Get Understanding about Data Set


control horn
Phillips screw
label should read "continuous rotation"
Case contains motor, circuits, and gears
mounting flange
cable for control signal and power
PARALLAX
plug for pins in the servo connection ports on the Board of Education Shield
mounting flange
access hole for center adjusting feedback potentiometer

What is Servo: In control engineering a servomechanism, usually shortened to servo, is an automatic device that user error-ensing negative feedback to correct the action of a mechanism. On displacement-controlled applications, it usually includes a build-in encoder or other position feedback mechanism to ensure the output is achieving the desired effect. The term correctly applies only to systems where the feedback or error-correction signals help control mechanism position, speed, attitude or any other measurable variables. For examples, an automotive power window control is not a servomechanism, as there is no automatic feedback that controls position-the operator does this by observation. By contrast a car's cruise control user closed-loop feedback, which classifies it as a servomechanism.

A data frame with 167 observations on 5 variables, 4 nominal and 1 as the target class. This data set is fom a simulation of a servo system involving a servo amplifier, a lead screw/nut, and a sliding n on the translational axes of a robot on the 9th floor of the almost certainly a rise time, or the time required for the system to respond to a step change in a position set point. The variables that describe the data set and their values are the following:

Saving... ×

1. Motor A,B,C,D,E
2. Screw A,B,C,D,E
3. Pgain 3,4,5,6
4. Vgain 1,2,3,4,5
5. Class 0.13 to 7.10

Import Library

```
import pandas as pd
```

```
import numpy as np
```

Import CSV as DataFrame

```
df = pd.read_csv(r'https://raw.githubusercontent.com/YBI-Foundation/Dataset/main/Servo%20Mech
```

Get the First Five Rows of DataFrame

```
df.head()
```

	Motor	Screw	Pgain	Vgain	Class
0	E	E	5	4	4
1	B	D	6	5	11
2	D	D	4	3	6
3	B	A	3	2	48
4	D	B	6	5	6

Saving...

Get Information of DataFrame

```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 167 entries, 0 to 166
Data columns (total 5 columns):
 #   Column  Non-Null Count  Dtype 
---  ------  --------------  ----- 
 0   Motor   167 non-null    object
 1   Screw   167 non-null    object
 2   Pgain   167 non-null    int64 
 3   Vgain   167 non-null    int64 
 4   Class   167 non-null    int64 
```

```
dtypes: int64(3), object(2)
memory usage: 6.6+ KB
```

Get the Summary Statistics

```
df.describe()
```

	Pgain	Vgain	Class
count	167.000000	167.000000	167.000000
mean	4.155689	2.538922	21.173653
std	1.017770	1.369850	13.908038
min	3.000000	1.000000	1.000000
25%	3.000000	1.000000	10.500000
50%	4.000000	2.000000	18.000000
75%	5.000000	4.000000	33.500000
max	6.000000	5.000000	51.000000

Get Column Names

```
df.columns
```

```
Index(['Motor', 'Screw', 'Pgain', 'Vgain', 'Class'], dtype='object')
```

Saving...

Get Shape of DataFrame

```
df.shape
```

```
(167, 5)
```

Get Categories and Counts of Categorical Variables

```
df[['Motor']].value_counts()
```

```
Motor
C        40
A        36
B        36
E        33
D        22
dtype: int64
```

```
df[['Screw']].value_counts()
```

```
Screw
A        42
B        35
C        31
D        30
E        29
dtype: int64
```

```
df[['Pgain']].value_counts()
```

```
Pgain
4        66
3        50
5        26
6        25
dtype: int64
```

```
df[['Vgain']].value_counts()
```

```
Vgain
2        49
1        47
3        27
4        22
```

Saving... ×

```
df[['Class']].value_counts()
```

```
Class
11       14
12       11
9         9
13        8
20        7
6         6
8         6
41        5
3         5
4         5
44        5
35        4
```

```
        34       4
        45       4
        27       4
        26       4
        7        4
        42       3
        30       3
        19       3
        43       3
        21       3
        22       3
        23       3
        37       3
        2        3
        18       3
        5        2
        46       2
        17       2
        29       2
        25       2
        24       2
        16       2
        28       2
        47       1
        49       1
        50       1
        48       1
        1        1
        40       1
        39       1
        38       1
        36       1
        33       1
        32       1
        31       1
        15       1
        14       1
```

Saving...

Get Encoding of Categorical Features

```
df.replace({'Motor':{'A':0, 'B':1, 'C':2, 'D':3, 'E':4}},inplace=True)
```

```
df.replace({'Screw':{'A':0, 'B':1, 'C':2, 'D':3, 'E':4}},inplace=True)
```

Define y (dependent or label or target variable) and X (independent or features or attribute Variable)

```
y = df['Class']
```

```
y.shape
```

```
(167,)
```

```
y
```

```
0       4
1      11
2       6
3      48
4       6
       ..
162    44
163    40
164    25
165    44
166    20
Name: Class, Length: 167, dtype: int64
```

```
X = df[['Motor', 'Screw', 'Pgain', 'Vgain']]
```

```
X.shape
```

```
(167, 4)
```

Saving... ×

```
X
```

	Motor	Screw	Pgain	Vgain
0	4	4	5	4
1	1	3	6	5
2	3	3	4	3
3	1	0	3	2

Get Train Test Split

```
from sklearn.model_selection import train_test_split
```

```
164     2     3     4     3
```

```
X_train, X_test, y_train, y_test = train_test_split(X,y, test_size = 0.3, random_state=2529)
```

```
X_train.shape, X_test.shape, y_train.shape, y_test.shape
```

```
     ((116, 4), (51, 4), (116,), (51,))
```

Get Model Train

```
from sklearn.linear_model import LinearRegression
```

```
lr = LinearRegression()
```

Saving... ×

```
     ▸ LinearRegression
     LinearRegression()
```

Get Model Prediction

```
y_pred = lr.predict(X_test)
```

```
y_pred.shape
```

```
     (51,)
```

```
y_pred
```

```
array([24.55945258, 30.98765106, 18.54485477, 25.51524243, 38.56082023,
       23.52007775, 11.61947065, 20.03335614, 40.60404401, 41.7009556 ,
       13.66269443, 26.01242807, 16.50163099, 16.54663453, 21.92598051,
       22.52570646, -5.46449561, 30.68912392, 32.7323477 ,  1.41282941,
       33.97718702, 31.63543611, 33.52806048, 30.04133887, 19.38557109,
        6.49364826, 28.5528375 , 17.04382017, 25.06611589,  3.50411229,
       30.59606128, 23.67067716, 35.72188367, 32.08456265, 12.46018697,
        3.6547117 , 23.47201865, 33.03087484, 17.49294672, 37.61450804,
       27.54898855, 22.07657992, 11.51387478,  9.470651  , 30.53852451,
       28.64590014, 33.67865989,  4.60102388, 24.1198037 , 21.13026773,
       25.71390094])
```

Get Model Evaluation

```
from sklearn.metrics import mean_squared_error, mean_absolute_error, r2_score
```

```
mean_squared_error(y_test, y_pred)
```

```
66.03589175595563
```

```
mean_absolute_error(y_test, y_pred)
```

```
7.190539677251235
```

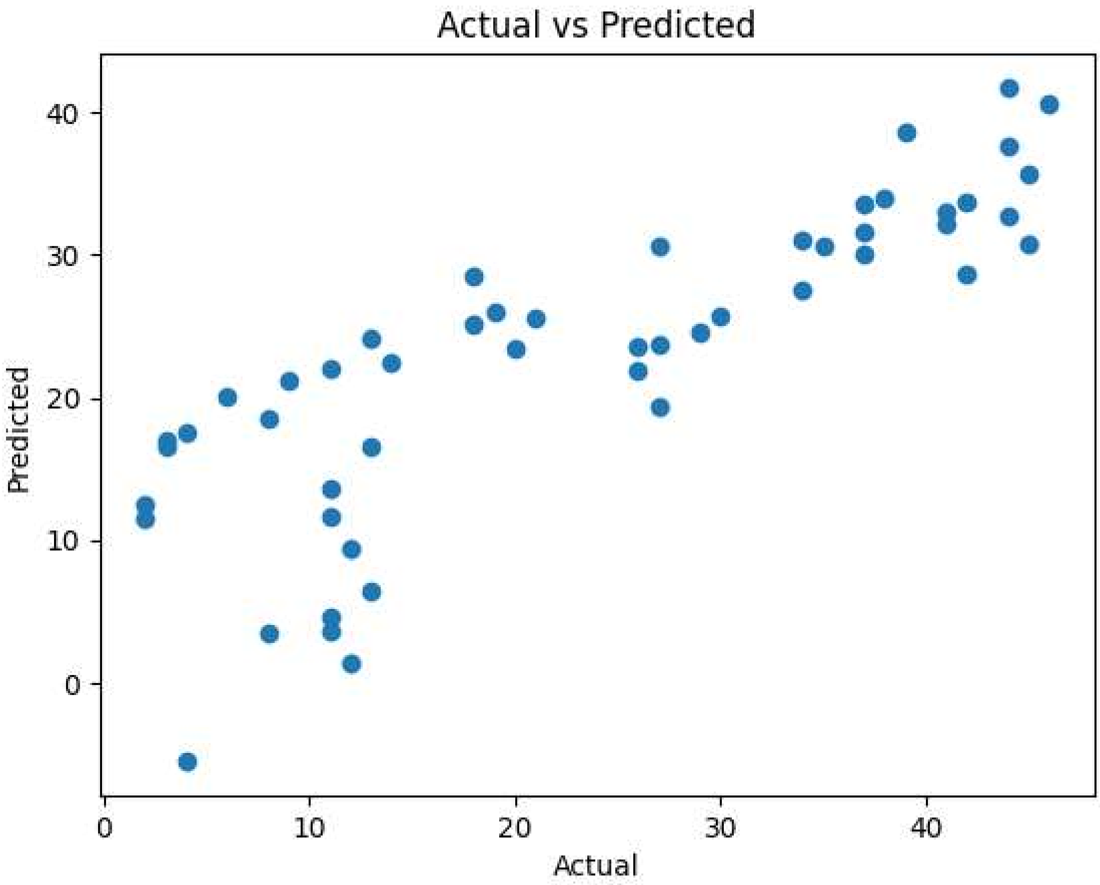
```
r2_score(y_test, y_pred)
```

```
0.6807245170563927
```

Saving... ×

ual Vs Predicted Results

```
import matplotlib.pyplot as plt
plt.scatter(y_test, y_pred)
plt.xlabel("Actual")
plt.ylabel("Predicted")
plt.title("Actual vs Predicted")
plt.show()
```



Saving...

completed at 5:47 PM