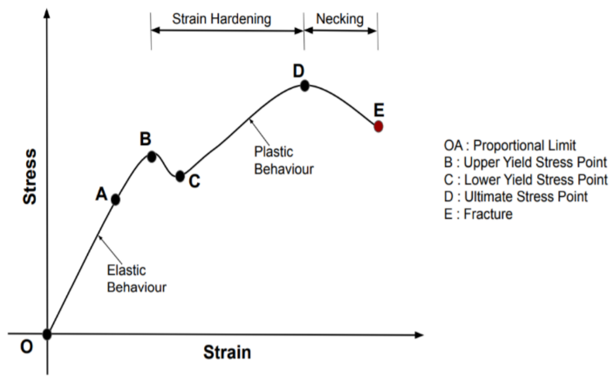
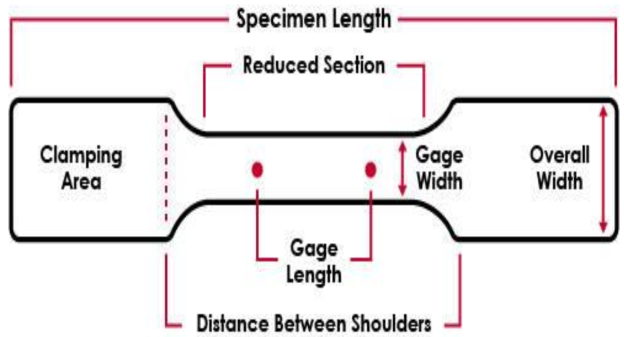
Prediction of Elongation of test specimen using Liner Regression





Strength of Material: is capacity of a material to withstand with force that applied on it without failure.

UTM(Universal Testing Machine): is equipment used to test material with its strength until it fractures.

Elongation: is extension in length of a specimen, when it subjected to force.

The relation between elongation and force is somewhat liner, until the bottleneck formation point reach, and after that fraction of more force will break the specimen apart.

Here in this model, the elongation of material is predicted using liner regression.

Amount of **force applied** is considered as **independent entity**, and **elongation** is considered as **dependent** entity jupyter UTM_TESTING Last Checkpoint: 1 minute ago

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Code

JupyterLab Python 3 (ipykernel)

[5]:
```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn.metrics import mean_absolute_error
import matplotlib.pyplot as plt
```

[ ]:
```
# Reading csv file dd
```

[3]:
```
import pandas as pd
dataframe=pd.read_csv(r'E:\project_stuff\datasets\OSERVATION.csv')
dataframe.head()
```

[3]:

	Load_KG	Load	Area	Stress	Length	Elongation	Strain
0	1	784.8	101.23	7.75	56.56	0	0.00
1	4	3139.2	101.23	31.01	56.56	2	0.04
2	7	5493.6	101.23	54.27	56.56	4	0.07
3	13	10202.4	101.23	100.78	56.56	6	0.11
4	18	14126.4	101.23	139.55	56.56	8	0.14

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Code JupyterLab Python 3 (ipykernel)

[ ]:
```python
# checking on dataset properties
```

[11]:
```python
dataframe.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 21 entries, 0 to 20
Data columns (total 7 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   Load_KG     21 non-null     int64
 1   Load        21 non-null     float64
 2   Area        21 non-null     float64
 3   Stress      21 non-null     float64
 4   Length      21 non-null     float64
 5   Elongation  21 non-null     int64
 6   Strain      21 non-null     float64
dtypes: float64(5), int64(2)
memory usage: 1.3 KB
```

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Code JupyterLab Python 3 (ipykernel)

[ ]:
```
# statistical data details
```

[13]:
```
dataframe.describe()
```

[13]:

	Load_KG	Load	Area	Stress	Length	Elongation	Strain
count	21.000000	21.000000	2.100000e+01	21.000000	2.100000e+01	21.000000	21.000000
mean	42.142857	33073.714286	1.012300e+02	326.718095	5.656000e+01	20.000000	0.335714
std	24.511805	19236.864357	1.456179e-14	190.031368	2.184269e-14	12.409674	0.203779
min	1.000000	784.800000	1.012300e+02	7.750000	5.656000e+01	0.000000	0.000000
25%	25.000000	19620.000000	1.012300e+02	193.820000	5.656000e+01	10.000000	0.180000
50%	43.000000	33746.400000	1.012300e+02	333.360000	5.656000e+01	20.000000	0.320000
75%	62.000000	48657.600000	1.012300e+02	480.660000	5.656000e+01	30.000000	0.500000
max	75.000000	58860.000000	1.012300e+02	581.450000	5.656000e+01	40.000000	0.670000

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Code

JupyterLab Python 3 (ipykernel)

[15]:
```
dataframe.dtypes
```

[15]:
```
Load_KG         int64
Load          float64
Area          float64
Stress        float64
Length        float64
Elongation      int64
Strain        float64
dtype: object
```

[ ]:
```
# checking for nulls
```

[5]:
```
dataframe.isnull().sum()
```

[5]:
```
Load_KG       0
Load          0
Area          0
Stress        0
Length        0
Elongation    0
Strain        0
dtype: int64
```

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Code

JupyterLab Python 3 (ipykernel)

[ ]:
```
# defining X and Y variables. X is for dates and Y is for observations
```

[19]:
```
# Define features (X) and target (y)
X = dataframe[['Load']]
y = dataframe['Elongation']
```

[ ]:
```
#now lets dive into traing and testing part, we need to splite the data into traing and testing datasets.
#80% of the data will be used for training. 20% of the data will be used for testing.
```

[21]:
```
# Split the data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)
```

[ ]:
```
# Now here onwards actual process starts.
# starting with initializing and training the model.
# calculating mean error and
# finaly obtain requred results from trained model.
```

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Code | JupyterLab | Python 3 (ipykernel)

[23]:
```
# Initialize and train the model
model = LinearRegression()
model.fit(X_train, y_train)
```

[23]:
```
LinearRegression
LinearRegression()
```

[25]:
```
# Make predictions
y_pred = model.predict(X_test)
```

[31]:
```
# Calculate mean absolute error
mae = mean_absolute_error(y_test, y_pred)
print(f"Mean Absolute Error: {mae}")
# Plot actual vs predicted values
plt.figure(figsize=(10, 3))
plt.plot(X_test, y_test, 'b.', label='Actual')
plt.plot(X_test, y_pred, 'r.', label='Predicted')
plt.xlabel('LOAD APPLIED')
plt.ylabel('ELONGATION')
plt.title('Actual vs Predicted elongation')
plt.legend()
plt.show()
```

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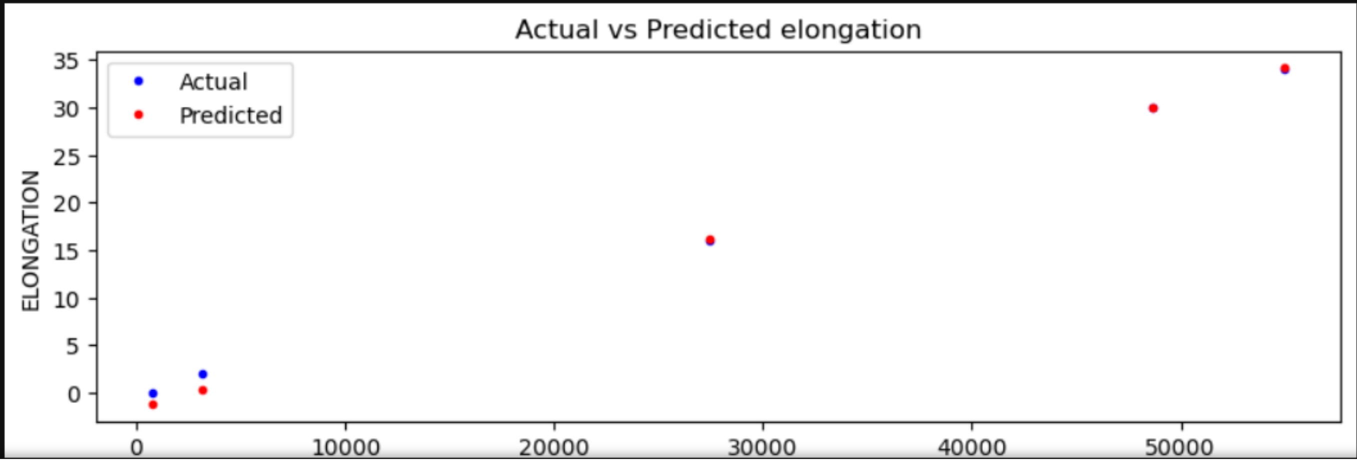
Code JupyterLab Python 3 (ipykernel)

```
# Plot actual vs predicted values
plt.figure(figsize=(10, 3))
plt.plot(X_test, y_test, 'b.', label='Actual')
plt.plot(X_test, y_pred, 'r.', label='Predicted')
plt.xlabel('LOAD APPLIED')
plt.ylabel('ELONGATION')
plt.title('Actual vs Predicted elongation')
plt.legend()
plt.show()
```

```
Mean Absolute Error: 0.6762797547636632
```



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Code JupyterLab Python 3 (ipykernel)

[35]:
```python
# Predicting elongation for given load value
load = [60661]
load_applied=np.array(load).reshape(-1,1)
```

[37]:
```python
# elongation = np.array([load + i for i in range(1, 5)]).reshape(-1, 1)
elongation=np.array([[x + i for x in load_applied] for i in range(1, 5)])
expected_elongation = model.predict(load_applied)
```

```
C:\Users\Vinayak\anaconda3\Lib\site-packages\sklearn\base.py:493: UserWarning: X does not have valid feature names, but LinearRegression was fitted with feature names
  warnings.warn(
```

[39]:
```python
#Display the predictions
print("\nExpected Elongation:")
for load, elongation in zip(load_applied.flatten(), expected_elongation):
 print(f"Load Applied(N): {load_applied}, Expected Elongation (mm): {expected_elongation}")
```

```
Expected Elongation:
Load Applied(N): [[60661]], Expected Elongation (mm): [37.91975182]
```