Question3_a

March 24, 2023

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[ ]: """import necessary library"""
     import numpy as np
     import matplotlib.pyplot as plt
     import pandas as pd
     from scipy.optimize import curve_fit
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[ ]: """reading csv file"""
     p1 = pd.read_csv('Q3_first_part_data.csv')
     # rename the columns
     p1 = p1.rename(columns={'Force(N)': 'f', 'voltage(mv)': 'v'})
```

1 mx + c linear plot

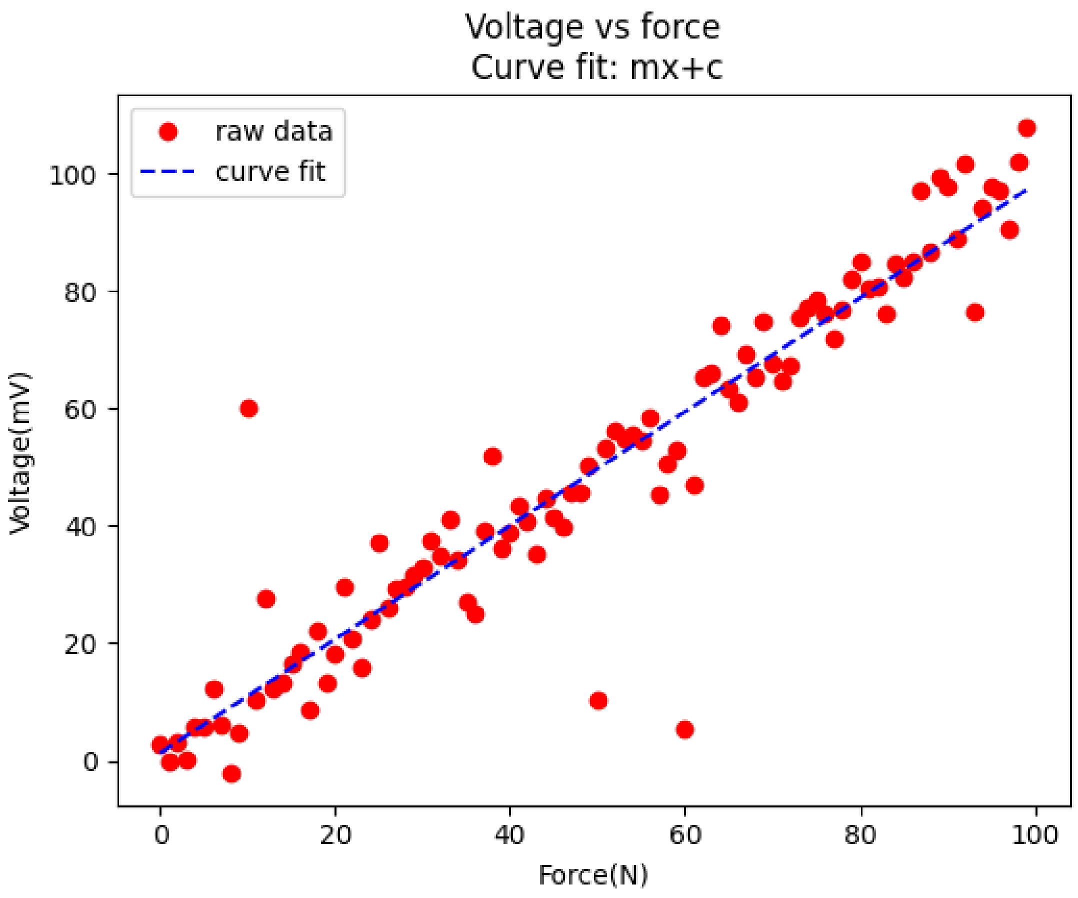
```
[ ]: def func(x, a, b):
         return a*x + b

     param, param_cov = curve_fit(func, p1["f"], p1["v"])
     print("coefficients:")
     print(param)
     print("Covariance:")
     print(param_cov)

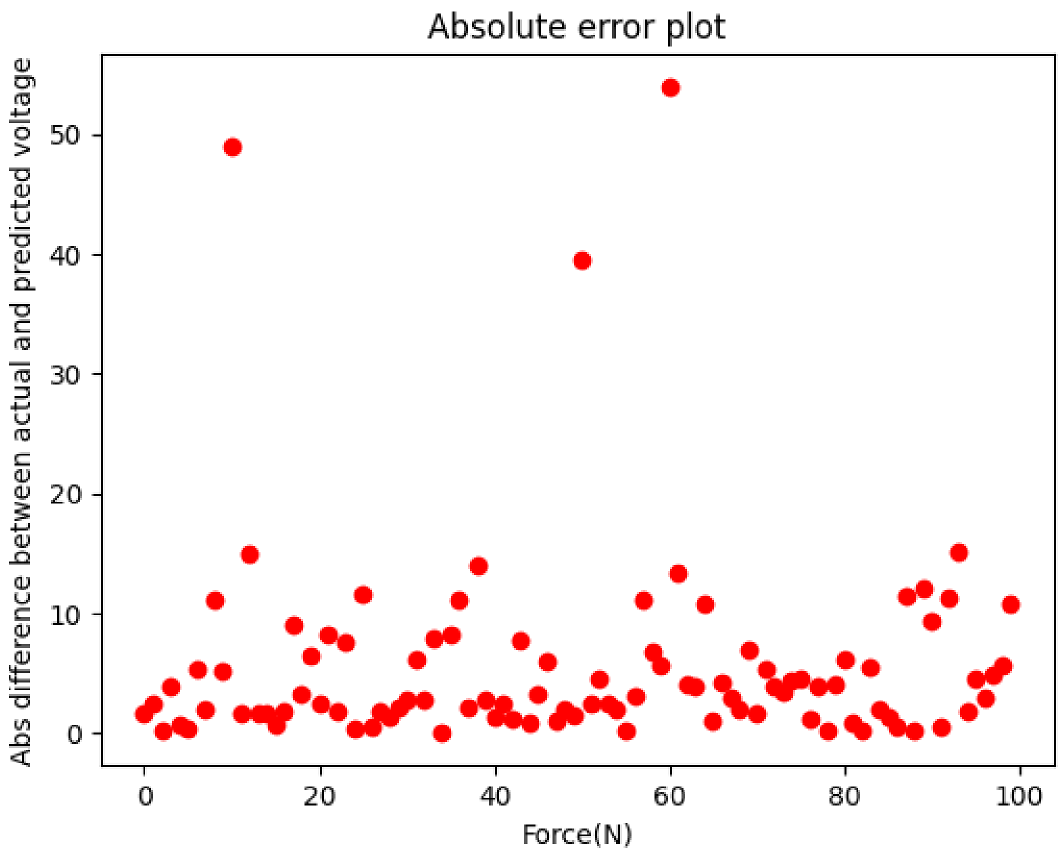
     v_tcap = param[0]*p1["f"] + param[1]

     plt.plot(p1["f"], p1["v"], 'o', color ='red', label ="raw data")
     plt.plot(p1["f"], v_tcap, '--', color ='blue', label ="curve fit")
     plt.xlabel("Force(N)")
     plt.ylabel("Voltage(mV)")
     plt.title("Voltage vs force\n Curve fit: mx+c")
     plt.legend()
     plt.show()
```

```
coefficients:
[0.96908216 1.27142099]
Covariance:
[[ 1.24053509e-03 -6.14064857e-02]
 [-6.14064857e-02  4.07329614e+00]]
```



```
[ ]: # p1.f.describe(percentiles=[0.05,0.95])
     _diff = abs(p1.v - v_tcap)
     _err_f = _diff/100
     plt.plot(p1['f'], _diff, 'o', color ='red', label ="data")
     plt.xlabel("Force(N)")
     plt.ylabel("Abs difference between actual and predicted voltage")
     plt.title("Absolute error plot")
     plt.show()
     lower_bound, upper_bound =  np.percentile(_diff, [0, 95])
```



```
[ ]: # remove outliers
     # _df = p1["f"][_diff < upper_bound]
     _max_er = np.percentile(_diff, 95)
     # print("Accuracy of the model is:", _max_er.max())
     # 52.3 mV
     print("The maximum error is:", _max_er)
     # _value = param[0]*p1["f"] + param[1]
     _force = (52.3 - param[1])/param[0]
     print(f"The force at 52.3mV is from {_force + _max_er}: to {_force - _max_er}")

     _forces = [_force + _max_er, _force - _max_er]

     # calculate the standard deviation
     _sd = np.std(_forces)
     # print("The standard deviation is:", _sd)
```

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The maximum error is: 14.02706850457919
The force at 52.3mV is from 66.68367593351635: to 38.62953892435798
```