In [ ]:
```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
import csv
from scipy.optimize import curve_fit
from scipy.stats.distributions import  t
import seaborn as sns
```

In [ ]:
```
p2 = pd.read_csv('Q3_second_part_data.csv')
```

In [ ]:
```
df = p2[1:]
df = df.rename(columns={'Force(N)': 'f', "Voltage(mv)": "v_20d", "Unnamed: 2": "v_2
                        "Unnamed: 4": "v_28d", "Unnamed: 5": "v_30d", "Unnamed: 6"
                        "Unnamed: 8": "v_36d", "Unnamed: 9": "v_38d", "Unnamed: 10'
df
```

Out[ ]:

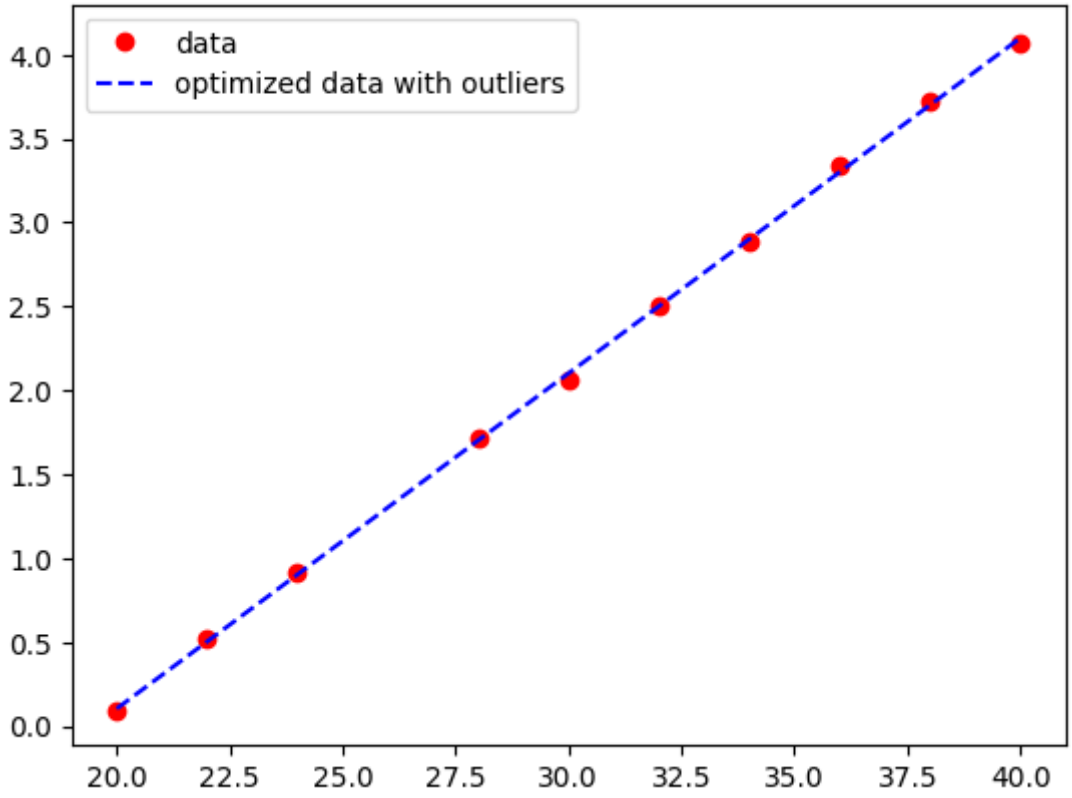
	f	v_20d	v_22d	v_24d	v_28d	v_30d	v_32d	
1	0.0	6.006905827	-2.423679253	-1.722799529	-6.933400103	4.402350146	5.127226165	-2.43
2	1.0	-3.106761297	3.539384952	3.135793254	-2.957198958	9.181497501	8.988834808	5.95
3	2.0	-2.461201398	7.46668575	8.063233487	3.908818507	9.376398329	10.85365658	6.87
4	3.0	2.610435387	3.308725995	13.58262318	4.24332935	3.220049265	3.353392541	11.6
5	4.0	0.222915629	3.810135577	-9.309103593	13.37303825	13.63587884	12.51947226	19.9
...	...	...	...	...	...	...	...	
96	95.0	6.562904759	49.72346432	79.81869583	157.7428474	207.8793925	243.1154874	276.
97	96.0	9.007491572	43.21648247	87.47228247	165.6245551	208.6206138	236.790158	287.
98	97.0	12.03388393	47.35557317	87.22951431	166.5920236	206.4196747	241.9564881	272.
99	98.0	7.384459586	62.02480688	86.17742592	168.0524904	202.459576	243.3556196	292.
100	99.0	6.73246141	56.0909217	86.26760537	171.3225548	208.9561533	249.6213226	286.

100 rows × 11 columns

In [ ]:
```
cols = df.columns[1:]

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

_params = []
_params_cov = []
_a2 = []

for i in cols:
    _val = df[i].astype(float)

    # param, param_cov = curve_fit(func, _val, df["f"])
    param, param_cov = curve_fit(func, df["f"], _val)
    _params.append(param)
    _params_cov.append(param_cov)

for i in _params:
```

```
    _a2.append(i[0]) # a2 coefficient for each column in linear fit

_col_num = [20, 22, 24, 28, 30, 32, 34, 36, 38, 40]

# _col_num = _col_num[2:] # if we are not considering 20 and 22
# _a2 = _a2[2:]
```

In [ ]:
```
param_t, param_cov_t = curve_fit(func, _col_num, _a2)

_a2 = np.array(_a2)
_col_num = np.array(_col_num)
ans = param_t[0]*_col_num + param_t[1]

plt.plot(_col_num, _a2, 'o', color ='red', label ="data")
plt.plot(_col_num, ans, '--', color ='blue', label ="optimized data with outliers")
plt.legend()
plt.show()
param_t
```



Out[ ]:
```
array([ 0.19982715, -3.89377181])
```

In [ ]:
```
_coeff33 = param_t[0]*33 + param_t[1]
_volt = 67.0
c1 = 3
_f = (_volt + c1)/_coeff33
print("The force is: ", _f)
```

```
The force is:  25.920893318868856
```

Out[ ]:
```
array([3.34050096, 1.12537046])
```

In [ ]:
```
_voltage_values = [2.1, 10.5, 67.0, 34.3, 11.3, 88.9]

_force_33 = []
_force_39 = []

_c = _params[7][1]
```

```
for i in _voltage_values:
    """calculate for 33 degrees"""
    _tmp = param_t[0]*33 + param_t[1]
    _volt = i
    _f = (_volt - _c)/_tmp
    _force_33.append(_f)

    """calculate for 39 degrees"""
    _tmp = param_t[0]*39 + param_t[1]
    _volt = i
    _f = (_volt - _c)/_tmp
    _force_39.append(_f)

"""calculate deviation"""

_tmp = param_t[0]*36 + param_t[1]
_volt = 3
_f = _volt/_tmp
print(_f)
print(-_f)
```

```
0.9090893476364842
-0.9090893476364842
```

In [ ]:
```
_force_39
```

Out[ ]:
```
[0.24993787773652817,
 2.4040673137746573,
 16.89315221093588,
 8.507434049216021,
 2.6092224981592413,
 22.509275383463862]
```

In [ ]:
```
_force_33
```

Out[ ]:
```
[0.3609038318738258,
 3.4714110301380887,
 24.393274923225093,
 12.284514758553499,
 3.7676498109251617,
 32.50281154727121]
```

In [ ]:
```
_c
```

Out[ ]:
```
1.1253704638806696
```

In [ ]: