

Experiment 2a:

Aim: To fit a straight line across current vs voltage data and find the value of resistance.

Software packages used: language- Python3, packages- Pandas, Numpy, Matplotlib

Theory: The least square fit method minimizes the sum of the squares of the errors or deviations between the observed values and the fitted values.

The formula for the line of best fit is $y = ax + b$, where a is the slope and b is the y-intercept. We require that our fitted straight line passes through the origin, hence, $b = 0$. In this case, the slope can be found out using the formula

$$a = \frac{\sum x_i y_i}{\sum x_i^2}$$

The error associated with the slope is

$$a_{err} = \sqrt{\frac{\sum (y - ax_i)^2}{n - 1}} \times \frac{\sqrt{\sum x_i^2}}{\sum x_i^2}$$

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In [1]: import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
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The file "current_vs_voltage.csv" contains data of voltage vs current

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In [2]: #reading data from file

df = pd.read_csv("current_vs_voltage.csv")
```

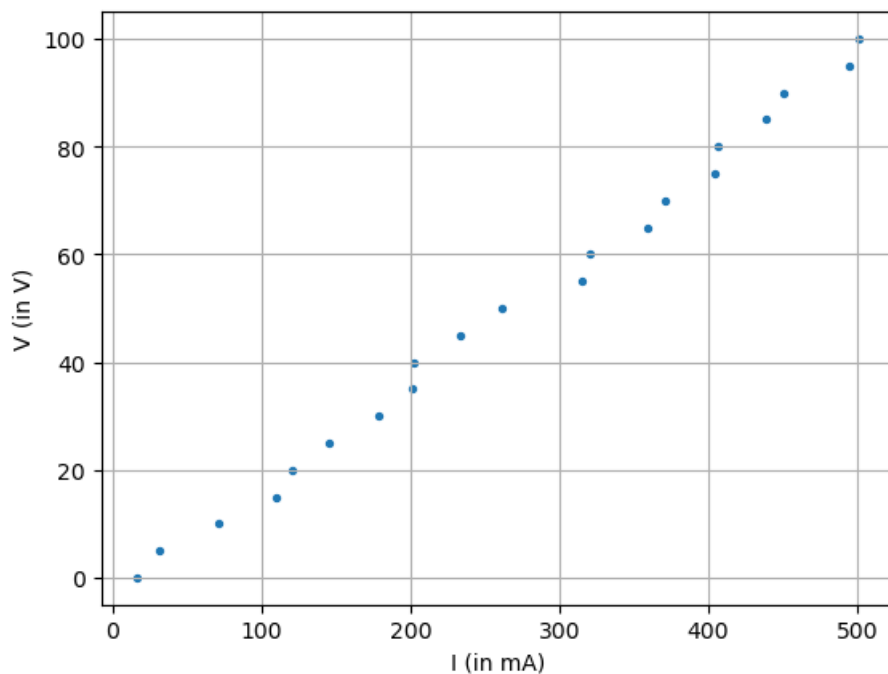
```
In [3]: #displaying data

display(df)
```

	V (in V)	I (in mA)
0	0.0	16.80
1	5.0	30.83
2	10.0	70.61
3	15.0	109.55
4	20.0	120.12
5	25.0	144.93
6	30.0	178.29
7	35.0	201.44
8	40.0	202.74
9	45.0	233.24
10	50.0	261.46
11	55.0	315.47
12	60.0	320.38
13	65.0	358.82
14	70.0	370.38
15	75.0	404.07
16	80.0	406.62
17	85.0	439.07
18	90.0	450.36
19	95.0	494.03
20	100.0	501.31

In [4]: *# visualising data*

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df.plot(kind='scatter',y = 'V (in V)',x= 'I (in mA)', s = 8, grid = True)
plt.show()
```



In [5]: *# slope calculation*

```
a = ((df['I (in mA)']*df['V (in V)']).sum())/((df['I (in mA)']**2).sum())
print("slope =", a )
slope = 0.19022367504599955
```

In [6]: *# slope error calculation*

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a_1 = (((df['V (in V)'] - a*df['I (in mA)'])*2).sum())/20
a_2 = (((df['V (in V)']*2).sum())*0.5)/((df['V (in V)']*2).sum())
a_error = a_1 * a_2

print("slope error =", a_error )

slope error = 0.03569561676327668

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In [7]: # generating points for straight line
# y = ax

y = a*df['I (in mA)']

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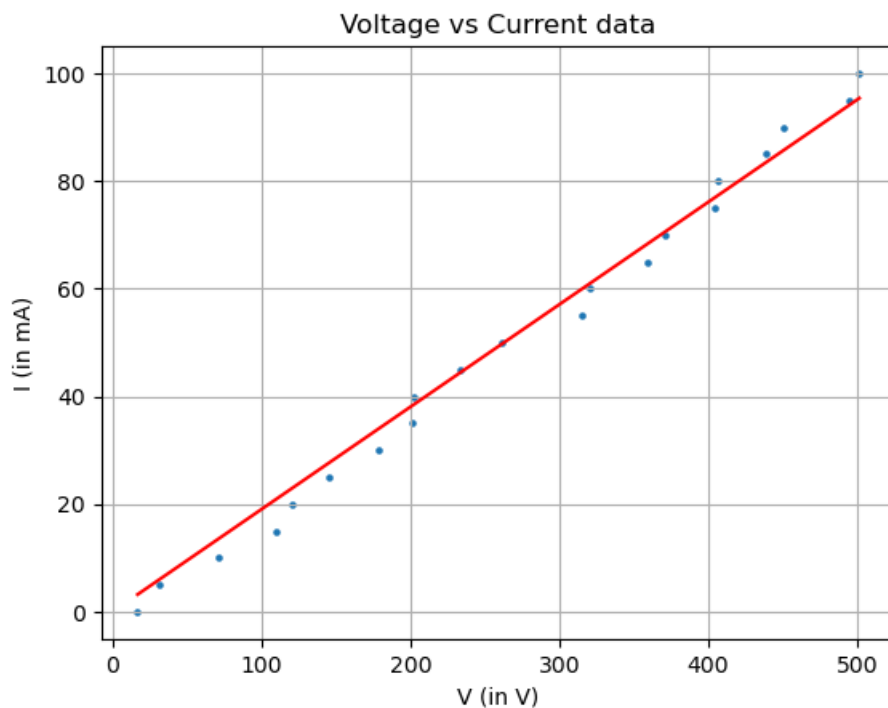
In [8]: # plotting data points and straight line

plt.plot(df["I (in mA)"], y, color = 'r')
plt.scatter(df['I (in mA)'], df["V (in V)"], s = 5)

plt.title("Voltage vs Current data")
plt.xlabel("V (in V)")
plt.ylabel("I (in mA)")
plt.grid()

plt.show()

```



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In [15]: # resistance calculation

resistance = a * 1000
error = a_error * 1000
print("resistance = %0.2f" %(resistance), u"\u00B1", "%0.2f" %(error), u"\u003A9" )

resistance = 190.22 ± 35.70 Ω

```