Curve Fitting (Mr. P Solver)

Video Link: https://youtu.be/peBOquJ3fDo (https://youtu.be/peBOquJ3fDo)

Codes: https://www.youtube.com/redirect?event=video_description&redir_token=QUFFLUhqa0lKYWJKTGs5amFORmhraS0tV1NCcjBlWDF1d3xBG
(https://www.youtube.com/redirect?event=video_description&redir_token=QUFFLUhqa0lKYWJKTGs5amFORmhraS0tV1NCcjBlWDF1d3xBG

In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
import scipy as sp
import pandas as pd
from scipy.optimize import curve_fit
```

Given some $x_{data} = [\dots]$ and $y_{data} = [\dots]$ and a model function f that dpends on unknown parameter(s) β. The goal is to find optimal set of parameters β such that the function $y = f(x, \beta)$ best resembles the data.

1. One way of doing this is to minimize $\sum_i (f(x_i, \beta) - y_i)^2$ by adjusting the parameters in β. Here x_i and y_i are the i^{th} data point. This is called **Least Square Method**.
2. If the y_i data points have corresponding errors on them, then minimizing $\sum_i (f(x_i, \beta) - y_i)^2/\sigma_i^2$ gives the **maximum likelihood** estimate for β.

Consider the model function $f(x, \beta) = f(x, a, b, c) = a(x-b)^2 + c$ for a given data (where $\beta = (a, b, c)$ are the optimal parameters). We fit the data in the following steps;

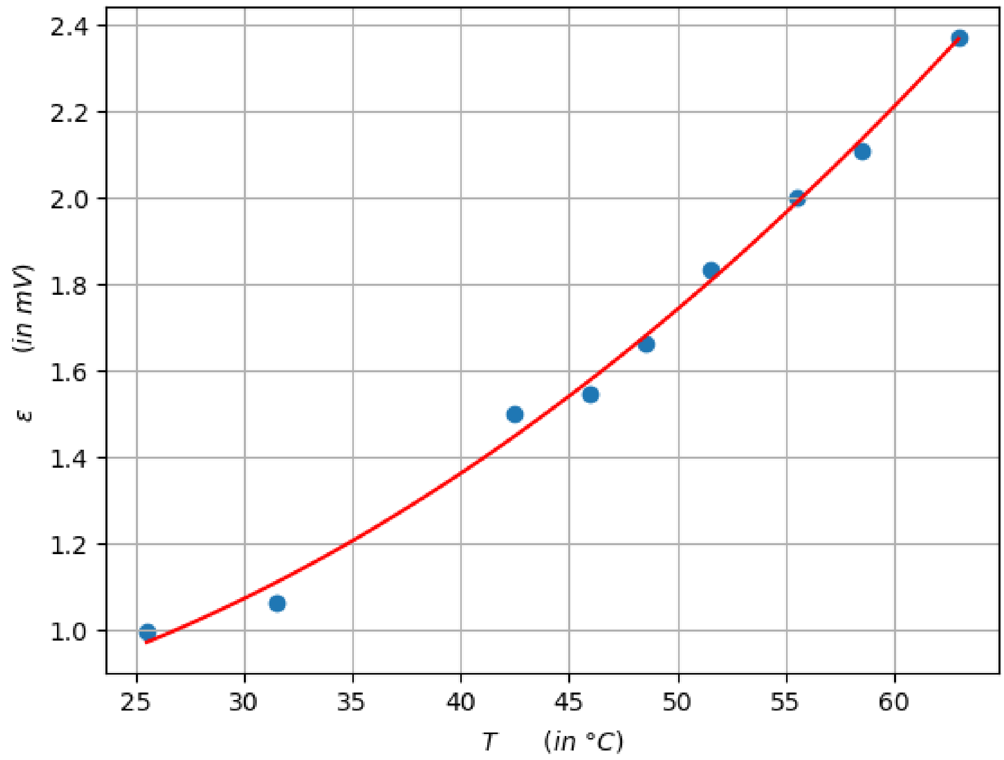
1. Define the model function.
2. Use **`curve_fit`** function of `scipy`. It requires initial guesses of β.

In [2]:
```
x_data = np.array([25.5,31.5,42.5,46,48.5,51.5,55.5,58.5,63])
y_data = np.array([0.995,1.06,1.5,1.545,1.66,1.833,2,2.108,2.37])
```

In [3]:
```
def model_f(x, a, b, c):
    return a*(x-b)**2 + c
```

In [4]:
```
popt, pcov = curve_fit(model_f, x_data, y_data, p0=[3,2,-16])
a_opt, b_opt, c_opt = popt
x_model = np.linspace(min(x_data), max(x_data), 100)
y_model = model_f(x_model, a_opt, b_opt, c_opt)
```

In [5]:
```
plt.scatter(x_data,y_data)
plt.plot(x_model,y_model, color='r')
plt.xlabel('$T$ \t $(in$ $\degree C)$')
plt.ylabel('$\epsilon$ \t $(in$ $mV)$')
plt.grid()
plt.show()
```



`curve_fit` gives *optimal parameters* `popt` and the corresponding *covariances* `pcov` .

In [ ]: