APL Assignment 3

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September 2024

1 Introduction

I am Deepak Charan S and this is my report for the third assignment of EE2703 course (Applied Programming Lab).

2 Overview:

In this assignment, we had to estimate various physical parameters using raw data (from the datasets) and Planck's formula

$$B_\lambda(\lambda, T)d\lambda = \frac{2hc^2}{\lambda^5}\frac{1}{e^{\frac{hc}{\lambda k_B T}} - 1}d\lambda,$$

where: B - Spectral Radiance
c - speed of light
h - Planck's constant
Kb - Boltzmann's constant
λ - Wavelength
T - Temperature

After getting some estimates, we also had to implement partial application to estimate one parameter while keeping others fixed
for all the functions, I used 'curve_fit' function from the *scipy.optimize* module to get a good estimate of the parameters

Note: since "d3.txt" had the best data, I have used that to compare my general and partial estimates

3 To run the notebook:

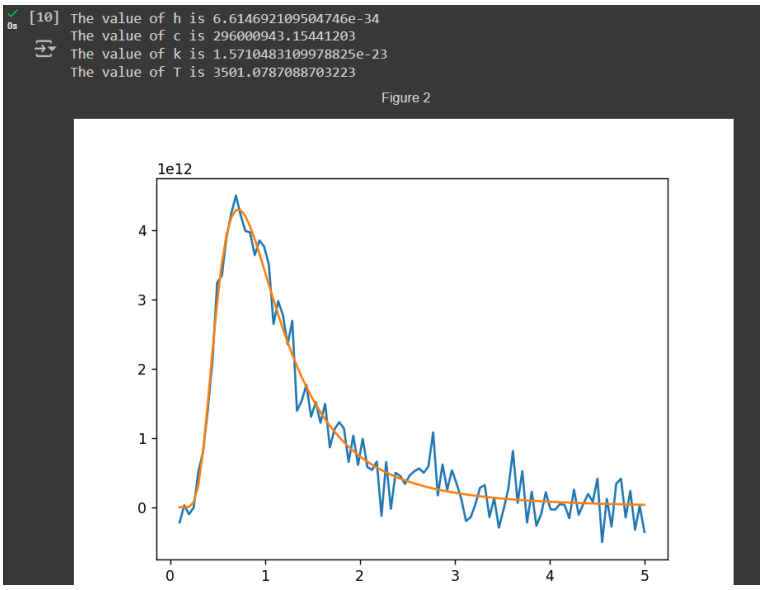
- Run the cells which imports the necessary libraries
- Upload the datasets provided (*"d1.txt","d2.txt","d3.txt","d4.txt"*) and first run the cells which read them
- Run the general function cell
- Now run the cells which plots the data and the curve fits of all 4 datasets (using the general function)
- After noting the general estimates, run the partial application cells and compare the estimates

4 Initial Estimation:

Initially, I wrote a function which returns the Planck's formula. This function uses h,c,t,Kb as parameters.
Upon reading and plotting the dataset and fitting a curve (whose function is the Planck's formula) on it, I get the following curves:

4.1 d1.txt

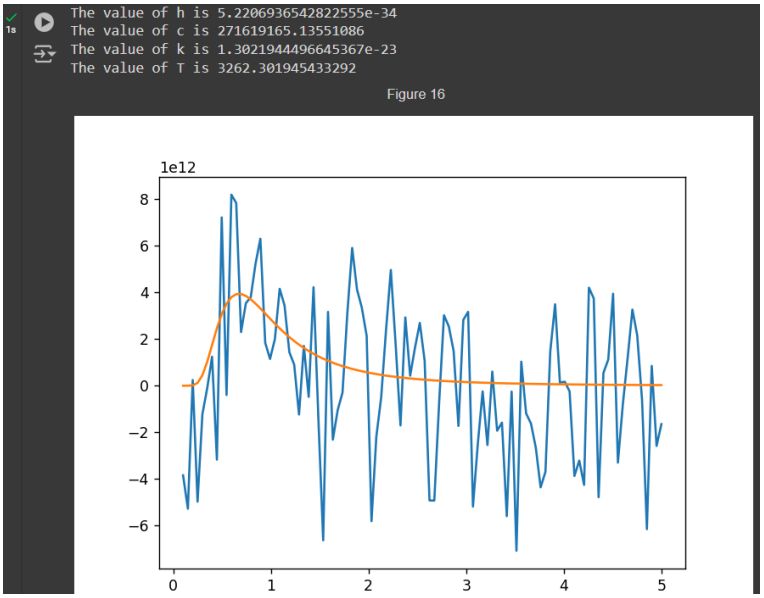
Initalising,
h= $6.69 * 10^{-34}$ J.s
c= $2.7 * 10^{8}$ m/s
t= $1.3 * 10^{-23}$ K
Kb= 3000 J.K^{-1}



4.2 d2.txt

Initalising,

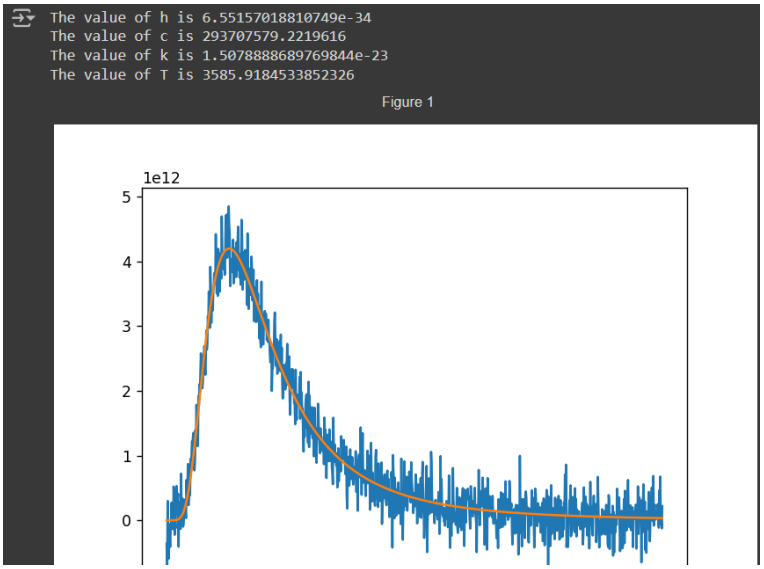
h= $7.8 * 10^{-34}$ J.s
c= $2.65 * 10^{8}$ m/s
t= $1.15 * 10^{-23}$ K
Kb= 3000 J.K^{-1}



4.3 d3.txt

Initalising,

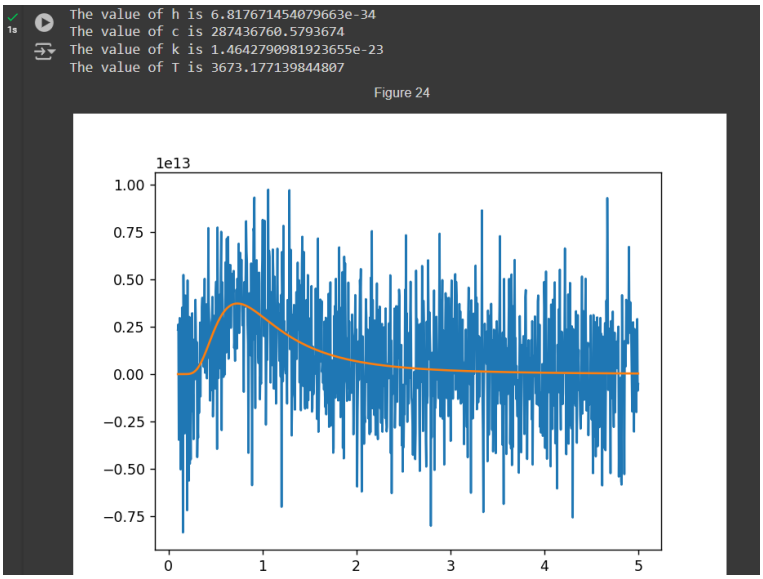
h= $6.5 * 10^{-34}$ J.s
c= $2.7 * 10^{8}$ m/s
t= $1.3 * 10^{-23}$ K
Kb= 3000 J.K^{-1}



4.4 d4.txt

Initalising,

h= $6.4 * 10^{-34}$ J.s
c= $2.7 * 10^{8}$ m/s
t= $1.35 * 10^{-23}$ K
Kb= 3002 J.K^{-1}

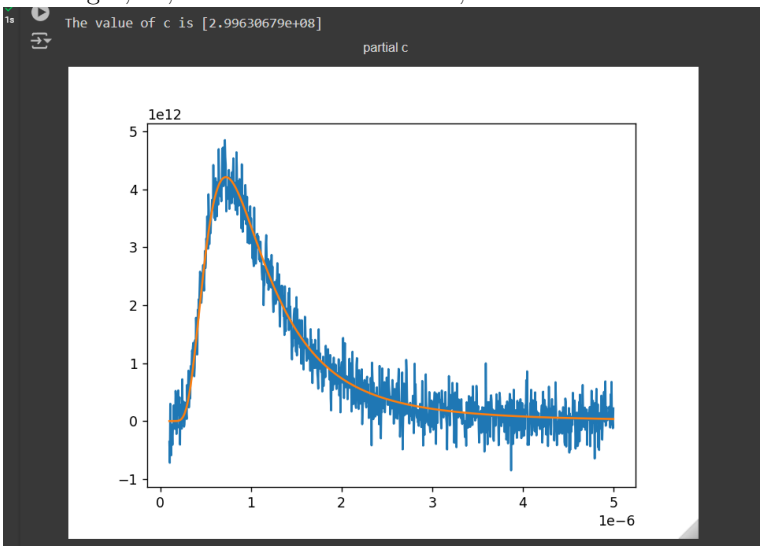


5 Partial Application:

In order to get a better estimate of the parameters, we know apply partial application.

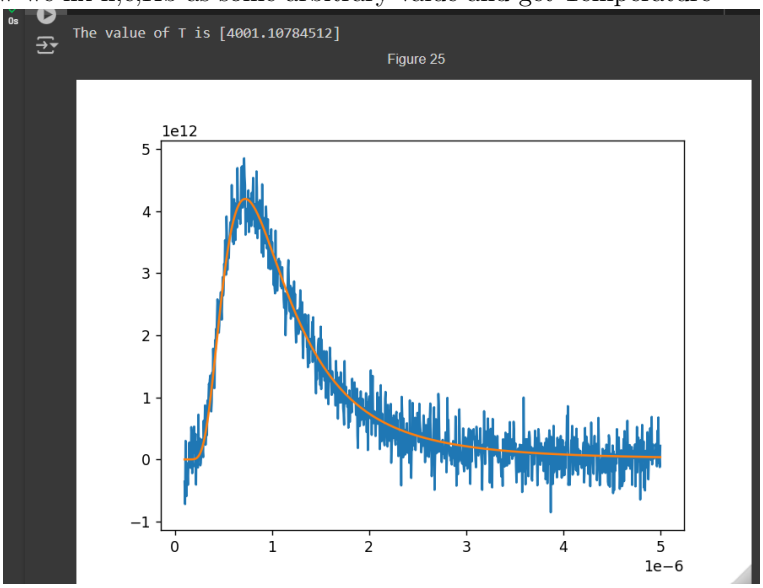
5.1 Speed of Light:

Upon fixing h,Kb,T as some random value, we estimate c



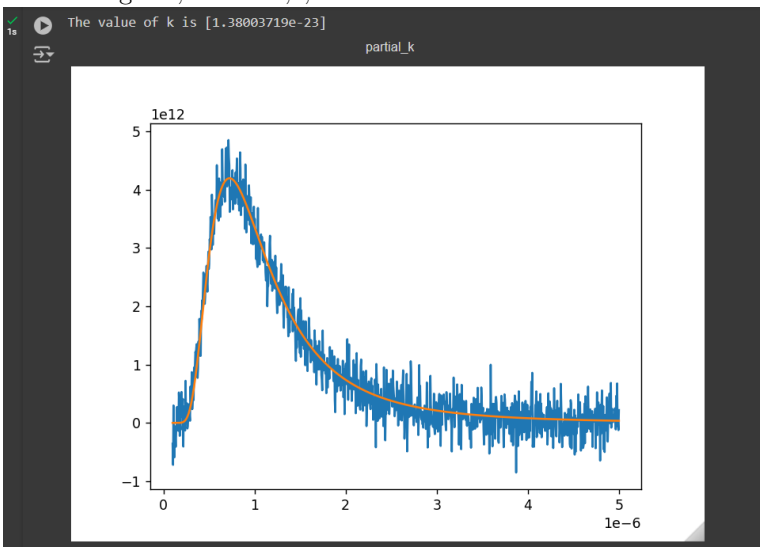
5.2 Temperature:

Now we fix h,c,Kb as some arbitrary value and get Temperature



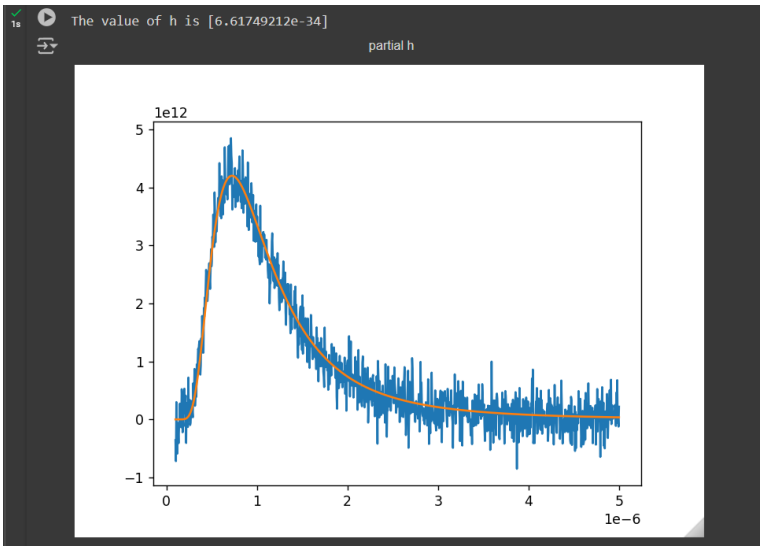
5.3 Boltzmann Constant:

For estimating Kb, we fix h,c,T and fit a curve



5.4 Planck's Constant:

Finally we fix c,Kb,T to estimate h



6 Observation:

The Initial Estimates were okay-ish but open partial application, we end up getting a better estimate of our parameters

Parameter	General	Partial
h	1.1232993041429142 %	0.12840157 %
c	2.097473592679461 %	0.12310701 %
Kb	9.267309346158283 %	0.00269494 %

7 References :

- *https : //docs.scipy.org/doc/scipy/reference/generated/scipy.optimize.curve_fit.html* To Understand The curve fit function provided by scipy
- My roommate, N Deenabandhan (EE23B022) and my friend Nishant Senthil Kumar (EE23B049) also helped me clear some doubts I had and helped me with an Overflow Error I was getting