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Lab Assesment-1

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1. Problem Statement :

An Advanced Sensing monitoring System uses various types of temperature Sensors such as thermoresistive, thermooptical, thermoElectric, thermoacoustic types. depending upon the complexity of the Sensing. Such as External factors and internal arrangement of Machines.

If we want to measure the temperature in a pipeline we can only use the thermoacoustic Sensor. as all other Sensing devices could not able to Sense

We can only measure very high temperature With the help of thermoElectric all other Sensors could not sustain high temperatures

Thermo optical Sensors could be used to detect the temperatures at a place which are at a depth / above the Ground.

Thermo-Resistive Sensors were used to ~~km~~ calculate the very Small Temperatures.

As a complex industry having almost all types of complexity such as oil Refinery usage of all four Sensors were identified

Pseudocode :

1. Start
2. function Fanon (temp)
3. If (temp > 35) → Fanon = true;
4. Else → Fanon = false;
5. function Heateron (temp)
6. If (temp < 6) → Heateron = true
7. Else → Heateron = false;
8. & Define n (integer)
9. printf (" Enter your choice 1. Hemorector 2. Hemoprical 3. HemoElectric 4. Hermoacoustic ");
10. Scanf (" %d"; &n);
11. Switch (n) :
12. case 1
    input rcal
    ~~Hemo~~ import Hemorector Header file
    Hemorector (to, t, α, rcal);
    th = ((rcal(rt) - 1) / alpha + t;
    Fanon (th); Heateron(th)
    break
13. Case 2:
    input Emmicivity
    input Temp
    input density;
    input No. of Obj:
    Fanon (temp); Step 2 - 4
    Heateron (temp); Step 5 - 7
    Hemoaptical (α, E, T, d, n, G)
    Break;

14 Case 3:

```
int S   // S: Seebeck coefficient
int V   // V: voltage
int tcold // cold temp
double thot = (V/S) + tcold
Ramon (thot);
Heaterron (thot);
break;
```

15. Case 4:

```
input K; input S; input P
double V = (S*P) + pow(K*P,2)
int a = 100
int b = 50
double temp: 100 * a + b
Ramon (temp);
Heaterron (temp);
break;
```

16. default:

```
printf (" Incorrect input");
```

17 END

2. Problem analysis with numerical Example

Given,

Drift Rate = 0.6%

Accuracy Error

- Thermo Electric ±2.5°C
- Thermoresistive ± 1.0°C
- Thermo optical = ± 1.5°C
- Thermo-Acoustic ± 2.0°C

A) Thermo Electric Sensor

Formulae =

$V = S * (t_{hot} - t_{cold})$

$t_{hot} = (V/S) + t_{cold}$

$\boxed{t_{hot} = (V/S) + t_{cold}}$

$\boxed{t_n = (V/S) + t_c}$

i) Measured temp = 40°C ± 2°C

possible range = ~~37°C to 42.5°C~~

= 37.5°C to 42.5°C

ii) Apply Drift Range

Drift Rate : $1 + (0.006 \times \text{years})$

Meco temp : $40(1 + (0.006) 5) = 40 \times 1.03$

$= 41.2°C$

With Range : $41.2 - 2.5 \quad - \quad 41.2 + 2.5$

$= 38.7°C \quad . \quad 43.5°C$

$= \boxed{38.7°C \; . \; 43.5°C}$

2.

B) Thermo Resistive Sensor :-

$$R_t = R_0 (1 + \alpha(T - T))$$

e.g If measured = 40

1. By Accuracy Error

Range : 40 - 1.0 to 40 + 1.0

: (39 - 41)

Rang : 39°c - 41°c : 39°c - 41°c

2. By Applying Drift Rate

New temp after 5 years (t'')

$t'' = 40(1 + 0.006 \times 5)$

$= 40(1.03)$

$= 41.2$

By Applying Range

$= (41.2 - 1)$ to $(41.2 + 1)$

$= 40.2 - 42.2$

C) Thermo-optical Sensor :

a) Measured temp (t) : 40°c

By Accuracy Error : $40°c \pm 1.5$

$= (40°c - 1.5) - (40 + 1.5)$

$= (38.5 - 41.5)$

By Applying Drift Rate

Reco temp after 5 years (1°) : $40(1+(0.006)5)$

$= 40(1.03)$

$= 41.2$

By Accuracy

$\pm 1.5°C$

$= (41.2-1.5) - (41.2+1.5)$

$(39.7) - (42.7)$

$= \boxed{39.7°C - 42.7°C}$

D) Thermo-Acoustic Sensor

$$V = SP + (KP)^2$$

Let,

Measured temp (H) = 40

By Accuracy Error = $\pm 2.0°C$

$(40-2) - (40+2)$

Range = $\boxed{38-42}$

By Drift Rate :-

The temp after 5 years

$= 40(1+(0.006)5)$

$= 40(1.03)$

$= 41.2$

Accuracy Range

$= (41.2-2.0) - (41.2+2)$

$= \boxed{39.2 - 43.2}$

Result and Analysis :-

1. observed trends :-

→ Sensor trends varied due to accuracy errors and drift effects

→ Fan activated (when temp > 35°C, Heater Activated temp < 6°C

→ Sensor drift (0.6+ per year)

2. comparision of Sensors :

→ Thermoresistive : most Stable, least error (±1°C)

→ Thermoelectric :

Higher fluctuation (±2.5°C), prone to drift

→ Thermo-optical :

Moderate Accuracy (±1.5°C), quick Response

→ Thermo-Acoustic :

→ Affected by ambient noise, needs filtering

3. System Efficiency

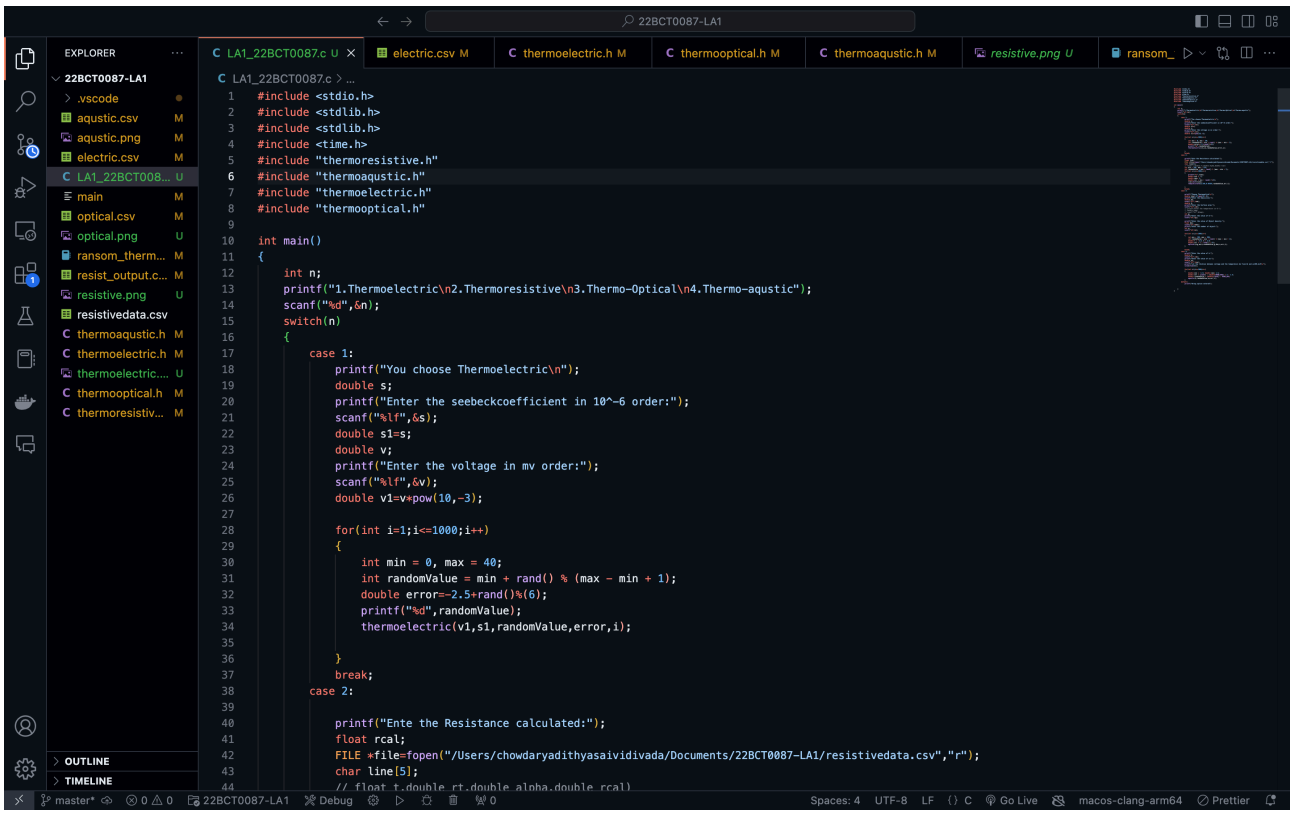
⊙ Averaging across improved Accuracy, Reducing outliners.

⊙ Anomaly detection, filtered Unreliable Sensor data

⊙ control System dynamically managed temparature.

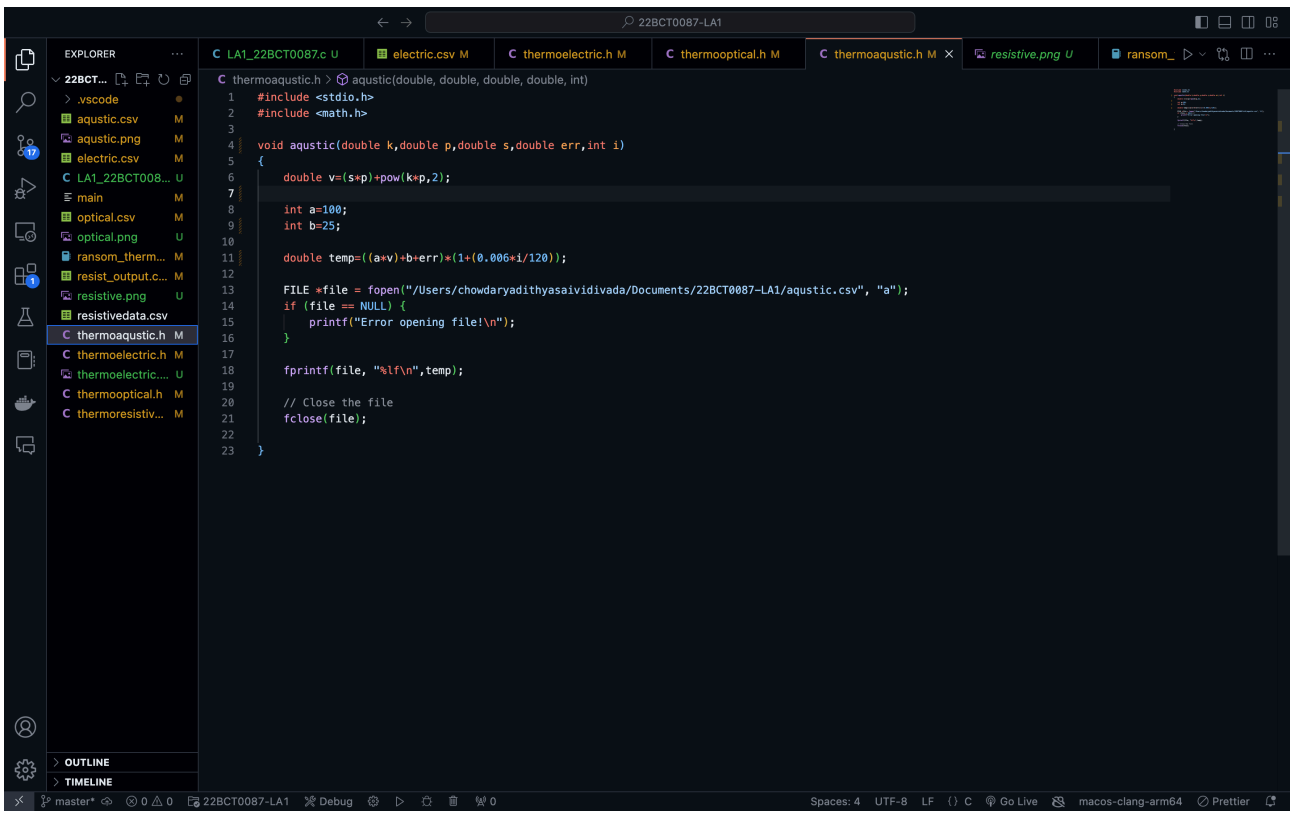
Output Screenshots:

MainFile:



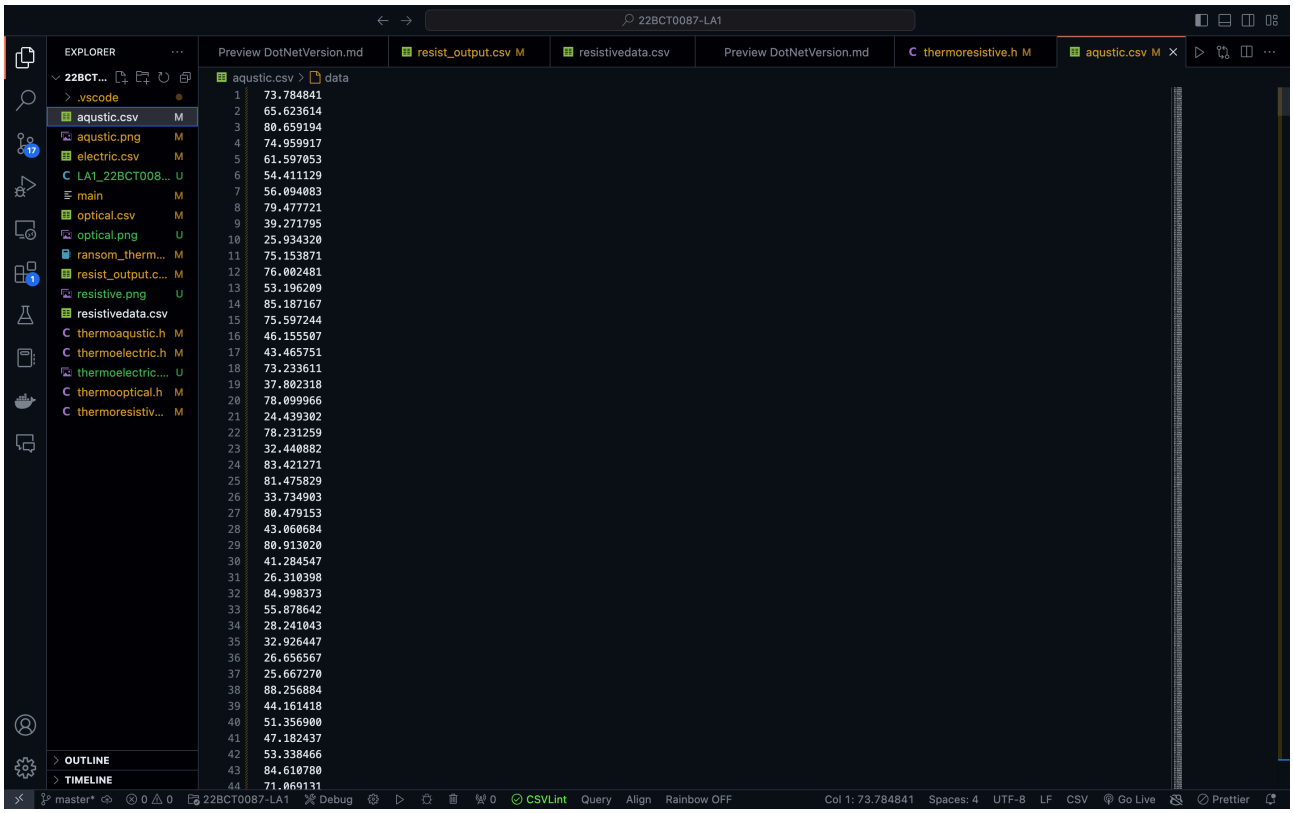
```c
#include <stdio.h>
#include <stdlib.h>
#include <stdlib.h>
#include <time.h>
#include "thermoresistive.h"
#include "thermoaqustic.h"
#include "thermoelectric.h"
#include "thermooptical.h"

int main()
{
    int n;
    printf("1.Thermoelectric\n2.Thermoresistive\n3.Thermo-Optical\n4.Thermo-aqustic");
    scanf("%d",&n);
    switch(n)
    {
        case 1:
            printf("You choose Thermoelectric\n");
            double s;
            printf("Enter the seebeckcoefficient in 10^-6 order:");
            scanf("%lf",&s);
            double s1=s;
            double v;
            printf("Enter the voltage in mv order:");
            scanf("%lf",&v);
            double v1=v*pow(10,-3);

            for(int i=1;i<=1000;i++)
            {
                int min = 0, max = 40;
                int randomValue = min + rand() % (max - min + 1);
                double error=-2.5+rand()%(6);
                printf("%d",randomValue);
                thermoelectric(v1,s1,randomValue,error,i);

            }
            break;
        case 2:

            printf("Ente the Resistance calculated:");
            float rcal;
            FILE *file=fopen("/Users/chowdaryadithyasaividivada/Documents/22BCT0087-LA1/resistivedata.csv","r");
            char line[5];
            // float t,double rt,double alpha,double rcal)
```

Thermoaqustic:

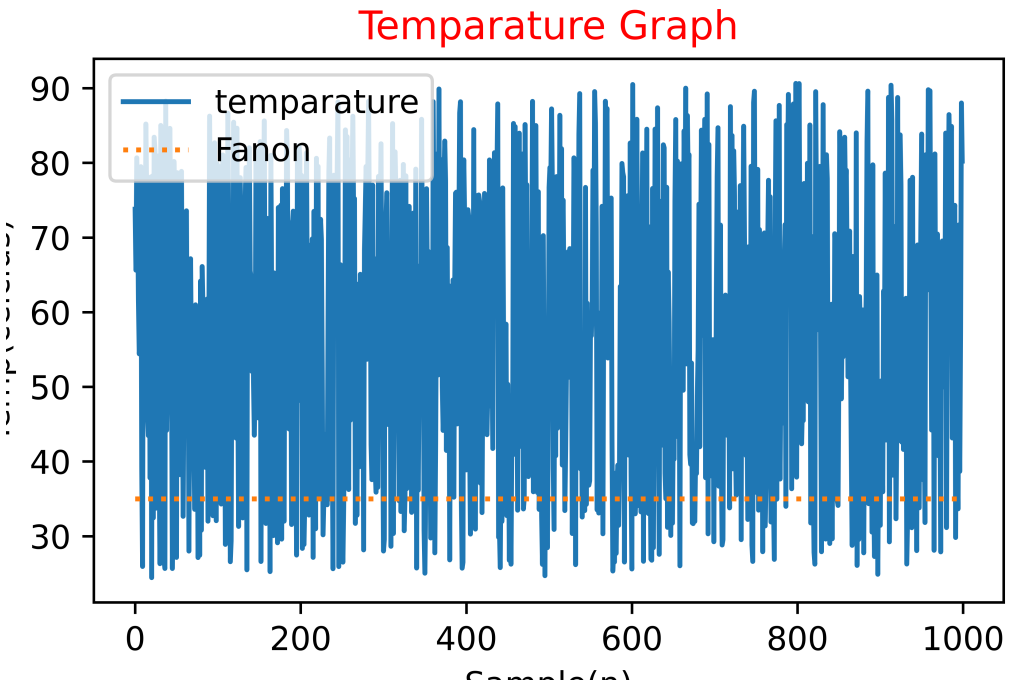


```c
#include <stdio.h>
#include <math.h>

void aqustic(double k,double p,double s,double err,int i)
{
    double v=(s*p)+pow(k*p,2);

    int a=100;
    int b=25;

    double temp=((a+v)+b+err)*(1+(0.006*i/120));

    FILE *file = fopen("/Users/chowdaryadithyasaividivada/Documents/22BCT0087-LA1/aqustic.csv", "a");
    if (file == NULL) {
        printf("Error opening file!\n");
    }

    fprintf(file, "%lf\n",temp);

    // Close the file
    fclose(file);

}
```

CSV file:



Plot:



Caption

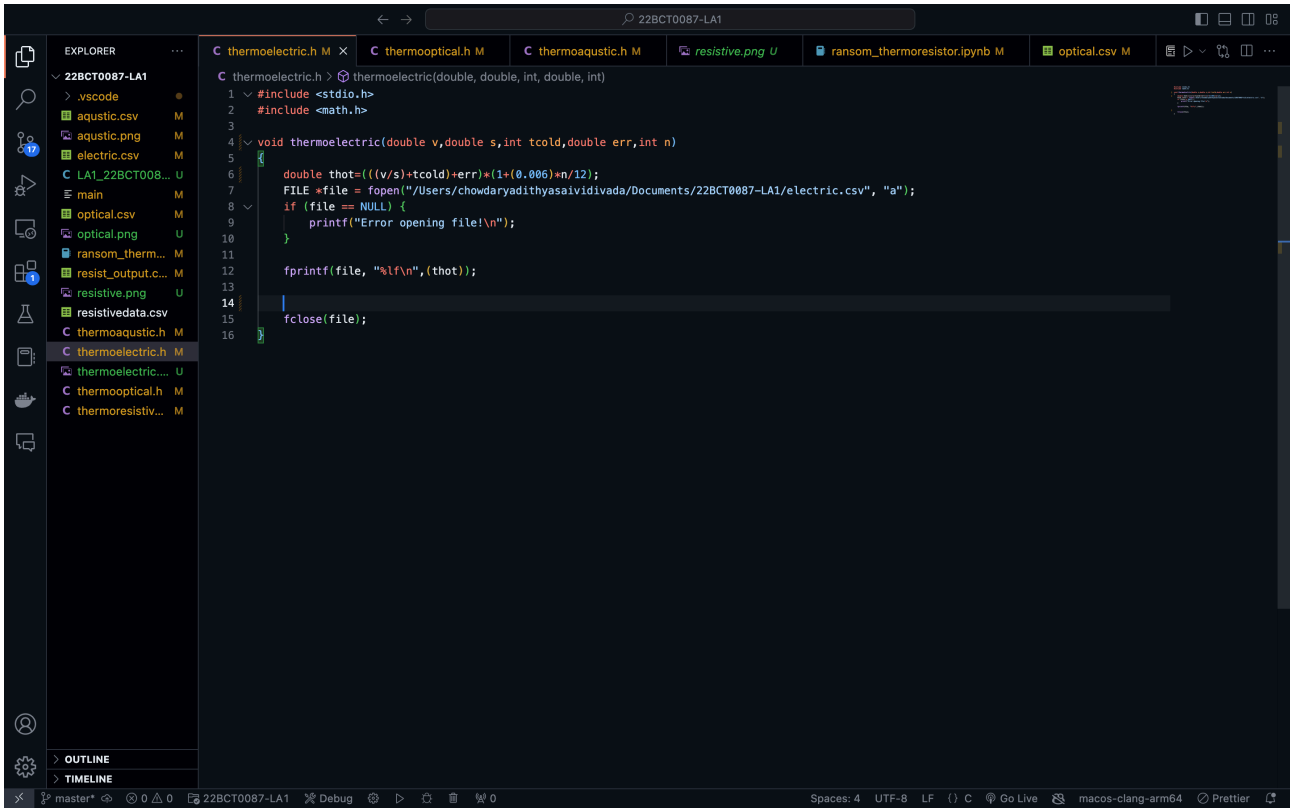
Header file:

```
#include <stdio.h>
#include <math.h>

void aqustic(double k,double p,double s,double err,int i)
{
    double v=(s*p)+pow(k*p,2);

    int a=100;
    int b=25;

    double temp=((a*v)+b+err)*(1+(0.006*i/120));

    FILE *file = fopen("/Users/chowdaryadithyasaividivada/Documents/22BCT0087-LA1/
aqustic.csv", "a");
    if (file == NULL) {
        printf("Error opening file!\n");
    }

    fprintf(file, "%lf\n",temp);

    // Close the file
    fclose(file);

}
```

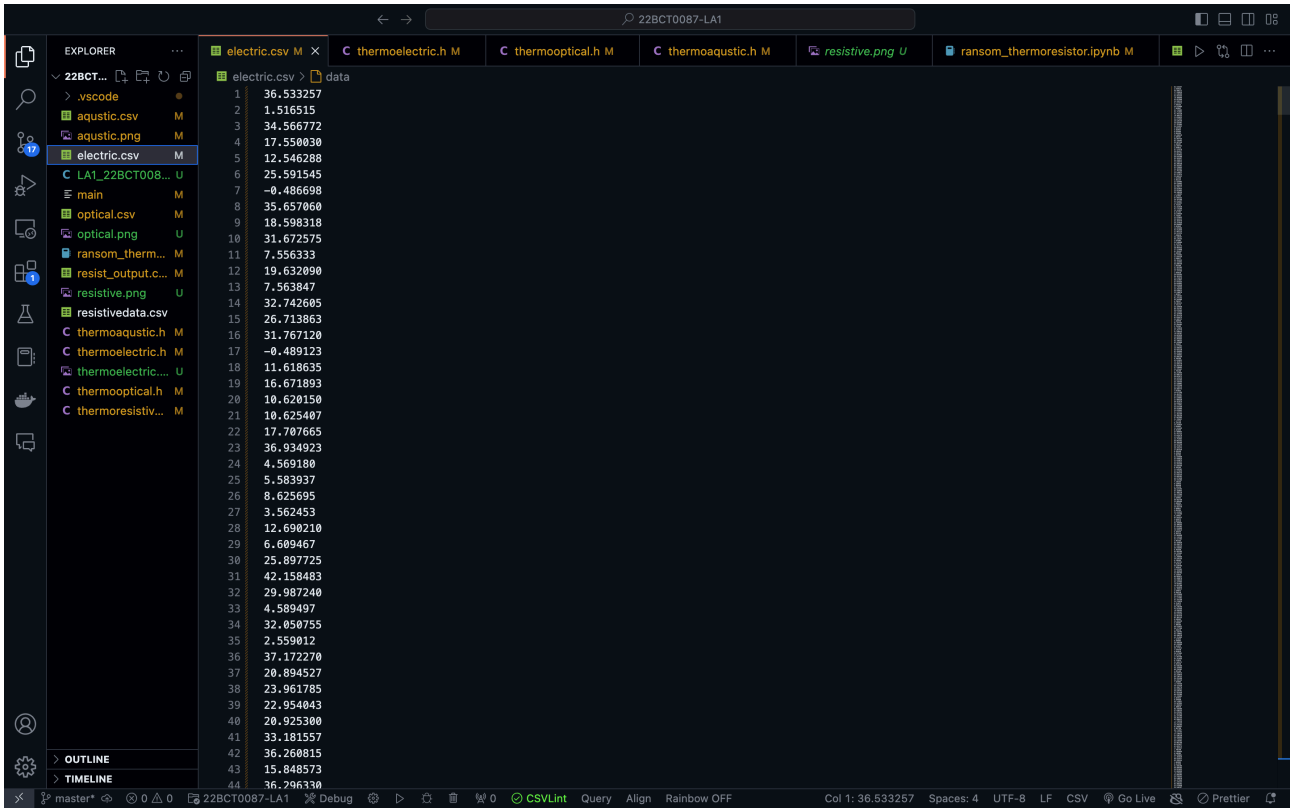
Thermoelectric:

Header file:

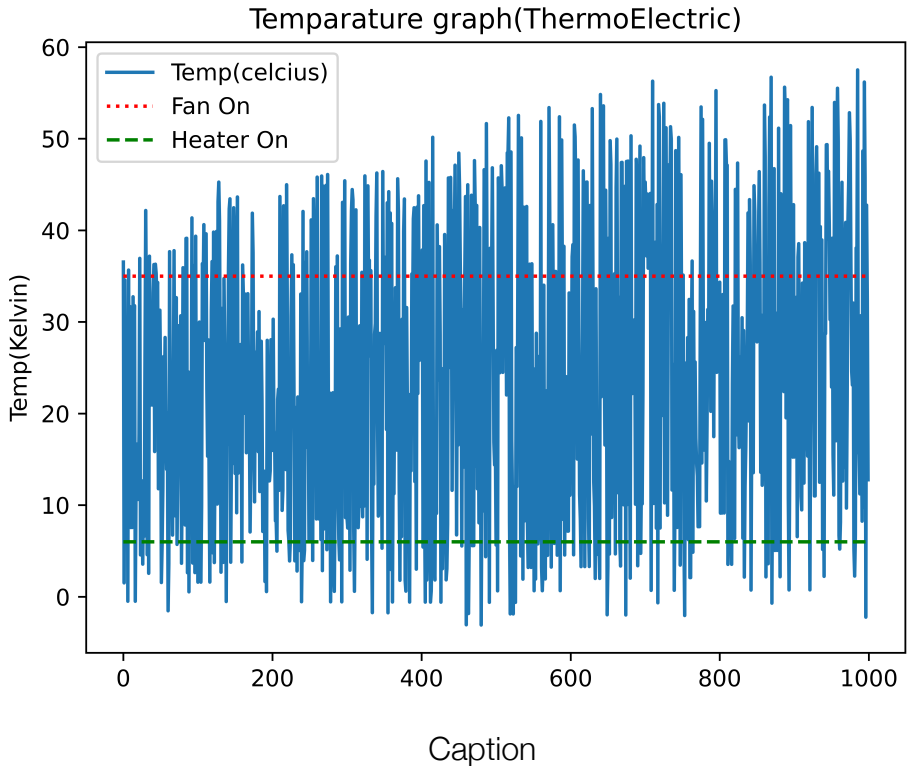
```
#include <stdio.h>
#include <math.h>

void thermoelectric(double v,double s,int tcold,double err,int n)
{
    double thot=(((v/s)+tcold)+err)*(1+(0.006)*n/12);
    FILE *file = fopen("/Users/chowdaryadithyasaividivada/Documents/22BCT0087-LA1/
electric.csv", "a");
    if (file == NULL) {
        printf("Error opening file!\n");
    }

    fprintf(file, "%lf\n",(thot));


    fclose(file);
}
```



CSV File:



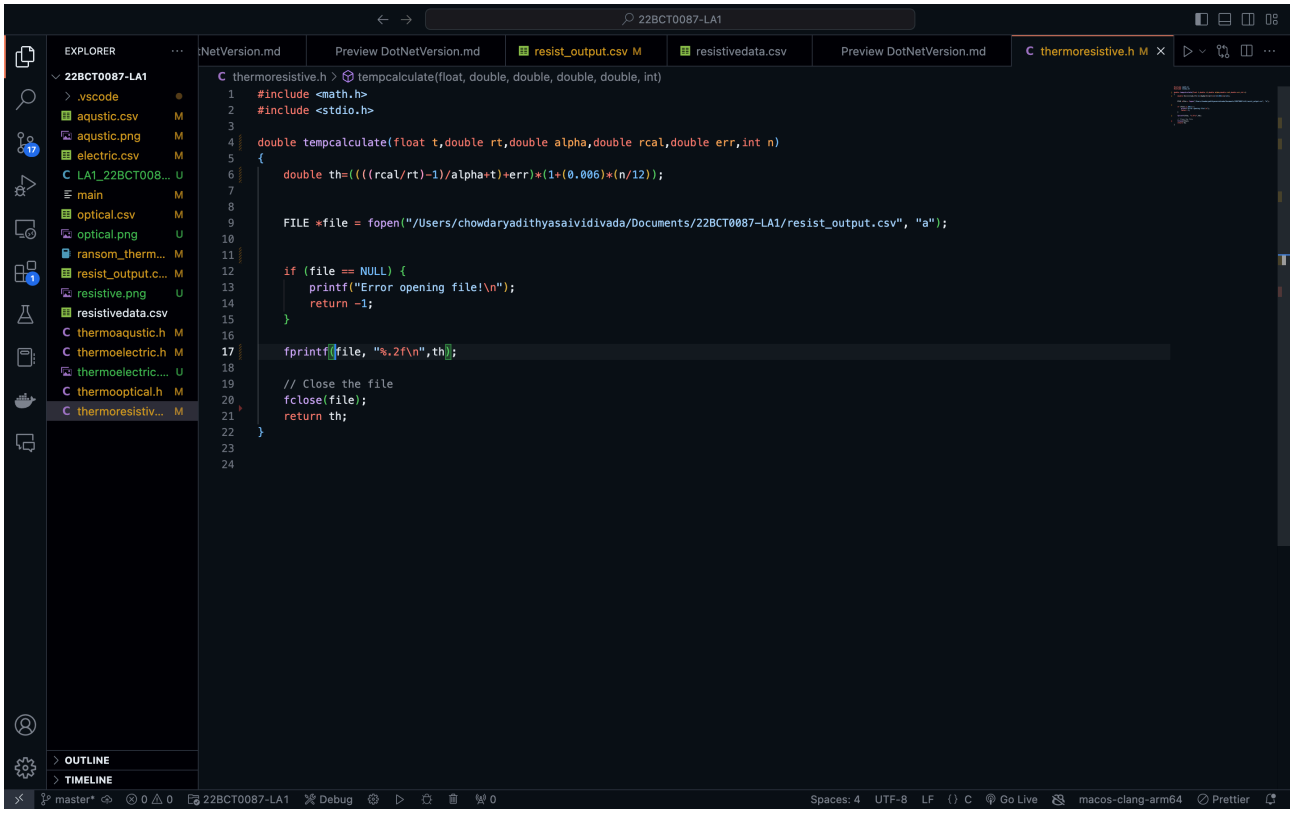
Plot:



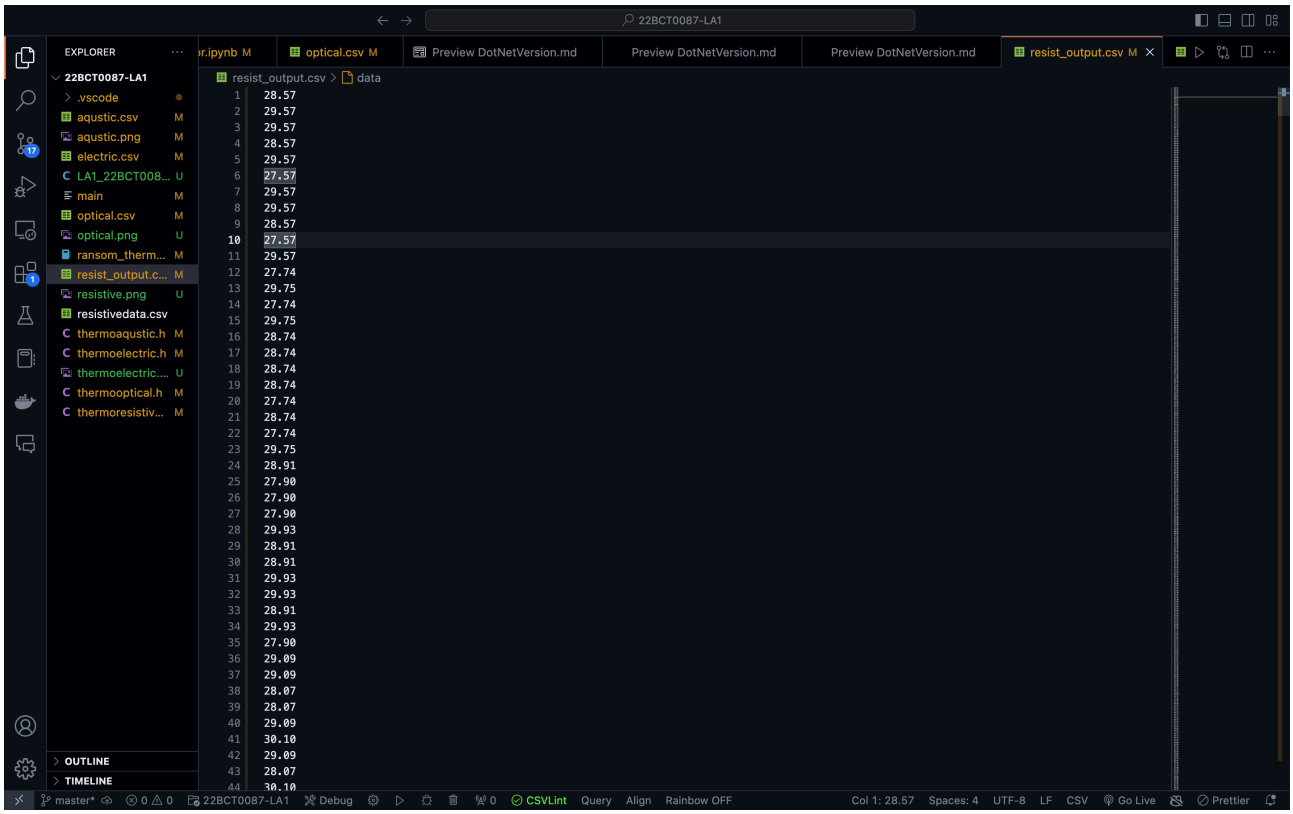
ThermoResistive:

Header File:

```
#include <math.h>
#include <stdio.h>

double tempcalculate(float t,double rt,double alpha,double rcal,double err,int n)
{
    double th=((((rcal/rt)-1)/alpha+t)+err)*(1+(0.006)*(n/12));


    FILE *file = fopen("/Users/chowdaryadithyasaividivada/Documents/22BCT0087-LA1/
resist_output.csv", "a");


    if (file == NULL) {
        printf("Error opening file!\n");
        return -1;
    }

    fprintf(file, "%.2f\n",th);

    // Close the file
    fclose(file);
    return th;
}
```



csvFile:


22BCT0087-LA1
EXPLORER
22BCT0087-LA1
.vscode
aqustic.csv M
aqustic.png M
electric.csv M
LA1_22BCT008... U
main M
optical.csv M
optical.png U
ransom_therm... M
resist_output.c... M
resistive.png U
resistivedata.csv
thermoaqustic.h M
thermoelectric.h M
thermoelectric.... U
thermooptical.h M
thermoresistiv... M
OUTLINE
TIMELINE
optical.csv M
Preview DotNetVersion.md
Preview DotNetVersion.md
Preview DotNetVersion.md
resist_output.csv M
resist_output.csv > data
28.57
29.57
29.57
28.57
29.57
27.57
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28.57
27.57
29.57
27.74
29.75
27.74
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27.74
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28.91
27.90
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29.93
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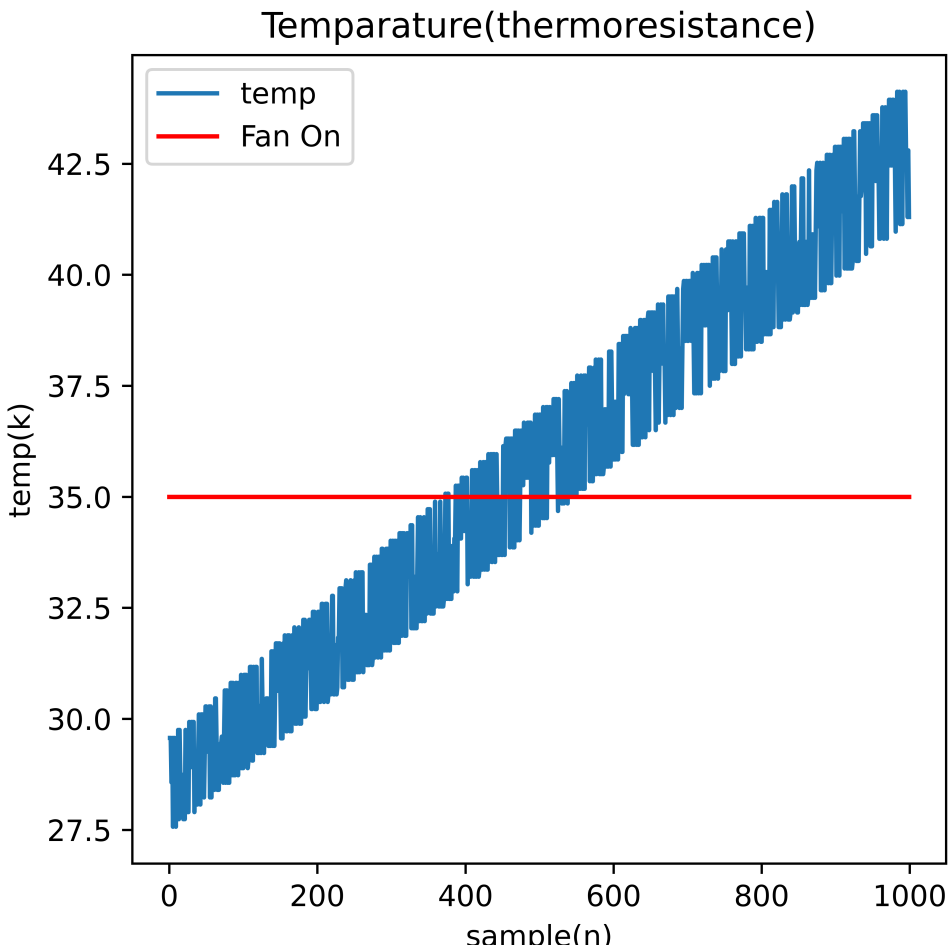
28.91
29.93
27.90
29.09
29.09
28.07
28.07
29.09
30.10
29.09
28.07
30.10
master*
22BCT0087-LA1
Debug
CSVLint
Query
Align
Rainbow OFF
Col 1: 28.57
Spaces: 4
UTF-8
LF
CSV
Go Live
Prettier

Plot:

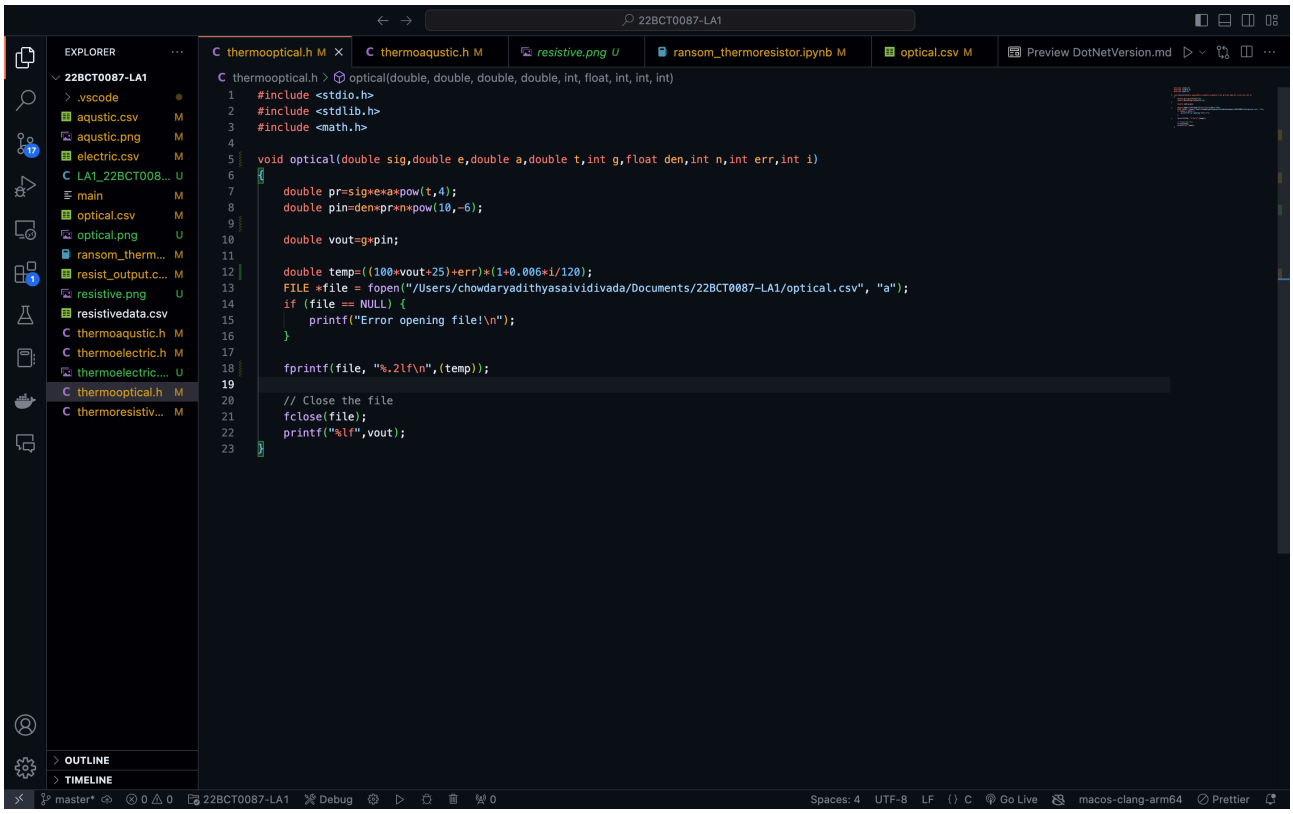


Caption

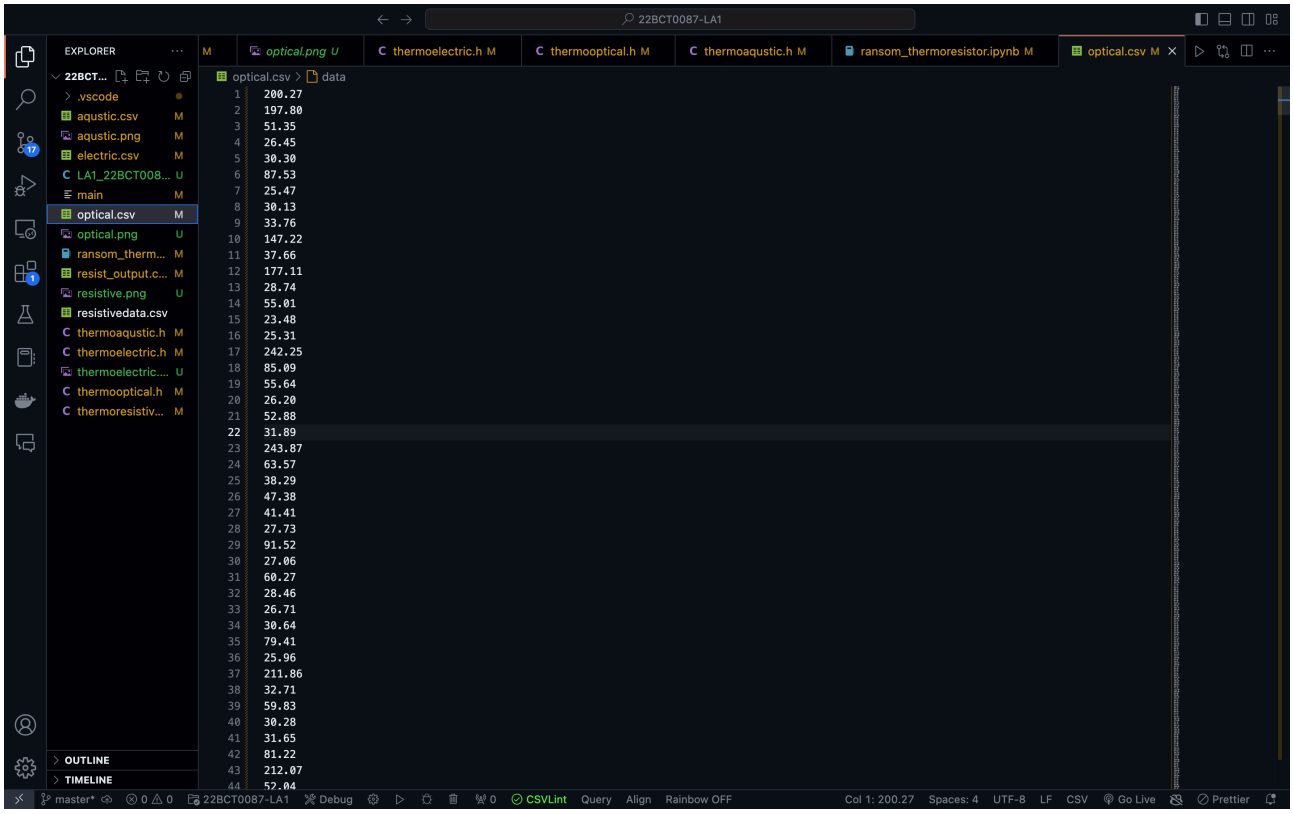
Thermooptical:

Headerfile:

```
#include <stdio.h>
#include <stdlib.h>
#include <math.h>

void optical(double sig,double e,double a,double t,int g,float den,int n,int err,int i)
{
    double pr=sig*e*a*pow(t,4);
    double pin=den*pr*n*pow(10,-6);

    double vout=g*pin;

    double temp=((100*vout+25)+err)*(1+0.006*i/120);
    FILE *file = fopen("/Users/chowdaryadithyasaividivada/Documents/22BCT0087-LA1/
optical.csv", "a");
    if (file == NULL) {
        printf("Error opening file!\n");
    }

    fprintf(file, "%.2lf\n",(temp));

    // Close the file
    fclose(file);
    printf("%lf",vout);
}
```



CSVFile:



Plot: