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Lab Assessment-1

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1. Problem Statement ::

An Advanced Sensing monitoring System uses various type of temperature Sensors such as Thermocouple, Thermo optical, thermo electric, thermocoustic 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 thermo electric all other sensors could not detect high temperatures.

Thermo optical Sensors could be used to detect the temperatures at a place which are at a depth 1 above the ground.

Thermo Resistive Sensors are used to calculate the very small temperatures.

As a complex industry having almost all type of complexity such as oil refinery usage of all four Sensors are justified.

Pseudocode :

1. Start
2. function Lemon (temp)
3. if (temp > 35) → Lemon = true;
4. else → Lemon = 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. Hemoptical
 3. Hemo-Electric 4. thermoclectric ");
10. Scanf (" %d ", &n);
11. Switch (n):
 12. case 1:
 input rcall
 thermo import Hemorector Header file
 Homorector (t0, t, d, rcal);
 th = (rcall/t) - 1 / alpha + t;
 Lemon (th); Heateron (th)
 break;
 13. case 2:
 input Emissivity
 input Tcmpl
 input density;
 input no. of Obj;
 Lemon (temp); Step 2 - 4
 Heateron (temp); Step 5 - 7
 Hemoptical (d, E, T, d, n, G)
 break;

14 Case 3:

```
int S // S: feedback coefficient  
int V // V: voltage  
int tcold // cold temp  
double thot = (V/S) + tcold  
Fanon (thot);  
Heateron (thot);  
break;
```

15. Case 4:

```
input k; input S; input P  
double V = (S*P) + P000(k*P,2)  
int a = 100  
int b = 50  
double temp = 100*a+b  
Fanon (temp);  
Heateron (temp);  
break;
```

16. default:

```
printf ("Invoked, input");
```

17 END.

2. problem analysis with numerical Example

Given,

$$\text{Drift Rate} = 0.6^\circ\text{C}$$

Accuracy Error

- Thermo Electric $\pm 2.5^\circ\text{C}$
- Thermoresistive $\pm 1.0^\circ\text{C}$
- Thermo optical $\pm 1.5^\circ\text{C}$
- Thermo-Acoustic $\pm 2.0^\circ\text{C}$

A) ThermoElectric Sensor

Formulae =

$$V = S \cdot (t_{\text{meas}} - t_{\text{cold}})$$

$$t_{\text{meas}} = (V/S) + t_{\text{cold}}$$

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

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

i) Measured temp = $40^\circ\text{C} \pm 2^\circ\text{C}$

possible range = ~~$37.5^\circ\text{C} \text{ to } 42.5^\circ\text{C}$~~
 $= 37.5^\circ\text{C} \text{ to } 42.5^\circ\text{C}$

ii) Apply Drift Range

$$\text{Drift Rate} = 1 + (0.006 \cdot \text{years})$$

$$\text{New temp.} \quad 40 \left(1 + (0.006 \cdot 5) \right) = 40 \cdot 1.03 \\ = 41.2^\circ\text{C}$$

$$= 41.2^\circ\text{C}$$

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

$$= 38.7^\circ\text{C} \quad - \quad 43.5^\circ\text{C}$$

$$\approx \boxed{38.7^\circ\text{C} \dots 43.5^\circ\text{C}}$$

2

B) Thermo Resistive Sensor :-

$$R_t = R_0 (1 + \alpha(t - t_0))$$

e.g if measured = 40

1. By Accuracy Error

$$R_{\text{range}} = 40 - 1.0 \quad \text{to} \quad 40 + 1.0$$

$$= (39 - 41)$$

$$R_{\text{avg}} = \frac{39^{\circ}\text{C} + 41^{\circ}\text{C}}{2} = \boxed{39^{\circ}\text{C} - 41^{\circ}\text{C}}$$

2. By Applying Drift Rate

New temp after 5 years (t'')

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

$$\approx 40 (1.03)$$

$$\approx 41.2$$

By Applying Range

$$= (41.2 - 1) \quad \text{to} \quad (41.2 + 1)$$

$$\therefore \boxed{40.2 - 42.2}$$

C) Thermo-optical Sensor:

1st, Measured temp (t): 40°C

By Accuracy Error: $40^{\circ}\text{C} \pm 1.5$

$$= (40^{\circ}\text{C} - 1.5) \quad \text{to} \quad (40^{\circ}\text{C} + 1.5)$$

$$\therefore \boxed{(38.5 - 41.5)}$$

By Applying Drift Rate

$$\text{New temp after 5 years (1')} = 40^\circ C (1 + 0.06)^5 \\ = 40(1.03) \\ = 41.2$$

By Accuracy

$$t \pm 1.5^\circ C \\ = (41.2 - 1.5) - (41.2 + 1.5) \\ = 39.7 - 42.7 \\ = [39.7^\circ C - 42.7^\circ C]$$

D) Thermo. Acoustic Sensor

$$V = 8P + (KP)^2$$

Let,

$$\text{Measured temp (t)} = 40$$

By Accuracy Error = $\pm 2.0^\circ C$

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

$$\text{Range} = [38 - 42]$$

By Drift Rate :

The temp after 5 years

$$= 40(1 + 0.06)^5 \\ = 40(1.03) \\ = 41.2$$

Accuracy Range

$$= (41.2 - 2.0) - (41.2 + 2) \\ = [39.2 - 43.2]$$

Result and Analysis :-

1. observed trends:-

- Sensor trends varied due to accuracy errors and drift effects
- Fan activated when temp $> 35^{\circ}\text{C}$, heater activated temp $< 6^{\circ}\text{C}$
- Sensor drift (0.6° per year)

2. comparison of sensors:-

→ Tremoresistive ; most stable, least error ($\pm 1^{\circ}\text{C}$)

→ Thermoelectric:

higher fluctuation ($\pm 25^{\circ}\text{C}$), prone to drift

→ Thermo-optical :-

Moderate Accuracy ($\pm 1.5^{\circ}\text{C}$), quick Response

→ Thermo-Anemotic:

→ Affected by ambient noise, needs filtering

3. System Efficiency

- Averaging across improved Accuracy, reducing outliers.
- Anomaly detection, filtered unreliable sensor data
- central System dynamically managed temperature.

Output Screenshots:

MainFile:

master" & cd ..' being typed." data-bbox="107 116 987 886"/>

CD command entered in the terminal.

```
22BCT0087-LA1
```

```
cd "/>master" & cd ..
```

File Explorer showing project structure and code files:

- 22BCT0087-LA1
- .vscode
- electric.csv M
- thermolectric.h M
- thermooptical.h M
- thermoacoustic.h M
- resistive.png U
- ransom_.png

Code Editor showing C code for a thermoelectric system simulation:

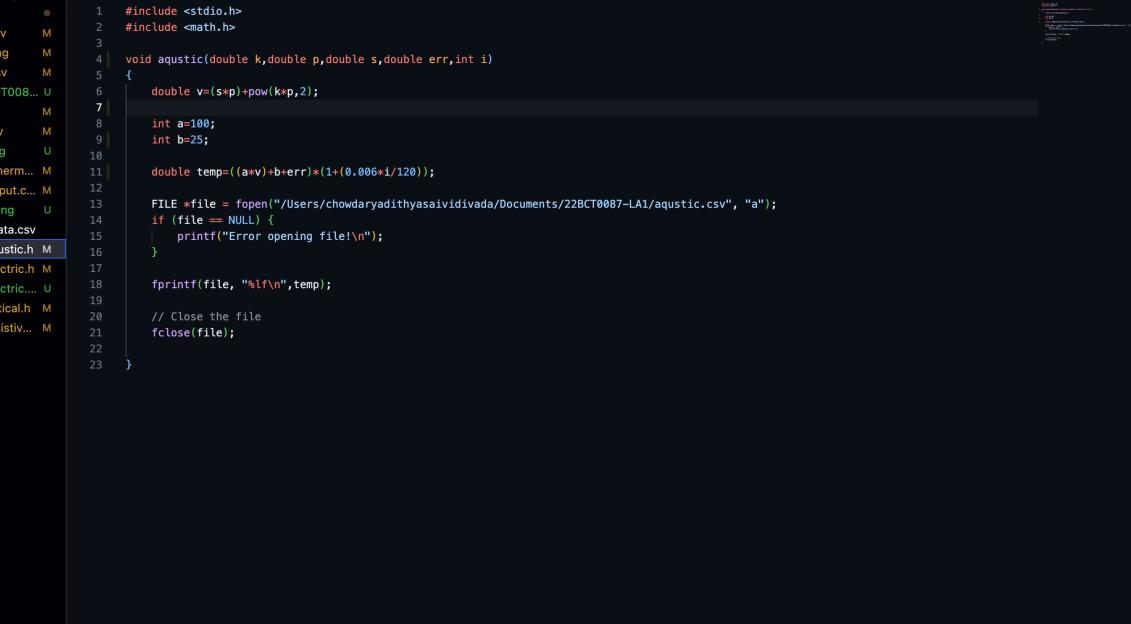
```
C LA1_22BCT0087.c x electric.csv M thermolectric.h M thermooptical.h M thermoacoustic.h M resistive.png U ransom_.png
```

```
#include <stdio.h>
#include <stdlib.h>
#include <stdlib.h>
#include <time.h>
#include "thermoresistive.h"
#include "thermoacoustic.h"
#include "thermolectric.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 sl=s;
            double v;
            printf("Enter the voltage in mv order:");
            scanf("%lf",&v);
            double vl=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(vi,sl,randomValue,error,i);
            }
            break;
        case 2:
            printf("Ente the Resistance calculated:");
            float rcal;
            FILE *file=fopen("/Users/chowdaryadithyaasiividivada/Documents/22BCT0087-LA1/resistivedata.csv","r");
            char line[5];
            // float t.double rt.double alpha.double rcall
```

Thermoacoustic:



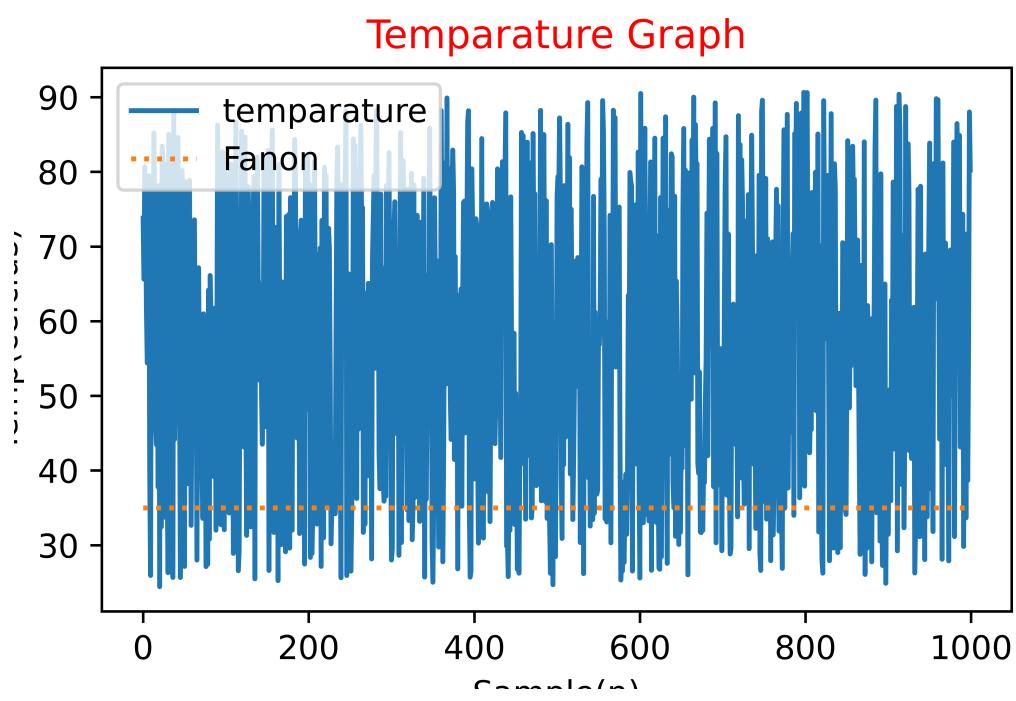
The screenshot shows a VS Code interface with the following details:

- Explorer View:** Shows files in the project: `22BCT...`, `vscode`, `aqustic.csv`, `aqustic.png`, `electric.csv`, `C LA1_22BCT008...`, `main`, `optical.csv`, `optical.png`, `ransom_therm...`, `resist_output.c...`, `resistive.png`, and `resistivedata.csv`. The file `thermoaquistic.h` is currently selected.
- Editor View:** Displays the content of `thermoaquistic.h`. The code includes headers for `stdio.h` and `math.h`, defines a function `aqustic` that takes `k, p, s, err, i` as parameters, and calculates `v = (s*p) * pow(k*p, 2)`. It then initializes `a=100` and `b=25`, and calculates `temp = ((a+v)+b+err)*(1+(0.006*i/120))`. The code then opens a file named `aqustic.csv` in append mode, checks if it's NULL, and prints an error message if so. It then prints the calculated `temp` value to the file using `fprintf`. Finally, it closes the file using `fclose`.
- Bottom Status Bar:** Shows the current branch is `master`, the file is `22BCT0087-LA1`, and the editor mode is `Debug`. It also displays system information like `Spaces: 4`, `UTF-8`, `LF`, and developer tools like `Go Live` and `Prettier`.

CSV file:

The screenshot shows a Microsoft Visual Studio Code (VS Code) interface. The left side features the Explorer sidebar with a tree view of files and folders. The main area displays a code editor with a CSV file named 'aquistic.csv'. The status bar at the bottom provides information about the current file ('22BCT0087-LA1'), the line number (44), the column number (71), and the word count (69131). The bottom right corner includes icons for Go Live and Prettier.

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/chowdaryadithyasaiividava/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:

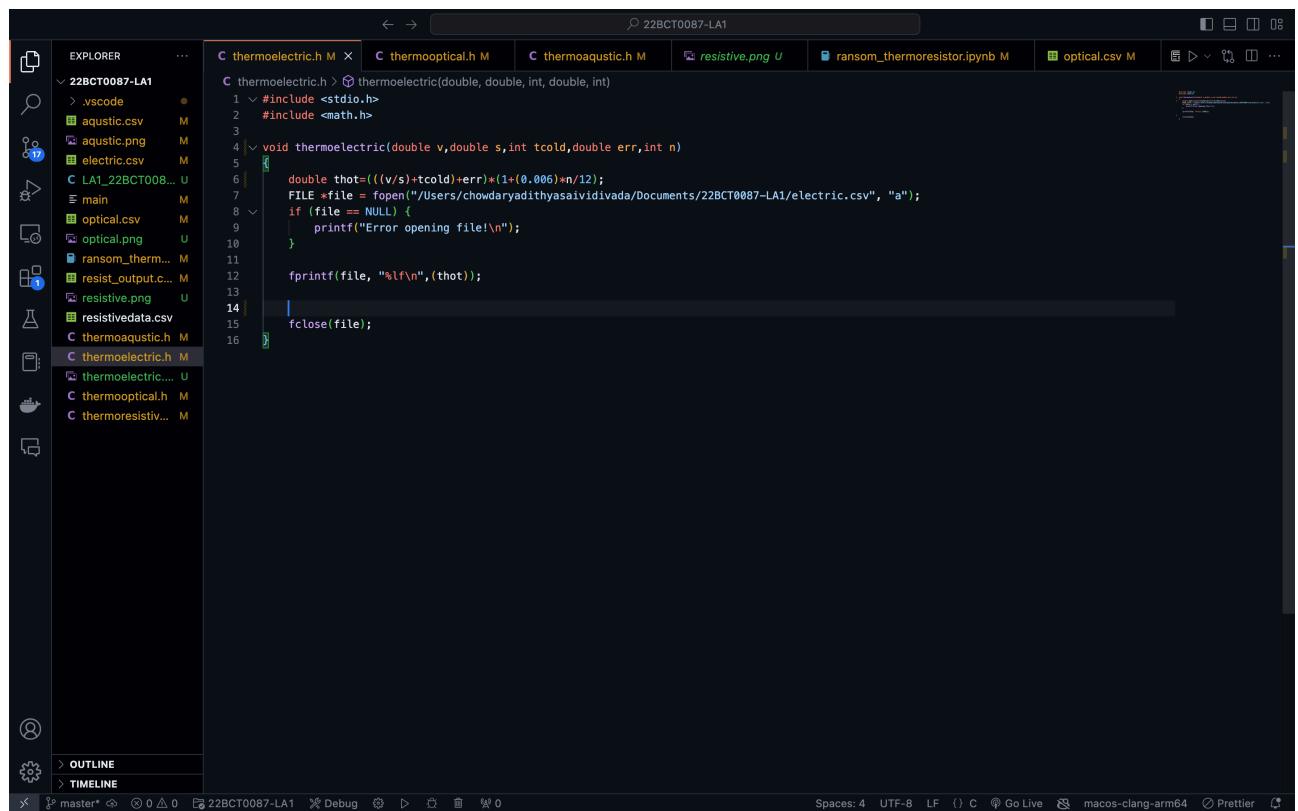
Header file:

```
#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/chowdaryadithyasaivdivada/Documents/22BCT0087-LA1/electric.csv", "a");
    if (file == NULL) {
        printf("Error opening file!\n");
    }

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

    fclose(file);
}
```



```
22BCT0087-LA1
```

```
C thermoelectric.h M C thermooptical.h M C thermoacoustic.h M resistive.png U ransom_thermoreistor.ipynb M optical.csv M
```

```
C thermoelectric.h > thermoelectric(double, double, int, double, int)
1 #include <stdio.h>
2 #include <math.h>
3
4 void thermoelectric(double v,double s,int tcold,double err,int n)
5 {
6     double thot=((v/s)+tcold)+err*(1+(0.006*n/12));
7     FILE *file = fopen("/Users/chowdaryadithyasaivdivada/Documents/22BCT0087-LA1/electric.csv", "a");
8     if (file == NULL) {
9         printf("Error opening file!\n");
10    }
11
12    fprintf(file, "%lf\n", (thot));
13
14
15    fclose(file);
16 }
```

```
OUTLINE
```

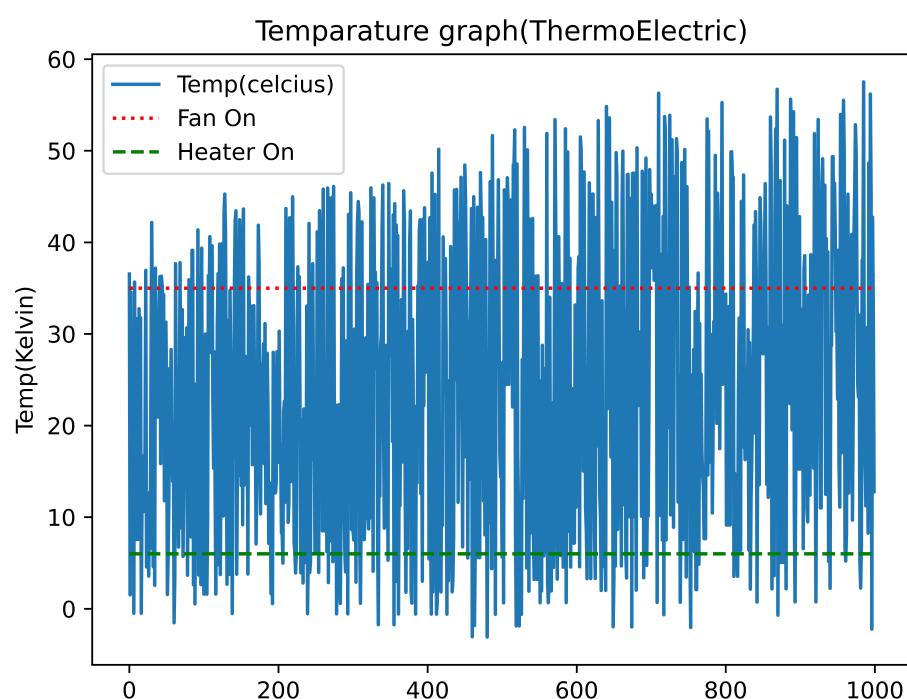
```
Timeline
```

```
master* 22BCT0087-LA1 Debug Spaces: 4 UTF-8 LF () C Go Live macos-clang-arm64 Prettier
```

CSV File:

The screenshot shows a code editor window titled "22BCT0087-LA1". The left sidebar contains icons for file operations like Open, Save, and Find. The main area displays the contents of a CSV file named "electric.csv". The file has 44 rows of data, each containing a single numerical value. The data ranges from approximately -0.486698 to 36.593373. The editor also shows tabs for other files such as "thermoacoustic.h" and "thermoacoustic.h". The status bar at the bottom provides information about the current file, including its name, line number, and character count.

Plot:



Caption

ThermoResistive:

Header File:

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

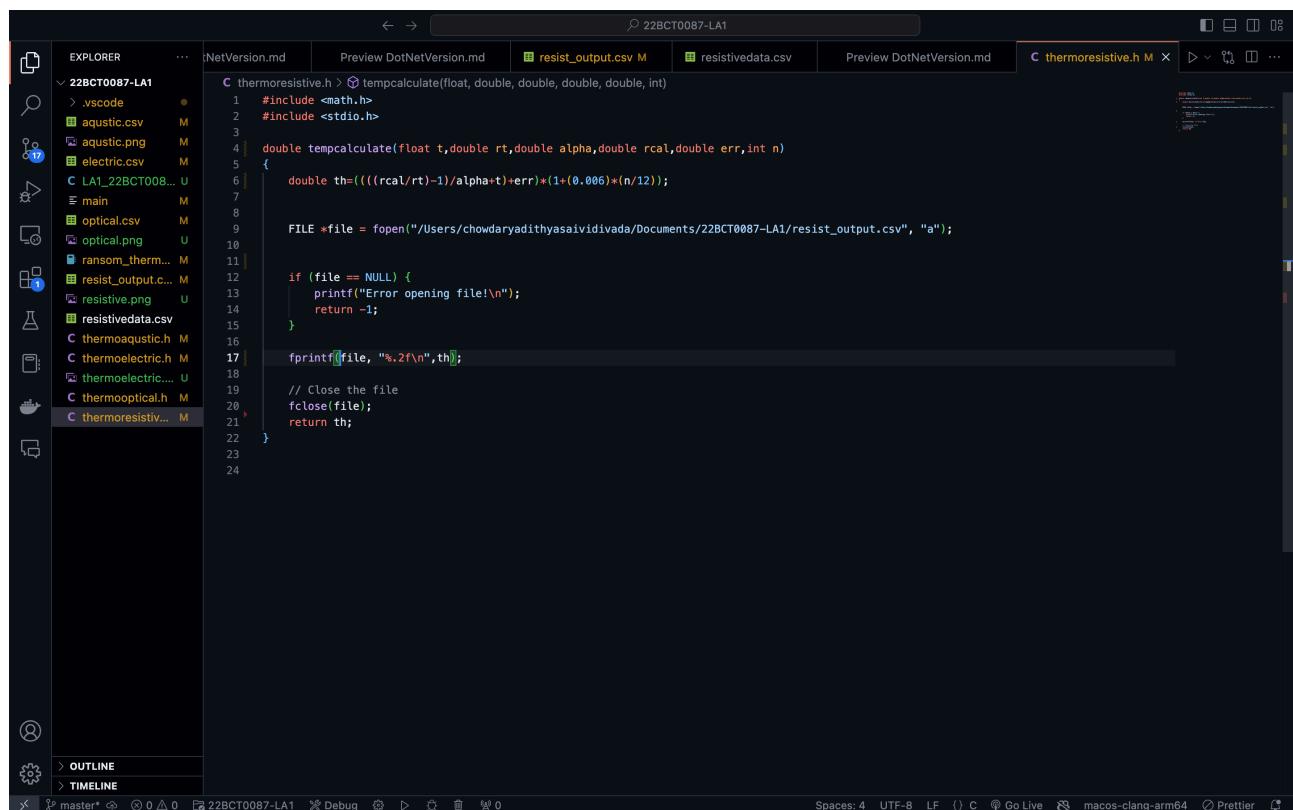
double tempcalculate float t, double rt, double alpha, double rcal, double err, int n
{
    double th=((((rcal/rt)-1)/alpha+t)+err)*(1+(0.006)*(n/12));

    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;
}
```



The screenshot shows the Visual Studio Code interface with the following details:

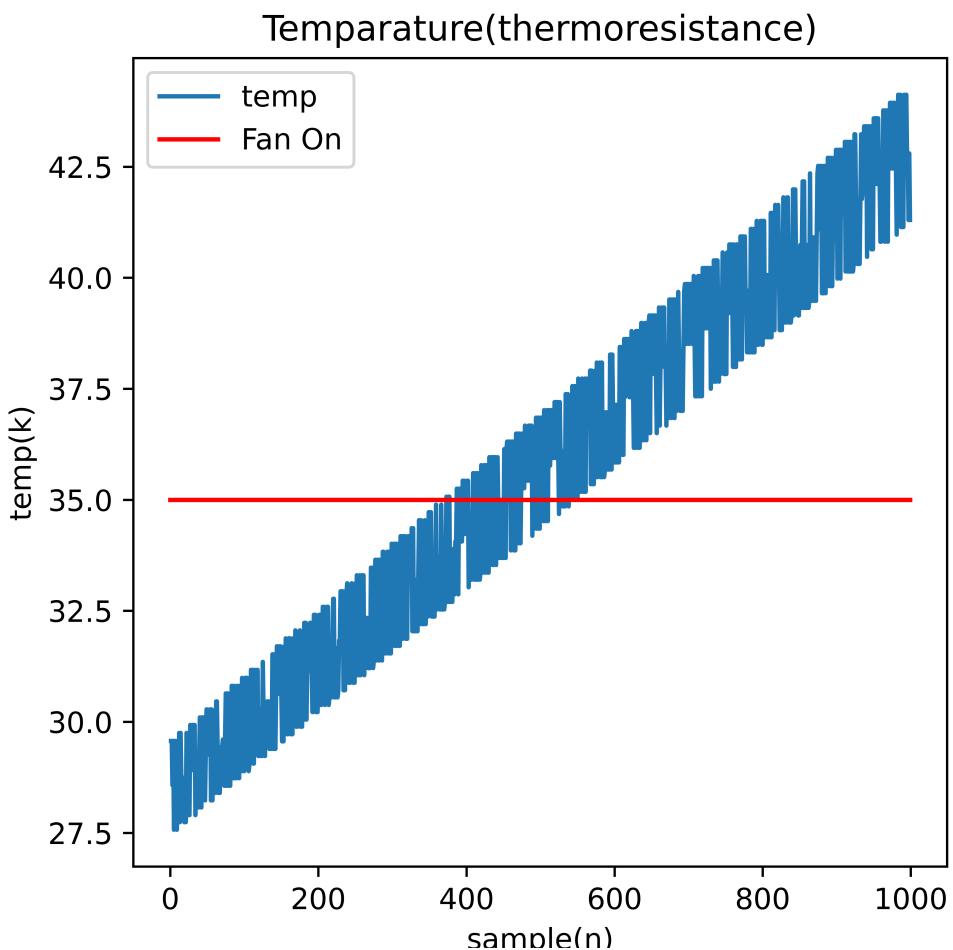
- Explorer View:** Shows the project structure under "22BCT0087-LA1" with files like "NetVersion.md", "Preview DotNetVersion.md", "resist_output.csv", "thermoresistive.h", and others.
- Code Editor:** The main pane displays the C code for "thermoresistive.h".
- Status Bar:** Shows "Spaces: 4" and "UTF-8 LF".
- Bottom Status Bar:** Shows "master" branch, file path "22BCT0087-LA1", and various icons for debugging, previewing, and live coding.

csvFile:

The screenshot shows the VS Code interface with the title bar "22BCT0087-LA1". The Explorer panel on the left displays a folder structure for "22BCT0087-LA1" containing files like "optical.csv", "Preview DotNetVersion.md", and "resist_output.csv". The "resist_output.csv" file is selected and shown in the main editor area. The content of the CSV file is as follows:

1	28.57
2	29.57
3	29.57
4	28.57
5	29.57
6	27.57
7	29.57
8	29.57
9	28.57
10	27.57
11	29.57
12	27.74
13	29.75
14	27.74
15	29.75
16	28.74
17	28.74
18	28.74
19	28.74
20	27.74
21	28.74
22	27.74
23	29.75
24	28.91
25	27.98
26	27.98
27	27.98
28	29.93
29	28.91
30	28.91
31	29.93
32	29.93
33	28.91
34	29.93
35	27.98
36	29.99
37	29.99
38	28.07
39	28.07
40	29.99
41	30.18
42	29.99
43	28.07
44	30.18

Plot:



Thermooptical:

Headerfile:

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

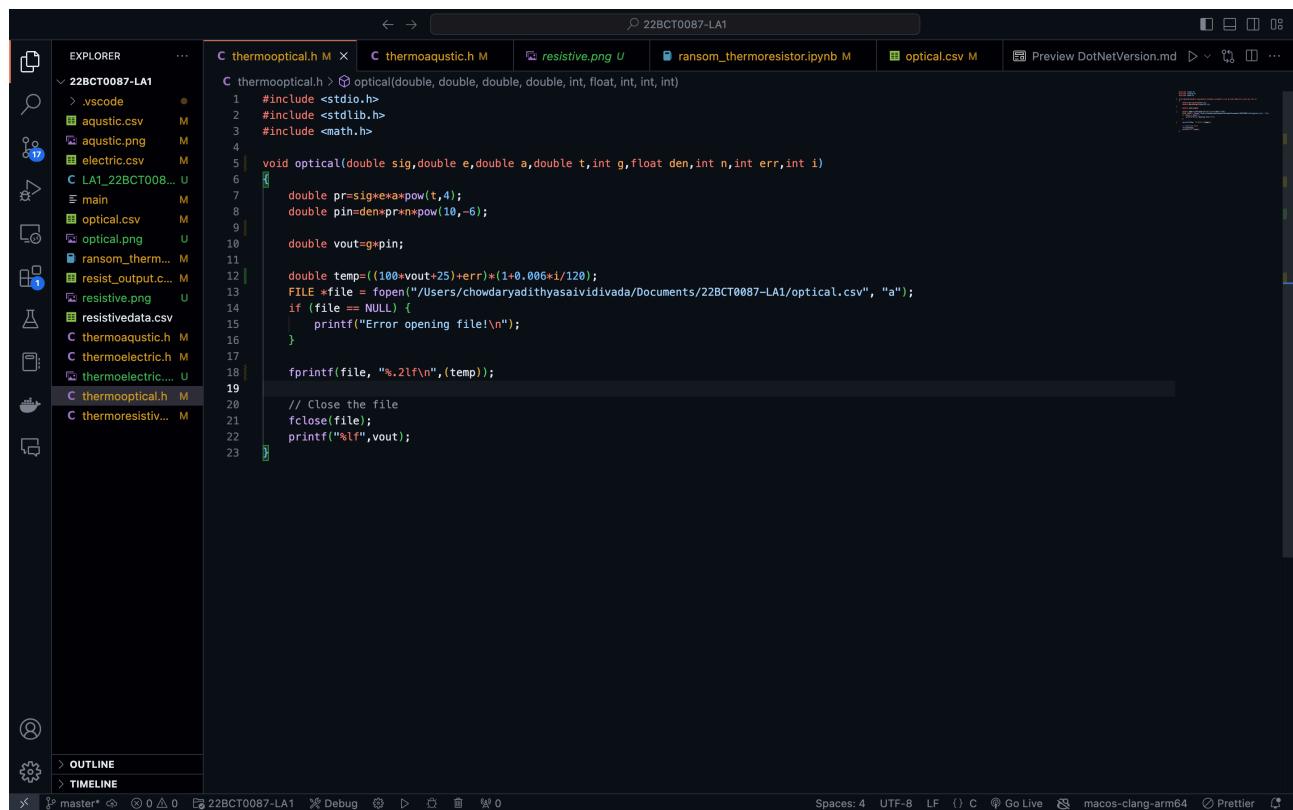
void optical(double sig,double e,double a,double t,int g float den,int n,int err,int i)
{
    double pr=sig*e*a*pow(t,4);
    double pin=den*pr*n*pow(10,-6);

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

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



```
22BCT0087-LA1
  - .vscode
  - acoustic.csv
  - acoustic.png
  - electric.csv
  - electric.png
  - main
  - optical.csv
  - optical.png
  - ransom_therm...
  - resistive.png
  - resistivedata.csv
  - thermoacoustic.h
  - thermoelectric.h
  - thermooptical.h
  - thermoresistiv...
```

```
C thermooptical.h M C thermoacoustic.h M resitive.png U ransom_thermoreistor.ipynb M optical.csv M Preview DotNetVersion.md D ...
```

```
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, "%lf\n", (temp));

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

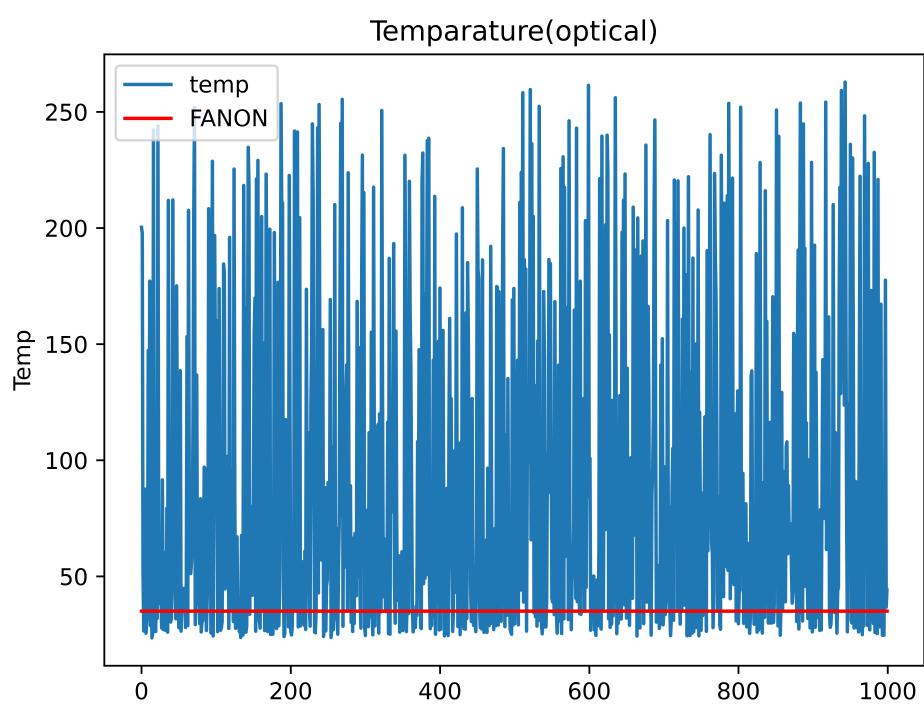
Spaces: 4 UTF-8 LF ⌘ C Go Live macos-clang-arm64 Prettier

CSVFile:

The screenshot shows a dark-themed code editor interface. In the Explorer panel on the left, there is a tree view of files and folders. A file named "optical.csv" is selected and highlighted with a blue border. The main workspace shows the content of "optical.csv". The terminal at the bottom displays the same data from "optical.csv".

Row	Value
1	200.27
2	197.89
3	51.35
4	26.45
5	30.30
6	87.53
7	25.47
8	30.13
9	33.76
10	147.22
11	37.66
12	177.11
13	28.74
14	55.01
15	23.48
16	25.31
17	242.25
18	85.89
19	55.64
20	26.20
21	52.88
22	31.89
23	243.87
24	63.57
25	38.29
26	47.38
27	41.41
28	27.73
29	91.52
30	27.86
31	60.27
32	28.46
33	26.71
34	30.64
35	79.41
36	25.96
37	211.86
38	32.71
39	59.83
40	30.28
41	31.65
42	81.22
43	212.07
44	52.04

Plot:



Caption

