BBQ Bonanza

PHYS 351.01

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"Also reason why we were late in Dr.D's class"

Overview

1. BBQ is…
    a. Difficult and Laborious to Control
    b. Requires experience for consistancy
    c. Expensive!!!
2. Simplify the process
    a. Make Cooking easier
    b. Get Quality BBQ

Project Goal

Prototype a temperature sensor system that can analyse the relationship between a conventional smoker’s operating temperature and its level of ventilation.

Criteria

- Our project tests our ability to integrate gathered data.
- Implement our analysis and measurements into software that can be used to predict a real world outcome.
- Our project will incorporate skills in programming to analyze and interpret data over a large period of time, and project this data to find a predictable outcome.

Methods

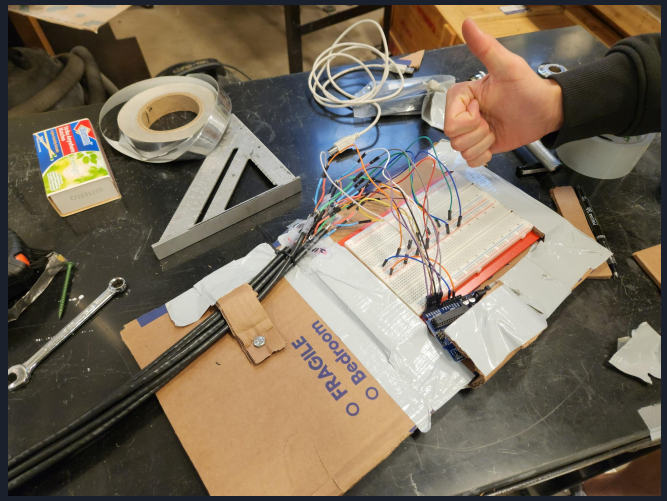
- Mount numerous temperature sensors inside smoker at different locations.
  - Levels of ventilation are recorded for given temperatures / rates of temperature increase.

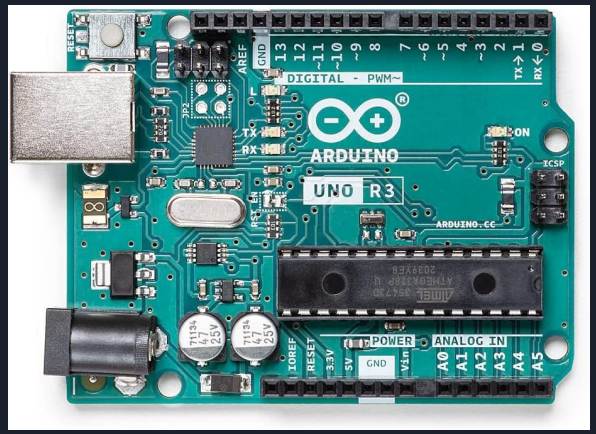
- Interpretation of this data to find and plot the relationship between temperature and ventilation.

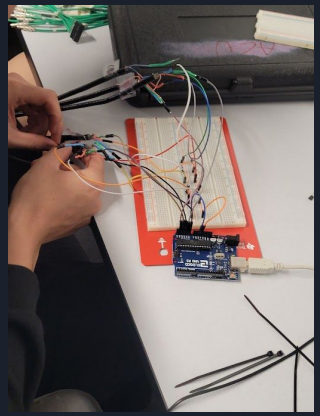
- Use interpolation / a fitting function to project necessary ventilation changes to achieve the target temperature.

Setup: Hardware

- Temperature Sensor (TMP 36)
    - Temperature Range: -40F to 302F
- World Stiffest Cable
- Connecting Wire
- Bread Board
- Arduino Board (UNO REV3)

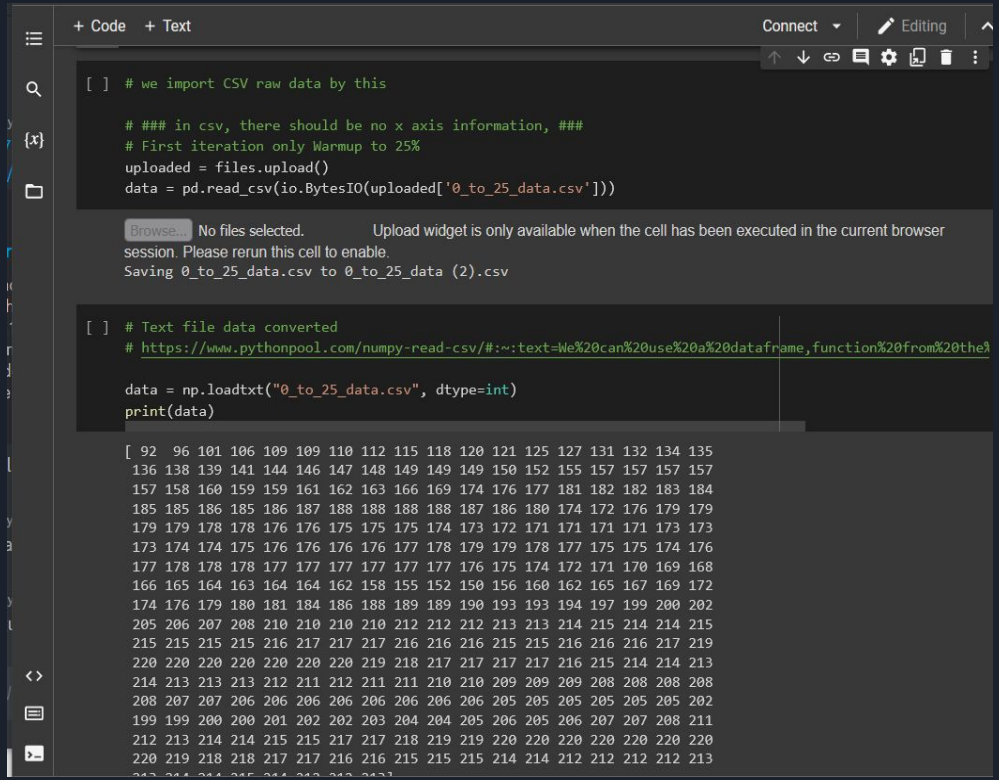




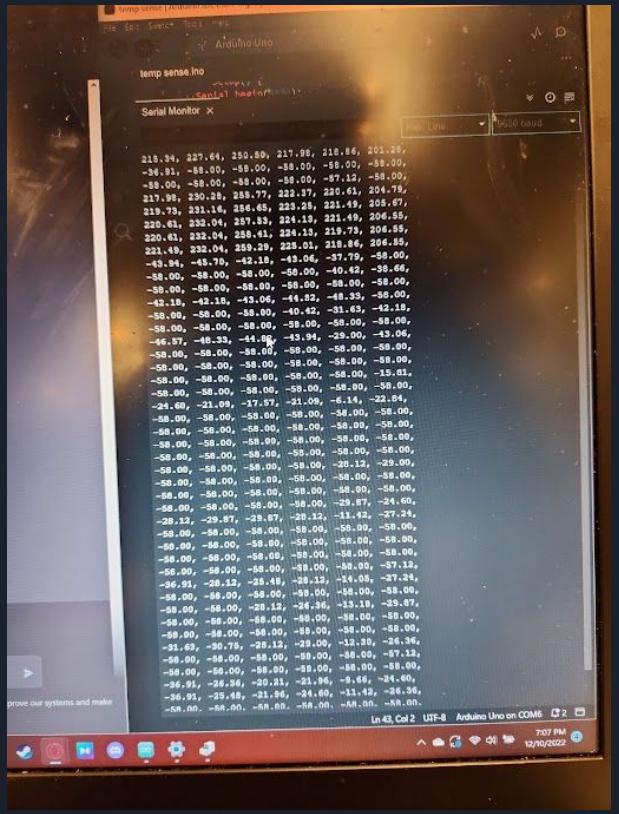


Setup: Software

- Find average values for peak temperature at ventilation levels 25%, 50%, 75%, 100%
- Fit a function to these values
- Use this function to determine the temperature for any given percentage of ventilation.



ISSUES!!?!?!


Arduino Uno
temp sense.ino
Serial Monitor
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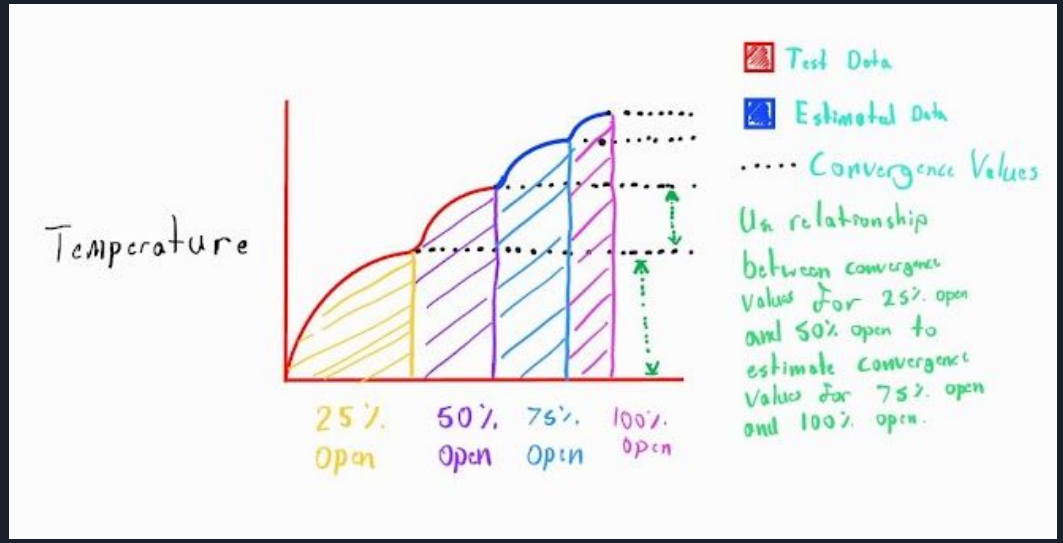
Ln 43, Col 2 UTF-8 Arduino Uno on COM6
7:07 PM
12/10/2022

Solution

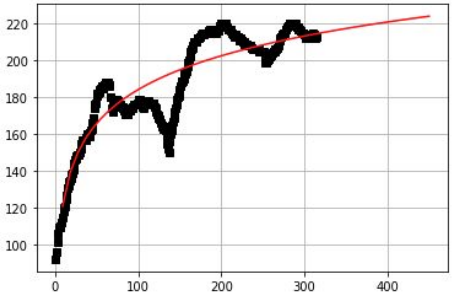
- Extrapolate Gathered data to full data range.
  - Data gathered from start up to 50% open.
- Plotted fully, data should follow a piecewise pattern, with each piece following a logarithmic curve.
- Convergence value for each logarithmic curve is our average temperature for each ventilation level.
- We must find the estimated convergence values for 75% open and 100% open.



```
#Extrapolate by large amount to find convergence value

x_fit = np.linspace(0,450)
plt.plot(t, data, 'ks', label = 'data')
plt.plot(x_fit, fitfun(x_fit,*popt), '-r', label = 'cubic')
plt.grid()
```

```
<ipython-input-54-45e7cc951432>:6: RuntimeWarning: divide by zero encountered in log
  return a*np.log(x) + b
```




```
fitfun(450, popt[0], popt[1])
```

```
224.14763436859883
```

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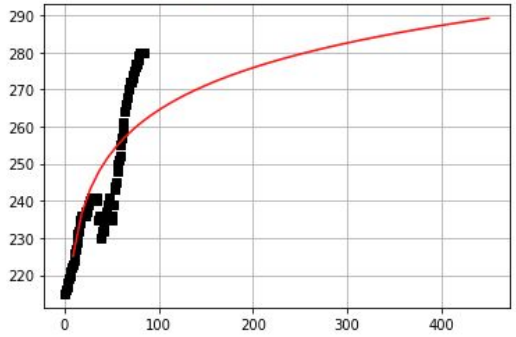
<ipython-input-68-ef09e9b7ecd0>:6: RuntimeWarning: divide by zero encountered in log
  return a*np.log(x) + b
```




```
fitfun(450, popt[0], popt[1])
```

```
289.16958397559455
```

Temperature increase between ventilation levels seems to degrade by 50% for each 1/4 increase in ventilation:

50% open Peak temperature is 289 Degrees, 25% open Peak temperature is 224 Degrees, Starting temperature is 94 Degrees:

$224 - 94 = 130$ degree increase

$289 - 224 = 65$ degree increase

Therefore, we can assume that the increase in temperature at 75% ventilation should be approximately:

$289 + \frac{65}{2} = 321.5$ Degrees

Subsequently we can determine the temperature at 100% to be approximately:

$321.5 + \frac{32.5}{2} = 354$ Degrees

We will then fit a curve to these four peak temperatures to plot the relationship between temperature and ventilation.

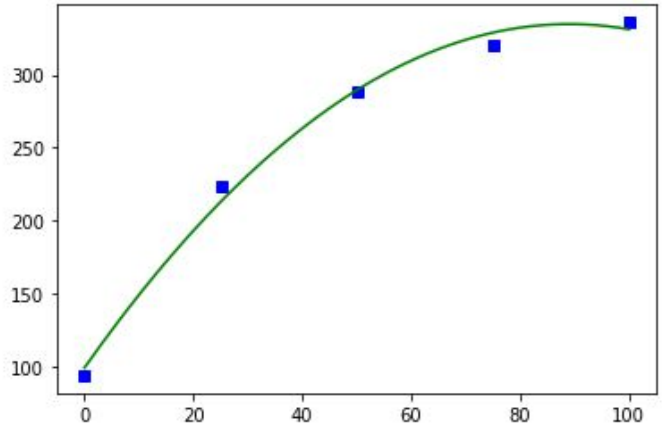
```
xdata = np.array([0, 25, 50, 75, 100])
ydata = np.array([94, 224, 288, 320, 336])
p = np.polyfit(xdata,ydata,2)

# evaluate the polynomial for a given x value
x = 79.2
y = np.polyval(p, x)
print(y)

x = np.linspace(0,100)
y = np.polyval(p, x)

plt.plot(xdata,ydata,'bs')
plt.plot(x,y,'g-')
plt.show()
```

```
331.95126857142856
```



Shortcomings

- Sensor system is fried
  - Can no longer definitively verify temperature estimations
- Large margin of error
  - Outdoor temperature can affect results by a large margin.
- Unable to verify results with actual BBQ
  - Time frame pushed significantly due to bad weather conditions. This negatively affected our schedule. Due to time restrictions, plans for actual BBQ is postponed.