q4

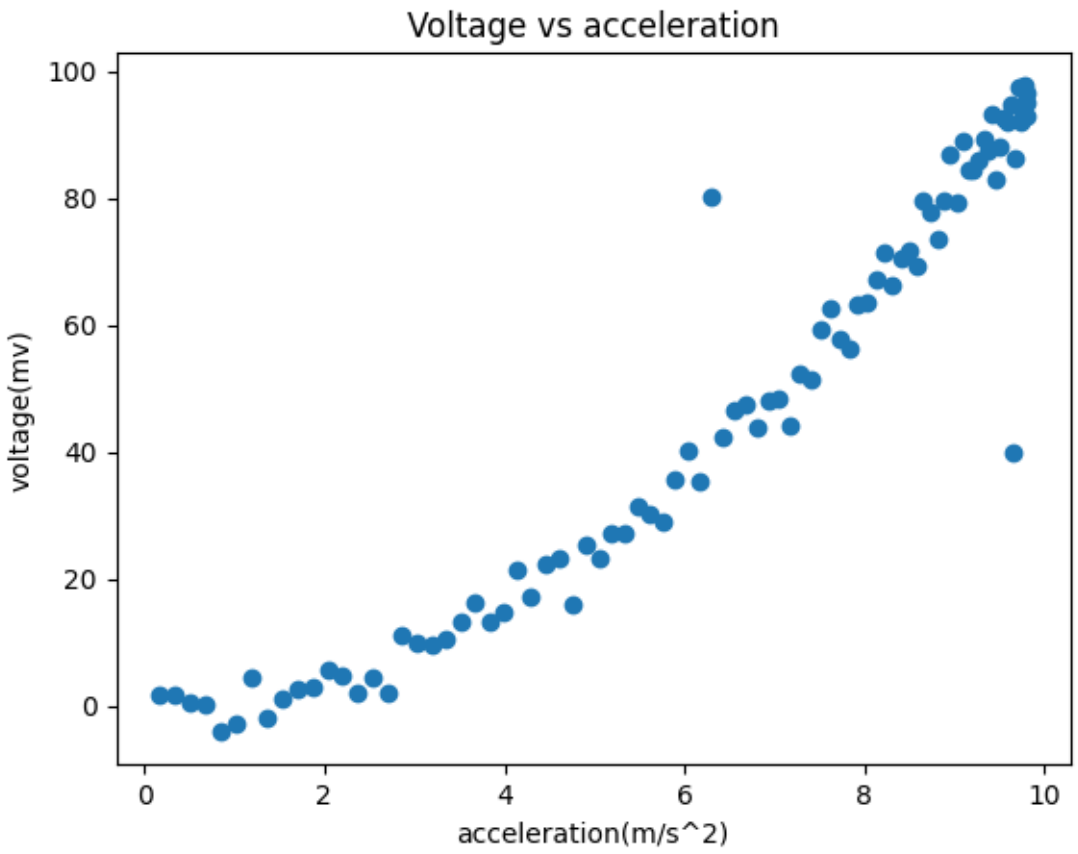
March 24, 2023

Question 4:

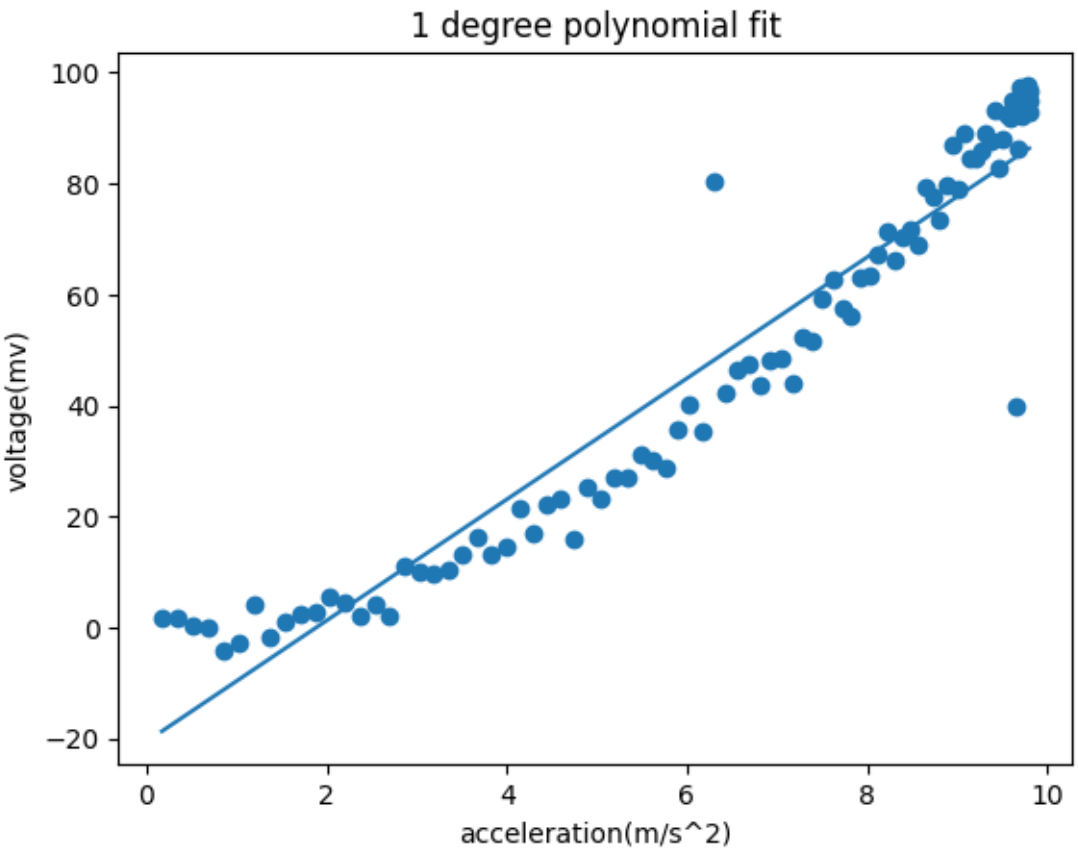
[ ]:
```
###### Import required libraries ########
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import numpy as np
```

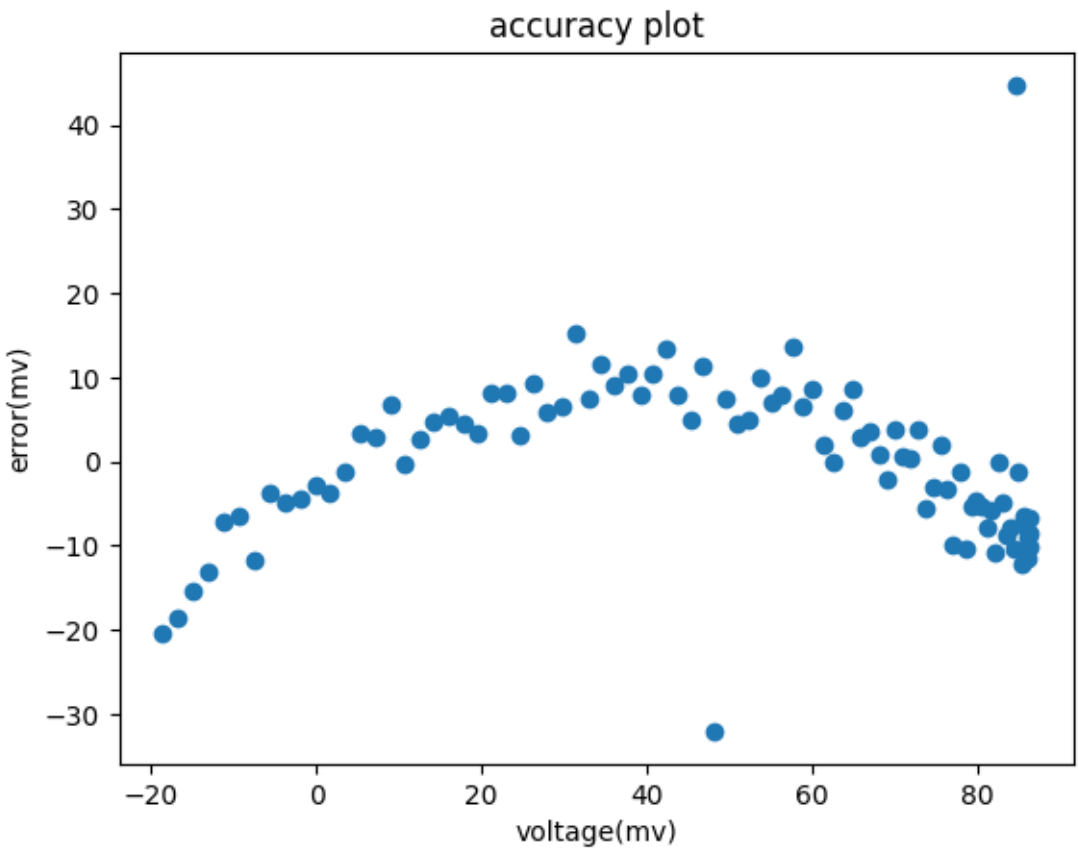
[ ]:
```
##### Read the data and acceleration values from orientation of the sensor
  ↪##############
columns=['angle','volt']
df=pd.read_csv("Q4_data .csv")
df.rename(columns={'Angle(degrees)':'angle', "voltage(mv)":"volt"},inplace=True)
g=9.8*np.cos(np.deg2rad(df.angle))
# df
```

[ ]:
```
plt.scatter(g,df.volt)
plt.xlabel('acceleration(m/s^2)')
plt.ylabel('voltage(mv)')
plt.title('Voltage vs acceleration')
plt.show()
```



[ ]:
```
### fit a one degree polynomial to the data ##############
z=np.polyfit(g,df.volt,1)
v=(z[0]*g)+z[1]
plt.scatter(g,df.volt)
plt.plot(g,v)
plt.xlabel('acceleration(m/s^2)')
plt.ylabel('voltage(mv)')
plt.title('1 degree polynomial fit')
plt.show()
######### plot the error of the fitted model ###################
error=np.subtract(v,df.volt)
plt.scatter(v,error)
plt.xlabel('voltage(mv)')
plt.ylabel('error(mv)')
plt.title('accuracy plot')
plt.show()
```

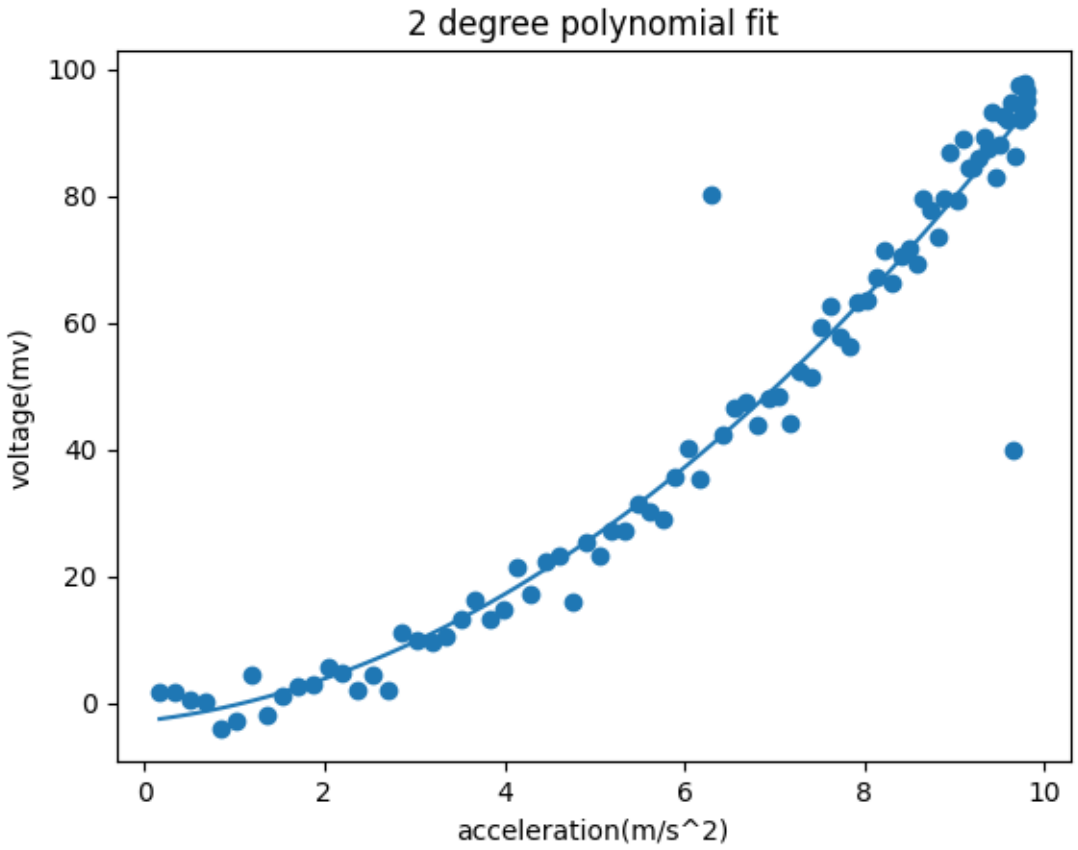

1 degree polynomial fit
voltage(mv)
acceleration(m/s^2)
100
80
60
40
20
0
−20
0
2
4
6
8
10

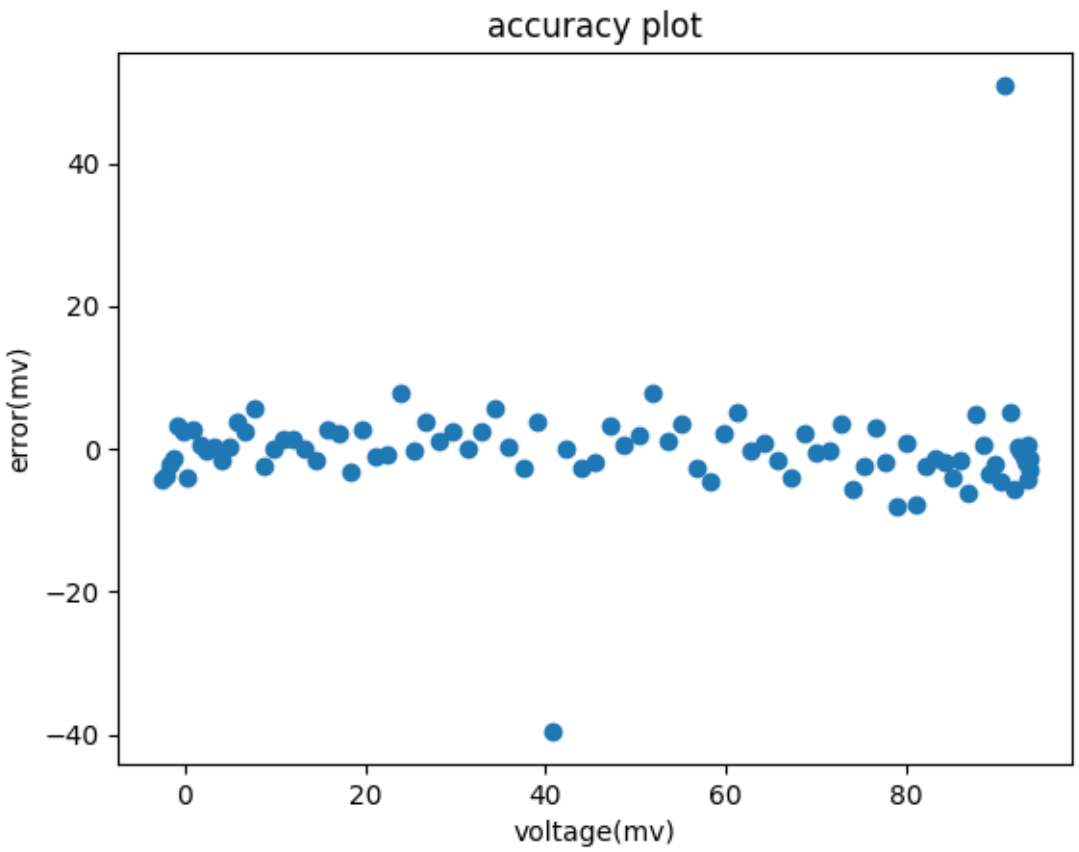


From the observation of accuracy plot, it seems like there is systematic error with the model that was fitted. so, best model could be higher order polynomials.

[ ]:
```
### fit a second degree polynomial to the data ##############
z=np.polyfit(g,df.volt,2)
v=(z[0]*np.multiply(g,g))+(z[1]*g)+z[2]
plt.scatter(g,df.volt)
plt.plot(g,v)
plt.xlabel('acceleration(m/s^2)')
plt.ylabel('voltage(mv)')
plt.title('2 degree polynomial fit')
plt.show()
error=np.subtract(v,df.volt)
plt.scatter(v,error)
plt.xlabel('voltage(mv)')
plt.ylabel('error(mv)')
plt.title('accuracy plot')
plt.show()
#### accurcay (to remove the impact of outliers in the accuracy, 95 percentile␣
 ↪of the error is used to calculate the accuracy###############
```

```
max_error=np.percentile(error,95)
print('Accuracy:'+str((max_error))+'%')
```





`Accuracy:5.3640019095892795%`

There is no systematic error found in the accuracy plot and so, the best fit for the given data is second degree polynomial with 5.36% accuracy.