HW 7 problem 1

For this homework, we have collected the monthly average data for Methane from the website : Global Monitoring Laboratory. The data available on this website is in .txt format is uploaded here for this analysis. we begin with the necessary library imports .We used Pandas for the plotting , other necessary imports are given below:

```
import math
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
%load_ext pycodestyle_magic
%pycodestyle_on
```

The linting with pycodestyle magic recommended to make some line shorter but I am not able to it for some lines to avoid the errors . We are only going to take 3 columns (Time_decimal,Value,Value_std_dev).

```
dataset = pd.read_csv('ch4.txt', skiprows=139, usecols=['time_decimal', 'value', 'value_std_
dataset = dataset.dropna()  # dropping the raws will any null values.
```

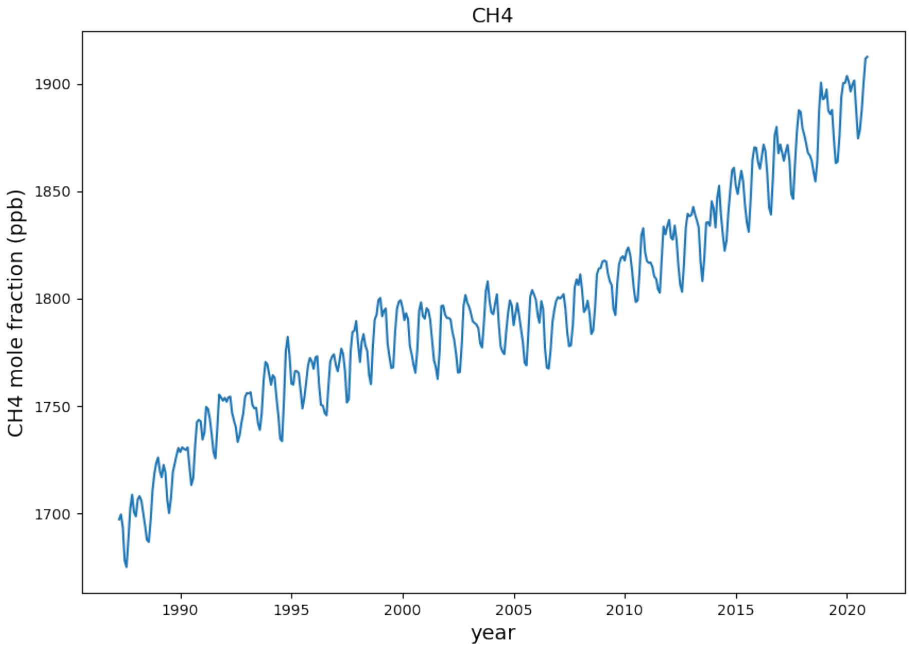
```
1:80: E501 line too long (136 > 79 characters)
```

Plot

The plot of the taken data of Mithane emission vs time (year)

```
X_orig = dataset["time_decimal"]
Y_orig = dataset["value"]
err = dataset["value_std_dev"]
plt.rcParams['figure.dpi'] = 100
fig, ax = plt.subplots(figsize=(10, 7))
ax.plot(X_orig, Y_orig)
ax.set_xlabel('year', fontsize=14)
ax.set_ylabel('CH4 mole fraction (ppb)', fontsize=14)
ax.set_title('CH4', fontsize=14)
```

```
Text(0.5, 1.0, 'CH4')
```



Analyzing data

I am going to use the numpy fft to take the fourier transfer of our data.

First we need to find the sample rate and sample spacing

```
samples = len(Y_orig)
years = int(X_orig.iloc[-1]-X_orig.iloc[0])
months = years * 12
sr = samples / months
ss = 1 / sr
ss
```

```
0.9777777777777777
```

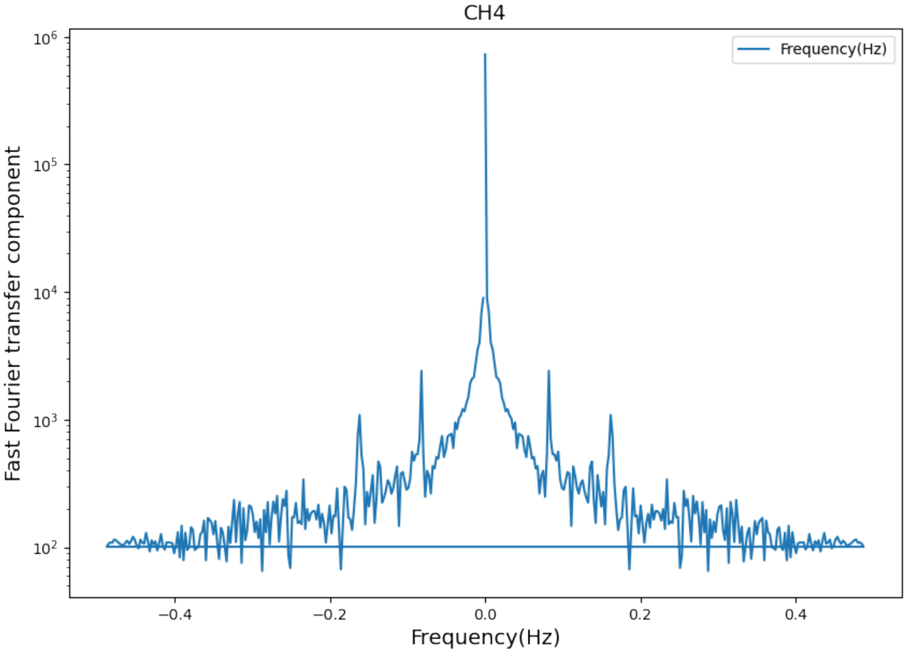
Plotting in frequency domain

using numpy fft lets plot the emission data using the sample rate and spacing above

```
Y_fft = np.fft.fft(Y_orig)
freqs = np.fft.fftfreq(len(Y_fft), sr)
fig, ax = plt.subplots(figsize=(10, 7))
ax.plot(freqs, np.abs(Y_fft), label="Frequency(Hz)")
plt.yscale('log')
```

```
ax.set_xlabel('Frequency(Hz)', fontsize=14)
ax.set_ylabel('Fast Fourier transfer component', fontsize=14)
ax.set_title('CH4', fontsize=14)
ax.legend()
```

```
<matplotlib.legend.Legend at 0xffff5cb80ca0>
```



Frequency of the peaks

if I put all of the picks in an array :

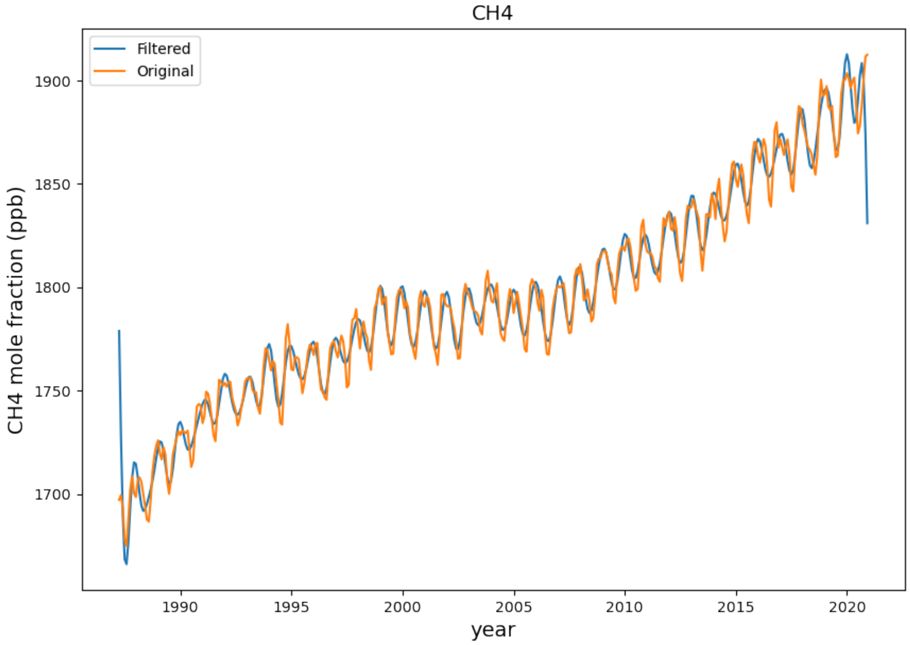
```
from scipy.signal import find_peaks
peaks, _ = find_peaks(np.abs(Y_fft), height=0)
freqs[peaks]
```

```
array([ 0.02897119,  0.03862826,  0.04345679,  0.05552812,  0.06277092,
        0.06759945,  0.07484225,  0.08208505,  0.09415638,  0.10622771,
        0.11347051,  0.12554184,  0.13761317,  0.14485597,  0.15209877,
        0.16175583,  0.18106996,  0.19072702,  0.19555556,  0.20038409,
        0.21004115,  0.21486968,  0.21969822,  0.22935528,  0.23418381,
        0.23901235,  0.24384088,  0.24866941,  0.25591221,  0.26074074,
        0.26798354,  0.27281207,  0.28005487,  0.2848834 ,  0.28971193,
        0.29454047,  0.30419753,  0.31144033,  0.31626886,  0.32351166,
        0.33075446,  0.34041152,  0.34765432,  0.35731139,  0.36213992,
        0.37903978,  0.38628258,  0.39111111,  0.39593964,  0.40559671,
        0.41042524,  0.41766804,  0.42491084,  0.42973937,  0.43698217,
        0.44422497,  0.45388203,  0.46112483,  0.47802469,  0.48285322,
       -0.48285322, -0.47802469, -0.46112483, -0.45388203, -0.44422497,
       -0.43698217, -0.42973937, -0.42491084, -0.41766804, -0.41042524,
       -0.40559671, -0.39593964, -0.39111111, -0.38628258, -0.37903978,
       -0.36213992, -0.35731139, -0.34765432, -0.34041152, -0.33075446,
       -0.32351166, -0.31626886, -0.31144033, -0.30419753, -0.29454047,
       -0.28971193, -0.2848834 , -0.28005487, -0.27281207, -0.26798354,
       -0.26074074, -0.25591221, -0.24866941, -0.24384088, -0.23901235,
       -0.23418381, -0.22935528, -0.21969822, -0.21486968, -0.21004115,
       -0.20038409, -0.19555556, -0.19072702, -0.18106996, -0.16175583,
       -0.15209877, -0.14485597, -0.13761317, -0.12554184, -0.11347051,
       -0.10622771, -0.09415638, -0.08208505, -0.07484225, -0.06759945,
       -0.06277092, -0.05552812, -0.04345679, -0.03862826, -0.02897119])
```

Using in class example this is my efort to clean up the peaks . (the codes are taken from the example) . I have to turn off pycodestyle becaus of its conflicts with this block

```
%pycodestyle_off

# Read like previous example with Ch4 data
x,y = X_orig, Y_orig
y_valid = y >= 0.
y = y[y_valid]

# instead of truncating, pad with values

N = len(y)
log2N = math.log(N, 2)
next_pow_of_2 = int(log2N) + 1
if log2N - int(log2N) > 0.0 :
    ypads = np.full( 2**( next_pow_of_2) - N, 0, dtype=np.double)
    y = np.concatenate( (y, ypads) )
    x = np.arange(len(y))
    N = len(y)

maxfreq = 50
Y_fft[maxfreq:len(Y_fft)-maxfreq] = 0.0

# Now go back to the frequency domain.
# Compare the data before and after filtering.
yfiltered = ifft(Y_fft)
yfiltered_abs= abs(yfiltered)


fig, ax = plt.subplots(figsize=(10,7))
plt.plot(X_orig, yfiltered_abs, label='Filtered' )
```

```
ax.plot(X_orig, Y_orig, label='Original')
ax.set_xlabel('year',fontsize=14)
ax.set_ylabel('CH4 mole fraction (ppb)',fontsize=14)
ax.set_title('CH4',fontsize=14)
ax.legend()
%pycodestyle_on
```



I am not sure why my plot is not more filtered. May be I have filtered my data (column for values) earlier already. I was expecting it to be more filtered. May be my filtering is not well defined .