# CIVE-650C –Homework
Data Smoothing, Classification, and Prediction

The data `VSL_Data1.csv` is the labeled the data, with the following schema

	Time	Speed	Occu	Label
0	14420	59.030245	1.5	70 MPH
1	14440	59.030245	2.0	70 MPH
2	14460	55.302019	2.0	70 MPH
3	14480	65.243955	1.5	70 MPH
4	14560	64.622584	2.5	70 MPH

- Time is the second representation during a day. For example, 16:30:16 (hh:mm:ss) = 16 * 3600 + 30 * 60 + 16 = 59416
- Speed and Occupancy is the Wavetronix sensor data
- The Label is the assigned Variable Speed Limit (VSL) Label for each row — 70 mph, 55 mph, 45 mph, and 35 mph.

Task 1 — Plot the raw data (`VSL_Data1.csv`), with proper legends, title, axis, etc.
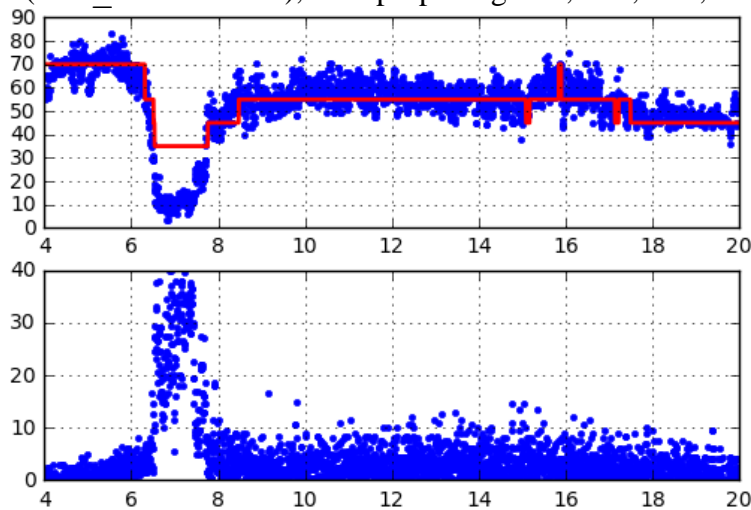
Task 2 — Data Smoothing
1) FFT Smoothing
As discussed during the class, plot the smoothed speed and occupancy.

2) Another
Choose another data smoothing method, plot the smoothed speed and occupancy.

Task 3 — Classification
Now you have three different datasets in hands:
- Raw data
- Another Smoothed data
- FFT smoothed data

Choose **TWO** different classification algorithms (A, B) and train the model, *Label = f(speed, occu)*, using 3 different dataset; therefore one should have 6 different models:
- Classification algorithm A based on:
    - Raw data → A_raw
    - Another smoothed data → A_another
    - FFT data → A_fft
- Classification algorithm B based on:
    - Raw data → B_raw
    - Another smoothed data → B_another
    - FFT data → B_fft
Also, please report the model accuracy.

Task 4 — Prediction
Once you have all 6 models ready, apply them on the new data set `VSL_Data2.csv`

	Time	Speed	Occu	Label
0	14420	67.108068	2.0	?
1	14440	77.050004	0.5	?
2	14460	67.729439	3.5	?
3	14480	61.515729	2.5	?
4	14500	73.321778	0.5	?

Process to follow:
- For the raw data set
    - Apply A_raw to fill in the Label column
        - Make a plot with raw data and predicted label
    - Apply B_raw to fill in the Label column.
        - Make a plot with raw data and predicted label
- Smooth the new dataset using another smoothing method, then
    - Apply A_another fill in the Label column.
        - Make a plot with raw data, smoothed data, and predicted label
    - Apply B_another to fill in the Label column.
        - Make a plot with raw data, smoothed data, and predicted label
- Smooth the new dataset using FFT, then
    - Apply A_fft to fill in the Label column
        - Make a plot with raw data, FFT data, and predicted label
    - Apply B_fft to fill in the Label column
        - Make a plot with raw data, FFT data, and predicted label
- Discussion