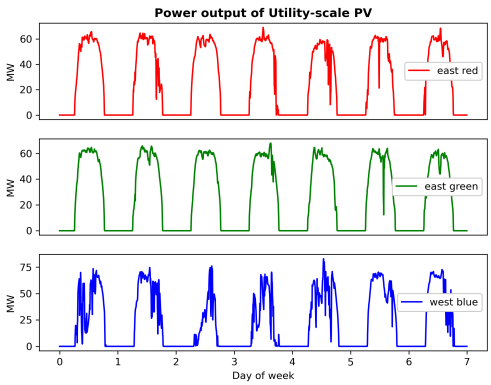
ICPE 637 DSPS - Spring 2022

HW 1

Please show your work for each problem, even if it does not completely solve the problem.

Problem 1 [50 points] - Statistics

Solve this problem using Python, and attach your code.



You are given in `solar.csv` some 7-day time-series data for real photovoltaic (PV) power output at 3 different locations in Texas. The three locations are labelled in the file as 'east red', 'east green' and 'west blue' to match the map and plot above.

1. **Reading files:**

   Extract The 3 time-series measurements, and store them as three different variables in Python, say `x_red`, `x_green` and `x_blue`.

2. **Plotting Time-series:**

   Generate a time-series plot similar to the one on the right above. What could be the reasons why the blue signal looks quite different from the other two?

3. **Cross-correlation:**

   Using `np.correlate`, compute the cross-correlation between all pairs of time-series (i.e. red-green, red-blue, green-blue). Finally, what conclusions can you draw?

Problem 2 [50 points] - Dimensionality Reduction

You are a power systems engineer, and your manager seeks your help to interpret a dataset of voltage magnitude measurements which are collected at 240 different buses in a transmission network. Each row of measurement (one per bus) contains 5 minutes of time-series data at 60 samples per second. To perform PCA on the given dataset, you first construct the measurement matrix, X.

1. What is the dimension of X. That is, how many rows and columns does it contain?
2. Do you expect the covariance of X to be a diagonal matrix? (Yes/No, and why)

3. Say you perform PCA, and obtain the transformed measurement matrix, Y.

   What can you say about the covariance of Y?

BONUS [25 points] - Power Systems Data

1. Download a publicly available power systems time-series dataset, other than the ones shown in class. Make sure to provide a link in your solution.
2. Analyze portions of the data using any of the methods we learned in class, and present some interesting findings.
3. Use Python for the step above, and share your code along with any files you used (e.g. the dataset).