Homework #1
AE6505 Kalman Filtering, Spring 2022
Prof. Gunter
Assigned: 1-16-22
Due: 1-28-22 (1-31-22 for DL Students)

Homework is due by 11:59p on the indicated due date, and should be submitted electronically via Canvas. Late homework will not be accepted without prior permission from the instructor. In-class verbal due date announcements override projected dates in the lecture plan. Please submit your materials as two files. The first should be a writeup of your solutions, complete with any figures, explanations, etc., in .pdf form. This is the document that will be graded, i.e., do not embed solutions in your code, or require the grader to run your code to get any results. Homework should be professional, legible, indicate units, and sufficiently describe all important steps in a solution. Your final answer for each problem should be boxed or clearly indicated. You are welcome to scan any pages that are handwritten, but please make sure any such pages are clear and legible. Deductions will be made for incomplete solutions and improper formats. In addition to the .pdf file, upload any Matlab files that you have developed to generate the results described in your writeup as a single .zip file. The Matlab code you submit should be able to be run without modification, so do not include hardcoded file paths.

1. Exercises 1.6, 1.7, 1.8, 1.17, 2.8, 2.9, 2.10, and 2.15 from the text by Simon.

2. Your experiment is to monitor three consecutive interactions from a mobile phone to a local cell phone tower. The interactions are classified as either voice (v) or data (d). Your observation is a sequence of three letters (each one is either v or d). For example, three voice packets corresponds to vvv. The outcomes vvv and ddd have probability 0.2 while the other outcomes vvd, vdv, vdd, dvv, dvd, and ddv each have probability 0.1. Count the number of voice calls N_V in the three interactions you have observed. Consider the four events $N_V = 0, N_V = 1, N_V = 2, N_V = 3$. Explain and calculate the following probabilities:

   (a) $P[N_V = 2]$
   (b) $P[N_V \geq 1]$
   (c) $P[vvd|N_V = 2]$
   (d) $P[ddv|N_V = 2]$
   (e) $P[N_V = 2|N_V \geq 1]$
   (f) $P[N_V \geq 1|N_V = 2]$

3. Show why the covariance (i.e., the cross-covariance defined in class) for any two continuous random variables X and Y is zero when X and Y are independent.