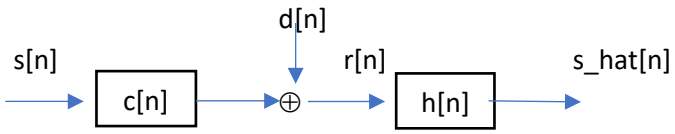
MATLAB exercise
Estimation of a random process with an FIR filter.

Overview: In this exercise, you will derive and implement two maximum likelihood estimators. Put your code in a MATLAB publisher file, you will be graded as follows:

80%: Technical Correctness of the code
10%: Quality of figures, meaning they should be annotated fully (legends, axes labels). You should also make judicious use of overlaid plots, or subplots, as appropriate. In general you should be striving to use only a few, well-annotated plots.
10%: Quality of comment in code. Your code should be well commented, with a few paragraphs describing your solution, referring to figures, as appropriate. The overall goal here is a single document that contains both your code and all necessary information so that someone with a general EE background could understand the document.

Part 1: Pencil and paper. Consider the following system:



We wish to design a filter h[n] to estimate s[n] from r[n] such that s_hat[n] is an MMSE estimate.

Assume that s[n] is an i.i.d processes which takes value +/-1 with equal probability for each sample. d[n] is a white, Gaussian noise process with variance σ^2. c[n] is an FIR filter with impulse response of [1 .2 .4].

Find an expression for $R_{sr}[n]$ and $R_{rr}[n]$. $R_{sr}[n]$ is the cross-correlation of the observations R[n] an $R_{rr}[n]$ is the auto-correlation of the observations.

Set up and solve the normal equations (9.55 or 11.11 from the MIT notes) for N = 4. (Note that N is the length of the FIR filter h[n], not c[n]

Part 2: MATLAB

MMSE estimation: Simulate the system for filters of length N = 4, 6 and 10. Report the MSE of your results in a table.