HW#6: Great Example of "Matched-Filter" Processing: "M"-Sequence Digital Correlator

(a) Use the MATLAB script provided in lecture to generate an "M"-sequence that is 1023 "chips" long, and in bipolar format (i.e., the "chips" are -1 or +1, not 0 or +1).

(b) In the MATLAB workspace, compute the rms deviation of this "pseudorandom-noise (PRN) " M sequence.

(c) Use the MATLAB script provide in lecture to compute the discrete-time autocorrelation of this "M" sequence, showing the remarkable property R_{xx} (i) = $\sum_{m}^{N} x_m x_{m-i}$ = N if i = 0, = -1 otherwise.

(d) Now use MATLAB to add Gaussian noise to this PRN sequence with rms deviation = 1.0.

(e) Use MATLAB to compute the input signal-to-noise ratio.

(f) Use MATLAB to compute the signal-to-noise ratio (SNR) after correlation. What is the ratio of output SNR to input SNR ? (clue: SNR is always defined in terms of power). In system language, this is called the "processing gain" – a metric that is very important in sensor and communications systems alike.