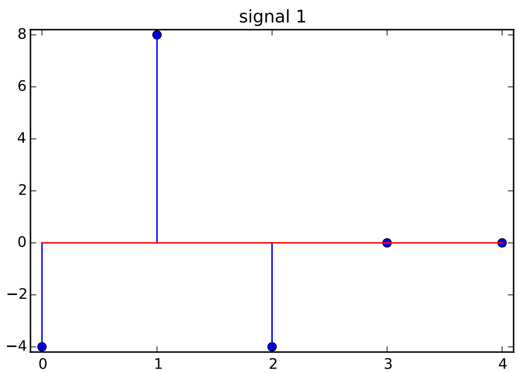
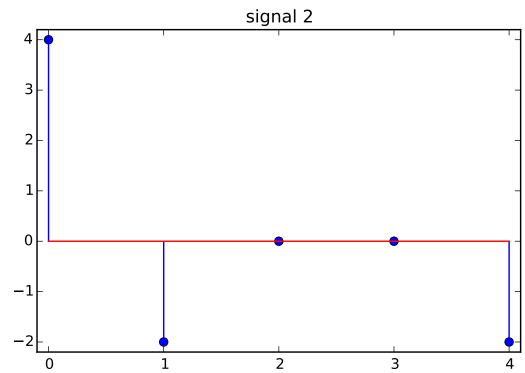
EECS 16A Designing Information Devices and Systems I
Spring 2017 Babak Ayazifar, Vladimir Stojanovic Discussion 11A

1. Correlation





Assume that both signals are periodic with period 5, that is, each plot shows one full period of a periodic signal.

(a) Sketch the autocorrelation (correlation with itself) of Signal 1.

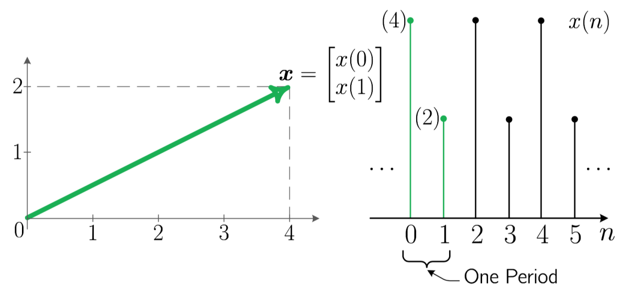
(b) Sketch the autocorrelation of Signal 2.

(c) Sketch the cross-correlation of Signal 1 with Signal 2. Suppose we know Signal 2 is a delayed (and attenuated) version of Signal 1. What does the cross-correlation tell us about the delay?

2. Periodic Signals

Periodic signals are ones that repeat themselves entirely after some time period. That is, after some time p, the signal $x(n)$ repeats itself so that $x(n+p) = x(n)$. Discrete periodic signals, during the period, do not update continuously through time. They instead update in specific discrete time steps, as if sampling a continuous signal.

Since there are a finite number of "unique" sequences in a discrete periodic signal, it is natural for us to represent the signal as a vector. We observe one period and treat the value at each time step as a different value in our vector.



Let us study the signal $\begin{bmatrix} 4 \\ 2 \end{bmatrix}$ that is periodic over $p = 2$.

(a) Write the signal as a linear combination of the standard/canonical basis. What signals do these vectors correspond to? How can we interpret the linear combination?

(b) Write the signal as a linear combination of the basis $\{\begin{bmatrix} 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ -1 \end{bmatrix}\}$. What signals does these vectors correspond do? How can we interpret the linear combination?

(c) Project the signal $\begin{bmatrix} 4 \\ 2 \end{bmatrix}$ onto each of the vectors in the previous part. How does these vectors relate to the linear combination from the previous part?

(d) Given the above, what is an easy way to find the coefficients for describing the signal as a linear combination of our basis? What property must hold about our basis?