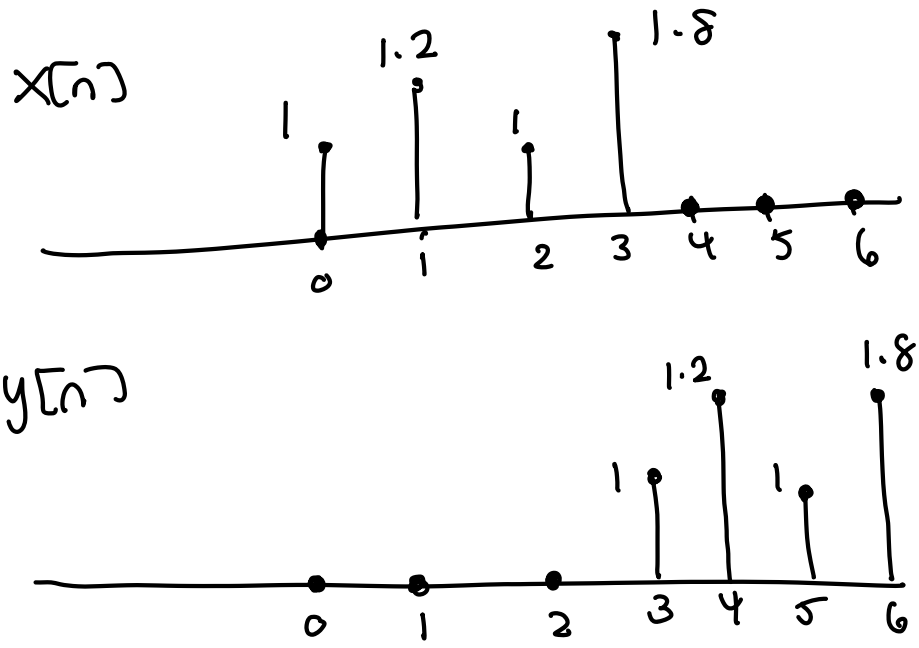
Chap 4.5.4

In many applications, we want to measure the similarity between a signal of interest ($x[n]$) and a reference signal $y[n]$



Correlation is a measure of similarity of two signals as a function of the displacement of one relative to the other

This displacement is known as the lag, l

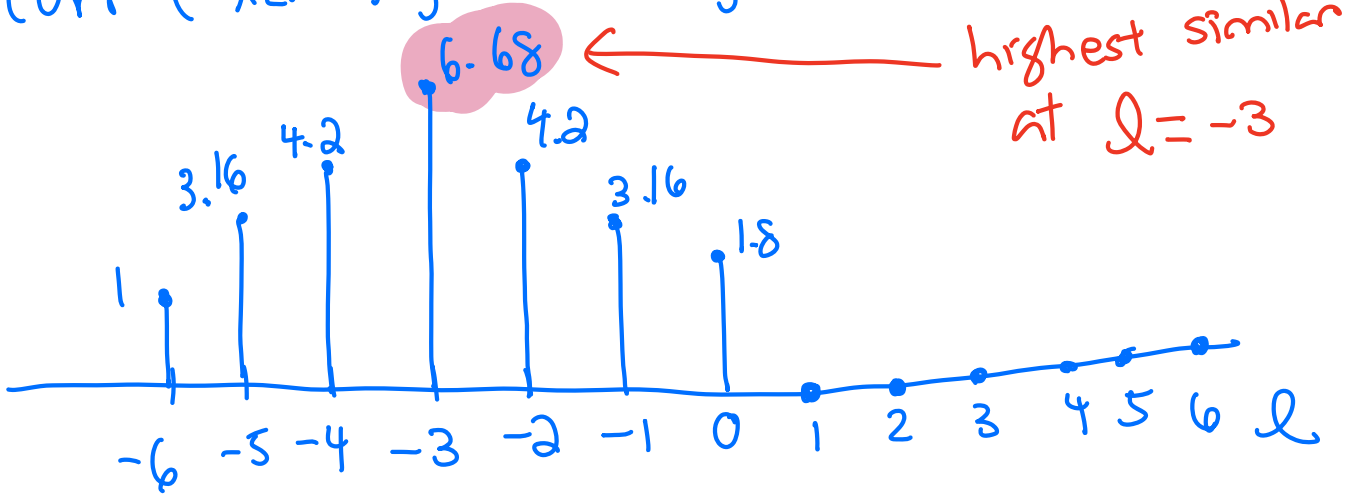
$$r_{xy}[l] = \sum_{n=-\infty}^{\infty} x[n]\, y[n-l], \quad -\infty < l < \infty$$

$$r_{xy}[l] = x[l] * y[-l] \quad \overset{\text{DTFT}}{\longleftrightarrow} \quad R_{xy}(e^{jw}) = X(e^{jw})\,Y(e^{-jw})$$

have to flip one of the signal

In matlab, you can use the xcorr( ) function

$xcorr(x[n], y[n]) = r_{xy}[l]$, $-6 \le l \le 6$



$l > 0$, $y[n]$ should shift to the right

$l < 0$, $y[n]$ should shift to the left

We see if $y[3]$ shift to the left by 3, then $y[n] = x[n] \Rightarrow$ maximum similarity

If we want to know how similar a signal in the future is to the past, we can compute its autocorrelation

$$r_x[l] = x[l] * x[-l] \xleftrightarrow{DTFT} R_x(e^{jw}) = X(e^{jw})X(e^{-jw}) = |X(e^{jw})|^2$$

what value of l is $r_x[l]$ maximum?