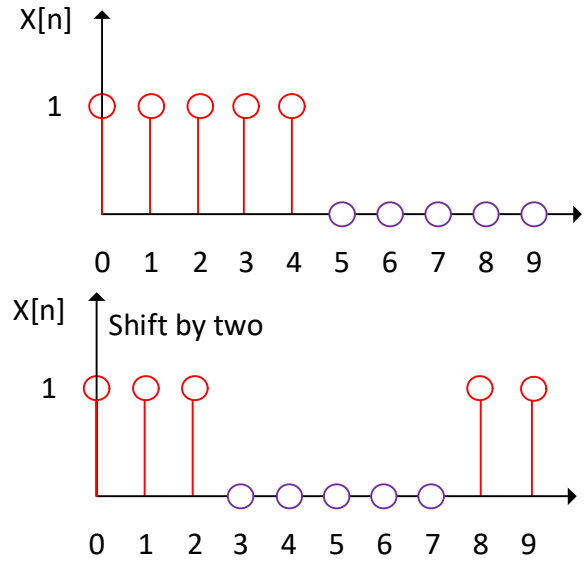
Properties of DFT

Shift – Cyclic Shift



Convolution – For DFT we do have same kind of convolution, Multiplication Properties but they are cyclic.

Cyclic convolution of $x[n]$ and $h[n]$ with the length of *N*.

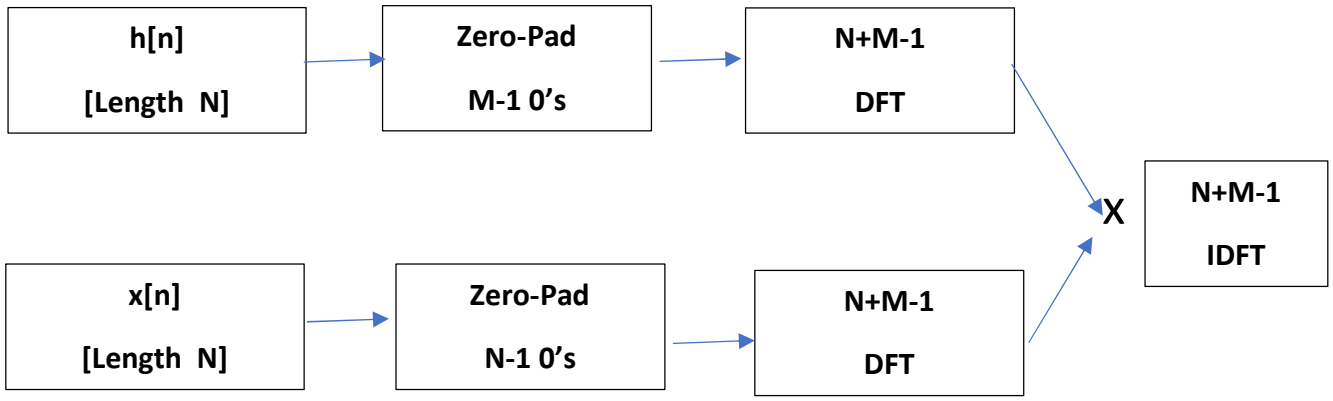
$$x[n] \otimes h[n] \leftrightarrow X[k]H[k]$$

When we are doing a cyclic convolution, we need to create a circulant matrix as follow to derive the output of $Y[k]$.

$$\begin{bmatrix} Y[0] \\ Y[1] \\ \vdots \\ Y[N-1] \end{bmatrix} = \begin{bmatrix} h[0] & h[N-1] & \dots & h[2] & h[1] \\ h[1] & h[0] & h[N-1] & \dots & h[2] \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ h[N-1] & h[N-2] & \dots & h[1] & h[0] \end{bmatrix} \begin{bmatrix} x[0] \\ x[1] \\ \vdots \\ x[N-1] \end{bmatrix}$$

↑ Circulant Matrix

To do a linear convolution with DFT



Example :