ICE503 Homework-02

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Q. 4 (a)

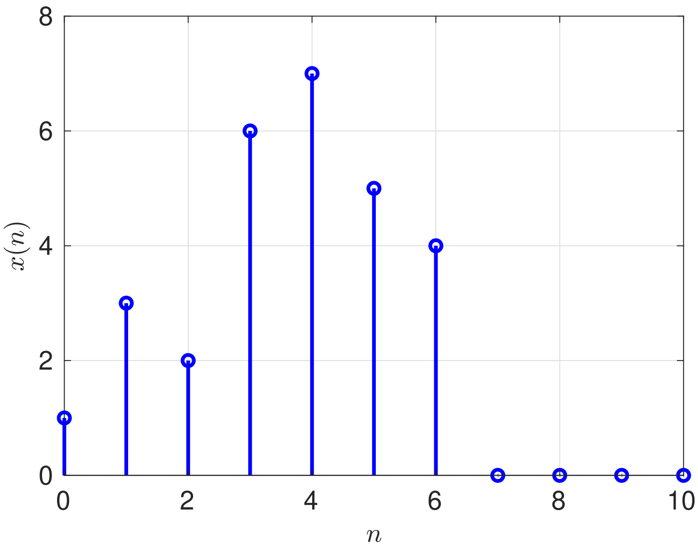

Fig. 1: 4(a) Plot of $x(n)$.

(b)
3-point moving average (MA) is defined as follows,

$$y(n) = \frac{1}{M}\sum_{k=0}^{2} x(n-k)$$

Since the data for $x(n)$ is considered from $n = 0$ to 10, while other values are 0. Therefore, the MA for the *for-loop* follows the formula,

$$\begin{aligned}
y(n<0) &= 0 \\
y(0) &= \frac{1}{3}x(0) = \frac{1}{3}\times 1 \\
y(1) &= \frac{1}{3}(x(1)+x(0)) = \frac{1}{3}\times 4 \\
y(2) &= \frac{1}{3}(x(2)+x(1)+x(0)) = \frac{1}{3}\times 6 \\
y(3) &= \frac{1}{3}(x(3)+x(2)+x(1)) = \frac{1}{3}\times 11 \\
y(4) &= \frac{1}{3}(x(4)+x(3)+x(2)) = \frac{1}{3}\times 15 \\
y(5) &= \frac{1}{3}(x(5)+x(4)+x(3)) = \frac{1}{3}\times 18 \\
y(6) &= \frac{1}{3}(x(6)+x(5)+x(4)) = \frac{1}{3}\times 16 \\
y(7) &= \frac{1}{3}(x(6)+x(5)) = \frac{1}{3}\times 9 \\
y(8) &= \frac{1}{3}x(6) = \frac{1}{3}\times 4 \\
y(n\geq 9) &= 0
\end{aligned}$$

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(c)

The 3-point MA formula is written as,

$$\begin{aligned} y(n) &= \frac{1}{3}\sum_{k=0} 2x(n-k) \\ &= \frac{1}{3}x(n) + \frac{1}{3}x(n-1) + \frac{1}{3}x(n-2) \end{aligned}$$

The impulse response of the 3-point MA is found when $x(n) = \delta(n)$, where $\delta(n)$ is the Dirac Delta function. Then, the corresponding output from this system is written as,

$$\begin{aligned} h(n) &= \frac{1}{3}\delta(n) + \frac{1}{3}\delta(n-1) + \frac{1}{3}\delta(n-2) \\ &= \frac{1}{3}\sum_{k=0}^{2}\delta(n) \end{aligned}$$

Hence, the output of the system $y(n)$ with input $x(n)$ can be equivalently written with *conv*olution operator ($\circledast$) as,

$$y(n) = h(n) \circledast x(n)$$

The resultant output is same as that of the 3-point MA definition $y(n) = \frac{1}{3}\sum_{k=0} 2x(n)$.

(d)

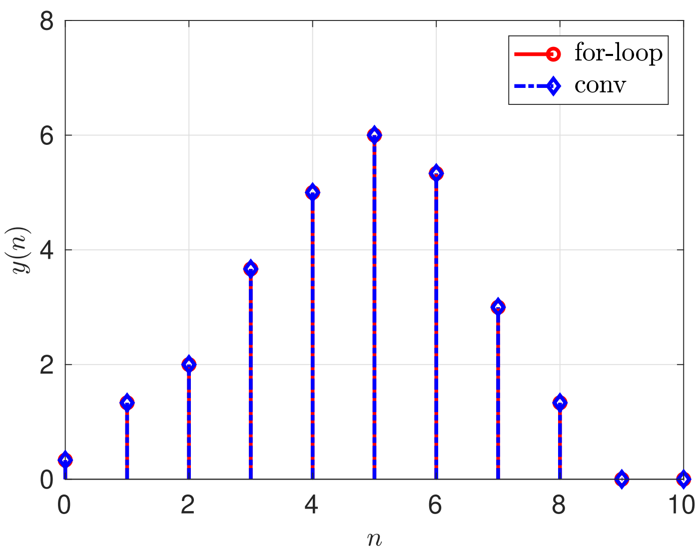

Fig. 2: 4(d) Plot of $y(n)$ by *for-loop* and *conv* method.