



Assignment - 2

Report

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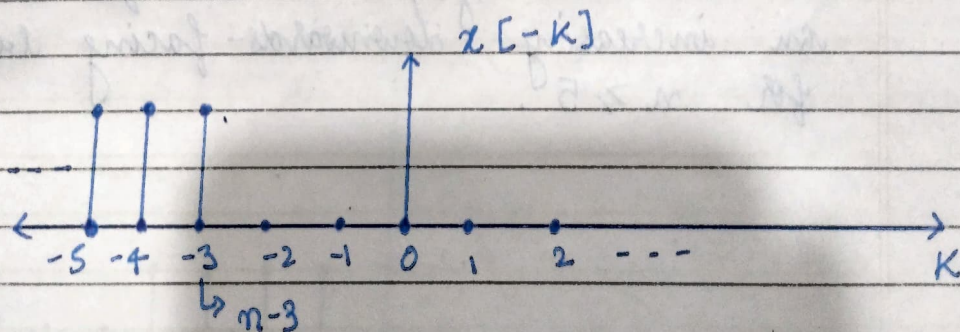
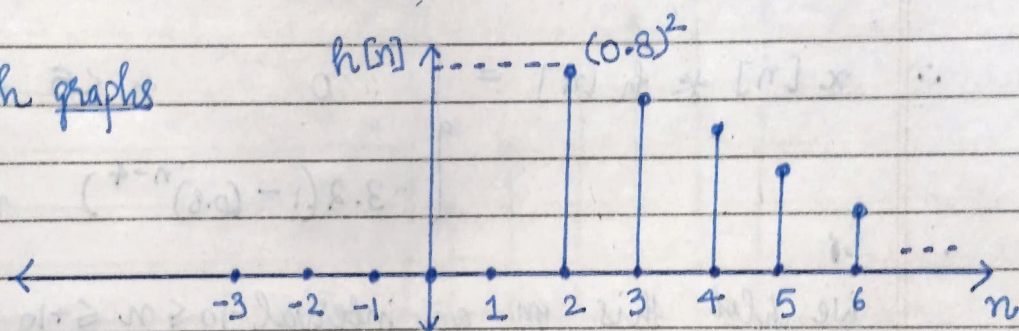
Branch : CSAI

Problem 1

$$x[n] = u[n-3]$$

$$h[n] = (0.8)^n u[n-2]$$

Rough graphs



Due to commutative property of convolution, we can reverse the roles of $h[n]$ and $x[n]$ and choose $h[n]$ as the weights for each of calculation.



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$$n-3 < 2 \Rightarrow n < 5:$$

$$x[n] * h[n] = 0$$

$$n-3 \geq 2 \Rightarrow n \geq 5$$

$$x[n] * h[n] = \sum_{k=2}^{n-3} (0.8)^k$$

$$= (0.8)^2 \frac{(1 - 0.8^{n-4})}{1 - 0.8}$$

$$= 3.2 (1 - 0.8^{n-4})$$

$$\therefore x[n] * h[n] = \begin{cases} 0 & n < 5 \\ 3.2(1 - (0.8)^{n-4}) & n \geq 5 \end{cases}$$

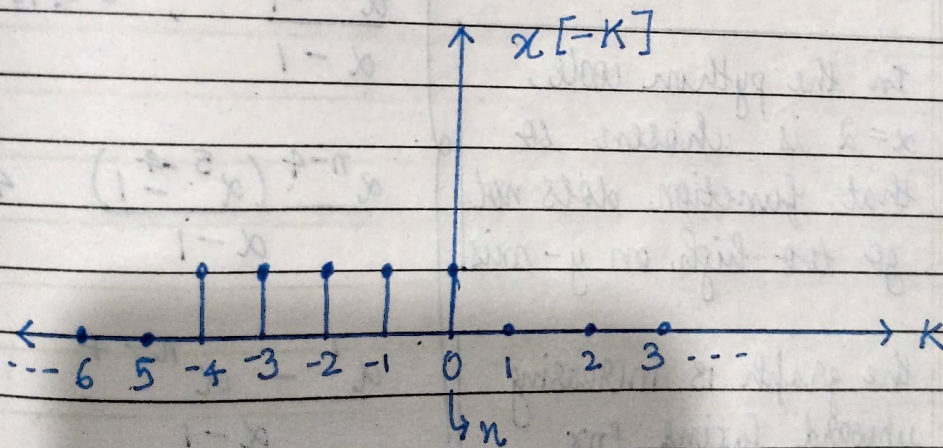
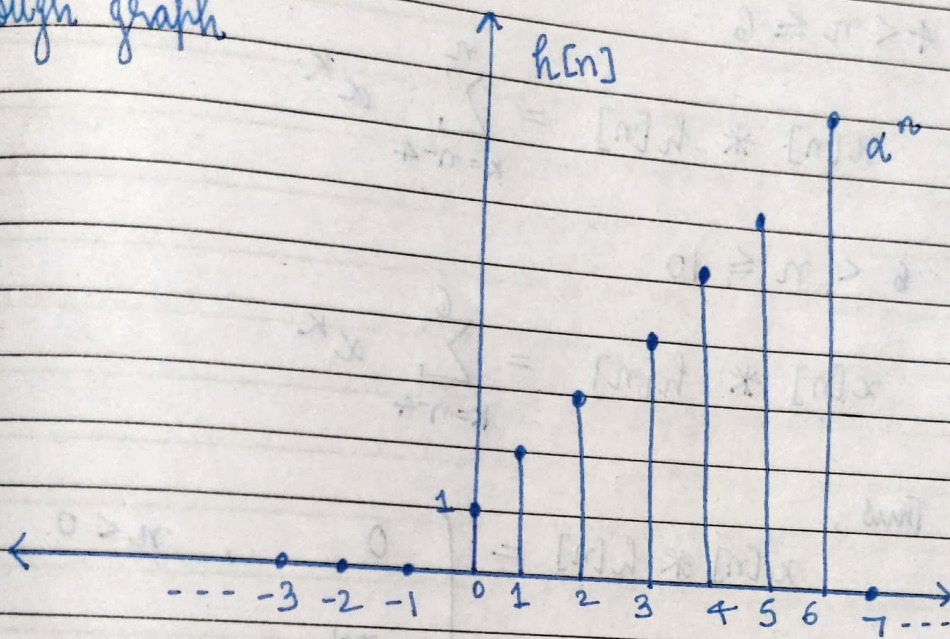
We plot this on an interval $-10 \leq n \leq +10$ in python. The resultant graph is zero for $n < 5$ and an increasing downwards-facing bell curve for $n \geq 5$.

Problem 2

$$x[n] = \begin{cases} 1, & 0 \leq n \leq 4 \\ 0, & \text{otherwise} \end{cases}$$

$$h[n] = \begin{cases} \alpha^n, & 0 \leq n \leq 6 \\ 0, & \text{otherwise} \end{cases}; \alpha > 1$$

Rough graph



Again for ease of calculation, we switch $x[n]$ and $h[n]$ using commutative property of convolution.

$$n < 0$$

$$x[n] * h[n] = 0$$

$$0 \leq n \leq 4$$

$$x[n] * h[n] = \sum_{k=0}^n \alpha^k$$

$$4 < n \leq 6$$

$$x[n] * h[n] = \sum_{k=n-4}^n \alpha^k$$

$$6 < n \leq 10$$

$$x[n] * h[n] = \sum_{k=n-4}^6 \alpha^k$$

Thus,

$$x[n] * h[n] = \begin{cases} 0 & , n < 0 \end{cases}$$

$$\frac{\alpha^{n+1} - 1}{\alpha - 1} \quad , \quad 0 \leq n \leq 4$$

$$\frac{\alpha^{n-4} (\alpha^5 - 1)}{\alpha - 1} \quad 4 < n \leq 6$$

$$\frac{\alpha^7 - \alpha^{n-4}}{\alpha - 1} \quad 6 < n \leq 10$$

$$0 \quad \text{otherwise}$$

NOTE: In the python code, $\alpha=2$ is chosen so that function does not go too high on y-axis

NOTE: the graph is increasing upward facing for $0 \leq n \leq 6$ and decreasing downward facing for $6 \leq n \leq 10$

Peak of graph is at $n=6$