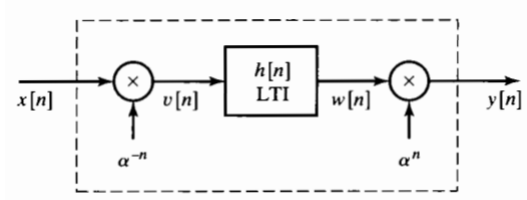# Assignment 2

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1 PROBLEM 1 - OPPENHEIMER 3.41.B

In the given figure, h[n] is the impulse response of the LTI system within the inner box. The input of system h[n] is v[n], and the output is w[n]. The z-transform of the h[n], H[z], exists in the following region of convergence:

$$0 < r_{min} < |z| < r_{max} < \infty$$

Is the overall system LTI? If so, find it's impulse response g[n]. If not, briefly explain why?

2 SOLUTION

Let's consider the system step by step-
1. First, $v[n] = \alpha^{-n}x[n]$. By taking z-tranform of both sides, $V(z) = X(\alpha z)$.
2. Second, v[n] is filtered to get w[n]. So $W(z) = H(z)V(z) = H(z)X(\alpha z)$.
3. Finally, $y[n] = \alpha^n w[n]$. In the z-transform domain, $Y(z) = W(z/\alpha) = H(z/\alpha)X(z)$.

In conclusion, the system is LTI, with system function $G(z) = H(z/\alpha)$ and $g[n] = \alpha^{-n}h[n]$.