EE3731C Tutorial - Classical Signal 1

Department of Electrical and Computer Engineering

1. In lecture, we learned about linearity, time invariance and memoryless. Two other interesting properties are stability and causal.

   - A system is stable if a bounded input ($|x[n]| < B_x$ for all n) results in a bounded output ($|y[n]| < B_y$ for all n). This is a nice property because we generally don't want our output to blow up if the input is finite. If a physical system is unstable, this could lead to a catastrophic situation (e.g., explosion).
   - A system is causal, if the output $y[n]$ at $n = n_0$ only depends on the input $x[n]$ for $n \leq n_0$. Another way of saying this is that the output at time n_0 does NOT depend on the input from the future, i.e., for $n > n_0$. This is important for real-time applications, where we would like to compute the output as data arrives in real time.

   Determine if the following systems are (i) stable, (ii) causal, (iii) linear, (iv) time invariant and (v) memoryless

   (a) $T(x[n]) = g[n]x[n]$ for given $g[n]$

   (b) $T(x[n]) = x[n - n_0]$

   (c) $T(x[n]) = e^{x[n]}$

   (d) $T(x[n]) = x[n] + 3u[n + 1]$

2. Let $h[n] = a^{-n}u[-n], 0 < a < 1$ and $x[n] = u[n]$. Compute $y[n] = x[n] * h[n]$

3. Determine and sketch the output $y[n]$ of the linear time invariant system shown in Figure 1, with input $x[n]$ and impulse response $h[n]$.

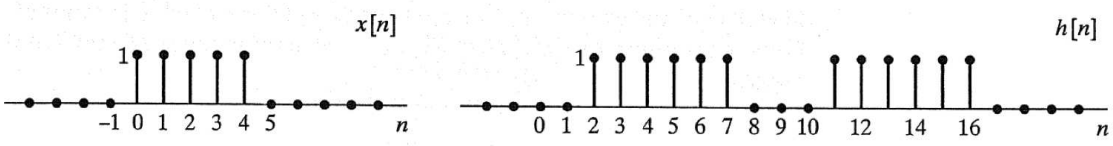

Figure 1: Input and impulse response for Q3