Tutorial - 3

1) a) $\Sigma_n x[n] = \Sigma_x \qquad \Sigma_n h[n] = \Sigma_h$

Both are finite

Suppose $\Sigma_n y[n]$ exists,

$$\Sigma_n y[n] = \Sigma_n \{\Sigma_k x[k]\, h[n-k]\}$$
$$= \Sigma_k x[k] \{\Sigma_n h[n-k]\}$$
$$= \sum_k x[k]\, \Sigma_h$$
$$= \underline{\underline{\Sigma_x \Sigma_h}}$$

$$\sum_n h[n-k] = \sum_{n=-\infty}^{\infty} h[n-k]$$

$n-k = l$

$$= \sum_{l=-\infty}^{\infty} h[l] = \Sigma_h$$

b) $\Sigma_n |x[n]| = X_0 \qquad \Sigma_n |h[n]| = H_0$

Both are finite

Suppose $\Sigma_n |y[n]|$ exists

$$\Sigma_n |y[n]| = \Sigma_n \left| \Sigma_k x[k] h[n-k] \right|$$

Using the property $\left|\sum_i a_i\right| \le \sum_i |a_i|$, we get

$$\Sigma_n |y[n]| \le \Sigma_n \Sigma_k |x[k]\, h[n-k]|$$
$$= \Sigma_n \Sigma_k |x[k]|\, |h[n-k]|$$
$$= \Sigma_k |x[k]| \{\Sigma_n |h[n-k]|\}$$
$$= \Sigma_k |x[k]|\, H_0$$
$$= X_0 H_0$$

Therefore, $\Sigma_n |y[n]| \le X_0 H_0$. Thus the output if absolutely summable has the upper bound given by $X_0 H_0$

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