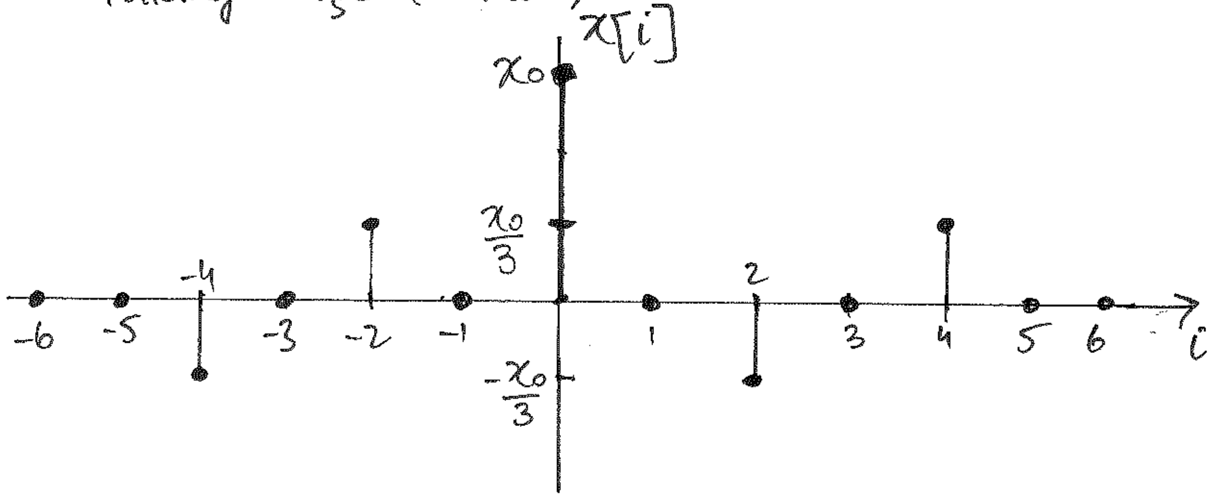
Ex 13.1

(a) Max possible rate for ISI free reception?

First we draw discrete time impulse response $x[i]$.

Taking $T_s = 100\,\mu s$, we have



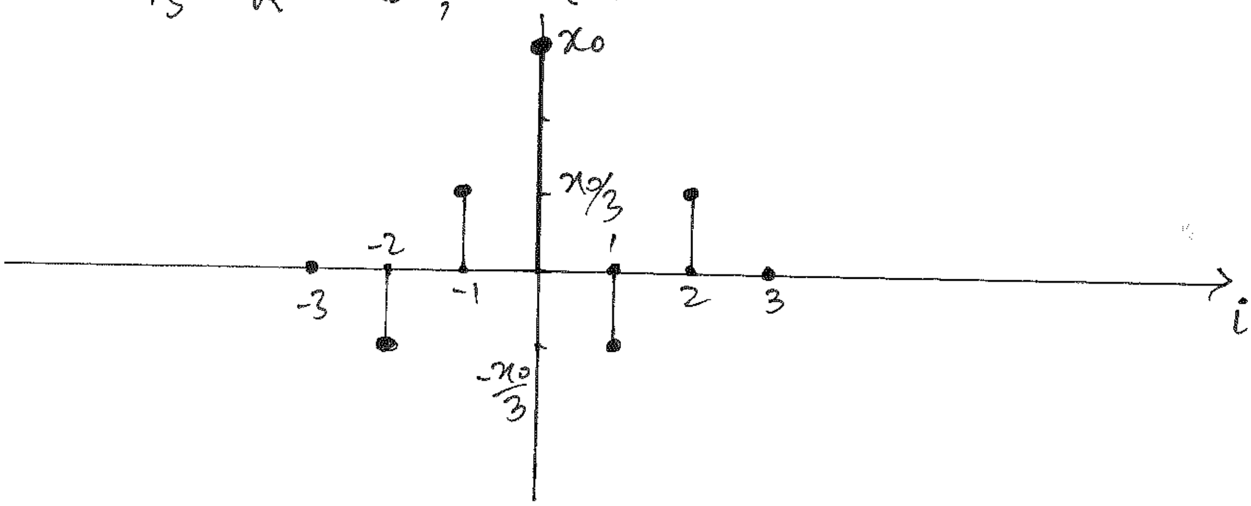
From the impulse responses, it can be seen that for $T_s = 300\,\mu s$, there will be no interference

as $x[i] = x\left(T + i\left(\frac{1}{R_s}\right)\right) = x_0\delta[i]$ when $T_s = 300\,\mu s$

(Refer to Eq. 6.23)

$x[i] = x_0\delta[i]$ for all cases when $T_s > 400\,\mu s$.

(b) $T_s = 200\,\mu s$, $x[i]$ will be



(c) when $T_s = 200\,\mu s$, then

$$ISI_{wc}^{+} = \sum_{\substack{n=-\infty \\ n \neq 0}}^{\infty} |x[n]| \quad \text{—} \quad [\text{Eq } 6.22]$$

$$= |x[-3]| + |x[-2]| + |x[-1]| + |x[1]| + \ldots + |x[3]|$$

$$= 0 + \frac{x_0}{3} + \frac{x_0}{3} + \frac{x_0}{3} + \frac{x_0}{3}$$

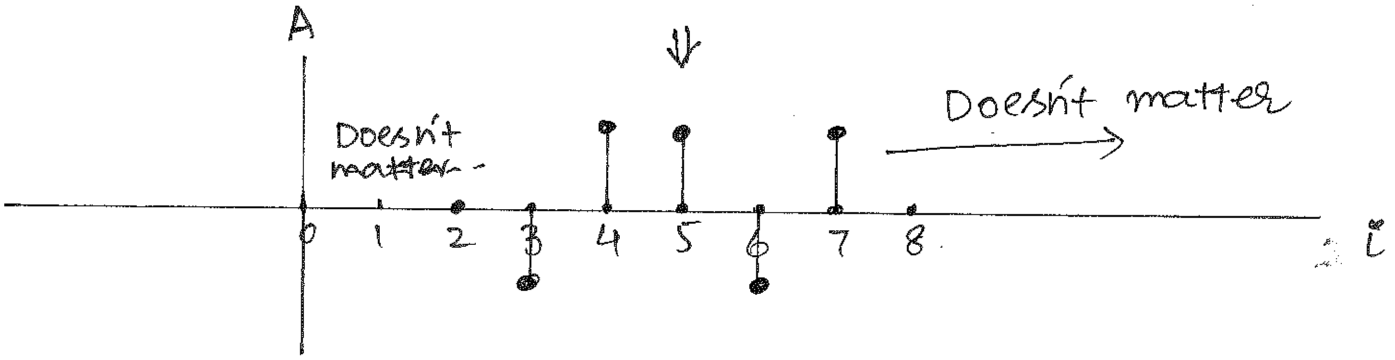
$$ISI_{wc}^{+} = 4\frac{x_0}{3} > x_0$$

and $ISI_{wc}^{-} = -\frac{4x_0}{3} < -x_0$

Hence ~~ISI~~ there is a risk of erroneous decision.

Example: Binary PAM with $A_0 = -1$ and $A_1 = 1$

we consider erroneous decision for $m[5] = 1$



For $i = 5$ message, receiver will sample it at $(i+1) = 6 = \frac{t}{T_s}$

$$\mathcal{E}[6] = x_0 + \big(A[3]x[+2] + A[4]x[+1] + A[6]x[-1] + A[7]x[-2]\big)$$

$$= x_0 + \left((-1)\left(\frac{x_0}{3}\right) + (1)\left(-\frac{x_0}{3}\right) + (-1)\left(\frac{x_0}{3}\right) + (1)\left(-\frac{x_0}{3}\right)\right)$$

$$\mathcal{E}[6] = x_0 - \frac{4x_0}{3} = -\frac{x_0}{3} < \text{'}0\text{'}$$

and $\hat{m}[5] = -1$ which is an error.