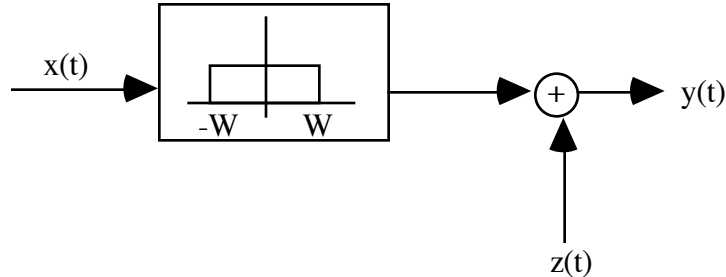


EEEE 6605
Information Theory

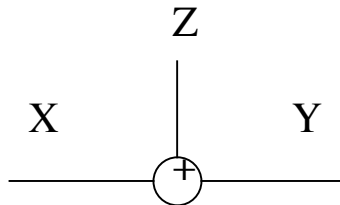
HW #7 Do not hand in.

- 1) Consider the following channel: with $W=10^6$ Hz



The average power available for transmission is P watts. What is the minimum P/N_0 needed to support a data rate of 333 kilo bits per second.

- 2) Let X and Z be independent, Gaussian random variables with $E(X) = E(Z) = 0$ and $\text{var}(X) = \sigma_X^2$ and $\text{var}(Z) = \sigma_Z^2$ and let $Y = X + Z$. What is the mutual information between X and Y ?
- 3) Plot the capacity of the AWGN as a function of SNR (in dB) from -5 dB to 40 dB. On the same graph, plot the mutual information of equiprobable AM with $M=2,4,8,16$. If the channel SNR is 20 dB what is the smallest value for M that gets closest to capacity?
- 4) Consider the channel



$X = \{1, 2, 3\}$, where $Y = X + Z$, and Z is uniformly distributed over three distinct integer values $Z = \{z_1, z_2, z_3\}$

- (a) What is the maximum capacity over all choices of the Z alphabet? Give distinct integer values z_1, z_2, z_3 and a distribution on X achieving this.
- (b) What is the minimum capacity over all choices for the Z alphabet? Give distinct integer values z_1, z_2, z_3 and a distribution on X achieving this.