Assignment of Chapter 2

1. Consider a binary-input discrete memoryless channel (B-DMC) with additive noise, as shown in Figure 1.

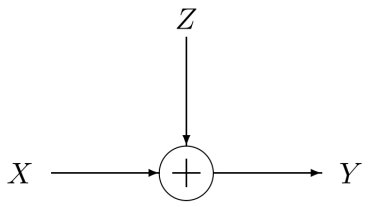

Figure 1: The B-DMC with additive noise.

Let $X \in \{0, 1\}$ and Y denote discrete input signal and output signal, respectively. Let Z denote the additive noise, where $\Pr\{Z = 0\} = \Pr\{Z = a\} = 1/2$. Assume that Z is independent of X. Please determine the capacity of the B-DMC.

Solution tip: The channel capacity depends on the value of a.

2. Consider a channel with probability transition matrix

$$\boldsymbol{P}_{y|x} = \begin{bmatrix} \frac{2}{3} & \frac{1}{3} & 0 \\ \frac{1}{3} & \frac{1}{3} & \frac{1}{3} \\ 0 & \frac{1}{3} & \frac{2}{3} \end{bmatrix}$$

In the matrix, X and Y represent the rows and columns, respectively.

(a) Please draw the trellis for this channel.

(b) Please determine the capacity of this channel and the probability distribution of X.

Solution tip: The capacity of the above mentioned channel is achieved by a distribution that places zero probability on one of input symbols.