COMP2610/COMP6261 – Information Theory

Tutorial 10

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Question 1.

Channel capacity. Consider the discrete memoryless channel $Y = X + Z \pmod{11}$, where

$$Z = \begin{pmatrix} 1, & 2, & 3 \\ 1/3, & 1/3, & 1/3 \end{pmatrix}$$

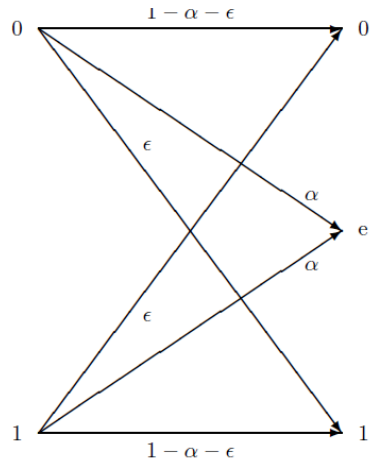
and $X \in \{0, 1, \ldots, 10\}$. Assume that Z is independent of X.

(a) Find the capacity.

(b) What is the maximizing $p^*(x)$?

Question 2.

Erasures and errors in a binary channel. Consider a channel with binary inputs that has both erasures and errors. Let the probability of error be ϵ and the probability of erasure be α, so the the channel is as illustrated below:



(a) Find the capacity of this channel.

(b) Specialize to the case of the binary symmetric channel ($\alpha = 0$).

(c) Specialize to the case of the binary erasure channel ($\epsilon = 0$).

Question 3.

Binary multiplier channel

(a) Consider the channel $Y = XZ$ where X and Z are independent binary random variables that take on values 0 and 1. Z is Bernoulli(α), i.e. $P(Z = 1) = \alpha$. Find the capacity of this channel and the maximizing distribution on X.

(b) Now suppose the receiver can observe Z as well as Y. What is the capacity?

Question 4.

Can signal alternatives lower capacity? Show that adding a row to a channel transition matrix does not decrease capacity.