

## ELL714 - Programming Assignment on Joint-Typicality based Decoding

This is a programming assignment which requires you to encode and decode binary message bits using a random codebook at the source and a joint-typicality decoder at the destination

### Objective:

- To familiarize yourself with decoding based on joint-typicality.

### Channel:

- You are given a binary symmetric channel (BSC) with transition probability  $q = 0.4$ .

### Computing Environment:

- Matlab

### Tasks:

- 1) Compute the channel capacity  $C$  of the above BSC.
- 2) Pick a non-zero rate  $R$  of your choice for some  $R < C$

### Experiment

- 1) For each  $n \in \{10, 100, 500, 1000, \dots\}$ , obtain a random codebook  $\mathcal{C}_n$  containing  $\lceil 2^{nR} \rceil$  codewords. You have to independently generate binary numbers using an underlying probability mass function  $p(x)$  of your choice.
- 2) Using  $\mathcal{C}_n$ , transmit codewords with uniform distribution over the channel.
- 3) At the receiver side, observe the binary sequences and then decode the input message using a decoder based on joint typicality. Pick  $\epsilon > 0$  of your choice when defining joint typicality.
- 4) Through simulations, compute the average probability of error of the decoder. Also, compute how many times the decoder is unable to decode the message?
- 5) Plot the average probability of error of the decoder against different values of  $n$ .
- 6) How does the above plot change when you vary the value of  $\epsilon$