



## Exercise 10 of May 4, 2017

<http://www.isi.ee.ethz.ch/teaching/courses/it2.html>

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### Problem 1

#### *Feedback Capacity of a Channel with Noncausal State Information at the Transmitter*

Show that for a discrete memoryless channel whose state is known *noncausally* to the transmitter but not to the receiver, noiseless feedback from the channel output to the transmitter does not increase the channel capacity.

### Problem 2

#### *Memory with Defects*

Consider a DMC with binary inputs and outputs and with IID states which take the values “good”, 0, and 1 with probabilities  $1 - p$ ,  $\frac{p}{2}$ , and  $\frac{p}{2}$ , respectively. When the state  $S =$  “good”, the channel is perfect, i.e.,  $Y = X$ ; when  $S = 0$ , the output  $Y$  is stuck at 0 irrespective of the input; and when  $S = 1$ , the output  $Y$  is stuck at 1.

- Compute the channel capacity when the states are known causally to the transmitter.
- Compute the channel capacity when the states are known noncausally to the transmitter.

### Problem 3

#### *BSC with Noncausal State Information*

Consider a DMC with binary inputs and outputs and with IID states which take the values “good”, 0, and 1 with probabilities  $1 - p$ ,  $\frac{p}{2}$ , and  $\frac{p}{2}$ , respectively. When the state  $S =$  “good”, the channel behaves like a binary symmetric channel of crossover probability  $\epsilon$ ; when  $S = 0$ , the channel output is stuck at 0; and when  $S = 1$ , the channel output is stuck at 1.

Assume that the transmitter knows the realization of the state sequence before the transmission starts. What is the capacity of this channel?