ETH
Eidgenössische Technische Hochschule Zürich
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Quantum Information Theory
Series 4

HS 13
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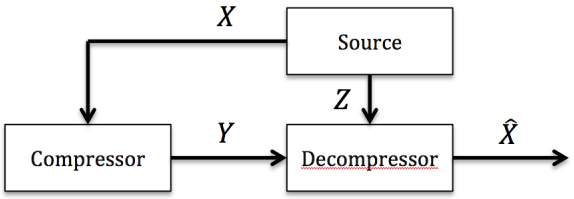
In this exercise sheet we will consider an extension of direct source coding that includes side information. Now, the source produces the random message X, as well as some side information Z, that may be correlated to X. If the side information is directly available during decompression, it can be used to increase the efficiency of decompression.



Exercise 4.1 Direct source coding theorem with side information

Prove that, given side information, the minimum length of the encoded message l^ϵ can be bounded by

$$l^\epsilon(X) \leq H_{\max}(X|Z) + \log \frac{1}{\epsilon} + 1$$

Use the proof for the standard source coding theorem from the lecture as reference.

Exercise 4.2 Converse for i.i.d sources with side information

Given an i.i.d source with side information Z, it may be possible to compress the message better than without Z. Therefore, it is not possible to lower-bound the compressibility by $H(X)$ any more. Modify the proof given in the lecture to show that the compressibility with side information can be lower-bounded by

$$C(X|Z) \geq H(X|Z)$$