S-72.341 CODING METHODS

Tutorial 6.5, Solutions

1. Describe the turbo coding scheme briefly.

   Solution:

   The default turbo encoder is illustrated in Figure 1. The rate of the encoder is 1/3, i.e., one part is the message directly (i.e., systematic part), one part is the output of a recursive convolutional encoder and the last part is the output of (usually) the same recursive convolutional encoder with the input bits permutated into different order by interliever.

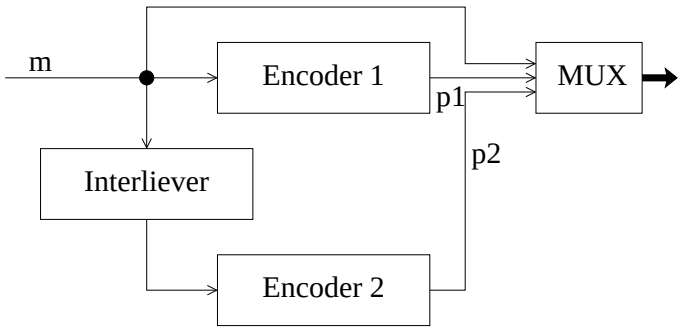

Figure 1: The default turbo encoder.

The role of the interliever is to make the input streams to the encoders as statistically independent as possible (while not making the interliever overly complicated).

The decoding happens iteratively between two decoders: the inputs for the decoders are a) the systematic part, b) the output of the corresponding encoder and c) the "belief" of the other decoder of what was really send. Naturally the "beliefs" must be directed through a interliever so that they match the corresponding encoder. The decoding stops, when the "beliefs" of both decoders agree. The process is illustrated in Figure 2. It is noteworthy, that all values for bits are soft, representing the certainty of the bit being either one or zero.

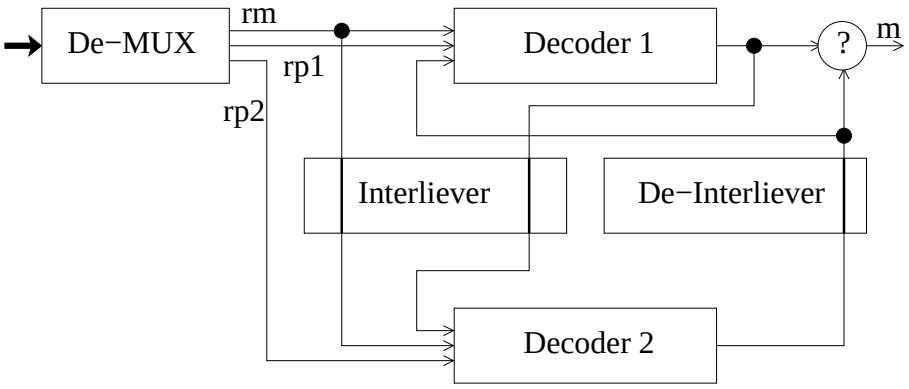

Figure 2: The default turbo decoder.

In order to improve the rate of a turbo encoder, one can puncture the output bits from the encoders: for instance puncturing every second bit from the outputs of both encoder, one achieves the rate 1/2. In the decoding the puctured bits are assumed to be in the halfway of 0 and 1.

2. The butterfly network in Figure 3 is capable of transferring two different packages from node A to nodes F and G in one step.

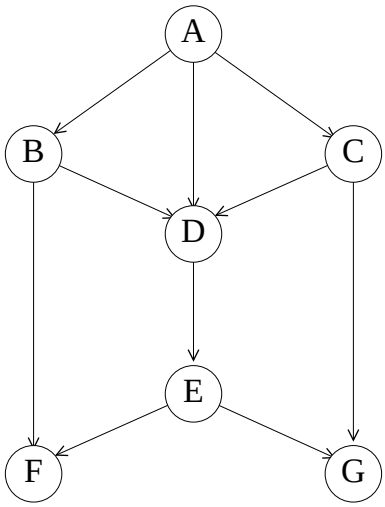

Figure 3: Butterfly network (exercise 2).

a) How many connections (it is only possible to upgrade single connections to double/triple connections) one should add in order to be able to transfer three packages in one step? Demonstrate how the packages flow through the network.

b) Same as a), but without the A→D connection.

Solution: Solutions are in Figure 4. The amount of new connections are 3 and 4 for a) and b), respectively.

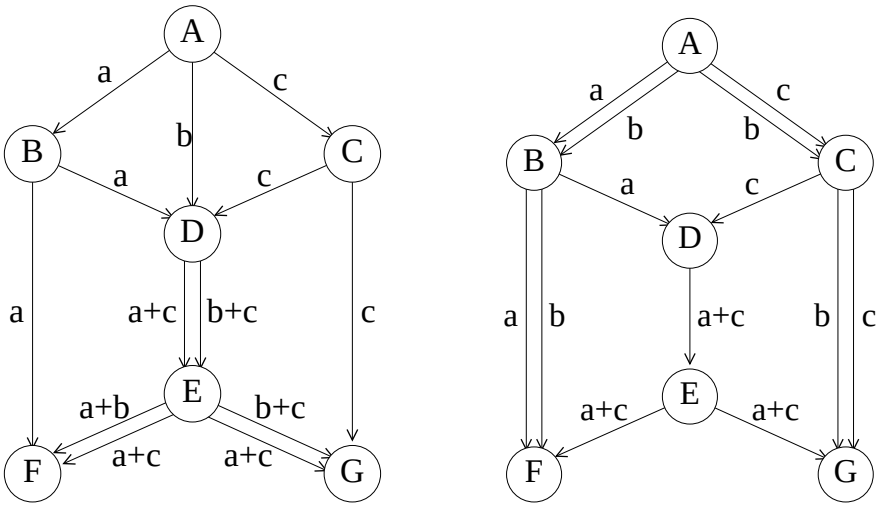

Figure 4: Butterfly networks for exercise 2 a) and b).