72.630 Capacity enhancement methods for radio interface
To be returned before 19.02.2005

Home assignment 2

1.
Take a convolutional code with the generator on Figure 1.

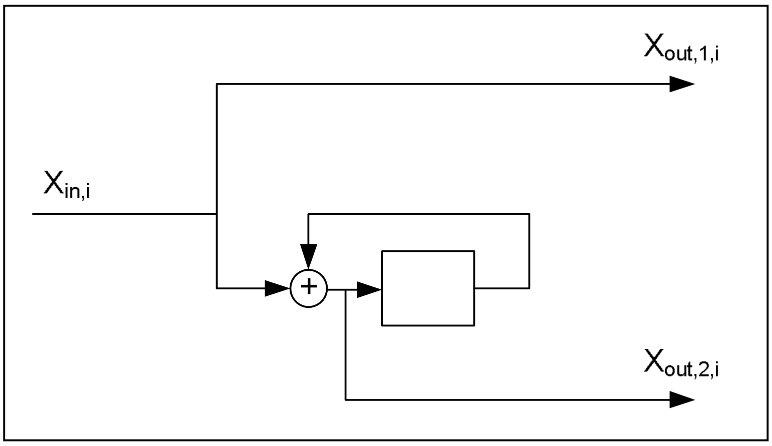

Figure 1. Convolutional encoder.

The first input bit to the encoder is 1, other input bits are calculated from your student number by taking modulo 2 from each individual number.

For example in case of the study number $\begin{bmatrix}1 & 2 & 3 & 4 & 5\end{bmatrix}$

$\begin{bmatrix}1 & 2 & 3 & 4 & 5\end{bmatrix} \bmod 2 \Rightarrow \begin{bmatrix}1 & 0 & 1 & 0 & 1\end{bmatrix}$.

$x_{in} = \begin{bmatrix}1 & [student\_number] \bmod 2\end{bmatrix}$.

The codeword contains only 12 first output bits: 6 systematic and 6 encoded bits.

$x_{out} = \begin{bmatrix}x_{out,1,1} & x_{out,2,1} & \dots & x_{out,1,6} & x_{out,2,6}\end{bmatrix}$.

The noise values in the channel are

$n_i = \begin{bmatrix}0.13 & 0.31 & 0.66 & -0.61 & -0.16 & 0.52 & -0.28 & 0.16 & -0.09 & 0.26 & 0.03 & -0.10\end{bmatrix}$

The Signal to noise ratio is 1 dB. Add the noise to the encoded signal.
Assume that we have extrinsic information for each bit in logarithmic domain is calculated as $2\left(x_{in,i} - 0.5\right) \cdot L_{extr,i}$. The extrinsic information values are

$L_{extr} = \begin{bmatrix}10 & 25 & 5 & 12 & 18 & 9\end{bmatrix}$.

1) What is the output codeword without the noise?
2) What is the transmitted signal power per transmitted bit if the signal power per information bit is 1?

3) What is the most likely codeword after the channel?
4) Calculate the marginal probability for each information bit without extrinsic information.
5) Calculate the marginal probability for each bit by considering also the extrinsic information.