School of Electrical and Information Engineering
University of the Witwatersrand, Johannesburg
ELEN7049 – Telecommunications Access Networks

Tutorial 3: Convolutional Codes and Viterbi Decoding

Question 1:

Given a convolutional code with the generator polynomial in the octal notation (5, 7) (left significant bit)

1. What is the generator polynomial?

2. What is the rate?

3. What is the overall constraint length?

Question 2:

Draw the state diagram of a convolutional code with the generator polynomial (6, 5) (left significant bit). On the basis of the state diagram, prove this code is catastrophic.

Question 3:

Given an encoder with generator polynomial

$$G = \begin{pmatrix} 1 + D^2 & 1 + D + D^2 \end{pmatrix}$$

and a puncturing matrix as

$$\mathbf{P} = \begin{pmatrix} 1 & 0 & 0 \\ 1 & 1 & 1 \end{pmatrix}$$

- Show the puncturing process in a trellis diagram.

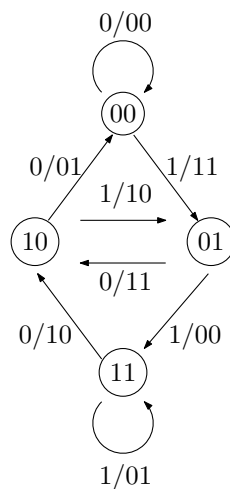- What is the rate of the punctured code?

Figure 1: State Diagram

Question 4:

Given a convolutional encoder with the generator matrix $g(D) = [1 + D^2, 1 + D + D^2]$, if the sequence 01 11 10 01 11 10 11 11 10 10 is received, find out the message sent by using the Viterbi algorithm. Show the decoding process in a trellis diagram.

Question 5: The state diagram of the convolutional code with the generator polynomial (6, 7) is shown in Fig 1.

- Draw the signal flow diagram of this code.

- Derive the path weight enumerator.

- For the binary symmetric channel with error probability 0.01, what the upper bound of the error probability by using Viterbi decoding.