

Solutions to Problem Set 9

EE419: Digital Communication Systems

Check the solutions for possible bugs!

2. (a) The relations between the input sequence $\{u_n\}$ and the output sequences $\{v_n^{(1)}\}$ and $\{v_n^{(2)}\}$ are as follows:

$$v_n^{(1)} = u_n^{(1)} + u_{n-3}^{(1)},$$

$$v_n^{(2)} = u_n^{(1)} + u_{n-1}^{(1)} + u_{n-2}^{(1)} + u_{n-3}^{(1)}.$$

- (b) The trellis is shown in Fig. 1.

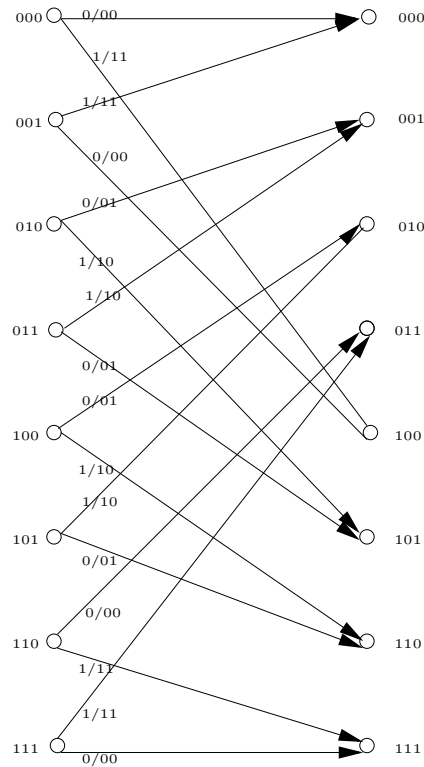


Figure 1: One stage of the trellis.

- (c) Encoding of (11111.....):

$$v_n^{(1)} = 11100000 \dots\dots$$

$$v_n^{(2)} = 10100000 \dots\dots$$

3. (a) The relations between the input sequence $\{u_n\}$ and the output sequences $\{v_n^{(1)}\}$ and $\{v_n^{(2)}\}$ are as follows:

$$v_n^{(1)} = u_n^{(1)},$$

$$v_n^{(2)} = u_n^{(1)} + u_{n-1}^{(1)}.$$

The trellis for 4 message bits is shown in Fig. 2.

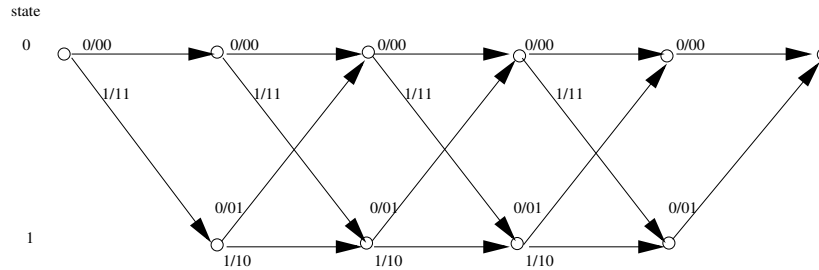


Figure 2: Trellis Diagram for 4 message bits with zero termination.

- (b) Number of codewords = Number of possible messages = $2^4 = 16$.
(c) Viterbi decoding over a BSC is shown in Fig. 3. The final survivor is shown in red. The ML decoded message is seen to be 1000.

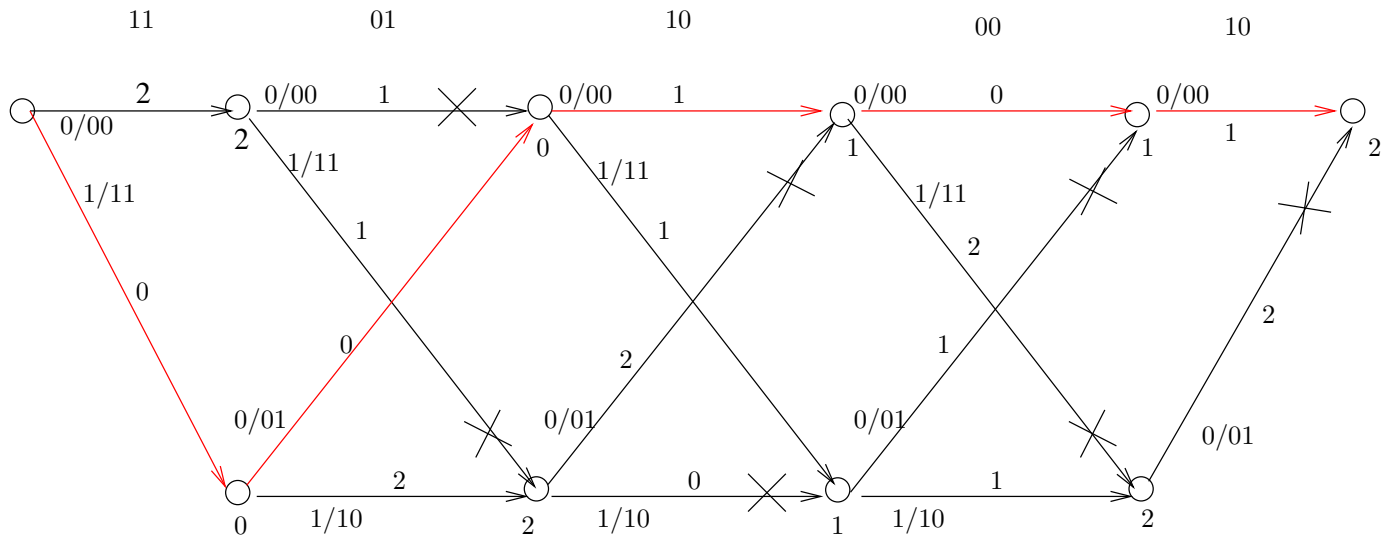


Figure 3: Viterbi Decoding over BSC.

- (d) Viterbi Decoding over AWGN is shown in Fig. 4. The final survivor is shown in red. The ML decoded message is seen to be 0111.

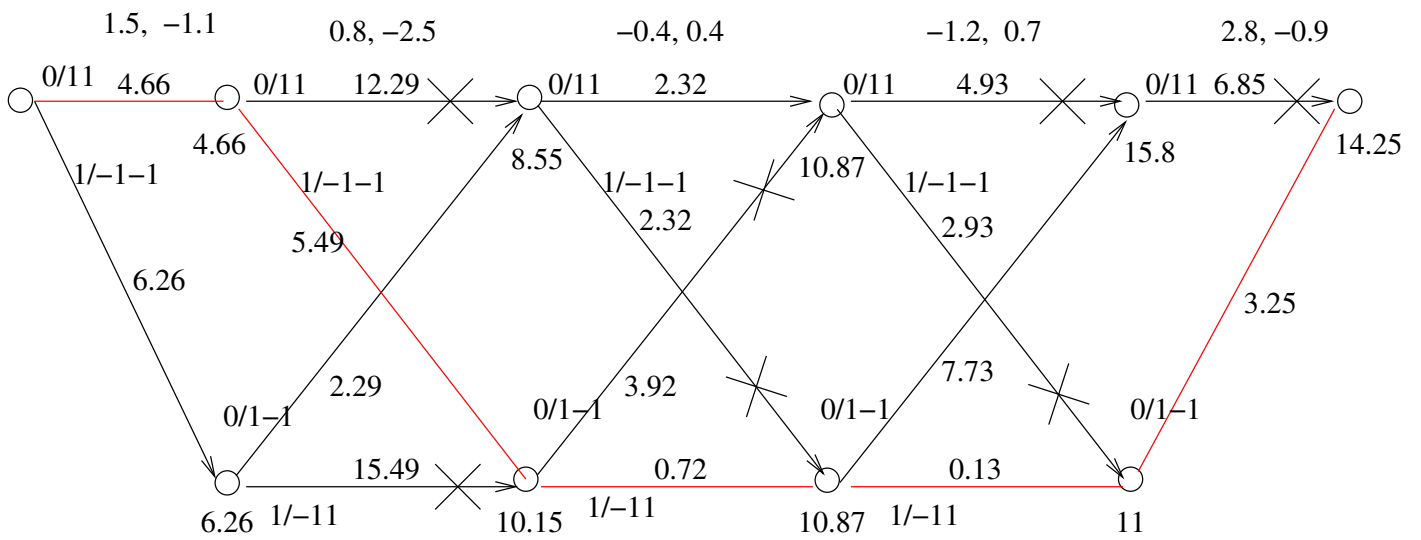


Figure 4: Viterbi Decoding over AWGN.