Home Work Set 1

Chapter 1 [S. Johnson]
1.26; 1.28

1.26 The encoder for a rate-1/q repetition code repeats each message bit q times. For example, if q = 2 then the message u = [u_1 u_2] will be encoded into the codeword c = [u_1 u_1 u_2 u_2]. If a codeword from a length N = 6, rate-1/3, repetition code is transmitted through a BSC and y = [1 1 0 0 0 1] is received, use ML decoding to find the most likely transmitted message, assuming that the message was generated by a binary equiprobable source,
(a) when _ = 0.1,
(b) when _ = 0.4,
(c) when _ = 0.6.

1.28 Repeat Exercise 1.26 but use MAP decoding.

Chapter 4,
4.1, 4.13, 4.17

4.1 The convolutional encoder used in the IS-95 code division multiple access (CDMA) system for mobile phones has the generators 753, 561.
(a) Determine the code rate and maximum memory order,
(b) give the generator matrix,
(c) determine the codeword produced by the message $\mathbf{u}^{(1)}$ = [1 0 1 1 0],
(d) draw this encoder's block diagram.

4.13 Find the MAP message using BCJR decoding (with probability metrics) for the encoder in Figure 4.3 assuming an equiprobable binary source:
(a) for an 8-bit terminated codeword sent on the BSC with crossover probability 0.02 when y = [1 1; 1 1; 0 1; 1 1] is received,
(b) for an 8-bit terminated codeword sent on the BI-AWGN channel with signal-to-noise ratio 5 dB when y = [1.1 0.9; −0.1 1.1; −1.1 0.9; 1.1 1.1] is received, for a biased source with $\mathbf{p}(\mathbf{u}_t) = 1) = 0.4$.

4.17 Write a Matlab program to implement log BCJR decoding.
(a) Using your program determine the MAP bit probabilities for the unterminated message corresponding to the received vector
y = [1 1 1; 1 0 1; 1 1 1; 0 1 0; 0 0 1; 0 1 1]
from the convolutional encoder of Figure 4.2. Assume a binary equiprobable source and a BSC with crossover probability 0.2.
(b) Using your program find the average bit error rate of the IS-95 convolutional code (see Exercise 4.1) operating on a BI-AWGN channel with signal-to-noise ratios of 1 dB and 3 dB for message lengths of 10 bits and 100 bits respectively. Assume an equiprobable binary source.