DETAILED LECTURE NOTES

Unit-5

Convolutional Code

Convolutional Code generate encoded sequence for input sequence on bit by bit basis. for suressive input bits output bits are generated.

It wookes on the input bit rather than block of input sequence.

A convolutional coding is done by combining the fixed number of input bits. The input bit stored in the fixed length register (shift register) an than combined with the help of mod 2 adders. The operation is equatent to binary convolution and hence it is called convolutional coding.

Code Rate

$$r = \frac{k}{n}$$

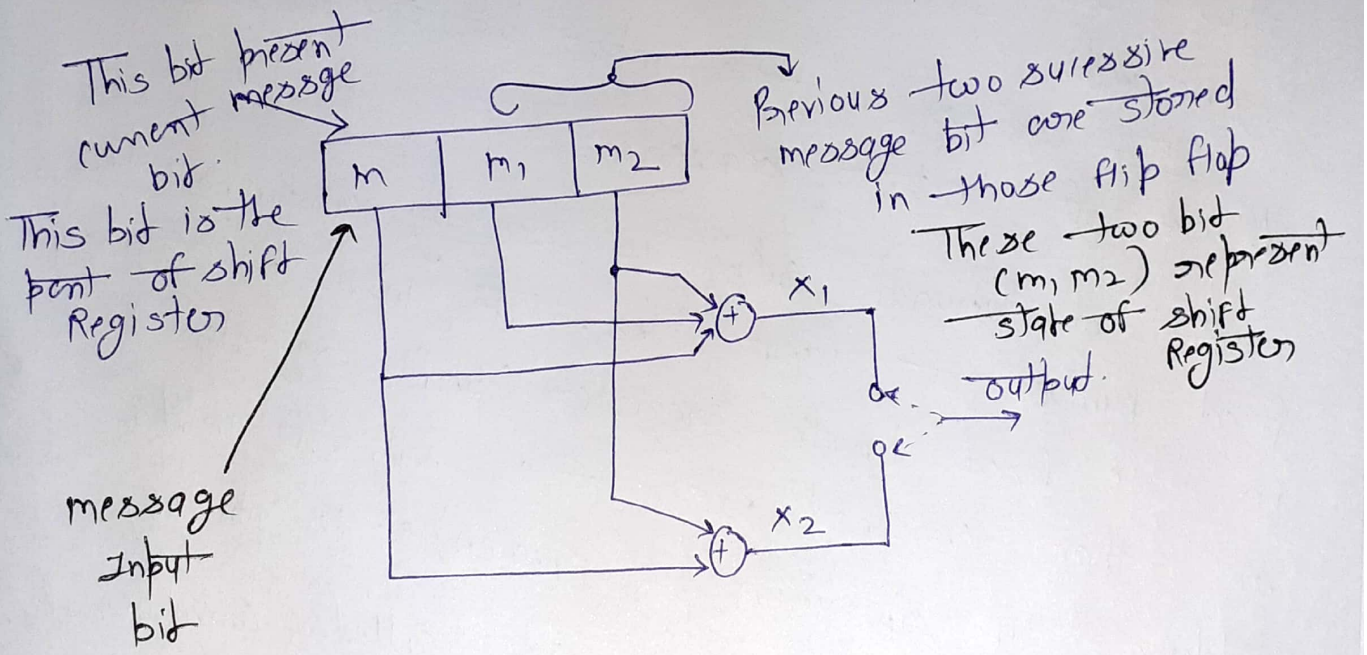
→ small k number of message bit

Constraint length (k)

It is defined as the number of shift over which a single message bit can influence the encoder output. It is expressed in terms of message bit.

Dimension of code

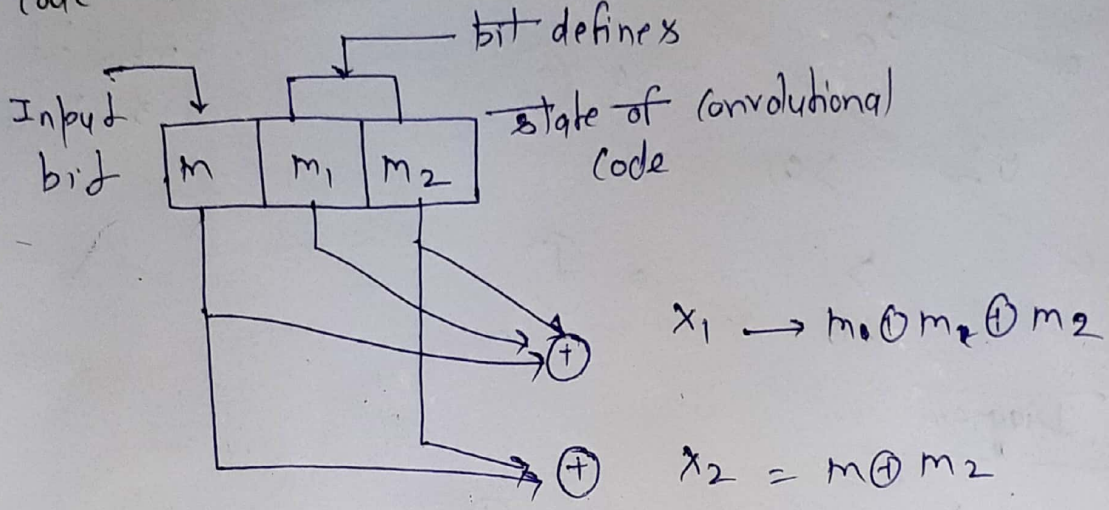
It is given by (n, k). k is the number of message bit taken at the particular time by the encoder, n is the encoded output bit for one message bit.



Convolutional Encoder with K=3, k=1 and n=2

DETAILED LECTURE NOTES

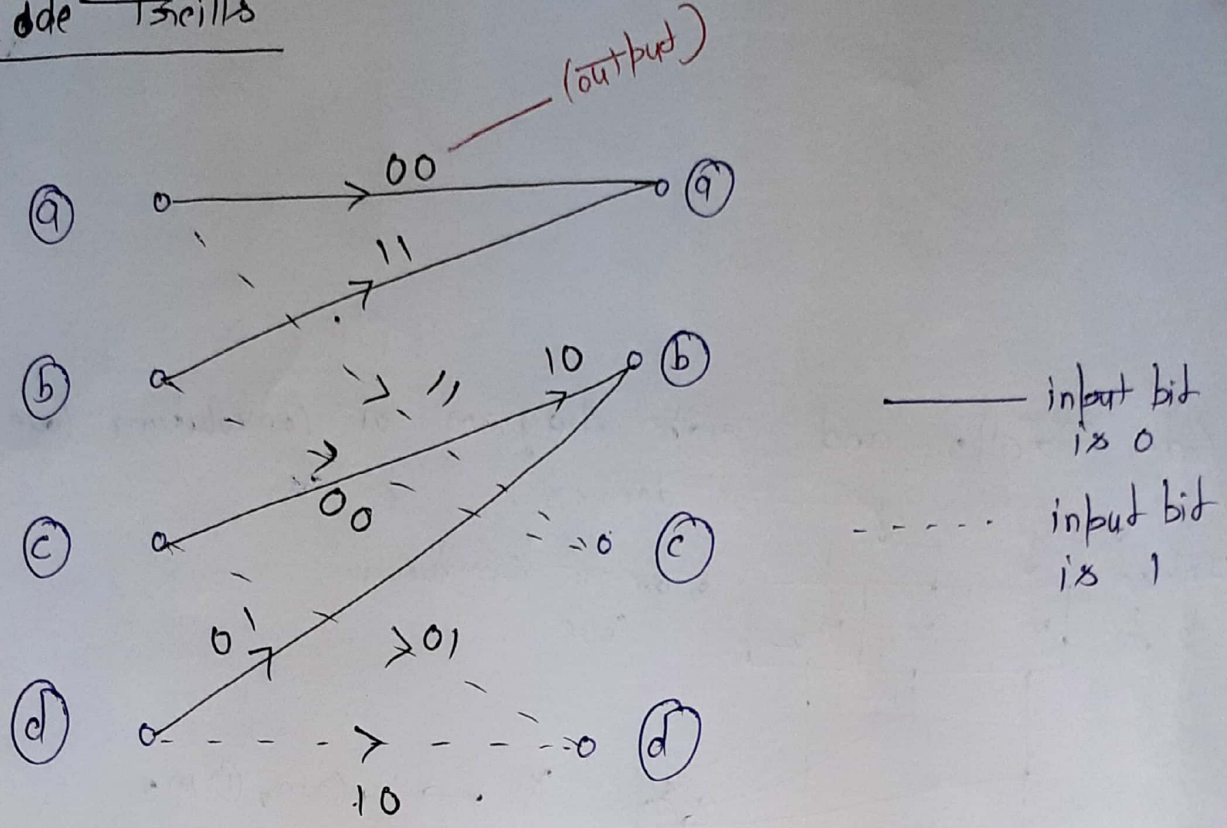
Code Trellis and state diagram of convolutional code



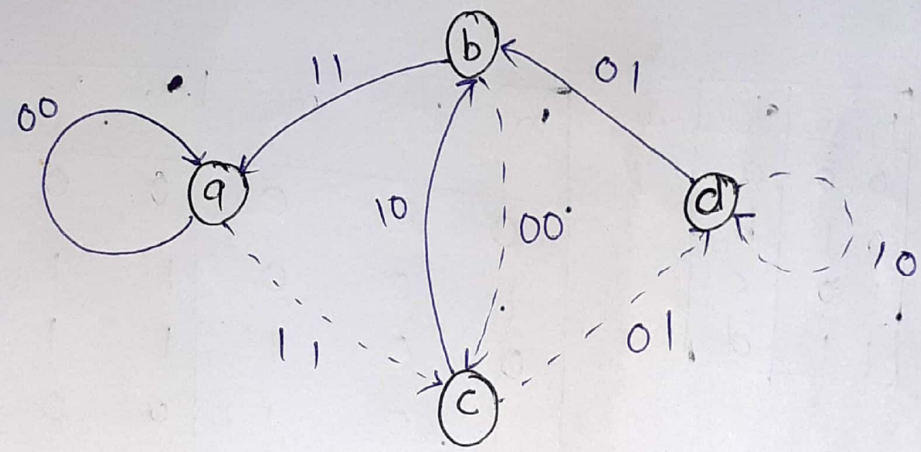
m_1 m_2	State
0 0	a
0 1	b
1 0	c
1 1	d

m	m_1	m_2	x_1	x_2	Current state	next state
0	0	0	0	0	a	a
1	0	0	1	1	a	c
0	0	1	1	1	b	a
1	0	1	0	0	b	c
0	1	0	1	0	c	b
1	1	0	0	1	c	d
0	1	1	0	1	d	b
1	1	1	1	0	d	d

Code trellis



State Diagram.



DETAILED LECTURE NOTES

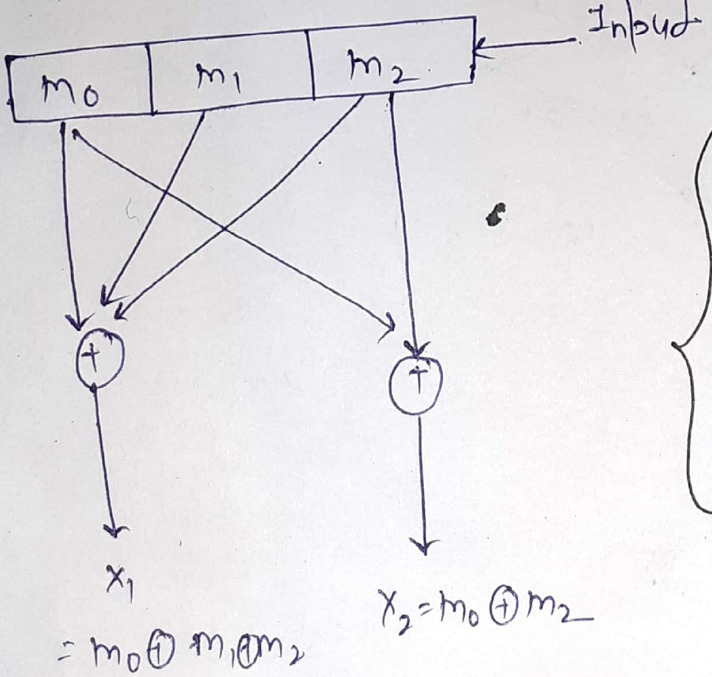
Viterbi Algorithm. (Maximum likelihood Decoding)

It is the method for decoding convolution codes.

We use trellis decoder to decode the receive data

Objective: To find the best path through the trellis that is closed using the trellis diagram.

Steps of trellis Viterbi Algorithm.



$m_0\ m_1 \rightarrow$ Present state

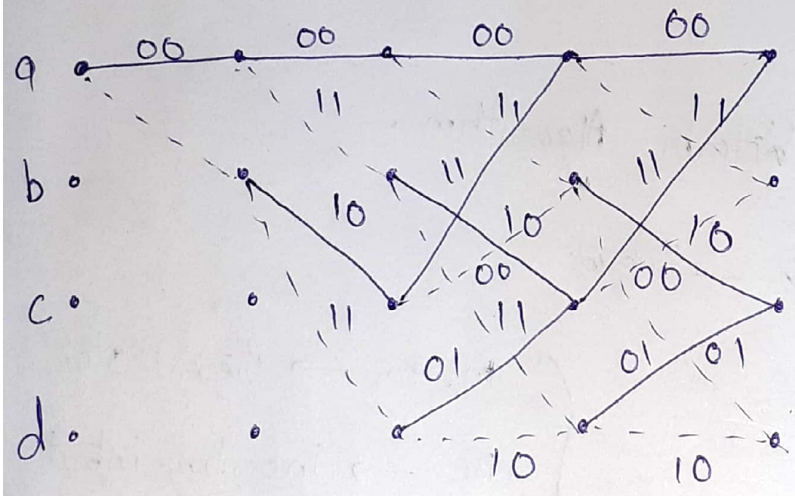
$m_2 \rightarrow$ Incoming input

$m_0\ m_1 \rightarrow$ Present state

$m_1\ m_2 \rightarrow$ next state.

m_0	m_1	m_2	x_1	x_2	PS	NS
0	0	0	0	0	a	a
0	0	1	1	1	a	b
0	1	0	1	0	b	c
0	1	1	0	1	b	d
1	0	0	1	1	c	a
1	0	1	0	0	c	b
1	1	0	0	1	d	c
1	1	1	1	0	d	d

Trellis Diagram



Viterbi Algorithm

Received Data Sequence — 01 10 11 00 00

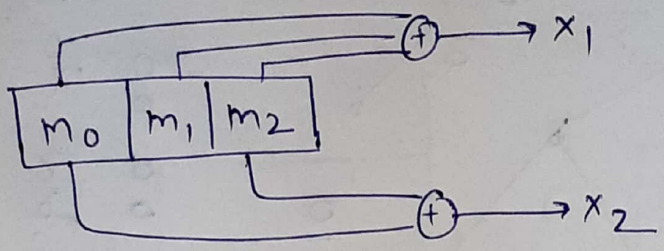
Match the weighted with received to the bits diagram.

Decoded data sequence of the Viterbi Algorithm. by computed hamming distance = 1

→ 11 10 11 00 00

So there error is the one bit during decoding by the Viterbi Algorithm.

Code Tree for the given encoder Design



Encoded sequence given by $x_1 x_2 x_1 x_2 x_1 x_2$

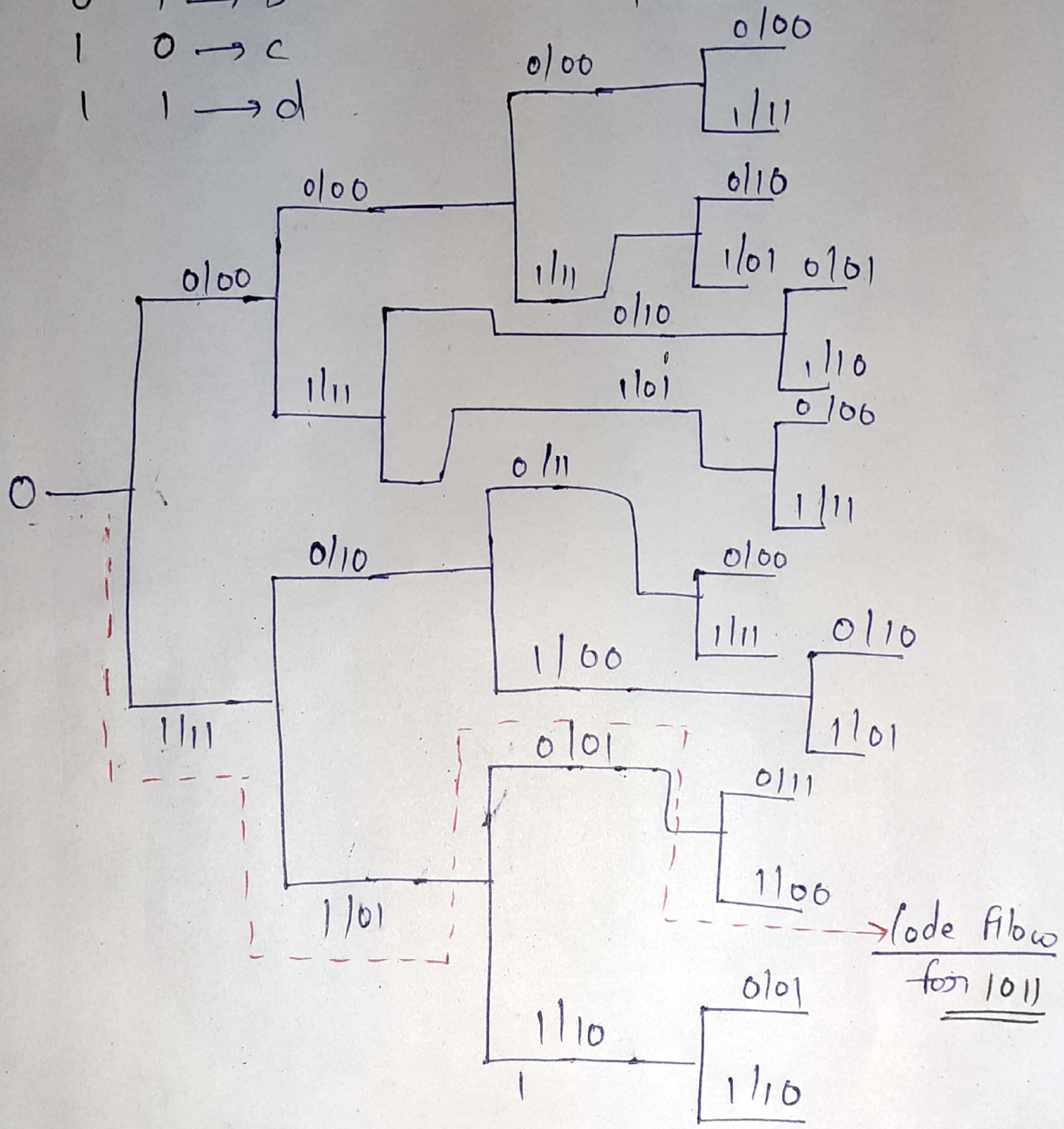
m_0	m_1	m_2	x_1	x_2
0	0	0	0	0
1	0	0	1	1
1	1	0	0	1
0	1	1	0	1
1	0	1	0	0
0	1	0	1	0
0	0	1	1	1
0	1	1	0	1
0	1	1	0	1

$2^{N-1} = 2^{3-1} = 2^2 = 4$ states

m_2	m_1	
0	0	→ a
0	1	→ b
1	0	→ c
1	1	→ d

0 input → more upside

1 input → more downside



Code tree for Convolution Encoder.