

Code words for $s_1 s_2$ and $s_2 s_1$ are same second extension of code B are not distinct and hence it become 'singular'

3. Uniquely Decodable codes:

A non-singular code is said to be "uniquely decodable" or "uniquely decipherable" if every code word present in a long received sequence can be uniquely identified.

eg: Received a sequence at the receiver in the absence of noise ; $R = 001100$.

① Code A is used :

Decoded as : $s_1 s_4 s_1$

→ It is the only possible way.

② Code B is used :

Decoded as : $s_2 s_4 s_2$ or

$s_1 s_1 s_4 s_1 s_1$ or

$s_1 s_1 s_4 s_2$ or

$s_2 s_4 s_1 s_1$

→ not uniquely decodable.

4. Instantaneous Codes:

A uniquely decodable code is said to be instantaneous if it is possible to recognize the end of any code word in any received sequence, without reference to the succeeding symbols. There is no time delay in the process of decoding & decoding is instantaneous.

eg: Consider three codes :

Source symbols	Code C	Code D	Code E
s_1	00	0	0
s_2	01	10	01
s_3	10	110	011
s_4	11	1110	0111

Received sequence ; $R = 001100$

using different coding schemes:

Code C : $s_1 s_4 s_1$

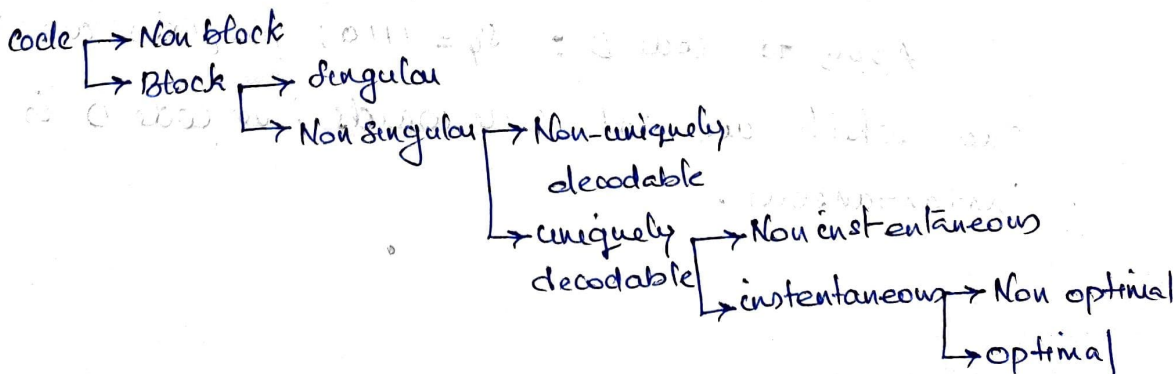
Code D : $s_1 s_1 s_3 s_1$

Code E : $s_1 s_3 s_1 s_1$

When code D is used for decoding, '0' arrives at receiver, it can immediately be decoded as ' s_1 ', because no other codewords are started with a '0'. A second zero is decoded as s_1 again. Here when a '0' arrives, it ends each code word, i.e. an imaginary "comma" may be inserted at the receiver after the reception of every zero. Then it is decoded. So it is called a "COMMA CODE".

5. Optimal Codes:

An instantaneous code is said to be "optimal code" if it has "minimum average length L " for a source with a given probability assignment for the source symbol.



Code property as tree diagram :

Prefix of a code :

Let $x = x_1 x_2 \dots x_m$ be a code word of some code, then the sequence $x_1 x_2 \dots x_j$ for all $j < m$ are called 'prefixes' of code x .

eg: Let $x = 0111$ $m=4$

when $j=1$; 0
 $j=2$; 01
 $j=3$; 011 } prefixes of code x .

Test for instantaneous Property (prefix property) :

A necessary and sufficient condition for a uniquely decodable code to be instantaneous is that

"No complete word of a code word be a prefix of any other code word"

→ If prefixes are present : code is not instantaneous.

→ If prefixes are not present : code is instantaneous.

Even if one prefix is present, the code will not be instantaneous.

Applying test to code E , for $S_4 = 0111$, prefixes are $0, 01, 011$, which are the code words of s_1, s_2, s_3 . So code E is not instantaneous.

Apply to code D : $S_4 = 1110$; prefixes are $1, 11, 111$, and which are not code words; so code D is instantaneous.