Note Title 1/2008

EE512: Error Control Coding

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G slot
- Wed 3-4:30pm
- Thu 11-11:55 am ESB242
- Fri 10-10:55 am

Website http://courses.cc.iitm.ac.in:8080

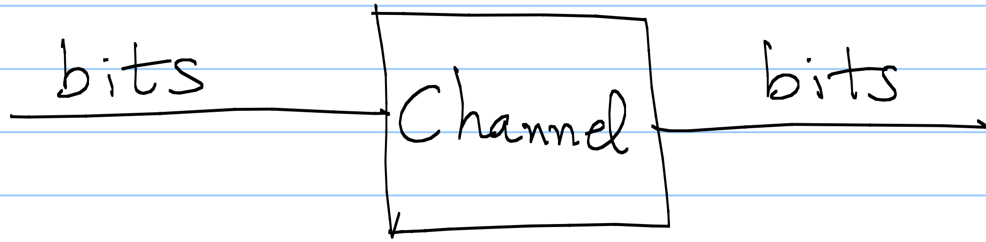
Sign-up sheet Roll no., email, name

Grading Q1 + Q2 + F
(25) (25) (50)

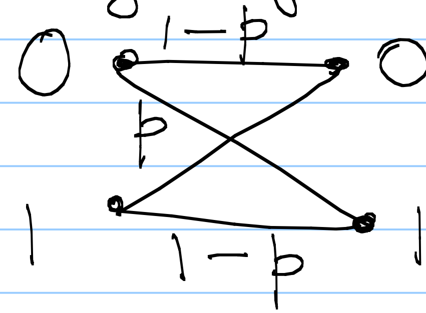
Prerequisites
- Binary arithmetic
- Linear Algebra
- Probability

↕ Mathematical maturity.

Digital Communication System



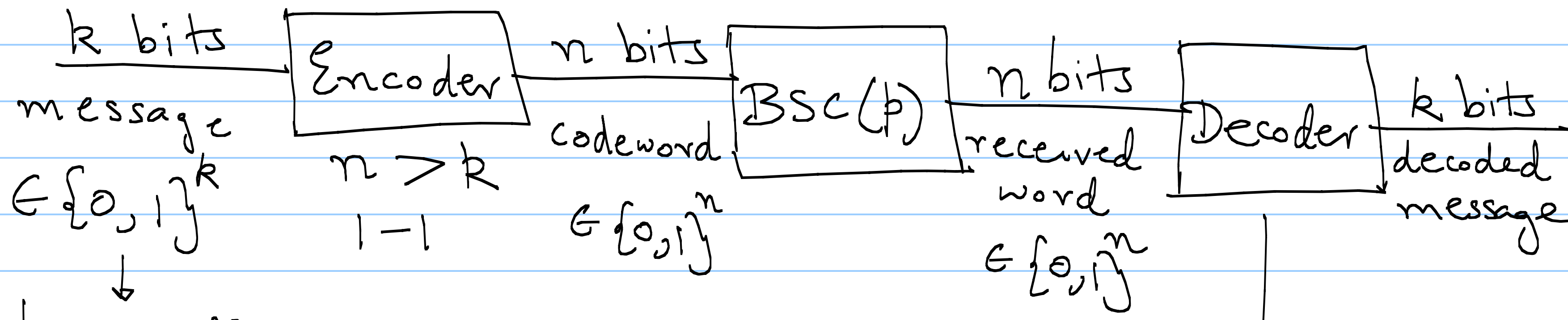
Binary Symmetric Channel



→ Not efficient to drive p to zero.

→ Efficient solution: Coding

Coding



binary sequences of length k

Rate $= k/n$

Minimize

Pr(decoded message ≠ txed message)

(many - 1 map)

→ Selection of Encoder

→ Design of Decoder

Penalties

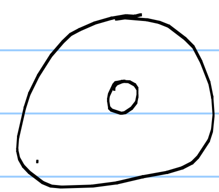
1) Complexity ✓
2) Delay
3) T[illegible]

Gains : 1) Pr(Error) at same transmit power

2) Transmit power at same error rate.

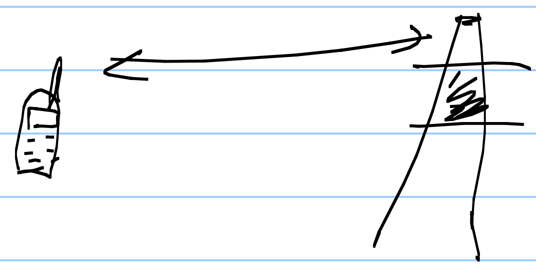
Examples

1)



→ recover from scratches

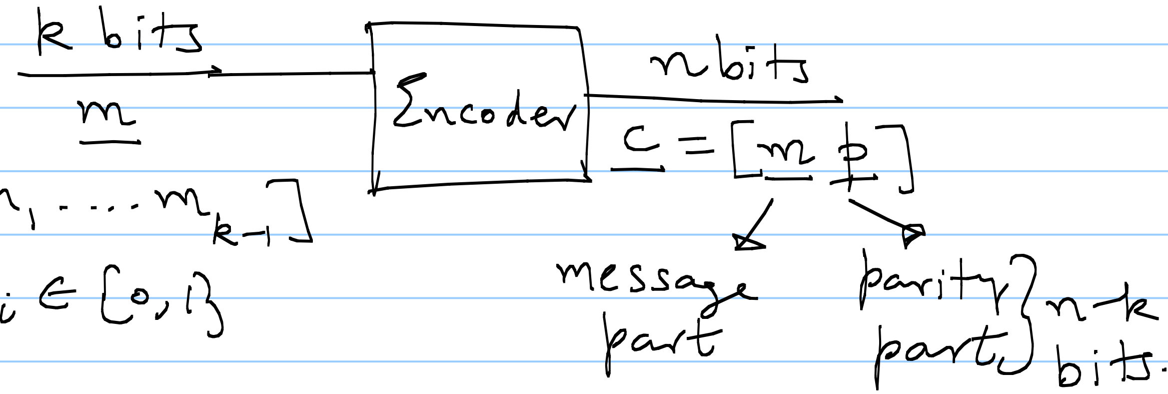
2)



Look-ahead: 1) Linear Codes (binary)
2) Decoders

Books: 1) Richard Blahut
2) Lin & Costello, 2nd edition
3) Ron Roth
4) F. J. MacWilliams & NJA Sloane

Linear Codes:



$\underline{m} = [m_0\ m_1 \ldots m_{k-1}]$

$m_i \in \{0, 1\}$

$\underline{p} = [p_0\ p_1 \ldots p_{n-k-1}]$

Linear: p_i = XOR of several bits from $\underline{m}$

Example: $k = 3,\ n = 6$

$p_0 = m_0 + m_1 \pmod 2$ ← implied

$p_1 = m_1 + m_2$

$p_2 = m_0 + m_2$

$\underline{m}$	$\underline{c}$
0 0 0	0 0 0 0 0 0
0 0 1	0 0 1 0 1 1
0 1 0	0 1 0 1 1 0
0 1 1	0 1 1 1 0 1
1 0 0	1 0 0 1 0 1
1 0 1	1 0 1 1 1 0
1 1 0	1 1 0 0 1 1
1 1 1	1 1 1 0 0 0

Example Code: $C = \{000000, 001011, \ldots, 111000\}$

$|C| = 2^k = 8$

Code = Set of all codewords

Generator matrix

$\underline{c} = \underline{m}\, G$ → $k \times n$ matrix

Ex:

$$\underline{c} = [m_0 \; m_1 \; m_2] \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$$

"systematic form"