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Experiment / assignment / tutorial No.
Grade: AA / AB / BB / BC / CC / CD / DD

Signature of the Faculty In-Charge with date

Q1) a)
$$\begin{bmatrix} 1/2 & 1/2 & 0 & 0 \\ 0 & 1/2 & 1/2 & 0 \\ 0 & 0 & 1/2 & 1/2 \\ 1/2 & 0 & 0 & 1/2 \end{bmatrix}$$

Draw channel diagram for following matrix

b) write the probability transition matrix for the following channel diagram and write comment about it

Q2) A binary symmetric channel has following noise matrix with source probabilities of

$P(x_1) = \frac{2}{3}$ and $P(x_2) = 1/3$

$$P(Y|X) = \begin{bmatrix} 0.75 & 0.25 \\ 0.25 & 0.75 \end{bmatrix}$$

a) Determine H(x)
b) Determine P(Y)
c) Determine joint probability matrix and H(Y/X)

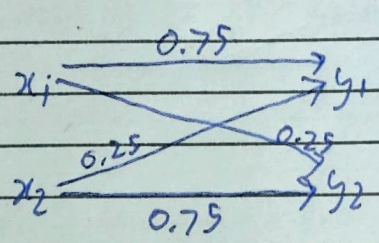
Q3) Match the following

A	B	C
i) H(X,Y)	$\sum_{j=1}^{m} P(x_j) \log_2 P(x_j)$	Mutual information
ii) H(X)	$-\sum_{j=1}^{m}\sum_{k=1}^{n} P(x_j, y_k) \log_2 P(x_j, y_k)$	Describes how well one can recover transmitted symbols from received symbol
iii) H(X/Y)	$H(X) - H(X/Y)$	Priori ~~energy~~ entropy
iv) I(X,Y)	$-\sum_{j=1}^{m}\sum_{k=1}^{n} P(x_j, y_k) \log P(x_j/y_k)$	Joint entropy of X and Y

Q1) (a)

Q2) $P(x_1) = 2/3 \qquad P(x_2) = 1/3$

$$P(Y|X) = \begin{bmatrix} 0.75 & 0.25 \\ 0.25 & 0.75 \end{bmatrix}$$



$P(x_1) = 2/3 \qquad P(x_2) = 1/3$

b) $P(Y) = P(X)\,P(Y|X)$

$$= \begin{bmatrix} 2/3 & 1/3 \end{bmatrix} \begin{bmatrix} 0.75 & 0.25 \\ 0.25 & 0.75 \end{bmatrix}$$

b) $P(Y) = [0.583 \qquad 0.416]$

a) $H(X) = -\sum_{j=1}^{m} P(x_j) \log_2 P(x_j)$

$$= -\left(\frac{2}{3}\log\left(\frac{3}{2}\right) + \frac{1}{3}\log_2 3\right)$$

$$= -0.917$$

c) $P(X,Y) = [P(X)][P(Y|X)]$

$$P(X,Y) = \begin{bmatrix} \frac{2}{3} & 0 \\ 0 & 1/3 \end{bmatrix} \begin{bmatrix} 0.75 & 0.25 \\ 0.25 & 0.75 \end{bmatrix}$$

$$= \begin{bmatrix} 1/2 & 1/6 \\ 1/12 & 1/4 \end{bmatrix}$$

$$H(Y|X) = -\sum_{j=1}^{m} \sum_{k=1}^{n} P(y_k, x_j) \log_2 P(y_k | x_j)$$

$$P(X,Y) = \begin{bmatrix} 1/2 & 1/6 \\ 1/12 & 1/4 \end{bmatrix}$$

$$P(Y|X) = \begin{bmatrix} 0.75 & 0.25 \\ 0.25 & 0.75 \end{bmatrix}$$

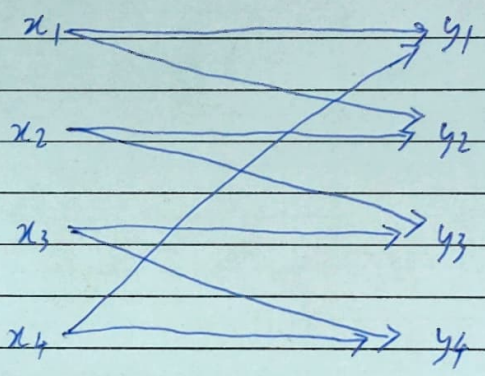
$$H(Y|X) = \frac{1}{2}\log_2\left(\frac{4}{3}\right) + \frac{1}{6}\log_2 4 + \frac{1}{12}\log_2 4 + \frac{1}{4}\log_2\frac{4}{3}$$

$$= 0.7386 \text{ bits/message}$$

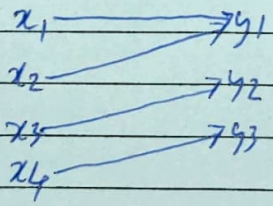
Q3)

A	C	B
i) $H(X,Y)$	Joint entropy of x and y	$-\sum_{j=1}^{m}\sum_{k=1}^{n} P(x_j, y_k)\log_2(x_j, y_k)$
ii) $H(X)$	Priori ~~energy~~ entropy	$-\sum_{j=1}^{m} P(x_j)\log_2 P(x_j)$
iii) $H(X/Y)$	How well one can recover transmitted symbol from received symbol	$-\sum_{j=1}^{m}\sum_{k=1}^{n} P(x_j, y_k)\log_2 P(x_j/y_k)$
iv) $I(X,Y)$	MI (mutual information)	$H(X) - H(X/Y)$

Q1) a)



b)



$$\begin{bmatrix} 1 & 0 & 0 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

The channel is nor uniform nor symmetric.