Department of Electronics & Communication Engineering

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Digital Communication

Assignment-1

1. A source emits one o four possible symbols during each signaling interval. The symbol occur with the probabilities are 0.4,0.3,0.2 and 0.1 . Find the amount of information gained by observing the source emitting each of these symbols. If successive symbols emitted by the source are statistically independent. Calculate the entropy of the source.

2. Let X be represent the outcome of a single roll of a fair die. What is the entropy of X ?

3. A discrete memoryless source has an alphabet of seven symbols with probabilities for its output, as described here:

Symbol	A	B	C	D	E	F	G
Probability	.25	0.25	0.125	0.125	0.125	0.0625	0.0625

Compute the Huffman code for this source, moving a combined symbol as high as possible. Explain why the computed source code has an efficiency of 100 percent.

4. Consider the four code listed below:

Symbol	Code1	CodeII	Code III	Code IV
A	0	0	0	00
B	10	01	01	01
C	110	001	011	10
D	1110	0010	110	110
E	1111	0011	111	111

Two of these codes are prefix codes. Identify them, and construct their individual decision tree.

5. A discrete memoryless source has an alphabet of five symbols with their probabilities for its output, as given here.

Symbol	A	B	C	E	E
Probability	0.55	0.15	0.15	0.10	0.05

Compute two different Huffman code for this source. Hence, for each of the two codes find,

(a) The average code-word length

(b) The variance of the average code-word length over the ensemble of source symbols.

6. A voice-grade channel of the telephone network has a bandwidth of 3.4 kHz.
   (a) Calculate the channel capacity of the telephone channel for a signal to noise ratio of 30 dB
   (b) Calculate the minimum signal-to-noise ratio required to support information transmission through the telephone channel at the rate of 4800 bits per symbol
7. Alphanumeric data are entered into a computer from a remote terminal through a voice-grade telephone channel. The channel has a bandwidth of 3.4 kHz, and output signal to noise ratio of 20 dB. The terminal has a total of 128 symbols. Assume that the symbols are equiprobable, and the successive transmission are statistically independent.
   (a) Calculate the channel capacity.
   (b) Calculate the maximum symbol rate for which error-free transmission over the channel is possible.
8. A black and white television picture may be viewed as consisting of approximately 3×10^5 $elements$, each one of which may occupy one of 10 distnict brightness levels with equal probability. Assume (a) the rate of transmission is 30 picture frames per second and (b) the signal to noise ratio is 30 dB.
   (i)Using the channel capacity theorem, calculate the minimum bandwidth required to support the transmission of the resultant video signal.
9. A discrete source emits one of five symbols once every millisecond with probabilities 1/2, 1/4 , 1/8, 1/16 and 1/16 respectively. Determine the source entropy and information rate.
10. The probabilities of the four possible outcomes of an experiment are given as 1/2, 1/4 , 1/8 and 1/16. Determine the entropy and information rate if there are 16 outcomes per second.