UIT2521 – Information Theory and Applications

UNIT II INFORMATION THEORY FUNDAMENTALS

Tutorial – III

Rate of Information

Date & Time: 16.08.2024 (Friday, 6th Hour)

1. An event has six possible outcomes with the probabilities $p_1 = 1/2$, $p_2 = 1/4$, $P_3 = 1/8$, $p_4 = 1/16$, $p_5 = 1/32$ and $p_6 = 1/32$. Find the entropy of the system. Also find the rate of information if there are 16 outcomes per second.

2. A discrete source emits one of the five symbols once every one microsecond with probabilities 1/2, 1/4, 1/8, 1/16, 1/32 respectively. Determine the entropy and information rate.

3. An analog signal is band limited to B Hz, sampled at the Nyquist rate and samples are quantized into 4 levels. These four levels are assumed to be purely independent with probabilities of occurrences are,

   $p_1 = 1/8$, $p_2 = 2/8$, $P_3 = 3/8$, $p_4 = 2/8$,

   Find the information rate of the source.

4. A continuous signal is band-limited to 5 kHz. The signal is quantized in 8 levels of a PCM system with probabilities 0.25, 0.2, 0.2, 0.1, 0.1, 0.05, 0.05 and 0.05. Calculate the entropy and rate of information.

5. A high-resolution black-and-white TV picture consists of about 2×10^6 picture elements and 16 different brightness levels. Pictures are repeated at the rate of 32 per second. All picture elements are assumed to be independent, and all levels have an equal likelihood of occurrence. Calculate the average rate of information conveyed by this TV picture source.

6. Consider a telegraph source having two symbols, dot and dash. The dot duration is 0.2 s. The dash duration is 3 times the dot duration. The probability of the dot's occurring is twice that of the dash, and the time between symbols is 0.2 s. Calculate the information rate of the telegraph source.

Hint:

Rate of Information:

If a message source generates message (or symbols) at the rate of *r* messages (or symbols) per second; then the rate of information is given by,

$$\mathbf{R = r\,H} \text{ bits/ second}$$

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