

## UIT2521 – Information Theory and Applications

### UNIT II INFORMATION THEORY FUNDAMENTALS

#### Tutorial – II

#### Entropy

**Date & Time: 09.08.2024 (Friday, 5<sup>th</sup> Hour)**

1. A source emits one of four symbols  $s_0, s_1, s_2, s_3$  with probabilities  $1/3, 1/6, 1/4$  and  $1/4$  respectively. The successive symbols emitted by the source are statistically independent. Calculate the entropy of the source.
2. Let  $X$  represents the outcome of a single roll of a fair die. Determine the entropy of  $X$ .
3. Let  $p$  denotes the probability of some event. Plot the amount of information gained by the occurrence of this event for  $0 \leq p \leq 1$ .
4. a) Calculate the average information in bits/character for the English language, assuming that, each of the 26 characters in the alphabet occurs with equal likelihood. Neglect spaces and punctuation.  
  
b) Since the alphabetic characters do not appear with equal frequency in the English language (or any other language), the answer to part a) will represent an upper bound on average information content per character. Repeat part a) under the assumption that the alphabet characters occur with the following probabilities:

$p = 0.10$  : for letters a, e, o, t

$p = 0.07$  : for letters h, i, n, r, s

$p = 0.02$  : for letters c, d, f, l, m, p, u, y

$p = 0.01$  : for letters b, g, j, k, q, v, w, x, z

5. Consider a discrete memoryless source with source alphabet  $S = \{s_0, s_1, s_2\}$ , and source statistics  $\{0.7, 0.15, 0.15\}$ . Calculate the entropy of the source.

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