UIT 2305
UNIT III Information Theory

Session Objectives

- To introduce the basic concepts of Information theory
  - Information measure

Session Outcomes

At the end of the session, students will be able to understand

- The concepts of Information measure

Outline

- Information measure
- Units of Information
- Properties of Information

Information Measure

- If the probability of occurrence of an event is more, there is a very less amount of information;
- otherwise, if the probability of occurrence of an event is less, then there will be more amount of information.
- Example:
  - if a dog bites a man, the probability of occurrence is more, so very less information, otherwise,
  - if a man bites a dog, the probability of occurrence is very less, hence more information.

Information Measure

This relationship is expressed as,

$$I(x_j) = f\left[\frac{1}{p(x_j)}\right] \quad \cdots (1)$$

where,

x_j – event

$P(x_j)$ – Probability of an event

$I(x_j)$ – Amount of information due to the occurrence of an event x_j

Information Measure

Therefore, the amount of information I_{x_j} is related to the logarithm on the inverse of the ***probability of occurrence*** *of an event $P(x_j)$.*

$$I_{x_j} = \log \frac{1}{p(x_j)} \qquad \ldots (2)$$

(i..e) $$I_k = \log \frac{1}{p_k} \qquad (\text{if } x_j = k) \qquad \ldots (3)$$

Units of Information

Different units of information can be defined for different ***bases*** of logarithms are,

(i) base '2' – the unit is bit,

(ii) base 'e' – the unit is nat, and

(iii) base '10' – the unit is decit

Properties of Information

The following are the properties of information,

(i) $I(x_j) = 0$ for $p(x_j) = 1$

$I(x_j) = \infty$ for $p(x_j) = 0$

This means ***no information*** gained

(ii) Non negative quantity i.e., $I(x_j) \geq 0$ for $0 \leq p(x_j) \leq 1$

This means no loss of information.

(iii) $I(x_j) > I(y_k)$ for $p(x_j) < p(y_k)$

This means more information gain.

(iv) $I(x_j, y_k) = I(x_j) + I(y_k)$

if x_j and y_k are statistically independent.

Summary

- Discussed the basic concepts such as
  - Information measure
  - Properties of Information

Test Your Understanding

- List the properties of information

References

- Thomas Cover, Joy Thomas, “Elements of Information Theory”, Wiley Inderscience, 2nd Edition, 2006.

THANK YOU