Module 1.1

Concepts about Information Theory

"Anyone who has never made a mistake has never tried anything new"

Albert Einstein (1879-1955)

Introduction :

"Information Theory is a branch of Applied Mathematics, Electrical engineering, bio informatics and computer science involving the quantification of information" Today we live in the information age, that owes its existance to a paper published in 1948 that laid in the foundation of the field "Information Theory" - a theory initiated by one man, the American Electrical Engineering Claude E. Shannon, whose ideas appeared in the article "The Mathematical Theory of Communication" in the Bell System Technical Journal (1948).

Information Theory is a part of probability theory, which can be applied to the study of communication systems, ie simple ideal statistical (means information obtained by studying numerical data) communication models. The chief concern is to discover mathematical laws governing systems designed to communicate information. It sets up a measure of information and the capacity of various systems to transmit, store and process information.

Concept of Data and Information:

Data

Means: Def: It is raw, un organized given input which need to be processed, which is simple and random.

Def: Data is the given input

eg: Each students test score

Information

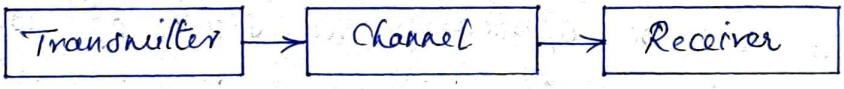
when the given data is processed, organised in a given context to make it useful called information.

Information is the interpreted data.

The class average calculated from the test score.

A communication system deals with the flow of some sort of information in some network. The information may be electrical signals, word, picture, music etc. There are three basic blocks of a communication system.

1. Transmitter or source.
2. Channel or transmission network.
3. Receiver or destination.



If the transmitted signal is electric current, study of communication system is relatively easy, because it is a measurable quantity.

But if we said it is an information, then the study becomes difficult.

So we have to measure a quantity called "amount of information"? Need for knowing the amount of information' transmitted for finding the systems overall or average performance. It is statistical parameter associate with probability.

The Amount of Information

"If a dog bites a man, it is not news; but if a man bites a dog, it is news." The probability of a dog biting a man is very high, so it is not a news ie it consist of "very little amount of information."

On the other hand the probability of a man biting a dog is extremely small, so it becomes news ie it contains a large amount of information.

So we conclude that there is an inverse relationship between the probability of occurance of an event and the amount of information associated with it. More the probability of an event, less is the amount of information associated with it and vice versa.

ie $$I(x_j) = f\left(\frac{1}{p(x_j)}\right)$$

where x_j is an event with a probability $p(x_j)$ and the amount of information associated with it is $I(x_j)$.

Let another event y_k such that x_j and y_k are independent. Then the probability of joint event. is,

$$p(x_j, y_k) = p(x_j) \cdot p(y_k).$$

Then the total information,

$$I(x_j, y_k) = f\left(\frac{1}{p(x_j, y_k)}\right) = f\left(\frac{1}{p(x_j) \cdot p(y_k)}\right)$$

The total information $I(x_j, y_k)$ must be also equal to the sum of individual informations $I(x_j)$ and $I(y_k)$.