KARNATAK LAW SOCIETY'S

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(An Autonomous Institution under Visvesvaraya Technological University, Belagavi)

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Department of Electronics and Communication Engineering

Course Activity Report on

Program To Find To All Entropy Functions And Channel Capacity Of a Channel.

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Introduction:

The entropy was originally created by Shannon as part of his theory of communication, in which a data communication system is composed of three elements: a source of data, a communication channel, and a receiver. In Shannon's theory, the "fundamental problem of communication" – as expressed by Shannon – is for the receiver to be able to identify what data was generated by the source, based on the signal it receives through the channel. Shannon considered various ways to encode, compress, and transmit messages from a data source, and proved in his famous source coding theorem that the entropy represents an absolute mathematical limit on how well data from the source can be losslessly compressed onto a perfectly noiseless channel. Shannon strengthened this result considerably for noisy channels in his noisy-channel coding theorem.

Theory:

Various types of Channel with their equation are:

1)Noise free Channel:

For noise free channel enter only diagonal elements of the joint probability matrix. Condition for this channel is that sum of all the entries in each row should be equal to 1.

2)Error free Channel:

A channel is said to be error free if capacity of the channel is greater than entropy of the channel.so at first calculate the capacity of the channel using the formula

Capacity C=log M bits/symbol

Where M is No. of inputs of the channel.

3)Binary Symmetric Channel:

A **binary symmetric channel** (or BSC) is a common communications channel model used in coding theory and information theory. In this model, a transmitter wishes to send a bit (a zero or a one), and the receiver receives a bit. It is assumed that the bit is *usually* transmitted correctly, but that it will be "flipped" with a small probability (the "crossover probability"). This channel is used frequently in information theory because it is one of the simplest channels to analyze.

A **binary symmetric channel with crossover probability** p denoted by **BSC**, is a channel with binary input and binary output and probability of error p; that is, if X is the transmitted random variable and Y is the received variable.

Conditional probability matrix is as follows

P(Y/X) = $\begin{bmatrix} 1-p & p \\ p & 1-p \end{bmatrix}$

Derive the joint probability matrix from this matrix by multiplying it by

P(X) = [0 1]

So the matrix which we take input from user is

P(X,Y) = $\begin{bmatrix} 0 & 0 \\ p & 1-p \end{bmatrix}$

Where p should be entered by the user.

Matlab code Entropy fuction and channel capacity:

```
clc;
clear all;
close all;
i=input('enter no. of element=');
q=input('enter joint probabilities matrix');
sum=0;
%probability P(x)
for n=1:i
    w=0;
    for m=1:i
        p(n)=w+q(n,m);
        w=p(n);
    end
end
disp('p(x):');
disp(p);

%channel capacity
C=log(i);
disp('C:');
disp(C);
%entropy H(x)
for n=1:i
    H=sum+(p(n)*log(1/p(n)));
    sum=H;
end
disp('H(x)');
disp(H);
```

```
%conditoinal probability matrix
for n=1:i
    for m=1:i
        a(n,m)=q(n,m)/p(n);
    end
end
disp('p(Y/X):');
disp(a);
%entropy H(Y/X)
d=0;
for n=1:i
    for m=1:i
        if(a(n,m)>0)
            H1=d+(q(n,m)*log(1/a(n,m)));
            d=H1;
        end
    end
end
disp('H(Y/X):');
disp(H1);
%probability P(Y)
for n=1:i
    w=0;
    for m=1:i
        s(n)=w+q(m,n);
        w=s(n);
    end
end
disp('P(Y):');
disp(s);
%entropy H(Y)
k=0;
for n=1:i
    H2=k+(s(n)*log2(1/s(n)));
    k=H2;
end
disp('H(Y):');
disp(H2);
```

Output:

enter no. of element=3

enter joint probabilities matrix=[.2 0 0;0 .4 0;0 0 .4]

p(x):

0.2000   0.4000   0.4000

C:

1.0986

H(x)

1.0549

p(Y/X):

1	0	0
0	1	0
0	0	1

H(Y/X):

0

P(Y):

0.2000 0.4000 0.4000

H(Y):

1.5219