Hand in problem 1 in Information Theory (EIT 080)

VT 2, 2012

Problem 1

In this problem you should write MATLAB functions for the information measures $H(X)$ and $I(X;Y)$.

Entropy

The first function to be implemented is the entropy function. The function header should be specified as

```
function H=Entropy(P)
% The Entropy function H(X)
%
% P column vector: the vector is the probability distribution.
% P matrix: Each column vector is interpreted as a probability distribution
% P scalar: The binary entropy function of [P; 1-P]
% P row vector: Each position gives binary entropy function
```

That is, the input is a matrix P, where the size determines the interpretation[1]. The basic idea is that each column in P corresponds to a probability distribution. If the column contains only one value, the script should derive the binary entropy function for this value. In this way the entropy for several distributions can be derived in a single call.

You can test your function with e.g.

```
>> P=[0:0.1:1];plot(P,Entropy(P))
>> Entropy([0.3 0.4 0.8; 0.1 0.3 0; 0.3 0.2 0.2; 0.3 0.1 0])
ans =
    1.8955    1.8464    0.7219
>> Entropy(1/8.*ones(8,1))
ans =
    3
```

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[1]The command size can be used to find the size of a matrix. Also, $\log_2$ is implemented as log2 in MATLAB.

Note hat you need to take care of the case $0 \log 0 = 0$ separately. Details on error handling to check that the input satisfies the above specifications is optional.

Mutual Information

The second function to be implemented is the mutual information. The header of the function is specified as

```
function I=MutualInformation(P)
% The mutual information I(X;Y)
%
% P=P(X,Y) is the joint probability of X and Y.
```

The input matrix P is the joint probability distribution, $p(x, y)$.

The function can be tested by e.g.[2]

```
>> MutualInformation([0 3/4; 1/8 1/8])
ans =
    0.2936
```

Hand in details

To hand in the problem send the m-files to adnan.prlja@eit.lth.se and/or stefan. host@eit.lth.se. Do not forget to write your name and STIL or student ID.

We will test it according to the specifications and reply with the result pass or fail.

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[2]The MATLAB function reshape might come in handy.