Çankaya University
Department of Computer Engineering

CENG 290 - Data Communications

03.03.2015

LABWORK 1

In this lab, our aim is to write two files, *Encode* and *Decode*, that use CDMA encoding for 4 users and 8 bit codewords. The messages may be of any length, but the example provided is for 5-bits. The first file will combine the messages and the second one will separate them.

ENCODE

```
%The aim of this file is to use CDMA encoding for 4 users. Each user sends
%an arbitrary binary message. Messages must be of the same length. In the
%example below, the length is 5.
%Each user has a codeword of 8 bits. Note that codewords are orthogonal
%in the sense of inner product. dot product)
%The file combines the messages by multiplying the codeword by +1 for input 1
%and -1 for input 0, and then adding all. The result is stored in the variable MSG.
%For the example below, MSG is 40 bits.
%Written by Emre Sermutlu, 10.03.2015


%Codewords necessary for each user
CodeA = [-1 -1 -1 +1 +1 -1 +1 +1];
CodeB = [-1 -1 +1 -1 +1 +1 +1 -1];
CodeC = [-1 +1 -1 +1 +1 +1 -1 -1];
CodeD = [-1 +1 -1 -1 -1 -1 +1 -1];

%Messages of each user
MsgA = [1 0 1 0 1];
MsgB = [0 1 1 0 1];
MsgC = [1 1 1 0 1];
MsgD = [0 0 1 0 0];

%Input ends here. We assume all messages are of the same size.
%Actually, we need a check here.


%Can you see what trick is being done here?
MsgA = 2 * MsgA - 1;
MsgB = 2 * MsgB - 1;
MsgC = 2 * MsgC - 1;
MsgD = 2 * MsgD - 1;

bits = size(MsgA,2);

MSG = zeros(1, 8*bits);

%It is not a good idea to write this manually like that. I advise you to
%develop this code by adding a third for loop over the users.
for i = 1:bits
    for j = 1:8
        MSG((i-1) * 8 + j) = MsgA(i) * CodeA(j) + MsgB(i) * CodeB(j) +...
MsgC(i) * CodeC(j) + MsgD(i) * CodeD(j);
    end
end

clear MsgA MsgB MsgC MsgD
```

DECODE

```
%The aim of this file is to use CDMA to decode messages encoded by another file.
%First, use the command Encode on the command prompt to obtain MSG.
%The aim is to obtain MsgA, MsgB, MsgC, MsgD using MSG and codewords.
%Written by Emre Sermutlu, 10.03.2015

%Codewords necessary for each user
CodeA = [-1 -1 -1 +1 +1 -1 +1 +1];
CodeB = [-1 -1 +1 -1 +1 +1 +1 -1];
CodeC = [-1 +1 -1 +1 +1 +1 -1 -1];
CodeD = [-1 +1 -1 -1 -1 -1 +1 -1];

bits = size(MSG,2)/8;

MsgA = zeros(1,bits);
MsgB = zeros(1,bits);
MsgC = zeros(1,bits);
MsgD = zeros(1,bits);


for i = 1:bits
    cntrA = 0;
    cntrB = 0;
    cntrC = 0;
    cntrD = 0;
    for j = 1:8
        cntrA = cntrA + MSG((i-1) * 8 + j) * CodeA(j);
        cntrB = cntrB + MSG((i-1) * 8 + j) * CodeB(j);
        cntrC = cntrC + MSG((i-1) * 8 + j) * CodeC(j);
        cntrD = cntrD + MSG((i-1) * 8 + j) * CodeD(j);
    end
    if cntrA > 0 MsgA(i) = 1; end
    if cntrB > 0 MsgB(i) = 1; end
    if cntrC > 0 MsgC(i) = 1; end
    if cntrD > 0 MsgD(i) = 1; end

end
```