MARKS:

AMERICAN INTERNATIONAL UNIVERSITY-BANGLADESH (AIUB)

Data Communication Laboratory

LAB PROJECT

.

Section: [G]

Semester: Spring 20-21

Course Teacher: MD MEHEDI HASAN

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Data Communication

Lab Project

Develop a communication system using MATLAB/Octave that will send and receive images in a form of analog signal. Consider 10X10 pixel color images. You will require 24 bits to represent 1 pixel. The system uses synchronous transmission considering QPSK modulation and demodulation.

1. Show the transmuted bits at the sender.

2. Show the analog signals after modulation.

3. Show received signal considering AWGN channel.

4. Demonstrate your system with an input image (show the output image).

Hint: You should create a function to encode the 10X10 pixel color image into binary bit sequence. Then, convert the bit sequence to analog signal and add noise. Finally, decode at the receiver.

Function:

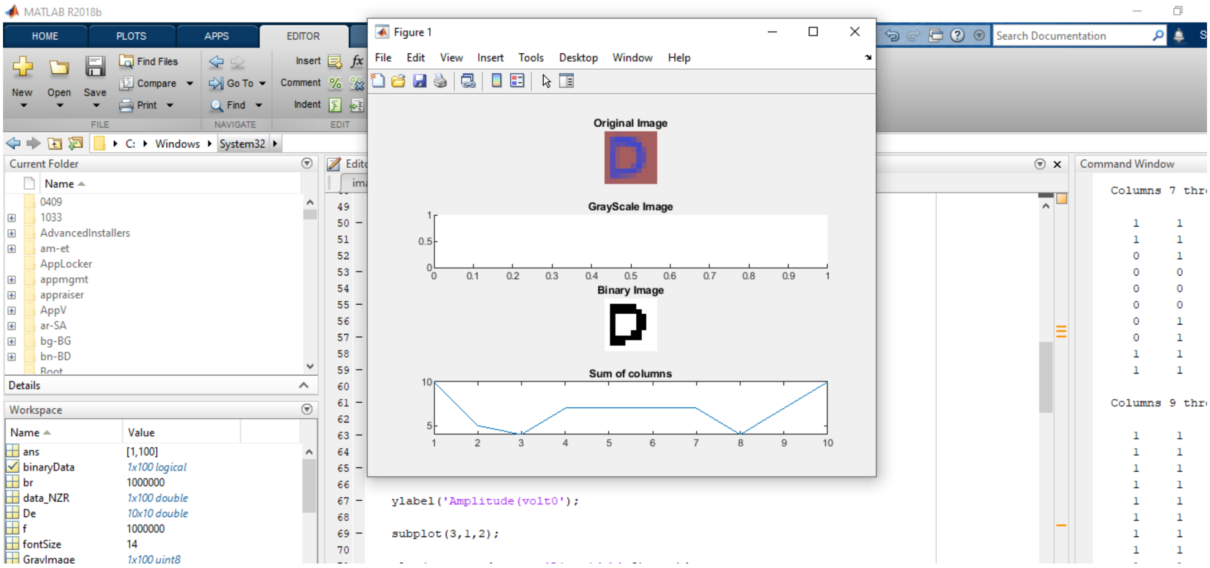
```
function DEB = imageTobinConverter(image)

figure
subplot(4,1,1);
imshow(image);

title('Original Image');
subplot(4,1,2);

grimage = rgb2gray(image);
grimageAdj = imadjust(grimage);

title('GrayScale Image');

binimage = imbinarize(grimageAdj);
subplot(4,1,3);

imshow(binimage)
title('Binary Image');
s = sum(binimage,2);

subplot(4,1,4);
plot(s)
title('Sum of columns');

disp("Original binary matrix for Image:");
disp(binimage);

DEB = reshape(binimage, 1, numel(binimage));

end
```

Code:

```
%  DEBORAJ ROY 19-40158-1.

clc;
close all;
workspace;
fontSize = 14;
image = imread("40158.png"); % can use any size image.



binaryData = imageTobinConverter(image);
disp("Message transmitter: ");

figure
stem(binaryData, 'Linewidth',1), grid on;
title('Information before Transmiting ');
axis([ 0 99 0 1.5]);

disp(binaryData);
size(binaryData);


data_NZR=2*binaryData-1;
SPData=reshape(data_NZR,2,length(binaryData)/2);

br=10^6;
f=br;
T=1/br;
t=T/99:T/99:T;

y=[];
yInPhase=[];
yQuadrature=[];

rcvddata=image;


for i=1:length(binaryData)/2

    y1=SPData(1,i)*cos(2*pi*f*t);

    y2=SPData(2,i)*sin(2*pi*f*t) ;

    yInPhase=[yInPhase y1];

    yQuadrature=[yQuadrature y2];

    y=[y y1+y2];

end


transmittedSignal=awgn(y,10);
```

```
tt=T/99:T/99:(T*length(binaryData))/2;

figure

subplot(3,1,1);

plot(tt,y_inPhase,'Linewidth',3), grid on;

title('QPSK modulation');

xlabel('time(sec)');

ylabel('Amplitude(volt0');

subplot(3,1,2);

plot(tt,y_quadrature,'Linewidth',3), grid on;

title('QPSK modulation ');
xlabel('time(sec)');
ylabel('Amplitude(volt0');

subplot(3,1,3);
plot(tt,transmittedSignal,'r','Linewidth',3), grid on;

title('QPSK modulated signal (sum of inphase and Quadrature phase
signal)');
xlabel('time(sec)');
ylabel('Amplitude(volt0');


receivedData=[];
receivedSignal=transmittedSignal;


for i=1:1:length(binaryData)/2


    ZInPhase=receivedSignal((i-1)*length(t)+1:i*length(t)).*cos(2*pi*f*t);

    ZInPhase_intg=(trapz(t,ZInPhase))*(2/T);


    if(ZInPhase_intg>0)
        receivedInphaseData=1;

    else
       receivedInphaseData=0;

    end


    Quadrature=receivedSignal((i-
1)*length(t)+1:i*length(t)).*sin(2*pi*f*t);

    Quadrature_intg=(trapz(t,Quadrature))*(2/T);
```

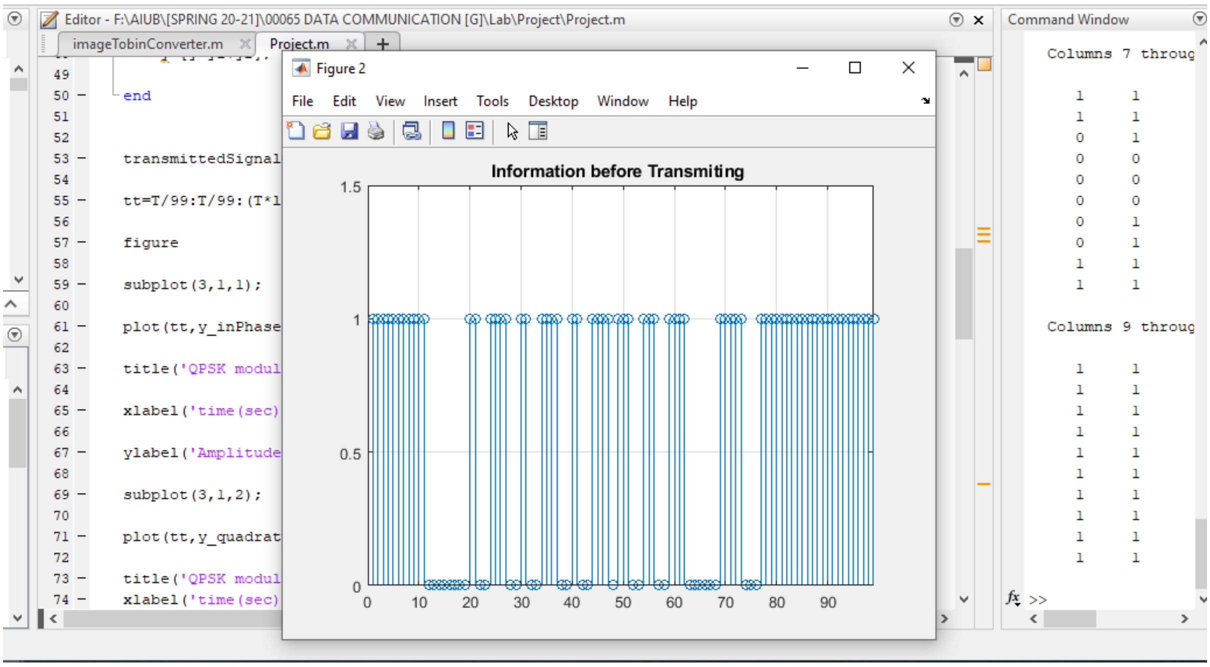
```
        if (Quadrature_intg>0)
           receivedQuadratureData=1;

        else
           receivedQuadratureData=0;

        end


        receivedData=[receivedData  receivedInphaseData
receivedQuadratureData]; % Received Data vector
end


figure

stem(receivedData,'Linewidth',1);

title('Information after Receiveing ');

axis([ 0 99 0 1.5]), grid on;

figure

subplot(2,1,1);

imshow(rcvddata);

title('Output Image');

De=reshape(receivedData,10,[]);

disp("binary matrix after receiving & demodulation");

disp(De);

GrayImage = uint8(255 *receivedData);
```



Name	Value
ans	[1,100]
binaryData	1x100 logical
br	1000000
data_NZR	1x100 double
De	10x10 double
f	1000000
fontSize	14
GrayImage	1x100 uint8

```
ylabel('Amplitude(volt0');

subplot(3,1,2);
```

```
Columns 7 thr

   1    1
   1    1
   0    1
   0    0
   0    0
   0    0
   0    1
   0    1
   1    1
   1    1

Columns 9 thr

   1    1
   1    1
   1    1
   1    1
   1    1
   1    1
   1    1
   1    1
```



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```
    end


    transmittedSignal

    tt=T/99:T/99:(T*1

    figure

    subplot(3,1,1);

    plot(tt,y_inPhase

    title('QPSK modul

    xlabel('time(sec)

    ylabel('Amplitude

    subplot(3,1,2);

    plot(tt,y_quadrat

    title('QPSK modul
    xlabel('time(sec)
```

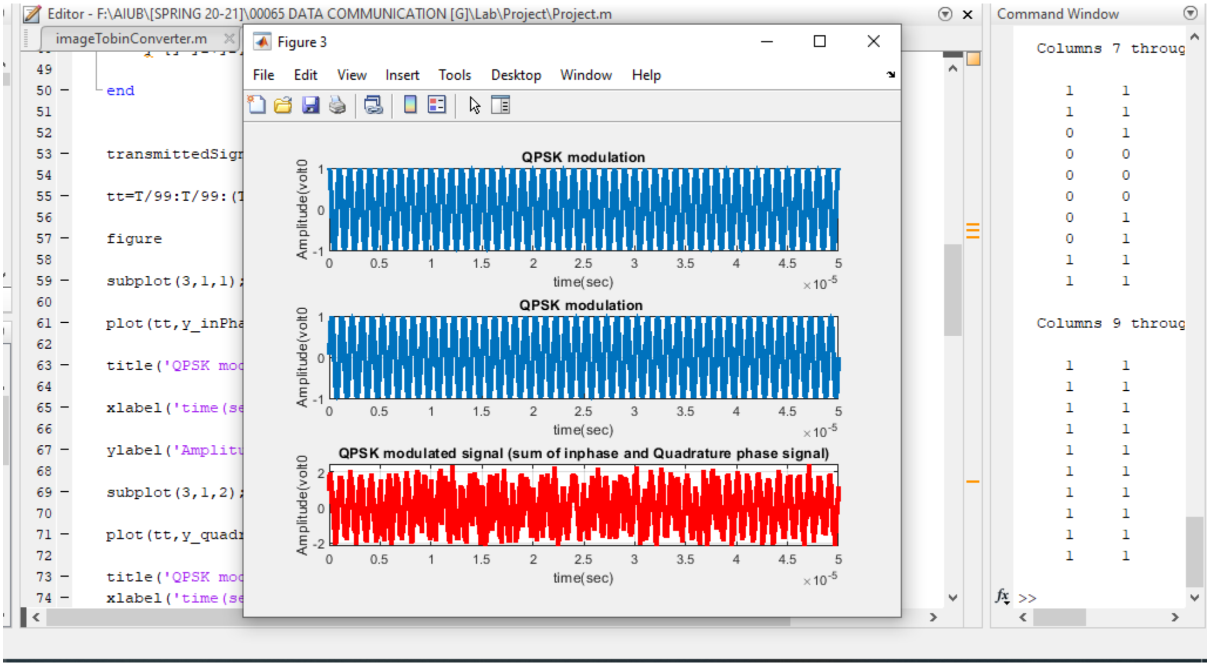
```
Columns 7 throug

   1    1
   1    1
   0    1
   0    0
   0    0
   0    0
   0    1
   0    1
   1    1
   1    1

Columns 9 throug

   1    1
   1    1
   1    1
   1    1
   1    1
   1    1
   1    1
   1    1
   1    1
   1    1

fx >>
```



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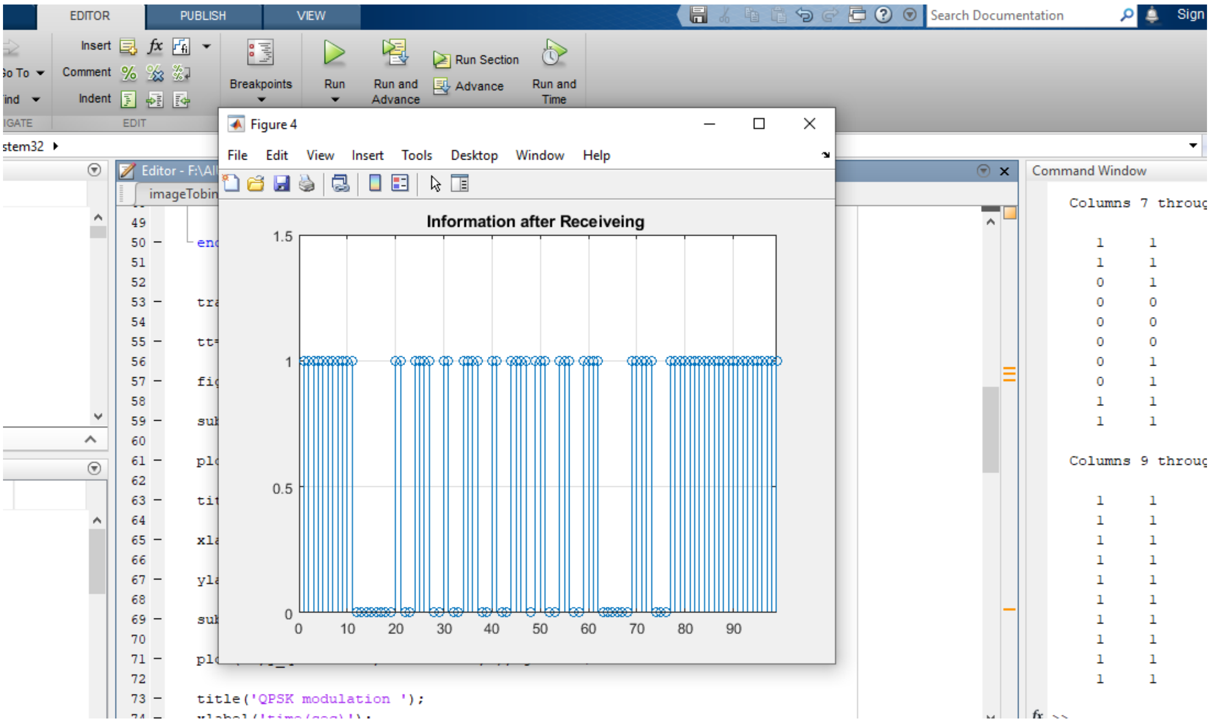
imageTobinConverter.m
Figure 3
File Edit View Insert Tools Desktop Window Help
Command Window
QPSK modulation
Amplitude(volt0
time(sec)
$\times 10^{-5}$
QPSK modulation
QPSK modulated signal (sum of inphase and Quadrature phase signal)
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5
1 0 -1
2 0 -2

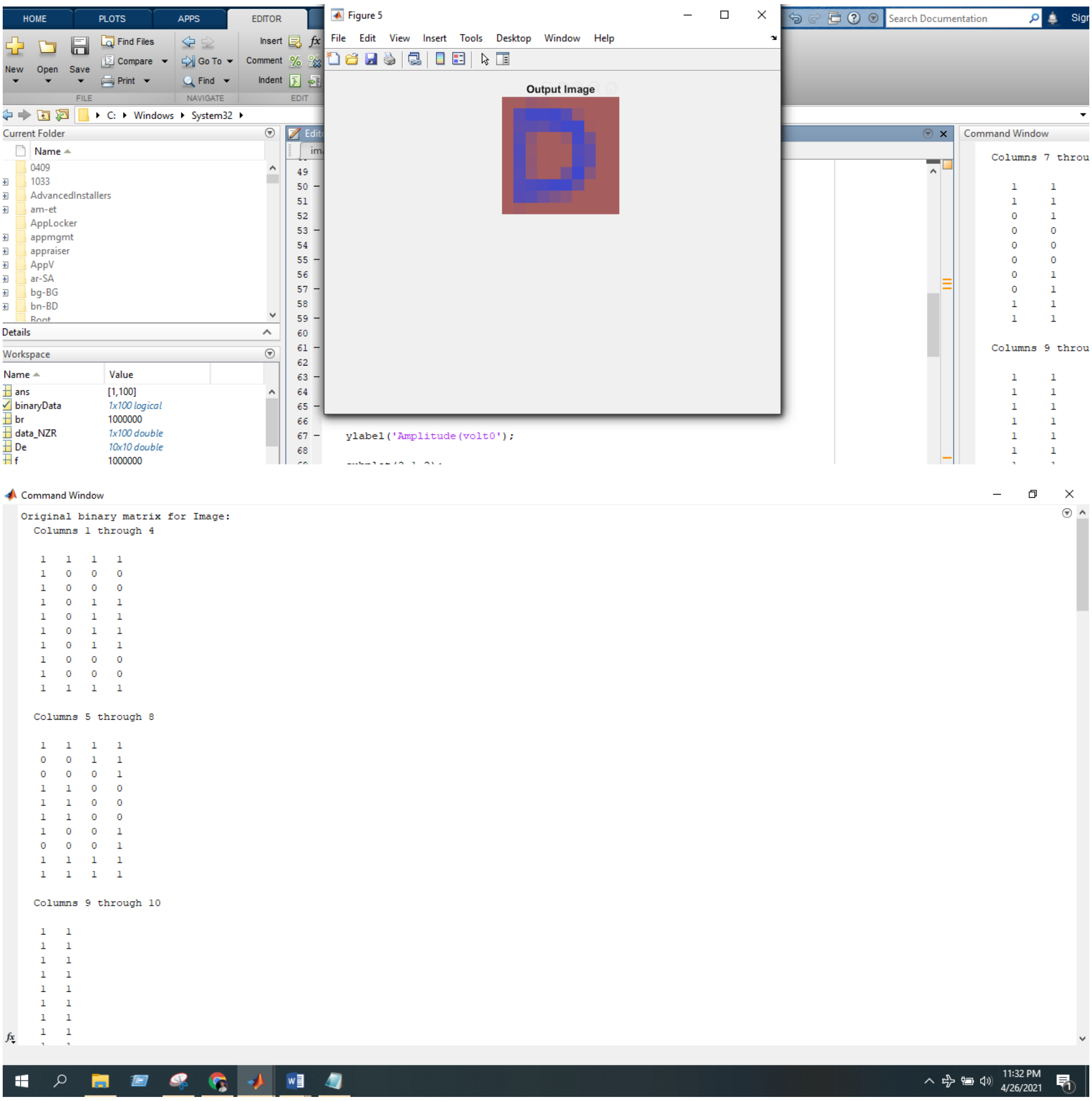
```
        end

        transmittedSigr

        tt=T/99:T/99:(T

        figure

        subplot(3,1,1);

        plot(tt,y_inPha

        title('QPSK mod

        xlabel('time(se

        ylabel('Amplitu

        subplot(3,1,2);

        plot(tt,y_quadr

        title('QPSK mod
        xlabel('time(se
```

```
  Columns 7 throug

     1     1
     1     1
     0     1
     0     0
     0     0
     0     0
     0     1
     0     1
     1     1
     1     1

  Columns 9 throug

     1     1
     1     1
     1     1
     1     1
     1     1
     1     1
     1     1
     1     1
     1     1
     1     1

fx >>
```



```
        end

        tra

        tt=

        fi

        sul

        pl

        ti

        xl

        yl

        sul

        pl

        title('QPSK modulation ');
```

```
  Columns 7 throug

     1     1
     1     1
     0     1
     0     0
     0     0
     0     0
     0     1
     0     1
     1     1
     1     1

  Columns 9 throug

     1     1
     1     1
     1     1
     1     1
     1     1
     1     1
     1     1
     1     1
     1     1
     1     1
```

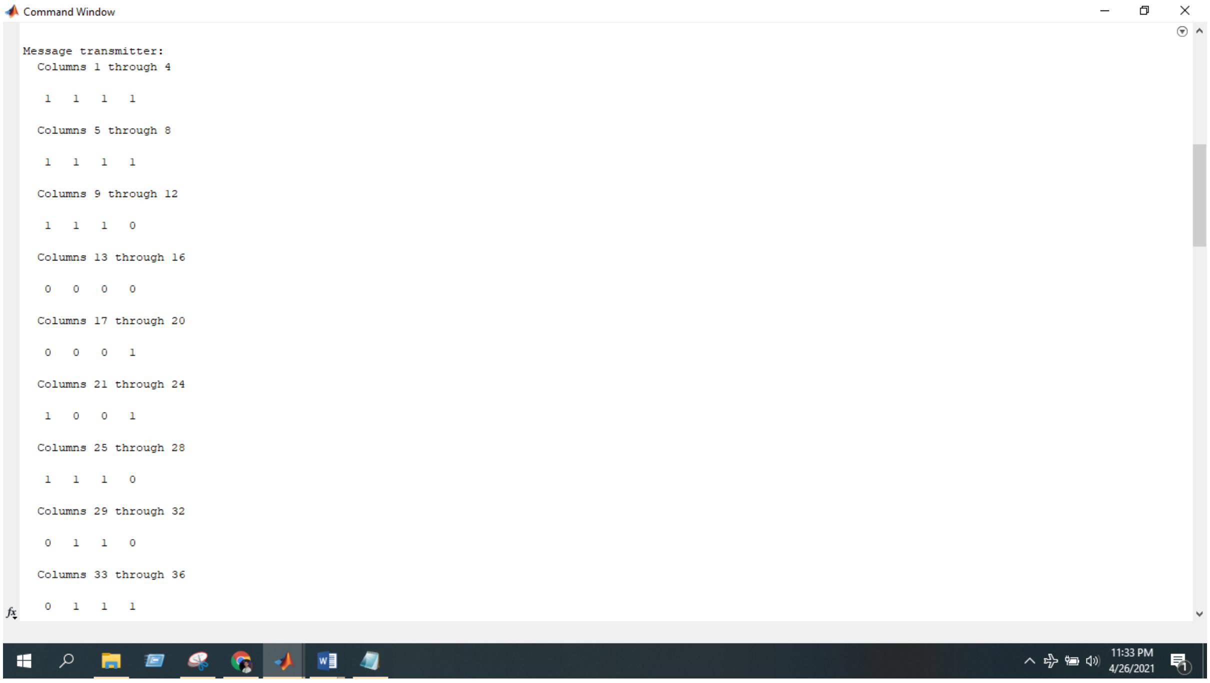


Name	Value
ans	[1,100]
binaryData	1x100 logical
br	1000000
data_NZR	1x100 double
De	10x10 double
f	1000000

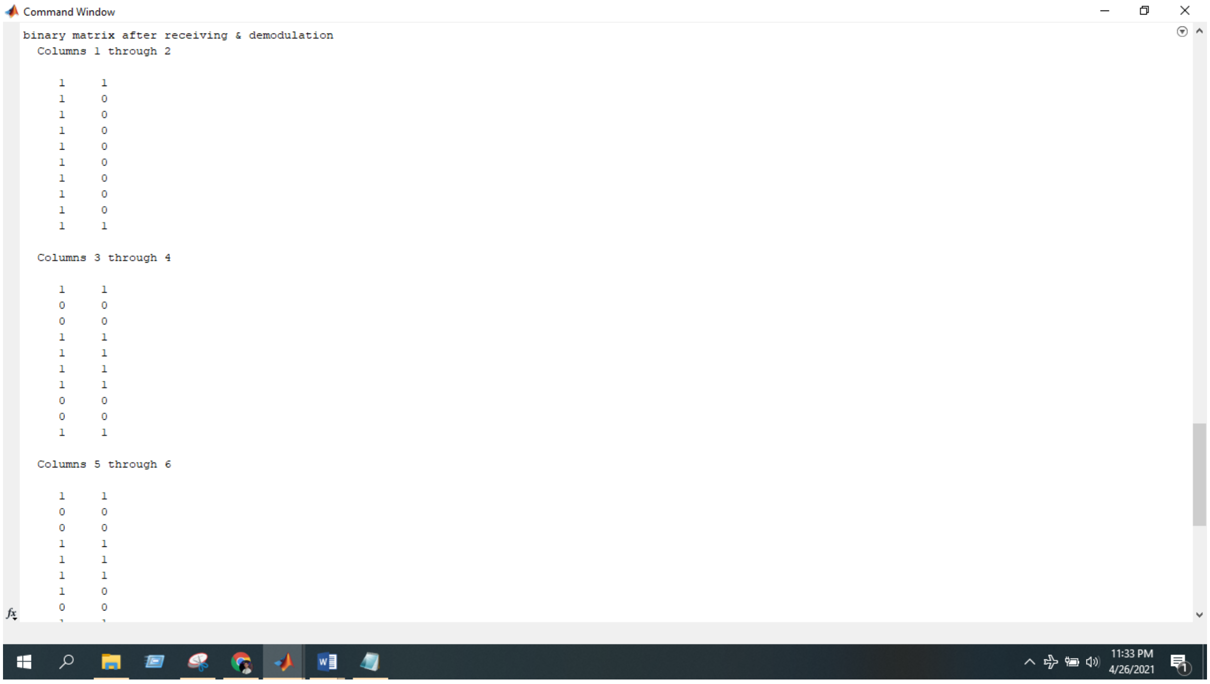
```
ylabel('Amplitude(volt0');
```

```
  Columns 7 throu

    1     1
    1     1
    0     1
    0     0
    0     0
    0     0
    0     1
    0     1
    1     1
    1     1

  Columns 9 throu

    1     1
    1     1
    1     1
    1     1
    1     1
    1     1
```

```
Original binary matrix for Image:
  Columns 1 through 4

    1    1    1    1
    1    0    0    0
    1    0    0    0
    1    0    1    1
    1    0    1    1
    1    0    1    1
    1    0    1    1
    1    0    0    0
    1    0    0    0
    1    1    1    1

  Columns 5 through 8

    1    1    1    1
    0    0    1    1
    0    0    0    1
    1    1    0    0
    1    1    0    0
    1    1    0    0
    1    0    0    1
    0    0    0    1
    1    1    1    1
    1    1    1    1

  Columns 9 through 10

    1    1
    1    1
    1    1
    1    1
    1    1
    1    1
    1    1
    1    1
```



```
Message transmitter:
  Columns 1 through 4

   1   1   1   1

  Columns 5 through 8

   1   1   1   1

  Columns 9 through 12

   1   1   1   0

  Columns 13 through 16

   0   0   0   0

  Columns 17 through 20

   0   0   0   1

  Columns 21 through 24

   1   0   0   1

  Columns 25 through 28

   1   1   1   0

  Columns 29 through 32

   0   1   1   0

  Columns 33 through 36

   0   1   1   1
```



```
binary matrix after receiving & demodulation
  Columns 1 through 2

     1     1
     1     0
     1     0
     1     0
     1     0
     1     0
     1     0
     1     0
     1     0
     1     1

  Columns 3 through 4

     1     1
     0     0
     0     0
     1     1
     1     1
     1     1
     1     1
     0     0
     0     0
     1     1

  Columns 5 through 6

     1     1
     0     0
     0     0
     1     1
     1     1
     1     1
     1     0
     0     0
```