ELEC 342 Lab 1 ---- Introduction to MATLAB

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Course number:	ELEC342-X Lab 2224
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Due Date:	Monday, 13 February 2023
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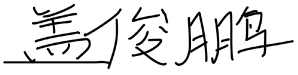
"I certify that this submission is my original work and meets the Faculty's Expectations of Originality"

Junpeng gai



Objectives

The objectives of this lab are to get familiar with MATLAB window and use some basic commands, like arithmetic operations, create an array and plot the 2d graph, to start. Because this course is ELEC342, a continued course of ELEC242, so I believe we will need MATLAB to plot the signal, impulse response, DT/CT Fourier series and Fourier transform. All of those performance based on this very first lab which leads us to know how to use some basic command.

At the end of this lab section we are supposed to be able to write .m file scripts to solve our lab questions in the lab manual.

Theory

Plot/stem: plot can be used to plot 2 D line one of its syntax is plot(x , y) ,by entering the parameter we can create a 2D line plot of given 2 sets of data. Stem can plot discrete sequence date with a syntax of stem(x , y).

Subplot command: subplot(m,n,p) can be used to plot a m*n grid and create the plot in the position p. The order of number is from top to bottom and from left to the right.

Array: If we want to create an array from 1to 10, we can use x=[1,2,3….10] or x=[1:10] to create the array. By default, the increment is 1. If we want to create an array with and increment of 2, we can use x=[1:2:10] command to create the array.

Ones and zeros: They have the similar functionality, x=zeros/ones(1:10) will create an array of size 10 and filled with 0/1.if we want to fill specific position we can use x(position)=1 or 0 to change the data.

Load: this command can be used to load variables from file into work space but it has to be in the same root. Syntax is load(filename).

Tasks/Results/Discussion

1.Plot and subplot

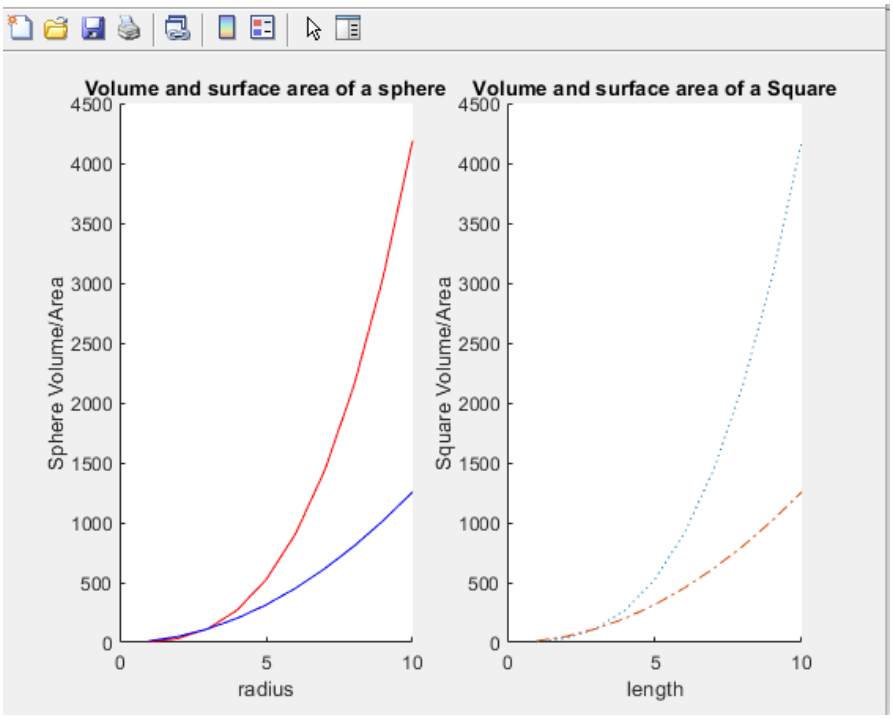


Figure 1 linespec display

plot(radius,VolumeSphere,':')%plot and set color to red.

plot(radius,SurfaceSphere,'-.')%plot and set color to blue.

By changing the linespec to ':'(dotted line) and '-.'(dash-dotted line) on right.

We can compare the differences.

2.Zeros and ones

Zeros and ones can be used to allocate the to a known size.

If we set Y1=zeros(0,9)I find that we can used 2 different commands to perform the same function.

Y2(3:5:8) is in the form of Y2(start:increment:destination)

```
Y1=zeros(1,10);%first set all to 0

Y1(3)=1;%first select the 3rd position

Y1(8)=1;%second select the 8th position

Y2=zeros(1,10); % I chose the first 3 are 1,which means n=3

Y2(3:5:8)=1;% the positions after n=3 are 0;
```

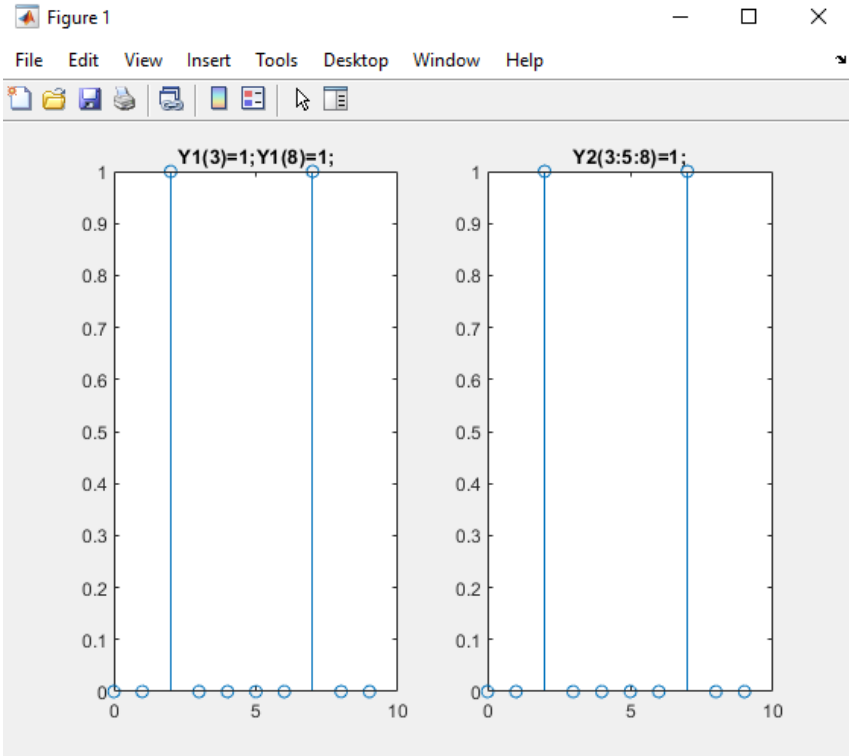


Figure 2 2 diffreent ways of adding 2impulse

3.Prove 2 discrete signals are identical

$$x1 = \cos(\frac{\pi}{4} * n + \frac{\pi}{3})$$

$$x2 = \cos\left(\frac{9\pi}{4} * n + \frac{\pi}{3}\right) = \cos\left(\frac{\pi}{4} * n + 2\pi n + \frac{\pi}{3}\right) = x1$$

$$K_{0,x1} = \frac{2\pi}{\pi} * 4 * m$$

So the fundamental period is 4 when m=1;

$$K_{0,x2} = \frac{2\pi}{9\pi} * 4 * m$$

So the fundamental period is 4 when m=9;

There function x1 and x2 have the same period.

We calculate the value within the same signal and draw the graph.

N=0:

For x1: $\cos(\frac{\pi}{3})$ n=0

For x2: $\cos(\frac{\pi}{3})$ n=0

N=1:

For x1: $\cos(\frac{7\pi}{12})$ n=1

For x2: $\cos(\frac{7\pi}{12})$ n=1

N=2:

For x1: $\cos(\frac{10\pi}{12})$ n=2

For x2: $\cos(\frac{10\pi}{12})$ n=2

N=3:

For x1: $\cos(\frac{13\pi}{12})$ n=3

For x2:$\cos(\frac{13\pi}{12})$ n=3

So same period and data are the same within the same period, so the functions are identical.

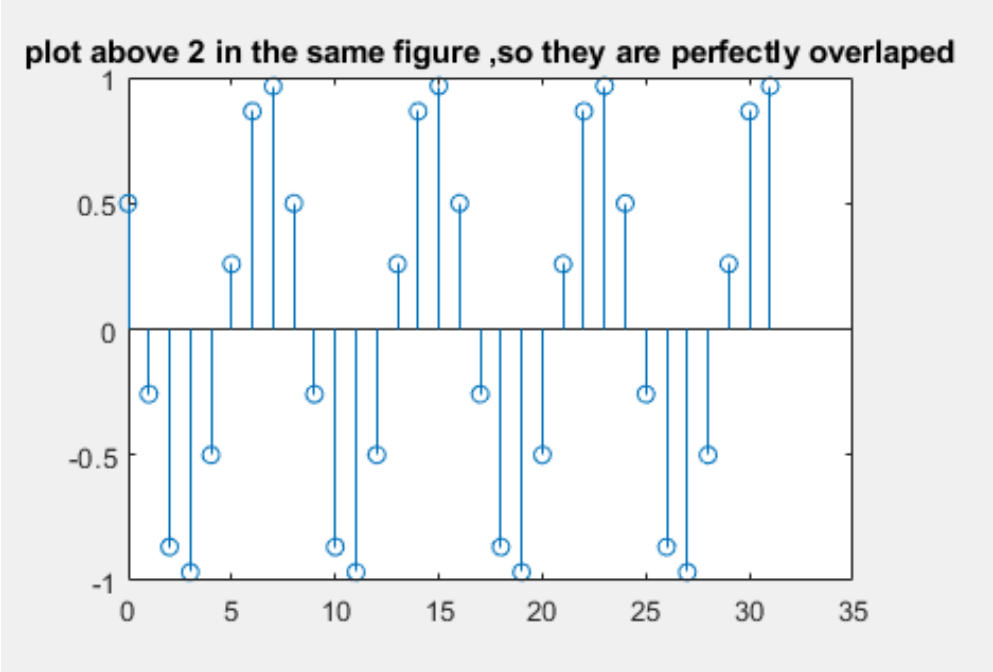


Figure 3 plot both function in the same graph

4.Load files

my_big_array=load('my_big_array.txt');%load the arrat txt into the variable my_big_array

I used this load('file name') to load the variable.

Questions

Question 1:

Volume of sphere = (4/3) * pi * radius^3

Surface area of a sphere = 4 * pi * radius^2

Volume of a square = length of side^3

Surface area of a square = 6 * length of side^2

Those 4 plots are required to be plotted in the same window.

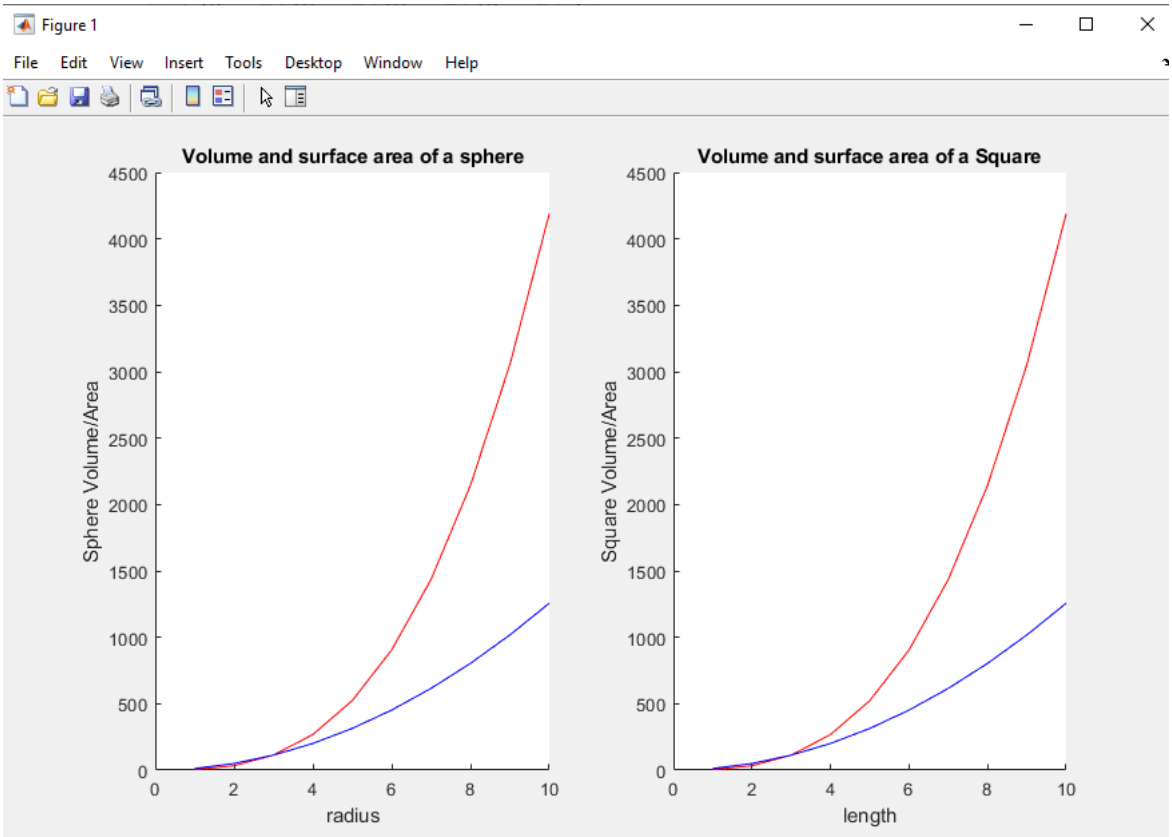


Figure 4 Question 1 result

Question 2:

Using the zeros and ones functions, create two different row_vectors:

The first vector is to consist of all zeros except for two elements (which two are to be 1 is left up to you).

The second vector is to consist of the first n elements being 0, and the remaining elements all equal to 1. The value of n is arbitrary.

Plot in one window stem plots of these two vectors as a function of x as x varies from -5 to +4 in the left hand pane, and as x varies from 0 to 9 in the right half pane. Refer to the following figure for details:

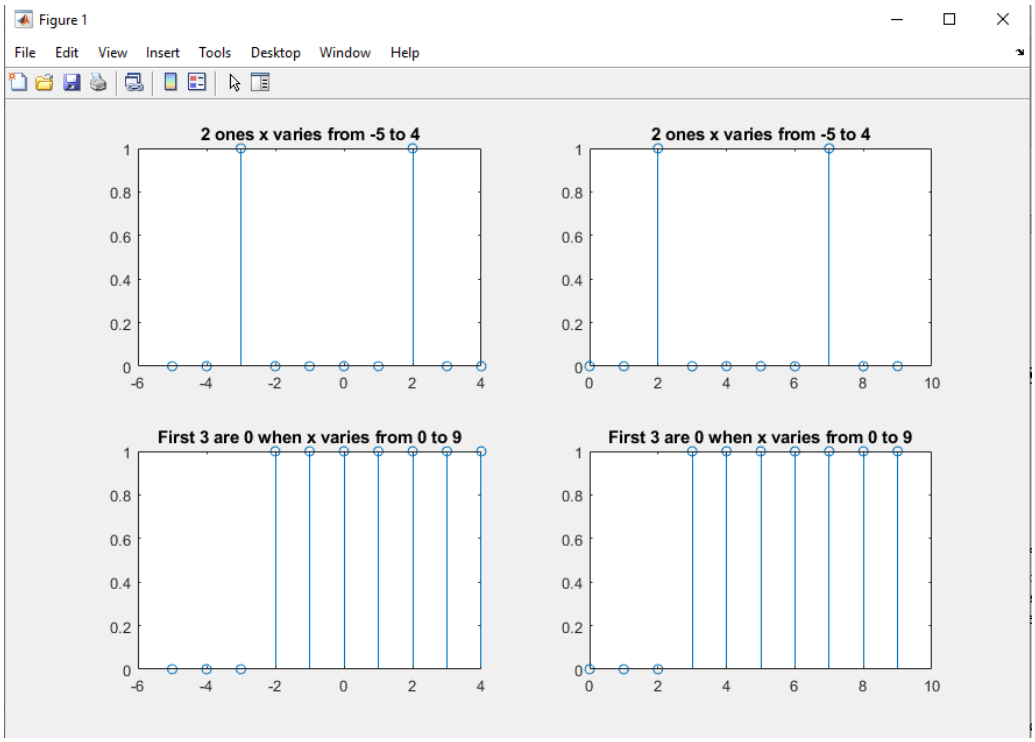


Figure 5Question 2 result

Question 3:

(i) A signal X[n] is said to be periodic (with period T) if X[n + T] = x[n]. This question investigates the effect how floating-point numbers are stored internally within a computer. Sample the signal x = cos((2*pi)/1024 * n) over 4 periods and then determine whether x[n]

= x[n + 1024]. For example, you can compute the difference of x[1] - x[1+1024] to see if it is equal to 0.0. It would be useful to use the: >> format long command so that doubles are displayed to their full 15 decimal place accuracy.

(ii) Instead of using the MATLAB constant, pi, use the value of 3.14 and compare your results with those obtained in part (i).

(iii) Determine (using MATLAB) whether the signals:

```
>> Q3
The result when pi is constant, pi  is:
     0

The result when pi is 3.14 is:
     5.073086624785006e-06
```

Figure 6 Question 3(i) and 3(ii) result

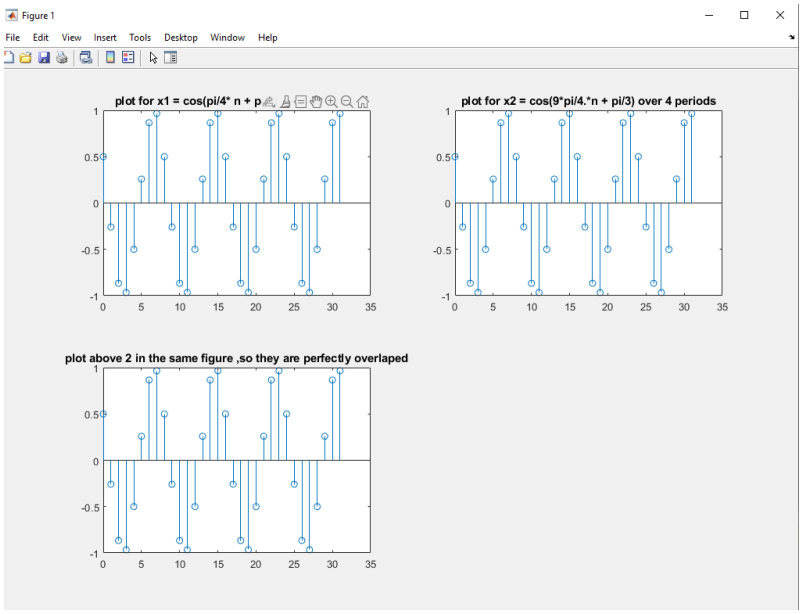


Figure 7Question 3(iii) result

Question 4:

Use the load command to read in these 100 numbers and store the values into an array called my_big_array.

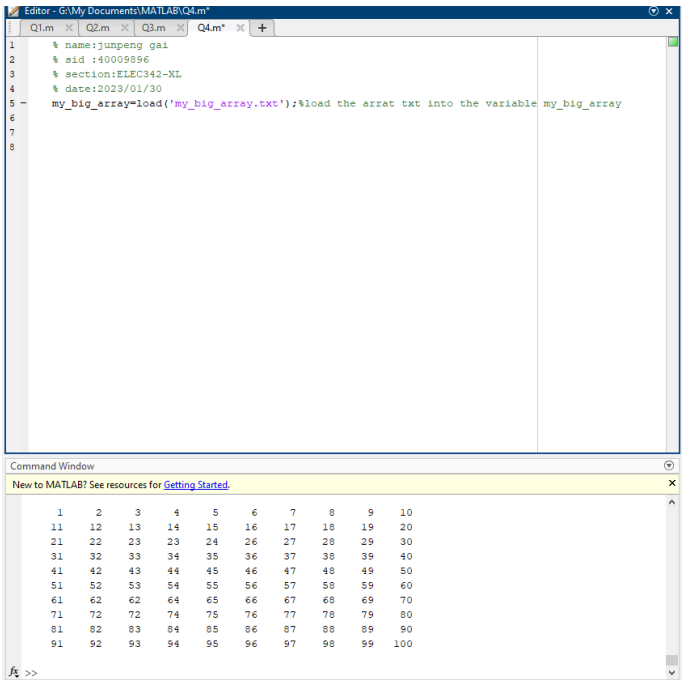


Figure 8Question 4 result and my_big_array variable display

Conclusions

By doing this lab, we explored the used of basic MATLAB command.

For question 1.Plot and subplot command enable us to plot single 2d graph or multiple graphs in the same windows. Besides, we have practiced hot wo modify labels and title, Also we can use plot(x,y,linespec) to customize our own line style.

For question 2. We learnt how to use zeros and ones to simplify our data input, which is very used in discrete signal analysis.

For question 3. I learnt the different with long format and precision of pi and 3.14 in MATLAB. There is a tiny difference in calculation and also we can see that 2 signal can be identical in discrete signal analysis.

For question 4. Now I know how to import variable from a file, therefore, it would simplify the process when we have a huge file to input.

Appendix

Q1 source code

```
% name:junpeng gai
% sid :40009896
% section:ELEC342-XL
% date:2023/01/30
radius=(1:10);
%set the variable for spheres and square,
%because they have the same range
VolumeSphere=(4/3)*pi*(radius).^3;
SurfaceSphere=4*pi*(radius).^2;
%plug the variable to the sphere equations
VolumeSquare=(radius).^3;
SurfaceSquare=6*(radius).^2;
%plug the variable to the square equations
subplot(1,2,1);%place it in the first location of 2*2 grid
title('Volume and surface area of a sphere')%set the tittle
xlabel('radius')%set label for x
ylabel('Sphere Volume/Area')%set label for y
hold on; %hold on so we can plot all the plots in the same window
plot(radius,VolumeSphere,'red')%plot and set color to red.
plot(radius,SurfaceSphere,'blue')%plot and set color to blue.
hold off;
subplot(1,2,2);
hold on;%hold on for next plot
title('Volume and surface area of a Square')
xlabel('length')%set label for x
ylabel('Square Volume/Area')%set label for y

plot(radius,VolumeSphere,'red')%plot and set color to red.
plot(radius,SurfaceSphere,'blue')%plot and set color to blue.
hold off; %all plots are done.
```

Q2 source code

```
% name:junpeng gai
% sid :40009896
% section:ELEC342-XL
% date:2023/01/30

Y1=zeros(1,10);%first set all to 0
Y1(3)=1;%first select the 3rd position
Y1(8)=1;%second select the 8th position

Y2=zeros(1,10); % I chose the first 3 are 1,which means n=3
Y2(4:10)=1;% the positions after n=3 are 0;

x1=(0:9); %range from 0 to 9
```

```
x2=(-5:4);%range from -5 to 4
subplot(2,2,1);%place plot at 1st position
stem(x2,Y1);%plot 2impulse in domain x2
title('2 ones x varies from -5 to 4');
subplot(2,2,2);%place plot at 2ed position
stem(x1,Y1);%plot 2impulse in domain x1
title('2 ones x varies from -5 to 4');
subplot(2,2,3);%place plot at 3rd position
stem(x2,Y2);%plot first in domain x2
title('First 3 are 0 when x varies from 0 to 9');
subplot(2,2,4);%place plot at 4th position
stem(x1,Y2);%plot 2impulse in domain x1
title('First 3 are 0 when x varies from 0 to 9');
```

Q3 source code

```
% name:junpeng gai
% sid :40009896
% section:ELEC342-XL
% date:2023/01/30
format long %long format
N = 1024;   %given in question
n = (0 : 4095 ) ;%required 4 periods so it's 4*1024
x = cos( (2*pi)/N * n );%Build the expression
stem(n,x);%plot the graph
s1=x(1)-x(1+1024);%calculate the difference between x[1] - x[1+1024]
x = cos( (2*3.14)/N * n );%rewrite the function and change the pi to 3.14
s2=x(1)-x(1+1024);%calculate the difference between x[1] - x[1+1024]

%Following part is for the question(iii)
n = ( 0 : 31) ;
x1 = cos(pi/4* n + pi/3);
hold on
subplot(2,2,1)
stem(n,x1)%plot the x1 = cos(pi/4* n + pi/3) over 4 periods
title('plot for x1 = cos(pi/4* n + pi/3) over 4 periods')
x2 = cos(9*pi/4.*n + pi/3);
subplot(2,2,2)
stem(n,x2)%plot for x2 = cos(9*pi/4.*n + pi/3) over 4 periods
title('plot for x2 = cos(9*pi/4.*n + pi/3) over 4 periods')
subplot(2,2,3)%plot above 2 in the same figure
stem(n,x1)
stem(n,x2)
title('plot above 2 in the same figure ,so they are perfectly overlaped')
hold off

disp('The result when pi is constant, pi  is:')
disp(s1)%display the result for (1) x[1] - x[1+1024]
disp('The result when pi is 3.14 is:')
disp(s2)%display the result for (2) x[1] - x[1+1024] when pi=3.14
```

Q4 source code

```
% name:junpeng gai
% sid :40009896
% section:ELEC342-XL
% date:2023/01/30
my_big_array=load('my_big_array.txt');%load the arrat txt into the variable
my_big_array
```