DFT of a sequence:

$$x[n] = \underbrace{\{x[0], x[1], x[2], \ldots, x[N-1]\}}_{N \text{ samples}}$$

DFT of $x[n]$ is given by:

$$X[k] = \sum_{n=0}^{N-1} x[n] \exp\left(-j\left(\frac{2\pi}{N}\right) kn\right)$$

where, k runs from 0 to $(N-1)$ taking only integer values.

$$\therefore \begin{pmatrix} X[0] \\ X[1] \\ X[2] \\ \vdots \\ X[N-1] \end{pmatrix} = \begin{pmatrix} 1 & 1 & \cdots & 1 & \cdots & 1 \\ 1 & w & w^2 & \cdots & & w^{N-1} \\ 1 & w2 & w4 & \cdots & & 1 \\ \vdots & \vdots & \vdots & & & \vdots \\ 1 & w^{N-1} & w^{2(N-1)} & \cdots & & w^{(N-1)2} \end{pmatrix} \begin{pmatrix} x[0] \\ x[1] \\ \vdots \\ x[N-1] \end{pmatrix}$$

```
%DISCRETE FOURIER TRANSFORM
%x[n]={x[0],x[1],...x[N-1]}
%total N samples
%X[k]=summation(n goes from zero to N-1)x[n]exp(-j*2*pi/N*k*n)
% k goes from 0 to N-1
%Input discrete sequence:
x=[1,2,0.9,0.4,4];

N=length(x);
%DFT Matrix
DFT=zeros(N,N);%initializing the DFT matrix
%Nth root of unity
omega=exp(-i*2*pi/N);
for i=1:length(DFT)
  for j=1:length(DFT)
      DFT(i,j)=power(omega,(i-1)*(j-1));
  end

end

%final DFT
x_t=transpose(x);
X=DFT*x_t;%DFT of the input sequence
%Plotting the DFT coefficients

%Real coefficients
figure,
n=[1,2,3,4,5];
stem(n,real(X),'green');
xlabel('index of coefficient');
ylabel('Real part of DFT');
title('DFT');

%Imaginary coefficients
figure,
n=[1,2,3,4,5];
stem(n,imag(X),'red');
xlabel('index of coefficient');
ylabel('Imaginary part of DFT');
title('DFT');
```

Variables - DFT

X | x | DFT

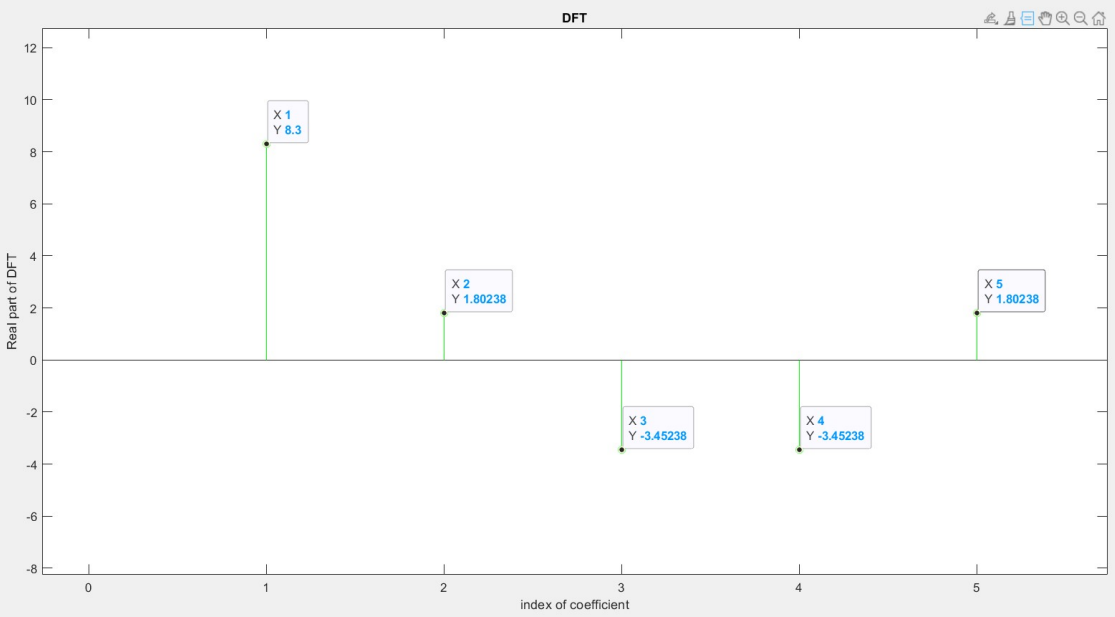
5x5 complex double

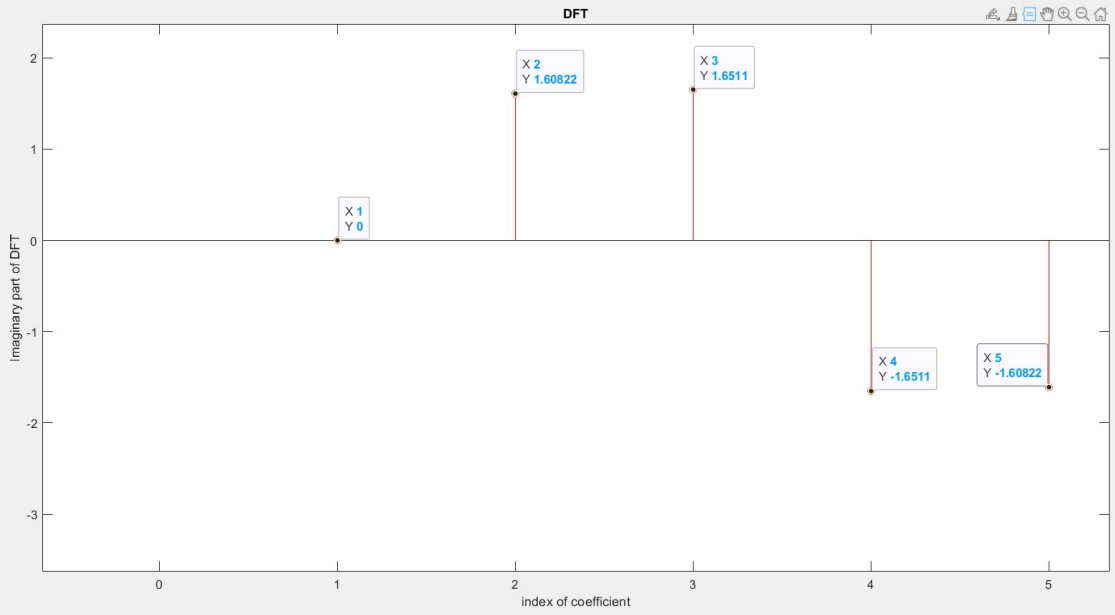
	1	2	3	4	5	6
1	1.0000 + 0.0000i	1.0000 + 0.0000i	1.0000 + 0.0000i	1.0000 + 0.0000i	1.0000 + 0.0000i	
2	1.0000 + 0.0000i	0.3090 - 0.9511i	-0.8090 - 0.5878i	-0.8090 + 0.5878i	0.3090 + 0.9511i	
3	1.0000 + 0.0000i	-0.8090 - 0.5878i	0.3090 + 0.9511i	0.3090 - 0.9511i	-0.8090 + 0.5878i	
4	1.0000 + 0.0000i	-0.8090 + 0.5878i	0.3090 - 0.9511i	0.3090 + 0.9511i	-0.8090 - 0.5878i	
5	1.0000 + 0.0000i	0.3090 + 0.9511i	-0.8090 + 0.5878i	-0.8090 - 0.5878i	0.3090 - 0.9511i	
6						

DFT Coefficients:

5x1 complex double

	1
1	8.3000 + 0.0000i
2	1.8024 + 1.6082i
3	-3.4524 + 1.6511i
4	-3.4524 - 1.6511i
5	1.8024 - 1.6082i
6	
7	


DFT
Real part of DFT
index of coefficient
X 1
Y 8.3
X 2
Y 1.80238
X 3
Y -3.45238
X 4
Y -3.45238
X 5
Y 1.80238


DFT
Imaginary part of DFT
index of coefficient
X 1
Y 0
X 2
Y 1.60822
X 3
Y 1.6511
X 4
Y -1.6511
X 5
Y -1.60822