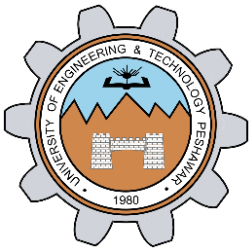
# Assignment # 1




**Fall 2023**

**CSE-402 Digital Signal Processing**

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Class Section: **C**

"On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work."

Submitted to:

**Engr. Ihsan Ul Haq**

Date:

**24th October 2023**

**Department of Computer Systems Engineering**

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## Task:

Write MATLAB code to generate output graphs for exponential sequences for Real and Complex parameters.

- Using Equations **x[n] = A α^n** for Real Graphs.
- Using Equations **x[n]=|A |e j(ω0n+ϕ) = |A | cos (ω0n + ϕ) + j |A |sin (ω0n + ϕ)** for Complex Graphs.

## Real Exponential:

Let A=1.5, n= -10 to 10

1. for (alpha = -1), try alpha= -1
2. for (0 < alpha < 1), try alpha=0.7
3. for (|alpha| > 1), try alpha= 1.1

### Code:

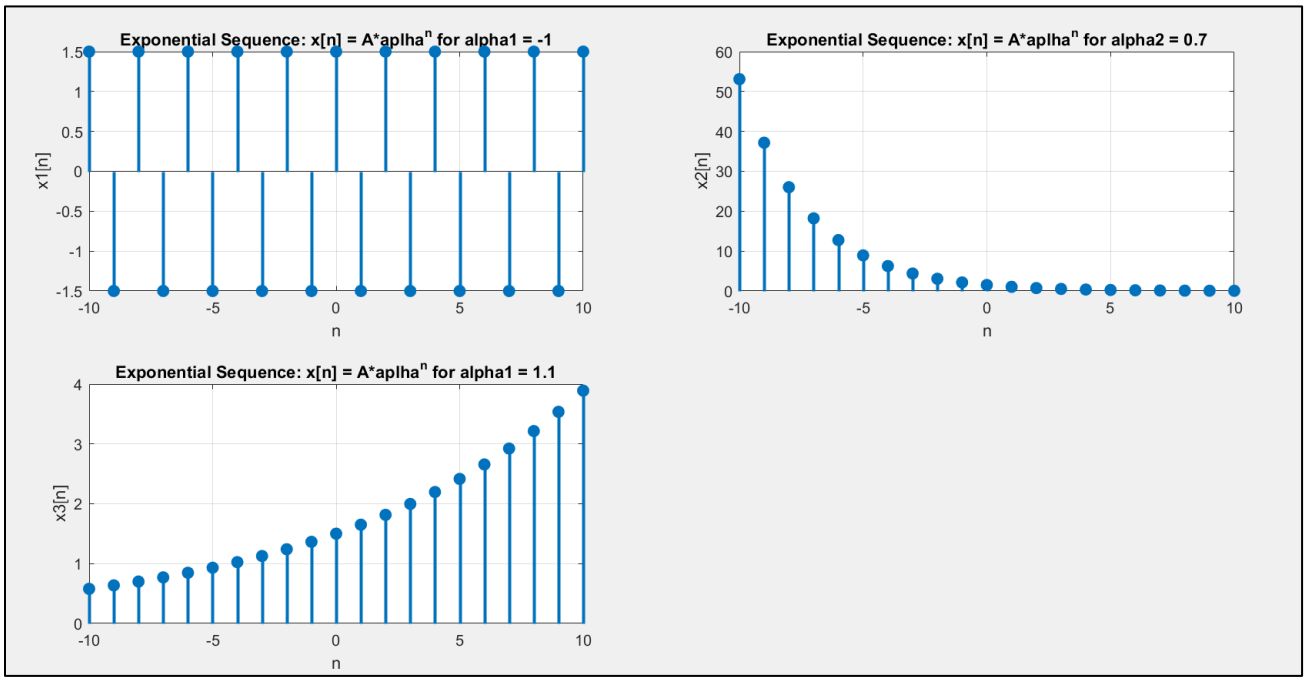
Editor - D:\Uni\DSP\Assignment\RealExpon.m

RealExpon.m | ComplexExpon.m

```
n = -10:1:10;

A=1.5;
alpha1 = -1;
alpha2 = 0.7;
alpha3 = 1.1;

x1 = A * alpha1.^(n);
x2 = A * alpha2.^(n);
x3 = A * alpha3.^(n);

% Create the first subplot
subplot(2,2,1);
stem(n, x1, 'filled', 'LineWidth', 2);
grid on;
title('Exponential Sequence: x[n] = A*aplha^n for alpha1 = -1');
xlabel('n');
ylabel('x1[n]');

% Create the second subplot
subplot(2,2,2);
stem(n, x2, 'filled', 'LineWidth', 2);
grid on;
title('Exponential Sequence: x[n] = A*aplha^n for alpha2 = 0.7');
xlabel('n');
```

```
24 -    title('Exponential Sequence: x[n] = A*aplha^n for alpha2 = 0.7');
25 -    xlabel('n');
26 -    ylabel('x2[n]');
27
28      % Create the third subplot
29 -    subplot(2,2,3);
30 -    stem(n, x3, 'filled', 'LineWidth', 2);
31 -    grid on;
32 -    title('Exponential Sequence: x[n] = A*aplha^n for alpha1 = 1.1');
33 -    xlabel('n');
34 -    ylabel('x3[n]');
```

**Output:**




## Remarks on Output:

First plot in above figure shows the exponential sequence for α = -1. Whenever α = -1, the exponential sequence alternates between A (for even n) and -A (for odd n).

Second plot in above figure shows the exponential sequence for α = 0.7 (0 < α < 1). It represents an exponential decay graph. The values of sequence decreases with increasing n because the increasing exponent decreases the resulting number. This is an example of convergent sequence as it is converging to zero when n approaches to infinity.

Third plot shows the exponential sequence for α = 1.1 (|α| > 1). It represents an exponential growth graph. The values of sequence increases with increasing n because the increasing exponent increases the resulting number. This is an example of divergent sequence as it diverges to infinity when n approaches to infinity.

Let A=2, n= -10 to 10

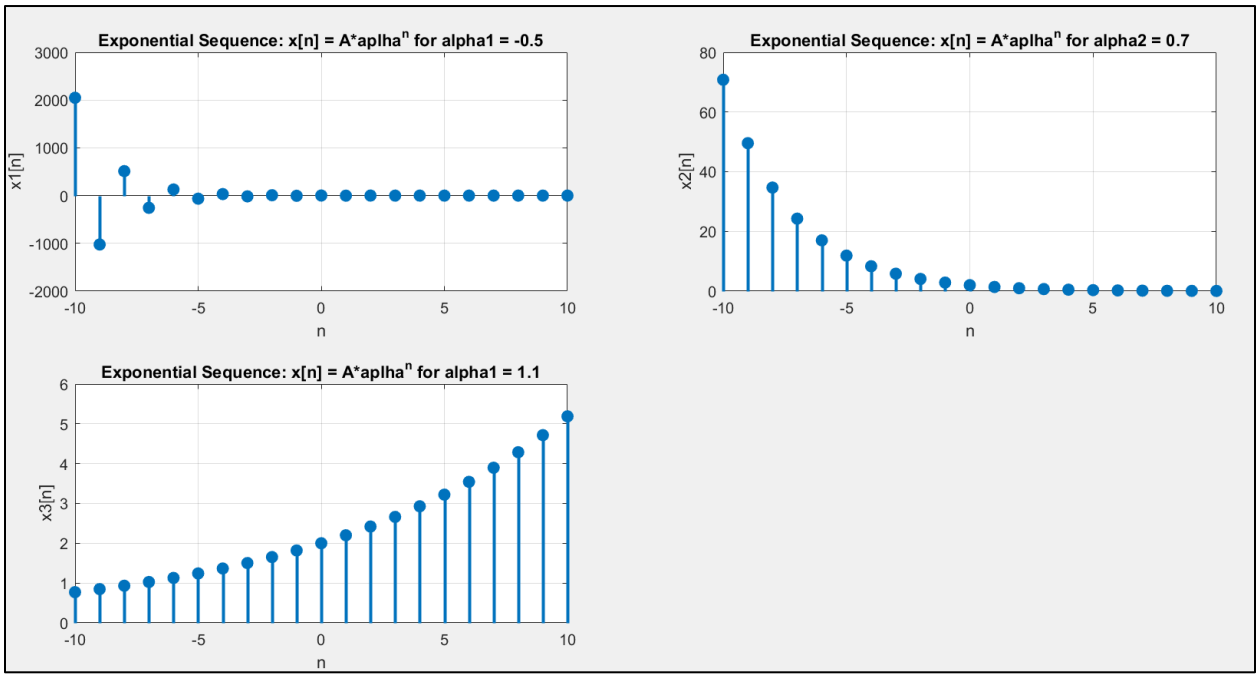
1. for (-1 < alpha < 0), try alpha= -0.5
2. for (0 < alpha < 1), try alpha=0.7
3. for (|alpha| > 1), try alpha= 1.1

**Code:**

```
3 —    A=2;
4 —    alpha1 = -0.5;
5 —    alpha2 = 0.7;
6 —    alpha3 = 1.1;
7
```

Rest of the code same as above task.

**Output:**



## Remarks on Output:

First plot in above figure shows the exponential sequence for α = -0.5(-1 < α < 0). Whenever α = -0.5, the sequence oscillate between negative and positive values while its magnitude decrease with increasing n.

Second plot in above figure shows the exponential sequence for α = 0.7 (0 < α < 1). It represents an exponential decay graph. The values of sequence decreases with increasing n because the increasing exponent decreases the resulting number. This is an example of convergent sequence as it is converging to zero when n approaches to infinity.

Third plot shows the exponential sequence for α = 1.1 (|α| > 1). It represents an exponential growth graph. The values of sequence increases with increasing n because the increasing exponent increases the resulting number. This is an example of divergent sequence as it diverges to infinity when n approaches to infinity.

## Complex Exponential:

### Code:

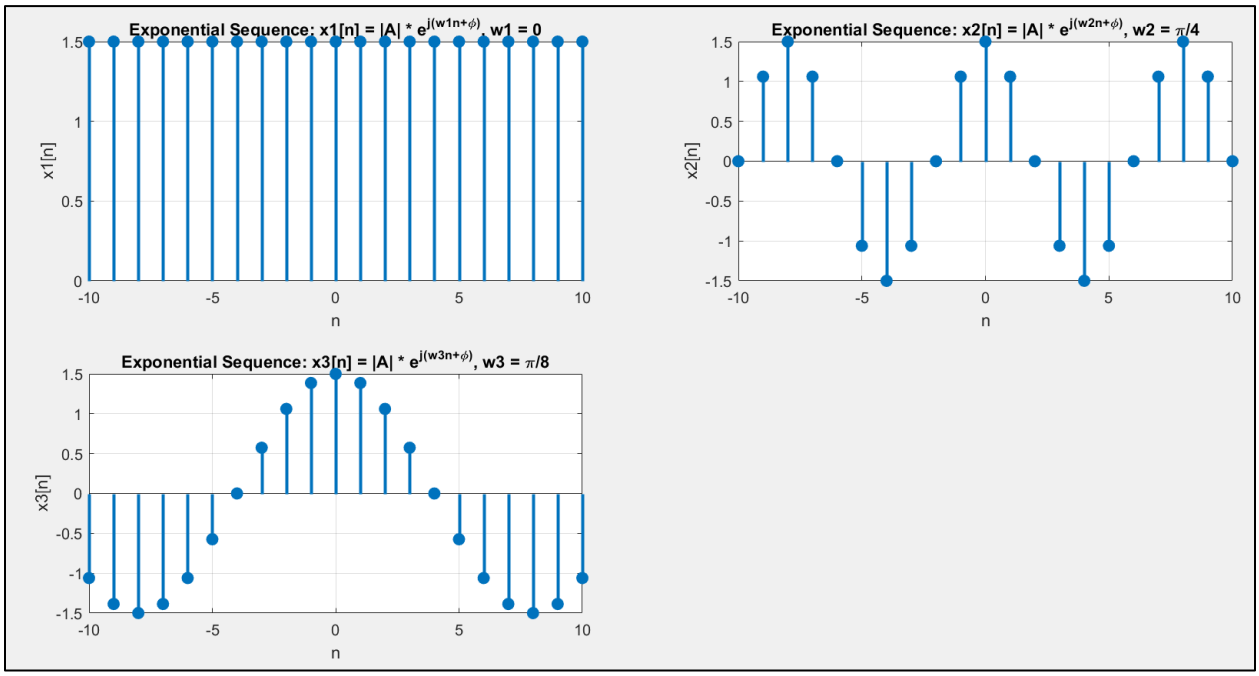
Editor - D:\Uni\DSP\Assignment\ComplexExpon.m

RealExpon.m | ComplexExpon.m

```
n = -10:1:10;

A=1.5;

w1 = 0;
w2 = pi/4;
w3 = pi/8;

phi = 0;

x1 = abs(A) * exp(1i*(w1*n + phi));
x2 = abs(A) * exp(1i*(w2*n + phi));
x3 = abs(A) * exp(1i*(w3*n + phi));


% Create the first subplot
subplot(2,2,1);
stem(n, x1, 'filled', 'LineWidth', 2);
grid on;
title('Exponential Sequence: x1[n] = |A| * e^j^(^w^1^n^+^\phi^), w1 = 0');
xlabel('n');
ylabel('x1[n]');

% Create the second subplot
subplot(2,2,2);
```

```
    stem(n, x2, 'filled', 'LineWidth', 2);
    grid on;
    title('Exponential Sequence: x2[n] = |A| * e^j^(^w^2^n^+^\phi^), w2 = \pi/4');
    xlabel('n');
    ylabel('x2[n]');

    % Create the third subplot
    subplot(2,2,3);
    stem(n, x3, 'filled', 'LineWidth', 2);
    grid on;
    title('Exponential Sequence: x3[n] = |A| * e^j^(^w^3^n^+^\phi^), w3 = \pi/8');
    xlabel('n');
```

**Output:**




## Remarks on Output:

First plot in above figure shows the complex exponential sequence for $w = 0$. The graph shows a constant function because $w = 0$ in this case.

Second and third plot shows complex exponential sequence for non-zero $w$. It forms a complex sinusoid, which has both real and imaginary parts. We can split it into real and imaginary parts using Euler's Formula.