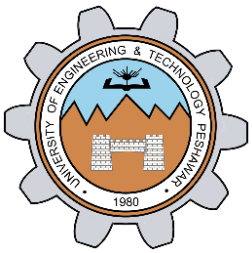
BASIC SIGNAL OPERATIONS

LAB # 07



Spring 2023

CSE301L Signals & Systems Lab

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"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:

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Date:

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Lab Objective(s):

Objectives of this Lab are;

- Generating unit impulse and unit step sequences
- Basic signal operations

Task # 01:

Using ones function; plot the signum sequence over interval -10≤n≤10. It can be defined as:

$$sign(n) = \begin{cases} 1, & for\ n > 0 \\ -1, & for\ n < 0 \\ 0, & for\ n = 0 \end{cases}$$

Problem Analysis:

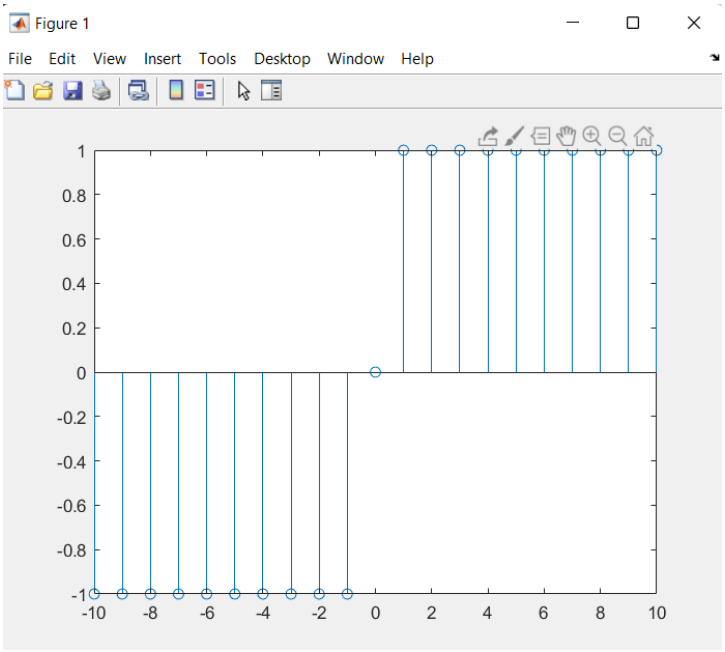
Impulse signals are important type of signals in SS.

Algorithm:

- Take in the signal parameters
- Plot the signal

Code:

Output / Graphs / Plots / Results:



Discussion and Conclusion:
We can produce signum sequence in MATLAB.

Task # 02:

Prove the following:

$$\delta[n] = u[n] - u[n-1]$$

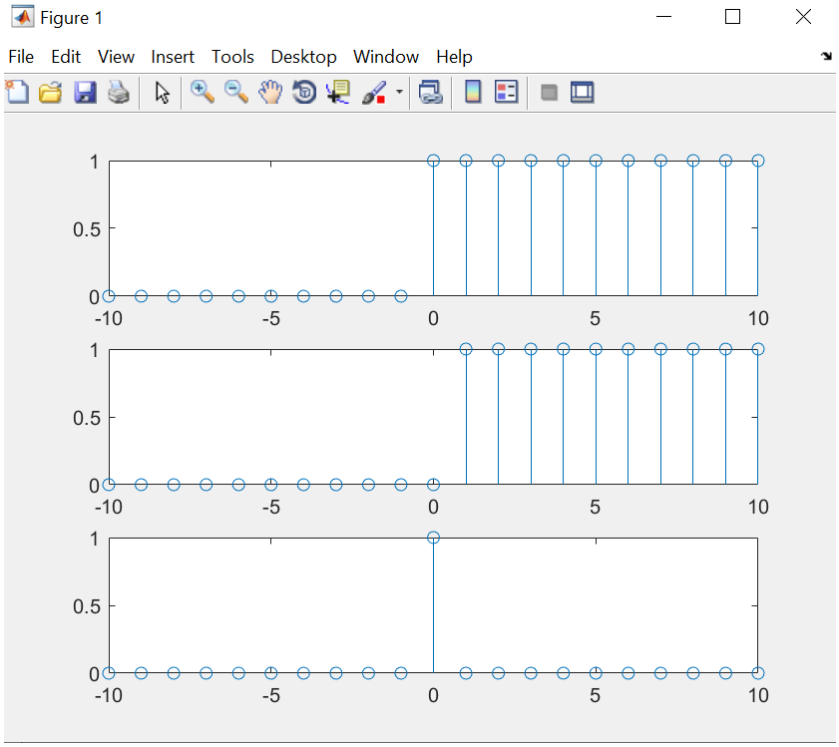
Problem Analysis:
Unit Impulse signal is a difference of unit step and delayed unit step signal. We prove that,

Algorithm:

- Take in unit step signal.
- Take in delayed unit step signal.
- Subtract both signals.
- Plot all three (including resultant) signals

Code:

Output / Graphs / Plots / Results:



Discussion and Conclusion:
Hence L.H.S == R.H.S

Task # 03:

Delay the original signal given in above example by 1 sec. Plot both the delayed & original signal on the same figure.

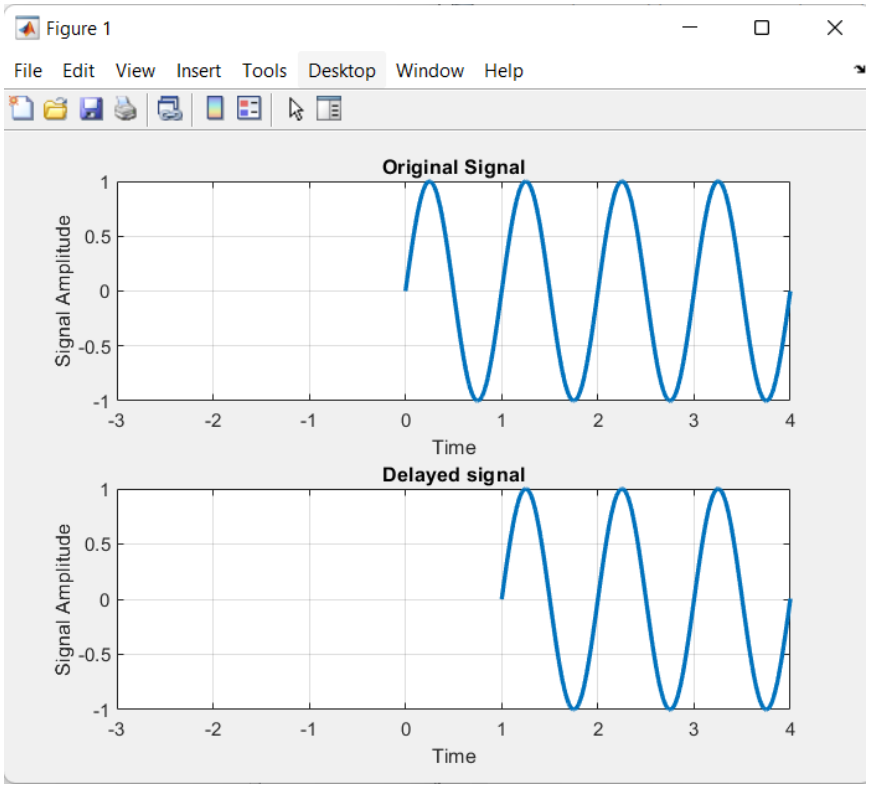
Problem Analysis:
Delaying a signal is important for certain signal operations.

Algorithm:

- Take in the signal
- Delay the signal
- Plot the signal

Code:

Output / Graphs / Plots / Results:



Discussion and Conclusion:
Thus we can delay a signal in MATLAB.

Task # 04:

Flip the following signal:

$$y = 5 \exp\left(i * n * \frac{\pi}{4}\right)$$

Plot the original signal as well as the flipped one in the same figure.

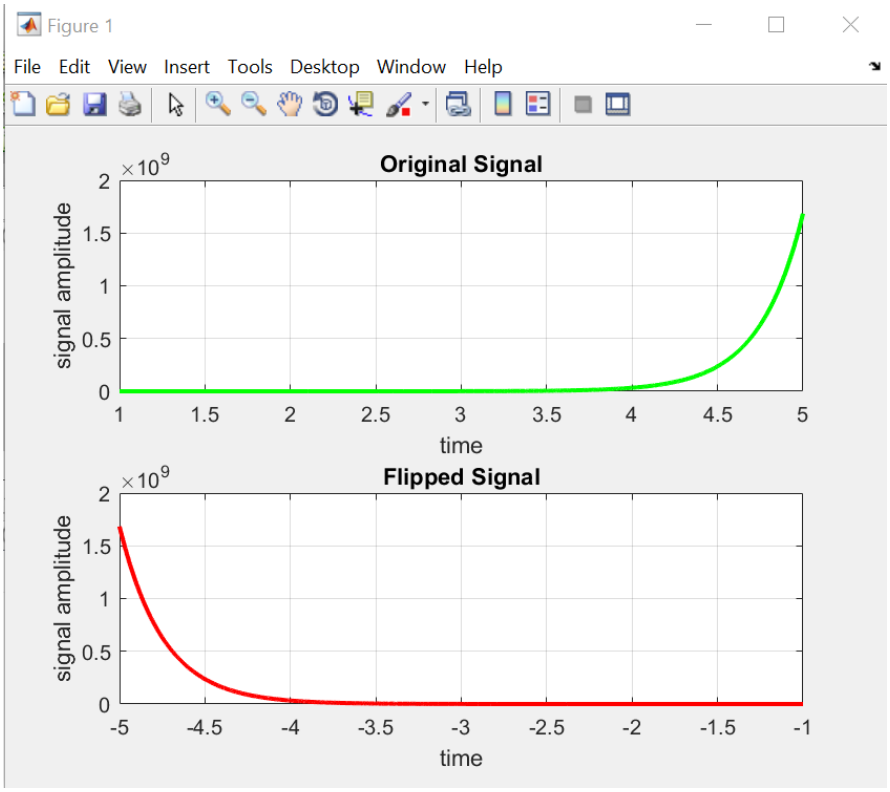
Problem Analysis:
Signal flipping is sometimes desired in MATLAB.

Algorithm:

- Take in the signal
- Flip the signal
- Plot both signals

Code:

Output / Graphs / Plots / Results:



Discussion and Conclusion:
Thus we can flip a signal in MATLAB.

Task # 05:

Flip the following signal:

$$x[n]= 2\delta[n]+ 5\delta[n-1] + 8\delta[n-2] + 4\delta[n-3] + 3\delta[n-4]$$

Plot the original signal as well as the flipped one in the same figure.

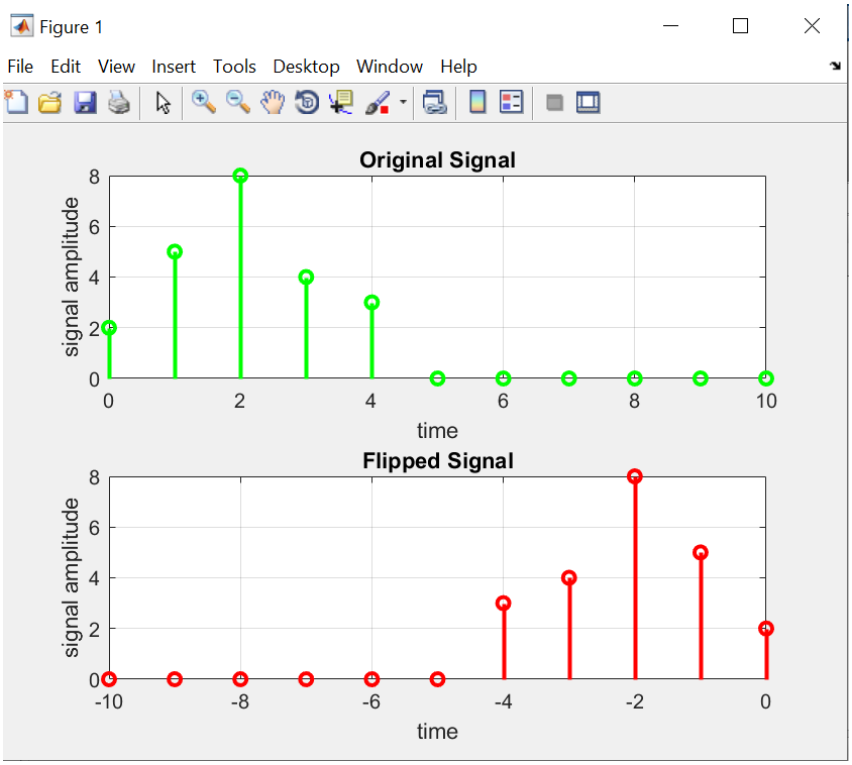
Problem Analysis:
Signal inversion or flipping is an important signal operation.

Algorithm:

- Take in the original signal.
- Flip the original signal.
- Plot both signals

Code:

Output / Graphs / Plots / Results:



Discussion and Conclusion:
Thus we can flip a signal in MATLAB.

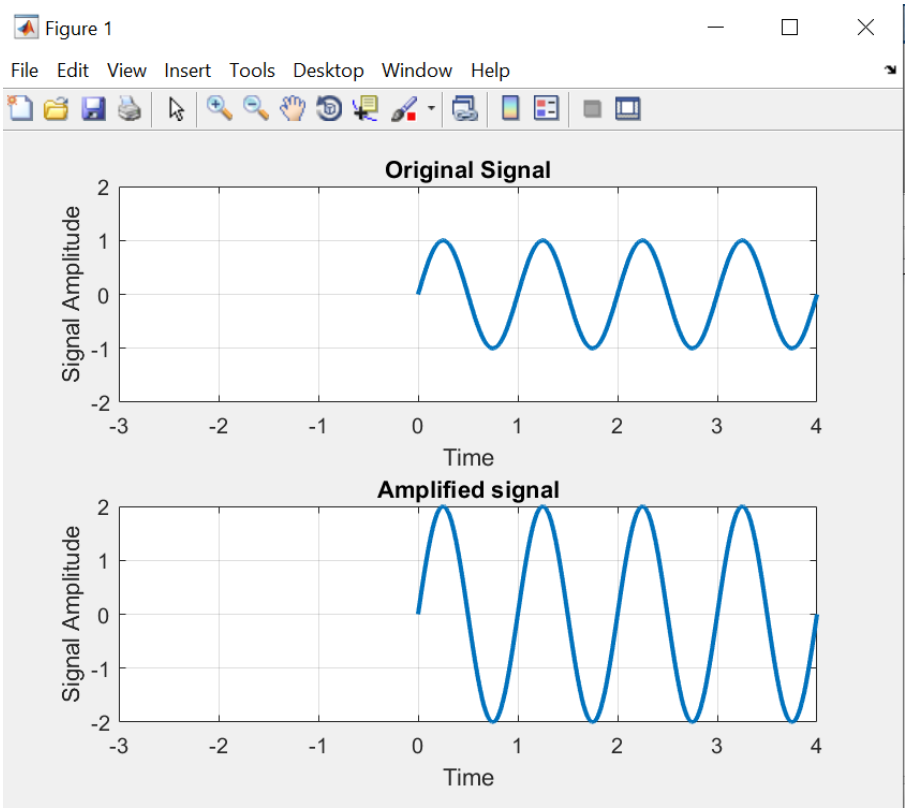
Task # 06:
Scale the continuous-time sinusoid used in signal shifting example by a factor of 2.

Problem Analysis:
Amplitude scaling is necessary for signal operations. Here we perform amplitude scaling

Algorithm:
- Take in the original signal.
- Scale its amplitude by 2.
- Plot both signals.

Code:

Output / Graphs / Plots / Results:



Discussion and Conclusion:
Thus we can shift a signal in MATLAB.

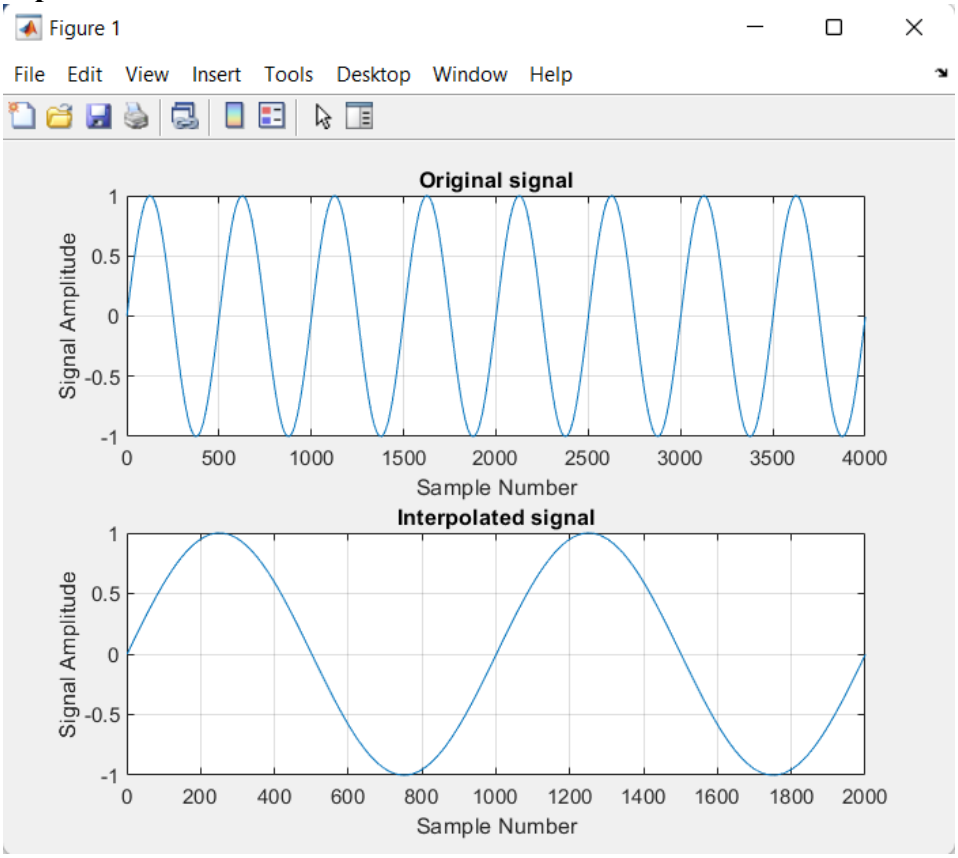
Task # 07:
Use interp command in the above program to interpolate (up-sample) the signal by a factor of 2.

Problem Analysis:
Interpolation is necessary for signal operations. We perform interpolation.

Algorithm:
- Take in the signal.
- Interpolate it.
- Plot the signal.

Code:

Output / Graphs / Plots / Results:



Discussion and Conclusion:
Thus we can interpolate a signal in MATLAB.

Conclusion:

Basic Signal Operations:

There are different operations that can be performed on the signals such as time shifting, flipping, amplitude scaling, time scaling, amplitude clipping, and signal replication.

Signal Shifting

In Signals & System theory, we perform signal shifting operation on signal in time domain by adding or subtracting a number t_o from independent variable, let's say t.

- If t_o is positive, then signal is advanced (Will shift towards left)
- If t_o is negative, then signal is delayed (Will shift towards right)

In MATLAB, we perform signal shifting operation on signal in time domain as described above but the results are opposite.

- If t_o is positive, then signal is delayed (Will shift towards right)
- If t_o is negative, then signal is advanced (Will shift towards left)

Signal Flipping

Signal Flipping means time reversal of a signal. We can achieve it by multiplying -1 with the independent variable. In MATLAB, same procedure is followed as mentioned above.

Amplitude scaling

In SS Theory, we define amplitude scaling as multiplying a signal by a constant factor. In MATLAB, we can scale the amplitude of a signal by multiplying it by a constant.

Time scaling

In SS Theory, we define time scaling as multiplying independent variable of a signal by a constant factor. In MATLAB, we can perform time scaling on a signal by manipulating the time vector associated with the signal. The time vector represents the time instances at which the signal is sampled. By modifying the time vector, we can change the time scale of the signal.