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Final Project (Part 2) “General Signal Generator”

Error Handling:

1. In Break points part → if the user enters a number not in the limits the program will continue asking to enter a number between the region (start & end points will appear) until the user enter correct number.
2. In Break points part → if the user enters the break points places unsorted the program will arrange them correctly. So, the signal will be graphed correctly.
3. In Signal specifications part → if the user did not enter a number between 1 & 5 the program will continue asking him to enter number between 1 & 5 until he enter correct number.
4. In Sinusoidal Signal part → if the user did not enter 1 or 2 the program will continue asking him to enter 1 or 2 until he enter correct number.
5. In Modifications part → if the user did not enter a number between 1 & 6 the program will continue asking him to enter a number between 1 & 6 until the user enter correct number

User Manual:

Firstly, the program will ask you to enter the Frequency Sampling (F_s), the start and end time of the signal, and number of breakpoints and their places.

Secondly, the program will print out all the signals available to draw (You must enter a number from 1 to 5). If, you chose 5 “sinusoidal signal” the program will ask you to choose Sine (1) or Cosine (2) (You must enter 1 or 2. Phase must be in radian).

According to the signal you choose the program will ask you about things you must enter. This is repeated until all regions finished.

Thirdly, a figure will pop up have the signal you entered with title (The Original Signal).

Fourthly, the program will ask you if you want to make any operation to the signal (You must enter a number from 1 to 6).

According to the operation you chose the program will ask you about things you must enter. This is repeated until the user enter 6 “none”.

A figure will pop up after each operation the user made with title (After The Operation).

➔Very Important⬅ (on Operation Part)

If the user entered 2 operations the operation will happen on the signal after each other. So, the user will be able to do for example $(4t-2)$. For example, if he chose time reversal and compressing, time reversal is happened to the signal then compression will happen to the time reversed signal not to the original signal.

Finally, “when the user enters 6” a final figure will pop up according what the user made of operations. If no operations are done a figure will pop with title (No Operations Done). Else, a figure will pop up with title (After All Operations Are Done). This Figure will have the signal after all operations.

Source Code (.m File)

```
Fs = input('Sampling frequency of signal : ');
Start = input('Start time scale : ');
End = input('End of time scale : ');
breakpoints = input('Number of the break points : ');
temp = zeros(1,breakpoints);
z = [Start temp End];
Ttol = linspace(Start,End,Fs*(End-Start));
TolSignal = [];
for i=2:breakpoints+1
    fprintf('Position of break point number %d : ',i-1);
    z(i)=input('');
    while z(i) >= End || z(i) <= Start
        fprintf('Please enter the position of break point number %d between [%d %d] : ',i-
```

```

1,Start,End);
    z(i)=input('');
    end
end
z=sort(z);
for k=1:breakpoints+1
    limits = z(k+1)-z(k);
    t = linspace(z(k),z(k+1),Fs*limits);
    fprintf('what is the Signal type in region from %d to %d ?',z(k),z(k+1));
    fprintf('\n1)DC Signal\n2)Ramp Signal\n3)General order polynomial\n4)Exponential
signal\n5)Sinusoidal signal\n');
    str = input(' ');
    while str > 5 || str < 1
        fprintf('Please choose a correct Signal number between 1 and 5 in region [%d %d]
:',z(k),z(k+1));
        str=input(' ');
    end
    if str == 1
        AmpDC = input('Amplitude = ');
        Signal = AmpDC * ones(1,int16(limits*Fs));
        TolSignal=[TolSignal Signal];
    elseif str == 2
        slope = input('Slope = ');
        InterceptR = input ('Intercept = ');
        Signal = slope*t+InterceptR;
        TolSignal=[TolSignal Signal];
    elseif str == 3
        Order = input('Order of this signal : ');
        temp1=Order;
        coeff=[];
        for v=1:Order
            fprintf('Amplitude of power %d (Coefficient) = ',temp1);
            coeff(end+1)=input(' ');
            temp1=temp1-1;
        end
        fprintf('Amplitude of power %d (intercept) = ',temp1);
        coeff(end+1)=input(' ');
        Signal=polyval(coeff,t);
        TolSignal=[TolSignal Signal];
    elseif str == 4
        AmpExp = input ('Amplitude = ');
        Exponent = input ('exponent = ');
        Signal = AmpExp*exp(Exponent*t);
        TolSignal=[TolSignal Signal];
    elseif str == 5
        type=input('Choose the type ?\n1)Sine wave\n2)Cosine wave\n');
        while type < 1 || type > 2
            type=input('Please Choose the 1 (Sine) or 2 (Cosine) : ');
        end
        AmpSin = input ('Amplitude = ');
        Frequency = input ('Frequency = ');
        W=2*pi*Frequency;
        Phase = input ('Phase in radian = ');
        switch type

```

```

        case 1
            Signal = AmpSin*sin(W*t+Phase);
            TolSignal=[TolSignal Signal];
        case 2
            Signal = AmpSin*cos(W*t+Phase);
            TolSignal=[TolSignal Signal];
    end
end
end
figure;plot (Ttol,TolSignal);title('Original Signal');
modify = 0;
op = 0;
while op ~=6
    if modify == 0
        fprintf('which operation do you want to preform on the signal?\n');
    elseif modify ~= 0
        fprintf('Do you want to preform another operation on the signal?\n');
    end
    fprintf('1)Amplitude Scaling\n2)Time Reversal\n3)Time Shift\n4)Expanding the Signal\n5)Compressing the Signal\n6)None\n');
    op = input(' ');
    while op > 6 || op < 1
        fprintf('Please choose a correct operation number between 1 and 6 : ');
        op=input(' ');
    end
    if op == 1
        Scale=input('Scale value = ');
        TolSignal=Scale.*TolSignal;
    elseif op == 2
        Ttol=Ttol.*-1;
    elseif op == 3
        Shift=input('Shift value = ');
        Ttol=Ttol-Shift;
    elseif op == 4
        Expand=input('Expand value = ');
        Ttol=Ttol.*Expand;
    elseif op == 5
        Compress=input('Compression value = ');
        Ttol=Ttol./Compress;
    elseif op == 6
        break
    end
    fprintf('=> Operation Done Successfully <=\n');
    figure;plot (Ttol,TolSignal);title('After The Operation');
    modify = modify +1 ;
end
if modify ~=0
    figure;plot (Ttol,TolSignal);title('After All Operations Are Done');
else
    figure;plot (Ttol,TolSignal);title('No Operations Done');
end

```

Test Cases

(Assume that Frequency Sample at all the test cases = 100)

1st Case:

Function: $y = 5(u(t+5)-u(t-4))$

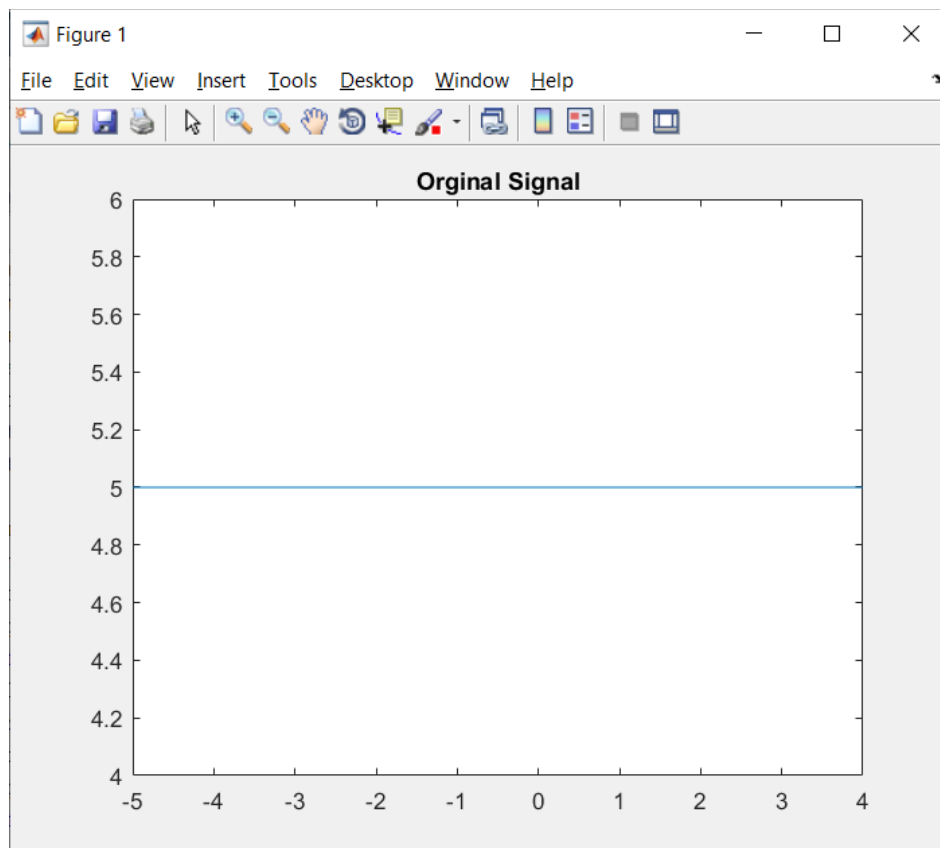
Start Point: -5

End Point: 4

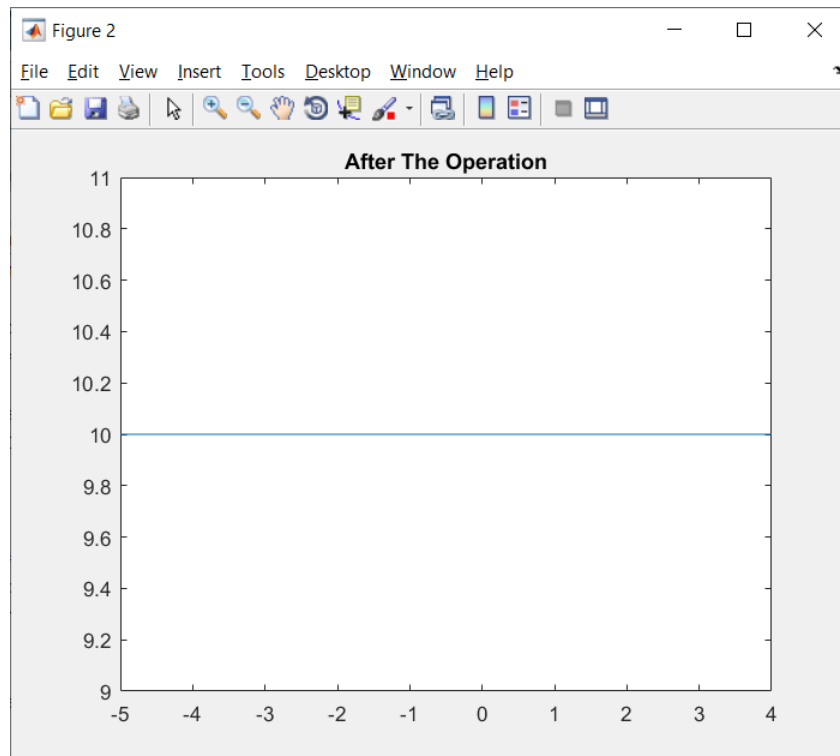
Number of break points: 0

From point -5 to 4 → Dc Signal

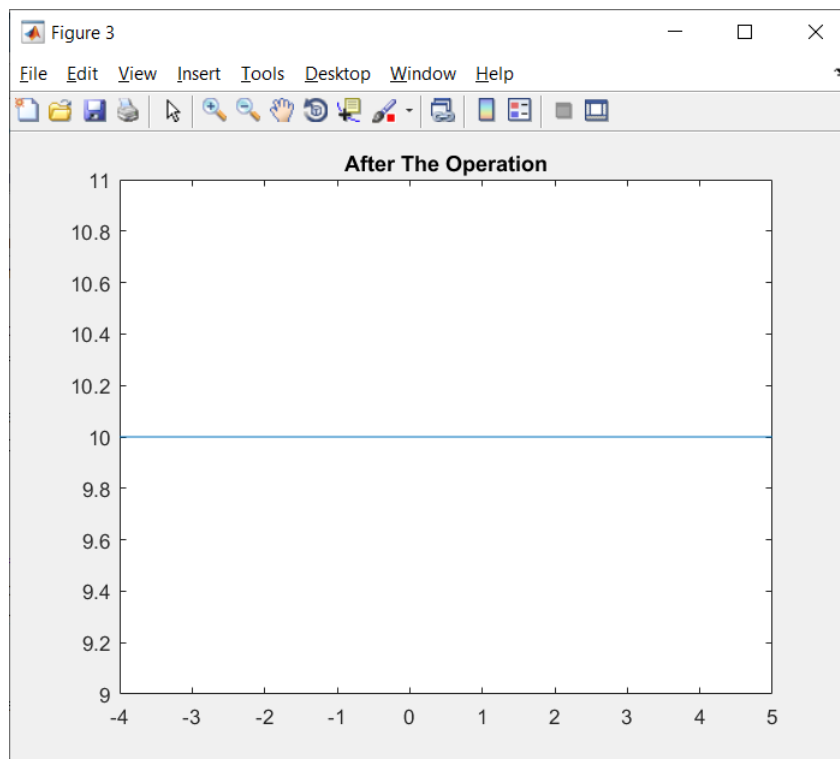
Amplitude: 5



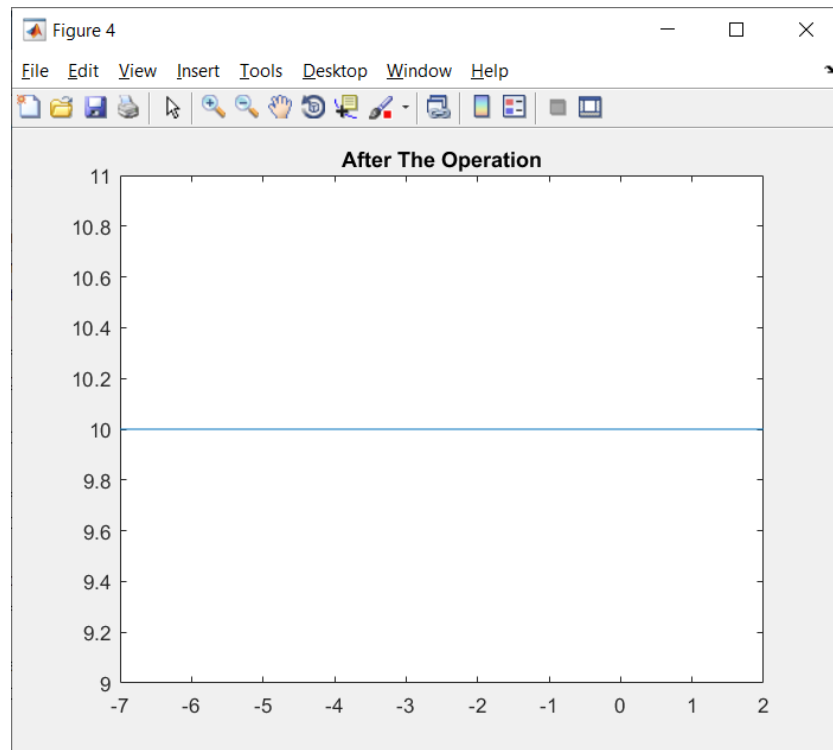
1st operation → Amplitude Scaling by 2



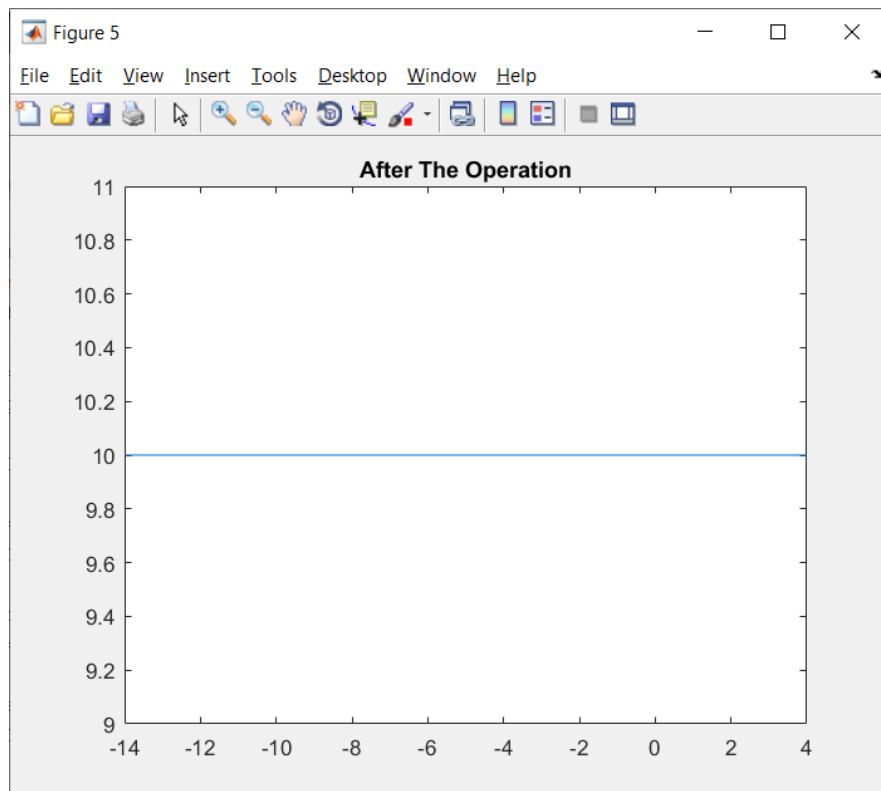
2nd operation → Time Reversal



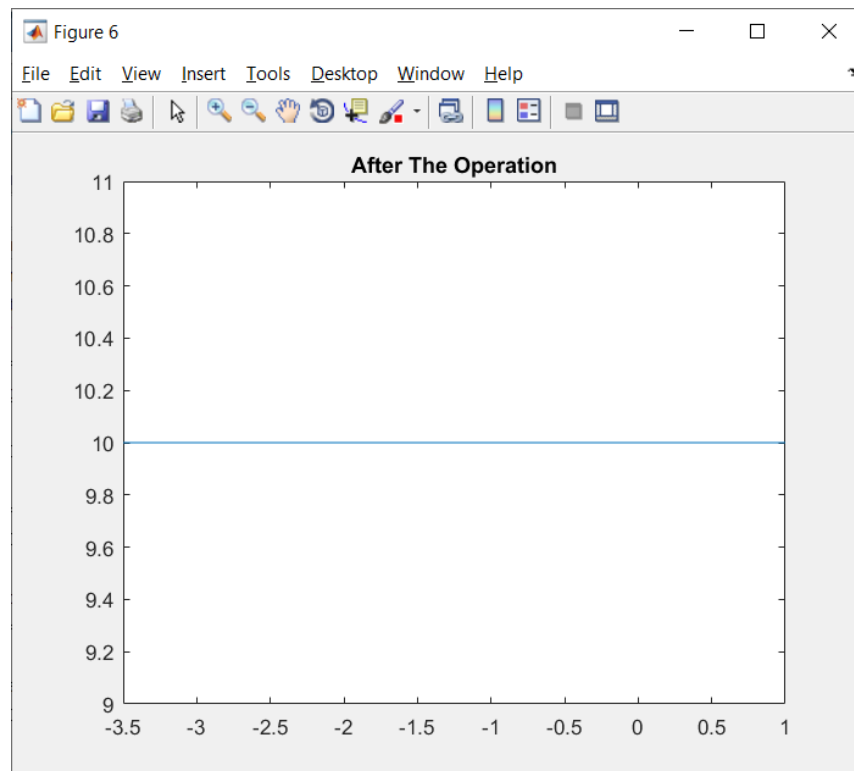
3rd operation → Time Shift with value of 3



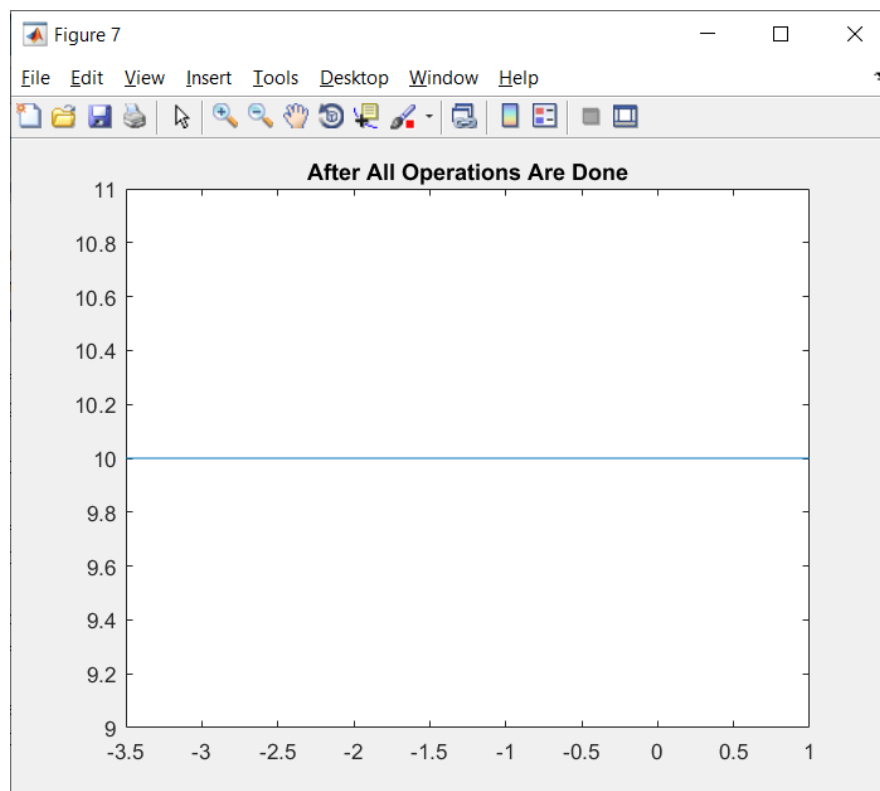
4th operation → Expanding the signal with value of 2



5th operation → Compressing the signal with value of 4



After pressing 6 "none"



2nd Case:

Function: $y = t*(u(t)-u(t-5))$

Start Point: 0

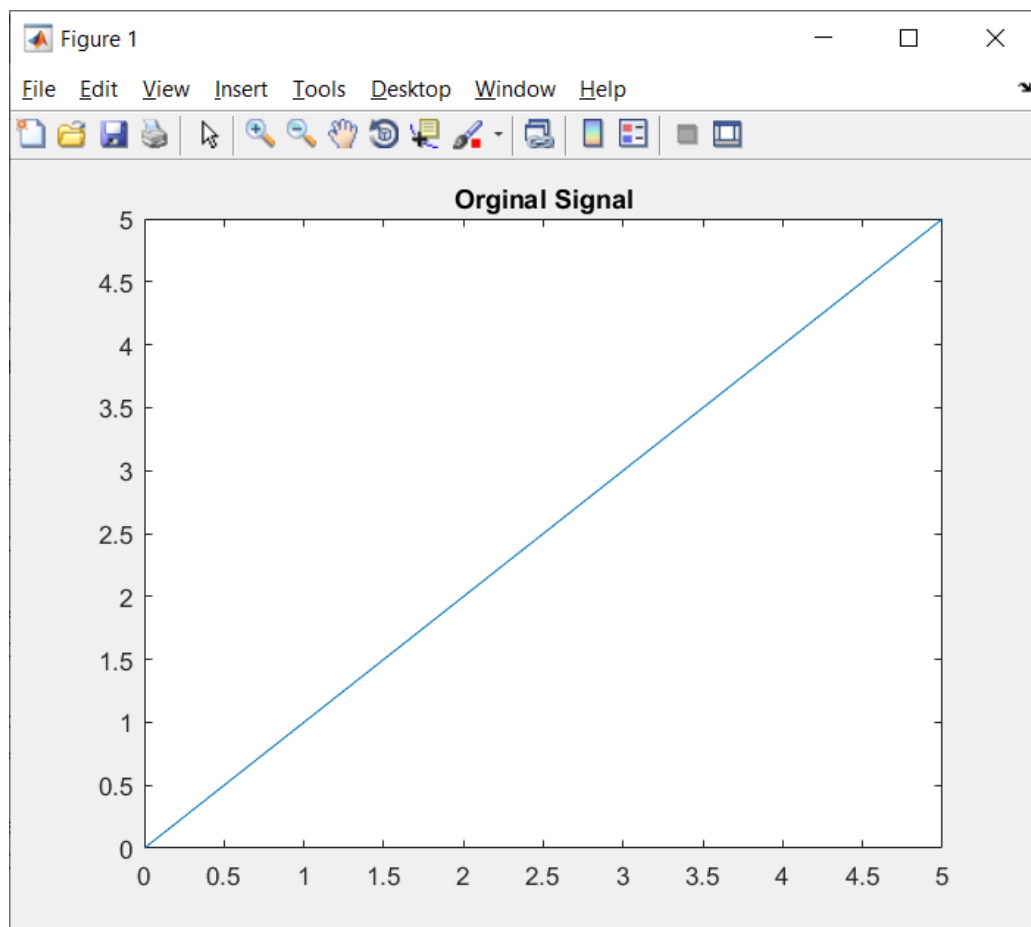
End Point: 5

Number of break points: 0

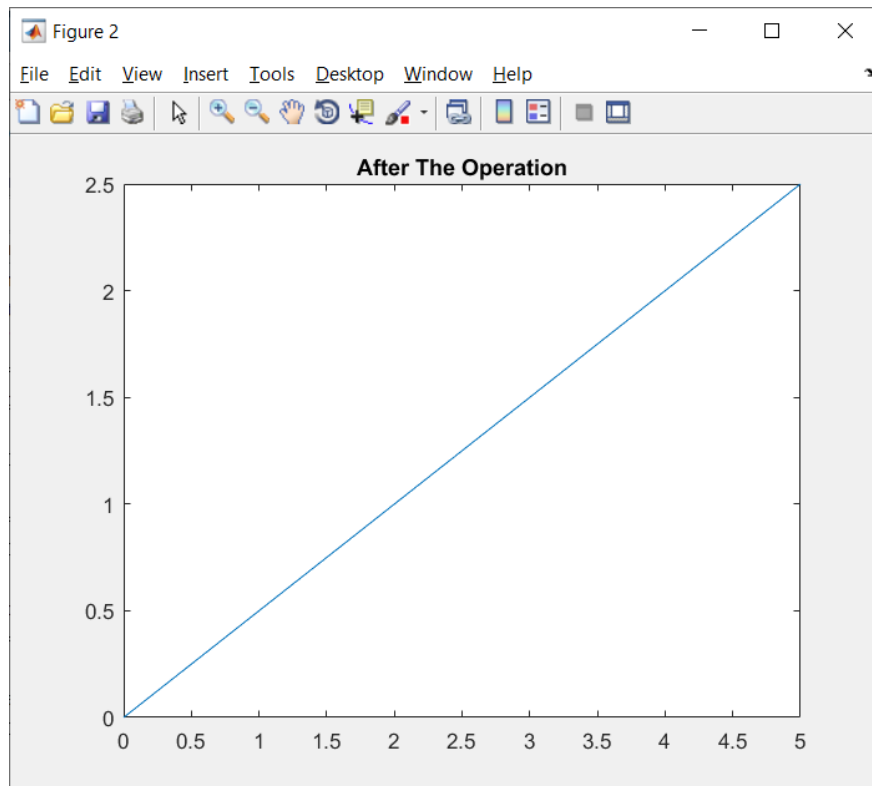
From point 0 to 5 → Ramp Signal

Slope: 1

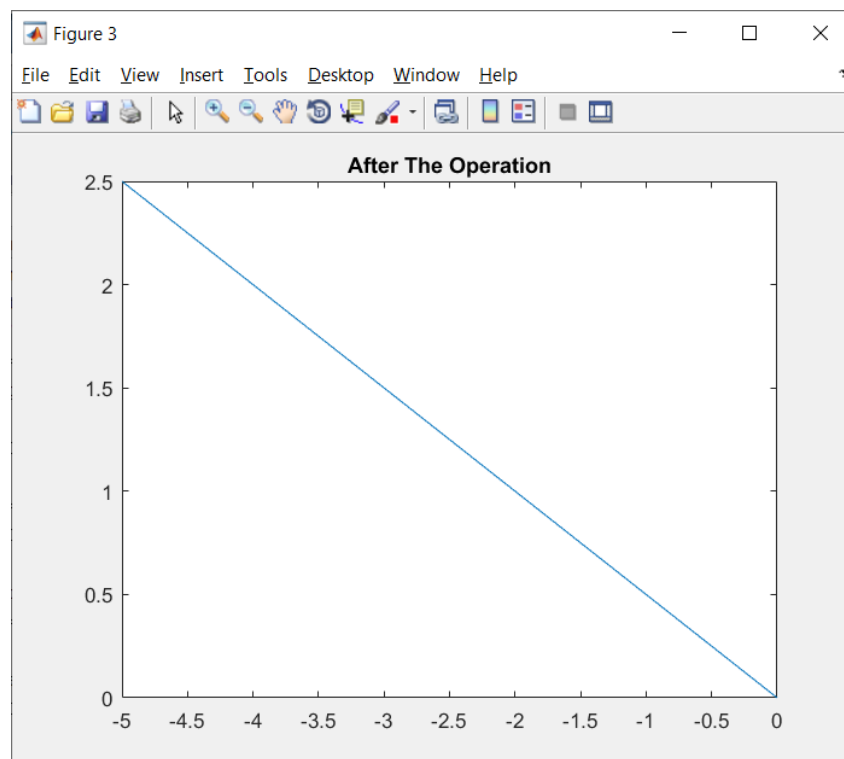
Intercept: 0



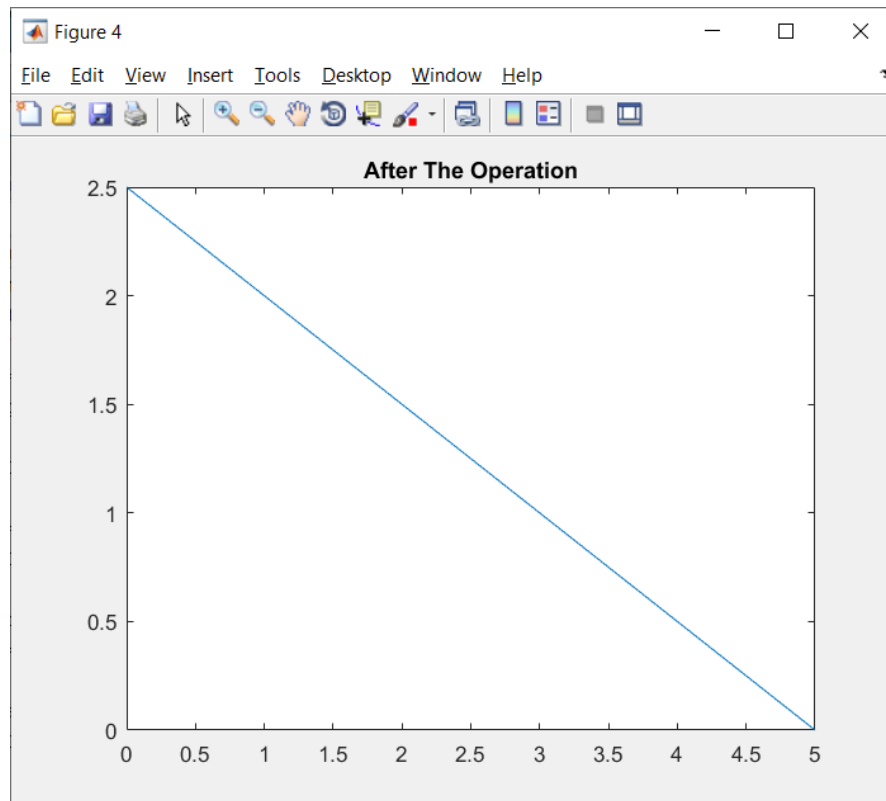
1st operation → Amplitude Scaling by 0.5



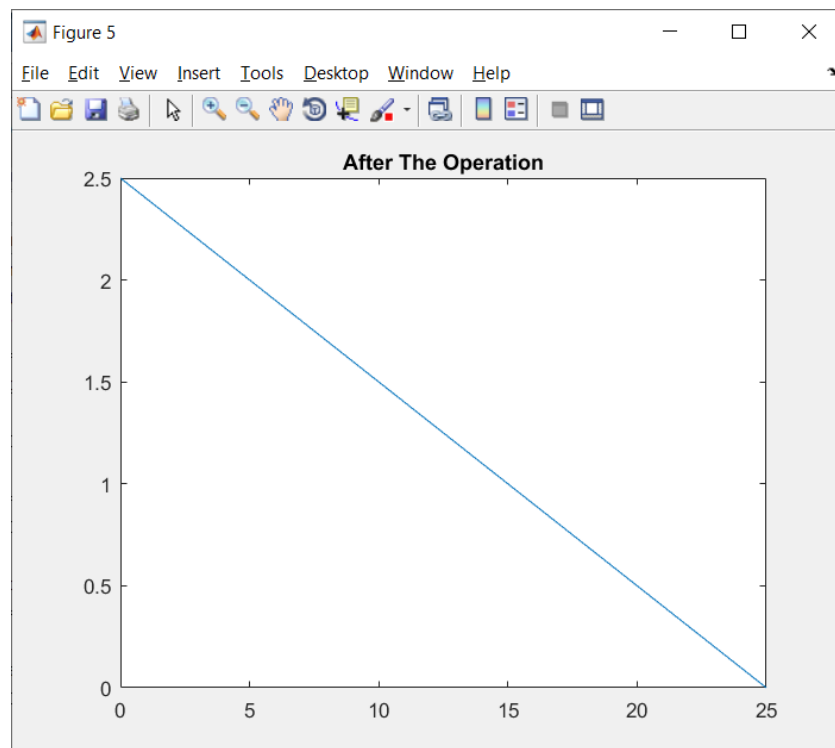
2nd operation → Time Reversal



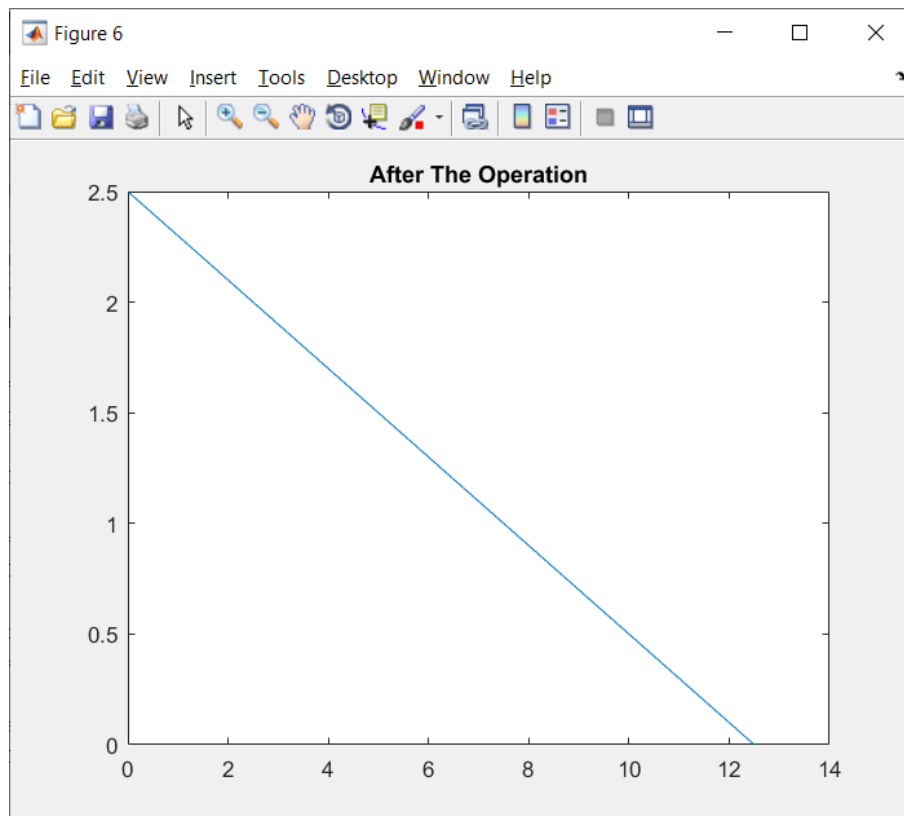
3rd operation → Time Shift with value of -5



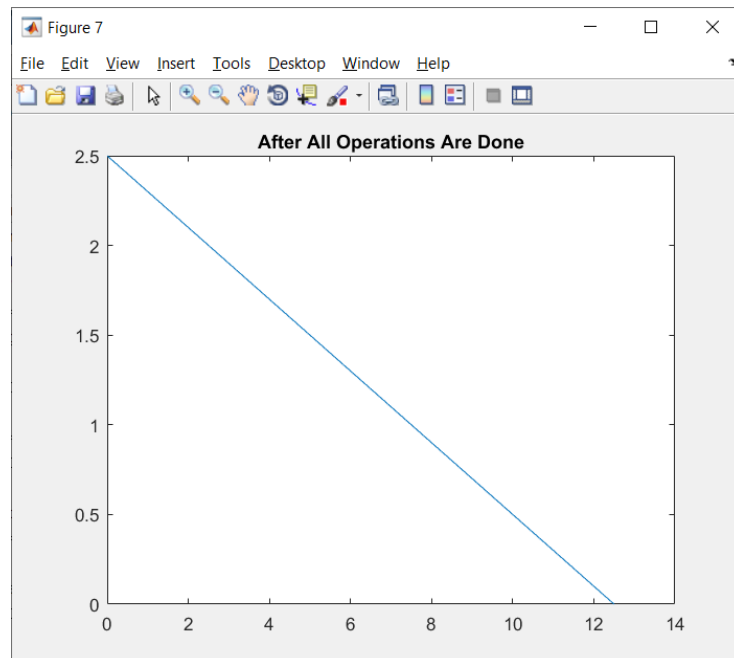
4th operation → Expanding the signal with value of 5



5th operation → Compressing the signal with value of 2



After pressing 6 "none"



3rd Case:

Function: $y = (3t^3 + 3t + 3) * (u(t+3) - u(t-3))$

Start Point: -3

End Point: 3

Number of break points: 0

From point -3 to 3 → General Order polynomial Signal

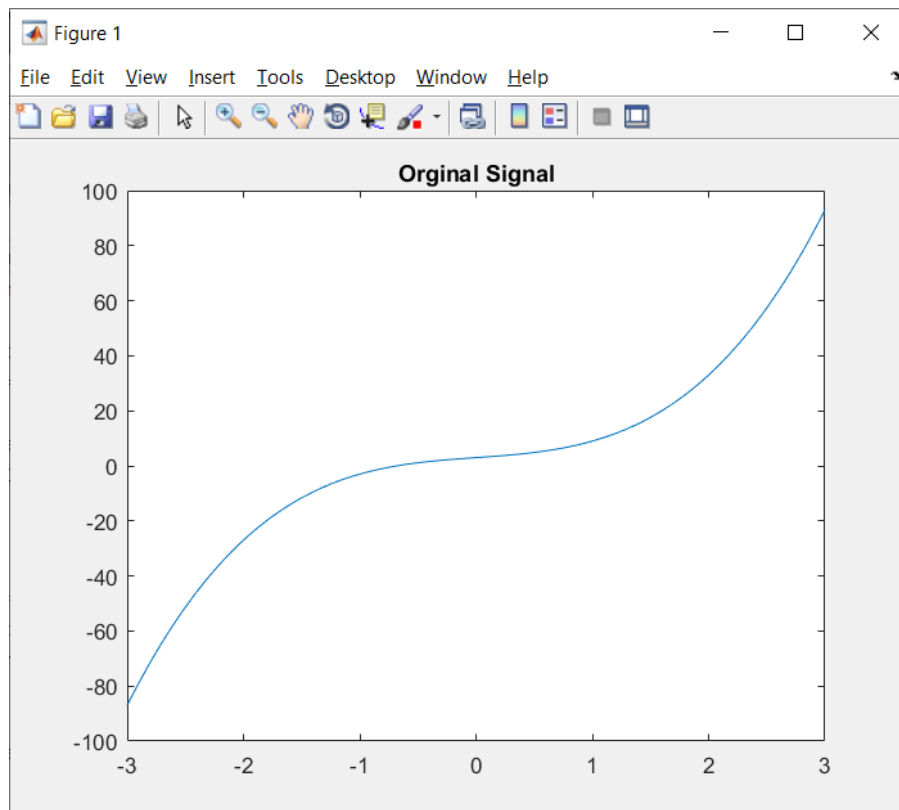
Order of the Signal: 3

Amplitude of power 3 (Coefficient): 3

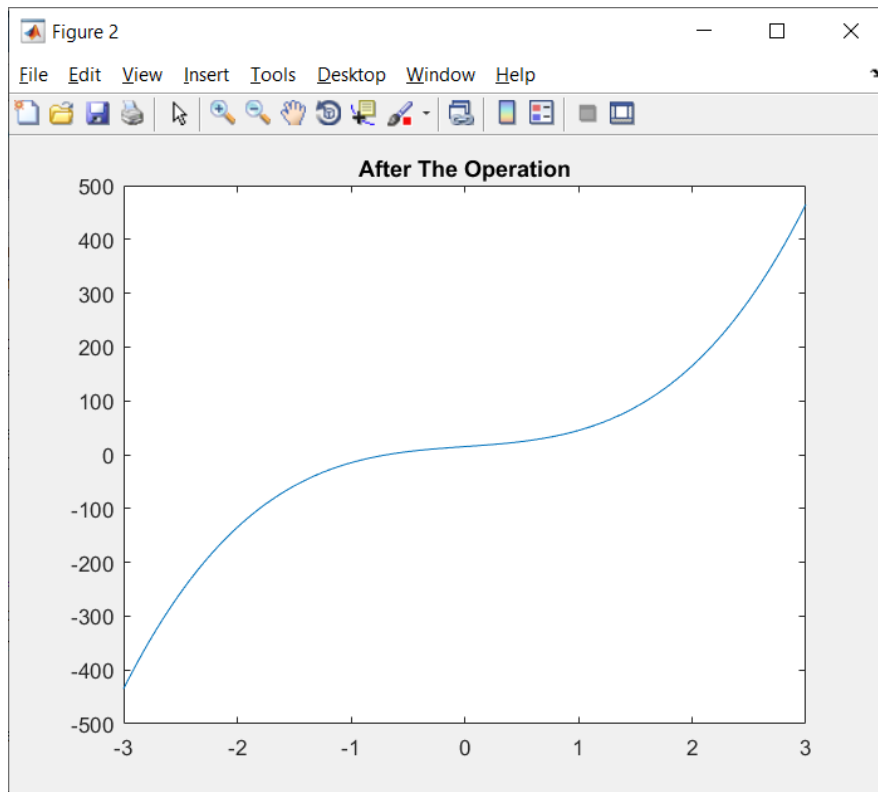
Amplitude of power 2 (Coefficient): 0

Amplitude of power 1 (Coefficient): 3

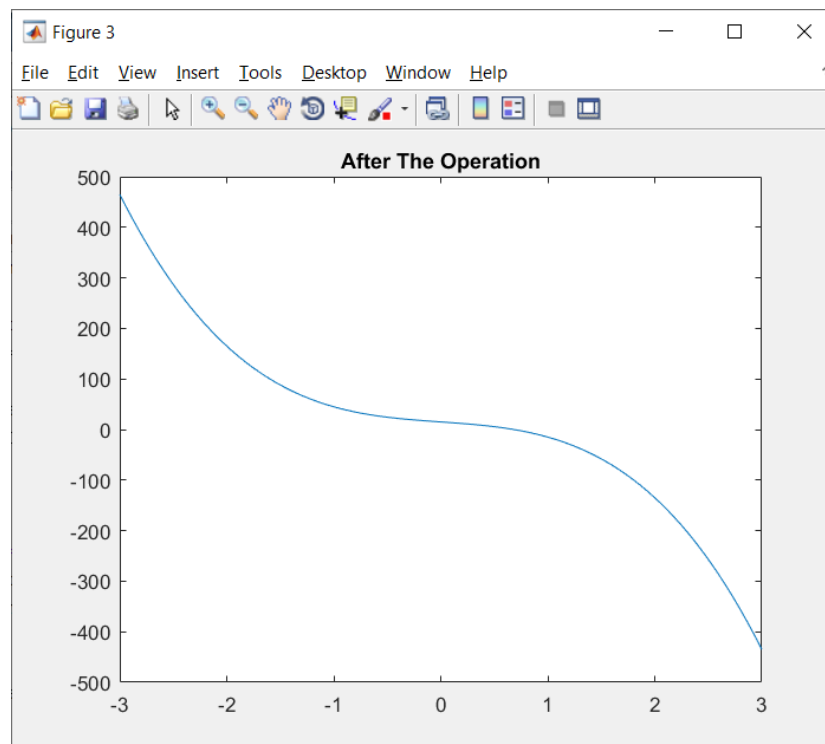
Amplitude of power 0 (intercept): 3



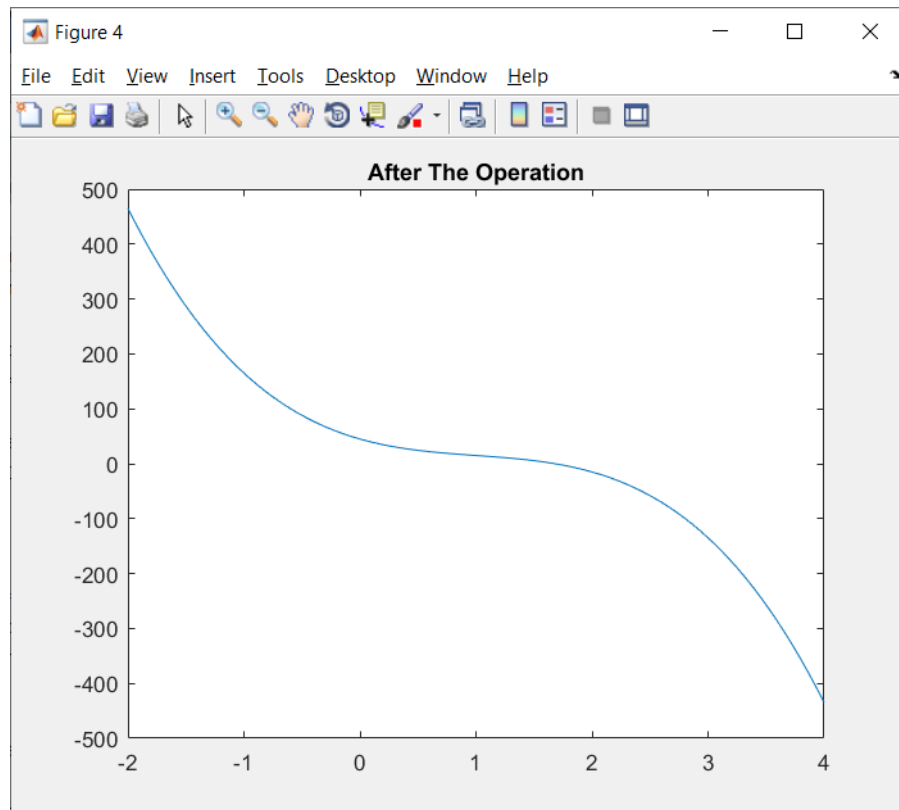
1st operation → Amplitude Scaling by 5



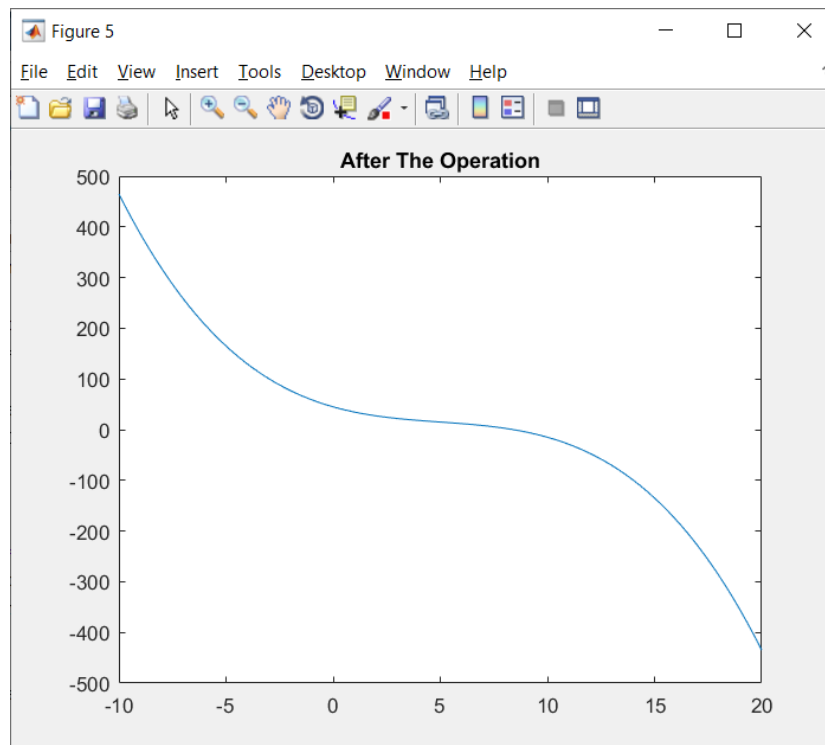
2nd operation → Time Reversal



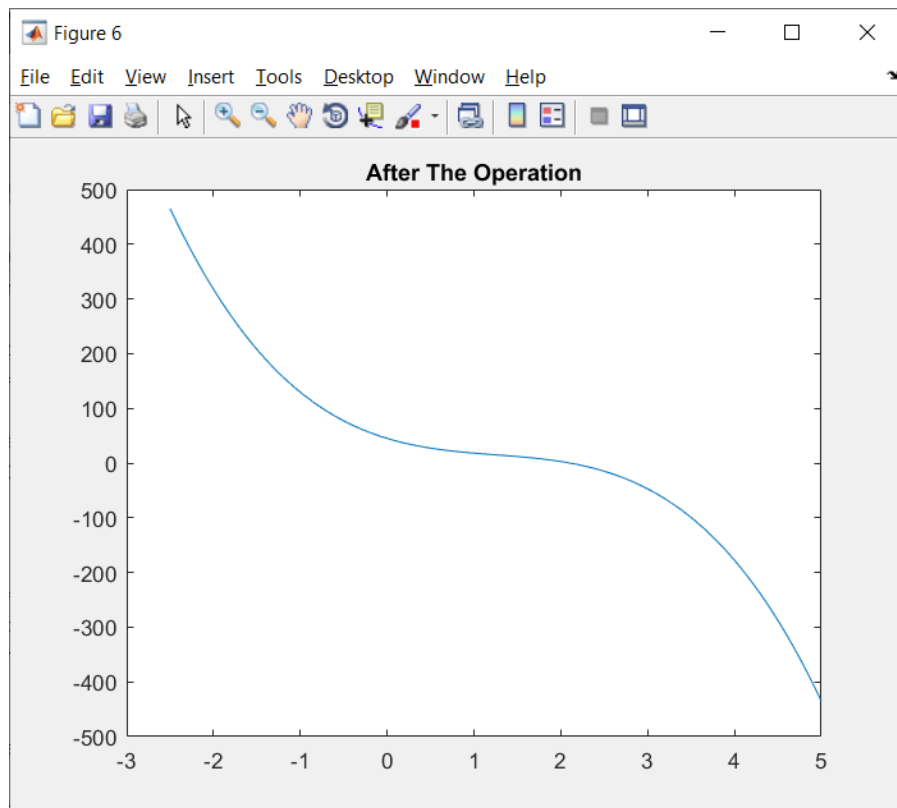
3rd operation → Time Shift with value of -1



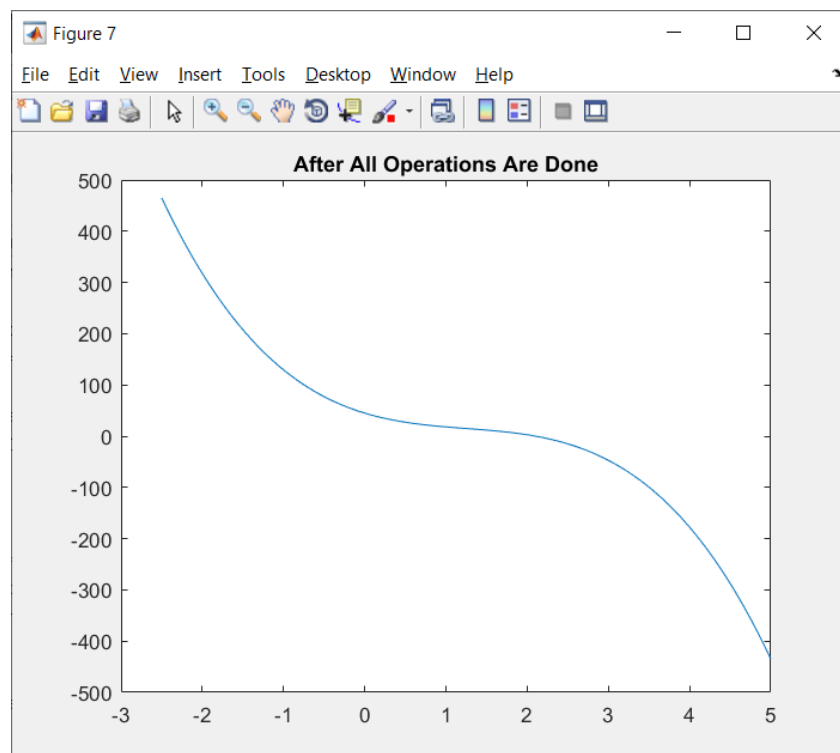
4th operation → Expanding the signal with value of 5



5th operation → Compressing the signal with value of 4



After pressing 6 "none"



4th Case:

Function: $y = 5e^{0.5*(u(t+2)-u(t-2))}$

Start Point: -2

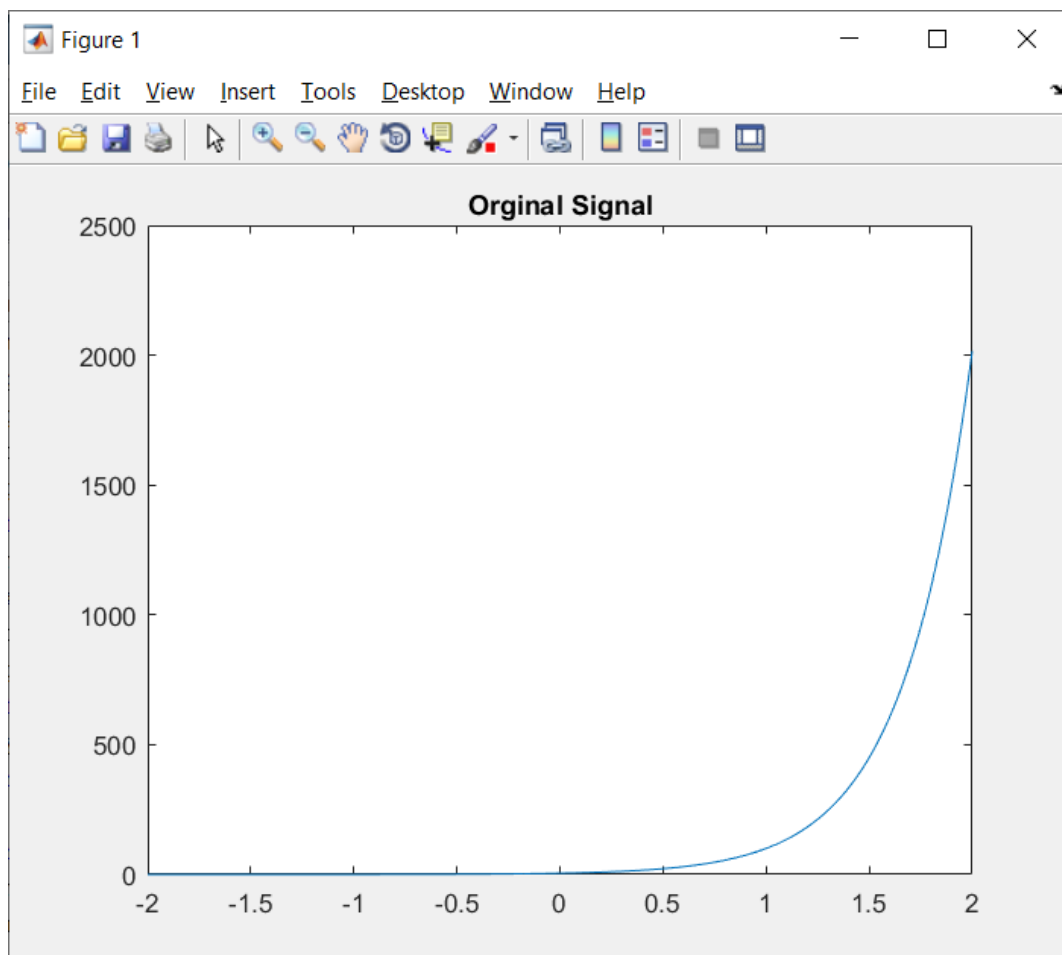
End Point: 2

Number of break points: 0

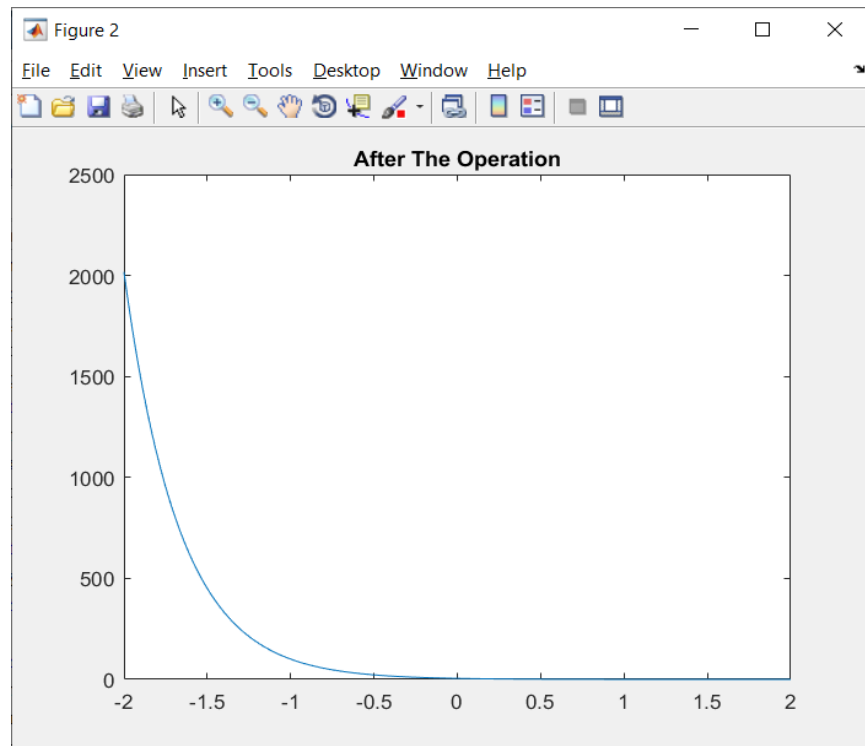
From point -2 to 2 → Exponential Signal

Amplitude: 5

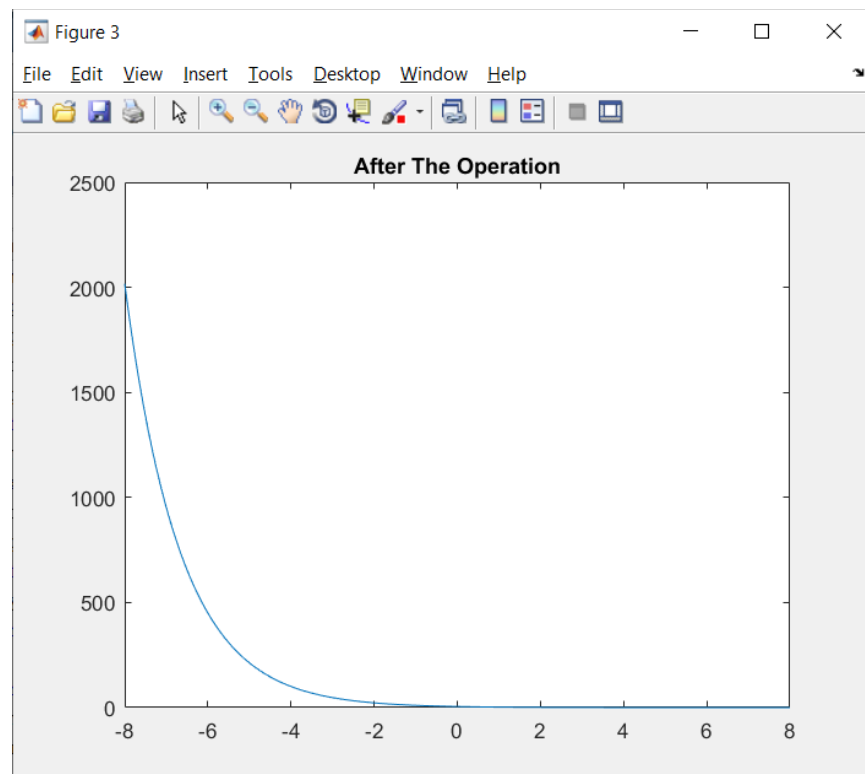
Exponent: 3



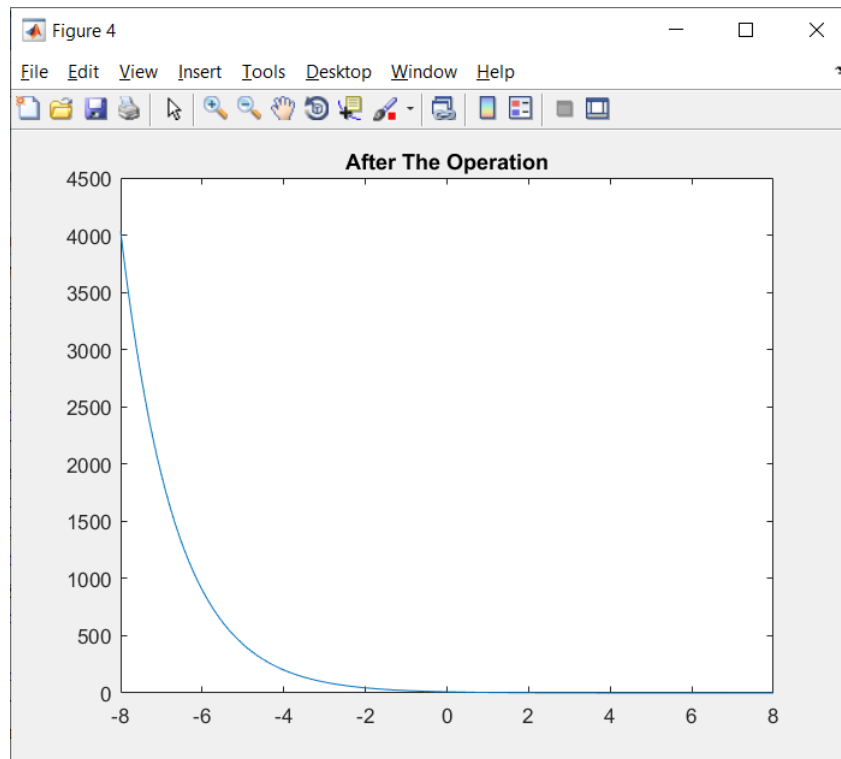
1st operation → Time Reversal



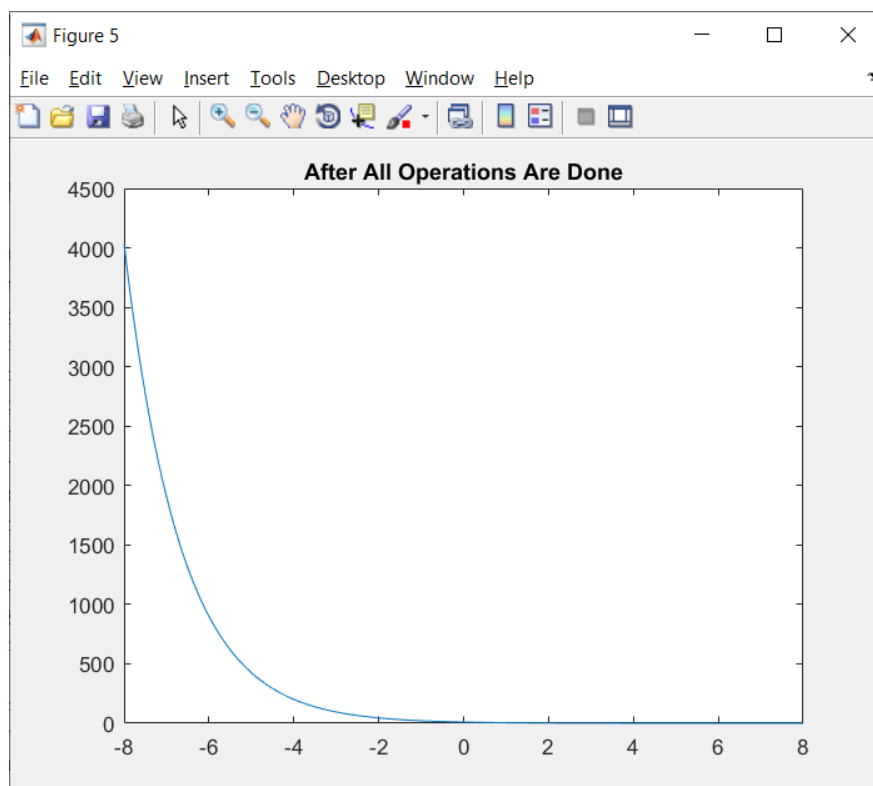
2nd operation → Expanding the signal with value of 4



3rd operation → Amplitude Scaling by 2



After pressing 6 "none"



5th Case:

Function: $y = 3 \cdot \sin(2 \cdot \pi \cdot 0.25 + \frac{\pi}{2}) \cdot (u(t+3) - u(t-3))$

Start Point: -3

End Point: 3

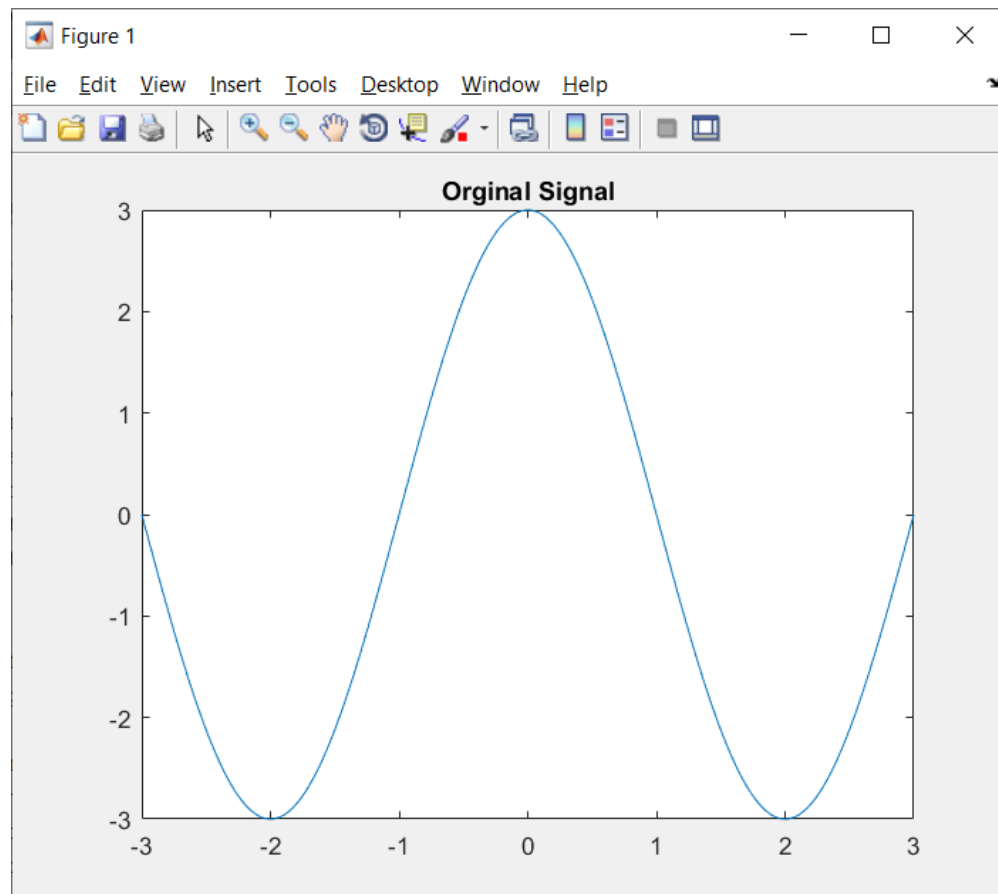
Number of break points: 0

From point -3 to 3 → Sinusoidal Signal (Sine)

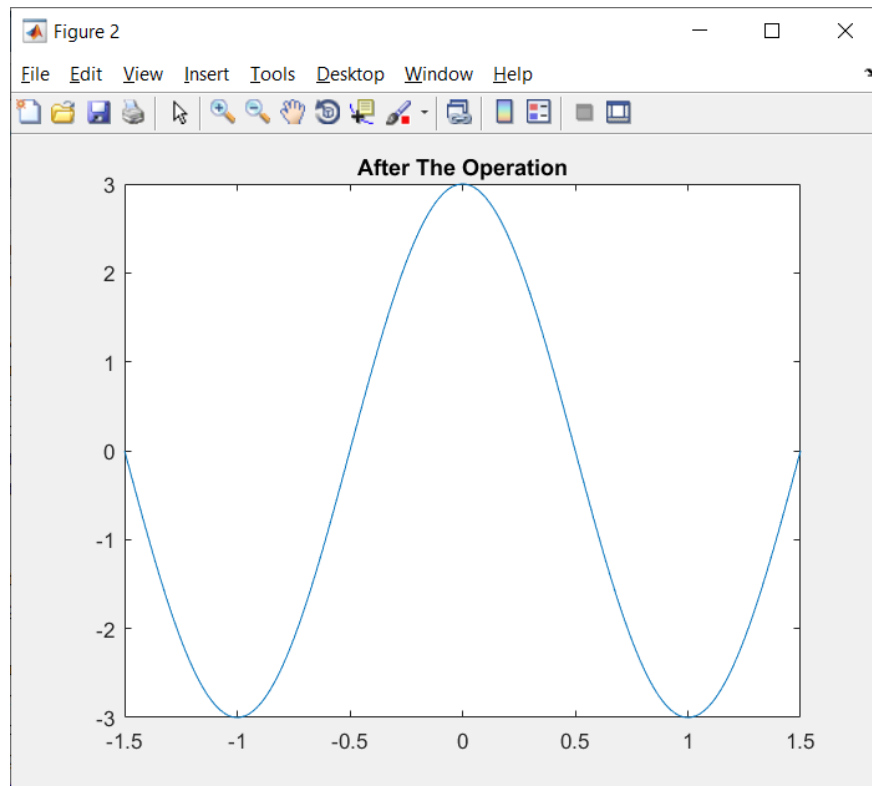
Amplitude: 3

Frequency: 0.25

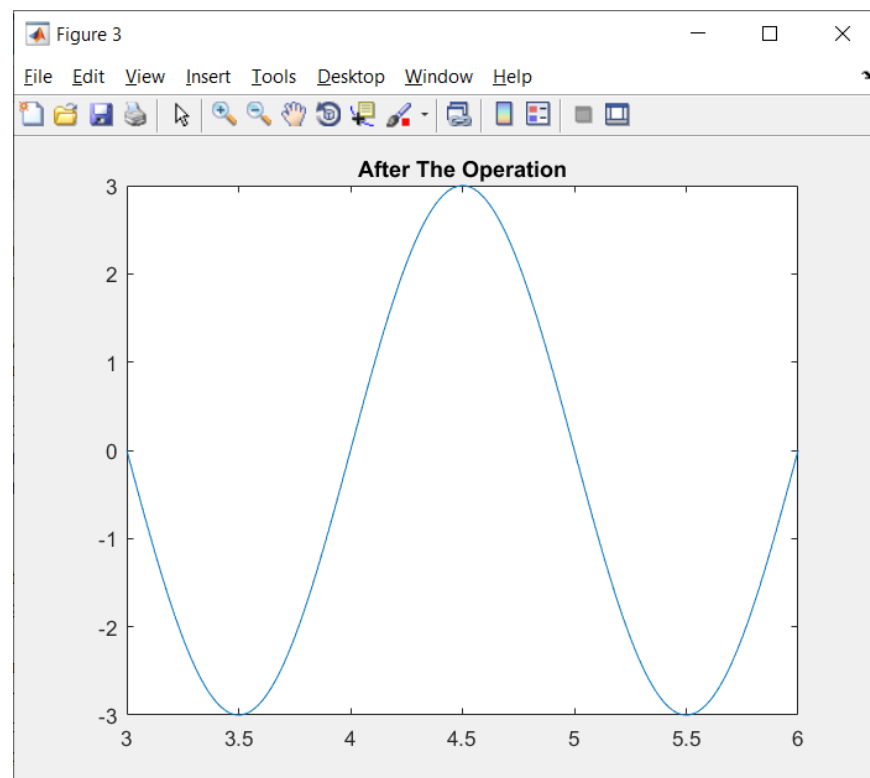
Phase: $\frac{\pi}{2}$



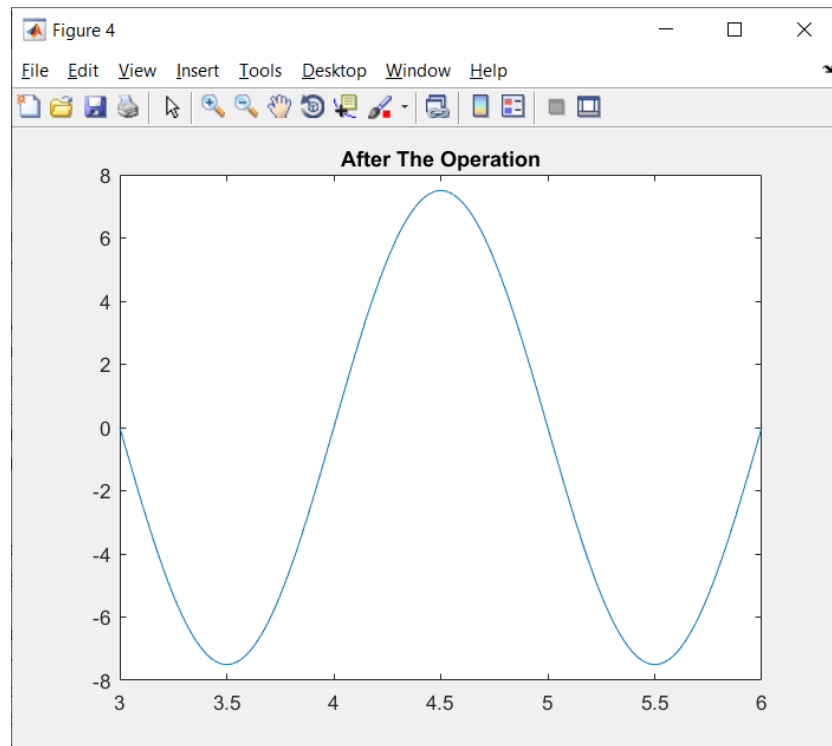
1st operation → Compressing the Signal with value of 2



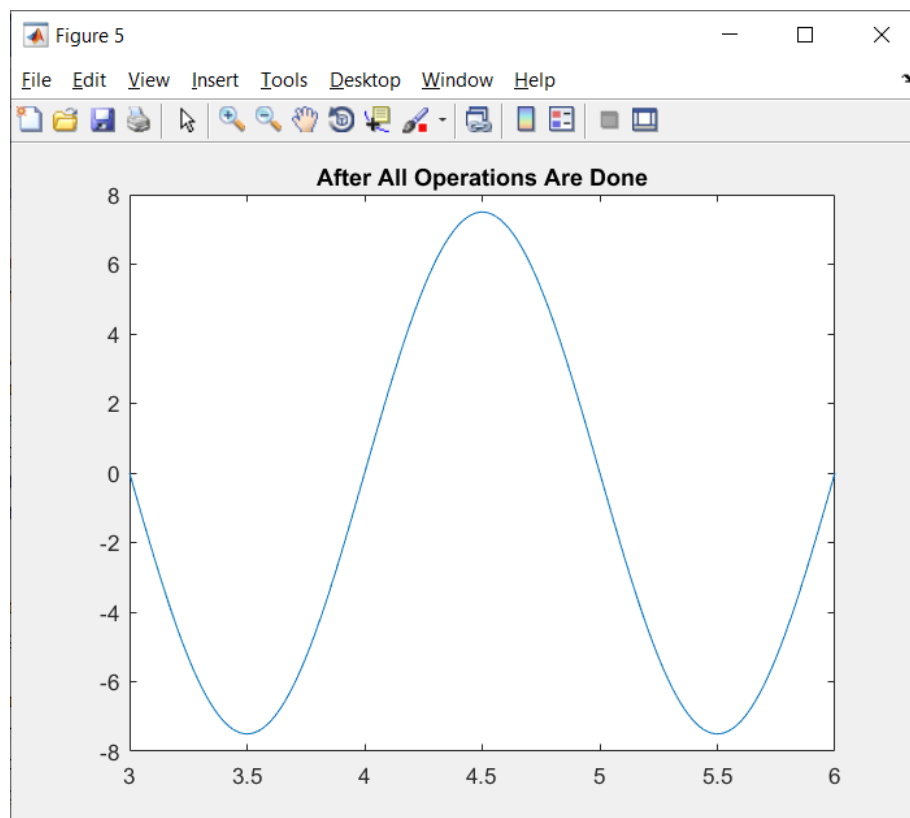
2nd operation → time shift with value of -4.5



3rd operation → Amplitude Scaling by 2.5



After pressing 6 "none"



6th Case:

Function: $y = 4 \cdot \cos(2 \cdot \pi \cdot 0.5 + \pi) \cdot (u(t+15) - u(t-15))$

Start Point: -15

End Point: 15

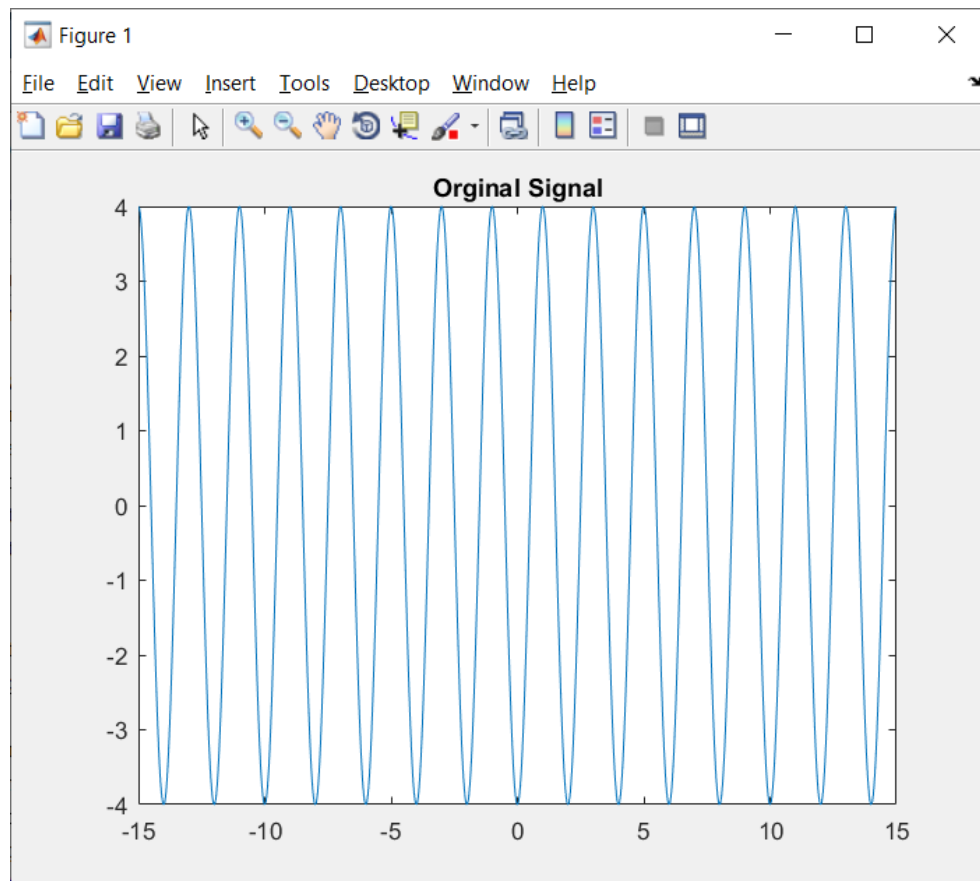
Number of break points: 0

From point -15 to 15 → Sinusoidal Signal (cosine)

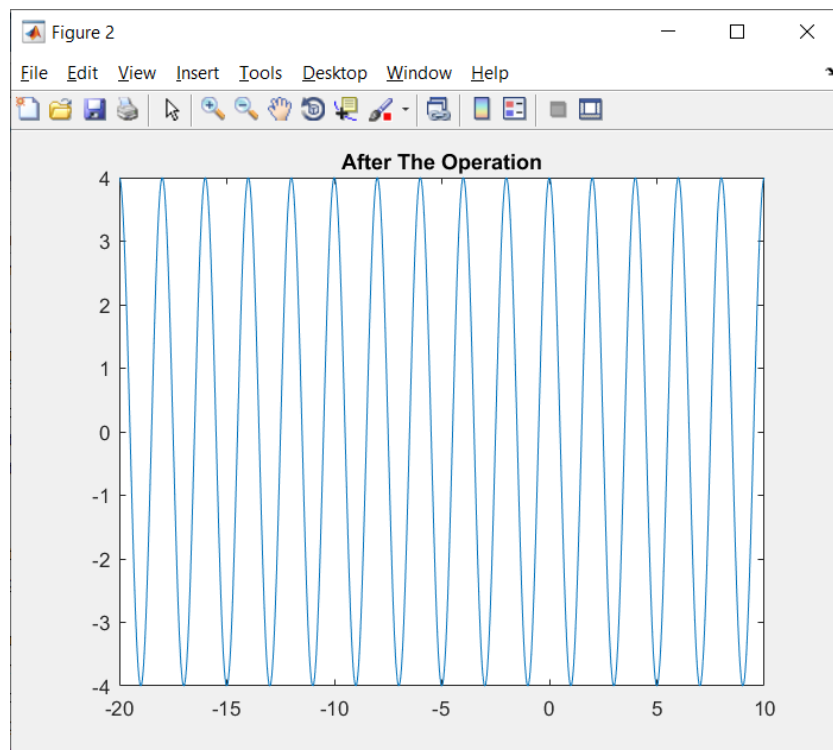
Amplitude: 4

Frequency: 0.5

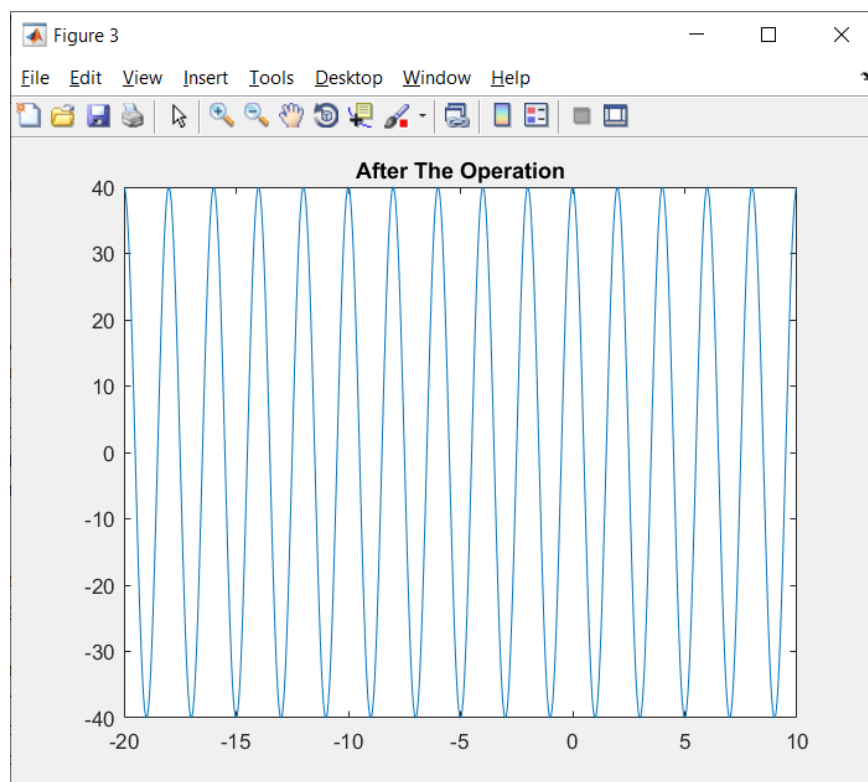
Phase: π



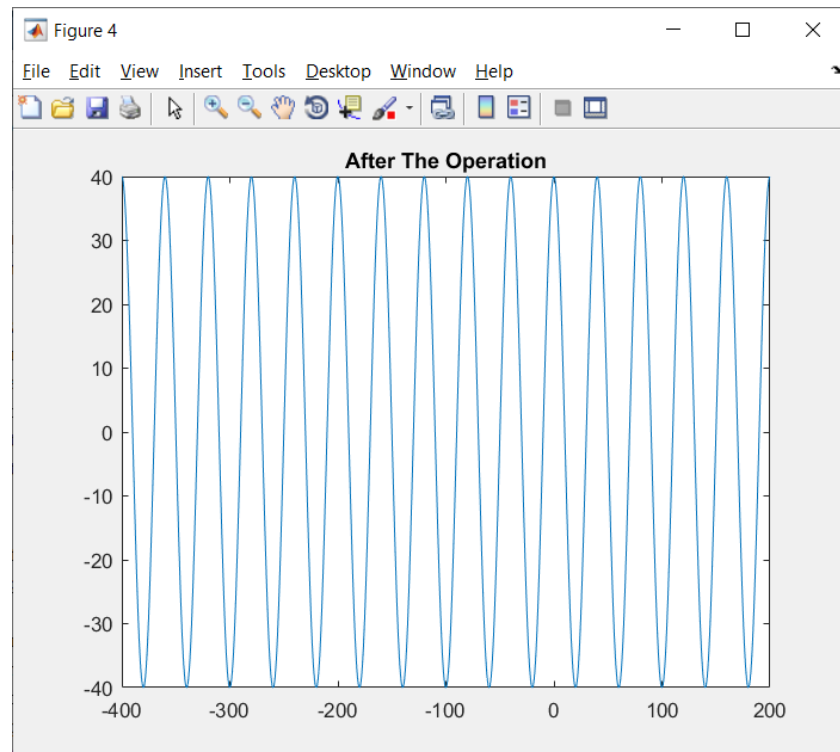
1st operation → Time Shift with value of 5



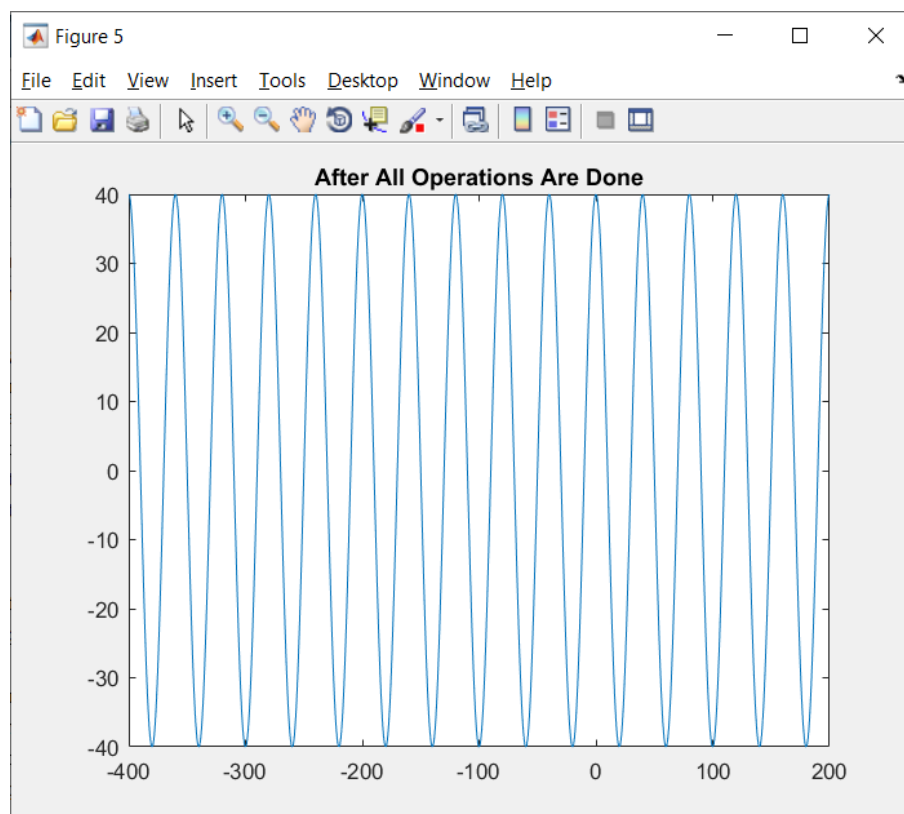
2nd operation → Amplitude Scaling with value of 10



3rd operation → Expanding the Signal with Value of 20



After pressing 6 "none"



7th Case:

Function: $y = (t+2)u(t+2) - 2(t)u(t) + (t-2)u(t-2)$

Start Point: -2

End Point: 2

Number of break points: 1

From point -2 to 0 → Ramp Signal

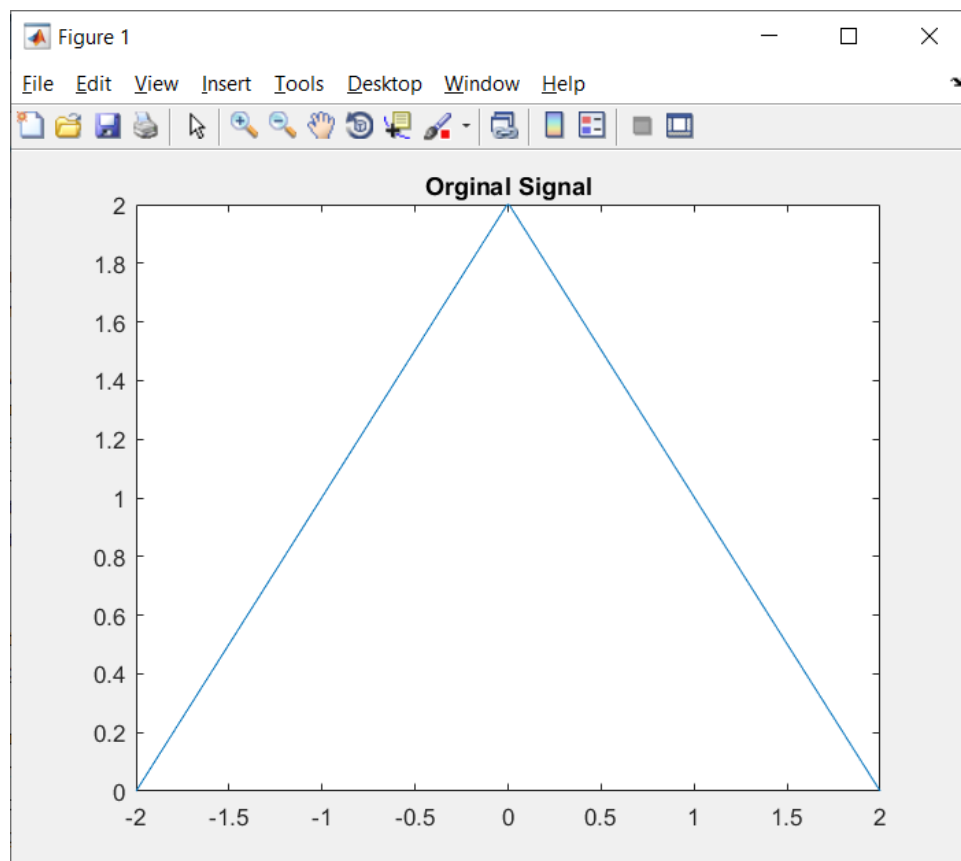
Slope: 1

Intercept: 2

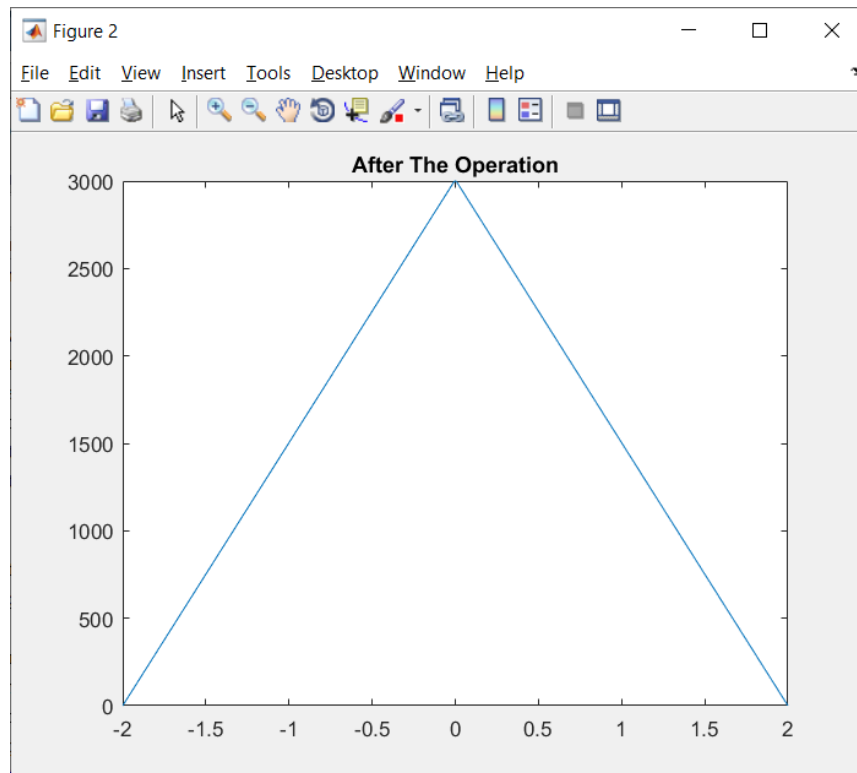
From point 0 to 2 → Ramp Signal

Slope: -1

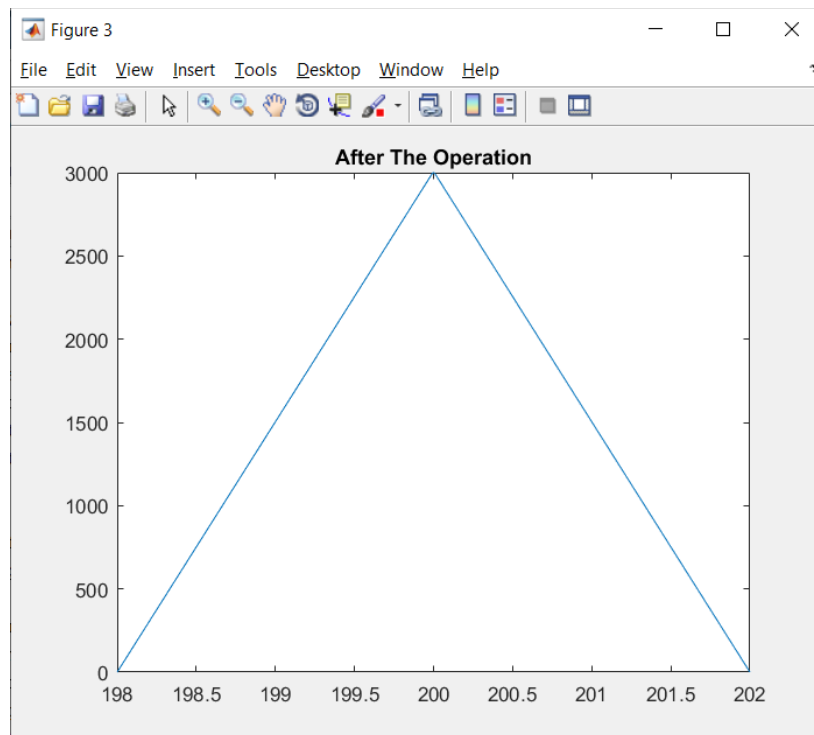
Intercept: 2



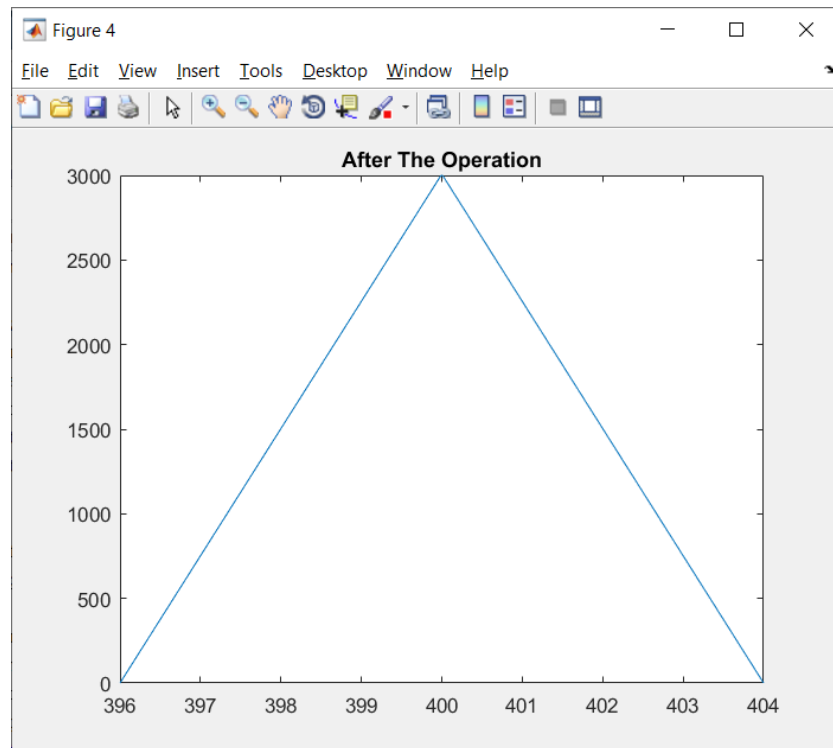
1st operation → Amplitude Scaling with a value of 1500



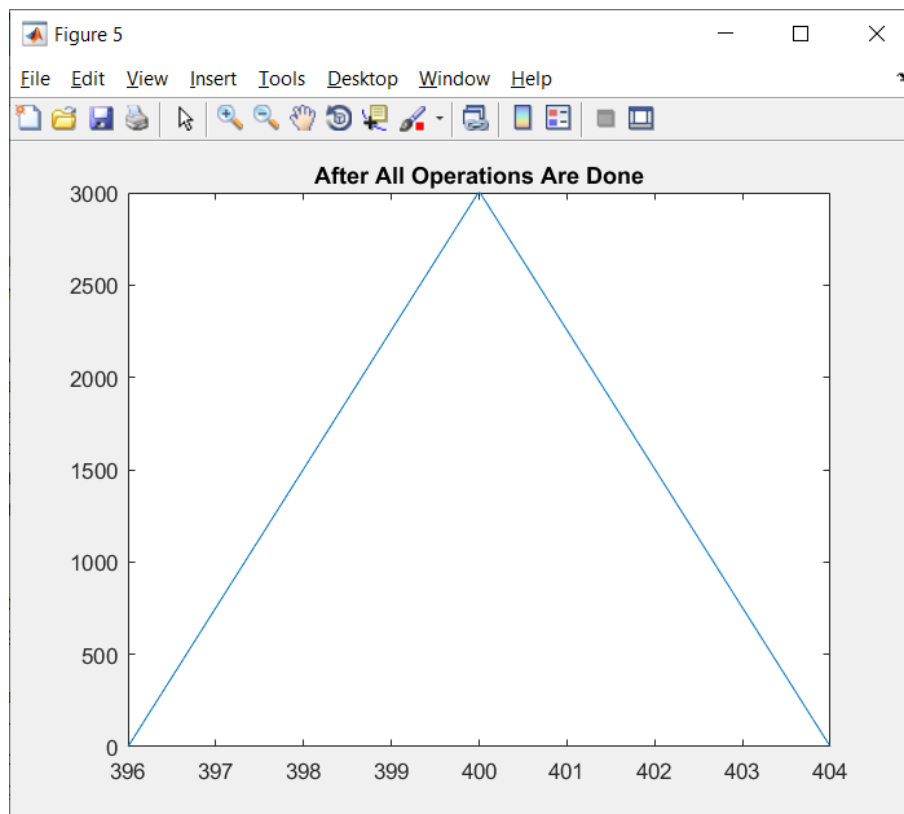
2nd operation → Time Shift with value of -200



3rd operation → Compressing the signal with value 0.5



After pressing 6 "none"



8th Case:

Function: $y = u(t) + r(t-1.5) - r(t-2.5) - 2u(t-5)$

Start Point: 0

End Point: 5

Number of break points: 2

From point 0 to 1.5 → Dc Signal

Amplitude: 1.5

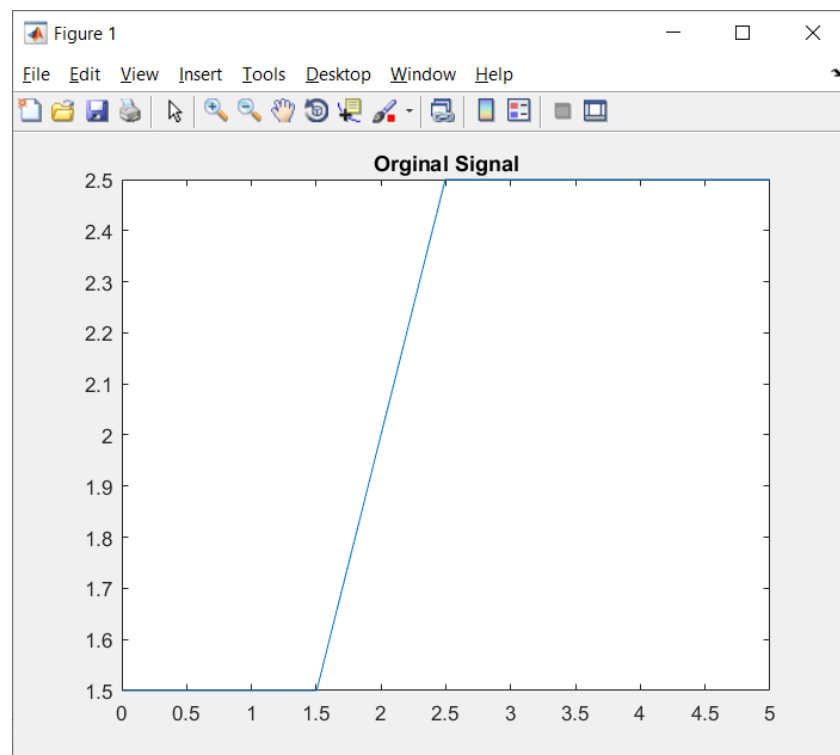
From point 1.5 to 2.5 → Ramp Signal

Slope: 1

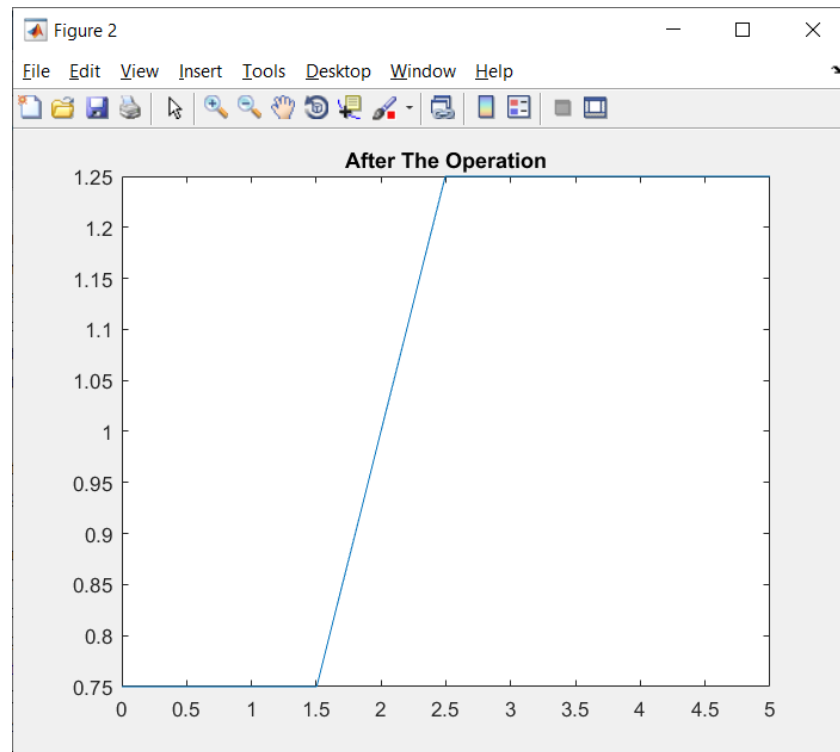
Intercept: 0

From point 2.5 to 5 → Dc Signal

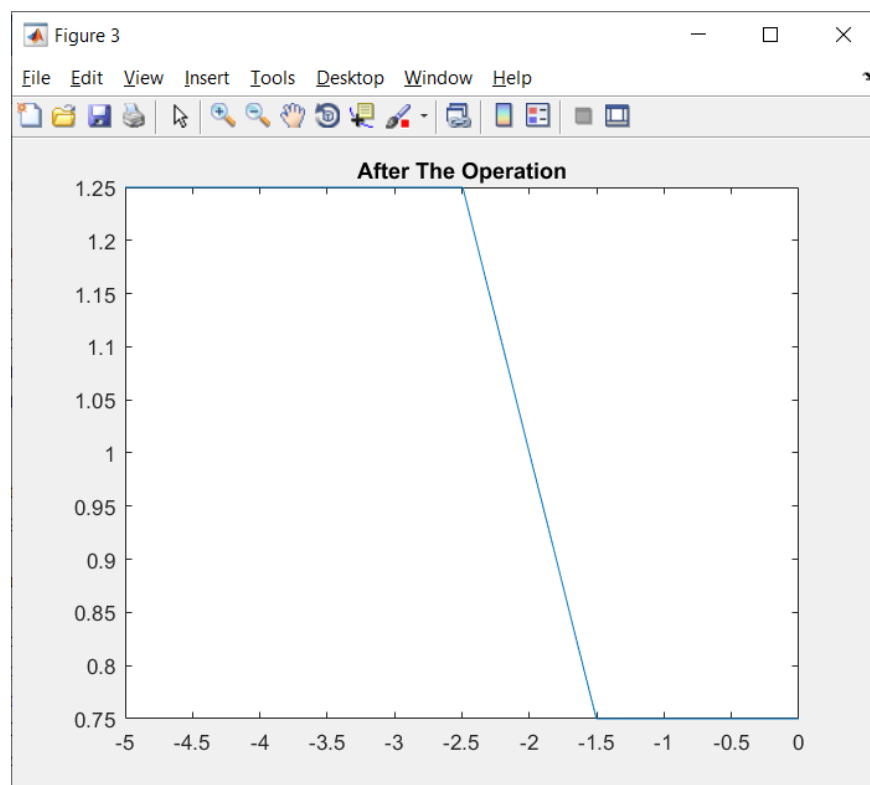
Amplitude: 2.5



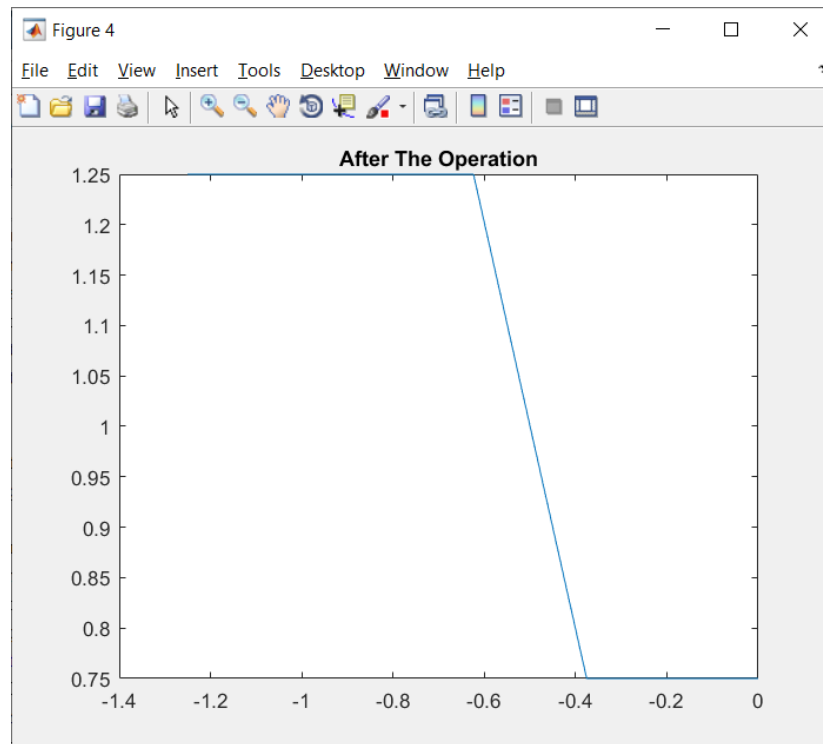
1st operation → Amplitude Scaling with a value of 0.5



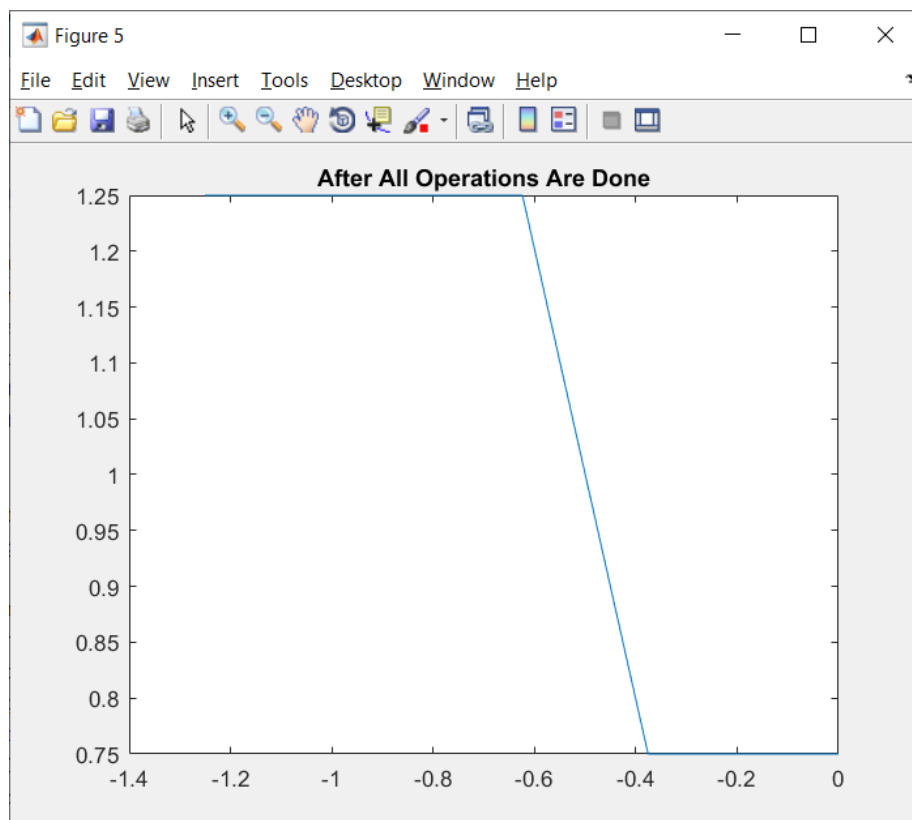
2nd operation → Time Reversal



3rd operation → Expanding the signal with value 0.25



After pressing 6 "none"



9th Case:

Function:

$$y = -(t+8)u(t+8)+5(t+6)-4(t+4)u(t+4)-6u(t+2)+(t^2+2)(u(t+2)-u(t))+2e^{-2t}(u(t)-2u(t-2))$$

Start Point: -8

End Point: 2

Number of break points: 4

From point -8 to -6 → Ramp Signal

Slope: -1

Intercept: -8

From point -6 to -4 → Ramp Signal

Slope: 4

Intercept: 22

From point -4 to -2 → Dc Signal

Amplitude: 6

From point -2 to 0 → General Order polynomial Signal

Order of the Signal: 2

Amplitude of power 2 (Coefficient): 1

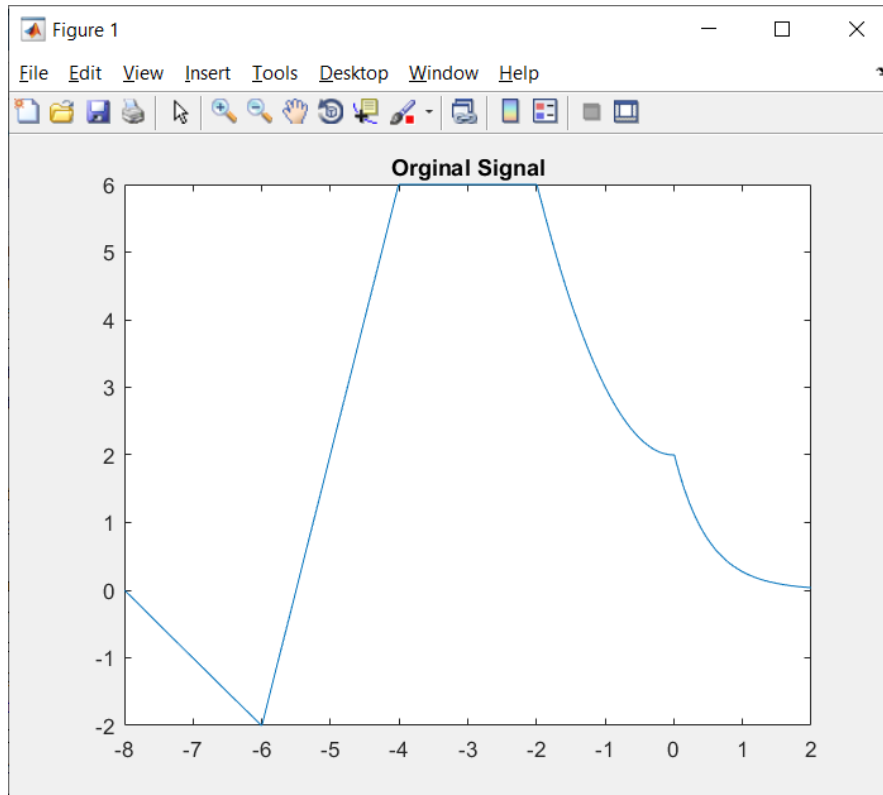
Amplitude of power 1 (Coefficient): 0

Amplitude of power 0 (intercept): 2

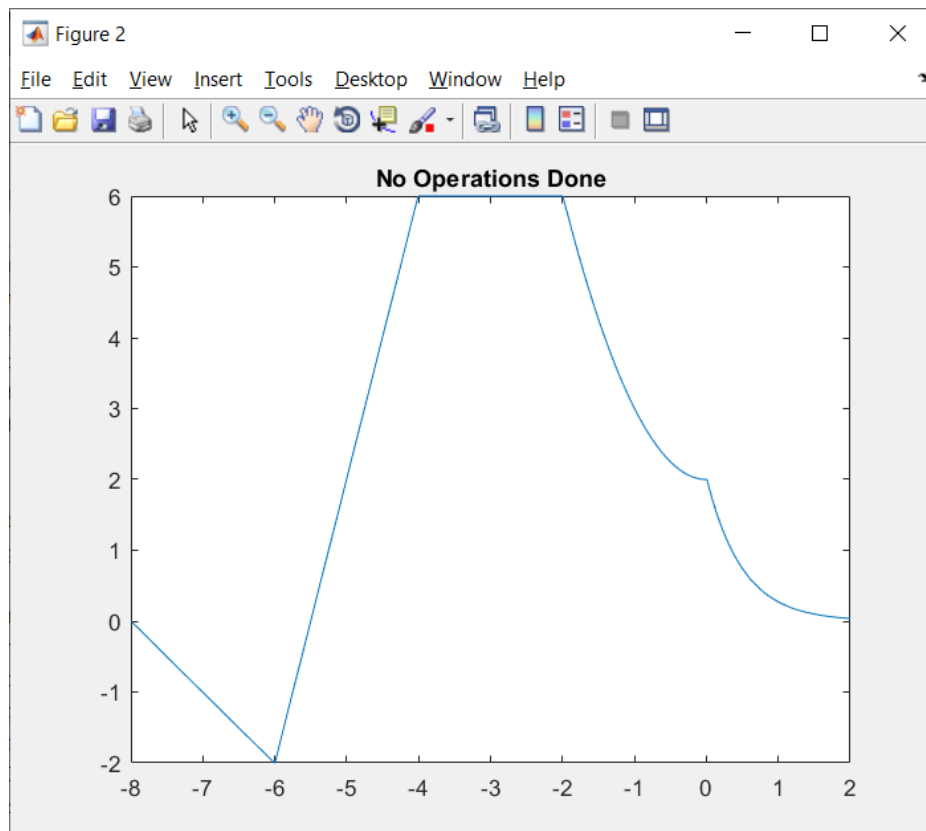
From point 0 to 2 → Exponential Signal

Amplitude: 2

Exponent: -2



No operations Done



10th Case:

Function:

$$y = (t+8)u(t+8)-(t+4)u(t+4)-4u(t+4) + 4\sin(2*\pi*0.25t+\frac{\pi}{2})(u(t+4)u(t+1)) + (2t^3+2t^2+t+1)(u(t+1)-u(t))+2(2(-t)^3+2(-t)^2+(-t)+1)(u(t)-u(t-1))+54.6e^{-2t}(u(t-2)-u(t-2.8)) + (t-1)u(t-1)-(t-2)u(t-2)-u(t-2)+0.2u(t-2.8)-0.2u(t-4)$$

Start Point: -8

End Point: 4

Number of break points: 5

From point -8 to -4 → Ramp Signal

Slope: 1

Intercept: 8

From point -4 to -1 → Sinusoidal Signal (sine)

Amplitude: 4

Frequency: 0.25

Phase: $\frac{\pi}{2}$

From point -1 to 0 → General Order polynomial Signal

Order of the Signal: 3

Amplitude of power 3 (Coefficient): 2

Amplitude of power 2 (Coefficient): 2

Amplitude of power 1 (Coefficient): 1

Amplitude of power 0 (intercept): 1

From point 0 to 1 → General Order polynomial Signal

Order of the Signal: 3

Amplitude of power 3 (Coefficient): -2

Amplitude of power 2 (Coefficient): 2

Amplitude of power 1 (Coefficient): -1

Amplitude of power 0 (intercept): 1

From point 1 to 2 → Ramp Signal

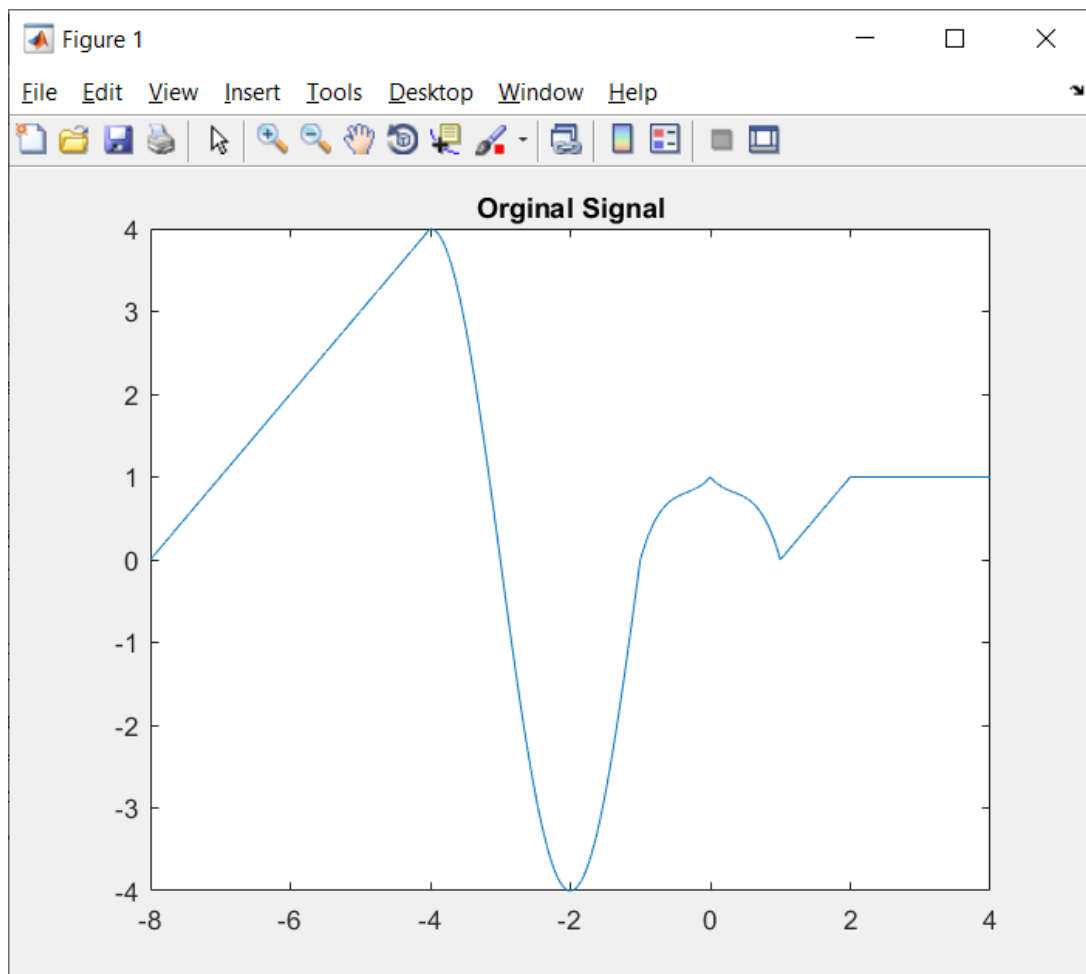
Slope: 1

Intercept: -1

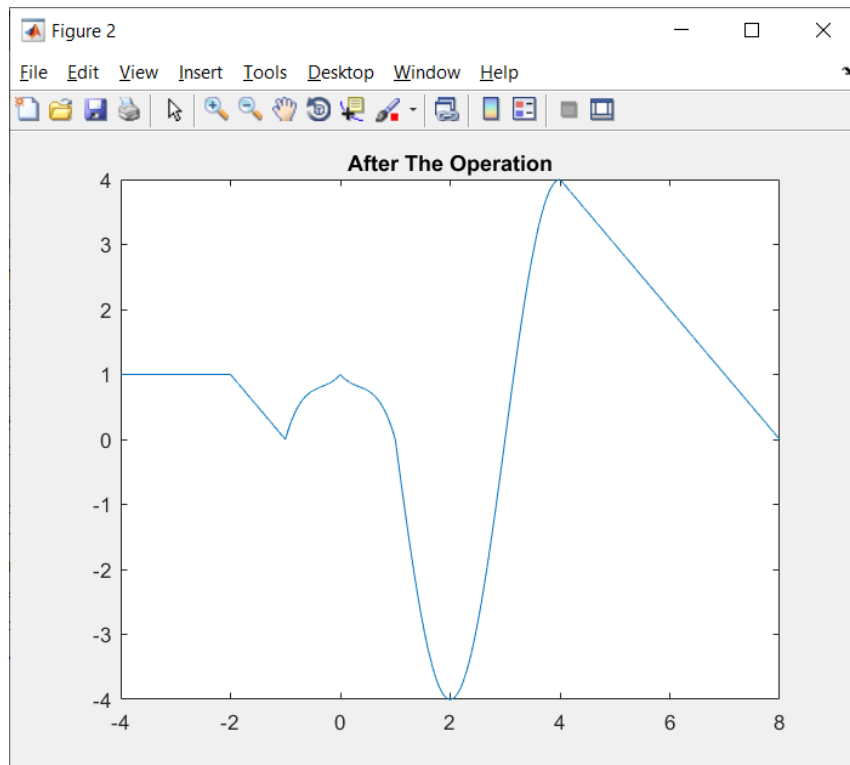
From point 2 to 4 → Exponential Signal

Amplitude: 54.6

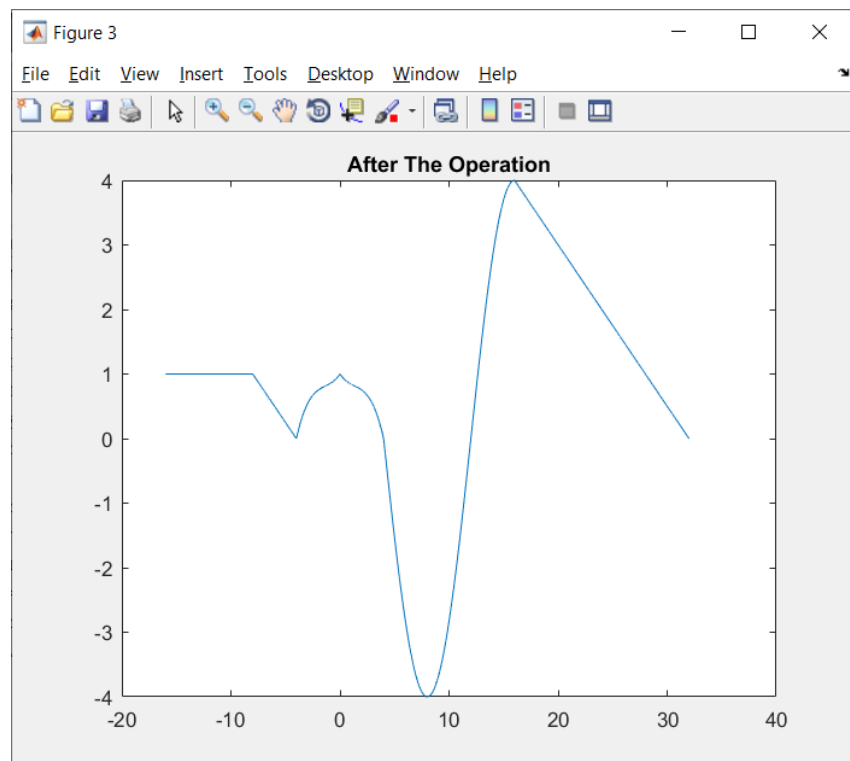
Exponent: -2



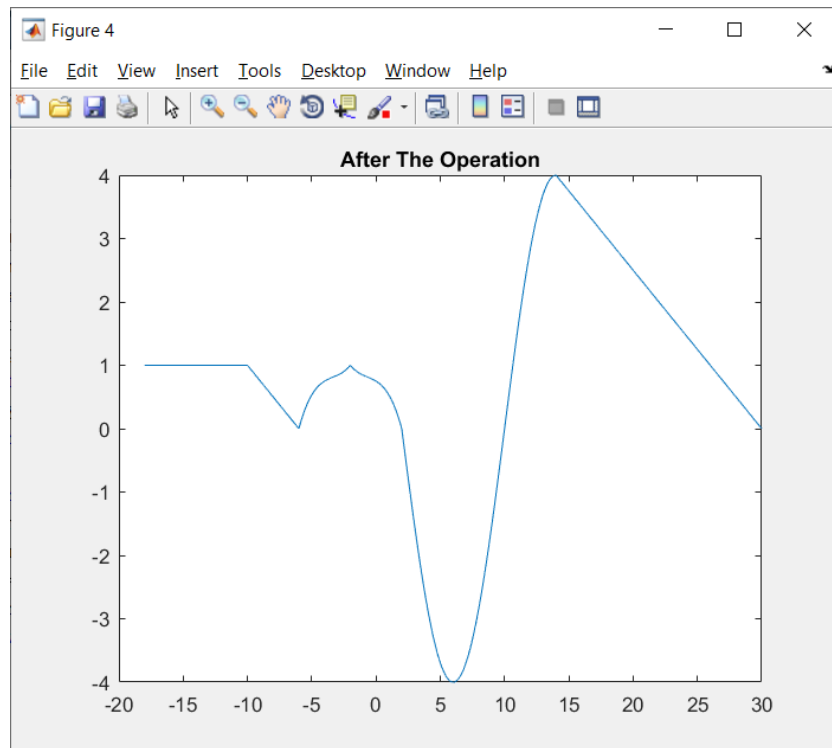
1st operation → Time Reversal



2nd operation → Expanding Scaling with a value of 4



3rd operation → Time shift with a value of 2



After pressing 6 "none"

