Table of Contents

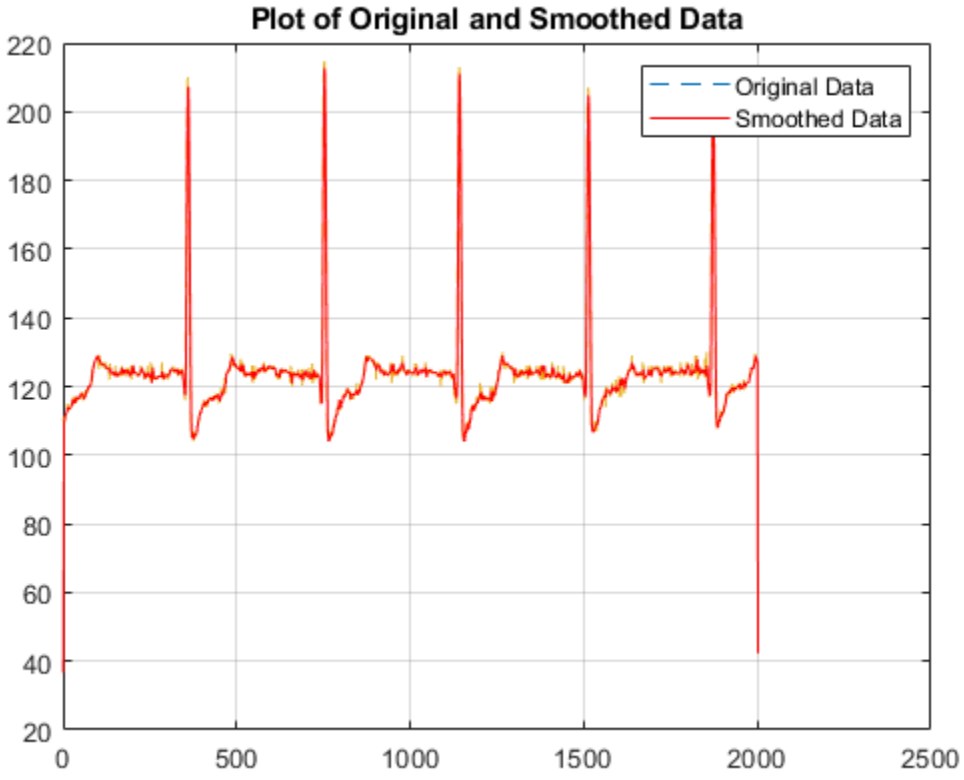
Problem 1

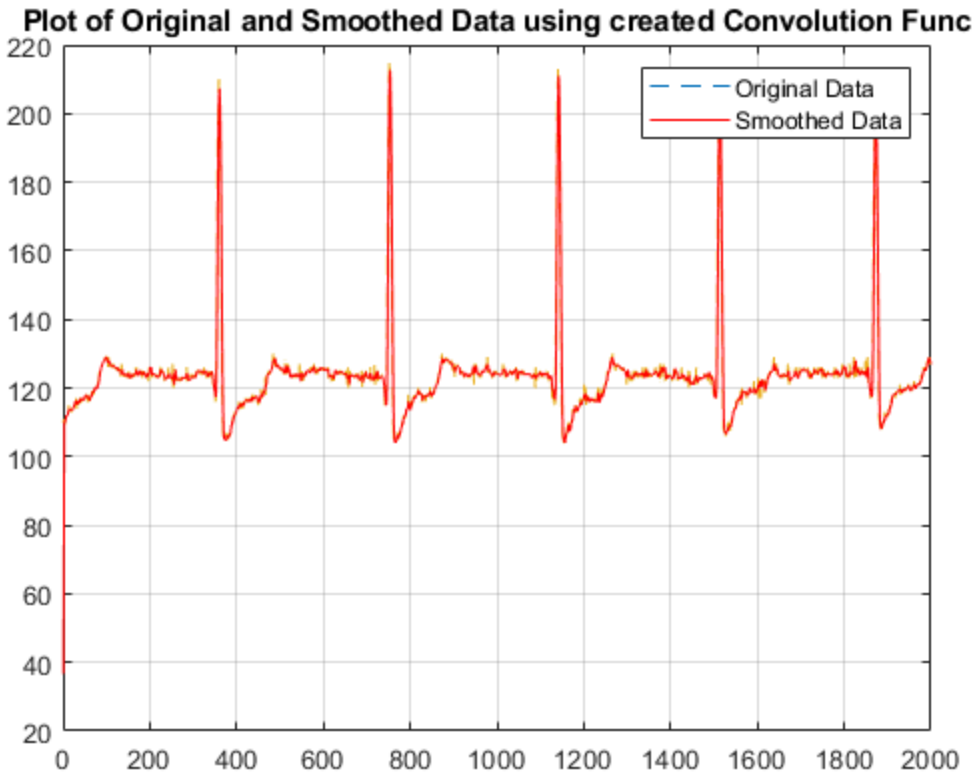
```
%a
load SAMPLE_ECG.mat
x = ECG_Data;   %save data
a = 1;
b = [1/3 1/3 1/3];  %num coeff
y = filter(b,a,x);
figure(1)
t = 1:length(x);
plot(t,x,'--'), hold on, plot(t,y,'r-'), grid on    %hold on used to overlay
 plots
legend('Original Data', 'Filtered Data')
title('Plot of Original and Filtered Data')

%b
h = [1/3 1/3 1/3];
y1 = conv(x,h);
t1 = 1:length(y1);
figure(2)
plot(t,x,'--'), hold on, plot(t1,y1,'r-'), grid on
legend('Original Data', 'Smoothed Data')
title('Plot of Original and Smoothed Data')

%c (write convolution function)
%matlab index start from 1, modify summation, k becomes k+1
[y2,n] = convolution(x,h);
t = 1:length(x);
t1 = 1:length(y);
figure(3)
plot(t,x,'--'), hold on, plot(t1,y2(1:length(x)),'r-'), grid on
legend('Original Data', 'Smoothed Data')
title('Plot of Original and Smoothed Data using created Convolution Func')
```


Plot of Original and Filtered Data
Original Data
Filtered Data
220
200
180
160
140
120
100
80
60
40
20
0
200
400
600
800
1000
1200
1400
1600
1800
2000


Plot of Original and Smoothed Data
Original Data
Smoothed Data
220
200
180
160
140
120
100
80
60
40
20
0
500
1000
1500
2000
2500

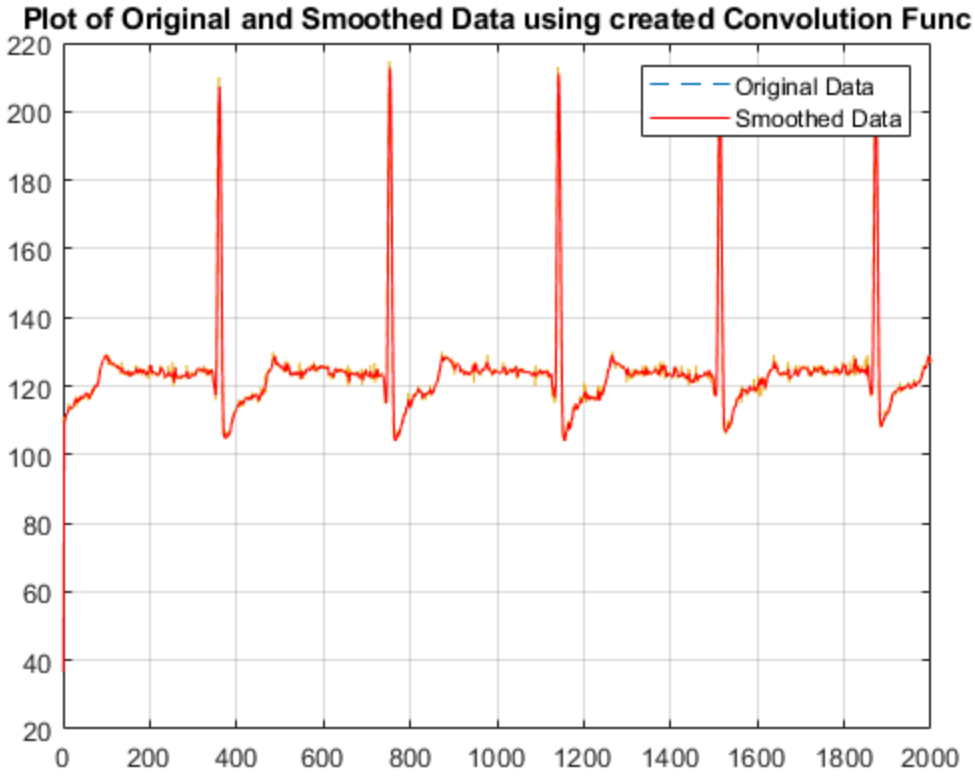


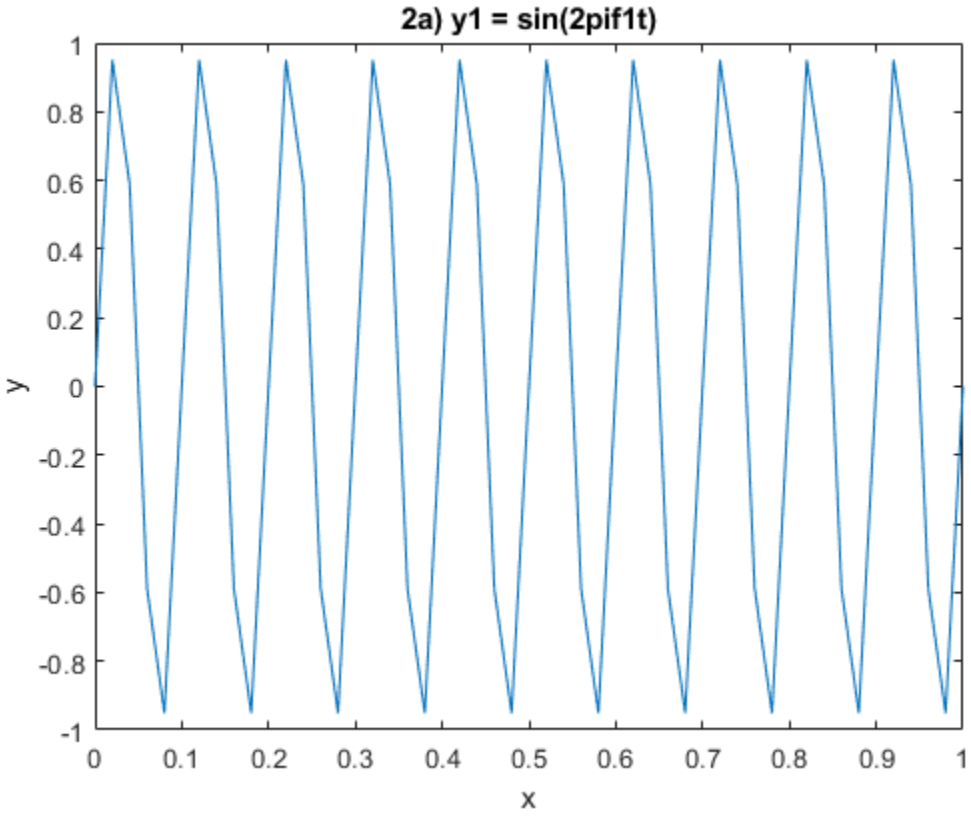
Problem 2

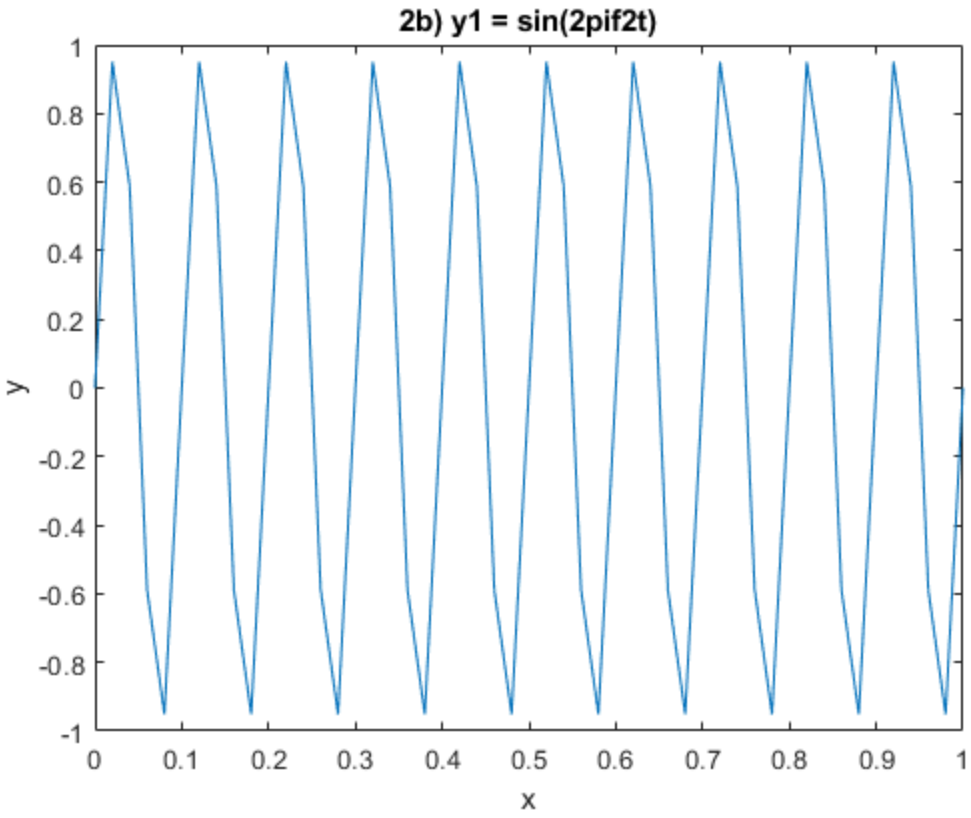
```
Fs = 50;
Ts = 1/Fs;
F1 = 10;
F2 = 60;
t = 0:Ts:1;
y1 = sin(2*pi*F1*t);     %a
y2 = sin(2*pi*F2*t);     %b

figure(4)
plot(t,y1),xlabel('x'), ylabel('y'),title('2a) y1 = sin(2pif1t)')
figure(5)
plot(t,y2),xlabel('x'),ylabel('y'),title('2b) y1 = sin(2pif2t)')

% No I can't differentiate between the two plots because there is not a
% huge difference between F1 and F2 and because those sampling frequency
% are close together
```


Plot of Original and Smoothed Data using created Convolution Func
Original Data
Smoothed Data
220
200
180
160
140
120
100
80
60
40
20
0
200
400
600
800
1000
1200
1400
1600
1800
2000


2a) y1 = sin(2pif1t)
y
x
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1



Problem 3

```
Fs = 50000;  %50 kHz
Ts = 1/Fs;
t = 0:Ts:0.01;
```

3a plot

```
figure(6)
f1 = 2000;
y1 = sin(2*pi*f1*t);    %a
plot(t,y1),xlabel('x'), ylabel('y'),title('y1 = sin(2pif1t)')
sound(y1,Fs);
```

3b plot

```
figure(7)
f2 = 6000;
y2 = sin(2*pi*f2*t);    %b
plot(t,y2),xlabel('x'), ylabel('y'),title('y2 = sin(2pif1t)')
sound(y2,Fs);
```

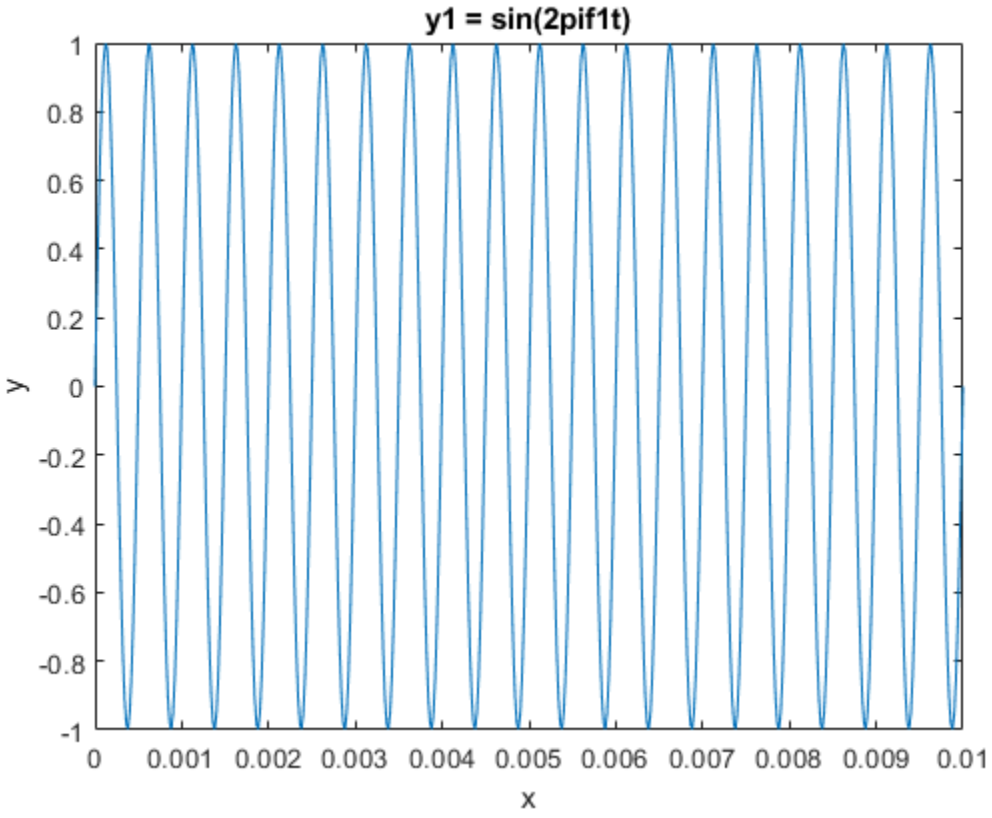
3c plot

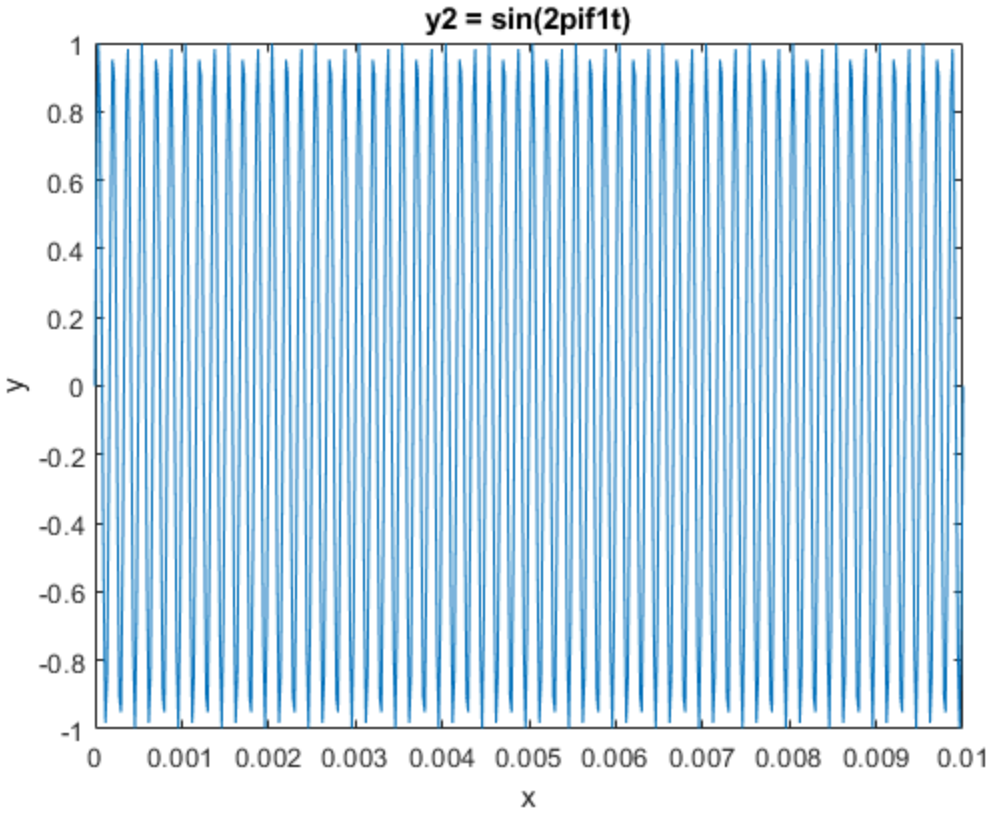
```
figure(8)
f3 = 25000;
y3 = sin(2*pi*f3*t);    %c
plot(t,y3),xlabel('x'), ylabel('y'),title('y3 = sin(2pif1t)')
sound(y3,Fs);
```

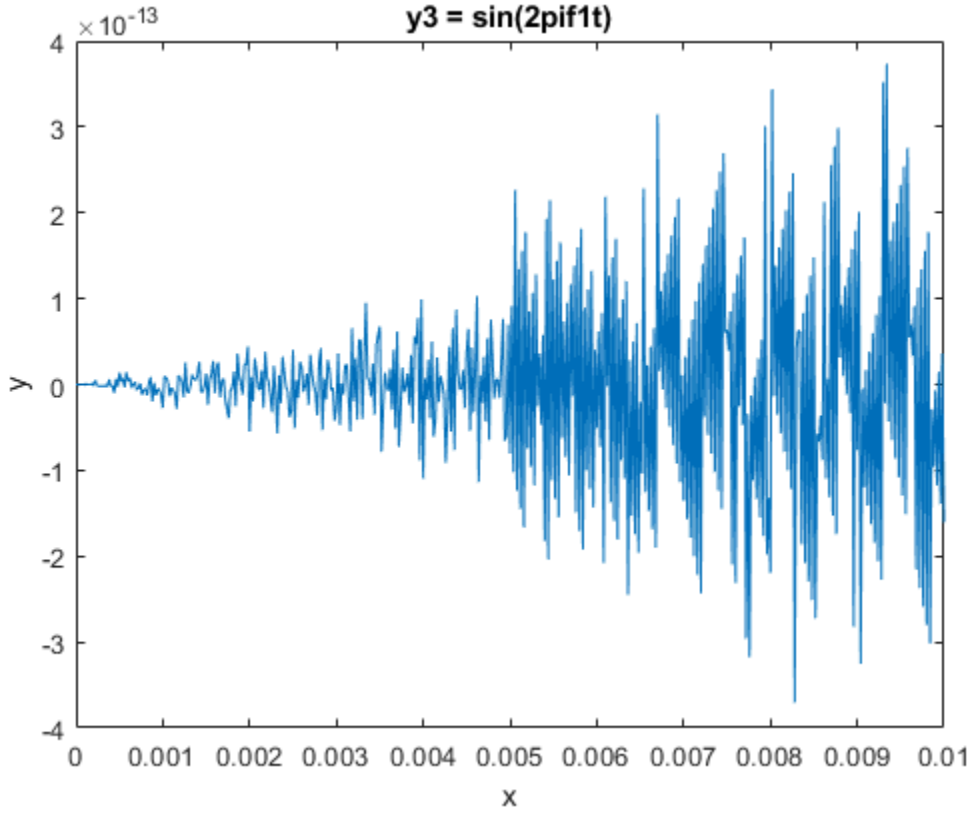
Plot of all 3

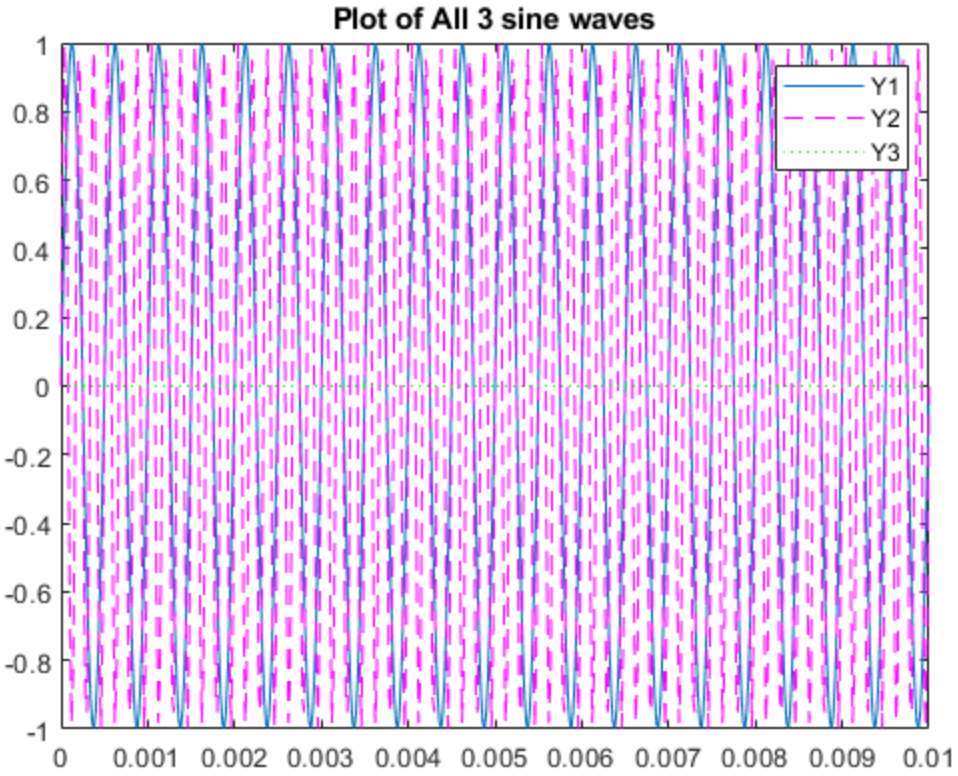
```
figure(9)
plot(t,y1), hold on, plot(t,y2,'m--'), hold on, plot(t,y3,'g:')
legend('Y1', 'Y2','Y3')
title('Plot of All 3 sine waves')

% A) is a quick low freq pop
% B) higher freq clink (sounds more like a coin dropping)
% C) you can't hear anything because the frequency is so high
```




y2 = sin(2pif1t)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
y
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009
0.01
x


y3 = sin(2pif1t)
×10^-13
4
3
2
1
0
-1
-2
-3
-4
y
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009
0.01
x



Unit Step Function

```
function [y,n] = convolution(x,h)
% convolution
%  Use 2 for loop and if
% for m = 1:M+N-1
%   y(n) = 0;
%   for k = 1:M
%       if(n-k+1 > 0 && n-k+1 <= N)
%           y(n) = y(n) + x(k)*h(n-k+1);
N = length(h);
M = length(x);
y = zeros(1, M + N -1);
for n = 1:(M+N-1)
    y(n) = 0;
    for k = 1:M
        if(n-k+1) > 0 && (n-k+1) <=N
            y(n) = y(n) + x(k) * h(n-k+1);
        end
    end
end
```

Published with MATLAB® R2022b