Table of Contents

Eric Jiang - 158002948

LSS Lab 6 - Summer C2 6/23/2017

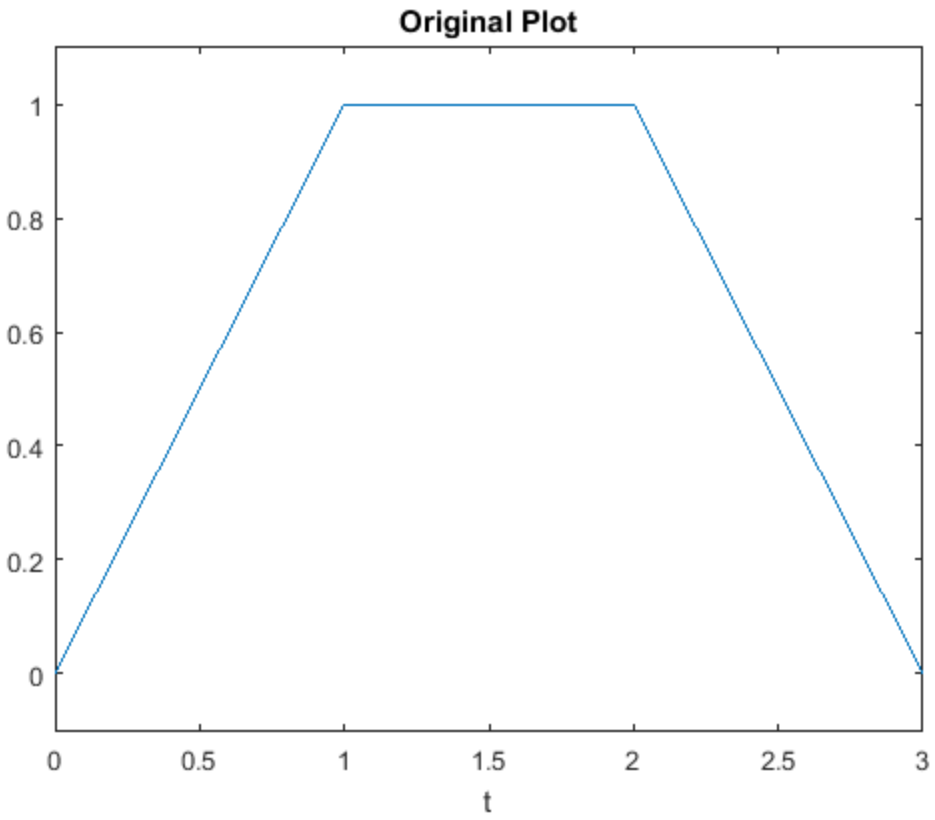
```
close all; clc; clear;
```

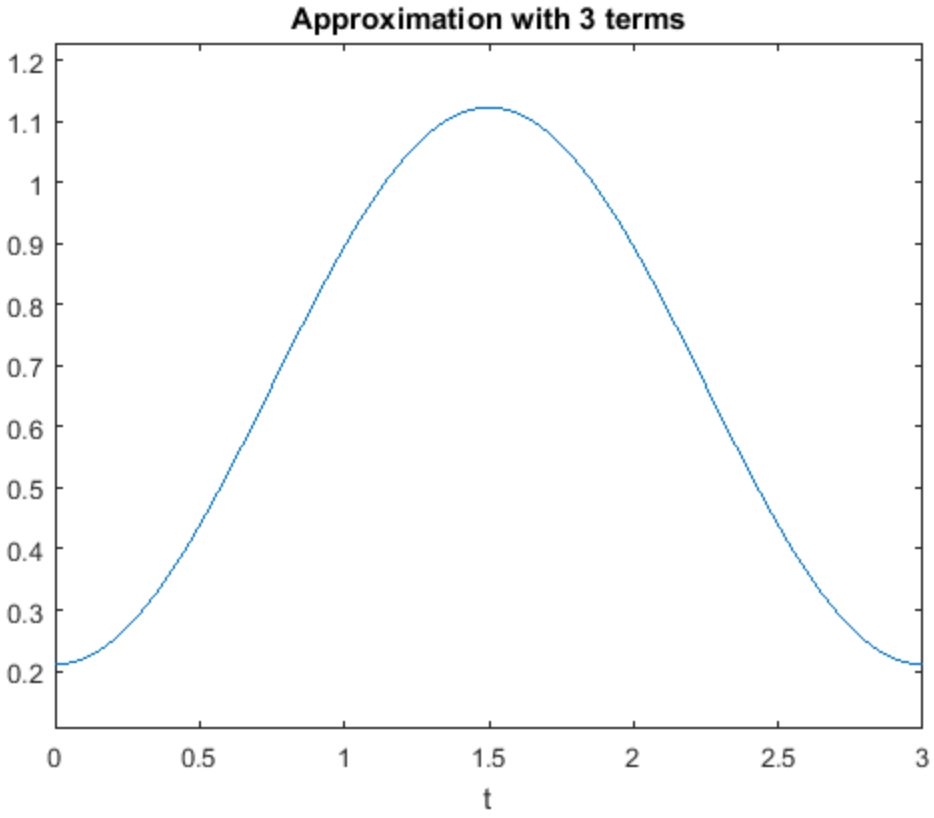
Problem 1

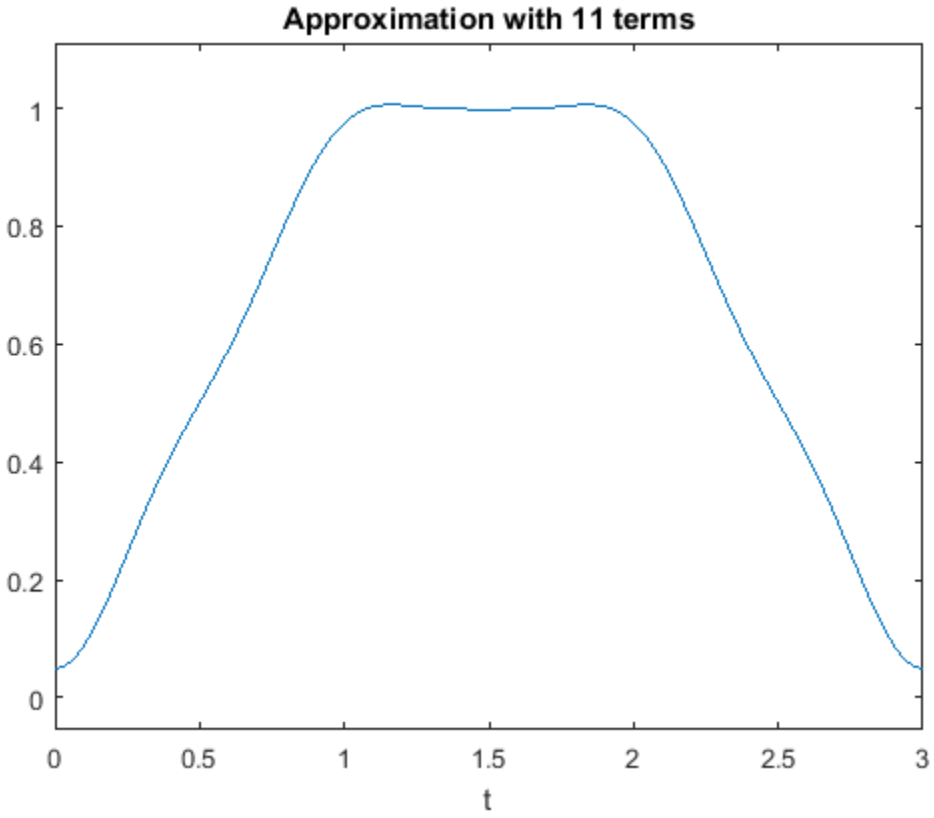
```
syms t
x = t.*(heaviside(t)-heaviside(t-1))+(heaviside(t-1)-
heaviside(t-2))+(3-t).*(heaviside(t-2)-heaviside(t-3));

t0 = 0;
T = 3;
w = 2*pi/T;
figure;
ezplot(x,[t0 t0+T])
title('Original Plot')

% 1.1 Complex Exponential Fourier
% 3 terms
for k = -1:1
    a(k+2)=(1/T)*int(x*exp(-j*k*w*t),t,t0,t0+T);
end

for k=-1:1
    ex(k+2)=exp(j*k*w*t);
end

xx=sum(a.*ex);
figure;
ezplot(xx, [t0 t0+T]);
title('Approximation with 3 terms')

% 11 terms
clear a ex;
for k = -5:5
    a(k+6)=(1/T)*int(x*exp(-j*k*w*t),t,t0,t0+T);
    ex(k+6)=exp(j*k*w*t);
end

xx=sum(a.*ex);
```

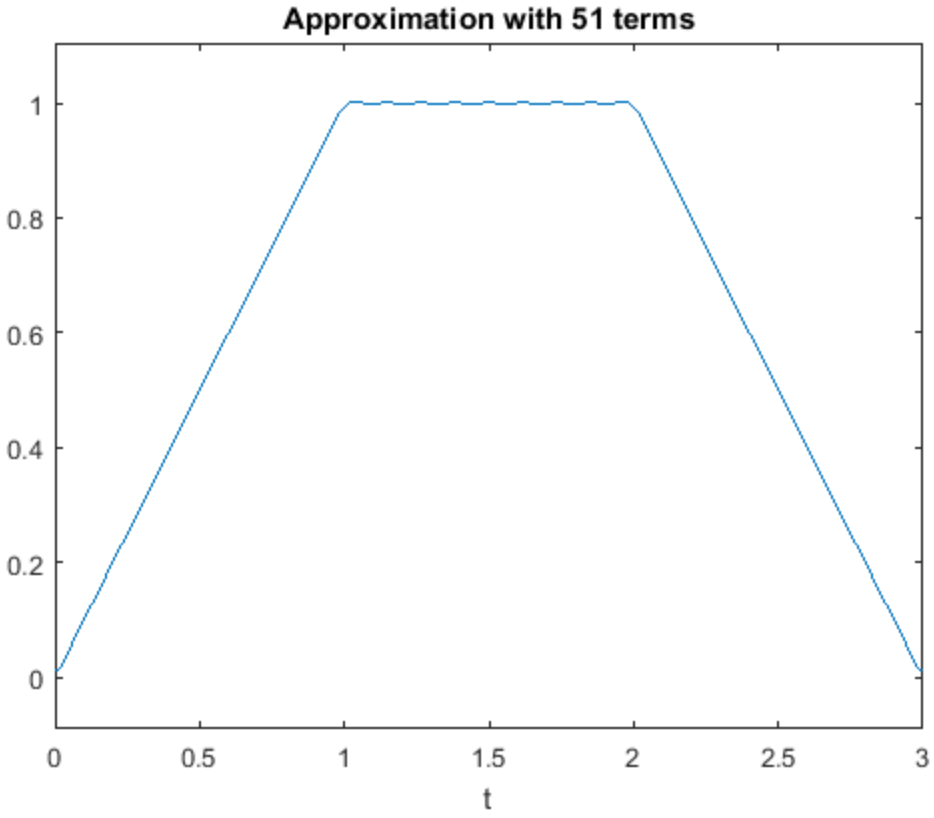
```
figure;
ezplot(xx, [t0 t0+T]);
title('Approximation with 11 terms')

% 51 terms
clear a ex;
for k =-25:25
    a(k+26)=(1/T)*int(x*exp(-j*k*w*t),t,t0,t0+T);
    ex(k+26)=exp(j*k*w*t);
end

xx=sum(a.*ex);
figure;
ezplot(xx, [t0 t0+T]);
title('Approximation with 51 terms')

% 1.2 - Trigonometric Fourier Series
% 3 terms
a0=(1/T)*int(x,t,t0,t0+T);

for n=1:2
    b(n)=(2/T)*int(x*cos(n*w*t),t,t0,t0+T);
end

for n=1:2
    c(n)=(2/T)*int(x*sin(n*w*t),t,t0,t0+T);
end

k=1:2;
xx=a0+sum(b.*cos(k*w*t))+sum(c.*sin(k*w*t));
figure;
ezplot(xx, [t0 t0+T]);
title('Approximation with 3 terms')

% 11 terms
clear b c;

for n=1:10
    b(n)=(2/T)*int(x*cos(n*w*t),t,t0,t0+T);
    c(n)=(2/T)*int(x*sin(n*w*t),t,t0,t0+T);
end

k=1:10;
xx=a0+sum(b.*cos(k*w*t))+sum(c.*sin(k*w*t));
figure;
ezplot(xx, [t0 t0+T]);
title('Approximation with 11 terms')

% 51 terms
clear b c;

for n=1:50
    b(n)=(2/T)*int(x*cos(n*w*t),t,t0,t0+T);
    c(n)=(2/T)*int(x*sin(n*w*t),t,t0,t0+T);
```

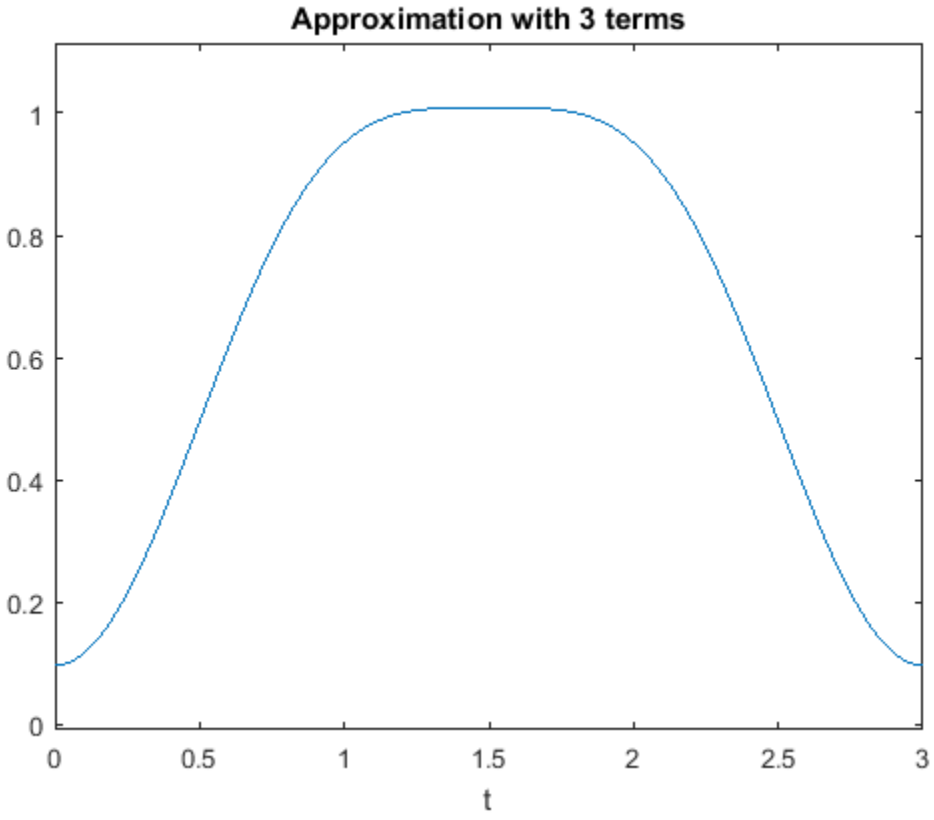
```
end

k=1:50;
xx=a0+sum(b.*cos(k*w*t))+sum(c.*sin(k*w*t));
figure;
ezplot(xx, [t0 t0+T]);
title('Approximation with 51 terms')
```

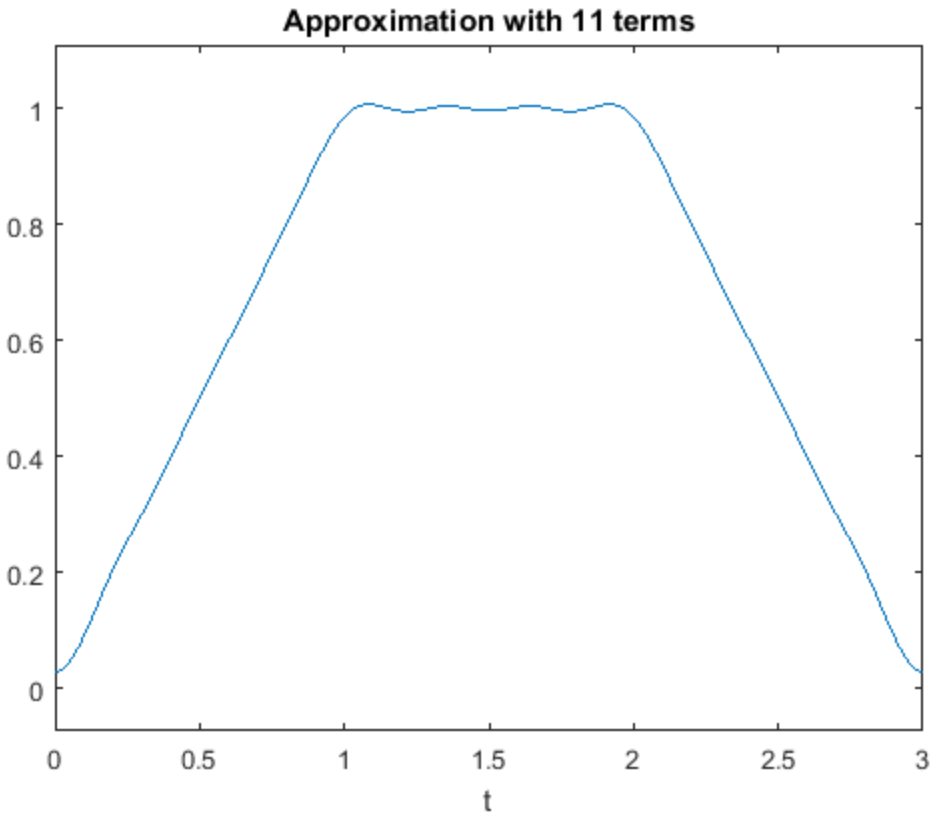


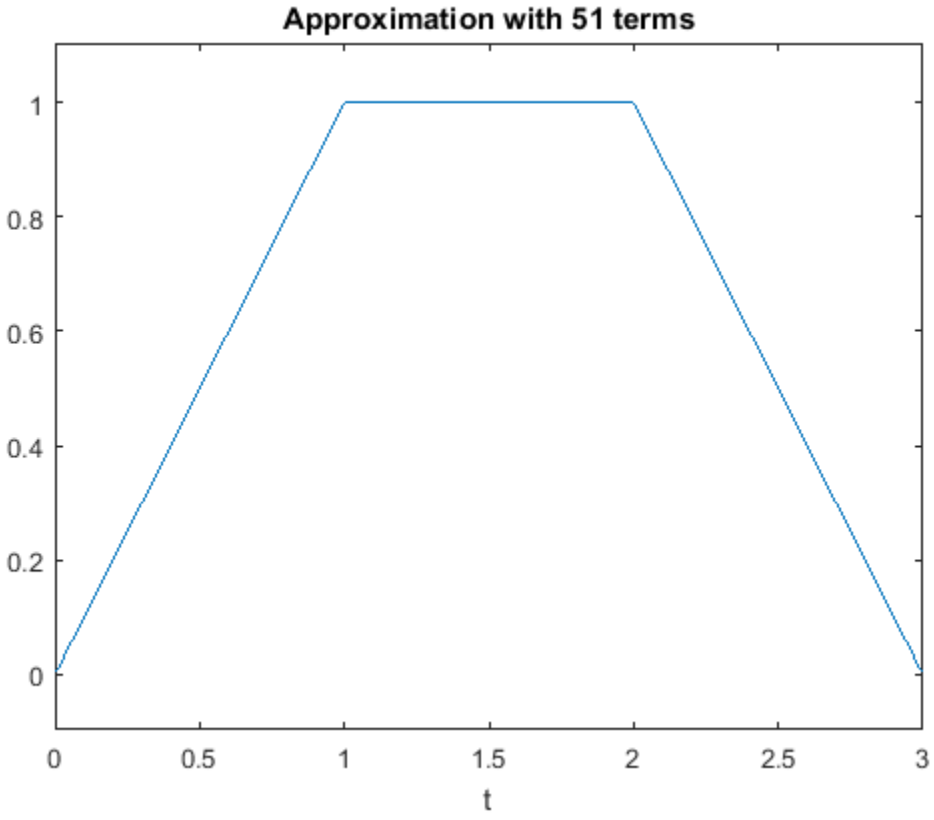

Approximation with 3 terms
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
0.5
1
1.5
2
2.5
3
t


Approximation with 11 terms
1
0.8
0.6
0.4
0.2
0
0
0.5
1
1.5
2
2.5
3
t


Approximation with 51 terms
1
0.8
0.6
0.4
0.2
0
0
0.5
1
1.5
2
2.5
3
t


Approximation with 3 terms
1
0.8
0.6
0.4
0.2
0
0
0.5
1
1.5
2
2.5
3
t

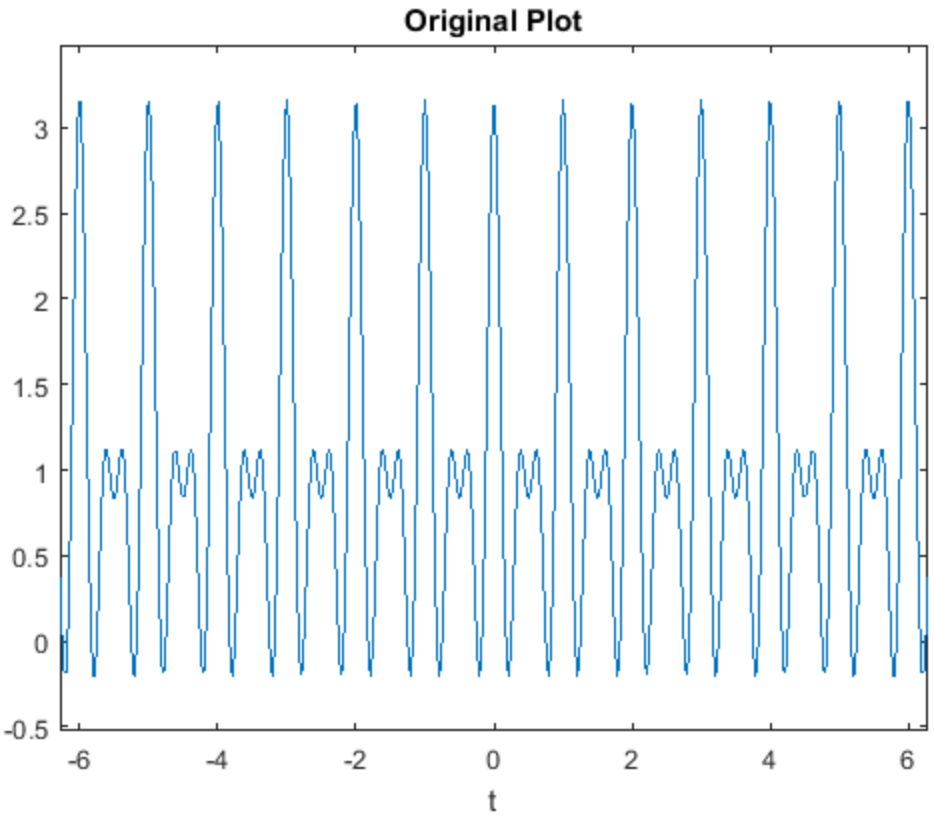

Approximation with 11 terms
1
0.8
0.6
0.4
0.2
0
0
0.5
1
1.5
2
2.5
3
t

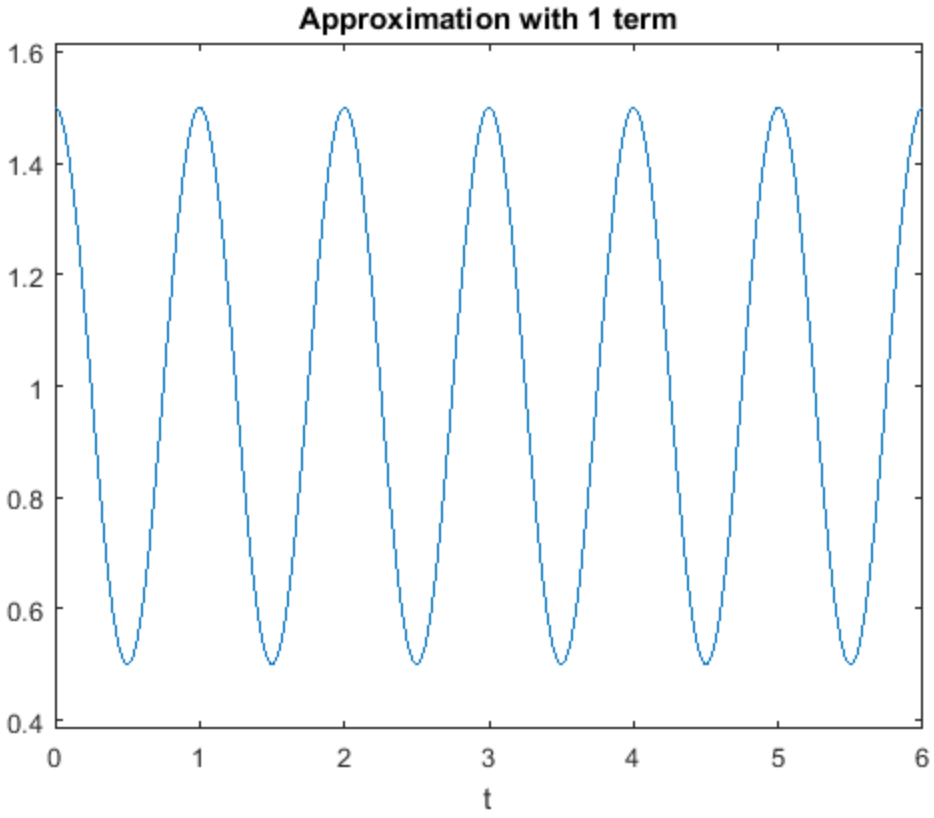

Approximation with 51 terms
1
0.8
0.6
0.4
0.2
0
0
0.5
1
1.5
2
2.5
3
t

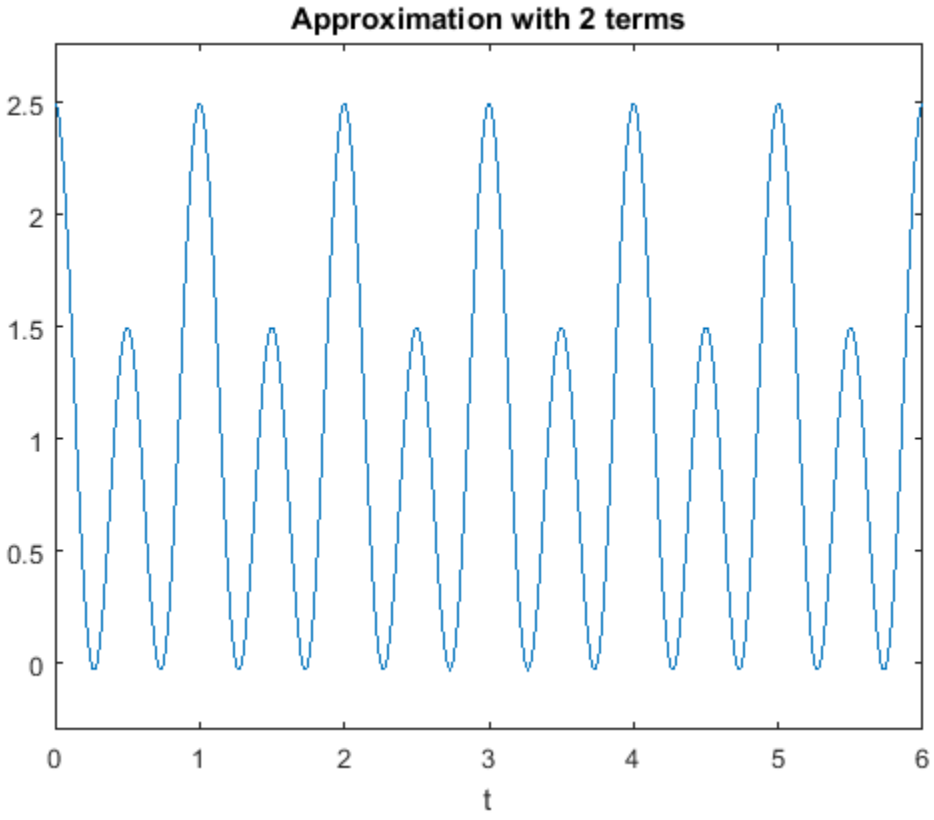
Problem 2

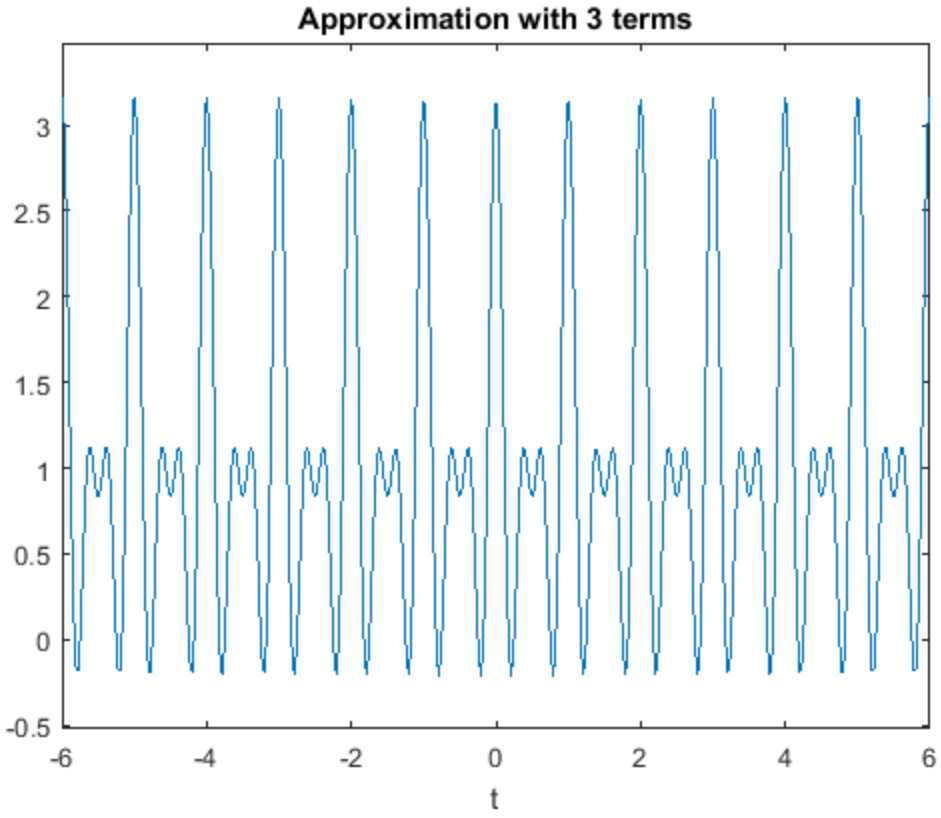
```
close all; clc; clear;

syms t
x = 1 + 0.5*cos(2*pi*t)+cos(4*pi*t)+2/3*cos(6*pi*t);
t0 = 0;
T = 1;
w = 2*pi/T;
figure;
ezplot(x);
title('Original Plot')
a0=(1/T)*int(x,t,t0,t0+T);

% 2.1 - one term
n=1;
b(n)=(2/T)*int(x*cos(n*w*t),t,t0,t0+T);
c(n)=(2/T)*int(x*sin(n*w*t),t,t0,t0+T);

k=1;
xx=a0+sum(b.*cos(k*w*t))+sum(c.*sin(k*w*t));
figure;
ezplot(xx, [t0 6]);
title('Approximation with 1 term')

% 2.2 - two terms
for n=1:2
    b(n)=(2/T)*int(x*cos(n*w*t),t,t0,t0+T);
    c(n)=(2/T)*int(x*sin(n*w*t),t,t0,t0+T);
end

k=1:2;
xx=a0+sum(b.*cos(k*w*t))+sum(c.*sin(k*w*t));
figure;
ezplot(xx, [t0 6]);
title('Approximation with 2 terms')

% 2.3 - three terms
for n=1:3
    b(n)=(2/T)*int(x*cos(n*w*t),t,t0,t0+T);
    c(n)=(2/T)*int(x*sin(n*w*t),t,t0,t0+T);
end

k=1:3;
xx=a0+sum(b.*cos(k*w*t))+sum(c.*sin(k*w*t));
figure;
ezplot(xx, [-6 6]);
title('Approximation with 3 terms')

% 2.4 - four terms
for n=1:4
    b(n)=(2/T)*int(x*cos(n*w*t),t,t0,t0+T);
    c(n)=(2/T)*int(x*sin(n*w*t),t,t0,t0+T);
```

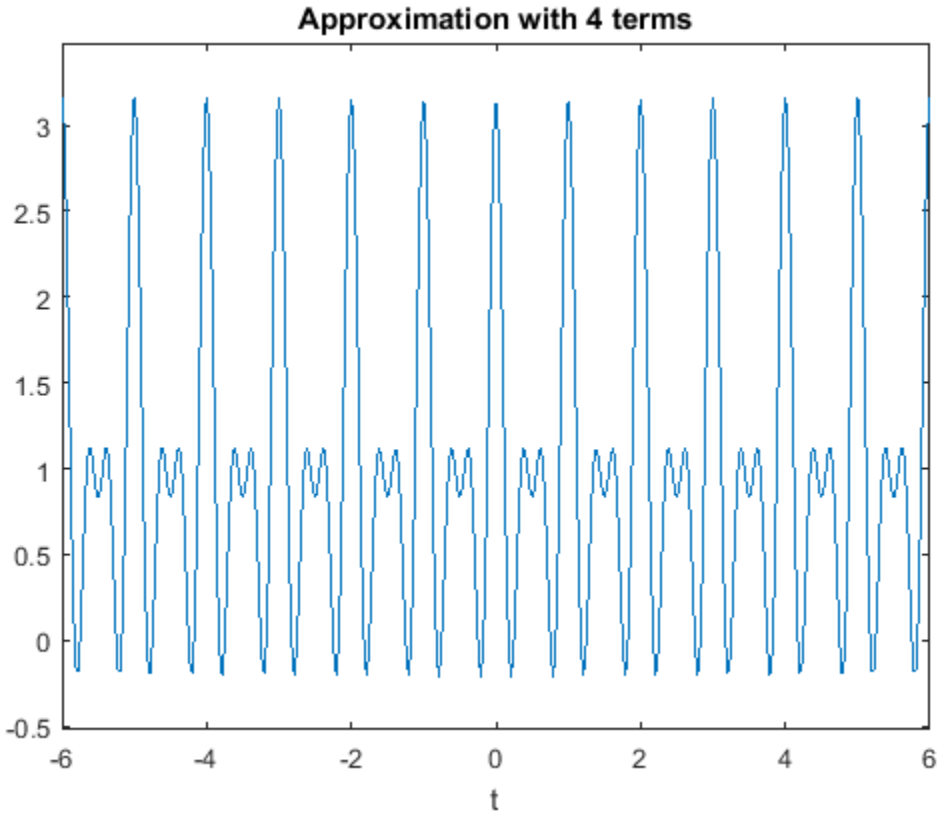
```
end

k=1:4;
xx=a0+sum(b.*cos(k*w*t))+sum(c.*sin(k*w*t));
figure;
ezplot(xx, [-6 6]);
title('Approximation with 4 terms')

% Since the function is a fourier series with 3 coefficients, there
 only
% only needs to be 3 terms to be entirely plot the expansion.
```




Approximation with 1 term
1.6
1.4
1.2
1
0.8
0.6
0.4
0
1
2
3
4
5
6
t

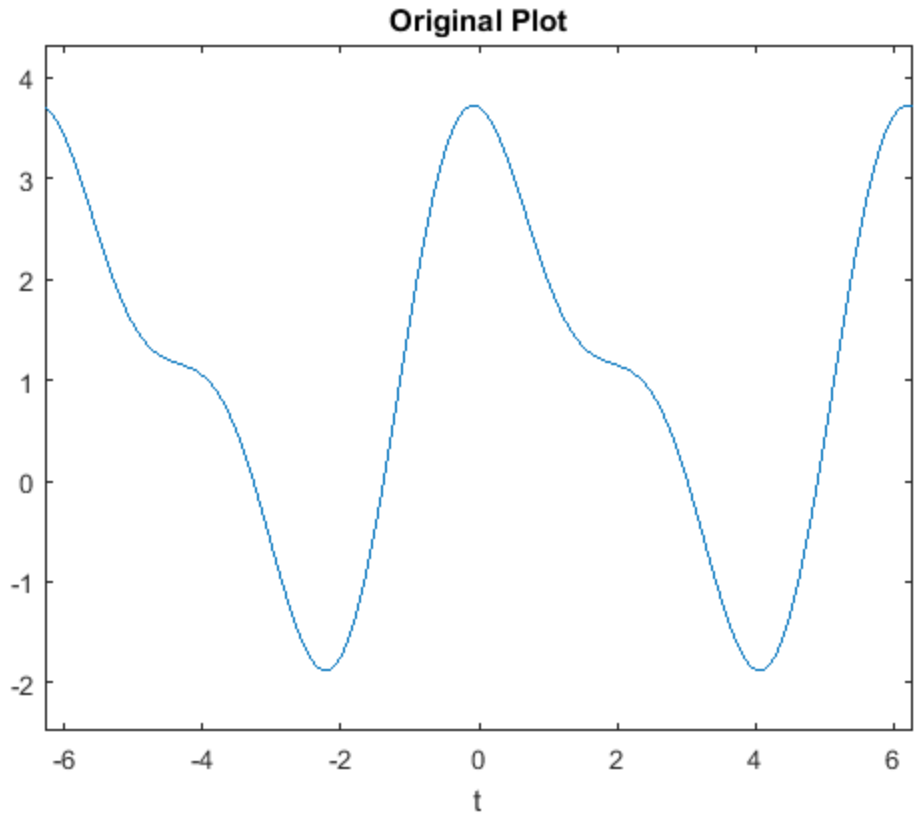

Approximation with 2 terms
2.5
2
1.5
1
0.5
0
0
1
2
3
4
5
6
t

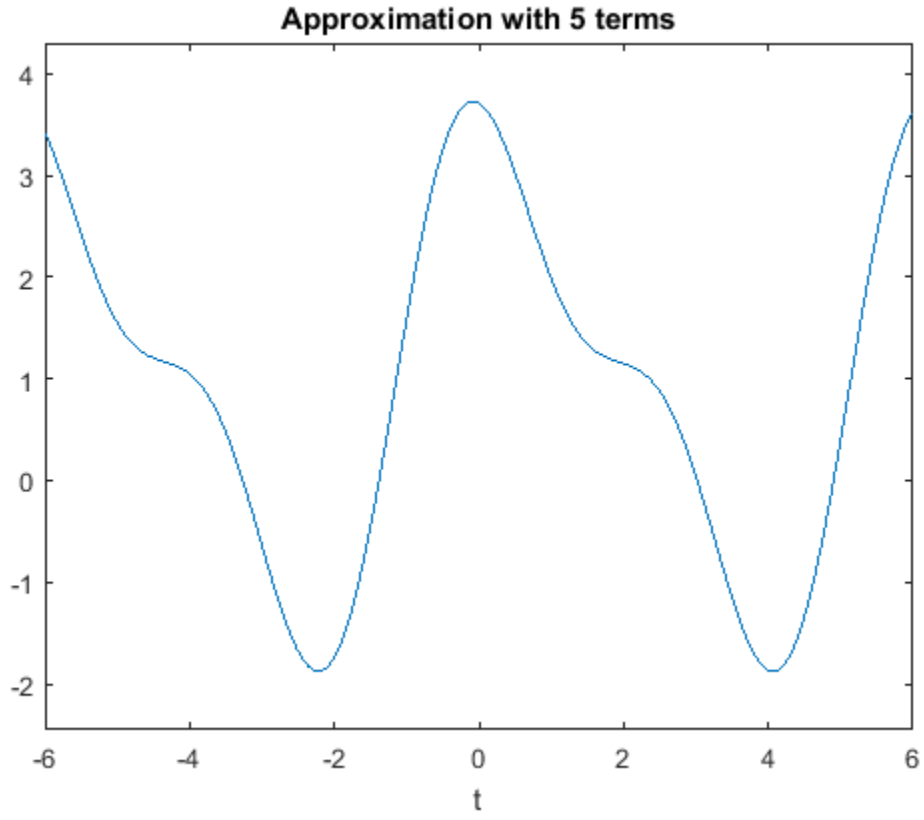

Approximation with 3 terms
3
2.5
2
1.5
1
0.5
0
-0.5
-6
-4
-2
0
2
4
6
t

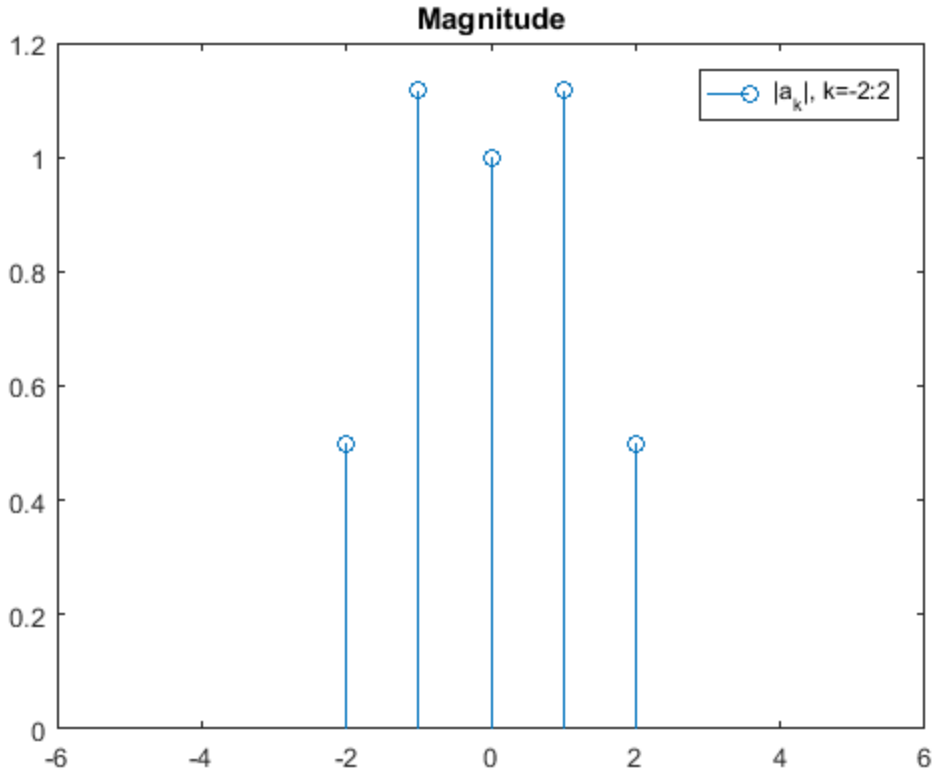

Approximation with 4 terms
3
2.5
2
1.5
1
0.5
0
-0.5
-6
-4
-2
0
2
4
6
t

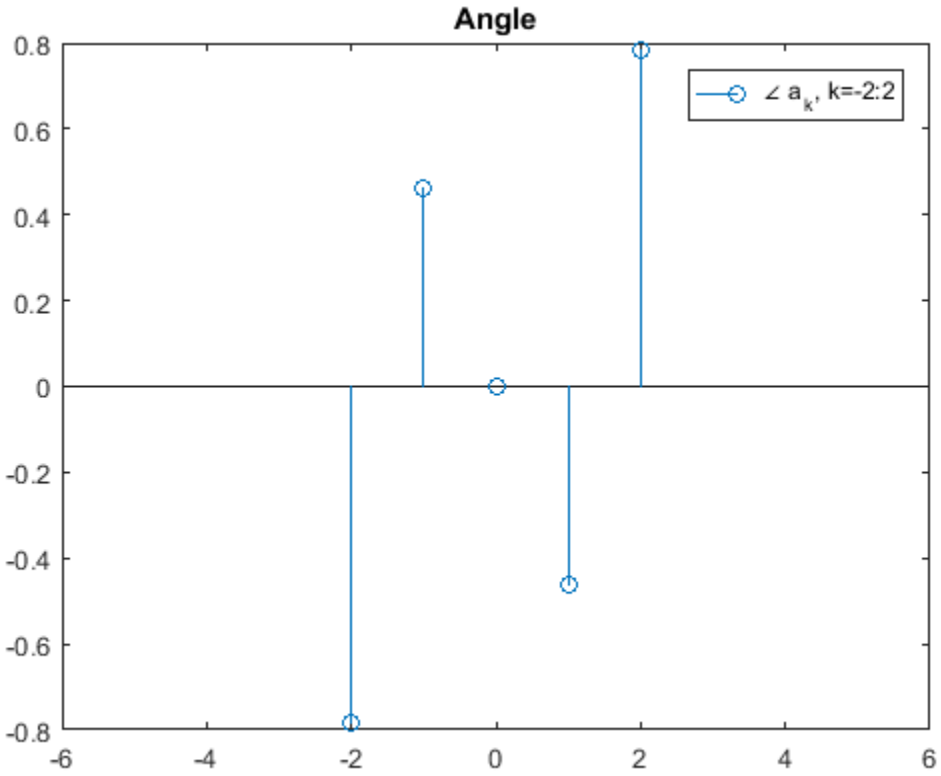
Problem 3

```
close all; clc; clear;

syms t k n
x = 1 + sin(t)+2*cos(t)+cos(2*t+pi/4); %since w = 1
t0 = 0;
T = 2*pi;
w = 1;
figure;
ezplot(x);
title('Original Plot')

for k = -2:2
    a(k+3)=(1/T)*int(x*exp(-j*k*w*t),t,t0,t0+T);
end

for k= -2:2
    ex(k+3)=exp(j*k*w*t);
end

xx=sum(a.*ex);
figure;
ezplot(xx, [-6 6]);
title('Approximation with 5 terms')

figure;
stem(-2:2,abs(a));
title('Magnitude')
xlim([-6 6])
legend('|a_k|, k=-2:2')

figure;
stem(-2:2,angle(a));
title('Angle')
legend('\angle a_k, k=-2:2')
xlim([-6 6])
```


Original Plot
4
3
2
1
0
-1
-2
-6
-4
-2
0
2
4
6
t


Approximation with 5 terms
4
3
2
1
0
-1
-2
-6
-4
-2
0
2
4
6
t


Magnitude
1.2
1
0.8
0.6
0.4
0.2
0
-6
-4
-2
0
2
4
6
|a_k|, k=-2:2


Angle
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-6
-4
-2
0
2
4
6
∠ a_k, k=-2:2

Published with MATLAB® R2016a