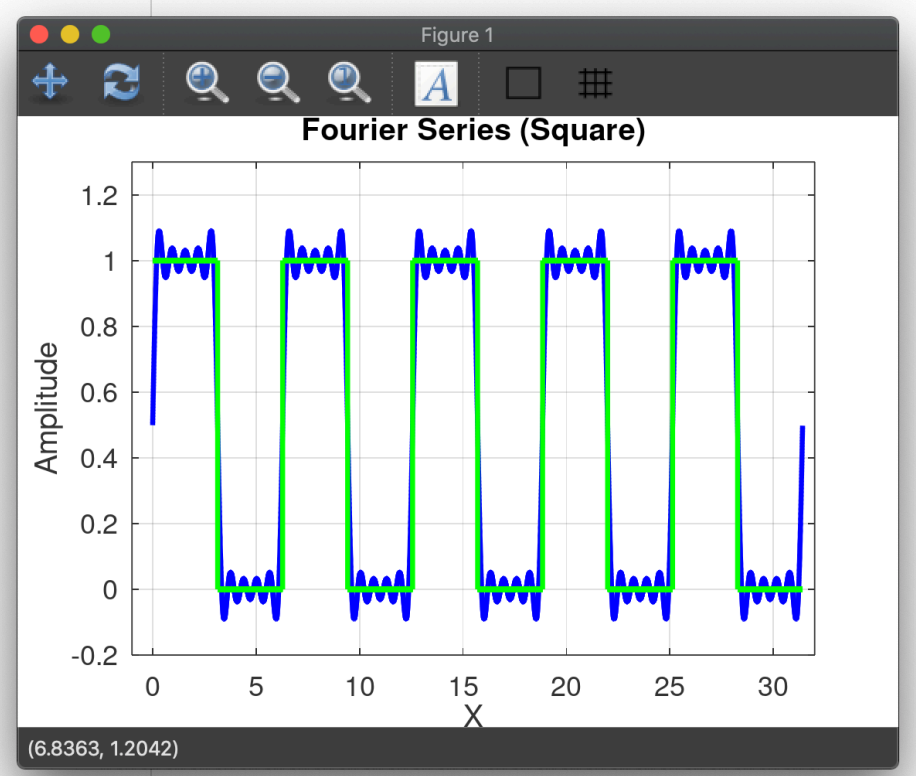
```
1
2  %Fourier Square Series that plays a noise
3  %through the speakers when amplitude is peaking and turns back off
4  %then graph will appear.
5
6  pkg load signal;
7
8  function product = product_An(n,x)
9    An = 2.0/pi/n;
10   product = An*sin(n.*x);
11 endfunction
12
13 function product = Series(n,x)
14   product = 0.5;
15   for i=[0:n]
16     product = product+product_An(2*i+1,x);
17     fs = 44100;
18     ts = 0:1/fs:1;
19     signal = cos(2*pi*500*ts);
20     player = audioplayer(signal, fs,8);
21     playblocking(player);
22     endfor
23 endfunction
24
25 x = 0.0:0.001:(2.0*pi)*5;
26 S = Series(4,x);
27
28 plot(x,S,'color','blue','linewidth',4);
29 title("Fourier Series (Square)");
30 xlabel("X","fontsize",12);
31 ylabel("Amplitude","fontsize",12);
32 axis([-1 32 -.2 1.3]);
33 set(gca, "fontsize",18);
34 hold on;
35 grid on;
36 plot(x,square(x)*0.5+0.5,'color','green','linewidth',4);
37
38
```



Homework 2 - Matthew Townsend
COSC: 360

1)

$a\delta(t-t_0) = f(t) \rightarrow a\,\delta(t-t_0)$

$f(t) = f(w)$ $\qquad \delta(t) = 1$

$f(t) \Rightarrow f(t-t_0) = f(w)e^{-jwt_0}$ $\qquad \delta(t-t_0) = 1 \cdot e^{-jwt_0}$

Fourier Transform $\Rightarrow F(w) = \int_{-\infty}^{\infty} a\delta(t-t_0)\, e^{-jwt}\, dt$

Sin and Cos in frequnecy Domain

$\Rightarrow F(w) = a\cos(wt_0) - ajsin(wt_0)$

2) $|F(w)|^2 = F(w)F^*(w)$

$= (a\cos(wt_0) - ajsin(wt_0))(a\cos(wt_0) + ajsin(wt_0))$

$= \underbrace{a\cos(wt_0)^2 - ajsin(wt_0)^2} + a\cos(wt_0)\,ajsin(wt_0) - ajsin(wt_0)a\cos(wt_0)$

$a\cos(wt_0)^2 - ajsin(wt_0)^2$

$= a(\cos(wt_0)^2 - jsin(wt_0)^2) \Rightarrow a(\cos(wt_0)^2 - jsin(wt_0)^2)$

3) Phase-Angle of F(w)

$\phi = \tan^{-1}(y/x)$ $\quad x = a\cos(wt_0)$ $\quad y = -a\sin(wt_0)$

$\Rightarrow \tan^{-1}(-a\sin(wt_0)/a\cos(wt_0))$

$\Rightarrow \tan^{-1}\left(\frac{-a\sin(wt_0)}{a\cos(wt_0)}\right) = \tan^{-1}(-\tan(wt_0)) = \phi$

4) Group Delay $\qquad w = 2\pi f$

$\Rightarrow -\frac{d\phi}{dw} \Rightarrow \frac{-\left\{-\left(\frac{\sec^2(wt_0)}{\tan^2(wt_0)+1}\right)\right\}}{-(2\pi)}$ $\quad \tan^2(wt_0)+1 \Rightarrow \frac{\sec^2(wt_0)}{\sec^2(wt_0)} \Rightarrow -1$

$\Rightarrow \frac{-1}{-2\pi}$

Group Delay $\Rightarrow \frac{-1}{-2\pi} \approx -0.15915$