**Fourier sine and cosine series**

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**The cosine series of x**

Let f(x) = x. First I calculate the Fourier cosine series of f on the interval [0,1].

syms x k n

evalin(symengine,'assume(k,Type::Integer)');

f = x

f =

x

The following commands compute the partial sum of the Fourier cosine series of f.

a = @(k) 2\*int(x\*cos(k\*pi\*x),x,0,1);

fourier\_cosine\_partial\_sum = @(x,n) a(0)/2 + ...

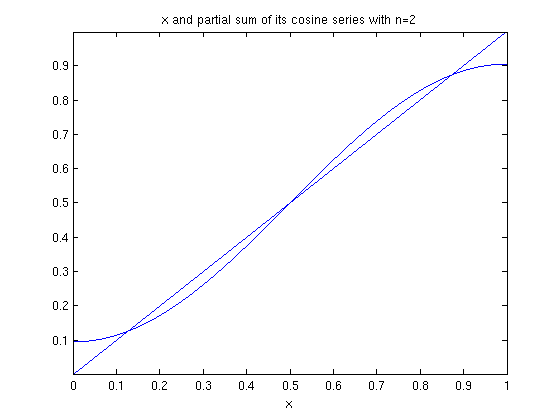
symsum(a(k)\*cos(k\*pi\*x),k,1,n);

Here are plots of the partial sums for n=2,5,10.

ezplot(f,0,1), hold on

ezplot(fourier\_cosine\_partial\_sum(x,2),0,1), hold off

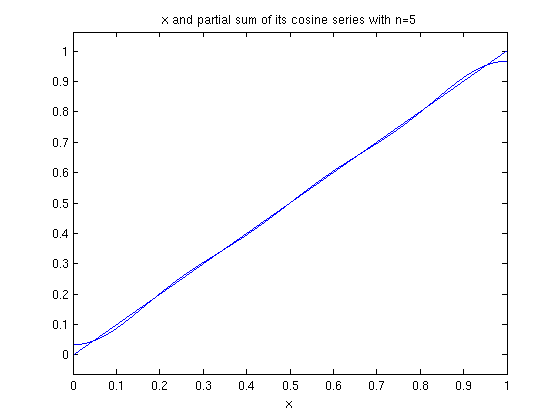
title('x and partial sum of its cosine series with n=2')



ezplot(f,0,1), hold on

ezplot(fourier\_cosine\_partial\_sum(x,5),0,1), hold off

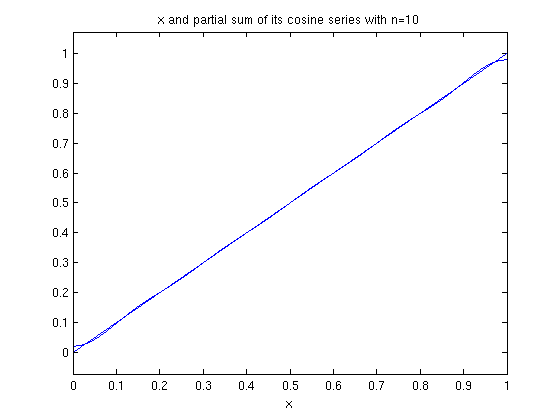
title('x and partial sum of its cosine series with n=5')



ezplot(f,0,1), hold on

ezplot(fourier\_cosine\_partial\_sum(x,10),0,1), hold off

title('x and partial sum of its cosine series with n=10')

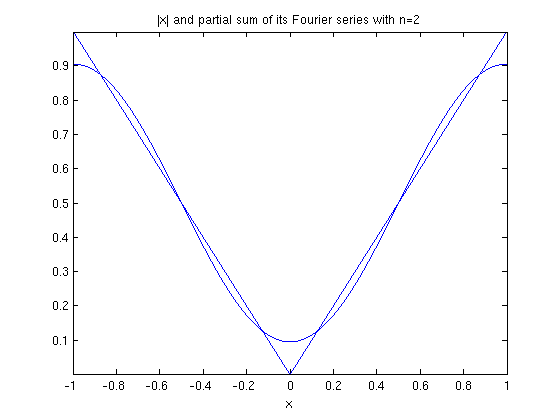


Recall that the cosine series is the Fourier series of the even extension of f. The even extension to [-1,1] is just abs(x). Here are plots of abs(x) and the Fourier cosine series of x on [-1,1].

ezplot(abs(x),-1,1), hold on

ezplot(fourier\_cosine\_partial\_sum(x,2),-1,1), hold off

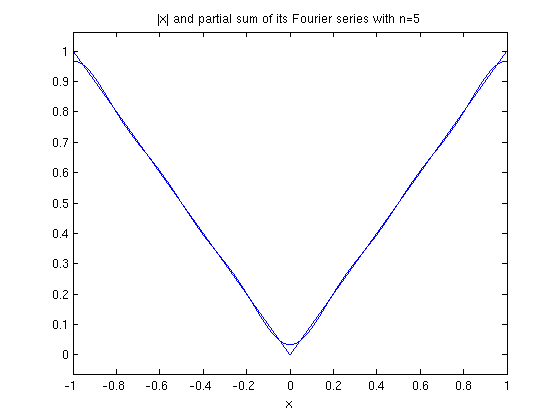
title('|x| and partial sum of its Fourier series with n=2')



ezplot(abs(x),-1,1), hold on

ezplot(fourier\_cosine\_partial\_sum(x,5),-1,1), hold off

title('|x| and partial sum of its Fourier series with n=5')



**The sine series of x**

The following commands calculate the nth partial sum of the Fourier sine series of f.

b = @(k) 2\*int(x\*sin(k\*pi\*x),x,0,1);

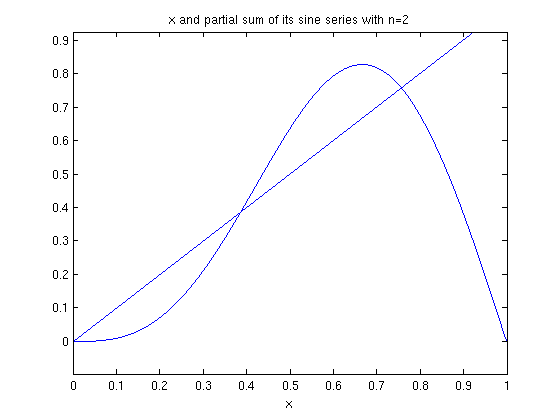
fourier\_sine\_partial\_sum = @(x,n) symsum(b(k)\*sin(k\*pi\*x),k,1,n);

Here are plots of the partial sums for n = 2,5,10.

ezplot(f,0,1), hold on

ezplot(fourier\_sine\_partial\_sum(x,2),0,1), hold off

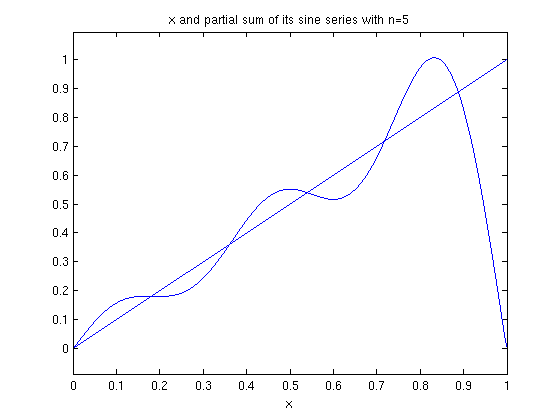
title('x and partial sum of its sine series with n=2')



ezplot(f,0,1), hold on

ezplot(fourier\_sine\_partial\_sum(x,5),0,1), hold off

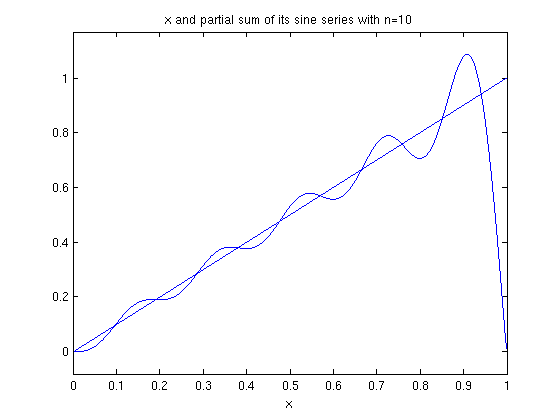
title('x and partial sum of its sine series with n=5')



ezplot(f,0,1), hold on

ezplot(fourier\_sine\_partial\_sum(x,10),0,1), hold off

title('x and partial sum of its sine series with n=10')

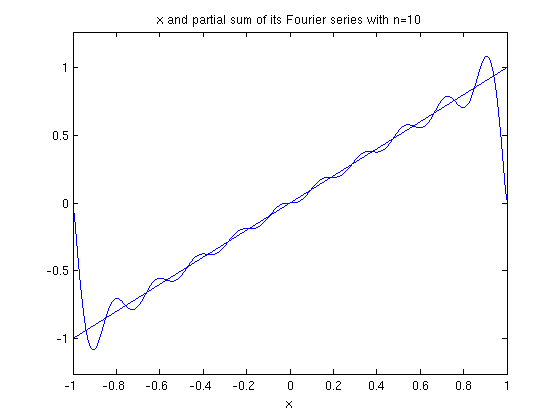


Recall that the Fourier sine series is the Fourier series of the odd extension of f. The odd extension of f to [-1,1] is x.

ezplot(x,-1,1), hold on

ezplot(fourier\_sine\_partial\_sum(x,10),-1,1), hold off

title('x and partial sum of its Fourier series with n=10')



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