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Math 362 Fourier Analysis

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Class Prep 4

Section 3.3

Key Concepts: In this section, we study comparisons using sine and cosine functions (Fourier expansions). The similarity coefficient formulas generate the Fourier coefficients. And we will use integration by parts to compute Fourier coefficients analytically. Also covered in this section is a theorem establishing the pointwise convergence of a Fourier series, and a discussion of Gibbs Phenomena. MATLAB will be used to plot graphs that help visualize the results of the section.

|  |  |
| --- | --- |
| Input | Output |
| >> BoxExpansionSawtooth(-1,1)  coeffs =  -0.7510 -0.2510 0.2490 0.7490 |  |
| >> FourierSawtooth(4)  Coeff\_a\_0 =  -9.7656e-04  Coeffs\_ak\_bk =  -0.0020 -0.6366  -0.0020 -0.3183  -0.0020 -0.2122  -0.0020 -0.1591 |  |

|  |  |
| --- | --- |
| >> FourierBox(6)  Coeff\_a\_0 =  0.5000  Coeffs\_ak\_bk =  0.0020 0.6366  0 0  0.0020 0.2122  0 0  0.0020 0.1273  0 0 |  |
| >> FourierSawtooth(3)  Coeff\_a\_0 =  -9.7656e-04  Coeffs\_ak\_bk =  -0.0020 -0.6366  -0.0020 -0.3183  -0.0020 -0.2122 |  |
| >> FourierSeriesSawtooth(4) |  |
| >> FourierSeriesSawtooth(8) |  |
| >> FourierSeriesSawtooth(16) |  |
| >> FourierSeriesSawtooth(32) |  |
| >> x=audioread('aah1sec.wav');  >> plot(x) |  |

|  |  |
| --- | --- |
| >> plot(x(9300:11700)), axis tight |  |
| >> FourierSeriesDoubleBox(8) |  |
| >> FourierSeriesDoubleBox(32) |  |
| >> FourierSeriesSinCos(3)  Coeff\_a\_0 =  1  Coeffs\_ak\_bk =  0.0000 -0.0000  -0.0000 0.0000  0.0000 -0.5000 |  |
| >> FourierSeriesSinCos(5)  Coeff\_a\_0 =  1  Coeffs\_ak\_bk =  0.0000 -0.0000  -0.0000 0.0000  0.0000 -0.5000  -0.0000 -0.0000  -0.0000 0.5000 |  |

Section 3.4

Key Concepts: In this section, we will consolidate the sine and cosine Fourier coefficient formulas into a single formula using complex exponentials, and similarly with the sine and cosine Fourier expansions. We will then generalize these results to the Fourier and inverse Fourier transforms, respectively.