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Math 362 Fourier Analysis

September 20, 2017

Ch. 3.3 HW

3.3.15

1. Adapt an appropriate MATLAB program to graph together with on [0,1], for = 4, 8, 16, 32.
2. Discuss the pointwise convergence of the Fourier series on [0,1]. Be sure to indicate whether the hypothesis of Theorem 3.3.1 is satisfied, and include in your discussion what the convergence results say about the pointwise limit at any given point [0,1].

|  |  |
| --- | --- |
| a.)  >> FourierFcn(4)  Coeff\_a\_0 =  5  Coeffs\_ak\_bk =  -0.0078 -2.5465  0 0  -0.0078 -0.8488  0 0 |  |
| >> FourierFcn(8)  Coeff\_a\_0 =  5  Coeffs\_ak\_bk =  -0.0078 -2.5465  0 0  -0.0078 -0.8488  0 0  -0.0078 -0.5093  0 0  -0.0078 -0.3637  0 0 |  |

|  |  |
| --- | --- |
| >> FourierFcn(16)  Coeff\_a\_0 =  5  Coeffs\_ak\_bk =  -0.0078 -2.5465  0 0  -0.0078 -0.8488  0 0  -0.0078 -0.5093  0 0  -0.0078 -0.3637  0 0  -0.0078 -0.2829  0 0  -0.0078 -0.2314  0 0  -0.0078 -0.1958  0 0  -0.0078 -0.1696  0 0 |  |
| >> FourierFcn(32)  Coeff\_a\_0 =  5  Coeffs\_ak\_bk =  -0.0078 -2.5465  0 0  -0.0078 -0.8488  0 0  -0.0078 -0.5093  0 0  -0.0078 -0.3637  0 0  -0.0078 -0.2829  0 0  -0.0078 -0.2314  0 0  -0.0078 -0.1958  0 0  -0.0078 -0.1696  0 0  -0.0078 -0.1497  0 0  -0.0078 -0.1339  0 0  -0.0078 -0.1211  0 0  -0.0078 -0.1105  0 0  -0.0078 -0.1017  0 0  -0.0078 -0.0941  0 0  -0.0078 -0.0876  0 0  -0.0078 -0.0819  0 0 |  |

b.)

The pointwise convergence of this function for the Fourier Expansion stated above is very prominent because of the convergence in the graph. At all points of discontinuity, the function converges to the average of the two discontinuity points. Also found in these graphs are the fact that the expansion converges to one common value at the extremes of the graph. This means that the beginning where the function is equal to three, it has a convergence point that is the same at the end of the function when it is seven. This common convergence is five. In short, the Theorem 3.3.1 is satisfied because the expansion converges pointwise to f on the above graphs. So in short, at any given point t in the above graphs, the pointwise limit of the Fourier expansion is the sum of the left and right and limits and then half of that.

3.3.20

1. Adapt an appropriate MATLAB program to graph together with on [0,1], for = 4, 8, 16, 32.
2. Discuss the pointwise convergence of the Fourier series on [0,1]. Be sure to indicate whether the hypothesis of Theorem 3.3.1 is satisfied, and include in your discussion what the convergence results say about the pointwise limit at any given point [0,1].

|  |  |
| --- | --- |
| a.)  >> FourierFcn(4)  Coeff\_a\_0 =  3.4985  Coeffs\_ak\_bk =  -0.0029 -0.9549  -0.0029 -0.4775  -0.0029 -0.3183  -0.0029 -0.2387 |  |
| >> FourierFcn(8)  Coeff\_a\_0 =  3.4985  Coeffs\_ak\_bk =  -0.0029 -0.9549  -0.0029 -0.4775  -0.0029 -0.3183  -0.0029 -0.2387  -0.0029 -0.1910  -0.0029 -0.1591  -0.0029 -0.1364  -0.0029 -0.1193 |  |
| >> FourierFcn(16)  Coeff\_a\_0 =  3.4985  Coeffs\_ak\_bk =  -0.0029 -0.9549  -0.0029 -0.4775  -0.0029 -0.3183  -0.0029 -0.2387  -0.0029 -0.1910  -0.0029 -0.1591  -0.0029 -0.1364  -0.0029 -0.1193  -0.0029 -0.1061  -0.0029 -0.0955  -0.0029 -0.0868  -0.0029 -0.0795  -0.0029 -0.0734  -0.0029 -0.0682  -0.0029 -0.0636  -0.0029 -0.0596 |  |
| >> FourierFcn(32)  Coeff\_a\_0 =  3.4985  Coeffs\_ak\_bk =  -0.0029 -0.9549  -0.0029 -0.4775  -0.0029 -0.3183  -0.0029 -0.2387  -0.0029 -0.1910  -0.0029 -0.1591  -0.0029 -0.1364  -0.0029 -0.1193  -0.0029 -0.1061  -0.0029 -0.0955  -0.0029 -0.0868  -0.0029 -0.0795  -0.0029 -0.0734  -0.0029 -0.0682  -0.0029 -0.0636  -0.0029 -0.0596  -0.0029 -0.0561  -0.0029 -0.0530  -0.0029 -0.0502  -0.0029 -0.0477  -0.0029 -0.0454  -0.0029 -0.0433  -0.0029 -0.0414  -0.0029 -0.0397  -0.0029 -0.0381  -0.0029 -0.0367  -0.0029 -0.0353  -0.0029 -0.0340  -0.0029 -0.0328  -0.0029 -0.0317  -0.0029 -0.0307  -0.0029 -0.0297 |  |

b.)

The above graphs indicate that this function has pointwise convergence for all points t on it. Wherever there is discontinuity in the graph, the expansion converges to the average. Also in the graph is a prominent demonstration of converging to the average at the endpoints of the graph. The periodic extension of this graph has a convergence at the ends of the extension that is the average between the two endpoints. As follows in the last problem, this expansion satisfies Theorem 3.3.1 because of everything stated above. This in turn means that the expansion converges and pointwise to f and has a significance that follows,