Report: Homework 3 Math/CS 471

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Abstract

This report will explore two methods of approximating the following integral
$$I = \int_{-1}^{1} e^{cos(kx)} dx,$$
for $k = pi$ or pi^2. The first method is known as the trapezoidal rule and the second as Gauss quadrature.

1 Trapezoidal Rule

The trapezoidal rule is given by the following expression

$$\int_{X_L}^{X_R} f(x)dx \approx h\left(\frac{f(x_0) + f(x_n)}{2} + \sum_{i=1}^{n-1} f(x_i)\right)$$

where the grid is given by $x_i = X_L + ih$, $i = 0, ..., n$, $h = \frac{X_R - X_L}{n}$.

2 Gauss Quadrature

[**?**]In Gauss quadrature the location of the grid-points and weights, ω_i, are chosen so that the order of the approximation to the weighted integral

$$\int_{-1}^{1} f(z)w(z)dz \approx \sum_{i=0}^{n} \omega_i f(z_i),$$

is maximized. (The function $w(z)$ is positive and integrable. In this report we will only consider the case when $w(z) = 1$ in order to simplify things.

3 Methods

Here is how the programs were executed...

4 Results

Figure 1: Plot of error against **n**

In the figure shown above, different rates of convergence are observed for each of the methods and for each of the values of k. The trapezoidal method where $k = \pi^2$ is the only case in which the order of the method may be read from the slope of its plot. This slope is ≈ -3 which is consistent with the theory as shown for

5 Appendix

In order to compile and execute the code for this assignment perl is used. The directory in which the code can be found is:

/Homework/Homework2/Code/

Once in this directory the following command will compile and execute the code:

$ perl newtonS.p

References

[1] Daniel Appelo *Homework 3*. referenced Sep. 26, 2015