Composite Numerical Integration

Talk to a Teacher Project
http://spoken-tutorial.org
National Mission on Education through ICT
http://sakshat.ac.in

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Objectives

At the end of this tutorial, you will learn how to:

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- **Develop Scilab code for different Numerical Integration algorithms**

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- **Develop Scilab code for different Numerical Integration algorithms**
- **Divide the integral into equal intervals**

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- **Apply the algorithm to each interval**

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- **Apply the algorithm to each interval**
- **Calculate the composite value of the integral**

System Requirements

- **OS: Ubuntu Linux 12.04**

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- **Scilab 5.3.3**

Prerequisites

- **Basic knowledge of Scilab**

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- **Integration using Numerical Methods**

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- Basic knowledge of Scilab
- Integration using Numerical Methods
- Please refer to the relevant Scilab tutorials available on http://spoken-tutorial.org

Numerical Integration

- **Study of how the numerical value of an integral is found**

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- **Used when exact mathematical integration is not available**

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- **Study of how the numerical value of an integral is found**
- **Used when exact mathematical integration is not available**
- **Approximates the definite integral from values of the integrand**

Composite Trapezoidal Rule- I

- **Extension of trapezoidal rule**

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- **Divide the interval [a, b] into n equal intervals**

Composite Trapezoidal Rule- I

- **Extension of trapezoidal rule**
- **Divide the interval [a, b] into n equal intervals**
- **$h = (b - a)/n$ is the common length of the intervals**

Composite Trapezoidal Rule- II

- **Then composite trapezoidal rule is given by**

$$\int_a^b f(x)\,\mathrm{d}x \approx h\left\{\frac{f(x_0)}{2} + f(x_1) + \cdots + f(x_{n-1}) + \frac{f(x_n)}{2}\right\}$$

Example

- **Find the value of this integral with 10 intervals**

$$\int_0^1 \frac{1}{1+2x} \mathrm{d}x$$

Composite Simpson's Rule-I

- **Decompose the interval [a, b]**

Composite Simpson's Rule-I

- **Decompose the interval [a, b]**
- **n $>$ 1 subintervals of equal length**

Composite Simpson's Rule-I

- **Decompose the interval [a, b]**
- **$n > 1$ subintervals of equal length**
- **Apply Simpson's rule to each interval**

Composite Simpson's Rule-II

- **Composite Simpson's Rule is given by**

$$\int_a^b f(x)\,\mathrm{d}x \approx \frac{h}{3}\{f_0 + 4f_1 + 2f_2 + 4f_3 + \ldots + 4f_{n-1} + f_n\}$$

Example

- **Solve the example**

$$\int_1^2 \frac{1}{1+x^3} \mathrm{d}x$$

Example

- **Solve the example**
- **Assume n=20**

$$\int_1^2 \frac{1}{1+x^3} \mathrm{d}x$$

Composite Midpoint Rule-I

- **Integrates polynomials of degree one or less**

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- **Divide the interval [a,b]**

Composite Midpoint Rule-II

- **n subintervals of equal width**

Composite Midpoint Rule-II

- **n subintervals of equal width**
- **Find the midpoint of each interval indicated by x_i**

Example

- **Solve:**
- **Assume n=20**

$$\int_0^{1.5} 1 - x^2 \, \mathrm{d}x$$

Summary

In this tutorial, we have learnt to:

- **Develop Scilab code for numerical integration**
- **Find the value of an integral**

About the Spoken Tutorial Project

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- More information on this Mission is available at http://spoken-tutorial.org/NMEICT-Intro