International Islamic University Chittagong

Dept. of CSE

Project Proposal

On

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Submitted To:

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Project Topic

Numerical Integration

Project Title

Calculating the Approximating work of an object done by a variable force using numerical integration.

Problem description

Suppose we have an object that is moved along a straight line by a force that varies with position. The force F(x) is given by F(x) = $3x^2$ - 2x + 1, where x is the position of the object in meters, and the force is measured in Newtons.

The task is to calculate the work done by the force as the object is moved from position x = 0 to x = 5 meters using numerical integration.

Solution Approach

To solve this problem using numerical integration, we need to approximate the area under the curve of the force as a function of position.

The work done by the force as the object is moved from position x1 to x2 is given by:

$$W = \int_{x1}^{x2} F(x)\, dx$$

$$= \int_{x1}^{x2} (3x^2 - 2x + 1)\, dx$$

To calculate the work done by the force as the object is moved from position x = 0 to x = 5 meters, we need to evaluate the integral over the interval [0, 5]. The Trapezoidal rule, Simpson's 1/3 rule, and Simpson's 3/8 rule are three numerical methods that can be used for this purpose.

Methodology

The project will be carried out in the following steps:

1. The C++ code for Trapezoidal Rule, Simpson's 1/3 Rule, and Simpson's 3/8 Rule will be implemented and tested.
2. Each method's accuracy and convergence rate will be evaluated by comparing the estimated values with the exact values obtained using analytical methods.
3. The project will be extended to test the performance of these methods on various functions, including polynomials, trigonometric functions, and exponential functions.
4. A user-friendly interface will be developed that allows the user to input the function, the limits of integration, and the number of subintervals.
5. The interface will be tested with different input values, and the estimated results will be compared with the exact values.

Objectives

The main objectives of this project are as follows:

1. To implement the Trapezoidal Rule, Simpson's 1/3 Rule, and Simpson's 3/8 Rule in C++ programming language.

2. To test and compare the accuracy of these numerical integration methods on various functions.
3. To evaluate the convergence rate of each method.
4. To develop a user-friendly interface that allows the user to input the function, the limits of integration, and the number of subintervals.

Conclusion

In conclusion, this project aims to provide a practical and useful tool for approximating the area under the curve of a given function using numerical integration methods. The project will enable the user to select the most suitable method based on the required level of accuracy and computational cost.

The End