CS 3200: Introduction to Scientific Computing

In-class Activity 2 : Numerical Integration

Problem: You need to perform integration on a function and have completely forgotten your calculus training. Use the midpoint rule to determine the integral of the function.

$$I = \int_a^b f(x)\, dx \text{, where } a = 0, b = 1, f(x) = x^2$$

(a) Verify that the solution is 1/3

(b) Use the midpoint rue with one point and h = 1 to estimate the integral

$I_h =$

(c) Use the midpoint rule with two points and so h = 0.5 to estimate the integral

$I_{h/2} =$

(c) The error of the midpoint rule on one interval is given by $\quad I - I_h = \dfrac{h^3}{24}\dfrac{d^2 f}{dx^2}(\varsigma)\quad$ use this form to derive the

equation $\qquad I_{h/2} - I_h = \dfrac{3}{4}\dfrac{h^3}{24}\dfrac{d^2 f}{dx^2}(\varsigma)\quad$ and estimate the errors in I_h and $I_{h/2}$

(d) Hence calculate the estimate of the error in I_h and $I_{h/2}$ and use the exact solution ,I, to verify if these estimates work