CAIRO UNIVERSITY

FACULTY OF SCIENCE
DEPARTMENT OF COMPUTER SCIENCE

M351 project

PRESENTERS

Mohamed Atef Shata
Fares Magd Elamir
Mahmoud Atef Mahmoud

PROFESSOR

Nasser Sweilm

COURSE

Numerical Analysis (MATH 351)

Winter 2022

M351 project

Mohamed Atef Shata (2027115),
Mahmoud Atef Mahmoud (2027453) ,
Fares Magd Elamir (2027279)

Department of Computer Science
Faculty of Science
Cairo University

Winter 2022

1 Mid-point rule

Mid-point rule is a method of estimating the integral of a function or the area under a curve by dividing the area into rectangles of equal width.

$$M_n = \sum_{i=1}^{n} f(m_i)\Delta x \tag{1}$$

where i is the ith rectangle, n is the number of rectangles that the area under the curve is divided into, $f(m_i)$ is the function of the curve evaluated at the midpoint of the ith rectangle, and Δx of each rectangle can be calculated using the following formulas:

$$m_i = \frac{x_i - x_{i-1}}{2} \tag{2}$$

where x_i is the x -value of the right endpoint of the ith rectangle, and x_{i-1} is the x -value of the left endpoint of the ith rectangle.

$$\Delta x = \frac{b-a}{n} \tag{3}$$

where a is the lower boundary of the interval, b is the upper boundary of the interval, and $n$is the number of rectangles.

---

2 Trapezoidal rule

Trapezoidal rule is the first of the Newton-Cotes closed integration formulas, where:

$$I = \int_a^b f(x)dx \cong \int_a^b f_1(x)dx \tag{1}$$

$$I \cong \frac{f(a) + f(b)}{2}(b-a) \tag{2}$$

3 Simpson's rule

Simpson's rule is an extension of Trapezoidal rule where the integrand is approximated by a second-order polynomial, so:

$$I = \int_a^b f(x)dx \cong \int_a^b f_2(x)dx \tag{1}$$

$$I \cong \frac{b-a}{6}[f(a) + f(\frac{a+b}{2}) + f(b)] \tag{2}$$