Faculty of Mathematics and Computer Science
Babeş-Bolyai University, Cluj-Napoca
Numerical Analysis
MIE - semester IV

Laboratory 8

Deadline: 29 − 30 April 2024

Quadrature formulas II

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1. Let us consider the following integral

$$I = \int_1^{1.5} f(x)dx, \quad \text{where} \quad f(x) = e^{-x^2}.$$

   - Evaluate the integral I using the rectangle formula (*see Slide 5, Lecture 8*).
   - Plot the graph of the function and the graph of the rectangle which area approximates the integral using rectangle (midpoint) formula.
   - Use the repeated rectangle formula for $n \in \{150, 500\}$ to evaluate the integral (*see Slide 6, Lecture 8*).

2. Let us consider the following integral

$$I = \int_0^{1} f(x)dx, \quad \text{where} \quad f(x) = \frac{2}{1+x^2}.$$

   - Approximate the integral using the Romberg algorithm for trapezium formula (precision is $\varepsilon = 10^{-4}$). *Hint: see Slide 9, Lecture 7*
   - Approximate the integral using the Romberg algorithm in Aitken's form (precision is given by $\varepsilon = 10^{-4}$). *Hint: see Slide 12, Lecture 7*

3. Let us consider the function $f : [1,3] \to \mathbb{R}$ given by $f(x) = \frac{100}{x^2} \sin \frac{10}{x}$ for all $x \in [1,3]$.

   - Plot the graph of the function f.
   - Use an adaptive quadrature algorithm for Simpson's formula to approximate the integral $I = \int_1^3 f(x)dx$ with precision $\varepsilon = 10^{-4}$ (*see Slide 17, Lecture 7*).
   - Compare the obtained result with the one obtained applying repeated Simpson's formula for $n = 50$ and $n = 100$ (*value: -1.4260247818*).

Remark: 1-2 (1p), 3 (0.5p)