

Numerical Acoustics – Exercise 3

1. Numerical integration

The following definite integrals are given:

$$I = \int_0^4 (x^4 - 1) dx \quad (1)$$

$$I = \int_0^\pi \sin^2(x) dx \quad (2)$$

- Calculate the integrals analytically. (Hint: $\int \sin^2(x) dx = \frac{1}{2}[x - \sin(x) \cos(x)]$)
- Calculate the integral (1) by hand using the trapezoidal rule.
- Create a program in Python for calculating the two integrals with a selectable integration rule: trapezoidal (Newton-Cotes 1st-degree) rule, Simpson's (Newton-Cotes 2nd-degree) rule, Simpson's 3/8 (Newton-Cotes 3rd-degree) rule, or Gaussian quadrature (with 1, 2, and 3 integration points).
- Use the program from (c) to calculate both integrals with all implemented integration rules and compare the results with the exact solutions from (a).