

## Task 04 – Play with discrete math

Given the following function

$$f(x) = e^x \cos(x)$$

Write a program with your chosen compiled language

Input:

- take N (number of sampling points of the function f), x\_inf and x\_sup (the limits of the domain of f)

Output:

- save a file with N row and two columns representing the value of x and the respective f(x) using the information from the input
- print on terminal the value (with 16 decimal digits) of the following integral

$$I = \int_0^{\frac{\pi}{2}} f(x) dx$$

NOTE: to print the value with 16 digit you have to find information about “string formatting” for numbers in your chosen programming language

NOTE: you can calculate the integral using a numerical library of your choice (GSL is good choice) or use the [https://en.wikipedia.org/wiki/Trapezoidal\\_rule](https://en.wikipedia.org/wiki/Trapezoidal_rule)

Answer the following questions

- 1) The integral is analytic and its solution is  $I_{true} = \frac{e^{\pi/2}-1}{2}$ , how far are I from the real solution? [calculate the relative error:  $eps_{rel} = \frac{I}{I_{true}} - 1$ ]
- 2) How can you reduce the relative error?
- 3) Which is the minimum relative error you can find using the techniques you described in point 2?
- 4) Using the output file you produce, use an interpreted language to calculate the same integral (call it  $I_4$ ): is this output similar to the one in point 1? And how close it is? [calculate the absolute error:  $abs_{rel} = |I - I_4|$ ]