

Lab Assignment 6: Numerical Python

1. The integral of a function $f(x)$ from $x = a$ to $x = b$ can be calculated numerically by the Trapezoidal rule:

$$\int_a^b f(x) dx = \frac{h}{2}f(a) + \frac{h}{2}f(b) + h \sum_{i=1}^{n-1} f(a + ih)$$

where $h = (b - a)/n$.

First implement this approximation in a Python script containing a straight-forward loop.

The code will run slowly compared to a vectorized version. Make the vectorized version and introduce timings to measure the gain of vectorization. Use the function $f(x) = 1 + 2x$ as test function for the integration and choose $a = 0$, $b = 1000$.

2. Consider the following function $f(x)$:

$$f(x) = \begin{cases} 0.5^{1+1/n} - (0.5 - x)^{1+1/n}, & 0 \leq x \leq 0.5 \\ 0.5^{1+1/n} - (x - 0.5)^{1+1/n}, & 0.5 < x \leq 1 \end{cases}$$

where $n = 0.5$, make a vectorized Python **function** for evaluating $f(x)$ at a set of m equally spaced x values between 0 and 1. (No loop over the x values should appear).