# Errors in numerical analysis

Numerical analysis - University of Luxembourg - Session 1

Exercises

## Python documentation

* numpy: <https://numpy.org/doc/>
* matplotlib: <https://matplotlib.org/stable/gallery/subplots_axes_and_figures/index.html>
* scipy <https://scipy.org/>

## Exercises on global interpolation

Exercise 1. **Basic of Lagrange interpolation**

Write and plot the Lagrange basis associated to the points .

Then compute the Polynomial interpolant for the data .

Compare with the built-in scipy.interpolate.lagrange function.

Finally plot on the same graph the interpolation points, the built-in interpolant and your implemented interpolant.

Exercise 2. **Interpolating Runge function**

Using the built-in scipy.interpolateLagrange interpolation, compute the absolute interpolation error by sampling equidistant points for the function

Compare and discuss the error with the theoretical upper bound.

Repeat the exercise for the Runge function

for different values of . Explain your observations and give a theoretical argument from the lecture to justify them.

Do the same exercise but use the Chebyshev nodes that are defined in by

Compute the error when the number of points increases and comment your observations.

## Exercise on piece-wise interpolation

Exercise 3. **Linear piecewise interpolation**

Implement a piecewise interpolation for the set of points and data .

Generalize your code for an interval made of sub-intervals, using a random set of data "numpy.random.rand(N points)".

Apply your code to the sine and Runge functions defined earlier. todo

1. How does the error behaves as the number of sub-intervals increases ?

2. Find an error upper bound using the interpolation error formula from the lecture, and explain your observations

3. Mention the differences between the piecewise and global interpolations