NUMERICAL METHODS

INTERPOLATION, LAB REPORT

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Introduction

We will analyse the value of maximum interpolation error for a given function:

1. Polynomial function: $f(x) = x^2 + 2x - 1$
2. Rational function: $f(x) = \frac{5}{x^2+2}$
3. Modulus function: $f(x) = |x|$
4. Trigonometric function: $f(x) = \sin(x)$

We will perform Lagrange's rule for every single function for:

1. Equally spaced nodes
2. Chebyshev nodes

And we will perform it for n=5,10,….,30

Implementation

- We developed one method for Lagrange function for each single formula to get our approximated value.
- We developed two method to get the nodes in the x-axis
    - One method for equally spaced nodes, for a given [a, b] and n (number of points)
    - One method for Chebyshev nodes, for a given [a, b] and n (number of points)

    Both return an array of doubles (our set of nodes)

- To get our error (difference between analytical value and approximated value) we developed one method.
- Another method to get the analytical value of our function in a point x

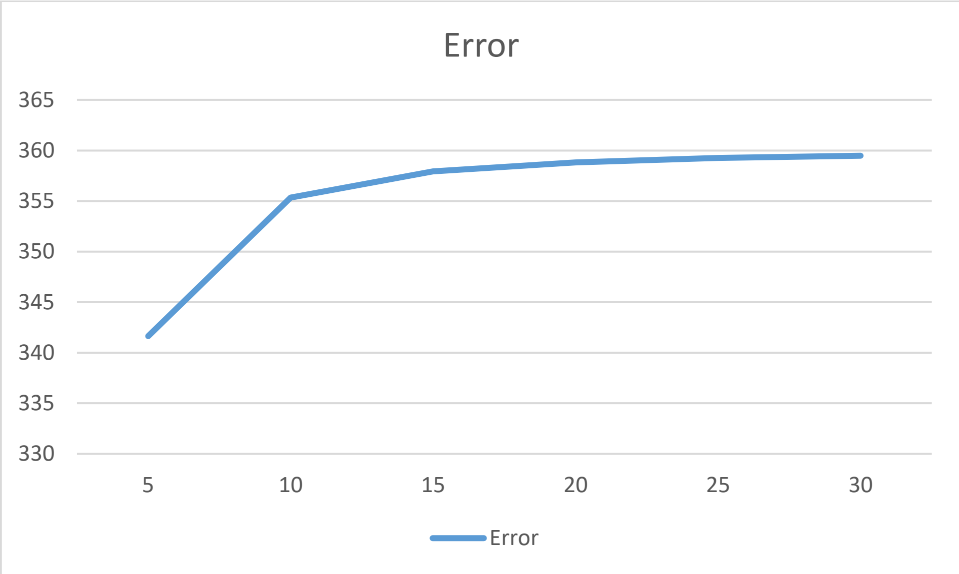
Apart from that, we thought necessary to create another class to write a set of results in a file .csv because we are interested in observing and analysing the behaviour of our results after running for each single parameter for a given [-a, a] and one point x.

By observing our results in our file "results.csv" generated by our program we can get the next conclusions:

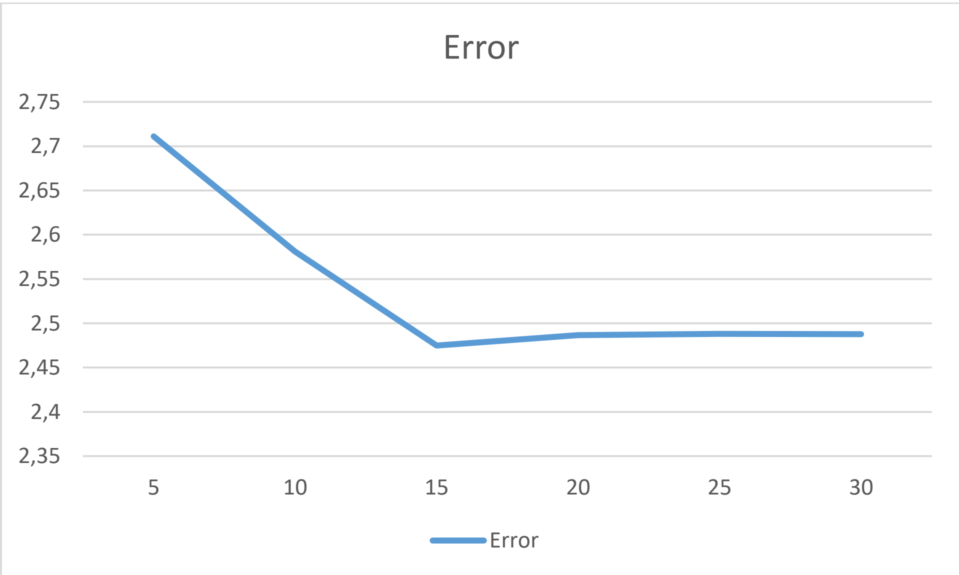
Results

We have taken the value x = 7 for an interval [-10,10]. All the results are available in the excel file "Inform.xlsl" with their graphics for each parameter but we are going to talk about the most remarkable results.

We can observe that for a polynomial function in a set of Chebyshev nodes our error increases a bit, from 341 with n=5 to 359 with n=30.



We also can see that for a rational function in a set of Chebyshev nodes our error decreases until n=15 where it's our minimum and from there is stabilized by being increased lightly.



It’s also remarkable that for a modulus function in a set of equally spaced nodes our error is being decreased and increased every step of n+=5

Meanwhile, for a Chebyshev set of nodes this same function is more stable, increasing its error every step of n