**Tasks for NUMMETH project #1**

In the process of working with the program and when you write a Report, you must answer the following questions:

1. How the interpolation accuracy depends on the:

a) growth of the number of nodes (N);

b) decrease of the parameter?

Compare this accuracy with theoretical estimates of Theorems 1 and 2; explain how these estimates depend on the parameters N and .

2. Compare two types of spline interpolation: linear and cubic; note the advantages and disadvantages of each. Describe effects related to these types of interpolation and emerged in the process of conducting numerical experiments.

3. What can you say about mesh adaptation mechanism: whether it is useful in the case of linear interpolation? Cubic interpolation?

You must include in the Report the most relevant experimental results.

**Menu of the NUMMETH program**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **File** | **Sections** | **Grid type** | **Test problems** | **Number of mesh points (N)** | **Parameter** | **Result** | **Help** |
| Graphics of the Errors | Methods for solving problems of algebra and analysis | Adapted | Problem №1 | N=9 | =0.5 | Linear spline | Theory |
| Save results in a file | Methods of solution of ordinary differential equations | Uniform | Problem №2 | N=17 | =0.25 | Quadratic spline | Task |
| Save graphics in a file |  |  | Problem №3 | …….. | ……….. | Cubic spline | Test problems |
| Exit the program |  |  | Problem №4 | Enter N | Enter |  |  |

**Individual project I.1.**

**Requirements for the program.** The program must include:

1. The Lagrange polynomial interpolation in accordance with formulas (I.1.2-3): a) on a uniform grid, b) on the Chebyshev grid.

2. The polynomial interpolation in accordance with the Neville method (Algorithm I.1.1.): a) on a uniform grid, b) on the Chebyshev grid.

3. Test functions (in accordance with the instructions of the teacher) with selectable parameter "ε". Discrete choice can be implemented according the formula: ε=2-к, к=0,1,2,…

4. Selection of the number of mesh points "N", for example, the following version: N=1+2к, к=2,3,4,…

5. Computing the interpolation error “Err (f)” on the "control" grid with nodes:

yi, i=1,2,...N-1;



6. Graphics: simultaneously drawing graphs of the function f(x) and the interpolation polynomials constructed above in two ways; drawing the interpolation mesh {xi}.

**The tasks for work with the program.** A numerical calculations, by varying the values of ε, N; use all test functions and interpolation options. Analyzing the results, answer the following questions:

1) Does the process of polynomial interpolation converge: a) on a uniform grid, b) for the Chebyshev grid?

2) Compare the accuracy of two interpolation variants (on a uniform and Chebyshev grids).

The main criteria of comparison: a) error (I. 1.6), b) visual proximity graphs of the function f(x) and the corresponding interpolant.

3) in all cases to evaluate the effectiveness of the method of Neville.

All conclusions need to argue by the results of numerical calculations and take the form of a Report.