

## DEPARTMENT OF MATHEMATICS, I.I.T. GUWAHATI

### MA 332: Scientific Computing Lab - IV

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1. The following data represents the function  $f(x) = \exp(x)$ .

$x$	1.0	1.5	2.0	2.5
$f(x)$	2.7183	4.4817	7.3819	12.1825

Estimate the value of  $f(2.25)$  using the (i) Newton's forward difference interpolation and (ii) Newton's backward difference interpolation. Compare with the exact value.

2. Approximate  $f(0.05)$  using the following data and the Newton forward-difference formula:

$x$	0.0	0.2	0.4	0.6	0.8
$f(x)$	1.00000	1.22140	1.49182	1.82212	2.22554

Use the Newton backward-difference formula to approximate  $f(0.65)$ .

3. Find the Newton's forward interpolating polynomial of degree 10 that interpolates the function  $\arctan x$  at 11 equally spaced points in the interval  $[1, 6]$ . Print the coefficients in the Newton form of the polynomial. Compute and print the difference between the polynomial and the function at 33 equally spaced points in the interval  $[0, 8]$ . What conclusion can be drawn?
4. Construct the Lagrange interpolating polynomial for the function  $f(x) = \ln x$ , and find a bound for the absolute error on the interval  $[x_0, x_3]$ , where  $x_0 = 1$ ,  $x_1 = 1.1$ ,  $x_2 = 1.3$ ,  $x_3 = 1.4$ .
5. Use appropriate Lagrange interpolating polynomials to approximate each of the following:
- a.  $f(0.18)$  if  $f(0.1) = -0.29004986$ ,  $f(0.2) = -0.56079734$ ,  $f(0.3) = -0.81401972$ ,  $f(0.4) = -1.0526302$
- b.  $f(0.25)$  if  $f(-1) = 0.86199480$ ,  $f(-0.5) = 0.95802009$ ,  $f(0) = 1.0986123$ ,  $f(0.5) = 1.2943767$
6. A census of the population of the United States is taken every 10 years. The following table lists the population, in thousands of people, from 1950 to 2000:

Year	1950	1960	1970	1980	1990	2000
Populations (in thousands)	151,326	179,323	203,302	226,542	249,633	281,422

Use appropriate divided differences to approximate the population in the years 1940, 1975, 2020.

7. Use the divided-difference method to obtain a polynomial of least degree that fits the values shown.

a. 

$x$	0	1	2	-1	3
$y$	-1	-1	-1	-7	5

b. 

$x$	1	3	-2	4	5
$y$	2	6	-1	-4	2

8. Write programmes for constructing Lagrange and Newton's divided difference interpolating polynomials for approximating a function at a given set of data points. Using them, find  $f(0.2)$  from the following table:

$x$	0.0	0.1	0.3	0.6	1.0
$f(x)$	-6.00000	-5.89483	-5.65014	-5.17788	-4.28172

Are you getting the same result from both the polynomials? If so, why?  
Add  $f(1.1) = -3.99583$  and see how it effects your solution.

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