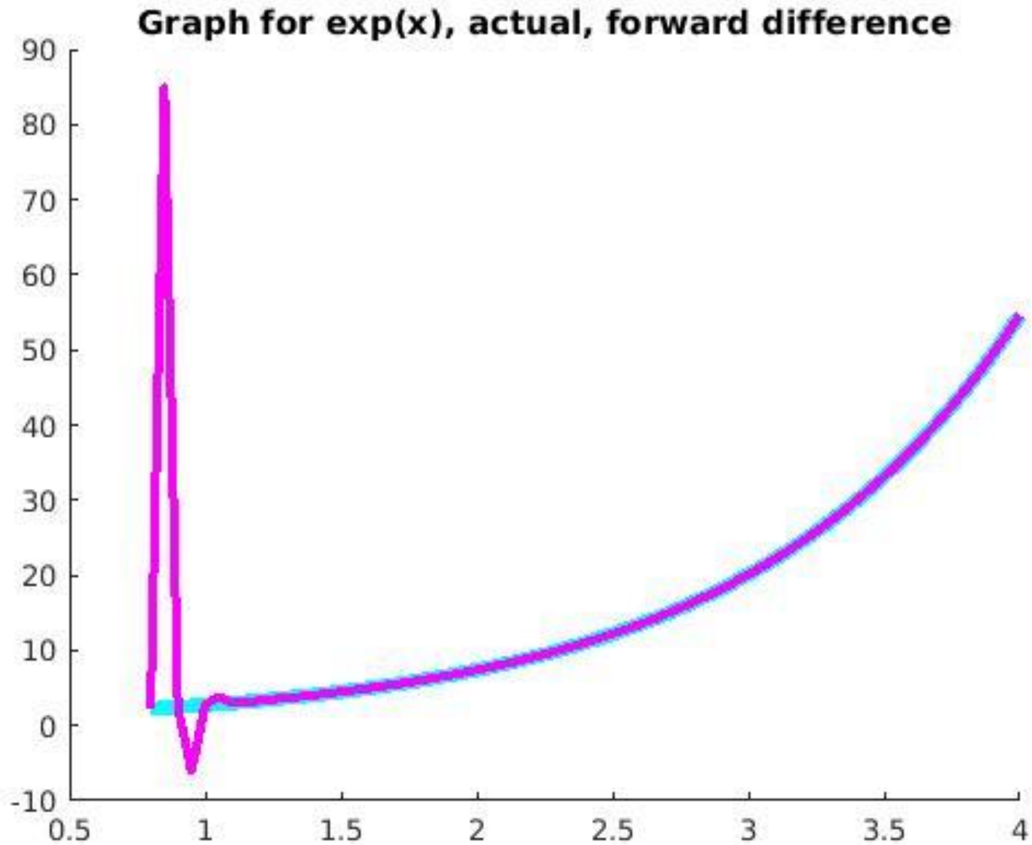
LAB 04

Lab Additional Assignment

Question: To interpolate exp(x) using forward difference and backward difference at 101 points and plot the graphs comparing actual vs the polynomials.

Solution:

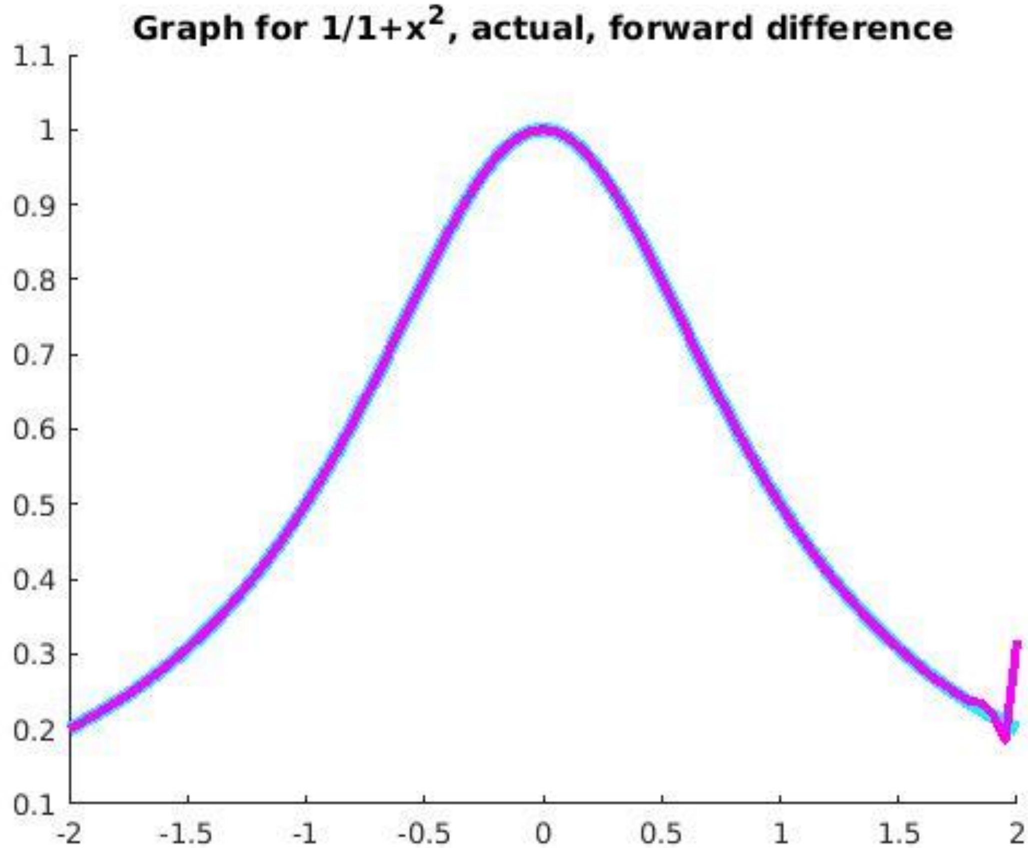
Define nodal points for exp(x)	Define query array
Enter start value 0 Enter increment 0.1 Enter end value 10	Enter start value 0.8 Enter increment 0.05 Enter end value 4



Question: To interpolate 1/1+x^2 using forward difference and backward difference at 101 points and plot the graphs comparing actual vs the polynomials.

Solution:

Define nodal points for 1/1+x^2	Define query array
Enter start value -5 Enter increment 0.1 Enter end value 5	Enter start value -2 Enter increment 0.05 Enter end value 2



Q1)

x: [1 1.5000 2 2.5000] y: [2.7183 4.4817 7.3819 12.1825] n: 4 f: exp(x) Calculating for: 2.2500	Exact Answer: 9.4877 Solution by Forward Difference Method: 9.4969 Solution by Forward Difference Method: 9.4969

Forward Difference Table

2.7183	1.7634	1.1368	0.7636
4.4817	2.9002	1.9004	0
7.3819	4.8006	0	0

12.1825	0	0	0

Backward Difference Table

2.7183	0	0	0
4.4817	1.7634	0	0
7.3819	2.9002	1.1368	0
12.1825	4.8006	1.9004	0.7636

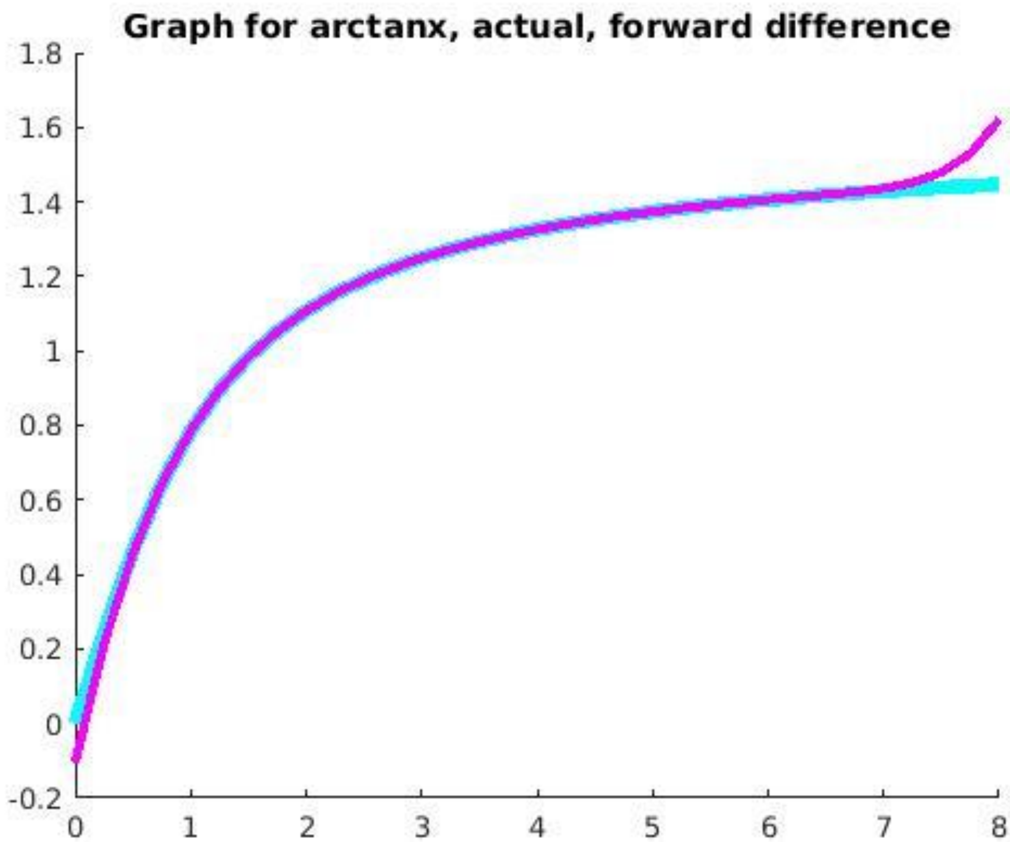
Result:

Difference between exact values and computed values is O(1e-2);

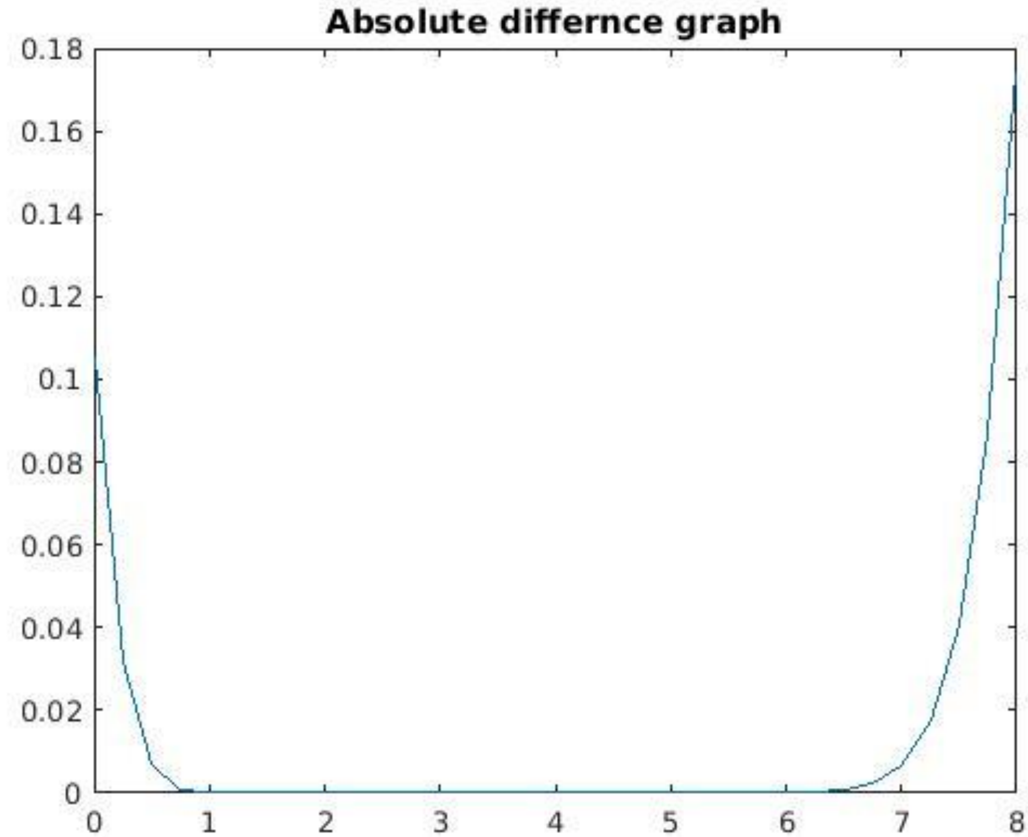
Q2)

x = 1:0.5:6; 11 values

v = 0:0.25:8; 33 values



Graph for arctanx, actual, forward difference
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
1
2
3
4
5
6
7
8



Coefficients of the polynomial:

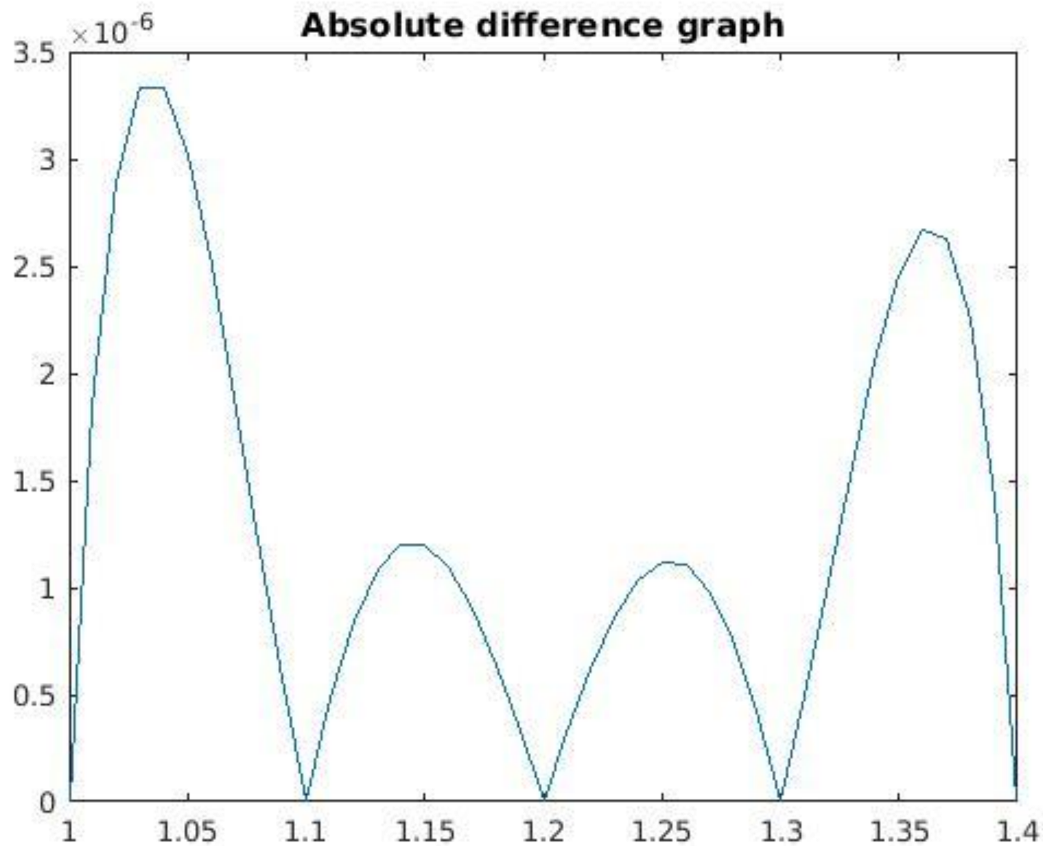
1.38E-07
-4.77E-06
6.96E-05
-0.000535462
0.002016113
0.000592218
-0.046966121
0.257510527
-0.773587747
1.451620024
-0.105316315

Conclusion:

Outside the range of [1 6] the error of the interpolating polynomial increases drastically.

Q3)

Bound for absolute error: 3.3349e-06 (maximum error in this interval)



Conclusion:

These points are not enough to properly interpolate this function we need a polynomial of higher degree.

Q4)

x: [0 0.1000 0.3000 0.6000 1]

y: [-6 -5.8948 -5.6501 -5.1779 -4.2817]

n: 5

Calculating for: 0.2000

Lagrange Interpolation: -5.77858958730159

Divided Difference Interpolation: -5.77858958730159

x: [0 0.1000 0.3000 0.6000 1 1.1000]

y: [-6 -5.8948 -5.6501 -5.1779 -4.2817 -3.9958]

n: 6

Calculating for: 0.2000

Lagrange Interpolation: -5.77859864935065

Divided Difference Interpolation: -5.77859864935065

Conclusion:

There was a slight change in the values after adding another degree O(1e-5).

Q5)

part a:

x: [0.1000 0.2000 0.3000 0.4000]

y: [-0.2900 -0.5608 -0.8140 -1.0526]

n: 4

Calculating for: 0.1800

Lagrange Interpolation: -0.5081

part b

x: [-1 -0.5000 0 0.5000]

y: [0.8620 0.9580 1.0986 1.2944]

n: 4

Calculating for: 0.2500

Lagrange Interpolation: 1.1889

Q6)

x: [1950 1960 1970 1980 1990 2000]

y: [151326 179323 203302 226542 249633 281422]

n: 6

Calculating for: 1940 1975 2020

Divided Difference Interpolation: 102397   215042.75 513443

Q7)

Using second degree polynomial

x: [2 3 5]

y: [1.5713 1.5719 1.5738]

n: 3

Calculating for: 4

Lagrange Interpolation: 1.5727

Using third degree polynomial

x: [2 3 5 6]

y: [1.5713 1.5719 1.5738 1.5751]

n: 4

Calculating for: 4

Lagrange Interpolation: 1.5727

Conclusion:

Here the value remained exactly same for both cases.

There was no advantage in taking a 3rd degree polynomial over a 2nd degree polynomial.