BLG202E Numerical Methods in Comp. Eng. Spring 2022 - Homework 4

Due:June 16, 2022

Question 1

Calculate the distance traveled based on the following.

Table 1: Velocity and time table

Time	1	2	3.25	4.5	6	7	8	8.5	9.3	10
Velocity	5	6	5.5	7	8.5	8	6	7	7	5

i) Use the trapezoidal rule.
ii) Use trapezoid and simpson rule together.
iii) Calculate the acceleration for t=7.3.

Question 2

Use the data in the table compute $f'(0.2)$ as accurately as possible.

Table 2: Velocity and time table

x	0	0.1	0.2	0.3	0.4
$f(x)$	0.000 000	0.078 348	0.138 910	0.192 916	0.244 981

Question 3

Using five significant figures in the computations, determine $d(sinx)/dx$ at $x = 0.8$ from a) the first forward difference approximation and b) the first central approximation. In each case, use h that gives the most accurate result(this requires experimentation).

Question 4

Determine $f'(0)$ and $f'(1)$ from the following noisy data with python.

x	0	0.2	0.4	0.6	0.8	1.0	1.2	1.4
$f(x)$	1.9934	2.1465	2.2129	2.1790	2.0683	1.9448	1.7655	1.5891

Question 5

x	0	0.4	0.8	1.2	1.8	2.2	2.6
$f(x)$	2.0	2.1465	2.5	2.6	2.0	0.8	0.4

a) Numerically calculate the position at t=2.6 seconds as precise as possible by using the most proper method(s). Initial position is 3 m.
b) Numerically calculate the acceleration at t=2.5 seconds by using the linear interpolation.
Obtain the results with 3 decimals.

Question 6

Given that

$$y' + 4y = x^2 \text{ and } y(0) = 1$$

determine y(0.2) with the fourth-order Taylor series method using a single integration step. Also compute the estimated error from Eq.(1) and compare it with the actual error.
The analytical solution of the differential equation is:

$$\frac{31}{32}e^{-4x} + \frac{1}{4} \times x^2 - \frac{1}{8} * x + \frac{1}{32}$$

Eq.(1):
$$\frac{h^m}{(m+1)!}[y^m * (x+h) - y^m * x]$$

Important Notes

• You are required to submit a PDF document and Python source codes to Ninova before the deadline.

• Solve questions 1, 2, 3, 5, 6 hand with necessary explanations of your steps. You may write your answers to a paper by hand, scan the papers and add them to the PDF document. In that case, please make sure that the scans are readable.

• For questions 4 write necessary Python programs and add the screenshots of the execution results to the document.

• Please make sure that you write your full name and student identification number to every file you submit.

• If you have any questions, please contact Seyma TAKIR via takir21@itu.edu.tr