**BACHELOR OF COMPUTER SCIENC**

**SCHOOL OF COMPUTER SCIENCE**

**BINA NUSANTARA UNIVERSITY**

**JAKARTA**

**ASSESSMENT FORM**

**Course: MATH6183001 – Scientific Computing**

**Method of Assessment:** **Case Study**

**Semester/Academic Year : 2/2022-2023**

**Name of Lecturer** **:**

**Date : 30 January 2023**

**Class : Computer Science**

**Topic : Regression & Interpolation, Taylor Series, Numerical Differentiation, Numerical Integration**

|  |  |
| --- | --- |
| **Group Members :** | 1\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  3\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  4\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  5\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  6\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  7\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  8\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

**Student Outcomes:**

(SO 1) Mampu menganalisis masalah komputasi yang kompleks dan mengaplikasikan prinsip komputasi dan keilmuan lain yang sesuai untuk mengidentifikasi solusi.

*Able to analyze a complex computing problem and to apply principles of computing and other relevant disciplines to identify solutions*

**Learning Objectives:**

(LObj 1.1) Mampu menganalisis masalah komputasi yang kompleks

*Able to analyze a complex computing problem*

(LObj 1.2) Mampu menerapkan prinsip komputasi dan disiplin ilmu terkait lainnya untuk mengidentifikasi solusi

*Able to apply principles of computing and other relevant disciplines to identify solutions*

**Learning Outcomes :**

(LO 1) Melakukan komputasi saintifik dasar menggunakan Pyhton

*Compute basic scientific computation using Python*

(LO 2) Menyelesaikan Sistem Persamaan Linear, Regresi dan Interpolasi menggunakan komputasi saintifik

*Solve the System of Linear Algebraic Equations, Regression and Interpolation through scientific computation*

(LO 3) Mengevaluasi penerapan Deret Taylor dan Akar Persamaan dalam komputasi saintifik

*Evaluate the application of Taylor Series and Root of Equations in scientific computation*

(LO 4) Menjelaskan konsep dasar dan penerapan Turunan Numerik, Integral Numerik, dan Persamaan Diferensial Biasa dalam komputasi saintifik

*Explain basic concept and application of Numerical Differentiation, Numerical Integration, and Ordinary Differential Equations in scientific computation*

| **No** | **Related LO-LOBJ-SO** | **Assessment criteria** | **Weight** | **Excellent (85 - 100)** | **Good (75-84)** | **Average (65-74)** | **Poor (0 - 64)** | **Score** | **(Score x Weight)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | LO2-L.Obj.1.2-SO1 | Understanding of Systems of Linear Equations, Regression and Interpolation | **35%** | Able to clearly explain the concept and solve problems in both numerical and computational approaches without errors. | Able to clearly explain the concept and solve problems in either numerical or computational approaches with some errors | Able to clearly explain the concept but unable to solve problems in both approaches | Only able to poorly explain the concept and unable to solve problems in both approaches | 100 | 35 |
| 2 | LO3-L.Obj.1.1-SO1 | Understanding of Taylor Series and Root of Equations | **30%** | Able to clearly explain the concept and solve problems in both numerical and computational approaches without errors. | Able to clearly explain the concept and solve problems in either numerical or computational approaches with some errors | Able to clearly explain the concept but unable to solve problems in both approaches | Only able to poorly explain the concept and unable to solve problems in both approaches | 100 | 30 |
| 3 | LO4-L.Obj.1.2-SO1 | Understanding of Numerical Differentiation, Integration, and Introductionary ODEs | **35%** | Able to clearly explain the concept and solve problems in both numerical and computational approaches without errors. | Able to clearly explain the concept and solve problems in either numerical or computational approaches with some errors | Able to clearly explain the concept but unable to solve problems in both approaches | Only able to poorly explain the concept and unable to solve problems in both approaches | 100 | 35 |
|  |  | **Total Score:** ∑(Score x Weight) | | | | | | | 100 |

Remarks:

**ASSESSMENT METHOD**

Instructions

The deadline of this comprehensive assignment is at the end the semester. Answer the questions below in .PDF format through BINUS Maya. Attach the manual calculation **AND** script that you use. All the answers **must** be rounded according to the given dataset!

1. The relationship between the average temperature on the earth's surface in odd years between 1981 - 1999, is given by the following below: **(35%)**

|  |  |
| --- | --- |
| **Year (y)** | **Temperature (x, oC)** |
| 1981 | 14.1999 |
| 1983 | 14.2411 |
| 1985 | 14.0342 |
| 1987 | 14.2696 |
| 1989 | 14.197 |
| 1991 | 14.3055 |
| 1993 | 14.1853 |
| 1995 | 14.3577 |
| 1997 | 14.4187 |
| 1999 | 14.3438 |

1. Estimate the temperature in even years by linear, quadratic, and cubic interpolation order! Choose the method that you think is appropriate, and explain the difference.
2. Perform a least-square regression of the above data to estimate the temperature in even years.
3. Perform an analysis of the difference between the results of the regression and interpolations you can above, explain based on the theoretical basis you have learned.
4. Make a plot that describes the relationship between Temperature (y) and Year (x) as informatively as possible for the reader, based on the results of your analysis using Python library.
5. Compute the fourth order Taylor expansion for sin(x) and cos(x) and sin(x)cos(x) around 0. **(30%)**
   1. Write down your manual calculation **AND** Python script to answer above’s question
   2. Which produces less error for x=π/2: computing the Taylor expansion for sin and cos separately then multiplying the result together, or computing the Taylor expansion for the product first then plugging in x?
   3. Use the same order of Taylor series to approximate cos (π/4) and determine the truncation error bound. You may include either your manual calculation **OR** Python script for this question
6. Given that . **(35%)**



1. Approximate   with 20 evenly-spaced grid points over the whole interval using Riemann Integral, Trapezoid Rule, and Simpson’s Rule. Explain the difference behind each of the method.



1. Compared to the methods above, do you think that analitycal integration could be more convenient to be done?
2. Use polynomial interpolation to compute and at *x* = 0, using the discrete data below



|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | -1.1 | -0.3 | 0.8 | 1.9 |
|  | 15.180 | 10.962 | 1.920 | -2.040 |

1. Calculate the accuracy result compared to the initial



**Note for Lecturers**:

1. The lecturers are advised to assess student’s understanding towards the topics included in the assignment.
2. The students will submit their answer in .PDF format through BINUS Maya.
3. The deadline of this comprehensive assignment is at the end the semester.