

UNIVERSITY OF MALAYA

TEST 2: FOR THE DEGREE OF BACHELOR OF ENGINEERING

ACADEMIC SESSION 2023 / 2024

: SEMESTER 1

KIL 2012 : Chemical Engineering Computing

January 2024

Marks: 30

Time: 1 hours

INSTRUCTIONS TO CANDIDATES:

Answer ALL questions.

QUESTION 1 (10 MARKS)

The `odeint` function from `scipy.integrate` is a powerful tool for solving ODEs. In this part, you will:

1. Solve the ODE:

$$\frac{dy}{dt} = -2yt$$

with the initial condition ($y(0) = 1$) for (t) within the interval $([0, 2])$.

2. Plot the solution ($y(t)$) versus (t) and analyze the behavior of the solution graphically.

**** Provide a well-commented Python script to solve the ODE.**

QUESTION 2 (5 MARKS)

Given the system of linear equations:

$$2x + 4y + 6z = 18$$

$$5x + 3y + 2z = 13$$

$$7x + 8y + 9z = 30$$

Represent this system in matrix form as ($AX = B$) and solve for the variables (x), (y), and (z).

Tasks:

1. Define the coefficient matrix (A) and the constant vector (B) using NumPy arrays.
 2. Use the `numpy.linalg.solve` function to find the solution vector (X) efficiently.
 3. Display the solution vector.
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Implementation Note:

- Make sure to output the solution in a readable format and comment on the code to explain the steps taken.

QUESTION 3 (15 MARKS)**Objective**

Write a Python script to retrieve hourly temperature data for a user-specified number of days (ranging from 1 to 16 days) from a weather API and plot the temperature trend.

Problem Statement

You are provided with an API endpoint that delivers hourly temperature data. Your task is to create a visualization of hourly temperature trends, showcasing how temperature changes over the specified number of days in a specific location.

API Endpoint Details

- URL: `https://api.open-meteo.com/v1/forecast`
- Parameters: `latitude=2.375&longitude=112.5&timezone=Asia/Singapore`
- Full URL (1 day) Example: `https://api.open-meteo.com/v1/forecast?latitude=2.5&longitude=112.5&hourly=temperature_2m&timezone=Asia%2FSingapore&forecast_days=1`

Tasks

1. Write a Python script to allow the user to input the number of days for the forecast. The range should be from 1 to 16 days.
2. The script should send a GET request to the API endpoint with parameters for the specified number of forecast days.
3. Extract the hourly time points and corresponding temperature data from the API response.
4. Use matplotlib to plot a line chart visualizing the hourly temperature trend.
5. The chart should include:
 - Axes labels.
 - A title that incorporates the latitude, longitude, elevation, and the number of forecast days from the API response.
 - A grid for enhanced readability.
6. The script should allow the user to reforecast with a different number of days or exit the program.

Instructions for Students

- Your code should include comments explaining each step and decision.
- Aim for a clear and visually appealing chart.
- After plotting the chart, provide a brief analysis of the temperature trend observed.
- Ensure the user inputs a valid number of days within the specified range.
- Include error handling for potential issues, such as invalid input.

END