Python with Parallel Programming Lab Exam questions by Praveen:

Shilpa/ Archana madam:

I plan to give 4 questions(2 from each part, in 2hrs) to be attended by participants for lab exam.

If only 2 questions to be given for this batch, then my choice is:

Part 1 : Q4

Part 2 : Q1 or Q2

Attend 2 questions from part-1(20 marks) and 2 from part-2(20 marks)

✅ Part 1: Python Lab Exam – Core Concepts

Total Questions: any 2 in 4 | Duration: 1 Hour | Format: Hands-on Tasks

Covers: Core Python, OOP, File Handling, Modules, Data Structures, Flask, NumPy, Pandas, Data Viz, Regex

🔷Q1. NumPy

- Generate a 5x5 matrix of random integers.
- Compute transpose, determinant, and inverse (handle exceptions).

🔷Q2. Pandas EDA

- Load data.csv with Pandas.
- Display basic info, handle missing values, group by a categorical column.

🔷 Q3. Data Visualization (Matplotlib + Seaborn)

- Load iris or tips dataset using Seaborn.
- Plot:
  - Histogram of a numeric column.
  - Boxplot comparing 2 categorical classes.
  - Heatmap of correlations.
- Save each plot as a PNG file.

🔷 Q4. Pandas DataFrames : Given the following two Pandas DataFrames:

import pandas as pd

import numpy as np

```
df1 = pd.DataFrame(
    np.arange(1,26).reshape(5,5),
    index=list('ABCDE'),
    columns = ['Col1', 'Col2', 'Col3', 'Col4', 'Col5']
)

df2 = pd.DataFrame(
    [
        ['Praveen', 'Kumar', 44, 'Male'],
        ['Ajay', 'Krishna', 54, 'Male'],
        ['Shreya', 'Rathi', 32, 'Female'],
        ['Vidya', 'Rao', 28, 'Female'],
    ],
    index = [101,102,103,104],
    columns = [ 'First Name', 'Last Name', 'AGE', 'GENDER' ]
)
```

Tasks (Perform all subparts):

◈ Part A – DataFrame df1 (Numeric Data)

1. **Print the first 3 rows and last 2 columns using both label-based and position-based slicing.**

2. **Display the sum of all values row-wise and column-wise. Add these as two new rows/columns named RowSum, ColSum.**
3. **Extract a sub-DataFrame containing:**
    - **Rows: 'B' to 'D' (inclusive)**
    - **Columns: 'Col2', 'Col3', 'Col4'**
4. **Create a line plot for all rows of df1, plotting values of 'Col1', 'Col2', 'Col3' using Matplotlib. Use different markers for each row.**

🔹 **Part B – DataFrame df2 (Categorical + Numeric Data)**

5. **Display only the records where:**
    - **Gender is 'Female'**
    - **Age is less than 35**
6. **Add a new column 'Full Name' by combining 'First Name' and 'Last Name'.**
7. **Create a bar plot using Matplotlib or Seaborn:**
    - **X-axis: 'Full Name'**
    - **Y-axis: 'AGE'**
    - **Color bars based on 'GENDER' using hue in Seaborn.**
8. **Create a pie chart showing the gender distribution in df2.**

✅ Part 2: Python Lab Exam – Parallel Programming

Total Questions: any 2 in 6 | Duration: 1 Hour | Format: Hands-on Tasks

Covers: Multiprocessing, Multithreading, AsyncIO, Distributed Python, GPU Programming, cupy, numba, pycuda

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🔷Q1. Multiprocessing – Basics

Create a script to:

- Spawn two child processes.
- First prints even numbers from 1 to 50.
- Second prints odd numbers from 1 to 50.

🔷Q2. Multiprocessing – Pool & Map

- Use multiprocessing.Pool to calculate square of numbers from 1 to 10.
- Log results using map() and apply().

🔷Q3. Multithreading – Synchronization

- Simulate a bank account using threading.Lock() where multiple threads try to withdraw money.

🔷Q4. Queue-based Thread Communication

- Producer thread: generate 10 random numbers and put in Queue.
- Consumer thread: read from queue and calculate factorial.

🔷Q5. Process Communication

- Two processes exchange data using multiprocessing.Pipe.

🔷 Q6. PyCUDA Programming

- Install PyCUDA (mock if GPU not available).
- Write a basic kernel for adding two vectors.