# Bytes of Intelligence: Set - 03

**Department of AI Engineering**

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**Semester Examination**

**Course Title:** Deep Learning Techniques in Python for Vision and Language

**Course Code:** DL-101

**Duration:** 3 Hours

**Total Marks:** 100

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## Instructions:

- **Attempt all questions.**
- **Read each question carefully before answering.**
- **All code should be properly commented and indented.**
- **Use appropriate data structures and algorithms where necessary.**
- **Marks are indicated next to each question.**
- **Assume any necessary imports (e.g., `import numpy as np`, `import pandas as pd`).**
- **Write your code in Python programming language.**

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## Question 1: Python Fundamentals and Data Types (15 Marks)

### (a) Basic Data Types and Operations (7 Marks)

Write a Python script that:

- Prompts the user to input two numbers (integer or float). *(2 Marks)*
- Performs and prints the result of the following operations between the two numbers: addition, subtraction, multiplication, division, and modulus. *(5 Marks)*

**Example:**

```
Enter the first number: 15
Enter the second number: 4
Results:
Addition: 19
```

```
Subtraction: 11
Multiplication: 60
Division: 3.75
Modulus: 3
```

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### (b) String Manipulation and Functions (8 Marks)

Define a function `process_string(s)` that takes a string `s` as input and performs the following:

- Converts the string to lowercase. *(1 Mark)*
- Counts and prints the number of vowels and consonants in the string. *(5 Marks)*
- Reverses the string and returns it. *(2 Marks)*

**Example:**

```
Input: "Hello World"
Output:
Number of vowels: 3
Number of consonants: 7
Reversed string: "dlroW olleH"
```

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## Question 2: Control Structures and Data Structures (20 Marks)

### (a) Conditional Statements and Loops (10 Marks)

Write a Python program that:

- Generates a list of numbers from 1 to 50. *(2 Marks)*
- Iterates through the list and prints "Fizz" for numbers divisible by 3, "Buzz" for numbers divisible by 5, and "FizzBuzz" for numbers divisible by both 3 and 5. For all other numbers, print the number itself. *(8 Marks)*

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### (b) Data Structures Manipulation (10 Marks)

You are given the following dictionary representing students and their scores:

```
students_scores = {
    "Emily": [88, 92, 85],
    "John": [78, 76, 80],
    "Sarah": [90, 91, 89],
    "Michael": [65, 70, 72],
```

```
    "Jessica": [95, 98, 94]
}
```

Perform the following tasks:

- Calculate and print the average score for each student. *(5 Marks)*
- Create a new dictionary `passed_students` that contains only the students with an average score of 85 or higher. *(5 Marks)*

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## Question 3: NumPy Arrays and Operations (15 Marks)

### (a) Array Creation and Indexing (8 Marks)

- Create a NumPy array of shape `(6, 6)` with random integers between 1 and 100. *(2 Marks)*
- Extract the subarray consisting of rows 2 to 4 and columns 3 to 5. *(3 Marks)*
- Calculate the maximum, minimum, and mean values of the extracted subarray. *(3 Marks)*

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### (b) Mathematical Operations and Broadcasting (7 Marks)

Given two NumPy arrays:

```
A = np.array([[2, 4, 6], [8, 10, 12]])
B = np.array([1, 2, 3])
```

- Use broadcasting to subtract array `B` from each row of array `A`. *(4 Marks)*
- Compute the element-wise square of the result. *(3 Marks)*

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## Question 4: Data Analysis with Pandas (25 Marks)

### (a) Data Loading and Preprocessing (10 Marks)

You have a CSV file named `employees.csv` with columns: `'EmployeeID'`, `'Name'`, `'Department'`, `'Salary'`, `'JoiningDate'`.

- Load the dataset into a Pandas DataFrame. *(2 Marks)*
- Convert the `'JoiningDate'` column to datetime format. *(2 Marks)*
- Add a new column `'Experience'` that calculates the number of years the employee has been with the company as of today's date. *(6 Marks)*

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**(b) Data Manipulation and Analysis (10 Marks)**

Using the DataFrame from part (a):

- Filter the DataFrame to include only employees from the 'IT' and 'HR' departments with a salary greater than $70,000. *(5 Marks)*
- Group the filtered data by `'Department'` and calculate the average `'Experience'` and average `'Salary'`. *(5 Marks)*

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**(c) Data Exporting (5 Marks)**

- Export the grouped data from part (b) to a new CSV file named `'department_analysis.csv'`. Ensure that the index is not included in the output file.

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## Question 5: Data Visualization with Matplotlib and Seaborn (15 Marks)

**(a) Matplotlib Visualization (7 Marks)**

Using the original `employees.csv` DataFrame:

- Create a **histogram** of the `'Salary'` column to visualize the distribution of salaries across all employees.
- Customize the plot by adding a title, labels for axes, and setting the number of bins to 10.

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**(b) Seaborn Visualization (8 Marks)**

- Using Seaborn, create a **violin plot** to compare the salary distributions across different departments.
- Interpret the plot and comment on any insights regarding salary variations between departments.

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## Question 6: Working with Pandas and External Data (15 Marks)

You are provided with an Excel file `sales_data.xlsx` containing two sheets: `'2022_Sales'` and `'2023_Sales'`. Each sheet has the columns: `'Date'`, `'Region'`, `'Product'`, `'Quantity'`, `'UnitPrice'`.

**Tasks:**

- Load both sheets into separate Pandas DataFrames and combine them into a single DataFrame. *(4 Marks)*

- Add a new column `'TotalSales'` calculated as `'Quantity'` * `'UnitPrice'`. *(2 Marks)*
- Find the top 5 products with the highest total sales across both years. *(4 Marks)*
- Using Matplotlib, plot a **line chart** showing the monthly total sales for the product with the highest sales. Include labels, title, and legend. *(5 Marks)*

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## Question 7: Capstone Coding Challenge (Bonus Question - Optional) (10 Marks)

**Data Processing and Visualization**

Write a Python script that:

- Reads a CSV file `'temperature_data.csv'` containing daily temperature readings with columns `'Date'` and `'Temperature'`. *(1 Mark)*
- Converts the `'Date'` column to datetime format and sets it as the index. *(2 Marks)*
- Resamples the data to calculate the **monthly average temperature**. *(2 Marks)*
- Detects and handles any missing data by interpolating missing temperature values. *(3 Marks)*
- Plots the original daily temperatures and the monthly average temperatures on the same graph using Matplotlib. Include appropriate labels, title, and legend. *(2 Marks)*