Algorithms, Programming, and Logic

1. Algorithm Design and Problem-Solving:

- **Program Development Life Cycle:**
  - **Analysis:**
    - **Abstraction:** Focus on essential aspects, ignoring irrelevant details.
    - **Decomposition:** Break down the problem into smaller parts.
    - **Identification:** Determine the exact problem and requirements.
  - **Design:**
    - **Decomposition:** Break down the problem into steps or modules.
    - **Structure Diagrams:** Visual representations (e.g., data flow diagrams).
    - **Flowcharts:** Diagrams showing control flow through an algorithm.
    - **Pseudocode:** High-level description resembling code.
  - **Coding:**
    - **Write Program Code:** Translate the algorithm into code.
    - **Iterative Testing:** Test and refine the code to find and fix errors.
  - **Testing:**
    - **Test Data:** Use various data sets (normal, boundary, extreme).
- **Standard Methods of Solution:**

Linear Search:
python
Copy code

```
def linear_search(arr, target):
    for i in range(len(arr)):
        if arr[i] == target:
            return i
    return -1
```

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Bubble Sort:
python
Copy code

```
def bubble_sort(arr):
    n = len(arr)
    for i in range(n):
        for j in range(0, n-i-1):
            if arr[j] > arr[j+1]:
                arr[j], arr[j+1] = arr[j+1], arr[j]
    return arr
```

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- **Validation and Verification:**
    - **Validation Checks:** Ensure data meets criteria (e.g., range check, format check).
    - **Verification Checks:** Confirm data accuracy (e.g., visual check, double entry check).
    - **Test Data Types:**
        - **Normal:** Typical data values.
        - **Abnormal:** Unexpected values.
        - **Extreme:** Boundary values.
        - **Boundary:** Edge of acceptable limits.

2. Programming Concepts:

- **Basic Constructs:**

Variables and Constants:
python
Copy code
```
age = 25  # Variable
PI = 3.14  # Constant
```

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    - **Data Types:** Integer, Real, Char, String, Boolean.
    - **Control Structures:**
        - **Sequence:** Direct execution of code.

Selection: Conditional execution.
python
Copy code
```
if age >= 18:
    print("Adult")
else:
    print("Minor")
```

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Iteration: Repeated execution.
python
Copy code
```
for i in range(5):
    print(i)
```

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- **String Handling:**

    - **Operations:**
        - **Length:** `len(string)`
        - **Substring:** `string[start:end]`
        - **Upper/Lower Case:** `string.upper()`, `string.lower()`
- **Operators:**

Arithmetic Operators:
python
Copy code
```
result = 10 + 5  # Addition
result = 10 - 5  # Subtraction
result = 10 * 5  # Multiplication
result = 10 / 5  # Division
result = 10 % 3  # Modulus
```

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    - **Boolean Operators:**
        - **AND:** `True and False` results in `False`
        - **OR:** `True or False` results in `True`
        - **NOT:** `not True` results in `False`
- **Procedures and Functions:**

Procedures: Perform tasks without returning a value.
python
Copy code
```
def greet():
    print("Hello, World!")
```

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Functions: Perform tasks and return a value.
python
Copy code
```
def add(a, b):
    return a + b
```

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Parameters: Input to procedures/functions.
python
Copy code
```
def multiply(x, y):
    return x * y
```

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- **Maintainable Programs:**
    - **Meaningful Identifiers:** Use descriptive names.
    - **Commenting:** Explain code parts.

3. Arrays:

One-Dimensional (1D) Arrays:
python
Copy code
```
numbers = [1, 2, 3, 4, 5]
print(numbers[0])  # Access first element
```

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Two-Dimensional (2D) Arrays:
python
Copy code
```
matrix = [[1, 2], [3, 4]]
print(matrix[0][1])  # Access element in first row, second column
```

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4. File Handling:

- **Purpose:** Store and retrieve data from files.
- **Operations:**
    - **Open File:** `file = open("filename.txt", "r")`

Read/Write Data:
python
Copy code
```
with open("filename.txt", "w") as file:
    file.write("Hello, World!")
```

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    - **Close File:** `file.close()`

5. Databases:

- **Single-Table Database:**
    - **Fields:** Columns (e.g., Name, Age).
    - **Records:** Rows (e.g., individual data).
    - **Primary Key:** Unique identifier for records.
- **SQL Basics:**

SELECT: Retrieve data.
sql
Copy code
```
SELECT * FROM table_name;
```

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- **FROM:** Specify table.

WHERE: Filter results.
sql
Copy code
```
SELECT * FROM table_name WHERE condition;
```

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ORDER BY: Sort results.
sql
Copy code
```
SELECT * FROM table_name ORDER BY column_name;
```

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6. Boolean Logic:

- **Logic Gates:**

AND Gate:
plaintext
Copy code
```
A B | Output
0 0 | 0
0 1 | 0
1 0 | 0
1 1 | 1
```

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OR Gate:
plaintext
Copy code
```
A B | Output
0 0 | 0
0 1 | 1
1 0 | 1
```

```
1 1 | 1
```

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NOT Gate:
plaintext
Copy code
```
A | Output
0 | 1
1 | 0
```

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- **Creating and Understanding Logic Circuits:**
    - **Truth Tables:** Show input combinations and outputs.

(https://compbridge.vercel.app/)