ASSIGNMENT-12.1

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Algorithms with AI Assistance – Sorting, Searching, and Optimizing Algorithms

Lab Objectives:

*** Apply AI-assisted programming to implement and optimize sorting and searching algorithms.**

*** Compare different algorithms in terms of efficiency and use**

*** Understand how AI tools can suggest optimized code and complexity improvements.**

Task Description #1 (Sorting – Merge Sort Implementation)

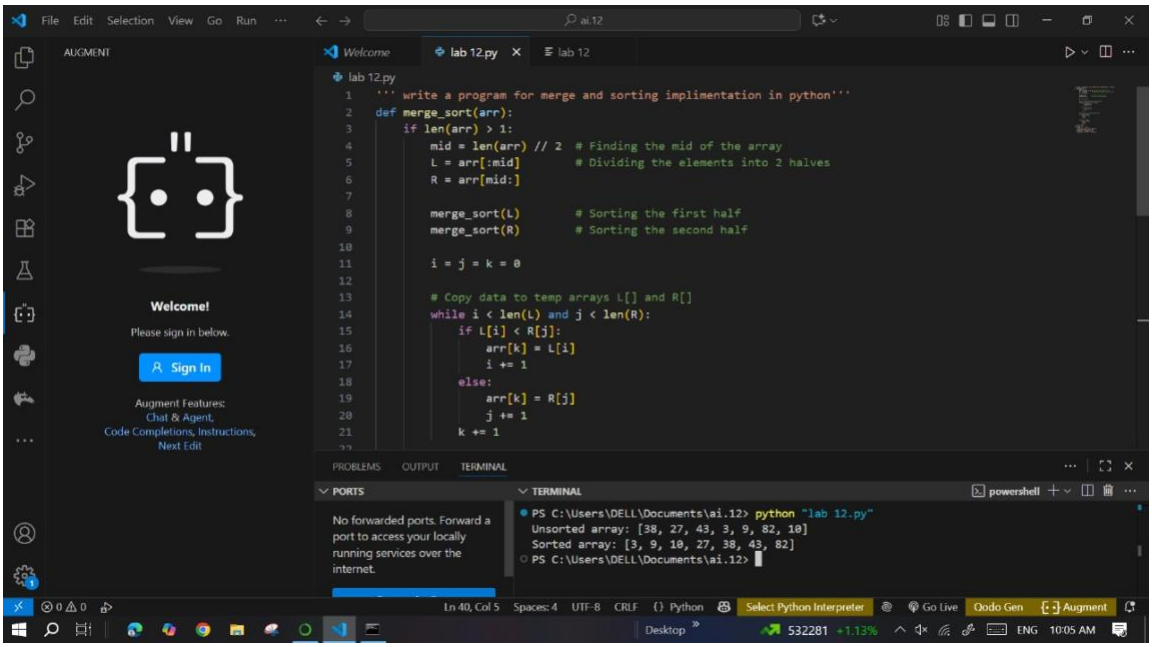
*** Task: Use AI to generate a Python program that implements the Merge Sort algorithm.**

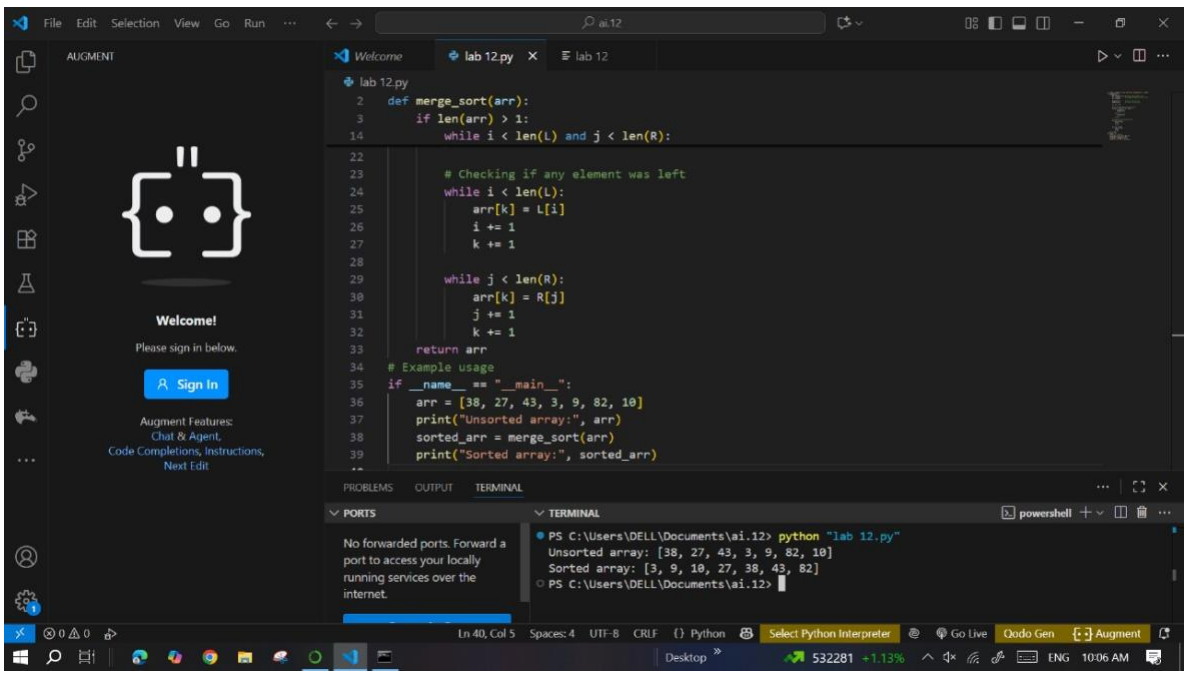
*** Instructions:**

o Prompt AI to create a function merge_sort(arr) that sorts a list in ascending order.

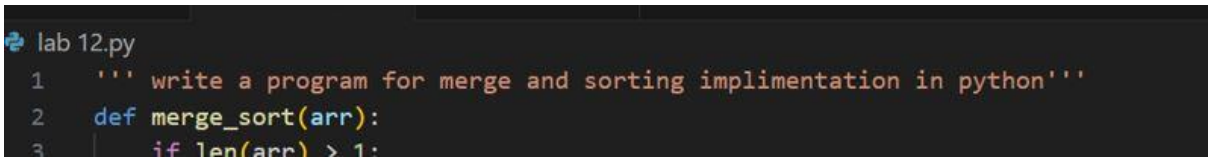
o Ask AI to include time complexity and space complexity in the function docstring

o Verify the generated code with test cases.





Prompt:



Expected output:

o A functional Python script implementing Merge Sort with

proper documentation

```
TERMINAL
PS C:\Users\DELL\Documents\ai.12> python "lab 12.py"
Unsorted array: [38, 27, 43, 3, 9, 82, 10]
Sorted array: [3, 9, 10, 27, 38, 43, 82]
PS C:\Users\DELL\Documents\ai.12>
```

Task Description #2 (Searching – Binary Search with AI Optimization)

*** Task: Use AI to create a binary search function that finds a target element in a sorted list.**

*** Instructions:**

o Prompt AI to create a function binary_search(arr, target) returning the index of the target or -1 if not found.

o Include docstrings explaining best, average, and worst-case complexities.

o Test with various inputs.

Prompt:

```
12.py
''' write a python program for binary search fpr a target one from the sorted list'''
def binary_search(arr, target):
```

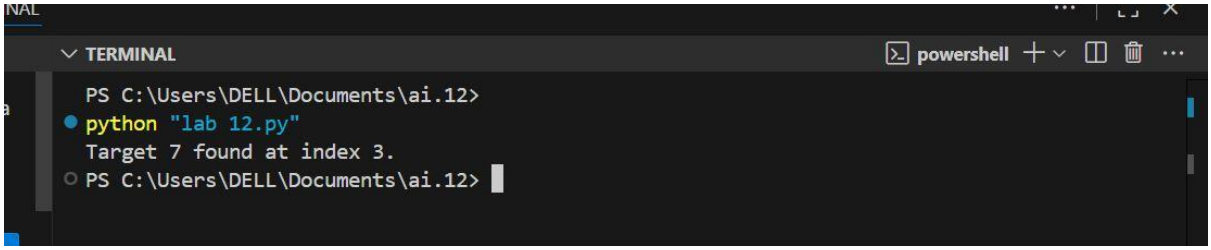
Code:

```
lab 12.py
''' write a python program for binary search fpr a target one from the sorted list'''
def binary_search(arr, target):
    left, right = 0, len(arr) - 1
    while left <= right:
        mid = (left + right) // 2
        if arr[mid] == target:
            return mid
        elif arr[mid] < target:
            left = mid + 1
        else:
            right = mid - 1
    return -1
# Example usage
sorted_list = [1, 3, 5, 7, 9, 11, 13, 15]
target = 7
result = binary_search(sorted_list, target)
if result != -1:
    print(f'Target {target} found at index {result}.')
else:
    print(f'Target {target} not found in the list.')
# Output: Target 7 found at index 3.
```

*** Expected Output:**

o Python code implementing binary search with AI-

generated comments and docstrings.



Task Description #3 (Real-Time Application – Inventory Management System)

*** Scenario: A retail store's inventory system contains thousands of products, each with attributes like product ID, name, price, and stock quantity. Store staff need to:**

1. Quickly search for a product by ID or name.

2. Sort products by price or quantity for stock analysis.

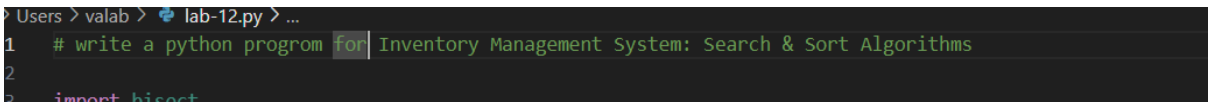
*** Task:**

o Use AI to suggest the most efficient search and sort algorithms for this use case.

o Implement the recommended algorithms in Python.

o Justify the choice based on dataset size, update frequency, and performance requirements.

Prompt:



```python
# Inventory Management System: Search & Sort Algorithms

import bisect

# Sample inventory: list of dicts
inventory = [
    {"id": 101, "name": "Apple", "price": 0.5, "quantity": 120},
    {"id": 102, "name": "Banana", "price": 0.3, "quantity": 200},
    {"id": 103, "name": "Orange", "price": 0.7, "quantity": 150},
    {"id": 104, "name": "Milk", "price": 1.2, "quantity": 80},
    {"id": 105, "name": "Bread", "price": 1.0, "quantity": 60},
]


def build_index(inventory):
    id_map = {item["id"]: item for item in inventory}
    name_map = {item["name"].lower(): item for item in inventory}
    return id_map, name_map

id_map, name_map = build_index(inventory)

def search_by_id(product_id):
    """Search product by ID using hash map."""
    return id_map.get(product_id)

def search_by_name(product_name):
    """Search product by name using hash map (case-insensitive)."""
    return name_map.get(product_name.lower())

def sort_by_price(inventory, reverse=False):
```

```
def sort_by_price(inventory, reverse=False):
    """Sort inventory by price using Timsort."""
    return sorted(inventory, key=lambda x: x["price"], reverse=reverse)

def sort_by_quantity(inventory, reverse=False):
    return sorted(inventory, key=lambda x: x["quantity"], reverse=reverse)

# --- Test Cases ---
def test_search_by_id():
    assert search_by_id(101)["name"] == "Apple"
    assert search_by_id(105)["price"] == 1.0
    assert search_by_id(999) is None

def test_search_by_name():
    assert search_by_name("banana")["id"] == 102
    assert search_by_name("MILK")["quantity"] == 80
    assert search_by_name("unknown") is None

def test_sort_by_price():
    sorted_inv = sort_by_price(inventory)
    assert sorted_inv[0]["name"] == "Banana"
    assert sorted_inv[-1]["name"] == "Milk"
    sorted_inv_desc = sort_by_price(inventory, reverse=True)
    assert sorted_inv_desc[0]["name"] == "Milk"

def test_sort_by_quantity():
    sorted_inv = sort_by_quantity(inventory)
    assert sorted_inv[0]["name"] == "Bread"
```

AI.py | lab-12.py

C: > Users > valab > lab-12.py > sort_by_quantity

```
48  def test_sort_by_price():
49      sorted_inv = sort_by_price(inventory)
50      assert sorted_inv[0]["name"] == "Banana"
51      assert sorted_inv[-1]["name"] == "Milk"
52      sorted_inv_desc = sort_by_price(inventory, reverse=True)
53      assert sorted_inv_desc[0]["name"] == "Milk"
54
55  def test_sort_by_quantity():
56      sorted_inv = sort_by_quantity(inventory)
57      assert sorted_inv[0]["name"] == "Bread"
58      assert sorted_inv[-1]["name"] == "Banana"
59      sorted_inv_desc = sort_by_quantity(inventory, reverse=True)
60      assert sorted_inv_desc[0]["name"] == "Banana"
61
62  # --- Run Tests ---
63  if __name__ == "__main__":
64      test_search_by_id()
65      test_search_by_name()
66      test_sort_by_price()
67      test_sort_by_quantity()
68      print("All tests passed.")
69
70
```

*** Expected Output:**

o A table mapping operation → recommended algorithm → justification.

o Working Python functions for searching and sorting the inventory.

Deliverables (For All Tasks)

1. AI-generated prompts for code and test case generation.

2. At least 3 assert test cases for each task.

3. AI-generated initial code and execution screenshots.

4. Analysis of whether code passes all tests.

5. Improved final version with inline comments and explanation.

6. Compiled report (Word/PDF) with prompts, test cases, assertions, code, and output.