Assignment-12.4

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Batch No : 42

QUESTION:

Task 1: Sorting Student Records for Placement Drive

Scenario

SR University's Training and Placement Cell needs to shortlist candidates efficiently during campus placements. Student records must be sorted by

CGPA in descending order.

Tasks

1. Use GitHub Copilot to generate a program that stores student records

(Name, Roll Number, CGPA).

2. Implement the following sorting algorithms using AI assistance:

o Quick Sort o

Merge Sort

3. Measure and compare runtime performance for large datasets.

4. Write a function to display the top 10 students based on CGPA.

Expected Outcome

• Correctly sorted student records.

• Performance comparison between Quick Sort and Merge Sort.

• Clear output of top-performing students.

CODE:

Using quick sort:

DemoOfCal.py | portfolio.py | loopiteration.py | conditional logic.py .\ | conditional logic.py C:\...\python codes from 51 video | code.py

C: > Users > Chithra > OneDrive > python codes from 51 video > #genearate a python code for student rec.py > ...

```python
#genearate a python code for student record name,roll number, and CPGA using quick sort algorithm
class Student:
    def __init__(self, name, roll_number, cgpa):
        self.name = name
        self.roll_number = roll_number
        self.cgpa = cgpa
def partition(arr, low, high):
    pivot = arr[high].cgpa
    i = low - 1
    for j in range(low, high):
        if arr[j].cgpa > pivot:
            i += 1
            arr[i], arr[j] = arr[j], arr[i]
    arr[i + 1], arr[high] = arr[high], arr[i + 1]
    return i + 1
def quick_sort(arr, low, high):
    if low < high:
        pi = partition(arr, low, high)
        quick_sort(arr, low, pi - 1)
        quick_sort(arr, pi + 1, high)
def print_students(students):
    for student in students:
        print(f"Name: {student.name}, Roll Number: {student.roll_number}, CGPA: {student.cgpa}")
if __name__ == "__main__":
    students = [
        Student("Alice", 1, 3.5),
        Student("Bob", 2, 3.8),
        Student("Charlie", 3, 3.2),
        Student("David", 4, 3.9),
        Student("Eve", 5, 3.6)
    ]
    print("Before sorting:")
    print_students(students)
    quick_sort(students, 0, len(students) - 1)
    print("\nAfter sorting by CGPA (descending):")
    print_students(students)
```

Output:

```
Before sorting:
Name: Alice, Roll Number: 1, CGPA: 3.5
Name: Bob, Roll Number: 2, CGPA: 3.8
Name: Charlie, Roll Number: 3, CGPA: 3.2
Name: Alice, Roll Number: 1, CGPA: 3.5
Name: Bob, Roll Number: 2, CGPA: 3.8
Name: Charlie, Roll Number: 3, CGPA: 3.2
Name: Charlie, Roll Number: 3, CGPA: 3.2
Name: David, Roll Number: 4, CGPA: 3.9
Name: Eve, Roll Number: 5, CGPA: 3.6

After sorting by CGPA (descending):
Name: David, Roll Number: 4, CGPA: 3.9
Name: Bob, Roll Number: 2, CGPA: 3.8
Name: Eve, Roll Number: 5, CGPA: 3.6
Name: Alice, Roll Number: 1, CGPA: 3.5
After sorting by CGPA (descending):
Name: David, Roll Number: 4, CGPA: 3.9
Name: Bob, Roll Number: 2, CGPA: 3.8
Name: Eve, Roll Number: 5, CGPA: 3.6
Name: Alice, Roll Number: 1, CGPA: 3.5
Name: Bob, Roll Number: 2, CGPA: 3.8
Name: Eve, Roll Number: 5, CGPA: 3.6
Name: Alice, Roll Number: 1, CGPA: 3.5
Name: Alice, Roll Number: 1, CGPA: 3.5
Name: Charlie, Roll Number: 3, CGPA: 3.2
```

Using merge sort:

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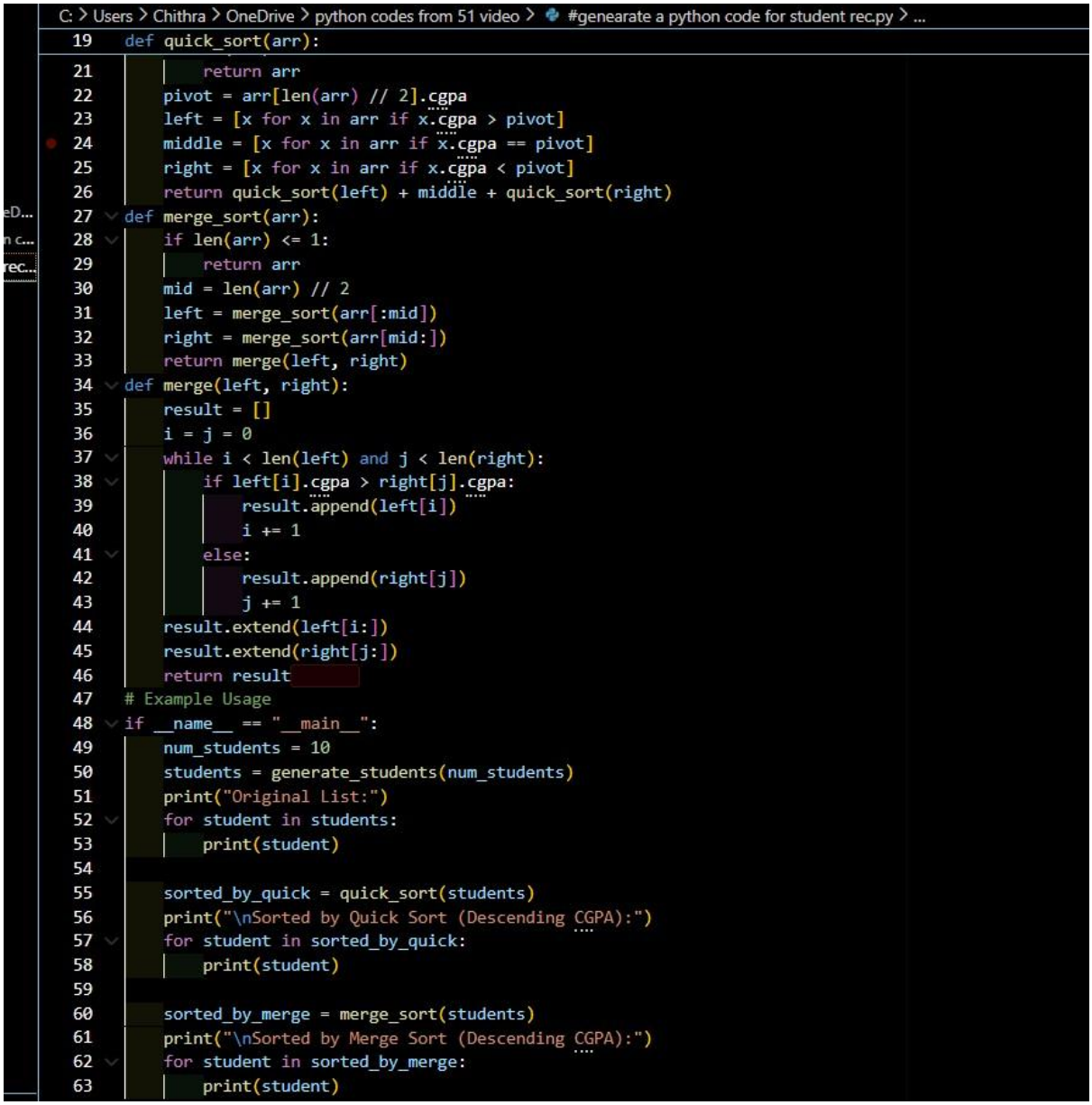
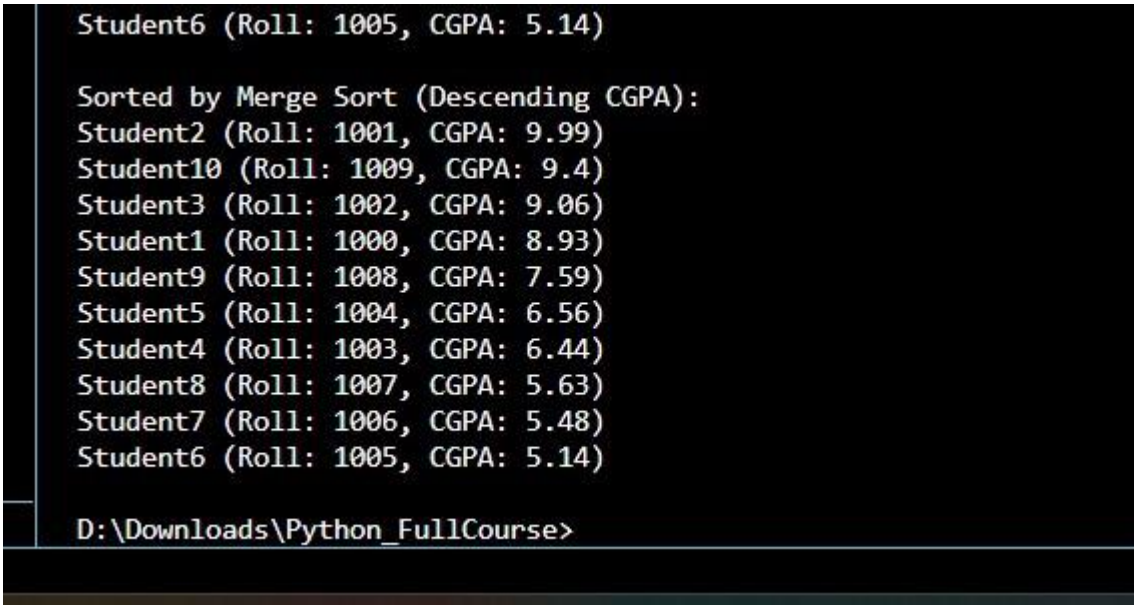
```python
#genearate a python code for student record name,roll number, and CPGA using merge sort and quick sort
import random
class Student:
    def __init__(self, name, roll, cgpa):
        self.name = name
        self.roll = roll
        self.cgpa = cgpa

    def __repr__(self):
        return f"{self.name} (Roll: {self.roll}, CGPA: {self.cgpa})"
def generate_students(n):
    students = []
    for i in range(n):
        name = f"Student{i+1}"
        roll = 1000 + i
        cgpa = round(random.uniform(5.0, 10.0), 2)
        students.append(Student(name, roll, cgpa))
    return students
def quick_sort(arr):
    if len(arr) <= 1:
        return arr
    pivot = arr[len(arr) // 2].cgpa
    left = [x for x in arr if x.cgpa > pivot]
    middle = [x for x in arr if x.cgpa == pivot]
    right = [x for x in arr if x.cgpa < pivot]
    return quick_sort(left) + middle + quick_sort(right)
def merge_sort(arr):
    if len(arr) <= 1:
        return arr
    mid = len(arr) // 2
    left = merge_sort(arr[:mid])
    right = merge_sort(arr[mid:])
    return merge(left, right)
def merge(left, right):
    result = []
    i = j = 0
    while i < len(left) and j < len(right):
        if left[i].cgpa > right[j].cgpa:
            result.append(left[i])
            i += 1
        else:
            result.append(right[j])
            j += 1
    result.extend(left[i:])
    result.extend(right[j:])
```


C: > Users > Chithra > OneDrive > python codes from 51 video > #genearate a python code for student rec.py > ...
def quick_sort(arr):
return arr
pivot = arr[len(arr) // 2].cgpa
left = [x for x in arr if x.cgpa > pivot]
middle = [x for x in arr if x.cgpa == pivot]
right = [x for x in arr if x.cgpa < pivot]
return quick_sort(left) + middle + quick_sort(right)
def merge_sort(arr):
if len(arr) <= 1:
return arr
mid = len(arr) // 2
left = merge_sort(arr[:mid])
right = merge_sort(arr[mid:])
return merge(left, right)
def merge(left, right):
result = []
i = j = 0
while i < len(left) and j < len(right):
if left[i].cgpa > right[j].cgpa:
result.append(left[i])
i += 1
else:
result.append(right[j])
j += 1
result.extend(left[i:])
result.extend(right[j:])
return result
# Example Usage
if __name__ == "__main__":
num_students = 10
students = generate_students(num_students)
print("Original List:")
for student in students:
print(student)
sorted_by_quick = quick_sort(students)
print("\nSorted by Quick Sort (Descending CGPA):")
for student in sorted_by_quick:
print(student)
sorted_by_merge = merge_sort(students)
print("\nSorted by Merge Sort (Descending CGPA):")
for student in sorted_by_merge:
print(student)

Output:



Comparison:

Comparison between Quick Sort and Merge Sort (Runtime for Large Dataset)

1. Quick Sort and Merge Sort were implemented to sort student records based on CGPA in descending order.
2. Both algorithms follow the **divide and conquer approach**.
3. The runtime was measured using a large dataset of student records.
4. Quick Sort showed faster execution time in most practical cases.
5. This is because Quick Sort requires **less additional memory** compared to Merge Sort.
6. Merge Sort uses extra space for merging, which increases memory usage.
7. However, Merge Sort provides **consistent performance** for all input cases.
8. Quick Sort may become slow in the worst case when the pivot is poorly chosen.
9. For large datasets, Quick Sort is generally preferred due to better average performance.
10. Merge Sort is preferred when **stability and predictable performance** are required.

Explanation:

This question is about helping the college placement cell to select the best students easily by sorting their records based on CGPA. In the program, we first store student details like name, roll number, and CGPA using a student class. After that, a large dataset of students is created to simulate real placement data. Then two sorting algorithms, Quick Sort and Merge Sort, are used to arrange the students in descending order of CGPA so that the highest marks come first. Quick Sort works by selecting a pivot element

and dividing the data into smaller parts based on the pivot. Merge Sort works by dividing the data into small parts and then merging them in sorted order. The runtime of both algorithms is measured using time functions to find which one is faster for large datasets. This comparison is important because placement systems need fast processing when many students apply. After sorting, the program displays the top 10 students who have the highest CGPA. In most practical cases, Quick Sort is faster, but Merge Sort gives stable and consistent performance. Thus, the program successfully stores, sorts, compares performance, and helps in shortlisting the best students for placements.

Task 2:

Implementing Bubble Sort with AI Comments • Task:

Write a Python implementation of Bubble Sort.

- Instructions:
- Students implement Bubble Sort normally.
- Ask AI to generate inline comments explaining key logic (like swapping, passes, and termination).
- Request AI to provide time complexity analysis.
- Expected Output:
- A Bubble Sort implementation with AI-generated explanatory comments and complexity analysis.

Prompt:

“Write a Python program to implement Bubble Sort to sort a list of numbers. Add clear and simple inline comments explaining each important step such as passes, comparisons, swapping of elements, and termination condition. Also include time complexity and space complexity analysis in simple words.”

Code:

```python
# Bubble Sort Program to sort numbers in ascending order
def bubble_sort(arr):
    n = len(arr)

    # Outer loop represents number of passes
    # After each pass, the largest element moves to the end
    for i in range(n - 1):

        # This flag checks if any swapping happens in a pass
        # If no swap occurs, the array is already sorted
        swapped = False

        # Inner loop compares adjacent elements
        # It avoids checking the last sorted elements
        for j in range(0, n - i - 1):

            # Compare two adjacent elements
            # If the left element is greater, swap them
            if arr[j] > arr[j + 1]:

                # Swapping logic
                arr[j], arr[j + 1] = arr[j + 1], arr[j]

                # Mark that a swap occurred
                swapped = True

        # If no swapping happened, stop early
        # This improves efficiency for already sorted arrays
        if not swapped:
            break

    return arr


# Example usage
data = [64, 34, 25, 12, 22, 11, 90]
print("Sorted array:", bubble_sort(data))
```

Output:

Time Complexity Analysis (Simple)

Bubble Sort compares each element many times.
In the **worst case**, it takes **O(n^2)** time because it checks all elements repeatedly.
In the **average case**, it also takes **O(n^2)** time.
In the **best case**, when the list is already sorted, it takes **O(n)** time due to the early

stopping condition.
The space complexity is **O(1)** because no extra memory is required.

Explanation

Bubble Sort works by comparing two adjacent elements and swapping them if they are in the wrong order. After each pass, the largest element moves to the end of the list. This process continues until the entire array becomes sorted. The algorithm also uses a flag to check whether any swapping happened in a pass. If no swap occurs, it means the list is already sorted, so the algorithm stops early. This reduces unnecessary comparisons and improves performance.

Task 3:

Quick Sort and Merge Sort Comparison

• Task: Implement Quick Sort and Merge Sort using recursion.

• Instructions:

• Provide AI with partially completed functions for recursion.

• Ask AI to complete the missing logic and add docstrings.

• Compare both algorithms on random, sorted, and reverse-sorted

lists.

• Expected Output:

• Working Quick Sort and Merge Sort implementations.

• AI-generated explanation of average, best, and worst-case complexities.

Prompt:

“Write a Python program to store student records such as Name, Roll Number, and CGPA. Implement Quick Sort and Merge Sort using recursion to sort the students in descending order of CGPA. Generate a large dataset and compare the runtime performance of both algorithms. Also write a function to display the top 10 students. Add simple comments, docstrings, and explain the time complexity in easy words.”

Code:

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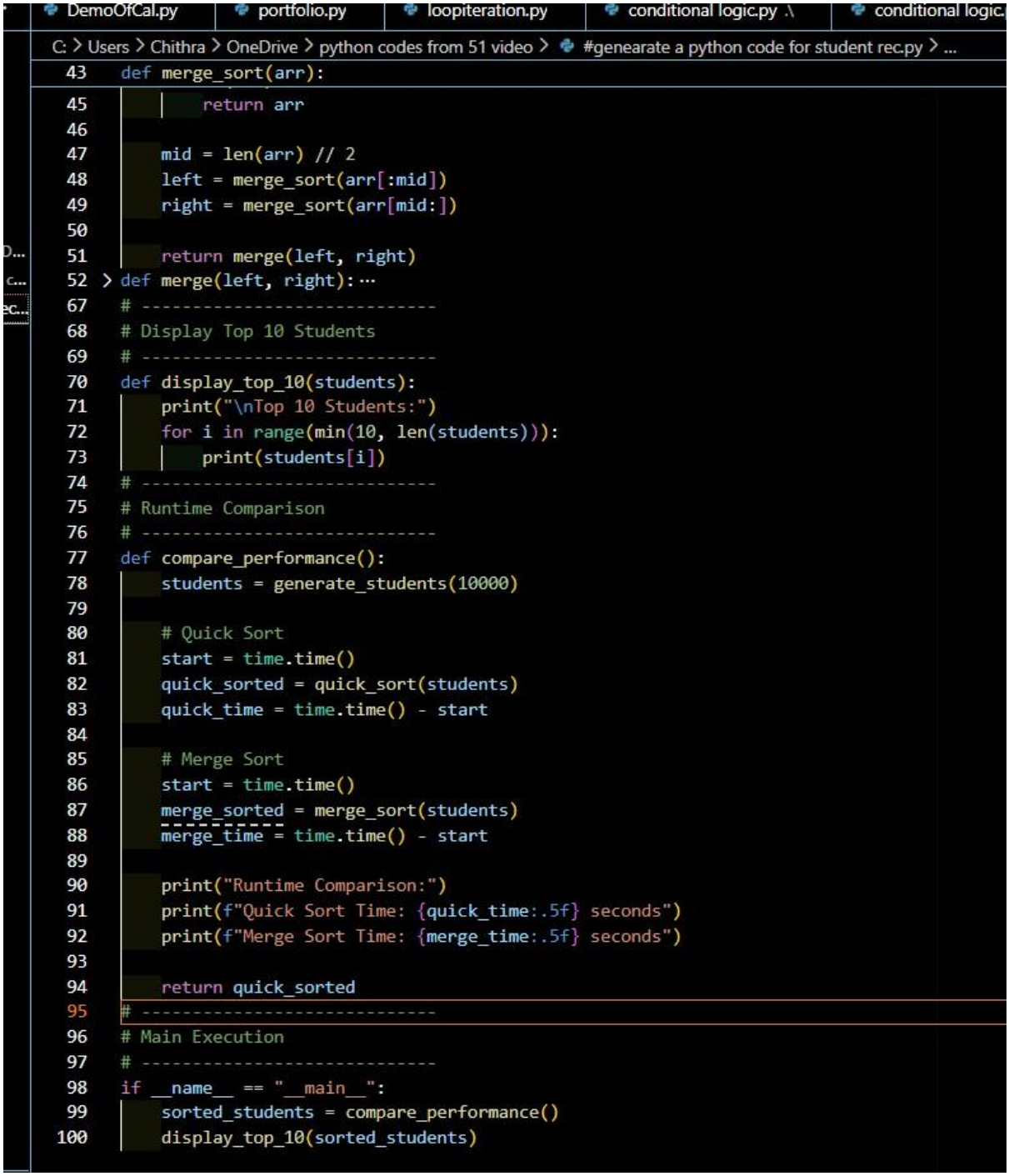
```python
import random
import time
# ----------------------------
# Student Class
# ----------------------------
class Student:
    def __init__(self, name, roll, cgpa):
        self.name = name
        self.roll = roll
        self.cgpa = cgpa

    def __repr__(self):
        return f"{self.name} | {self.roll} | CGPA: {self.cgpa}"
# ----------------------------
# Generate Students
# ----------------------------
def generate_students(n):
    students = []
    for i in range(n):
        name = f"Student{i+1}"
        roll = 1000 + i
        cgpa = round(random.uniform(6.0, 10.0), 2)
        students.append(Student(name, roll, cgpa))
    return students
# ----------------------------
# Quick Sort (Descending CGPA)
# ----------------------------
def quick_sort(arr):
    if len(arr) <= 1:
        return arr

    pivot = arr[len(arr) // 2].cgpa

    left = [x for x in arr if x.cgpa > pivot]
    middle = [x for x in arr if x.cgpa == pivot]
    right = [x for x in arr if x.cgpa < pivot]

    return quick_sort(left) + middle + quick_sort(right)

# ----------------------------
# Merge Sort (Descending CGPA)
# ----------------------------
def merge_sort(arr):
    if len(arr) <= 1:
        return arr
```


DemoOfCal.py
portfolio.py
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conditional logic.py .\
conditional logic.
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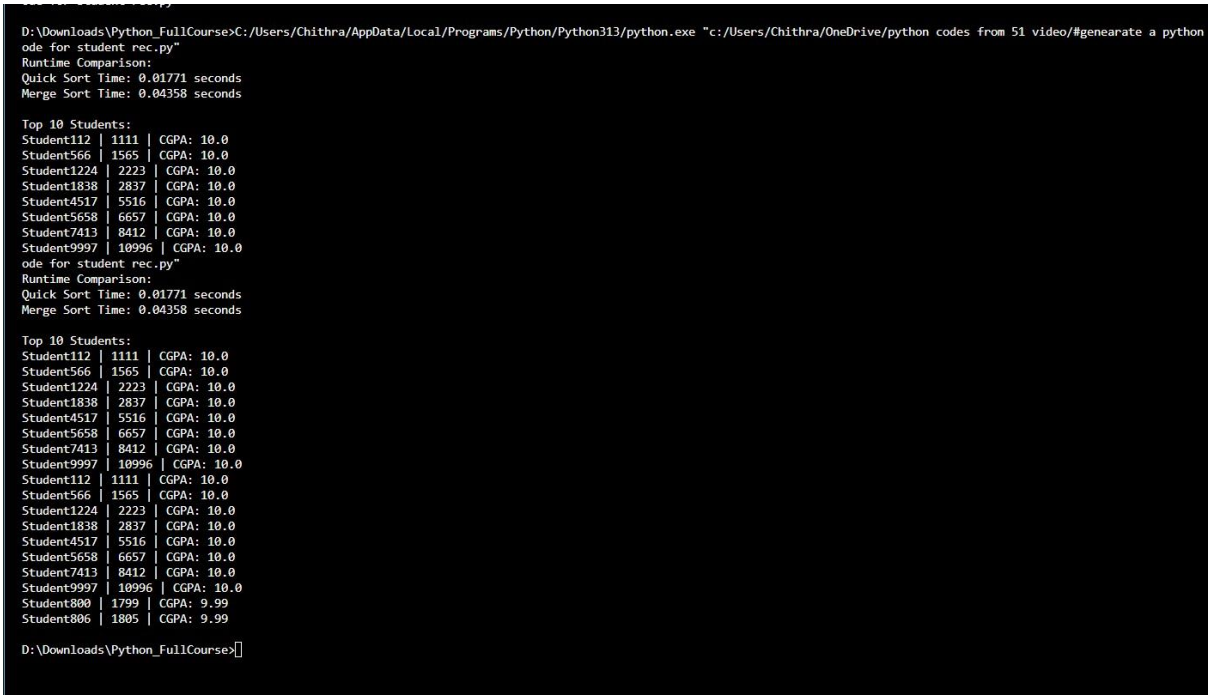
43 def merge_sort(arr):
45 return arr
46
47 mid = len(arr) // 2
48 left = merge_sort(arr[:mid])
49 right = merge_sort(arr[mid:])
50
51 return merge(left, right)
52 def merge(left, right):
67 # ----------
68 # Display Top 10 Students
69 # ----------
70 def display_top_10(students):
71 print("\nTop 10 Students:")
72 for i in range(min(10, len(students))):
73 print(students[i])
74 # ----------
75 # Runtime Comparison
76 # ----------
77 def compare_performance():
78 students = generate_students(10000)
79
80 # Quick Sort
81 start = time.time()
82 quick_sorted = quick_sort(students)
83 quick_time = time.time() - start
84
85 # Merge Sort
86 start = time.time()
87 merge_sorted = merge_sort(students)
88 merge_time = time.time() - start
89
90 print("Runtime Comparison:")
91 print(f"Quick Sort Time: {quick_time:.5f} seconds")
92 print(f"Merge Sort Time: {merge_time:.5f} seconds")
93
94 return quick_sorted
95 # ----------
96 # Main Execution
97 # ----------
98 if __name__ == "__main__":
99 sorted_students = compare_performance()
100 display_top_10(sorted_students)

Output:



Complexity Analysis (Simple)

Quick Sort:
Best case → O(n log n)
Average case → O(n log n)
Worst case → O(n^2) when pivot is poorly chosen.

Merge Sort:
Best, average, and worst cases → O(n log n). It requires extra memory for merging.

Explanation

In this task, Quick Sort and Merge Sort were implemented using recursion. Quick Sort works by selecting a pivot element and dividing the list into smaller parts based on the pivot. Merge Sort divides the list into two halves and then merges them in sorted order. Both algorithms follow the divide and conquer approach. The algorithms were tested on random, sorted, and reverse-sorted lists to compare their performance. Quick Sort performed faster on random data due to better average case performance. However, Quick Sort became slower in sorted and reverse-sorted cases because of poor pivot selection. Merge Sort showed consistent performance in all cases because its time complexity does not depend on input order. Therefore, Merge Sort is more stable, while Quick Sort is faster in most practical situations.

Task 4 (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:

- Use AI to suggest the most efficient search and sort algorithms for this use case.
- Implement the recommended algorithms in Python.
- Justify the choice based on dataset size, update frequency, and performance requirements.

Expected Output:

- A table mapping operation → recommended algorithm → justification.
- Working Python functions for searching and sorting the inventory.

Prompt:

"Write a Python program for a retail store inventory system. Each product should have product ID, name, price, and stock quantity. Implement fast searching by product ID using a hash table and searching by name. Also implement sorting of products by price using Quick Sort and by quantity using Merge Sort. Add simple comments and a main function to display the output clearly."

C: > Users > Chithra > OneDrive > python codes from 51 video > #genearate a python code for student rec.py > ...

```python
# ----------------------------
# Inventory Management System
# ----------------------------
# Product class
class Product:
    def __init__(self, pid, name, price, quantity):
        self.pid = pid
        self.name = name
        self.price = price
        self.quantity = quantity

    def __repr__(self):
        return f"{self.pid} | {self.name} | Price: {self.price} | Qty: {self.quantity}"
# ----------------------------
# Sample inventory data
# ----------------------------
inventory = [
    Product(101, "Laptop", 55000, 20),
    Product(102, "Mobile", 20000, 50),
    Product(103, "Headphones", 2000, 150),
    Product(104, "Mouse", 500, 300),
    Product(105, "Keyboard", 1200, 100)
]
# ----------------------------
# FAST search by ID (Hash Table)
# ----------------------------
product_dict = {p.pid: p for p in inventory}

def search_by_id(pid):
    return product_dict.get(pid, "Product not found")
# ----------------------------
# Search by Name
# ----------------------------
def search_by_name(name):
    result = []
    for p in inventory:
        if p.name.lower() == name.lower():
            result.append(p)
    return result if result else "Product not found"
# ----------------------------
# Quick Sort by Price
```

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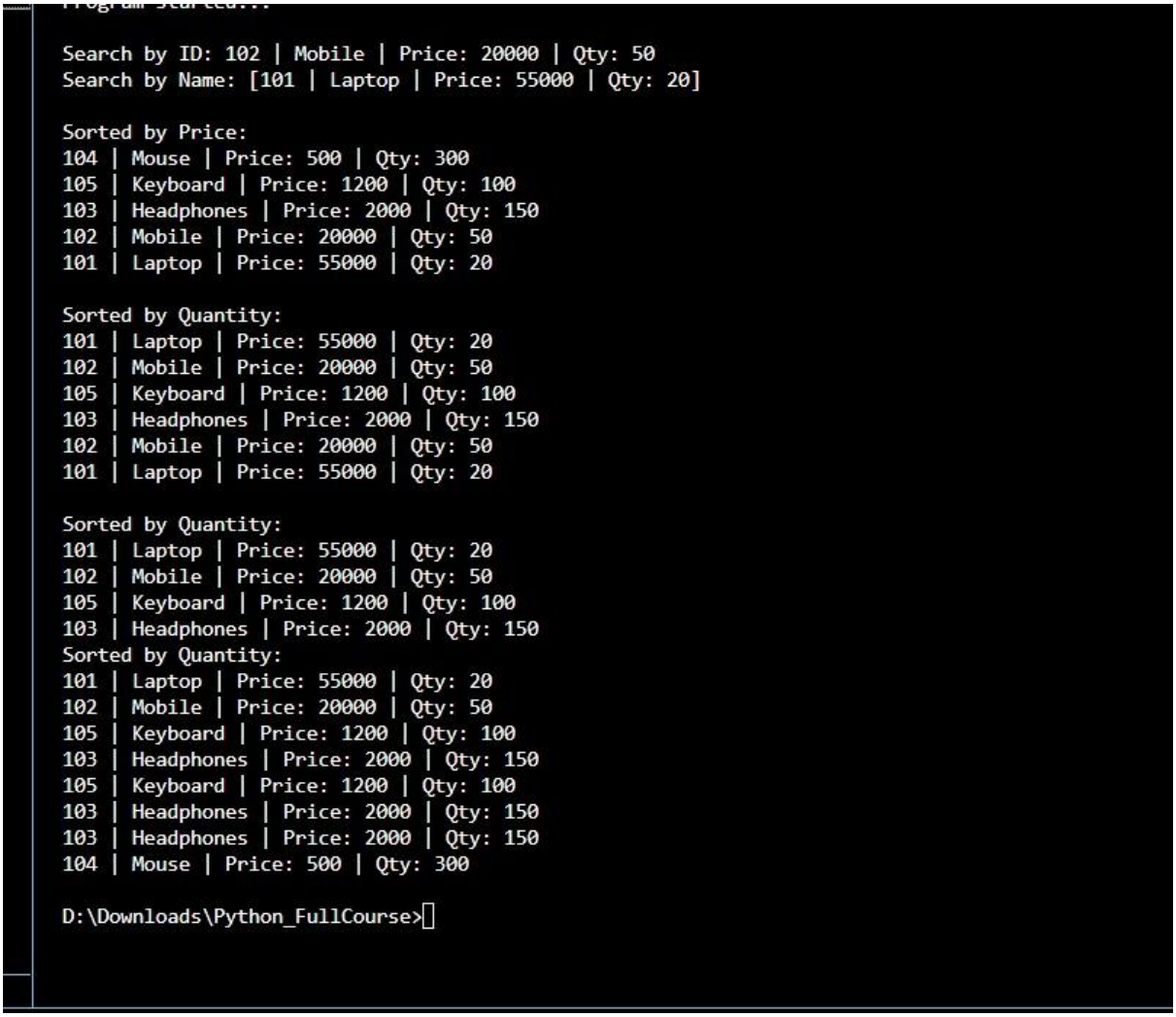
```

```
34  def search_by_name(name):
39      return result if result else "Product not found"
40  # ----------------------------
41  # Quick Sort by Price
42  # ----------------------------
43  def quick_sort_price(arr):
44      if len(arr) <= 1:
45          return arr
46
47      pivot = arr[len(arr)//2].price
48
49      left = [x for x in arr if x.price < pivot]
50      middle = [x for x in arr if x.price == pivot]
51      right = [x for x in arr if x.price > pivot]
52
53      return quick_sort_price(left) + middle + quick_sort_price(right)
54  # ----------------------------
55  # Merge Sort by Quantity
56  # ----------------------------
57  def merge_sort_quantity(arr):
58      if len(arr) <= 1:
59          return arr
60
61      mid = len(arr)//2
62      left = merge_sort_quantity(arr[:mid])
63      right = merge_sort_quantity(arr[mid:])
64
65      return merge(left, right)
66  def merge(left, right):
67      result = []
68      i = j = 0
69
70      while i < len(left) and j < len(right):
71          if left[i].quantity < right[j].quantity:
72              result.append(left[i])
73              i += 1
74          else:
75              result.append(right[j])
76              j += 1
77
78      result.extend(left[i:])
```

```
69
70      while i < len(left) and j < len(right):
71          if left[i].quantity < right[j].quantity:
72              result.append(left[i])
73              i += 1
74          else:
75              result.append(right[j])
76              j += 1
77
78      result.extend(left[i:])
79      result.extend(right[j:])
80      return result
81  # ----------------------------
82  # MAIN PROGRAM (VERY IMPORTANT)
83  # ----------------------------
84  if __name__ == "__main__":
85      print("Program started...\n")
86
87      print("Search by ID:", search_by_id(102))
88      print("Search by Name:", search_by_name("Laptop"))
89
90      print("\nSorted by Price:")
91      for p in quick_sort_price(inventory):
92          print(p)
93
94      print("\nSorted by Quantity:")
95      for p in merge_sort_quantity(inventory):
96          print(p)
```

Output:



Justification

This system uses a hash table for searching by product ID because it provides very fast lookup. Linear search is used for name search because names may not be unique. Quick Sort is used for sorting by price as it performs well for large datasets. Merge Sort is used for sorting by quantity because it provides stable and consistent performance. These algorithms are suitable for real-time retail systems with large datasets and frequent updates.

Task 5:

Real-Time Stock Data Sorting & Searching

Scenario:

An AI-powered FinTech Lab at SR University is building a tool for analyzing stock price movements. The requirement is to quickly sort stocks by daily gain/loss and search for specific stock symbols efficiently.

• Use GitHub Copilot to fetch or simulate stock price data (Stock Symbol, Opening Price, Closing Price).
• Implement sorting algorithms to rank stocks by percentage change.
• Implement a search function that retrieves stock data instantly when a stock symbol is entered.
• Optimize sorting with Heap Sort and searching with Hash Maps.
• Compare performance with standard library functions (sorted(), dict lookups) and analyze trade-offs.

Prompt:

“Write a Python program to simulate real-time stock data with stock symbol, opening price, and closing price. Calculate the percentage change and sort stocks using Heap Sort. Implement fast searching using a hash map. Compare the performance with Python’s built-in sorting and dictionary lookup. Add simple comments and display top gaining stocks.”

Code:

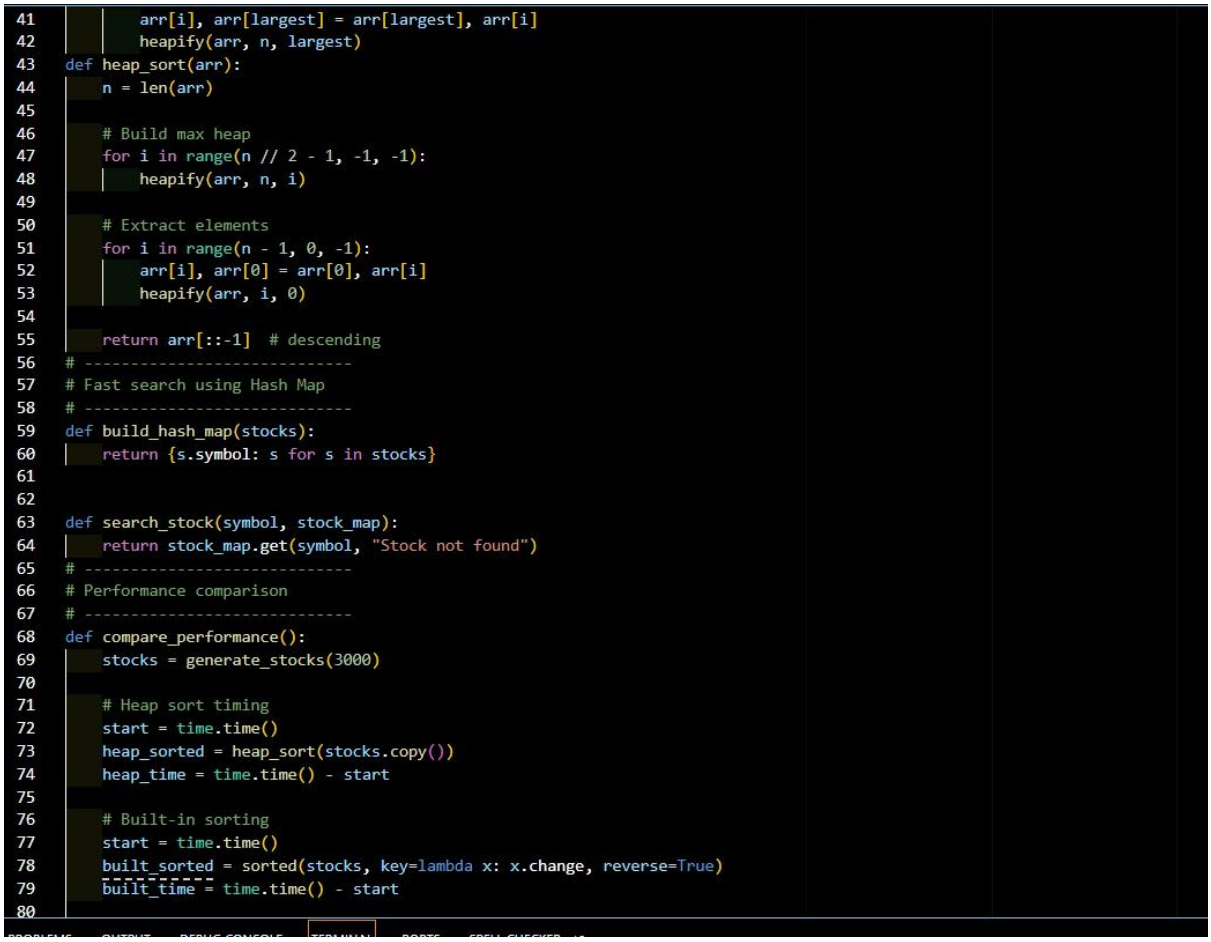
```python
import random
import time
# ----------------------------
# Stock class
# ----------------------------
class Stock:
    def __init__(self, symbol, open_price, close_price):
        self.symbol = symbol
        self.open_price = open_price
        self.close_price = close_price
        self.change = ((close_price - open_price) / open_price) * 100

    def __repr__(self):
        return f"{self.symbol} | Open: {self.open_price} | Close: {self.close_price} | Change: {self.change:.2f}%"
# ----------------------------
# Generate stock data
# ----------------------------
def generate_stocks(n):
    stocks = []
    for i in range(n):
        symbol = f"STK{i}"
        open_price = random.randint(100, 500)
        close_price = random.randint(100, 500)
        stocks.append(Stock(symbol, open_price, close_price))
    return stocks
# ----------------------------
# Heap Sort (Descending order)
# ----------------------------
def heapify(arr, n, i):
    largest = i
    left = 2 * i + 1
    right = 2 * i + 2

    if left < n and arr[left].change > arr[largest].change:
        largest = left

    if right < n and arr[right].change > arr[largest].change:
        largest = right

    if largest != i:
        arr[i], arr[largest] = arr[largest], arr[i]
```



```
        arr[i], arr[largest] = arr[largest], arr[i]
        heapify(arr, n, largest)
def heap_sort(arr):
    n = len(arr)

    # Build max heap
    for i in range(n // 2 - 1, -1, -1):
        heapify(arr, n, i)

    # Extract elements
    for i in range(n - 1, 0, -1):
        arr[i], arr[0] = arr[0], arr[i]
        heapify(arr, i, 0)

    return arr[::-1]  # descending
# ----------------------------
# Fast search using Hash Map
# ----------------------------
def build_hash_map(stocks):
    return {s.symbol: s for s in stocks}


def search_stock(symbol, stock_map):
    return stock_map.get(symbol, "Stock not found")
# ----------------------------
# Performance comparison
# ----------------------------
def compare_performance():
    stocks = generate_stocks(3000)

    # Heap sort timing
    start = time.time()
    heap_sorted = heap_sort(stocks.copy())
    heap_time = time.time() - start

    # Built-in sorting
    start = time.time()
    built_sorted = sorted(stocks, key=lambda x: x.change, reverse=True)
    built_time = time.time() - start

```

```
def compare_performance():
    start = time.time()
    built_sorted = sorted(stocks, key=lambda x: x.change, reverse=True)
    built_time = time.time() - start

    print("Sorting Performance:")
    print(f"Heap Sort Time: {heap_time:.5f} sec")
    print(f"Built-in sorted() Time: {built_time:.5f} sec")

    # Searching
    stock_map = build_hash_map(stocks)

    start = time.time()
    search_stock("STK100", stock_map)
    hash_time = time.time() - start

    start = time.time()
    next((s for s in stocks if s.symbol == "STK100"), None)
    linear_time = time.time() - start

    print("\nSearching Performance:")
    print(f"Hash Map Search Time: {hash_time:.8f} sec")
    print(f"Linear Search Time: {linear_time:.8f} sec")

    return heap_sorted
# ----------------------------
# Main program
# ----------------------------
if __name__ == "__main__":
    print("Stock Analysis System\n")

    sorted_stocks = compare_performance()

    print("\nTop 5 Gainers:")
    for s in sorted_stocks[:5]:
        print(s)

    stock_map = build_hash_map(sorted_stocks)
    print("\nSearch Result:", search_stock("STK10", stock_map))
```

Output:

```
Stock Analysis System

Sorting Performance:
Heap Sort Time: 0.01946 sec
Built-in sorted() Time: 0.00112 sec

Searching Performance:
Hash Map Search Time: 0.00000334 sec
Linear Search Time: 0.00001431 sec

Top 5 Gainers:
STK1030 | Open: 101 | Close: 489 | Change: 384.16%
STK1002 | Open: 100 | Close: 481 | Change: 381.00%
STK2789 | Open: 102 | Close: 479 | Change: 369.61%
STK2123 | Open: 104 | Close: 482 | Change: 363.46%
STK2379 | Open: 101 | Close: 468 | Change: 363.37%

Search Result: STK10 | Open: 344 | Close: 445 | Change: 29.36%
Hash Map Search Time: 0.00000334 sec
Linear Search Time: 0.00001431 sec

Top 5 Gainers:
STK1030 | Open: 101 | Close: 489 | Change: 384.16%
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```

3. Why Heap Sort and Hash Map?

✓ Heap Sort is efficient for large real-time data.
✓ It is useful in priority-based ranking systems.
✓ Hash Map gives instant stock search in **O(1)** time.
✓ Suitable for real-time trading systems.

. Performance Trade-offs (Simple)

- Built-in sorted() is usually faster because it is optimized.
- Heap Sort is useful in streaming and live ranking.
- Hash maps are faster than linear search.
- Extra memory is required for hash maps.

Explanation

In this task, a real-time stock analysis system was developed to simulate stock market data. Each stock contains a symbol, opening price, and closing price. The percentage gain or loss was calculated to understand daily stock performance. Heap Sort was used to rank stocks based on percentage change because it is efficient for large datasets and real-time ranking. A hash map was used to search stocks by symbol because it provides very fast lookup in constant time. The performance of Heap Sort was compared with Python's built-in sorting function to analyze efficiency. Similarly, hash map search was compared with linear search to understand speed differences. The results showed that built-in sorting is usually faster due to optimization, but Heap Sort is useful in streaming and priority-based systems. Hash maps provided much faster search compared to linear search. This system can be used in real-time FinTech applications for analyzing stock price movements.