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H.No:2303A51491 Batch:25

SCHOOL OF COMPUTER SCIENCE AND ARTIFICIAL INTELLIGENCE		DEPARTMENT OF COMPUTER SCIENCE ENGINEERING	
Program Name: B. Tech		Assignment Type: Lab	Academic Year:2025-2026
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CourseCode	23CS002PC304	Course Title	AI Assisted Coding
Year/Sem	III/II	Regulation	R23
Date and Day of Assignment	Week6 – Wednesday	Time(s)	23CSBTB01 To 23CSBTB52
Duration	2 Hours	Applicable to Batches	All batches
Assignment Number:12.3(Present assignment number)/24(Total number of assignments)			
Q.No.	Question	Expected Time to complete	
1	Lab 12: Algorithms with AI Assistance Sorting, Searching, and Algorithm	Week3 -	

	<p>Optimization Using AI Tools</p> <p>Lab Objectives The objectives of this laboratory exercise are to:</p> <ul style="list-style-type: none"> • Apply AI-assisted programming techniques to implement sorting and searching algorithms. • Analyze and compare algorithm efficiency using time and space complexity. • Understand how AI tools can suggest optimizations and alternative algorithmic approaches. • Strengthen problem-solving skills through real-world, data-driven scenarios. <hr/> <p>Learning Outcomes After completing this lab, students will be able to:</p> <ul style="list-style-type: none"> • Implement and optimize classic algorithms using AI-assisted coding tools. • Compare multiple algorithms for the same problem and justify their selection. • Measure and analyze runtime performance using experimental data. • Critically review and refine AI-generated algorithmic solutions. <hr/> <p>Task 1: Sorting Student Records for Placement Drive</p> <p>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.</p> <p>Tasks</p> <ol style="list-style-type: none"> 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: <ul style="list-style-type: none"> ○ Quick Sort ○ Merge Sort 3. Measure and compare runtime performance for large datasets. 4. Write a function to display the top 10 students based on CGPA. <p>Expected Outcome</p> <ul style="list-style-type: none"> • Correctly sorted student records. • Performance comparison between Quick Sort and Merge Sort. • Clear output of top-performing students. 	Wednesday
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WelcomeAAC A 12.3.py X

C:\Users\Public> AAC A 12.3.py > ...
1 import random, time, copy
2
3 def generate_students(n):
4 names = ["Aarav", "Vivaan", "Aditya", "Arjun", "Sai", "Ananya", "Diya", "Rohan", "Mehta", "Priya",
5 "Rahul", "Sneha", "Vikram", "Meera", "Karan", "Pooja", "Ishaan", "Riya", "Amit", "Navya"]
6 students = []
7 for i in range(1, n+1):
8 students.append({"name": random.choice(names), "roll": f"SRU{1:04d}", "cgpa": round(random.uniform(4.0, 10.0), 2)})
9 return students
10
11 def quick_sort(a):
12 if len(a) <= 1: return a
13 p = a[len(a)//2]["cgpa"]
14 return quick_sort([x for x in a if x["cgpa"] > p]) + [x for x in a if x["cgpa"] == p] + quick_sort([x for x in a if x["cgpa"] < p])
15
16 def merge_sort(a):
17 if len(a) <= 1: return a
18 m = len(a)//2
19 l, r = merge_sort(a[:m]), merge_sort(a[m:])
20 res, i, j = [], 0, 0
21 while i < len(l) and j < len(r):
22 if l[i]["cgpa"] >= r[j]["cgpa"]: res.append(l[i]); i += 1
23 else: res.append(r[j]); j += 1
24 return res + l[i:] + r[j:]
25
26 def top_10(students):
27 print(f"\n{'Rank':<6}{'Name':<12}{'Roll':<12}{'CGPA':<6}")
28 print("-"*38)
29 for i, s in enumerate(students[:10], 1):
30 print(f"{i:<6}{s['name']:<12}{s['roll']:<12}{s['cgpa']:<6}")
31
32 for size in [1000, 10000, 50000]:
33 data = generate_students(size)
34 d1, d2 = copy.deepcopy(data), copy.deepcopy(data)
35 t1 = time.perf_counter(); qs = quick_sort(d1); t1 = time.perf_counter() - t1
36 t2 = time.perf_counter(); ms = merge_sort(d2); t2 = time.perf_counter() - t2
37 print(f"nm={size} QuickSort={t1:.4f}s MergeSort={t2:.4f}s Faster={'QS' if t1<t2 else 'MS'}")
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```
Welcome AAC A 12.3.py X
C:\> Users > Public > AAC A 12.3.py > ...
16 def merge_sort(a):
23     else: res.append(r[j]); j += 1
24     return res + l[i:] + r[j:]
25
26 def top_10(students):
27     print(f"\n{'Rank':<6}{'Name':<12}{'Roll':<12}{'CGPA'}")
28     print("-"*38)
29     for i, s in enumerate(students[:10], 1):
30         print(f"{i:<6}{s['name']:<12}{s['roll']:<12}{s['cgpa']}")
31
32 for size in [1000, 10000, 50000]:
33     data = generate_students(size)
34     d1, d2 = copy.deepcopy(data), copy.deepcopy(data)
35     t1 = time.perf_counter(); qs = quick_sort(d1); t1 = time.perf_counter() - t1
36     t2 = time.perf_counter(); ms = merge_sort(d2); t2 = time.perf_counter() - t2
37     print(f"\nN={size} QuickSort={t1:.4f}s MergeSort={t2:.4f}s Faster={'QS' if t1<t2 else 'MS'}")
38
39 top_10(qs)
40

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

32-x64\bundled\libs\debugpy\launcher '54674' '--' 'c:\Users\Public\AAC A 12.3.py'
2 Pooja SRU0302 10.0
3 Meera SRU1117 10.0
4 Arjun SRU3139 10.0
5 Karan SRU4589 10.0
6 Aarav SRU4875 10.0
7 Vivaan SRU5385 10.0
8 Karan SRU7609 10.0
9 Pooja SRU8102 10.0
10 Priya SRU8824 10.0
PS C:\Users\Public>
```

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.

Welcome

AACA 12.3.py X

Python

Python

C:\Users\Public> AAC A 12.3.py ...

```
1 def bubble_sort(arr):
2     n = len(arr)
3     for i in range(n - 1):
4         swapped = False
5         for j in range(n - 1 - i):
6             if arr[j] > arr[j + 1]:
7                 arr[j], arr[j + 1] = arr[j + 1], arr[j]
8                 swapped = True
9         if not swapped:
10            break
11    return arr
12
13 data = [64, 34, 25, 12, 22, 11, 90]
14 print("Before:", data)
15 print("After :", bubble_sort(data))
16
```

PROBLEMS

OUTPUT

DEBUG CONSOLE

TERMINAL

PORTS

32-x64(bundle\libs\debugpy\launcher) "5d674" "--" "c:\Users\Public\AAC A 12.3.py"

6 Aarav SRU4875 10.0

7 Vivaan SRU5385 10.0

8 Karan SRU7609 10.0

9 Pooja SRU8182 10.0

10 Priya SRU8824 10.0

PS C:\Users\Public> cd 'c:\Users\Public'; & 'c:\Users\shash\anaconda3\envs\shashidhar\python.exe' 'c:\Users\shash\.vscode\extensions\ms-py'
thon.debugpy-2025.18.0-win32-x64(bundle\libs\debugpy\launcher) "64314" "--" "c:\Users\Public\AAC A 12.3.py"
Before: [64, 34, 25, 12, 22, 11, 90]
After : [11, 12, 22, 25, 34, 64, 90]
PS C:\Users\Public> |

CHAT

← SORTING STUDENT RECORDS FOR PLA...

Expected Output:

• A Bubble Sort implementation with AI-generated explanatory comments and complexity analysis.
give small and simple code in python without comments

✓ Created AAC A 12.3.py

python

✓ "C:\Users\Public\AAC A 12.3.py"

Code written to AAC A 12.3.py: Output:

Before: [64, 34, 25, 12, 22, 11, 90]
After : [11, 12, 22, 25, 34, 64, 90]

Time Complexity Analysis:

• Best Case: $O(n)$ — array already sorted, swapped flag breaks after first pass
• Worst Case: $O(n^2)$ — array sorted in reverse order, every pair needs swapping
• Average Case: $O(n^2)$
• Space Complexity: $O(1)$ — in-place sorting

AACA 12.3.py

Describe what to build next

Claude Opus 4.6

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.

VS Code editor showing a Python file named `AAC A 12.3.py`. The code implements a `quick_sort` function and a `merge_sort` function. The `quick_sort` function uses a pivot-based partitioning strategy, and the `merge_sort` function uses a divide-and-conquer approach. The code is being executed in a terminal window, and the output shows the execution of the `quick_sort` function on a list of numbers.

```
1 import random, time
2 def quick_sort(arr):
3     if len(arr) <= 1:
4         return arr
5     pivot = arr[len(arr) // 2]
6     left = [x for x in arr if x < pivot]
7     mid = [x for x in arr if x == pivot]
8     right = [x for x in arr if x > pivot]
9     return quick_sort(left) + mid + quick_sort(right)
10
11 def merge_sort(arr):
12     if len(arr) <= 1:
13         return arr
14     mid = len(arr) // 2
15     left = merge_sort(arr[:mid])
16     right = merge_sort(arr[mid:])
17     result, i, j = [], 0, 0
18     while i < len(left) and j < len(right):
19         if left[i] <= right[j]:
20             result.append(left[i]); i += 1
21         else:
22             result.append(right[j]); j += 1
23     return result + left[i:] + right[j:]
24
25 def measure(func, data):
26     start = time.perf_counter()
27     func(data)
28     return time.perf_counter() - start
29
30 n = 10000
31 cases = {
32     "Random": random.sample(range(n), n),
33     "Sorted": list(range(n)),
34     "Reversed": list(range(n, 0, -1))
35 }
36 print(f"Case: {c12} | Quick Sort: {c14} | Merge Sort: {c14}")
37 print("-" * 40)
38 for name, data in cases.items():
39     qt = measure(quick_sort, data)
40     mt = measure(merge_sort, data)
41     print(f"Case: {c12} | qt: {qt:.4f}s | mt: {mt:.4f}s")
42
```

Terminal Output:

```
PS C:\Users\Public> cd 'C:\Users\Public'; & 'C:\Users\shash\anaconda3\envs\shashidhar\python.exe' 'C:\Users\shash\.vscode\extensions\ms-py
thon.debugpy-2025.18.0-win32-x64\bundle\libs\debugpy\launcher' '64314' '-' 'C:\Users\Public\AAC A 12.3.py'
After : [11, 12, 22, 25, 34, 64, 90]
PS C:\Users\Public> cd 'C:\Users\Public'; & 'C:\Users\shash\anaconda3\envs\shashidhar\python.exe' 'C:\Users\shash\.vscode\extensions\ms-py
thon.debugpy-2025.18.0-win32-x64\bundle\libs\debugpy\launcher' '51664' '-' 'C:\Users\Public\AAC A 12.3.py'
Case Quick Sort Merge Sort
-----
Random 0.0159s 0.0238s
Sorted 0.0105s 0.0143s
Reversed 0.0111s 0.0182s
```

Chat window on the right shows a discussion about sorting algorithms, comparing Quick Sort and Merge Sort, and providing a complexity analysis table.

Case	Quick Sort	Merge Sort
Random	0.0315s	0.031s
Sorted	0.0204s	0.02s
Reversed	0.0263s	0.03s

Complexity Analysis:

	Quick Sort	Merge Sort
Best	$O(n \log n)$	$O(n \log n)$
Ave	$O(n \log n)$	$O(n \log n)$
rag	$O(n^2)$ (sorted input, bad pivot)	$O(n \log n)$
st	$O(n \log n)$ (call stack)	$O(n)$ (merge buffer)

VS Code editor showing the same Python file `AAC A 12.3.py`. The code is being executed in a terminal window, and the output shows the execution of the `merge_sort` function on a list of numbers.

```
10 def merge_sort(arr):
11     if len(arr) <= 1:
12         return arr
13     mid = len(arr) // 2
14     left = merge_sort(arr[:mid])
15     right = merge_sort(arr[mid:])
16     result, i, j = [], 0, 0
17     while i < len(left) and j < len(right):
18         if left[i] <= right[j]:
19             result.append(left[i]); i += 1
20         else:
21             result.append(right[j]); j += 1
22     return result + left[i:] + right[j:]
23
24 def measure(func, data):
25     start = time.perf_counter()
26     func(data)
27     return time.perf_counter() - start
28
29 n = 10000
30 cases = {
31     "Random": random.sample(range(n), n),
32     "Sorted": list(range(n)),
33     "Reversed": list(range(n, 0, -1))
34 }
35
36 print(f"Case: {c12} | Quick Sort: {c14} | Merge Sort: {c14}")
37 print("-" * 40)
38 for name, data in cases.items():
39     qt = measure(quick_sort, data)
40     mt = measure(merge_sort, data)
41     print(f"Case: {c12} | qt: {qt:.4f}s | mt: {mt:.4f}s")
42
```

Terminal Output:

```
PS C:\Users\Public> cd 'C:\Users\Public'; & 'C:\Users\shash\anaconda3\envs\shashidhar\python.exe' 'C:\Users\shash\.vscode\extensions\ms-py
thon.debugpy-2025.18.0-win32-x64\bundle\libs\debugpy\launcher' '64314' '-' 'C:\Users\Public\AAC A 12.3.py'
After : [11, 12, 22, 25, 34, 64, 90]
PS C:\Users\Public> cd 'C:\Users\Public'; & 'C:\Users\shash\anaconda3\envs\shashidhar\python.exe' 'C:\Users\shash\.vscode\extensions\ms-py
thon.debugpy-2025.18.0-win32-x64\bundle\libs\debugpy\launcher' '51664' '-' 'C:\Users\Public\AAC A 12.3.py'
Case Quick Sort Merge Sort
-----
Random 0.0159s 0.0238s
Sorted 0.0105s 0.0143s
Reversed 0.0111s 0.0182s
```

Chat window on the right shows a discussion about sorting algorithms, comparing Quick Sort and Merge Sort, and providing a complexity analysis table.

Case	Quick Sort	Merge Sort
Random	0.0315s	0.03s
Sorted	0.0204s	0.02s
Reversed	0.0263s	0.03s

Complexity Analysis:

	Quick Sort	Merge Sort
Best	$O(n \log n)$	$O(n \log n)$
Ave	$O(n \log n)$	$O(n \log n)$
rag	$O(n^2)$ (sorted input, bad pivot)	$O(n \log n)$
st	$O(n \log n)$ (call stack)	$O(n)$ (merge buffer)

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.

Python A12.3.py X

C:\Users\Public> python A12.3.py > ...

```
1 import random, time
2
3 def generate_inventory(n):
4     return [{"id": i, "name": f"Product_{i}", "price": round(random.uniform(10, 5000), 2),
5             "qty": random.randint(0, 500)} for i in range(1, n + 1)]
6
7 def binary_search_by_id(products, target_id):
8     lo, hi = 0, len(products) - 1
9     while lo <= hi:
10         mid = (lo + hi) // 2
11         if products[mid]["id"] == target_id:
12             return products[mid]
13         elif products[mid]["id"] < target_id:
14             lo = mid + 1
15         else:
16             hi = mid - 1
17     return None
18
19 def hash_search_by_name(index, name):
20     return index.get(name)
21
22 def build_name_index(products):
23     return {p["name"]: p for p in products}
24
```

PS C:\Users\Public> cd 'c:\Users\Public'; & 'c:\Users\shash\anaconda\envs\shashidhar\python.exe' 'c:\Users\shash\vscode\extensions\ms-py-thon.debugpy-2025.18.8.win32-x64\lib\debugpy\launcher' '57920' '-' 'c:\Users\Public\AC A 12.3.py'
== Search by ID (Binary Search) ==
Found: {'id': 5000, 'name': 'Product_5000', 'price': 2625.52, 'qty': 428} Time: 0.000007s

== Search by name (hash Map) ==
Found: {'id': 5000, 'name': 'Product_5000', 'price': 2625.52, 'qty': 428} Time: 0.000002s

== Sort by Price (Quick Sort) ==
Time: 0.00000s
ID Name Price Qty

CHAT

← SORTING STUDENT RECORDS FOR PL...
and sorting the inventory.
give simple and small code in python
without comments

✓ Reviewed and created AAC A 12.3.py
✓ Created • AAC A 12.3.py

python
✓ "c:/Users/Public/AC A 12.3.py"

Code written to AAC A 12.3.py, it implements:

Oper ation	Algor ithm	Justification
Search by ID	Binary Search	$O(\log n)$ — IDs are sequential/sorted, minimal comparisons
Search by Name	Hash Map (dict)	$O(1)$ average — instant lookup, ideal for frequent name queries
Sort by Price/ Qty	Quick Sort	$O(n \log n)$ average — fast in practice, good cache locality

Why these choices for Inventory:
Describe what to build next

Welcome

AAC A 12.3.py X

C: > Users > Public > AAC A 12.3.py > ...

```

22 def build_name_index(products):
23     return {p["name"]: p for p in products}
24
25 def quick_sort(arr, key):
26     if len(arr) <= 1:
27         return arr
28     pivot = arr[len(arr) // 2][key]
29     left = [x for x in arr if x[key] < pivot]
30     mid = [x for x in arr if x[key] == pivot]
31     right = [x for x in arr if x[key] > pivot]
32     return quick_sort(left, key) + mid + quick_sort(right, key)
33
34 def display(products, n=10):
35     print(f"{'ID':<8}{'Name':<16}{'Price':<12}{'Qty':<6}")
36     print("-" * 42)
37     for p in products[:n]:
38         print(f"{p['id']:<8}{p['name']:<16}{p['price']:<12}{p['qty']:<6}")
39
40 inventory = generate_inventory(10000)
41
42 print("=== Search by ID (Binary Search) ===")
43 sorted_by_id = sorted(inventory, key=lambda x: x["id"])
44 start = time.perf_counter()

```

PROBLEMS

OUTPUT

DEBUG CONSOLE

TERMINAL

PORTS

PS C:\Users\Public> c::; cd 'c:\Users\Public'; & 'c:\Users\shash\anaconda3\envs\Shashidhar\thon.debugpy-2025.18.0-win32-x64\bundled\libs\debugpy\launcher' '57920' '--' 'c:\Users\Publ

ID	Name	Price	Qty
3623	Product_3623	10.64	206
9538	Product_9538	10.67	14
122	Product_122	11.15	333
2235	Product_2235	11.41	386
6376	Product_6376	11.61	320
5937	Product_5937	11.75	324
3876	Product_3876	11.77	356

Welcome

AAC A 12.3.py X

C: > Users > Public > AAC A 12.3.py > ...

```
42 print("=== Search by ID (Binary Search) ===")
43 sorted_by_id = sorted(inventory, key=lambda x: x["id"])
44 start = time.perf_counter()
45 result = binary_search_by_id(sorted_by_id, 5000)
46 t1 = time.perf_counter() - start
47 print(f"Found: {result} Time: {t1:.6f}s")
48
49 print("\n=== Search by Name (Hash Map) ===")
50 name_index = build_name_index(inventory)
51 start = time.perf_counter()
52 result = hash_search_by_name(name_index, "Product_5000")
53 t2 = time.perf_counter() - start
54 print(f"Found: {result} Time: {t2:.6f}s")
55
56 print("\n=== Sort by Price (Quick Sort) ===")
57 start = time.perf_counter()
58 sorted_price = quick_sort(inventory, "price")
59 t3 = time.perf_counter() - start
60 print(f"Time: {t3:.4f}s")
61 display(sorted_price)
62
63 print("\n=== Sort by Quantity (Quick Sort) ===")
64 start = time.perf_counter()
65 sorted_qty = quick_sort(inventory, "qty")
66 t4 = time.perf_counter() - start
67 print(f"Time: {t4:.4f}s")
68 display(sorted_qty)
```

PROBLEMS

OUTPUT

DEBUG CONSOLE

TERMINAL

PORTS

```
PS C:\Users\Public> c:; cd 'c:\Users\Public'; & 'c:\Users\shash\anaconda\
thon.debugpy-2025.18.0-win32-x64\bundled\libs\debugpy\launcher' '57920'
```

122	Product_122	11.15	333
2235	Product_2235	11.41	386
6376	Product_6376	11.61	320
5937	Product_5937	11.75	324
3876	Product_3876	11.77	356
6326	Product_6326	12.62	235
8471	Product_8471	13.08	105
2856	Product_2856	13.3	141

```
Welcome AAC A 12.3.py X
C: > Users > Public > AAC A 12.3.py > ...
57 start = time.perf_counter()
58 sorted_price = quick_sort(inventory, "price")
59 t3 = time.perf_counter() - start
60 print(f"Time: {t3:.4f}s")
61 display(sorted_price)
62
63 print("\n=== Sort by Quantity (Quick Sort) ===")
64 start = time.perf_counter()
65 sorted_qty = quick_sort(inventory, "qty")
66 t4 = time.perf_counter() - start
67 print(f"Time: {t4:.4f}s")
68 display(sorted_qty)
69
70 print("\n=== Algorithm Recommendation Table ===")
71 print(f'{"Operation":<25}{ "Algorithm":<20}{ "Justification"}')
72 print("-" * 75)
73 print(f'{"Search by ID":<25}{ "Binary Search":<20}{ "O(log n), data sorted by ID"}')
74 print(f'{"Search by Name":<25}{ "Hash Map (dict)":<20}{ "O(1) average lookup"}')
75 print(f'{"Sort by Price/Qty":<25}{ "Quick Sort":<20}{ "O(n log n) avg, fast in practice"}')
76
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

```
PS C:\Users\Public> c:; cd 'c:\Users\Public'; & 'c:\Users\shash\anaconda3\envs\Shashidhar\python.exe' 'c:\Users\Public\AAC A 12.3.py'
=== Sort by Quantity (Quick Sort) ===
Time: 0.0557s
ID      Name      Price      Qty
-----
85      Product_85  4139.68    0
441     Product_441 4613.7     0
1338    Product_1338 3868.26    0
1408    Product_1408 56.08      0
```

Welcome AAC A 12.3.py X

C:\Users\Public> AAC A 12.3.py > ...
start = time.perf_counter()
58 sorted_price = quick_sort(inventory, "price")
59 t3 = time.perf_counter() - start
60 print(f"Time: {t3:.4f}s")
61 display(sorted_price)
62
63 print("\n=== Sort by Quantity (Quick Sort) ===")
64 start = time.perf_counter()
65 sorted_qty = quick_sort(inventory, "qty")
66 t4 = time.perf_counter() - start
67 print(f"Time: {t4:.4f}s")
68 display(sorted_qty)
69
70 print("\n=== Algorithm Recommendation Table ===")
71 print(f"{'Operation':<25}{'Algorithm':<20}{'Justification'}")
72 print("-" * 75)
73 print(f"{'Search by ID':<25}{'Binary Search':<20}{'O(log n), data sorted by ID'}")
74 print(f"{'Search by Name':<25}{'Hash Map (dict)':<20}{'O(1) average lookup'}")
75 print(f"{'Sort by Price/Qty':<25}{'Quick Sort':<20}{'O(n log n) avg, fast in practice'}")
76

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

PS C:\Users\Public> c:: cd 'c:\Users\Public'; & 'c:\Users\shash\anaconda3\envs\Shashidhar\python.exe'
thon.debugpy-2025.18.0-win32-x64\bundled\libs\debugpy\launcher' '57920' '--' 'c:\Users\Public\AAC A 12
441 Product_441 4613.7 0
1338 Product_1338 3868.26 0
1408 Product_1408 56.08 0
1740 Product_1740 660.14 0
2077 Product_2077 2768.81 0
2597 Product_2597 299.16 0
2837 Product_2837 3044.18 0
3438 Product_3438 3553.94 0
3474 Product_3474 3410.59 0

```

C:\Users\Public> cd C:\Users\Public & python AAC A 12.3.py ...
57 start = time.perf_counter()
58 sorted_price = quick_sort(inventory, "price")
59 t3 = time.perf_counter() - start
60 print(f"Time: {t3:.4f}s")
61 display(sorted_price)
62
63 print("\n=== Sort by Quantity (Quick Sort) ===")
64 start = time.perf_counter()
65 sorted_qty = quick_sort(inventory, "qty")
66 t4 = time.perf_counter() - start
67 print(f"Time: {t4:.4f}s")
68 display(sorted_qty)
69
70 print("\n=== Algorithm Recommendation Table ===")
71 print(f"{'Operation':<25}{'Algorithm':<20}{'Justification'}")
72 print("-" * 75)
73 print(f"{'Search by ID':<25}{'Binary Search':<20}{'O(log n), data sorted by ID'}")
74 print(f"{'Search by Name':<25}{'Hash Map (dict)':<20}{'O(1) average lookup'}")
75 print(f"{'Sort by Price/Qty':<25}{'Quick Sort':<20}{'O(n log n) avg, fast in practice'}")
76

```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

```

PS C:\Users\Public> c;; cd 'c:\Users\Public'; & 'c:\Users\shash\anaconda3\envs\Shashidhar\python.exe' '
thon.debugpy-2025.18.0-win32-x64\bundled\libs\debugpy\launcher' '57920' '--' 'c:\Users\Public\AAC A 12.3

```

```

3474 Product_3474 3410.59 0

```

```

=== Algorithm Recommendation Table ===
Operation           Algorithm           Justification
-----
Search by ID        Binary Search       O(log n), data sorted by ID
Search by Name      Hash Map (dict)     O(1) average lookup
Sort by Price/Qty   Quick Sort          O(n log n) avg, fast in practice

```

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.

WelcomeAAC A 12.3.py X

C:\Users > Public > AAC A 12.3.py > ...
1 import random, time, heapq
2
3 symbols = ["AAPL", "GOOG", "MSFT", "AMZN", "ISLA", "META", "NFLX", "NVDA", "INCY", "TCS",
4 "RELIANCE", "HDFC", "WIPRO", "KCLTECH", "SBIN", "LICICI", "BAJAJ", "SUNPHARMA",
5 "LT", "MARUTI", "TATAMOTORS", "ITC", "AXISBANK", "KOTAK", "ADANI"]
6
7 def generate_stocks(n):
8 stocks = []
9 for i in range(n):
10 sym = symbols[i % len(symbols)] + (f"_{i//25}" if i >= 25 else "")
11 open_p = round(random.uniform(100, 5000), 2)
12 close_p = round(open_p * random.uniform(0.9, 1.1), 2)
13 pct = round((close_p - open_p) / open_p * 100, 2)
14 stocks.append({"symbol": sym, "open": open_p, "close": close_p, "pct_change": pct})
15 return stocks
16
17 def heap_sort_by_pct(stocks):
18 heap = [(-s["pct_change"], i, s) for i, s in enumerate(stocks)]
19 heapq.heapify(heap)
20 return [heapq.heappop(heap)[2] for _ in range(len(heap))]
21
22 def hash_search(index, symbol):
23 return index.get(symbol)
24

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Python Deb...
PS C:\Users\Public> c;; cd 'c:\Users\Public'; & 'c:\Users\shash\anaconda3\envs\Shashidhar\python.exe' 'c:\Users\shash\.vscode\extensions\ms-py
thon.debugpy-2025.18.0-win32-x64\bundled\libs\debugpy\launcher' '58347' '-.' 'c:\Users\Public\AAC A 12.3.py'
=== Heap Sort vs sorted() - Rank by % Change ===

Heap Sort : 0.0091s
sorted() : 0.0018s
Faster : sorted()

Top 10 Gainers:
SymbolOpenCloseChange %

NFLX_1192147.642362.279.99
AXISBANK_149313.62344.949.99
META_235160.33175.349.99

CHAT
SORTING STUDENT RECORDS FOR PL...
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.
give simple and small code in python
✓ Reviewed AAC A 12.3.py
✓ Created AAC A 12.3.py
python
✓ "c:\Users\Public\AAC A 12.3.py"
Code written to AAC A 12.3.py. Results:
Sorting (10,000 stocks by % change):
• Heap Sort: 0.0056s
• sorted() (Timsort): 0.0030s — faster because Timsort is a highly optimized hybrid algorithm
AAC A 12.3.py
Describe what to build next
Claude Opus 4.5

WelcomeAAC A 12.3.py X

C:\Users > Public > AAC A 12.3.py > ...
28 def display(stocks, n=10):
32 print(f"{s['symbol']:<15}{s['open']:<12}{s['close']:<12}{s['pct_change']:<10}")
33
34 data = generate_stocks(10000)
35
36 print("=== Heap Sort vs sorted() - Rank by % Change ===\n")
37
38 start = time.perf_counter()
39 heap_sorted = heap_sort_by_pct(data)
40 t_heap = time.perf_counter() - start
41
42 start = time.perf_counter()
43 lib_sorted = sorted(data, key=lambda x: -x["pct_change"])
44 t_lib = time.perf_counter() - start
45
46 print(f"Heap Sort : {t_heap:.4f}s")
47 print(f"sorted() : {t_lib:.4f}s")
48 print(f"Faster : {'Heap Sort' if t_heap < t_lib else 'sorted()'}\n")
49
50 print("Top 10 Gainers:")
51 display(heap_sorted)
52 print("\nTop 10 Losers:")
53 display(heap_sorted[-10:][::-1])
54

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NFLX_1192147.642362.279.99
AXISBANK_149313.62344.949.99
META_235160.33175.349.99

Welcome AAC A 12.3.py X

C: > Users > Public > AAC A 12.3.py > ...

```
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NFLX_119	2147.64	2362.27	9.99
AXISBANK_149	313.62	344.94	9.99
META_225	160.32	176.34	9.99

Top 10 Losers:

Symbol	Open	Close	Change %
ITC_339	4372.67	3935.42	-10.0
BAJAJ_316	3547.91	3193.18	-10.0

VS Code Window: AAC A 12.3.py X

C:\Users\Public > AAC A 12.3.py > ...

```
28 def display(stocks, n=10):
32     print(f"{s['symbol']:<15}{s['open']:<12}{s['close']:<12}{s['pct_change']:<10}")
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thon.debugpy-2025.18.0-win32-x64\bundled\libs\debugpy\launcher' '58347' '--' 'c:\Users\Public\AAC A 12.

ADANI_258	3536.14	3182.58	-10.0
HCLTECH_254	3068.46	2761.7	-10.0
SUNPHARMA_222	3697.36	3327.72	-10.0
MARUTI_93	1783.28	1604.99	-10.0
WIPRO_334	861.71	775.65	-9.99
ITC_327	2201.07	1981.19	-9.99
GOOG_285	2888.79	2600.15	-9.99
NFLX_256	2957.21	2661.79	-9.99

Welcome AAC A 12.3.py X

C: > Users > Public > AAC A 12.3.py > ...

```
49
50 print("Top 10 Gainers:")
51 display(heap_sorted)
52 print("\nTop 10 Losers:")
53 display(heap_sorted[-10:][::-1])
54
55 print("\n=== Hash Map vs dict lookup - Search by Symbol ===\n")
56
57 index = build_hash_index(data)
58
59 start = time.perf_counter()
60 r1 = hash_search(index, "TSLA")
61 t_hash = time.perf_counter() - start
62
63 start = time.perf_counter()
64 r2 = next((s for s in data if s["symbol"] == "TSLA"), None)
65 t_linear = time.perf_counter() - start
66
67 print(f"Hash Map Search : {t_hash:.6f}s Result: {r1}")
68 print(f"Linear Search : {t_linear:.6f}s Result: {r2}")
69 print(f"Faster : {'Hash Map' if t_hash < t_linear else 'Linear'}")
70
71 print("\n=== Performance Comparison Table ===")
72 print(f"{'Operation':<20}{ 'Custom':<18}{ 'Standard Lib':<18}{ 'Trade-off'}")
```

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```
PS C:\Users\Public> c;; cd 'c:\Users\Public'; & 'c:\Users\shash\anaconda3\envs\Shashidhar\python.exe' 'c:\Users\shash\thon.debugpy-2025.18.0-win32-x64\bundled\libs\debugpy\launcher' '58347' '--' 'c:\Users\Public\AAC A 12.3.py'
```

=== Hash Map vs dict lookup - Search by Symbol ===

```
Hash Map Search : 0.000003s Result: {'symbol': 'TSLA', 'open': 3265.84, 'close': 2963.07, 'pct_change': -9.27}
Linear Search : 0.000013s Result: {'symbol': 'TSLA', 'open': 3265.84, 'close': 2963.07, 'pct_change': -9.27}
Faster : Hash Map
```

=== Performance Comparison Table ===

Operation	Custom	Standard Lib	Trade-off
-----------	--------	--------------	-----------

Welcome AAC A 12.3.py X

C: > Users > Public > AAC A 12.3.py > ...

```
60 r1 = hash_search(index, "TSLA")
61 t_hash = time.perf_counter() - start
62
63 start = time.perf_counter()
64 r2 = next((s for s in data if s["symbol"] == "TSLA"), None)
65 t_linear = time.perf_counter() - start
66
67 print(f"Hash Map Search : {t_hash:.6f}s Result: {r1}")
68 print(f"Linear Search : {t_linear:.6f}s Result: {r2}")
69 print(f"Faster : {'Hash Map' if t_hash < t_linear else 'Linear'}")
70
71 print("\n=== Performance Comparison Table ===")
72 print(f"{'Operation':<20}{ 'Custom':<18}{ 'Standard Lib':<18}{ 'Trade-off'}")
73 print(f"{'-' * 75}")
74 print(f"{'Sort by % change':<20}{ 'Heap Sort':<18}{ 'sorted()':<18}{ 'Timsort is hybrid, often faster'}")
75 print(f"{'Search by symbol':<20}{ 'Hash Map O(1)':<18}{ 'Linear O(n)':<18}{ 'Hash uses more memory'}")
76
```

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```
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```

```
Linear Search : 0.000013s Result: {'symbol': 'TSLA', 'open': 3265.84, 'close': 2963.07, 'pct_change': -9.27}
Faster : Hash Map
```

=== Performance Comparison Table ===

Operation	Custom	Standard Lib	Trade-off
Sort by % change	Heap Sort	sorted()	Timsort is hybrid, often faster
Search by symbol	Hash Map O(1)	Linear O(n)	Hash uses more memory

PS C:\Users\Public>

	Note: Report should be submitted as a word document for all tasks in a single document with prompts, comments & code explanation, and output and if required, screenshots.	
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