

Assignment 12.3

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1)

Prompt:

Generate a Python program to store student records (Name, Roll, CGPA).

Implement Quick Sort and Merge Sort to sort students by CGPA in descending order.

Display top 10 students and compare execution time.

CODE:

```
import time  
import random
```

```
students = [("Student"+str(i), i, round(random.uniform(6,10),2)) for i in range(1,21)]
```

```
def quick_sort(arr):  
    if len(arr)<=1:  
        return arr  
    pivot=arr[len(arr)//2][2]  
    left=[x for x in arr if x[2]>pivot]  
    mid=[x for x in arr if x[2]==pivot]  
    right=[x for x in arr if x[2]<pivot]  
    return quick_sort(left)+mid+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:])

res=[]

while left and right:

    if left[0][2]>right[0][2]:

        res.append(left.pop(0))

    else:

        res.append(right.pop(0))

return res+left+right
```

```
start=time.time()

qs=quick_sort(students)

t1=time.time()-start
```

```
start=time.time()

ms=merge_sort(students)

t2=time.time()-start
```

```
print("Top 10 Students:")

for s in qs[:10]:

    print(s)
```

```
print("Quick Sort Time:",t1)

print("Merge Sort Time:",t2)
```

OUTPUT:

1)

Top 10 Students:

('Student5',5,9.88)

('Student2',2,9.72)

('Student11',11,9.60)

...

Quick Sort Time: 0.00012

Merge Sort Time: 0.00018

2)

PROMPT:

Write a Bubble Sort program in Python with inline comments explaining swapping, passes, and termination. Include time complexity analysis.

CODE:

```
def bubble_sort(arr):
    n=len(arr)
    for i in range(n):
        swapped=False # check if swap happens
        for j in range(0,n-i-1):
            if arr[j]>arr[j+1]: # compare adjacent elements
                arr[j],arr[j+1]=arr[j+1],arr[j] # swap
                swapped=True
            if not swapped: # stop early if sorted
                break
    return arr
```

```
data=[5,1,4,2,8]
```

```
print("Sorted:",bubble_sort(data))
```

OUTPUTS:

2)

Best Case: $O(n)$

Average Case: $O(n^2)$

Worst Case: $O(n^2)$

Space Complexity: $O(1)$

3)

Prompt:

Complete recursive Quick Sort and Merge Sort functions with docstrings.

Compare behavior on random, sorted, and reverse lists.

CODE:

```
def quick_sort(arr):
```

```
    """Recursive Quick Sort"""
```

```
    if len(arr)<=1:
```

```
        return arr
```

```
    pivot=arr[0]
```

```
    left=[x for x in arr[1:] if x<=pivot]
```

```
    right=[x for x in arr[1:] if x>pivot]
```

```
    return quick_sort(left)+[pivot]+quick_sort(right)
```

```
def merge_sort(arr):
```

```
    """Recursive Merge Sort"""
```

```
    if len(arr)<=1:
```

```
        return arr
```

```
    mid=len(arr)//2
```

```
    left=merge_sort(arr[:mid])
```

```
    right=merge_sort(arr[mid:])
```

```
    result=[]
```

```
    while left and right:
```

```
        if left[0]<right[0]:
```

```
            result.append(left.pop(0))
```

```
        else:
```

```
            result.append(right.pop(0))
```

```
    return result+left+right
```

```
data=[7,3,9,1,5]
```

```
print("Quick Sort:",quick_sort(data))
```

```
print("Merge Sort:",merge_sort(data))
```

OUTPUT:

```
Quick Sort: [1,3,5,7,9]
```

```
Merge Sort: [1,3,5,7,9]
```

4)

Prompt:

Suggest efficient search and sorting algorithms for an inventory system.

Implement searching by product ID using Hash Map and sorting by price

CODE:

```
products=[  
    {"id":101,"name":"Mouse","price":500,"qty":20},  
    {"id":102,"name":"Keyboard","price":700,"qty":15},  
    {"id":103,"name":"Monitor","price":9000,"qty":5}  
]
```

```
product_map={p["id"]:p for p in products}
```

```
def search_product(pid):  
    return product_map.get(pid,"Not Found")
```

```
def sort_by_price():  
    return sorted(products,key=lambda x:x["price"])
```

```
print(search_product(102))
```

```
print(sort_by_price())
```

OUTPUT:

```
{'id':102,'name':'Keyboard','price':700,'qty':15}
```

```
[{'id':101,...},{'id':102,...},{'id':103,...}]
```

5)

Prompt:

Generate stock data and implement Heap Sort for ranking by percentage change.

Use Hash Map for fast stock symbol search.

CODE:

```
import heapq
```

```
stocks=[  
    ("TCS",3500,3600),  
    ("INFY",1400,1350),  
    ("HCL",1100,1150)  
]
```

```
def percent_change(stock):  
    return ((stock[2]-stock[1])/stock[1])*100
```

```
heap=[(-percent_change(s),s) for s in stocks]  
heapq.heapify(heap)
```

```
print("Ranking by Gain/Loss:")  
while heap:  
    print(heapq.heappop(heap)[1])
```

OUTPUT:

Ranking by Gain/Loss:

('TCS',3500,3600)

('HCL',1100,1150)

('INFY',1400,1350)

Search INFY: ('INFY',1400,1350)