Assignment - 5

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(i) Write the algorithm for insertion sort and sort of following

Sequence : 3, 1, 4, 1, 5, 9, 2, 6, 5

Algorithm :

1. Start with the second element (index) of the array
→ The first element is considered sorted
2. For each element from the second to the last.

Key : The element of key in the sorted portion.

Compare : The key with elements in the sorted portion from left to right.

Shift : Elements of the sorted portion to the right if they are greater than the key

Insert : The key into its correct position until the entire array is sorted.

3. Repeat the above step for each element until the entire array is sorted.

Given sequence : 3, 1, 4, 1, 5, 9, 2, 6, 5

3	1	4	1	5	9	2	6	5	→ First two elements are compared (3 & 1) 3>1, swap 1,3

1	3	4	1	5	9	2	6	5	→ Compare next two elements (4,1) 4>1, swap (1,4)

1	3	1	4	5	9	2	6	5	→ Compare next two elements (3,1) 3>1, swap (3,1)

1	1	3	4	5	9	2	6	5	→ 6>2, swap 9, 2

1	1	3	4	5	2	9	6	5	→ 5>2, swap

(vi) | 1 | 1 | 3 | 4 | 2 | 5 | 9 | 6 | 5 | → 4 > 2, swap

(vii) | 1 | 1 | 3 | 2 | 4 | 5 | 9 | 6 | 5 | → 3 > 2, swap

(viii) | 1 | 1 | 2 | 3 | 4 | 5 | 9 | 6 | 5 | → Compare the least element and shift its place towards left (6, 5)

(ix) | 1 | 1 | 2 | 3 | 4 | 5 | 9 | 5 | 6 | → Compare next element and (9,5) 9 > 5, swap

(x) | 1 | 1 | 2 | 3 | 4 | 5 | 5 | 9 | 6 | → Compare the next element (9,6) 9 > 6, swap

| 1 | 1 | 2 | 3 | 4 | 5 | 5 | 9 | 6 | ⇒ Sorted array.

(ii) Explain the procedure for merge sort and perform the merge sort for the following input. Also, show the input for each step of iteration.

64, 8, 216, 512, 27, 729, 0, 1, 343, 125

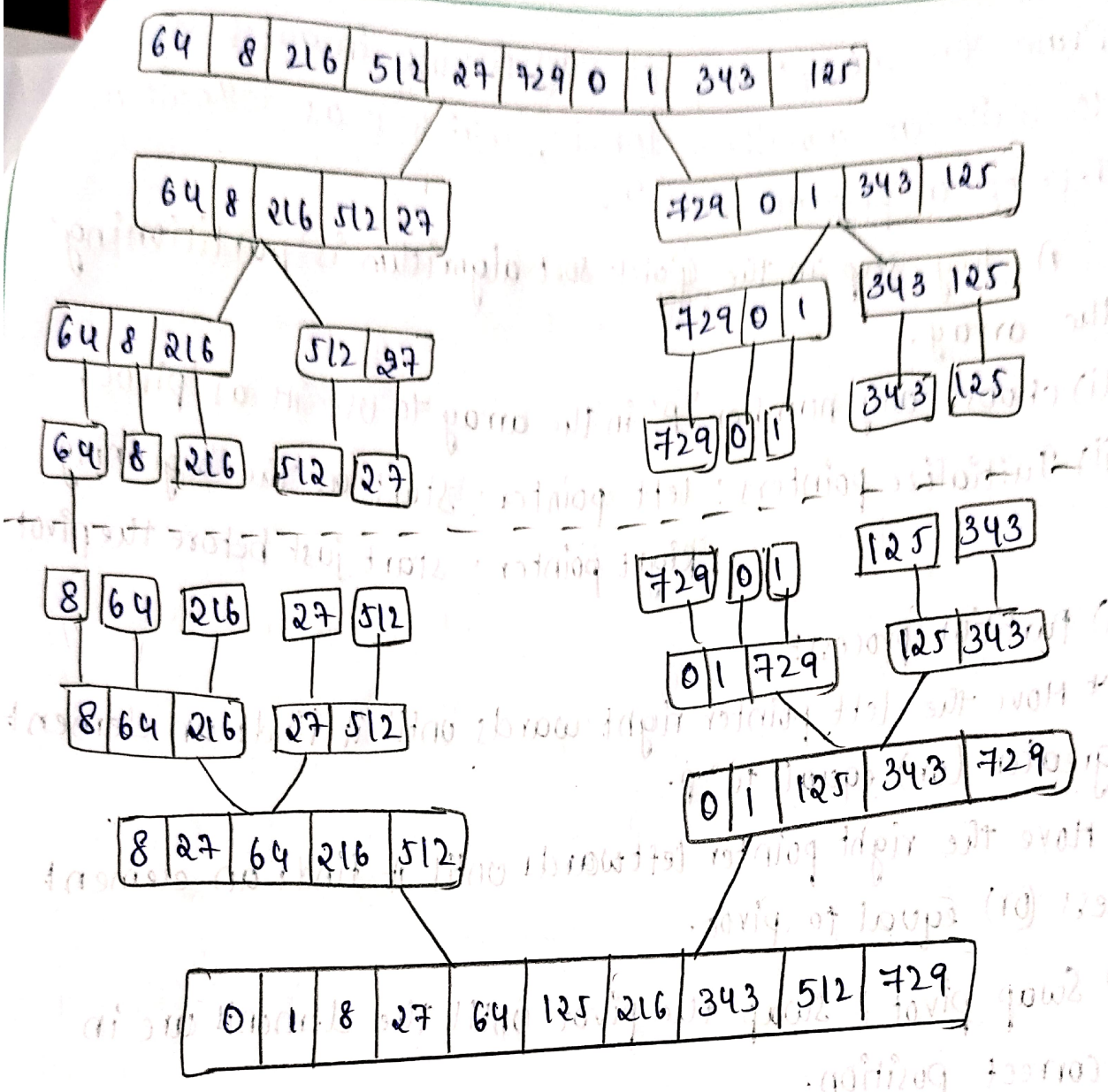
Algorithm :

Divide :

* If the array has more than one element, split into two halves
* Continue recursively splitting each half until you have subarrays that are trivially sorted.

Conquer :

* Recursively sort each other smaller subarrays. Since arrays with one element are already sorted, this focuses on the merging process.



⇒ SORTED ARRAY

2) Draw the concept map of partitioning in quick sort, try to write an algorithm for it, which is as follows and develop a program for it.

A key step in the Quick sort algorithm is 'partitioning' the array.

(i) choose any number 'p' in the array to use it as 'pivot'.

(ii) Initialize pointers: left pointer: start at the beginning
Right pointer: start just before the pivot.

(iii) Partition process:

* Move the left pointer right wards until it finds an element greater (or) equal to p.
* Move the right pointer leftwards until it finds an element less (or) equal to pivot.

(iv) Swap pivot: Swap the pivot until the elements are in correct position.

(v) Apply the same process to the left and right sub-arrays.

Algorithm:

1. Choose element at index 'high' as pivot.
2. Initialize - left = low
   - right = high - 1
3. While left <= right
   a. Increment left while A[left] < pivot
   b. Decrement right while A[right] > pivot.
   c. If left <= right; swap A[left] and A[right]

swap pivot
Return left

Program :

```
#include <stdio.h>
void swap (int *a, int *b) {
 int temp = *a;
     *a = *b;
     *b = temp;
}
 int partition (int arr[], int low, int high){
 int pivot = arr[high];
 int left = low;
 int right = high-1;
 while (left <= right) {
 while (left <= right && arr[left] < pivot) {
  left ++;
 }
 while (left <= right && arr[right] > pivot) {
    right--;
 }
 if (left <= right) {
 swap (&arr[left], &arr[right]);
 left ++;
 right--;
 }
}
swap (&arr[left], &arr[high]);
return left;
}
void quick_sort (int arr[], int low, int high){
```

```
if (low < high) {
 int pivot_index = partition (arr, low, high);
  quick_sort (arr, low, pivot_index-1);
  quick_sort (arr, pivot_index+1, high);
  }
}

 void print_array (int arr[], int size) {
  for (int i=0; i<size; i++){
  printf ("%d", arr[i]);
 }
 printf ("\n");
 }
 int main ()
 {
    int arr[] = {10,7,8,9,1,5};
    int size = sizeof(arr)/sizeof(arr[0]);
    print_array(arr, size);
    quick_sort(arr, 0, size-1);
    printf ("sorted array");
    print_array (arr, size);
    return 0;
 }
```