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SARDAR PATEL INSTITUTE OF TECHNOLOGY
(Empowered Autonomous Institute Affiliated to Mumbai University)
Department Of Computer Engineering

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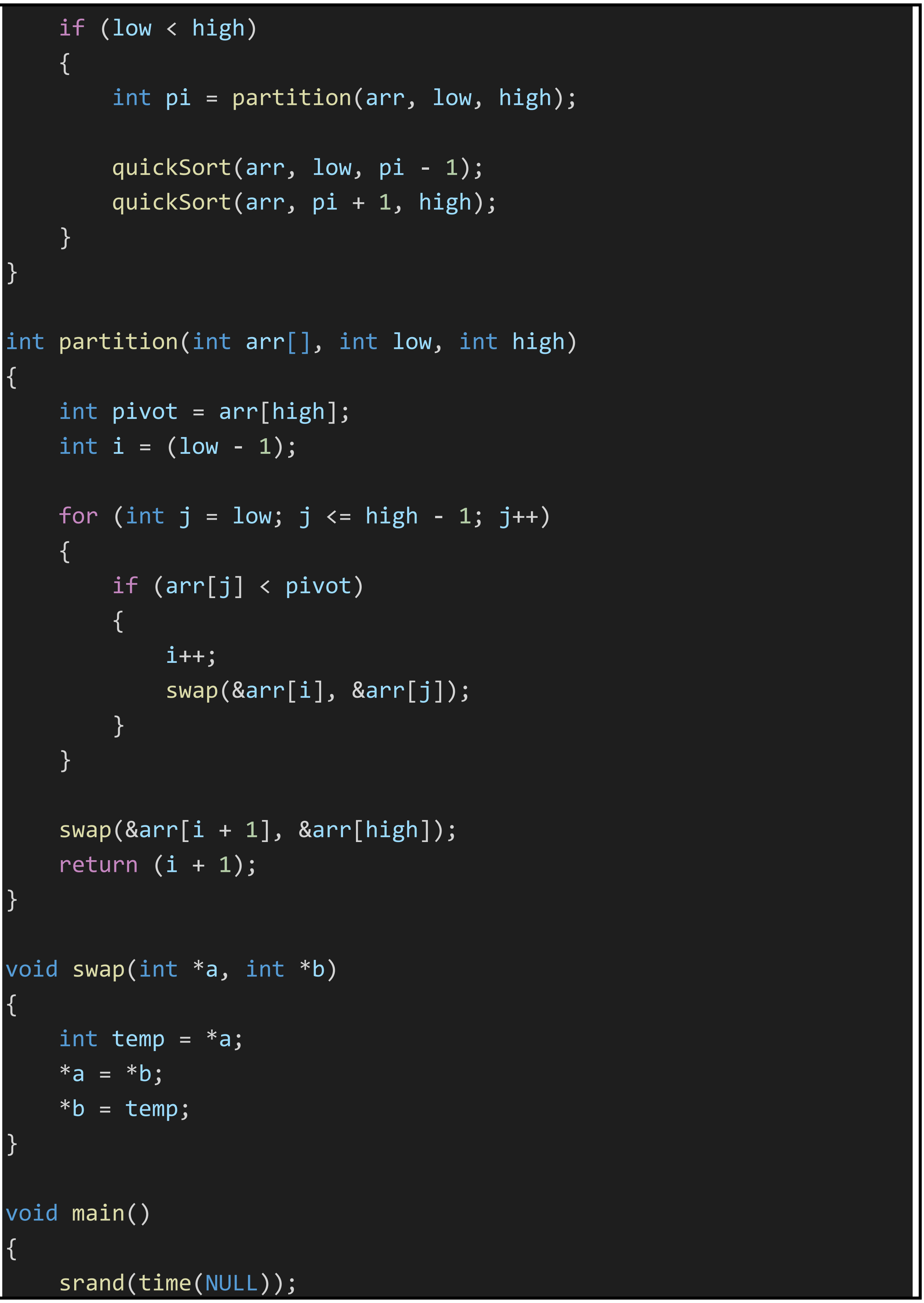
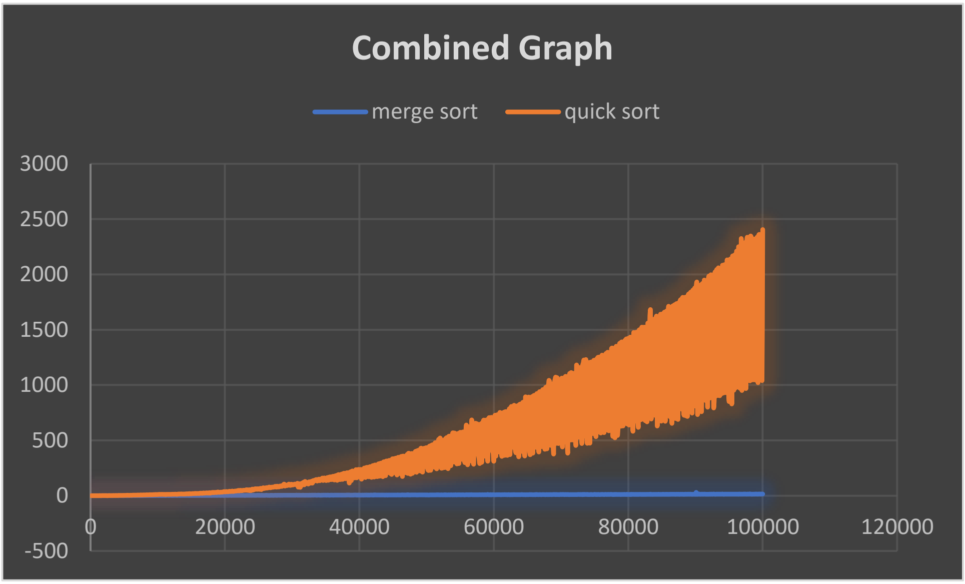
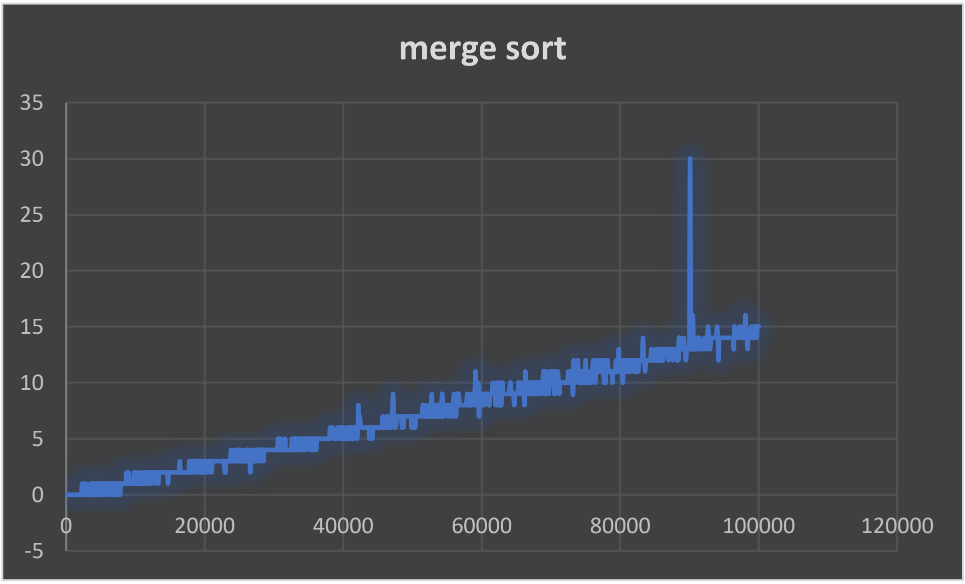
Subject	Design and Analysis of Algorithms (DAA)
Experiment No.	2
Aim	Experiment based on divide and conquer approach.

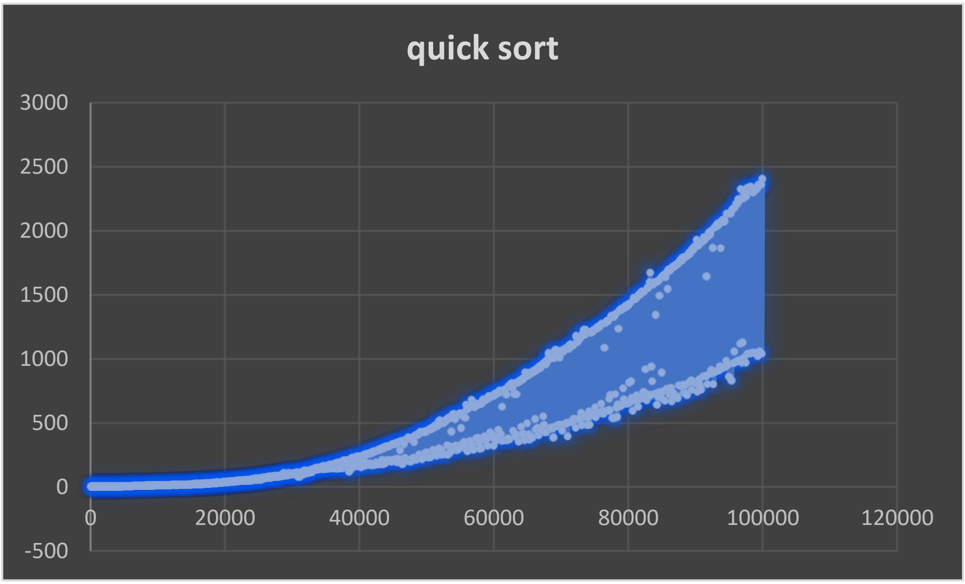
Code

```c
#include <stdio.h>
#include <stdlib.h>
#include <time.h>

void merge(int arr[], int l, int m, int r)
{
    int i, j, k;
    int n1 = m - l + 1;
    int n2 = r - m;

    int L[n1], R[n2];

    for (i = 0; i < n1; i++)
        L[i] = arr[l + i];
    for (j = 0; j < n2; j++)
        R[j] = arr[m + 1 + j];

    i = 0;
    j = 0;
    k = l;
    while (i < n1 && j < n2)
    {
        if (L[i] <= R[j])
        {
            arr[k] = L[i];
            i++;
        }
        else
        {
            arr[k] = R[j];
            j++;
        }
        k++;
    }

    while (i < n1)
    {
        arr[k] = L[i];
        i++;
        k++;
    }

    while (j < n2)
    {
        arr[k] = R[j];
        j++;
        k++;
    }
}

void mergeSort(int arr[], int l, int r)
{
    if (l < r)
    {
        int m = l + (r - l) / 2;

        mergeSort(arr, l, m);
        mergeSort(arr, m + 1, r);

        merge(arr, l, m, r);
    }
}

void quickSort(int arr[], int low, int high)
{
```



```
    if (low < high)
    {
        int pi = partition(arr, low, high);

        quickSort(arr, low, pi - 1);
        quickSort(arr, pi + 1, high);
    }
}

int partition(int arr[], int low, int high)
{
    int pivot = arr[high];
    int i = (low - 1);

    for (int j = low; j <= high - 1; j++)
    {
        if (arr[j] < pivot)
        {
            i++;
            swap(&arr[i], &arr[j]);
        }
    }

    swap(&arr[i + 1], &arr[high]);
    return (i + 1);
}

void swap(int *a, int *b)
{
    int temp = *a;
    *a = *b;
    *b = temp;
}

void main()
{
    srand(time(NULL));
    FILE *fileptr;
    FILE *fileptr1;
    int n = 100000;
    fileptr = fopen("inp.txt", "w");
    int arr[n];
    for (int j = 0; j < n; j++)
    {
        arr[j] = rand() % 100000 + 1;
        fprintf(fileptr, "%d\n", arr[j]);
    }
    fclose(fileptr);
    fileptr1 = fopen("time.csv", "w");
    printf("Block Size\tMerge Sort\tQuick Sort\n");
    fileptr = fopen("inp.txt", "r");
    for (int p = 99; p < n; p = p + 100)
    {
        int array[p + 1];
        int array1[p + 1];
        for (int j = 0; j < p; j++)
        {
            array[j] = arr[j];
            fscanf(fileptr, "%1d", &array1[j]);
        }
        clock_t begin = clock();
        mergeSort(array, 0, p);
        clock_t mid = clock();
        quickSort(array1, 0, p);
        clock_t end = clock();
        double time_spent = (double)(mid - begin);
        double time_spent1 = (double)(end - mid);
        printf("%d\t%lf\t%lf\n", p + 1, time_spent, time_spent1);
        fprintf(fileptr1, "%d,%lf,%lf\n", p + 1, time_spent,
time_spent1);
    }
    printf("\n");
}
```

Graphs	Combined Graph merge sort quick sort 3000 2500 2000 1500 1000 500 0 -500 0 20000 40000 60000 80000 100000 120000 merge sort 35 30 25 20 15 10 5 0 -5 0 20000 40000 60000 80000 100000 120000

quick sort
3000
2500
2000
1500
1000
500
0
-500
0
20000
40000
60000
80000
100000
120000

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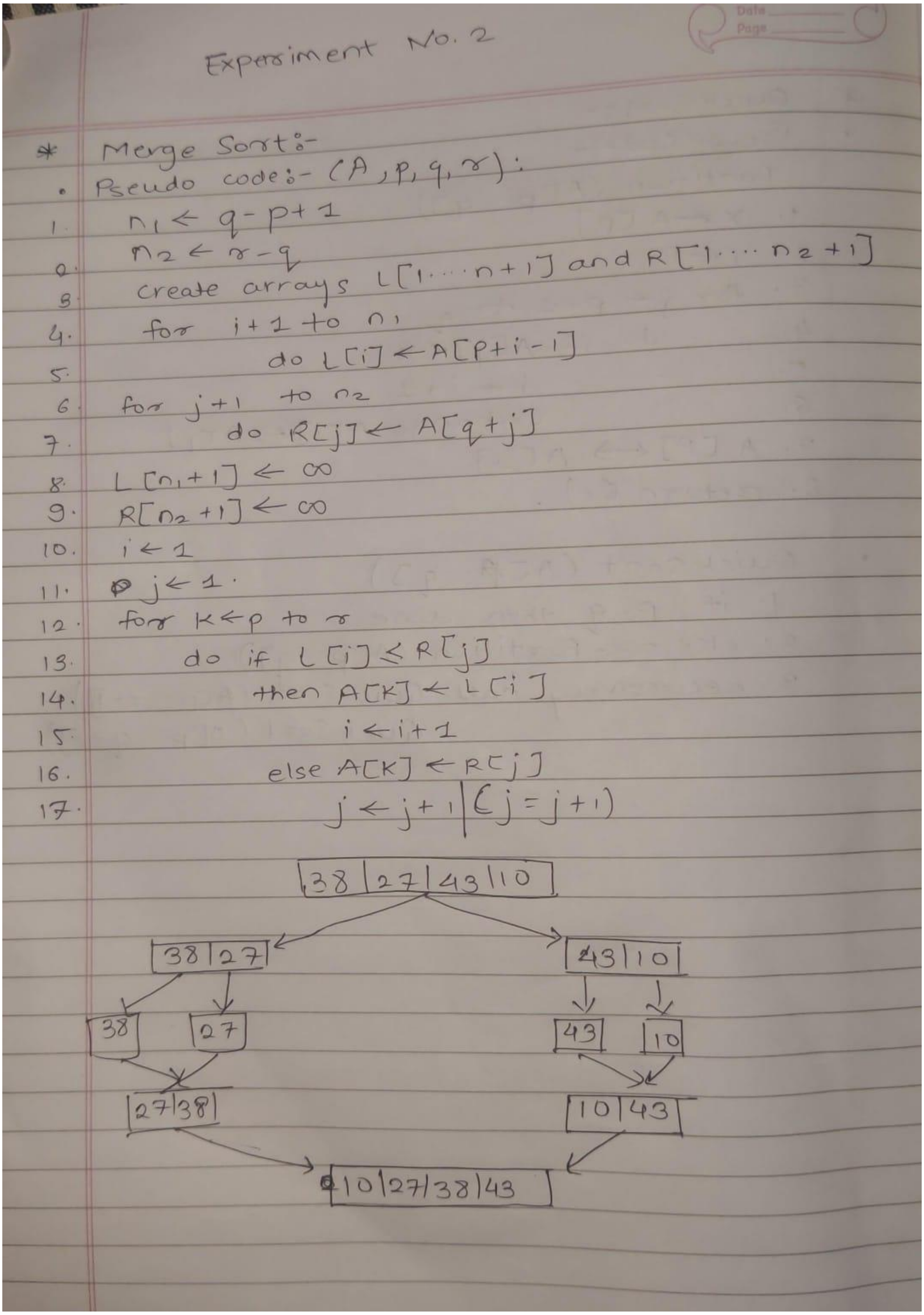
Pseudo Code & Example



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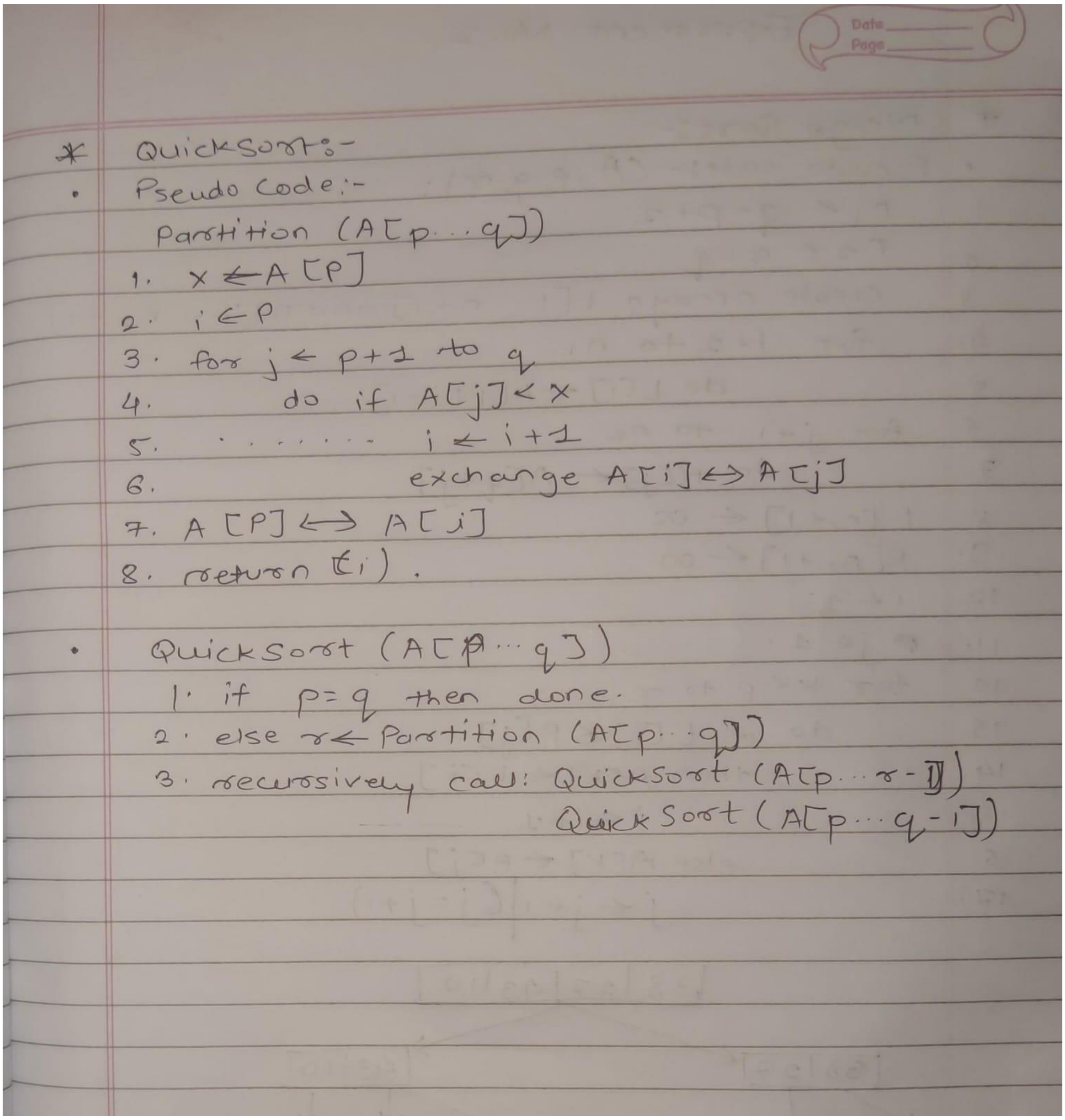
Experiment No. 2

* Merge Sort:-

• Pseudo code:- (A, p, q, r):

```
$n_1 \leftarrow q-p+1$
$n_2 \leftarrow r-q$
create arrays $L[1 \cdots n+1]$ and $R[1 \cdots n_2+1]$
for $i+1$ to $n_1$
        do $L[i] \leftarrow A[p+i-1]$
for $j+1$ to $n_2$
        do $R[j] \leftarrow A[q+j]$
$L[n_1+1] \leftarrow \infty$
$R[n_2+1] \leftarrow \infty$
$i \leftarrow 1$
$j \leftarrow 1$.
for $K \leftarrow p$ to $r$
    do if $L[i] \leq R[j]$
        then $A[K] \leftarrow L[i]$
            $i \leftarrow i+1$
        else $A[K] \leftarrow R[j]$
            $j \leftarrow j+1$ | $(j=j+1)$
```



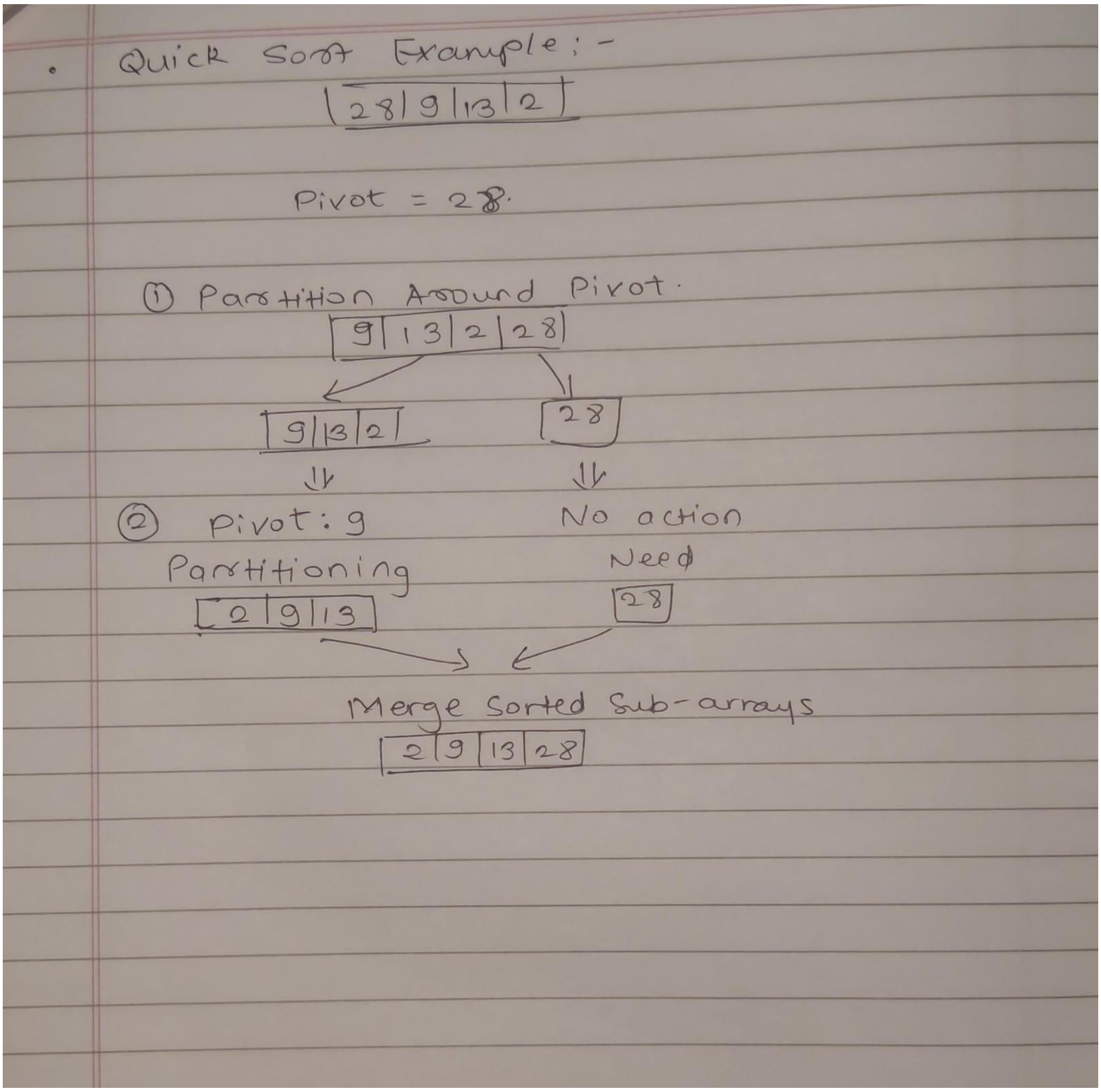
* QuickSort:-

- Pseudo Code:-

```
Partition (A[p...q])
1. x ← A[P]
2. i ← P
3. for j ← p+1 to q
4.       do if A[j] < x
5. ......      i ← i+1
6.              exchange A[i] ↔ A[j]
7. A[P] ↔ A[i]
8. return (i).
```

- QuickSort (A[p...q])

```
1. if p=q then done.
2. else r ← Partition (A[p..q])
3. recurssively call: QuickSort (A[p...r-1])
                      QuickSort (A[p...q-1])
```

<table>
<tr><td></td><td>
Quick Sort Example :-
| 28 | 9 | 13 | 2 |
Pivot = 28.
① Partition Around Pivot.
| 9 | 13 | 2 | 28 |
| 9 | 13 | 2 | | 28 |
② Pivot : 9   No action Need
Partitioning
| 2 | 9 | 13 | | 28 |
Merge Sorted Sub-arrays
| 2 | 9 | 13 | 28 |</td></tr>
<tr><td><b>Conclusion</b></td><td>Hence, by completing this experiment I came to know about divide and conquer approach.</td></tr>
</table>