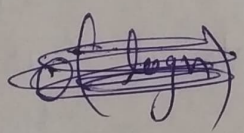
Tutorial-3

Ans-1

```
While (low <= high)
{
    mid = (low + high)/2;
    if (arr[mid] == key)
        return true;
    else if (arr[mid] > key)
        high = mid - 1;
    else
        low = mid + 1;
}
return false;
```

Ans-2 Iterative insertion sort:

```
for(int i = 1 ; i < n; i++)
{
    j = i - 1;
    x = A[i];
    while (j > -1 && A[j] > x)
    {
        A[j+1] = A[j];
        j--;
    }
    A[j+1] = x;
}
```



Recursive insertion sort:

```
void insertionSort( int arr[] , int n)
{
    if (n <= 1)
        return;
    insertionSort( arr, n-1);
    int last = arr[n-1];
    j = n-2;
    while ( j >= 0 && arr[j] > last)
    {
        arr[j+1] = arr[j];
        j--;
    }
    arr[j+1] = last;
}
```

Insertion sort is online soting because whenever a new element come, insertion sort define its right place.

Ans-3

Bubble sort — $O(n^2)$
Insertion sort → $O(n^2)$
Selection sort — $O(n^2)$
Merge sort — ~~$O(n \log n)$~~ $O(n * \log n)$
Quick sort — $O(n \log n)$
Count sort → $O(n)$
Bucket sort → $O(n)$

Ans-4

Online sorting → Insertion sort
Stable sorting → Merge sort, Insertion sort, Bubble sort
Inplace sorting → Bubble sort, Insertion sort, Selection sort

Ans-5

Iterative Binary Search:

$O(\log n)$

```
while (low <= high)
{ int mid = (low+high)/2;
  if (arr[mid] == key)
      return true;
  else if (arr[mid] > key)
      High = mid-1;
  else
      low = mid+1;
}
```

Recursive Binary Search:

$O(\log n)$

```
while (low <= high)
{ int mid = (low+high)/2
  if (arr[mid] == key)
      return true;
  else if (arr[mid] > key)
      Binary_search(arr, low, mid-1);
  else
      Binary_search(arr, mid+1, high);
}
return false;
```

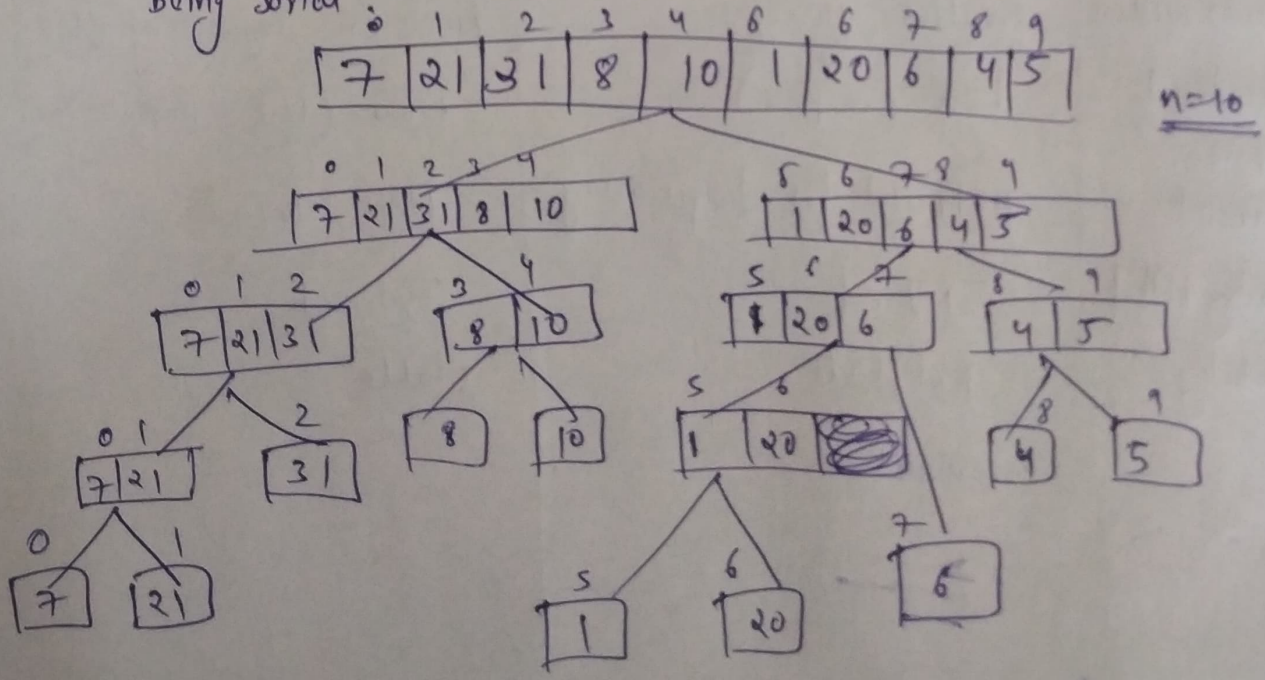
Ans-6 $T(n) = T(n/2) + T(n/2) + c$

Ans-7

```
map<int,int> m;
for (int i=0; i<arr.size(); i++)
{
    if (m.find(target - arr[i]) = m.end())
        m[arr[i]] = i;
    else
    {
        cout<< i <<" " <<mp[arr[i]];
    }
}
```

Ans-8 Quicksort is the fastest general Purpose sort. In most Practical situation, quicksort is the method of choice. If stability is important and space is available, mergesort might be best.

Ans-9 Inversion indicates — how far or close the array is from being sorted.



Inversions = 31

Ans 10 **Worst Case:** The worst Case occurs when the Picked Pivot is always an extreme (smallest as largest) element. This happens when input array is sorted as reverse sorted and either first as last element is Picked as Pivot.

$O(n^2)$.

Best Case: Best Case occurs when Pivot element is the middle element as near to the middle element.

$O(n \log n)$

Ans 11 **Merge Sort:** $T(n) = 2T\left(\frac{n}{2}\right) + O(n)$

Quicksort: $T(n) = 2T\left(\frac{n}{2}\right) + n+1$

Basis	Quicksort	Merge Sort
• Partition	splitting is done in any ratio	array is Parted into just 2 halves
• Works well on	smaller array	fine on any size of array.
• Additional Space	Less (in-place)	More (Not in-place)
• Efficient	inefficient for large array	More efficient
• Sorting Method	Internal	External
• Stability	Not stable	stable

Ans 14 We will use Merge Sort because We can divide the 4 GB data into 4 Packets of 1 GB and Sort them Seprately and Combine them lattes.

- Internal Sorting: all the data to Sort is stored in memory at all times while Sorting is in Progress.
- External Sorting: all the data is stord outside memory and only loaded into memory in small chunks.