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;
}
```

Ans 3) → Bubble sort = $O(n^2)$
Insertion sort - $O(n^2)$
Selection sort - $O(n^2)$
Merge sort $O(n \log n)$
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 -

```
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;
}
```

$O(\log n)$

Recursive Binary Search -

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

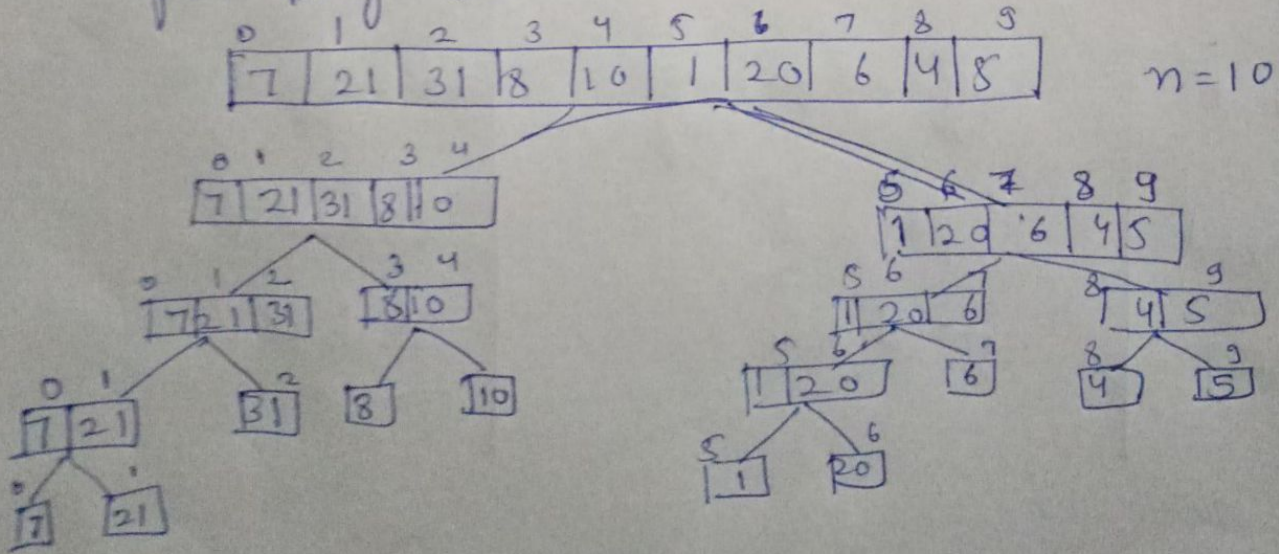
$O(\log n)$

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<< " " << m[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, merge sort might be best.

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



Ans 10) ⇒ Worst Case - The worst case occurs when the picked pivot is always an extreme (smallest / largest) element. This happens when input array is sorted as reverse sorted and either first or 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 - $T(n) = 2T(n/2) + O(n)$

Quicksort - $T(n) = 2T(n/2) + n + 1$

Basis	Quick Sort	~~Mergesort~~ 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 (inplace)	More (not inplace)
• Efficient	inefficient for larger array	More efficient
• Sorting method	Internal	External
• Stability.	not stable	Stable

Ans 14) We will use merge sort because we can divide the 4GB data into 4 packets of 1GB and sort them seperately and combine them later.

- 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 sorted outside memory and only loaded into memory in small chunks.