# ANS-1

| | |
|---|---|
| • IN PLACE algorithm requires small amount of extra space.<br>• Extra space should in range [O (1) to O(logN)].<br>• Produces array in same memory as input array.<br>• Example – insertion, selection, quick, bubble sort, heap sort uses in- place sorting. | • The Out-of-place sorting algorithm uses extra space for sorting.<br>• Extra space should be greater than log(N).<br>• Space depends on input size.<br>• Example – standard sort algorithm. |

# ANS-2

```
//insertion sort in-place
#include <bits/stdc++.h>
using namespace std;

void insertionSort(int arr[], int N)
{
   int i, key, j;
   for (i = 1; i < N; i++)
   {
      key = arr[i];
      j = i - 1;

      while (j >= 0 && arr[j] > key)
      {
         arr[j + 1] = arr[j];
         j = j - 1;
      }
      arr[j + 1] = key;
   }
}

void printArray(int arr[], int N)
{
   int i;
   for (i = 0; i < N; i++)
      cout << arr[i] << " ";
```

```
    cout << endl;
}



int main()
{
    int arr[] = { 1,2,3,6,7,18,19,25 };
    int N = sizeof(arr) / sizeof(arr[0]);

    insertionSort(arr, N);
    printArray(arr, N);

    return 0;
}




//insertion sort OUT-place
#include <bits/stdc++.h>
using namespace std;

void insertionSort(int arr[], int N)
{
    int i, key, j;
    for (i = 1; i < N; i++)
    {
        key = arr[i];
        j = i - 1;
```

```
        while (j >= 0 && arr[j] > key)
        {
            arr[j + 1] = arr[j];
            j = j - 1;
        }
        arr[j + 1] = key;
        int k =0;
        arr2[k] = key;
        k++;

    }
}


void printArray(int arr[], int N)
{
    int i;
    for (i = 0; i < N; i++)
        cout << arr[i] << " ";
    cout << endl;
}


int main()
{
    int arr[] = { 1,2,3,6,7,18,19,25 };
    int N = sizeof(arr) / sizeof(arr[0]);
```

```
    insertionSort(arr, N);
    printArray(arr, N);

    return 0;
}
```

# ANS-3

## **Inplace techniques** are useful to sort the lists containing limited amount of data in an efficient and space optimised manner.

**// Outplace techniques** are useful when we have large amount of data such that we need to store the immediate results. Here extra space requirement is necessary.