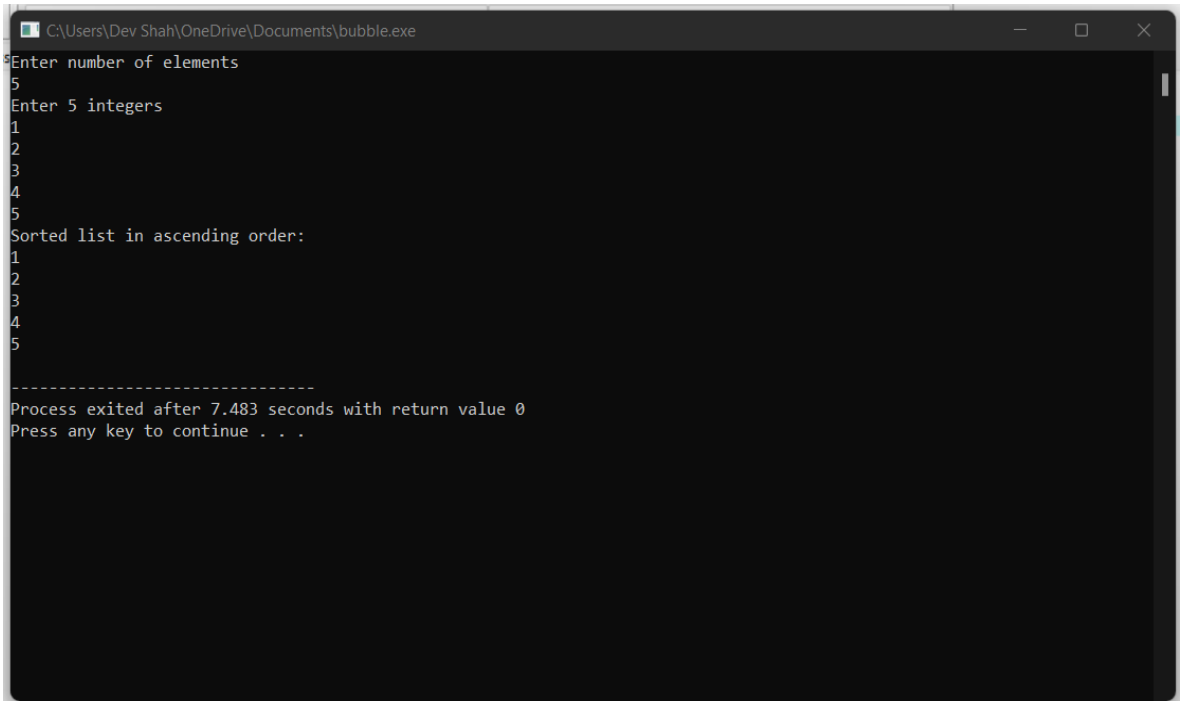
Practical 1

Aim: Write a program to sort given elements of an array in ascending order using bubble sort. Analyze the time complexity for best, average and worst case.

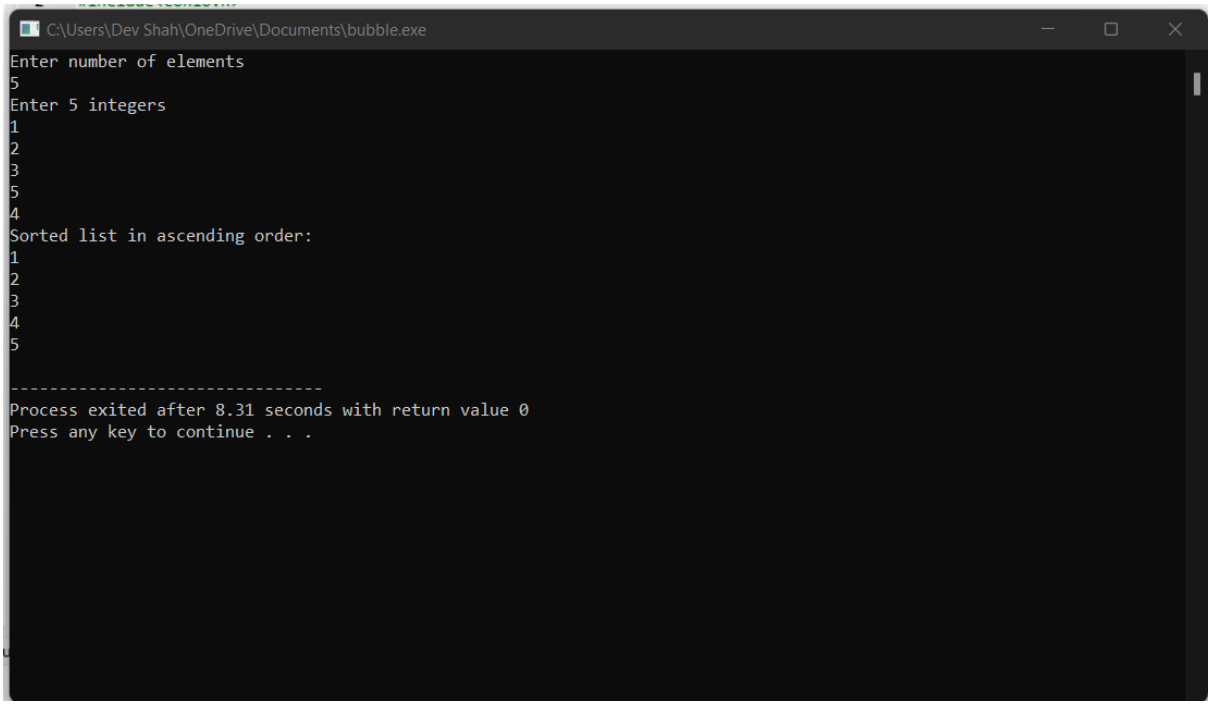
```
#include<stdio.h>
#include<conio.h>
int main()
{
   int  n, j, i, swap;
   printf("Enter number of elements\n");
   scanf("%d", &n);
   int array[n];
   printf("Enter %d integers\n", n);
   for (i= 0; i < n; i++)
   {
      scanf("%d", &array[i]);
   }
   for (i = 0 ; i < n - 1; i++)
   {
      for (j = 0 ; j < n - i- 1; j++)
      {
         if (array[j] > array[j+1])
         {
            swap       = array[j];
            array[j]   = array[j+1];
            array[j+1] = swap;
 }
      }
   }
```

```
    printf("Sorted list in ascending order:\n");

    for (i = 0; i < n; i++)
        printf("%d\n", array[i]);
    return 0;
}
```

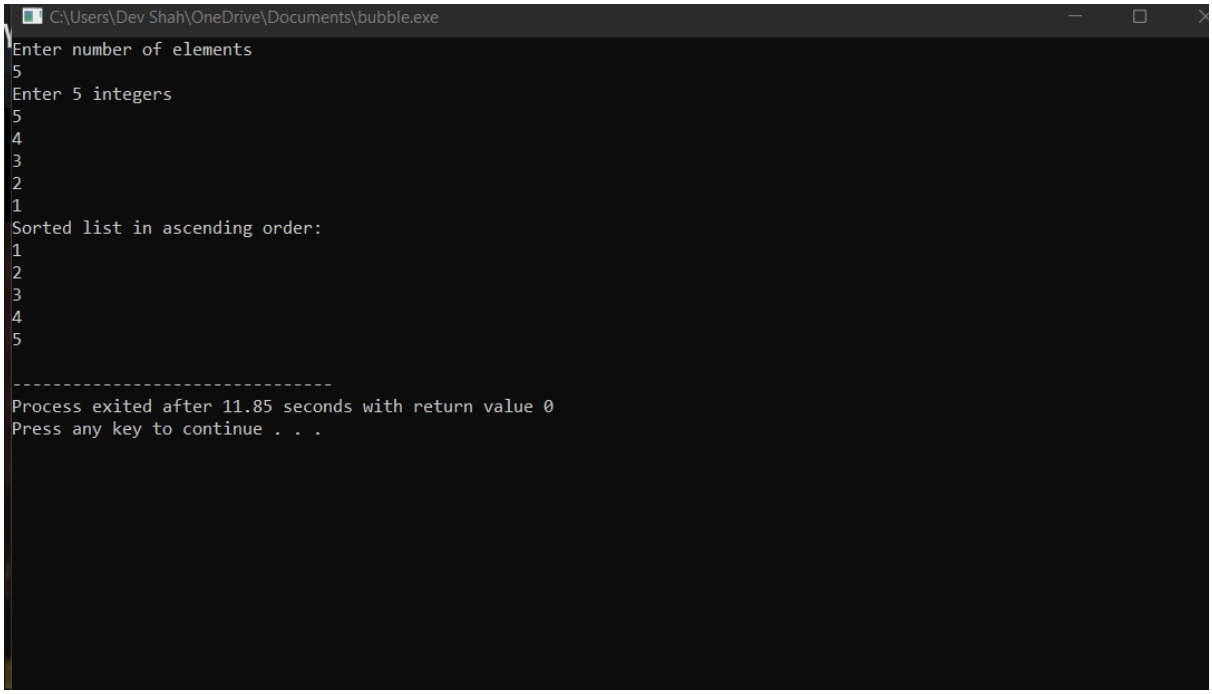
Output:



Best case



Average case



Worst case

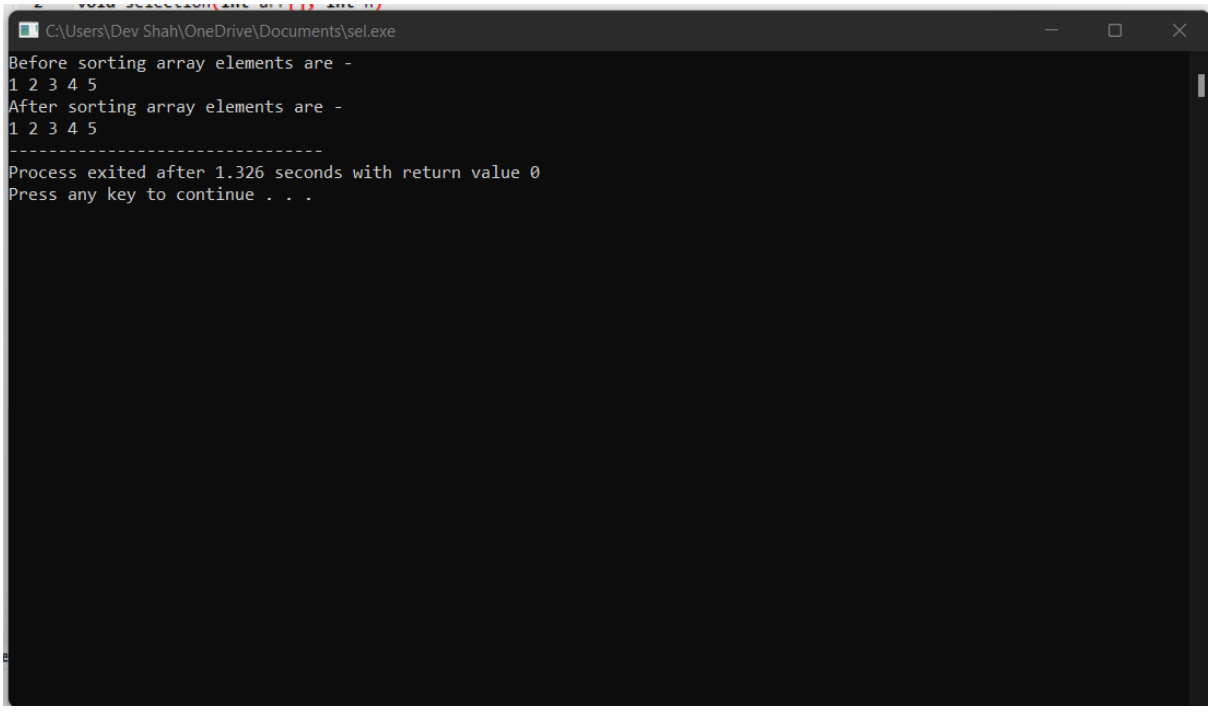
Practical 2

Write a program to sort given elements of an array in ascending order using selection sort. Analyze the time complexity for best, average and worst case.

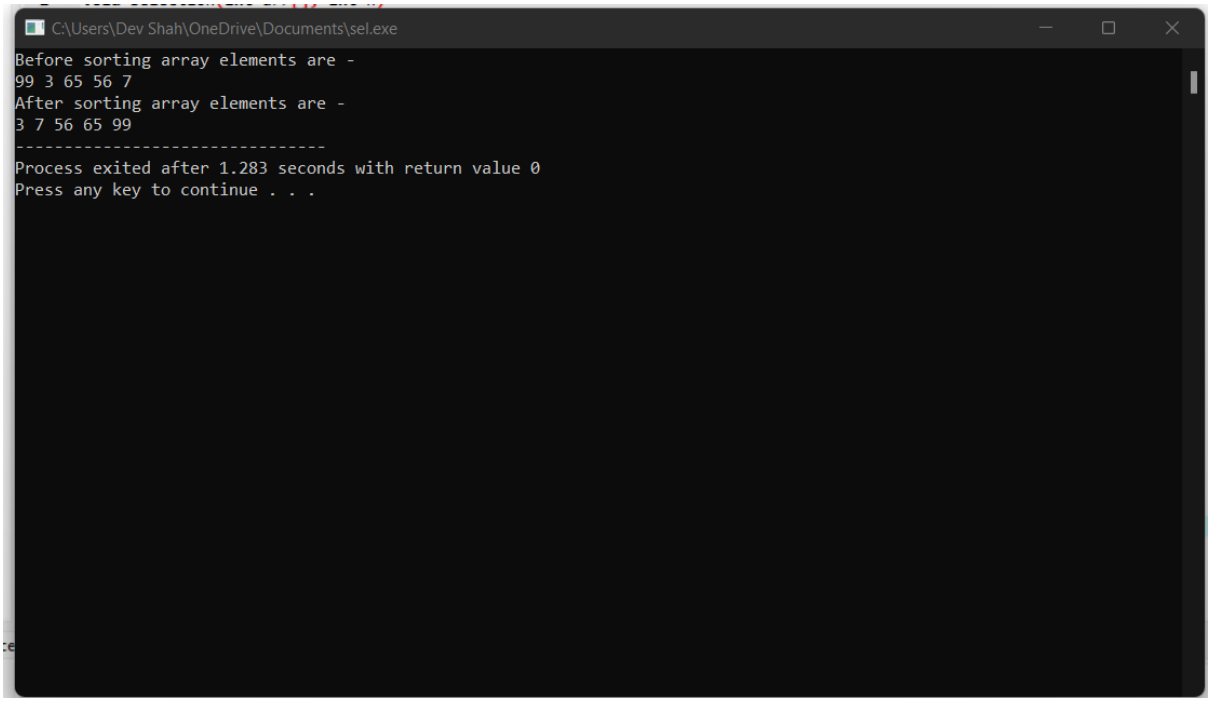
```
#include <stdio.h>

void selection(int arr[], int n)

{

   int i, j, small;

  for (i = 0; i < n-1; i++)    // One by one move boundary of unsorted subarray

   {

      small = i; //minimum element in unsorted array


      for (j = i+1; j < n; j++)

      if (arr[j] < arr[small])

         small = j;

// Swap the minimum element with the first element

   int temp = arr[small];

   arr[small] = arr[i];

   arr[i] = temp;

   }

}


void printArr(int a[], int n) /* function to print the array */

{

   int i;

   for (i = 0; i < n; i++)

      printf("%d ", a[i]);

}
```

```
int main()
{
    int a[] = { 12, 31, 25, 8, 32, 17 };
    int n = sizeof(a) / sizeof(a[0]);
printf("Before sorting array elements are - \n");
    printArr(a, n);
    selection(a, n);
    printf("\nAfter sorting array elements are - \n");
    printArr(a, n);
    return 0;
}
```

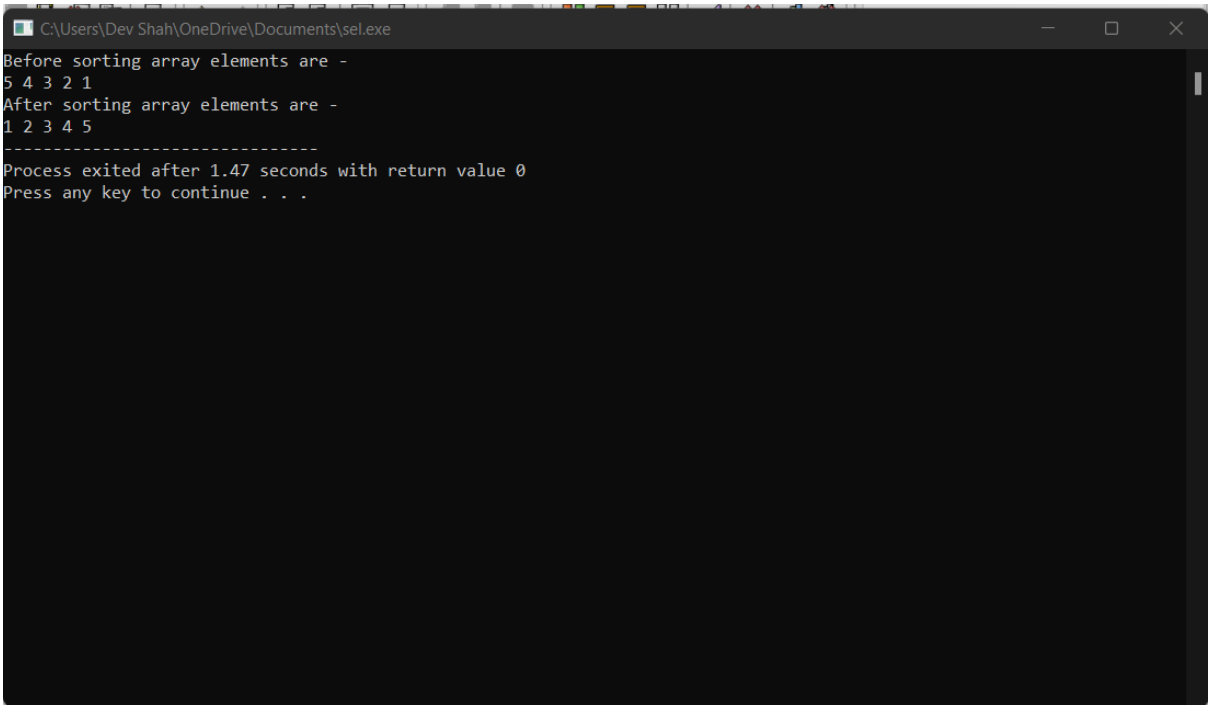
Output:



Best case



Average case



Worst case

Practical 3

```
#include <stdio.h>

 // Function to swap the the position of two elements
 void swap(int *a, int *b) {
  int temp = *a;
  *a = *b;
  *b = temp;
 }

 void heapify(int arr[], int n, int i) {
  // Find largest among root, left child and right child
  int largest = i;
  int left = 2 * i + 1;
  int right = 2 * i + 2;

  if (left < n && arr[left] > arr[largest])
   largest = left;

  if (right < n && arr[right] > arr[largest])
   largest = right;

  // Swap and continue heapifying if root is not largest
  if (largest != i) {
   swap(&arr[i], &arr[largest]);
   heapify(arr, n, largest);
```

```
  }
}

// Main function to do heap sort
void heapSort(int arr[], int n) {
  // Build max heap
  for (int i = n / 2 - 1; i >= 0; i--)
    heapify(arr, n, i);

  // Heap sort
  for (int i = n - 1; i >= 0; i--) {
    swap(&arr[0], &arr[i]);

    // Heapify root element to get highest element at root again
    heapify(arr, i, 0);
  }
}

// Print an array
void printArray(int arr[], int n) {
  for (int i = 0; i < n; ++i)
    printf("%d ", arr[i]);
  printf("\n");
}

// Driver code
int main() {
```

```
    int arr[] = {1, 12, 9, 5, 6, 10};
    int n = sizeof(arr) / sizeof(arr[0]);

    heapSort(arr, n);

    printf("Sorted array is \n");
    printArray(arr, n);
  }
```

Output:

Worst case

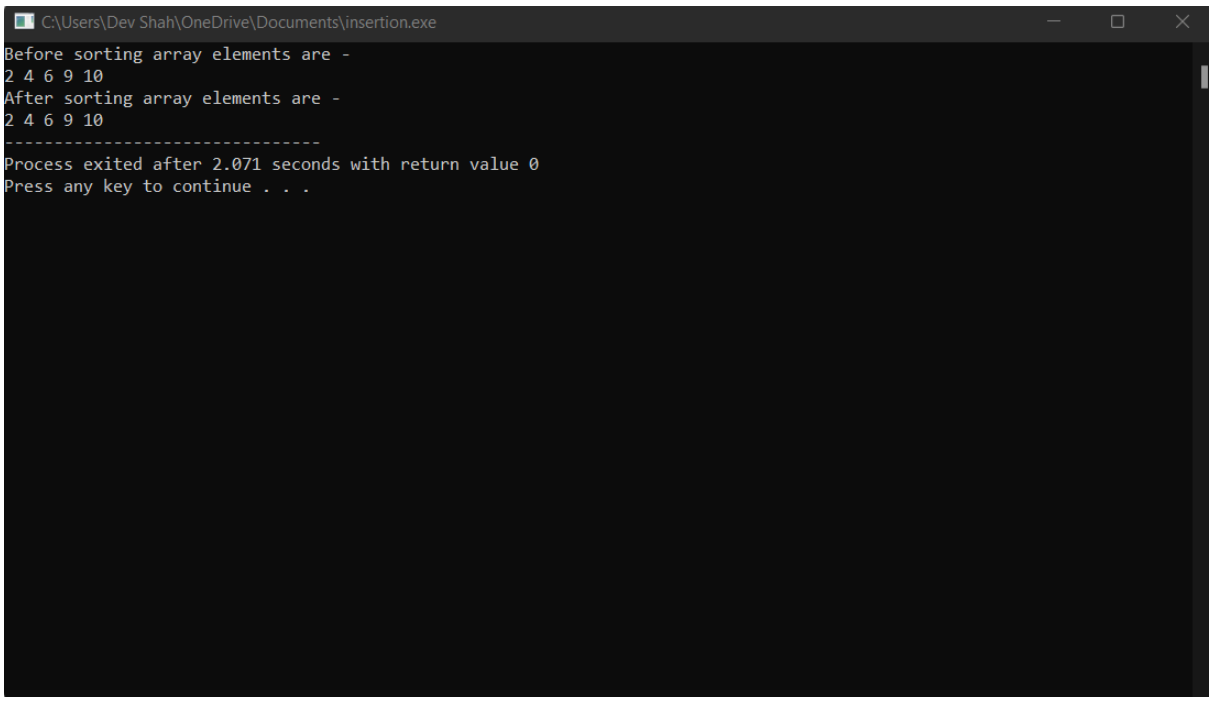
Practical 4

Write a program to sort given elements of an array in ascending order using insertion sort. Analyze the time complexity for best, average and worst case.

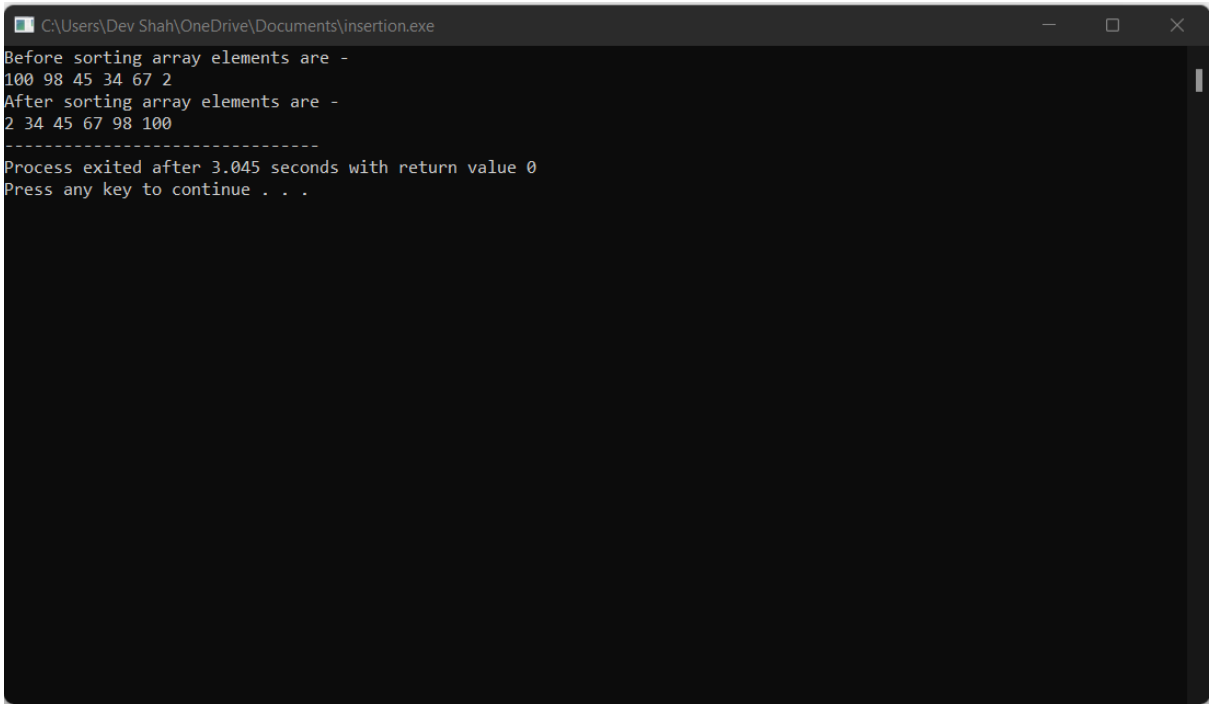
```
#include <stdio.h>

 void insert(int a[], int n)

{

   int i, j, temp;

   for (i = 1; i < n; i++) {

      temp = a[i];

      j = i - 1;

  while(j>=0 && temp <= a[j])

      {

         a[j+1] = a[j];

         j = j-1;

      }

      a[j+1] = temp;

   }

}

 void printArr(int a[], int n)

{

   int i;

   for (i = 0; i < n; i++)  zzz
```

```
        printf("%d ", a[i]);
}

int main()
{
    int a[] = { 12, 31, 25, 8, 32, 17 };
    int n = sizeof(a) / sizeof(a[0]);
    printf("Before sorting array elements are - \n");
    printArr(a, n);
    insert(a, n);
    printf("\nAfter sorting array elements are - \n");
    printArr(a, n);

    return 0;
}
```

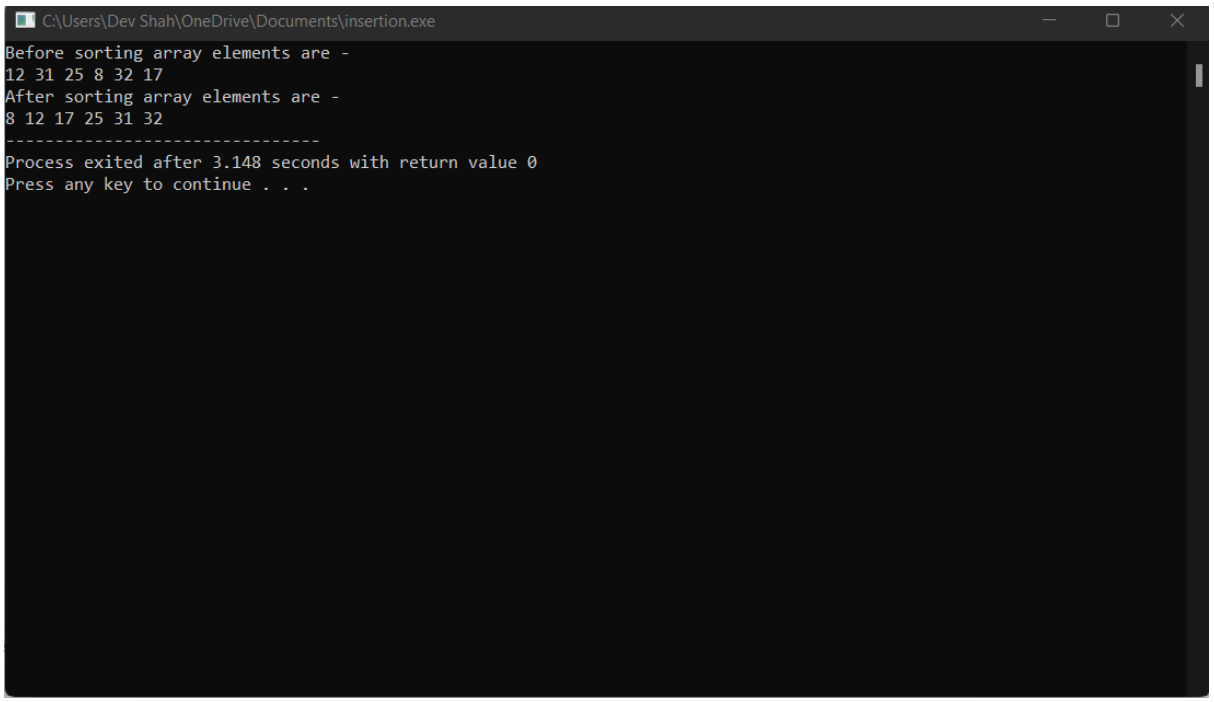
Output:



Best case



Average case


C:\Users\Dev Shah\OneDrive\Documents\insertion.exe
Before sorting array elements are -
12 31 25 8 32 17
After sorting array elements are -
8 12 17 25 31 32

Process exited after 3.148 seconds with return value 0
Press any key to continue . . .

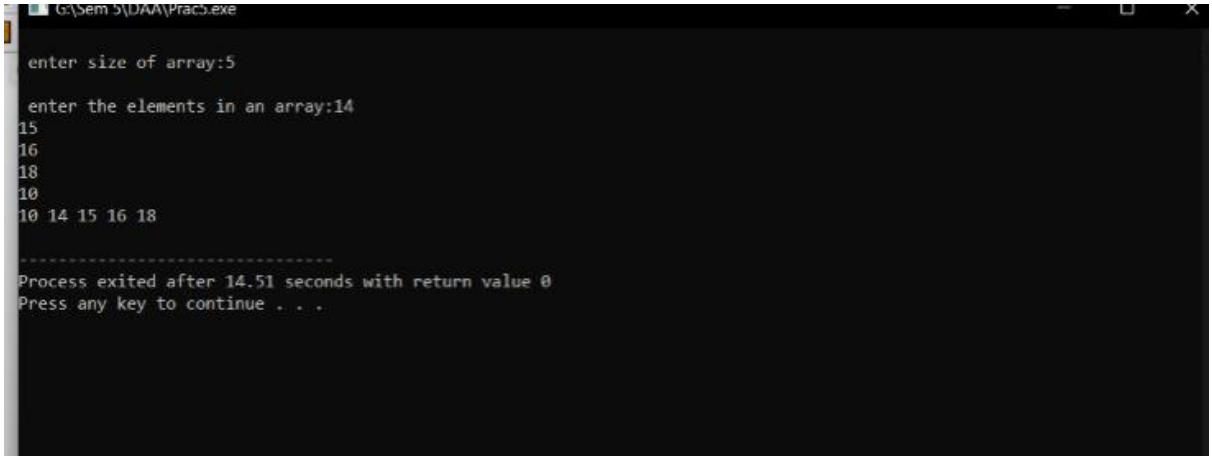
Worst case

Practical 5

```
#include <stdio.h>
void Merge(int * , int , int , int );
void MergeSort(int *array, int left, int right){
  int middle = (left+right)/2;
  if(left<right){
    //Sorting the left part
    MergeSort(array, left, middle);
    //Sorting the right part
    MergeSort(array, middle + 1, right);
    // Merge the two parts
    Merge(array, left, middle, right);
  }
}
void Merge(int *array, int left, int middle, int right){
  int tmp[right - left + 1];
  int pos = 0, leftposition = left, rightposition = middle + 1;
  while (leftposition <= middle && rightposition <= right){
    if (array[leftposition] < array[rightposition]){
      tmp[pos++] = array[leftposition++];
    }
    else{
      tmp[pos++] = array[rightposition++];
    }
  }
  while (leftposition <= middle)
```

```
    tmp[pos++] = array[leftposition++];
  while (rightposition <= right)
    tmp[pos++] = array[rightposition++];
  int i;
  for (i = 0; i < pos; i++){
    array[i + left] = tmp[i];
  }
  return;
}
int main(){
  int size;
  printf("\n enter size of array:");
  scanf("%d", &size);
  int array[size];
  int i, j, k;
  printf("\n enter the elements in an array:");
  for (i = 0; i < size; i++){
    scanf("%d", &array[i]);
  }
  MergeSort(array, 0, size - 1);//calling sort function
  for (i = 0; i< size; i++){
    printf("%d ", array[i]);
  }
  printf("\n");
  return 0;
}
```

Output:



Worst case

Practical 6

```
#include<stdio.h>
void quicksort(int [],int,int);

int main(){
  int size,i;

  printf("Enter size of the array: ");
  scanf("%d",&size);

  int x[size];

  printf("Enter %d elements: ",size);
  for(i=0;i<size;i++)
    scanf("%d",&x[i]);

  quicksort(x,0,size-1);

  printf("Sorted elements: ");
  for(i=0;i<size;i++)
    printf(" %d",x[i]);

  return 0;
}

void quicksort(int x[],int first,int last){
```

```
int pivot,j,temp,i;

 if(first<last){
    pivot=first;
    i=first;
    j=last;

    while(i<j){
       while(x[i]<=x[pivot]&&i<last)
          i++;
       while(x[j]>x[pivot])
          j--;
       if(i<j){
          temp=x[i];
           x[i]=x[j];
           x[j]=temp;
       }
    }

    temp=x[pivot];
    x[pivot]=x[j];
    x[j]=temp;
    quicksort(x,first,j-1);
    quicksort(x,j+1,last);

}
```

Output:

Worst case