NAME:	Pooja Patil
UID:	2022301011
SUBJECT	Design Analysis of Algorithm
EXPERIMENT NO :	1B
AIM:	Experiment on finding the running time of an algorithm.
OBJECTIVE:	To find out running time of 2 sorting algorithms like Selection sort and Insertion sort.
THEORY	**Insertion Sort** is a sorting algorithm where the array is sorted by taking one element at a time. The principle behind insertion sort is to take one element, iterate through the sorted array & find its correct position in the sorted array. **Selection sort** is a simple and efficient sorting algorithm that works by repeatedly selecting the smallest (or largest) element from the unsorted portion of the list and moving it to the sorted portion of the list. The algorithm repeatedly selects the smallest (or largest) element from the unsorted portion of the list and swaps it with the first element of the unsorted portion. This process is repeated for the remaining unsorted portion of the list until the entire list is sorted. One variation of selection sort is called “Bidirectional selection sort” that goes through the list of elements by alternating between the smallest and largest element, this waythe algorithm can be faster in some cases.

	The algorithm maintains two subarrays in a given array. • The subarray which already sorted. • The remaining subarray was unsorted. In every iteration of the selection sort, the minimum element (considering ascending order) from the unsorted subarray is picked and moved to the beginning of unsorted subarray. After every iteration sorted subarray size increase by one and unsorted subarray size decrease by one.
ALGORITHM	step 1: start Step2: call rand_num() function Step 2: create rand_num file and store the random numbers in it. Step3: open rand_num file in reading mode Step 4: Store all random numbers in an array Step5: Traverse all elements using for loop take n as 100 Step6: Perform insertion and selection sort on each block of 100 numbers Step7: Calculate time required to perform insertion and selection sort at each iteration Step8: Increment n by 100 Step 9: If n reaches 1000 then end else go to step 6 rand_num() function: step 1: start step 2: create the file pointer step 3: open the file in writing mode step 3: starts the loop from 0 to 100000 step 4: insert the 100000 random numbers in the file step 5: close the file handle step 6: end Insertion sort: Step 1: start Step 2: start the loop from 1 to n

	Step 3: initialize j with i-1 Step 4: current element is array(i) Step 5: if array(key)>0 and j>=0 Repeat below steps 6,7 Step 6: j+1th element will jth element Step 7: decrement j Step 8: array(j+1) = current. Step 9: end. selection sort: step 1: start step 2: start the loop step 3: initialize the min element step 4: start the loop from i+1 to n step 5: check the condition: if jth element less than min element then minimum element will be j. step 6: if minimum element not equal to i, then initialize variable t with array(i) perform ith element = array of min array(min) = t step 7: end.

PROGRAM:

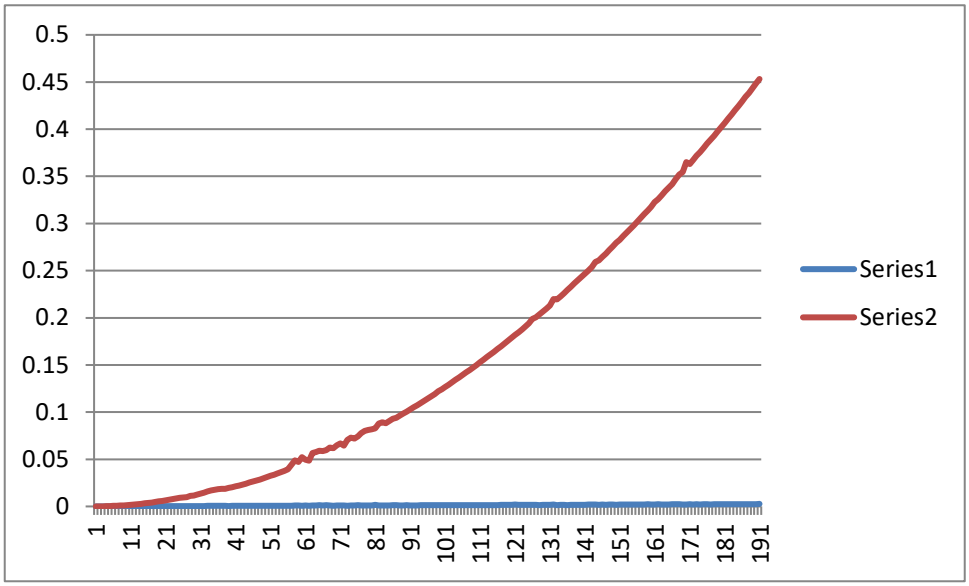
main.c

```c
#include <stdio.h>
#include <stdlib.h>
#include <math.h>
#include <time.h>
int * rand_num(){
 static int arr[100000];
 int i;
 for (i = 0; i < 100000; ++i){
 arr[i] = rand();
 }

 return arr;
}
void insertionSort(int array[], int n)
{
 int i, element, j;
 for (i = 1; i < n; i++) { element = array[i]; j = i
>= 0 && array[j] > element) {
 array[j + 1] = array[j];
 j = j - 1;
 }
 array[j + 1] = element;
 }
}
void swap(int *xp, int *yp)
{
 int temp = *xp;
 *xp = *yp;
 *yp = temp;
}
void selectionSort(int arr[], int n)
{
 int i, j, min_idx;
```

```
 for (i = 0; i < n-1; i++)
 {

 min_idx = i;
 for (j = i+1; j < n; j++)
 if (arr[j] < arr[min_idx])
 min_idx = j;

 if(min_idx != i)
 swap(&arr[min_idx], &arr[i]);
 }
}
int main()
{
 int *x1;
 int i,i1;
 int arr[100000];
 x1 = rand_num();
 FILE *fp;
 int ch;
 fp = fopen("rand_num.txt","w");
 for (i1 = 0; i1 < 100000; ++i1){
 fprintf(fp,"%d\n",*(x1 + i1));
 }
 fp = fopen("rand_num.txt", "r");

 for ( i = 0; i < 100000; i++)
 {
 fscanf(fp,"%d\n",&arr[i]);
 }

 FILE *file = fopen("output.txt","w");
```

```
66   FILE *file = fopen("output.txt","w");
67
68   int num = 100;
69   for ( i = 0; i < 1000; i++)
70   {
71   clock_t t1 = clock();
72   insertionSort(arr,num);
73   clock_t t2 = clock();
74   clock_t t3 = clock();
75   selectionSort(arr,num);
76   clock_t t4 = clock();
77   double insertion_time =
78  (double)(t2-t1)/(double)CLOCKS_PER_SEC;
79   double selection_time =
80  (double)(t4-t3)/(double)CLOCKS_PER_SEC;
81   fprintf(file,"%d\t",i+1);
82   fprintf(file,"%f\t",insertion_time);
83   fprintf(file,"%f\n",selection_time);
84
85   num += 100;
86   }
87   fclose(fp);
88   fclose(file);
89   return 0;
90  }
```

RESULT (SNAPSHOT):



Observation: As we can see from the above graph time taken for insertion sort is always ranging whereas as time taken by selectionsort is increasing as we keep adding 100 numbers to it. Hence we can say that insertion sort is better than selection sort. Both insertion sort and selection sort have a space complexity O(1), means the algorithms use a constant amount of extra memory regardless of the size of the input array.