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# Algorithm Lab. Class Assignment-2

## CSE Group 1

## Date: - 16th July 2021

Q1.

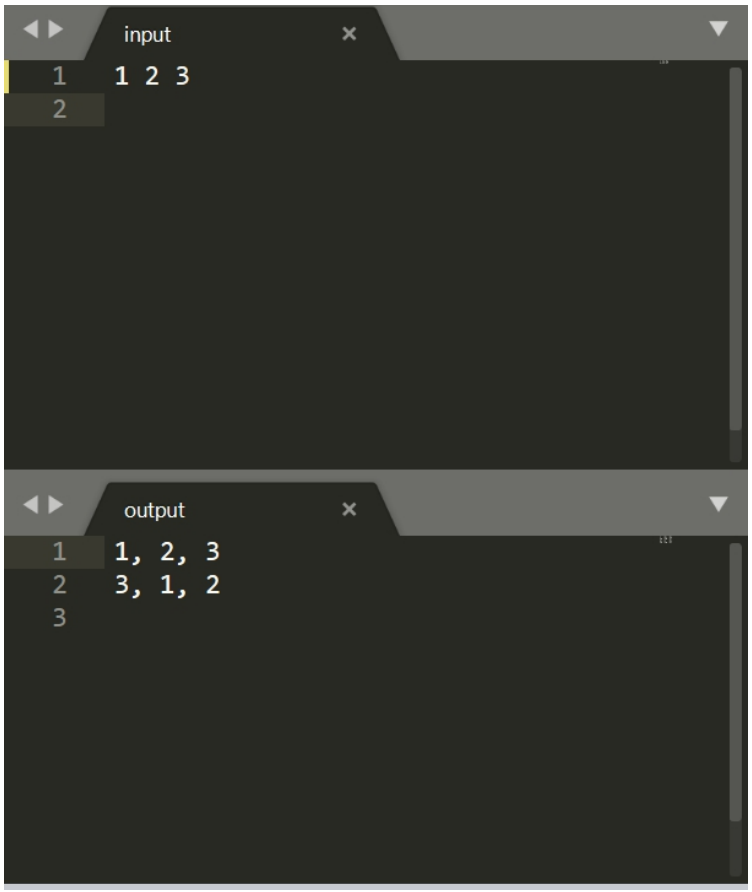
Write a program that takes three variables (A, B, C) as separate parameters and rotates the values stored so that value A goes to B, B to C, and C to A by using SWAP(x,y) as a function that swaps/exchanges the numbers x & y.

Code:

```
#include <stdio.h>

#define sf(x)                    scanf("%d", &x)
#define pf(x)                    printf("%d ", x)
#define pfn(x)                   printf("%d\n", x)
#define pfc(x)                   printf("%d, ", x)
#define f(i,x,y)                 for(int i = x; i < y; i++)
#define fi(i,x,y,inc)            for(int i = x; i < y; i += inc)
#define rf(i,x,y)                for(int i = x; i >= y; i--)


void c_() {

#ifndef ONLINE_JUDGE
    freopen("C:\\Users\\KIIT\\input", "r", stdin);
    freopen("C:\\Users\\KIIT\\output", "w", stdout);
#endif
}


void swap(int *x, int *y) {
    int temp = *x;
```

```
    *x =    *y;
    *y = temp;
}

int main() {

    c_();

    int a, b, c;
    sf(a); sf(b); sf(c);

    pfc(a); pfc(b); pfn(c);


    swap(&a, &b);
    swap(&a, &c);

    pfc(a); pfc(b); pfn(c);

    return 0;
}
```

Output:



Q2.

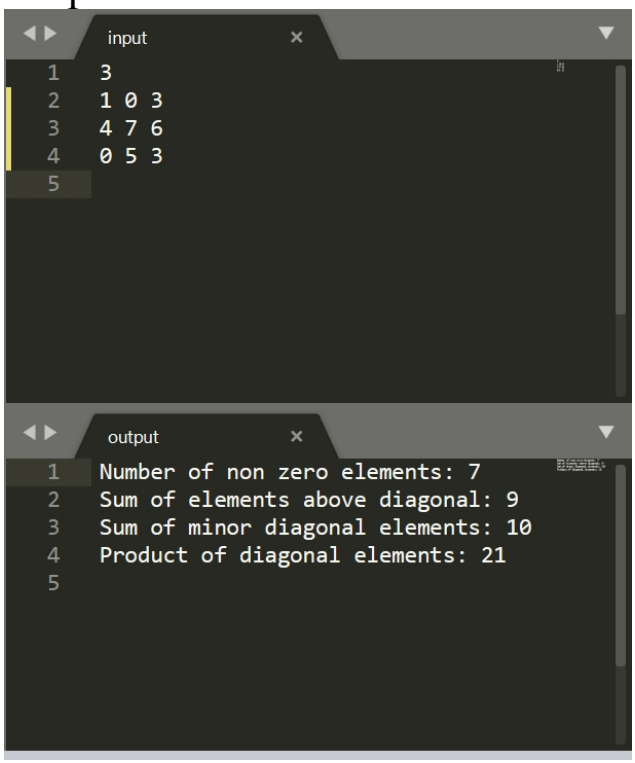
1. Let A be n*n square matrix array. WAP by using appropriate user-defined functions for the following:
   a) Find the number of nonzero elements in A
   b) Find the sum of the elements above the leading diagonal.
   c) Display the elements below the minor diagonal.
   d) Find the product of the diagonal elements.

Code:

```
#include <stdio.h>

#define sf(x)                    scanf("%d", &x)
#define pf(x)                    printf("%d ", x)
#define pfn(x)                   printf("%d\n", x)
#define pfc(x)                   printf("%d, ", x)
#define f(i,x,y)                 for(int i = x; i < y; i++)
#define fi(i,x,y,inc)            for(int i = x; i < y; i += inc)
#define rf(i,x,y)                for(int i = x; i >= y; i--)

void c_() {

#ifndef ONLINE_JUDGE
    freopen("C:\\Users\\KIIT\\input", "r", stdin);
    freopen("C:\\Users\\KIIT\\output", "w", stdout);
#endif
}

int main() {

    c_();

    int n;
    sf(n);

    int non_zero = 0;
    int sum_above = 0;
    int pro_diag = 1;

    int mat[n][n];
    for (int i = 0; i < n; i++) {
        for (int j = 0; j < n; j++) {
            sf(mat[i][j]);
            if (mat[i][j]) {
                non_zero++;
```

```
            }
            if (i == j) {
                pro_diag *= mat[i][j];
            }
            if (j > i) {
                sum_above += mat[i][j];
            }
        }
    }
    printf("Number of non zero elements: %d\n", non_zero);
    printf("Sum of elements above diagonal: %d\n", sum_above);
    printf("Product of diagonal elements: %d\n", pro_diag);
    printf("Minor diagonal elements: ");


    for (int i = 0; i < n; i++) {
        for (int j = 0; j < n; j++) {
            sf(mat[i][j]);
            if (i + j == n - 1) {
                pfc(mat[i][j]);
            }
        }
    }

    return 0;
}
```

Output:



Q3.

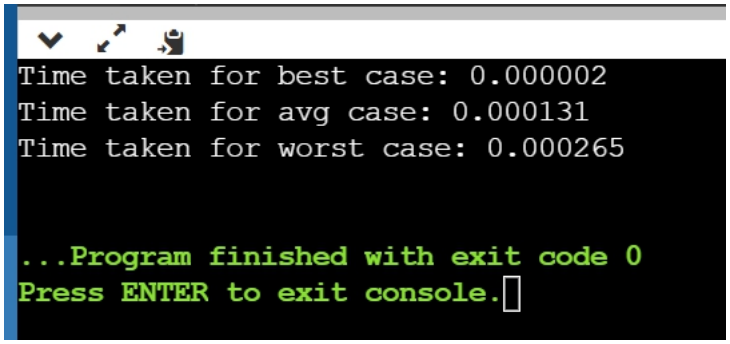
WAP in C to store 1 million integers in an array. To search an element in that array and find out its time complexity (best, worst, and average).

Code:

```
#include <stdio.h>
#include <time.h>
#include <stdlib.h>


#define sf(x)                    scanf("%d", &x)
#define pf(x)                    printf("%d ", x)
#define pfn(x)                   printf("%d\n", x)
#define pfc(x)                   printf("%d, ", x)
#define f(i,x,y)                 for(int i = x; i < y; i++)
#define fi(i,x,y,inc)            for(int i = x; i < y; i += inc)
#define rf(i,x,y)                for(int i = x; i >= y; i--)


void c_() {

#ifndef ONLINE_JUDGE
    freopen("C:\\Users\\KIIT\\input", "r", stdin);
    freopen("C:\\Users\\KIIT\\output", "w", stdout);
#endif
}


int main() {

    c_();

    int n = 100000;
    int arr[n];

    f(i, 0, n) {
        //arr[i] = 1 + rand() % 100;
        arr[i] = i + 1;
    }


    int best = arr[0];
    int worst = arr[n - 1];
    int avg = arr[n / 2];
    time_t strt, end;
```

```
    strt = clock();
    f(i, 0, n) {
        if (best == arr[i]) {
            end = clock();
            double t = end - strt;
            printf("Time taken for best case: %f\n", (t / CLOCKS_PER_SEC));
            break;
        }
    }

    strt = clock();
    f(i, 0, n) {
        if (avg == arr[i]) {
            end = clock();
            double t = end - strt;
            printf("Time taken for avg case: %f\n", (t / CLOCKS_PER_SEC));
            break;
        }
    }

    strt = clock();
    f(i, 0, n) {
        if (worst == arr[i]) {
            end = clock();
            double t = end - strt;
            printf("Time taken for worst case: %f\n", (t / CLOCKS_PER_SEC));
            break;
        }
    }

    return 0;
}

    return 0;
}
```

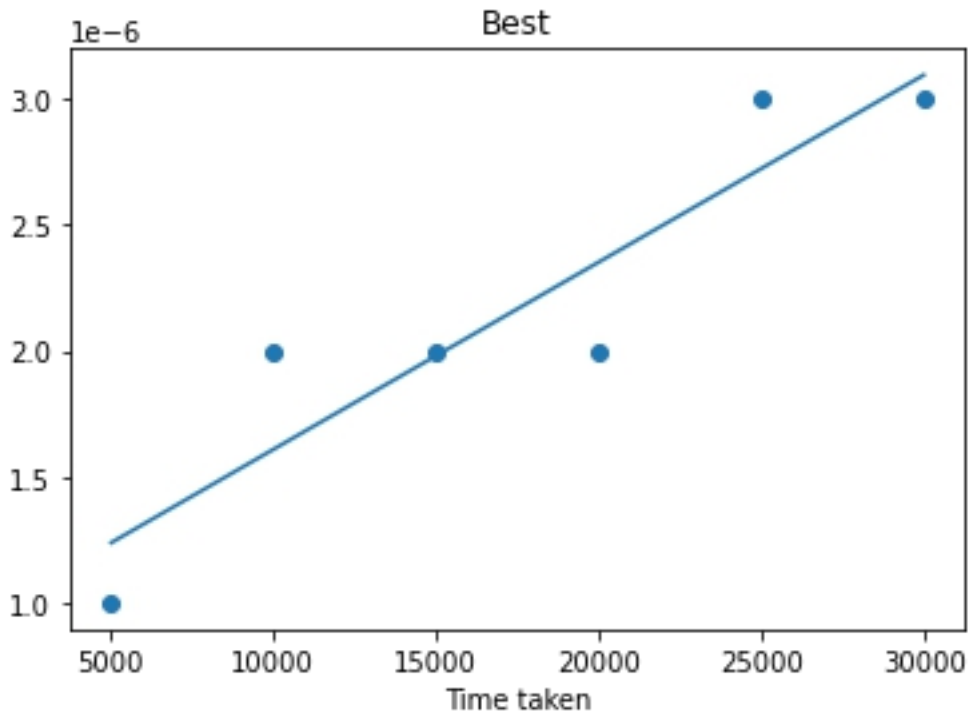
Output:

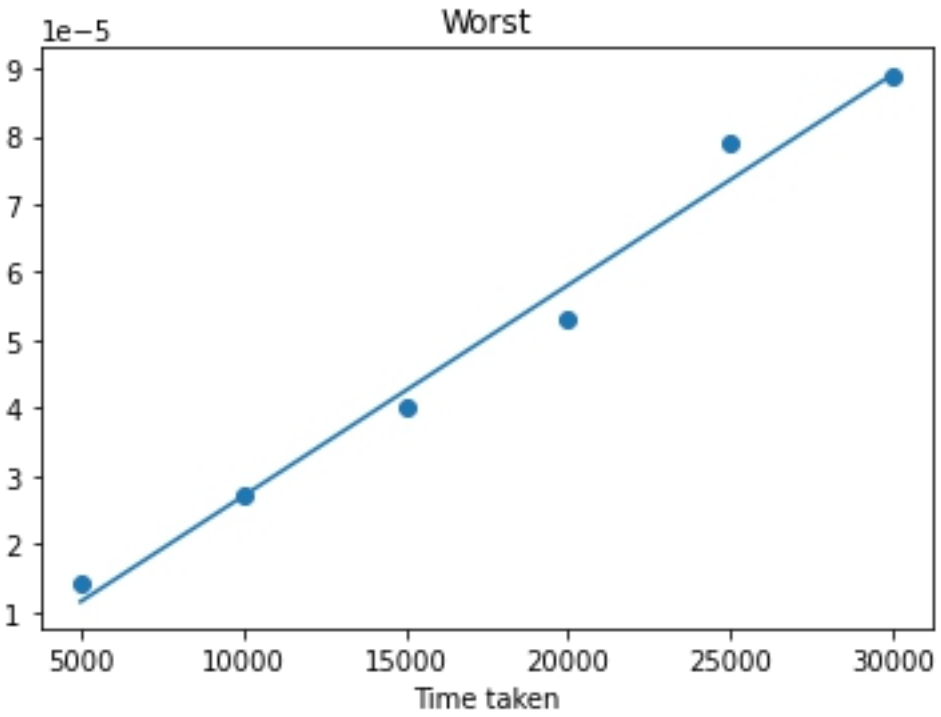


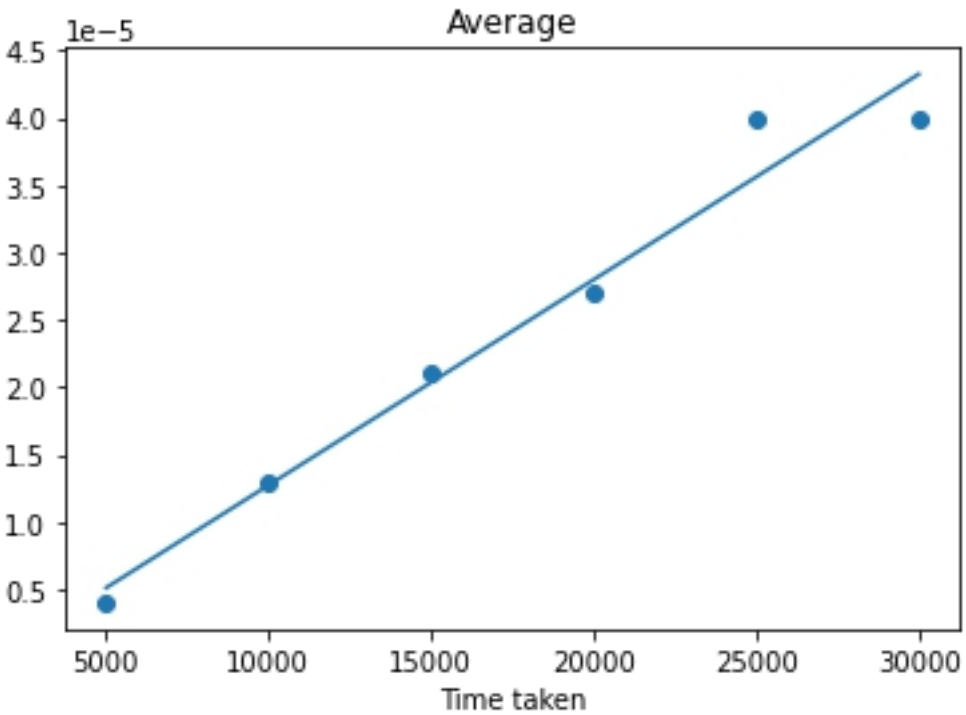
Tables:

| Sl No. | No. of element | Time Complexity ( Best Case) | Time Complexity (Worst Case) | Time Complexity (Average Case) |
|---|---|---|---|---|
| 1 | 5000 | 0.000001 | 0.000014 | 0.000004 |
| 2 | 10000 | 0.000002 | 0.000027 | 0.000013 |
| 3 | 15000 | 0.000002 | 0.000040 | 0.000021 |
| 4 | 20000 | 0.000002 | 0.000053 | 0.000027 |
| 5 | 25000 | 0.000003 | 0.000079 | 0.000040 |
| 6 | 30000 | 0.000003 | 0.000089 | 0.000040 |

Graphs:




Worst
1e−5
9
8
7
6
5
4
3
2
1
5000
10000
15000
20000
25000
30000
Time taken


Average
1e−5
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
5000
10000
15000
20000
25000
30000
Time taken

Q4.

WAP in C to store 1 million integers in an array. To search an element in that array and find out its time complexity using binary search (best, worst, and average).

Code:

```
#include <stdio.h>
#include <time.h>
#include <stdlib.h>


#define sf(x)                    scanf("%d", &x)
#define pf(x)                    printf("%d ", x)
#define pfn(x)                   printf("%d\n", x)
#define pfc(x)                   printf("%d, ", x)
#define f(i,x,y)                 for(int i = x; i < y; i++)
#define fi(i,x,y,inc)            for(int i = x; i < y; i += inc)
#define rf(i,x,y)                for(int i = x; i >= y; i--)


void c_() {

#ifndef ONLINE_JUDGE
    freopen("C:\\Users\\KIIT\\input", "r", stdin);
    freopen("C:\\Users\\KIIT\\output", "w", stdout);
#endif
}


int main() {

    c_();

    int n = 100000;
    int arr[n];

    f(i, 0, n) {
        //arr[i] = 1 + rand() % 100;
        arr[i] = i + 1;
    }


    int best = arr[(n - 1) / 2];
    int worst = arr[1];
    int avg = arr[n / 16];
    time_t strt, end;
```

```
int lo = 0, hi = n - 1;

strt = clock();
while (lo < hi)
{
    int mid = (lo + hi) / 2;

    if (arr[mid] == best) {
        end = clock();
        double t = end - strt;
        printf("Time taken for best case: %f\n", (t / CLOCKS_PER_SEC));
        break;
    }

    if (arr[mid] > best)
    {
        hi = mid;
    }
    else
    {
        lo = mid + 1;
    }
}


lo = 0, hi = n - 1;

strt = clock();
while (lo < hi)
{
    int mid = (lo + hi) / 2;

    if (arr[mid] == avg) {
        end = clock();
        double t = end - strt;
        printf("Time taken for avg case: %f\n", (t / CLOCKS_PER_SEC));
        break;
    }

    if (arr[mid] > avg)
    {
        hi = mid;
    }
    else
    {
        lo = mid + 1;
    }
}
```

```
    lo = 0, hi = n - 1;

    strt = clock();
    while (lo < hi)
    {
        int mid = (lo + hi) / 2;

        if (arr[mid] == worst) {
            end = clock();
            double t = end - strt;
            printf("Time taken for worst case: %f\n", (t / CLOCKS_PER_SEC));
            break;
        }

        if (arr[mid] > worst)
        {
            hi = mid;
        }
        else
        {
            lo = mid + 1;
        }
    }


    return 0;
}
```

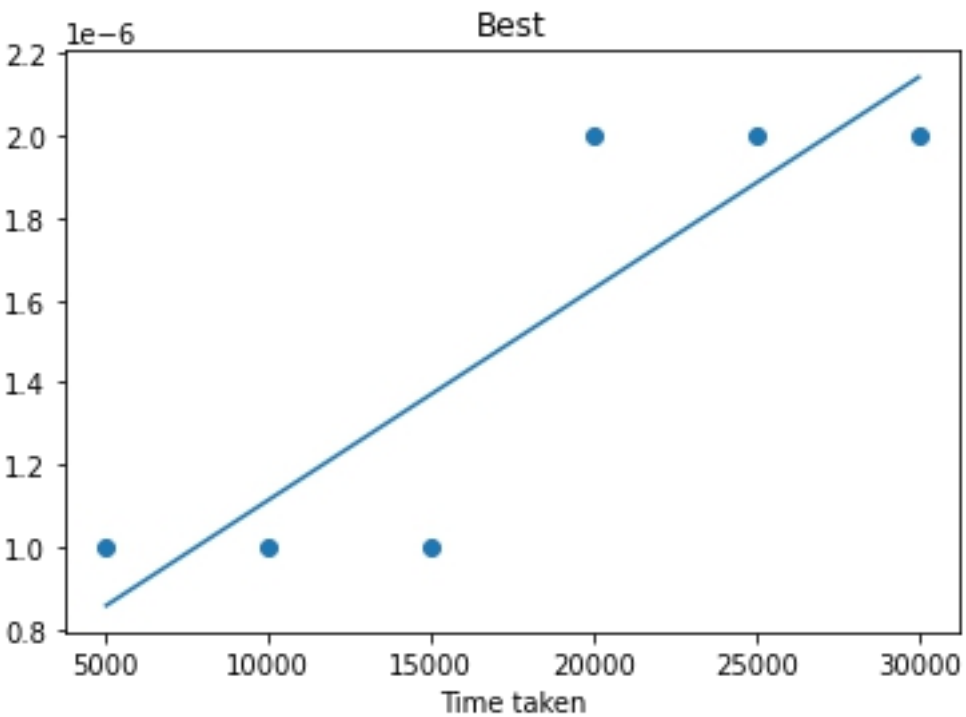
Output:

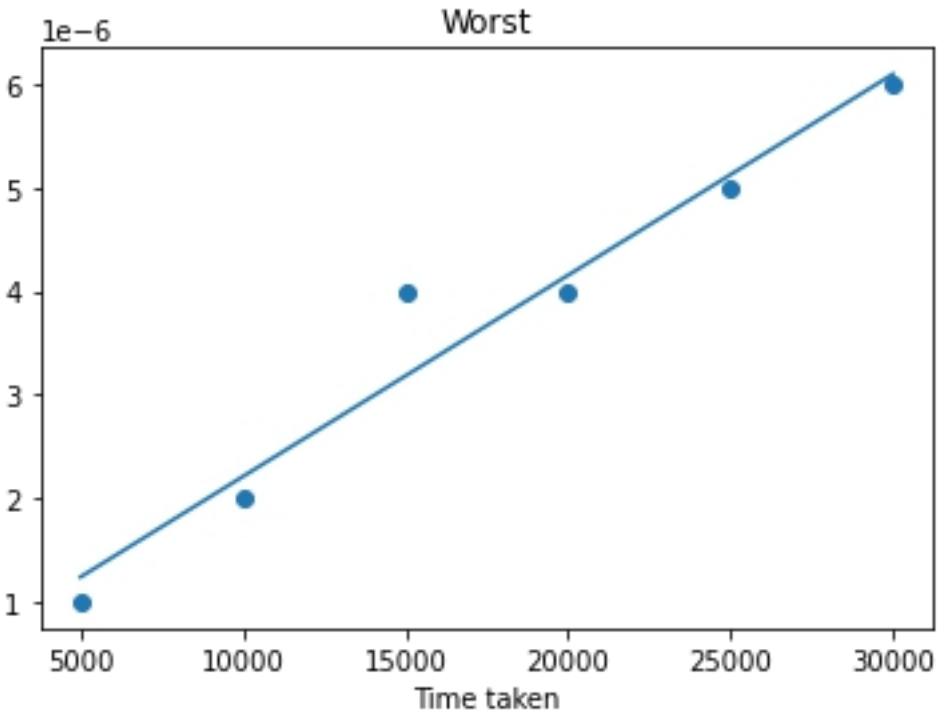
```
Time taken for best case: 0.000003
Time taken for avg case: 0.000001
Time taken for worst case: 0.000002


...Program finished with exit code 0
Press ENTER to exit console.
```

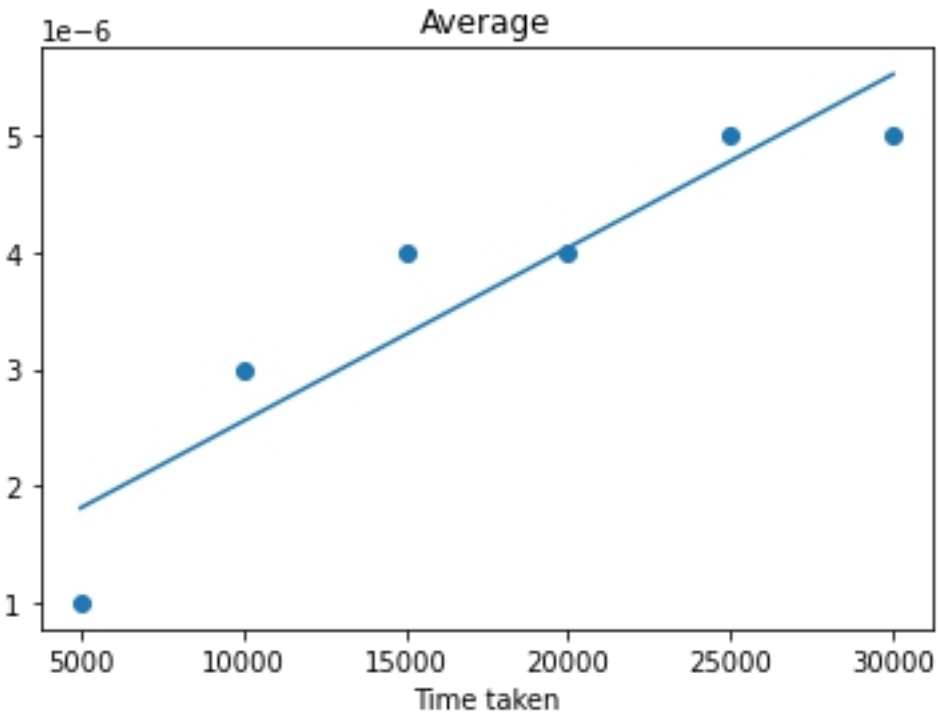
Table:

| Sl No. | No. of element | Time Complexity ( Best Case) | Time Complexity (Worst Case) | Time Complexity (Average Case) |
|---|---|---|---|---|
| 1 | 5000 | 0.000001 | 0.000001 | 0.000001 |
| 2 | 10000 | 0.000001 | 0.000002 | 0.000003 |
| 3 | 15000 | 0.000001 | 0.000004 | 0.000004 |
| 4 | 20000 | 0.000002 | 0.000004 | 0.000004 |
| 5 | 25000 | 0.000002 | 0.000005 | 0.000005 |
| 6 | 30000 | 0.000002 | 0.000006 | 0.000005 |

Graph:




Worst
1e−6
6
5
4
3
2
1
5000
10000
15000
20000
25000
30000
Time taken


Average
1e−6
5
4
3
2
1
5000
10000
15000
20000
25000
30000
Time taken