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Algorithm Lab. Class Assignment-2

CSE Group 1

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1. 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.

Program

```c
#include<stdio.h>

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

int main()
{
    int a,b,c;
    a = 1 , b = 2, c = 3 ;
    swap(&a,&b);
    swap(&a,&c);
    printf("%d %d %d",a,b,c);
}
```

Output

```
PS C:\Users\Prameet Upaddhyay\Desktop\DAA_lab> cd .\16july\
PS C:\Users\Prameet Upaddhyay\Desktop\DAA_lab\16july> gcc 1.c
PS C:\Users\Prameet Upaddhyay\Desktop\DAA_lab\16july> .\a.exe
3 1 2
PS C:\Users\Prameet Upaddhyay\Desktop\DAA_lab\16july>
```

2. 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.

Program

```c
#include<stdio.h>

int non_zero(int mat[3][3])
{
    int cnt = 0;
    for(int i=0;i<3;i++)
    {
        for(int j=0;j<3;j++)
        {
            if(mat[i][j] != 0)
                cnt++;
        }
    }
    return cnt;
}
```

```c
int sum_above_diag(int mat[3][3])
{
    int sum = 0;
    for(int i=0;i<3;i++)
    {
        for(int j=0;j<3;j++)
        {
            if(j > i)
                sum = sum + mat[i][j];
        }
    }
    return sum;
}
```

```c
int elements_below_diag(int mat[3][3])
{
    printf("\n\nThe elemnets below diagonal are:  ");
    for(int i=0;i<3;i++){
        for(int j=0;j<3;j++){
            if(j < i)
               printf("%d ",mat[i][j]);

        }
    }
}
```

```c
int product_of_diag(int mat[3][3]){
    int product = 1;
    for(int i=0;i<3;i++){
        for(int j=0;j<3;j++){
            if(j == i){
               product = product*mat[i][j];
            }
        }
    }
    return product;
}
```

```c
int main()
{
    int mat[3][3];
    for(int i=0;i<3;i++)
    {
        for(int j=0;j<3;j++)
        {
            scanf("%d",&mat[i][j]);
        }
    }
    printf("Number of nonzero elements  : %d ", non_zero(mat));
    printf("\n\n Sum above the diagonal is %d",sum_above_diag(mat));
    elements_below_diag(mat);
    printf("\nProduct of diagonal elemnets: %d",product_of_diag(mat));
}
```

Output

```
PS C:\Users\Prameet Upaddhyay\Desktop\DAA_lab\16july> gcc 2.c
PS C:\Users\Prameet Upaddhyay\Desktop\DAA_lab\16july> .\a.exe
1 2 0
2 1 0
1 2 0
The number of non-zero elements in matrix are : 6

 The sum above the diagonal is 2

The elemnets below diagonal are:  2 1 2

The product of diagonal elemnets are: 0
PS C:\Users\Prameet Upaddhyay\Desktop\DAA_lab\16july>
```

3. 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).

Program

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

int main() {
    int n = 1000000;
    int arr[n];
    for(int i=0;i<n;i++) {
        arr[i] = i + 1;
    }
    int best = arr[0];
    int worst = arr[n - 1];
    int avg = arr[n / 2];
    time_t strt, end;
    strt = clock();
    for(int i=0;i<n;i++) {
        if (best == arr[i]) {
            end = clock();
            double t = end - strt;
            printf("Time taken for best case: %f\n", (t / CLOCKS_PER_S
EC));
            break;
        }
    }
    strt = clock();
    for(int i=0;i<n;i++) {
        if (avg == arr[i]) {
            end = clock();
            double t = end - strt;
            printf("Time taken for avg case: %f\n", (t / CLOCKS_PER_SE
C));
            break;
        }
    }
    strt = clock();
    for(int i=0;i<n;i++) {
        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;
}
```

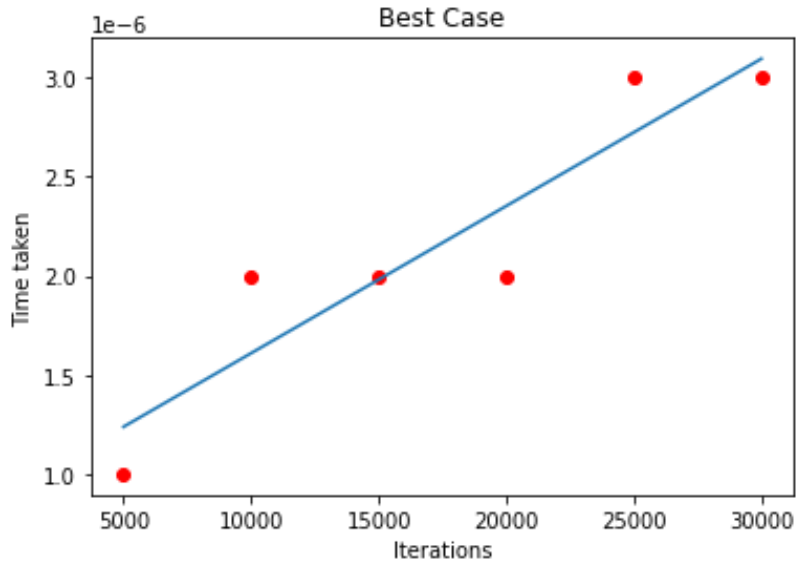
Output

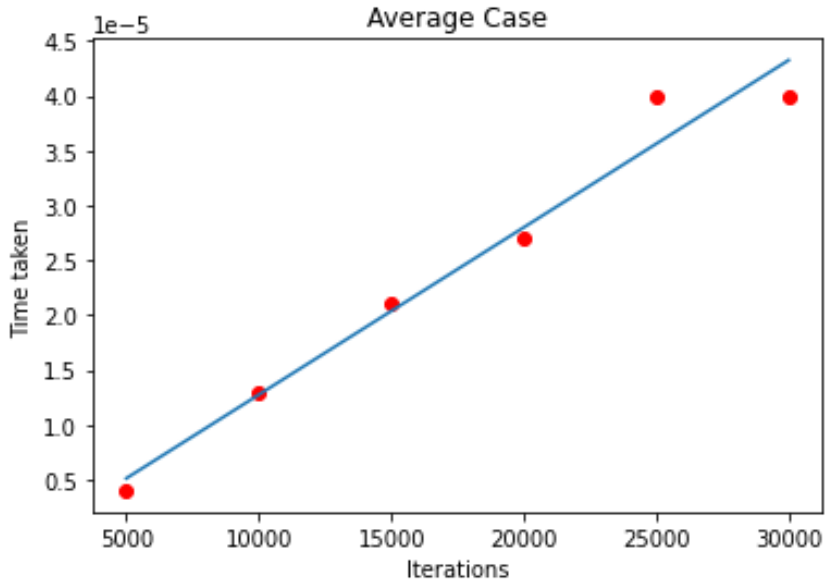
```
Output                                                    Clear

/tmp/IDG3bHEQeH.o
Time taken for best case: 0.000002
Time taken for avg case: 0.001378
Time taken for worst case: 0.002603
```

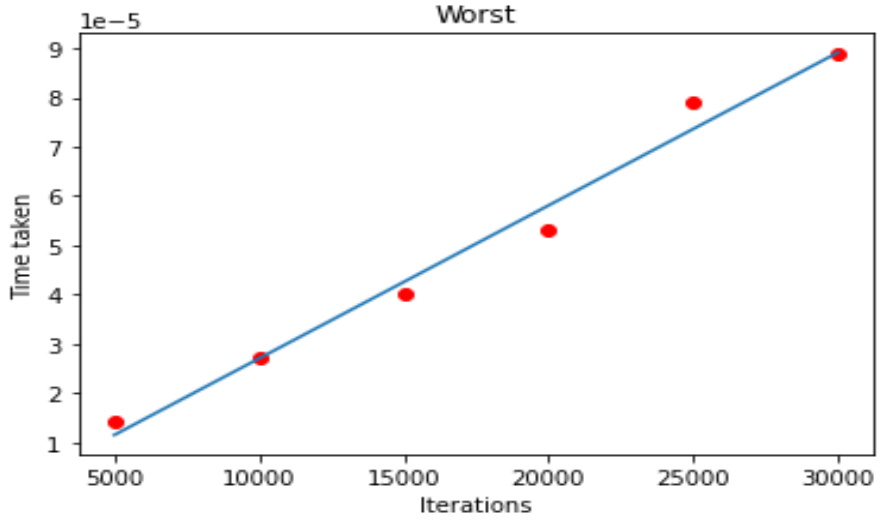
Draw the graph as the time found in each case.

Sl No.	No. of element	Time Complexity (Best Case)	Time Complexity (Worst Case)	Time Complexity (Average Case)
1	5000	0.000001	0.000013	0.000004
2	10000	0.000001	0.000029	0.000014
3	15000	0.000002	0.000038	0.000020
4	20000	0.000002	0.000050	0.000025
5	25000	0.000002	0.000080	0.000038
6	30000	0.000003	0.000088	0.000040

GRAPHS


Best Case
1e−6
3.0
2.5
2.0
1.5
1.0
Time taken
5000
10000
15000
20000
25000
30000
Iterations


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


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

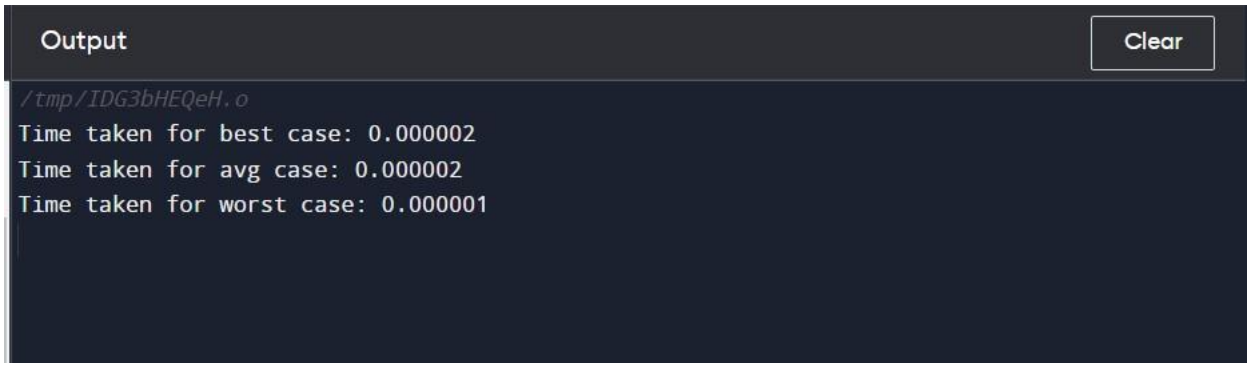
4. WAP in C to store 1 million integers in an array. To search an element in that array and find out its time complexity using binary search (best, worst, and average).

Program

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

int main()
{
    int n = 100000;
    int arr[n];
    for(int i=0;i<n;i++) {
        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_S
EC));
            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_SE
C));
            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;
}
```

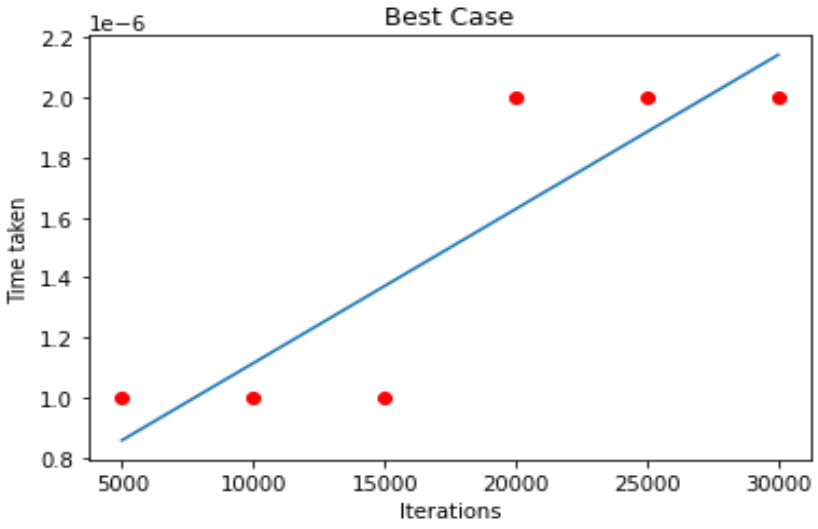
Output

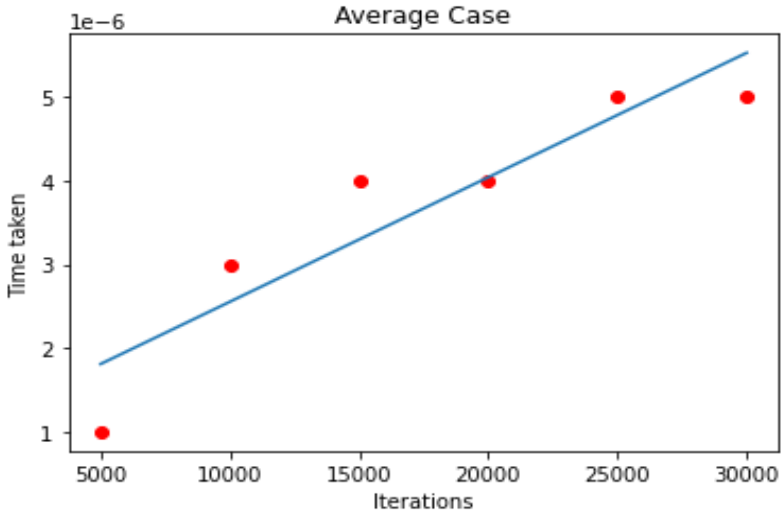


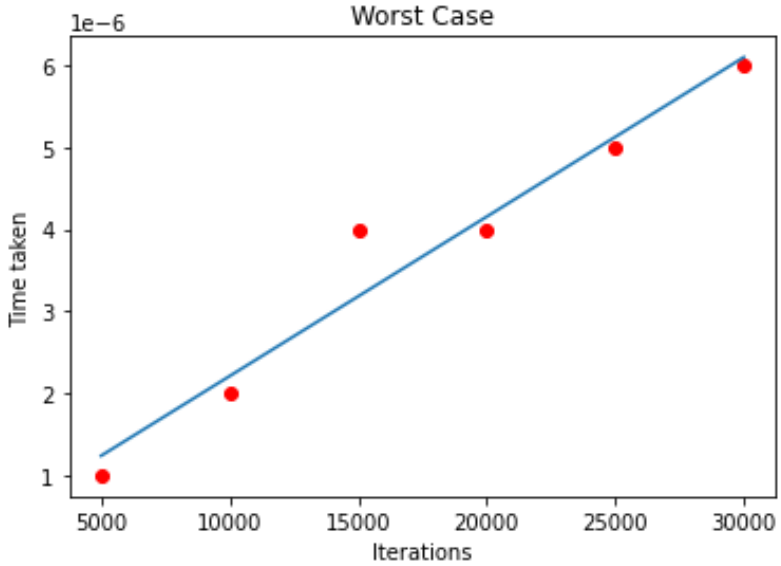
Draw the graph as the time found in each case.

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	0.000002
3	15000	0.000001	0.000003	0.000002
4	20000	0.000001	0.000003	0.000003
5	25000	0.000002	0.000005	0.000004
6	30000	0.000002	0.000007	0.000005

GRAPHS


Best Case
1e−6
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
Time taken
5000
10000
15000
20000
25000
30000
Iterations


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


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