

# Design and Analysis of Algorithm Lab

## Lab 2 – Selvakumar G (22MAI1004)

### Program : Execution Time Analysis: Insertion Sort

Code:

```
#include <math.h>
#include <stdio.h>
#include <ctime>
#include <cstdlib>
#include <fstream>
#include <iostream>
using namespace std;

/* Function to sort an array
   using insertion sort*/
void insertionSort(int arr[], int n)
{
    int i, key, j;
    for (i = 1; i < n; i++)
    {
        key = arr[i];
        j = i - 1;

        /* Move elements of arr[0..i-1],
           that are greater than key,
           to one position ahead of
           their current position */
        while (j >= 0 && arr[j] > key)
        {
            arr[j + 1] = arr[j];
            j = j - 1;
        }
        arr[j + 1] = key;
    }
}

// A utility function to print
// an array of size n
void printArray(int arr[], int n)
{
    int i;
```

```

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

// Driver code
int main()
{
    ofstream MyFile("executionTime.csv");

    for(int n = 1; n <= 100000; n*=2)
    {
        int arr[n];

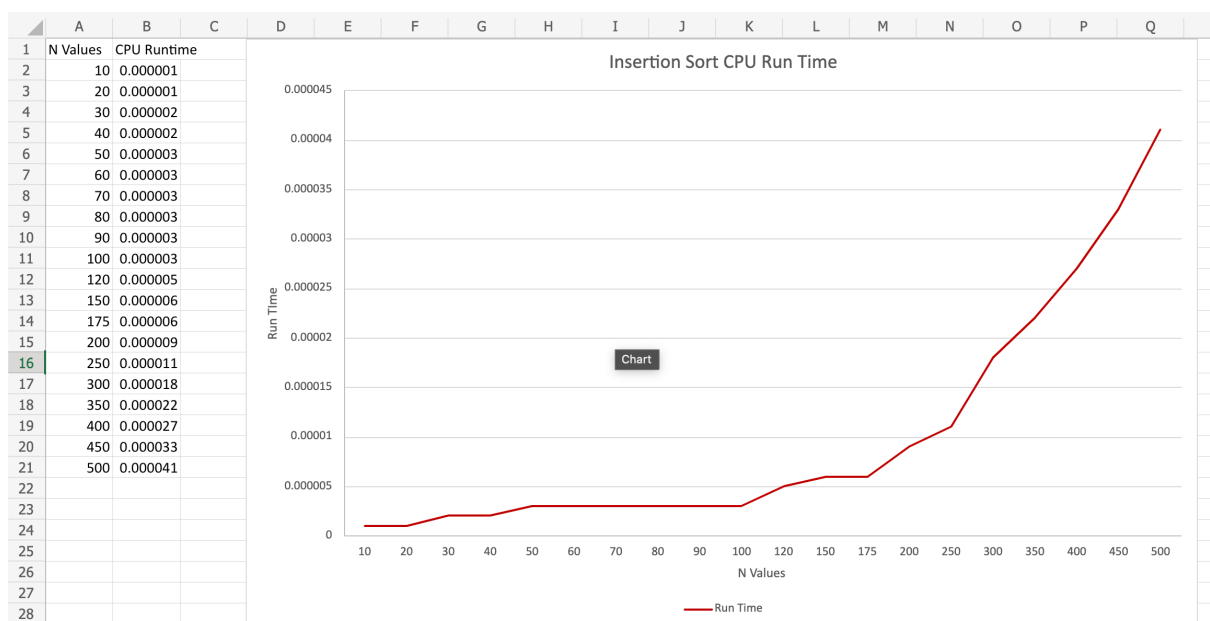
        for(int i = 0; i < n; i++)
        {
            arr[i] = rand();
        }

        clock_t tStart = clock();
        insertionSort(arr, n);
        double time1=(double)(clock() - tStart)/CLOCKS_PER_SEC;
        MyFile << n << "," << time1<< endl;
    }

    return 0;
}

```

Output:

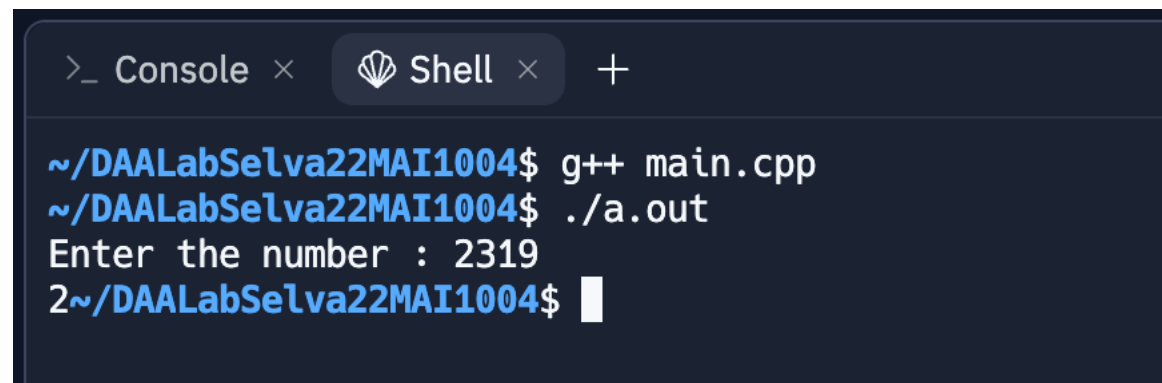


### Program 1. Define function to find first digit of a number

Code:

```
#include<iostream>
using namespace std;
void PrintLastDigit(int n){
    if(n > 10){
        PrintLastDigit(n/10);
    }
    else{
        cout<<n;
    }
}
int main()
{
    int n;
    std::cout<<"Enter the number : ";
    std::cin>>n;
    PrintLastDigit(n);
    return 0;
}
```

Output:

A screenshot of a terminal window with a dark background. At the top, there are two tabs: ">\_ Console" and "Shell", both with close buttons. The terminal shows the following sequence of commands and output: 1. A prompt "~ /DAALabSelva22MAI1004\$" followed by the command "g++ main.cpp". 2. The same prompt followed by the command "./a.out". 3. The program's output: "Enter the number : 2319". 4. The prompt again, followed by the number "2" entered by the user, and then a cursor.

```
>_ Console × Shell × +
~/DAALabSelva22MAI1004$ g++ main.cpp
~/DAALabSelva22MAI1004$ ./a.out
Enter the number : 2319
2~/DAALabSelva22MAI1004$
```

## Program 2. Define function to find second digit of a number.

Code:

```
#include<iostream>
using namespace std;

void PrintSecondDigit(int n)
{
    if(n > 100)
    {
        PrintSecondDigit(n/10);
    }

    else
        cout<<n%10;
}

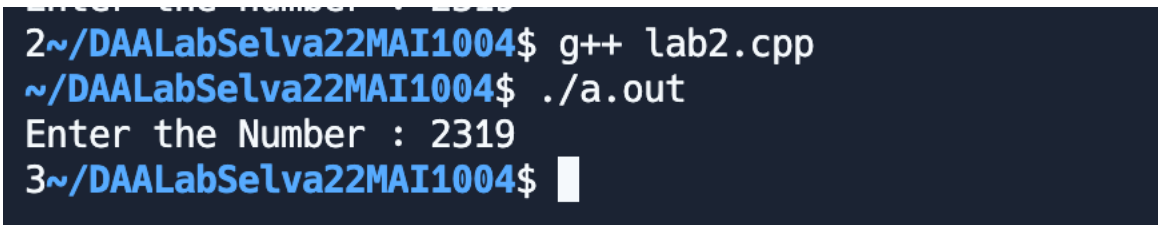
int main()
{
    int n;

    cout<<"Enter the Number : ";
    cin>>n;

    if(n < 10){
        cout<<"Please enter numbers having atleast 2 digits!! Try again.."<<endl;
    }
    else
        PrintSecondDigit(n);

    return 0;
}
```

Output:



```
2~/DAALabSelva22MAI1004$ g++ lab2.cpp
~/DAALabSelva22MAI1004$ ./a.out
Enter the Number : 2319
3~/DAALabSelva22MAI1004$
```

**Program 3. Define function to find the number of digits.**

Code:

```
#include<iostream>
using namespace std;

int GetNumberOfDigits(int n){
    if(n < 10){
        return 1;
    }

    return 1 + GetNumberOfDigits(n / 10);
}

int main(){

    int n;
    cout<<"Enter the number : ";
    cin>>n;

    cout<<GetNumberOfDigits(n);

    return 0;
}
```

Output:

```
~/DAALabSelva22MAI1004$ g++ lab3.cpp
~/DAALabSelva22MAI1004$ ./a.out
Enter the number : 231908
6~/DAALabSelva22MAI1004$
```

**Program 4. Define function to find sum of digits except second digit.**  
**sum(231456)=2+1+4+5+6=18.**

Code:

```
#include<iostream>
using namespace std;

int SumDigits(int n){

    if(n < 10)
        return n;

    if(n > 10 && n < 100){
        return SumDigits(n/10);
    }

    return (n % 10) + SumDigits(n / 10);
}

int main(){
    int n;
    cout<<"Enter the num ";
    cin>>n;

    cout<<SumDigits(n);

    return 0;
}
```

Output:

```
~/DAALabSelva22MAI1004$ g++ lab4.cpp
~/DAALabSelva22MAI1004$ ./a.out
Enter the num 234561
18~/DAALabSelva22MAI1004$
```

**Program 5. Define function to find last even digit. f(354683257) returns 2**

Code:

```
#include<iostream>
using namespace std;

void PrintLastEven(int n){
    if((n % 10) % 2 == 0){
        cout<< n % 10;
    }

    else{
        PrintLastEven(n / 10);
    }
}

int main(){
    int n;

    cout<<"Enter the Number : ";
    cin>>n;

    PrintLastEven(n);

    return 0;
}
```

Output:

```
Enter the Number : 354683257
3~/DAALabSelva22MAI1004$ g++ lab5.cpp
~/DAALabSelva22MAI1004$ ./a.out
Enter the Number : 354683257
2~/DAALabSelva22MAI1004$ █
```

**Program 6. Define function to find digit before last even digit. f(354683257) returns 3**

Code:

```
#include<iostream>
using namespace std;

void PrintLastEven(int n){
    if((n % 10) % 2 == 0){
        if(n > 10)
            cout<< (n / 10) % 10;
    }

    else{
        PrintLastEven(n / 10);
    }
}

int main(){
    int n;

    cout<<"Enter the Number : ";
    cin>>n;

    PrintLastEven(n);

    return 0;
}
```

Output:

```
~/DAALabSelva22MAI1004$ g++ lab6.cpp
~/DAALabSelva22MAI1004$ ./a.out
Enter the Number : 354683257
3~/DAALabSelva22MAI1004$
```



**Program 7. Define function to find digit after last even digit. f(354683257) returns 5.**

Code:

```
#include <iostream>
using namespace std;

void PrintLastEven(int n){
    if(n > 10 && ((n / 10) % 10) % 2 == 0){
        cout<< n % 10;
    }

    else{
        PrintLastEven(n / 10);
    }
}

int main(){
    int n;

    cout<<"Enter the Number : ";
    cin>>n;

    PrintLastEven(n);

    return 0;
}
```

Output:

```
~/DAALabSelva22MAI1004$ g++ lab7.cpp
~/DAALabSelva22MAI1004$ ./a.out
Enter the Number : 354683257
5~/DAALabSelva22MAI1004$
```

**Program 8. Define function to find the location of the last even digit from last. e.g. in 354683257 the last even digit is 2 and its location from last is 3.**

Code:

```
#include<iostream>
using namespace std;

void PrintLastEven(int n, int pos){
    if((n % 10) % 2 == 0){
        cout<< "Digit : "<< n % 10 << " Location : " << pos;
    }

    else{
        PrintLastEven(n / 10, pos+1);
    }
}

int main(){
    int n;

    cout<<"Enter the Number : ";
    cin>>n;

    PrintLastEven(n, 1);

    return 0;
}
```

Output:

```
~/DAALabSelva22MAI1004$ g++ lab8.cpp
~/DAALabSelva22MAI1004$ ./a.out
Enter the Number : 354683257
Digit : 2 Location : 3~/DAALabSelva22MAI1004$
```

**Program 9. Define function int g(int x, int k). It finds kth digit (from last) of number x. g(2536487,3) returns 4.**

Code:

```
#include<iostream>
using namespace std;

void PrintLastEven(int n, int pos, int currentPos){
    if(pos == currentPos){
        cout<< "Digit : "<< n % 10;
    }

    else{
        PrintLastEven(n / 10, pos, currentPos + 1);
    }
}

int main(){
    int n;
    int pos;

    cout<<"Enter the Number : ";
    cin>>n;
    cout<<"Enter the position : ";
    cin>>pos;

    PrintLastEven(n, pos, 1);

    return 0;
}
```

Output:

```
~/DAALabSelva22MAI1004$ g++ lab9.cpp
~/DAALabSelva22MAI1004$ ./a.out
Enter the Number : 2536487
Enter the position : 3
Digit : 4~/DAALabSelva22MAI1004$
```

**Program 10. Define function to find sum of even digits.**

Code:

```
#include<iostream>
using namespace std;

int SumEvenDigits(int n){
    if(n < 10){
        if(n % 2 == 0) return n;

        return 0;
    }

    if((n % 10) % 2 == 0){
        return (n % 10) + SumEvenDigits(n / 10);
    }

    return SumEvenDigits(n / 10);
}

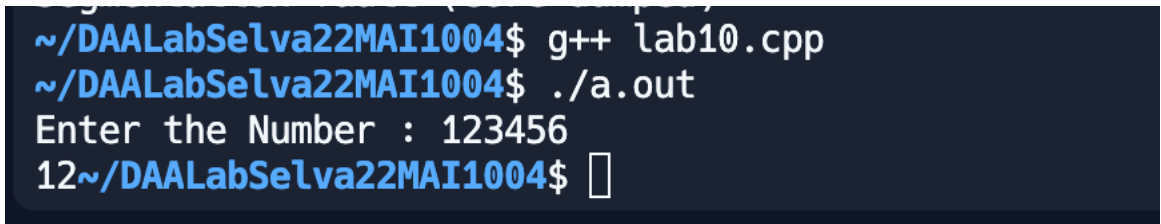
int main(){
    int n;

    cout<<"Enter the Number : ";
    cin>>n;

    cout<<SumEvenDigits(n);

    return 0;
}
```

Output:

A terminal window with a dark background and light blue text. The prompt is ~/DAALabSelva22MAI1004\$. The first command is g++ lab10.cpp. The second command is ./a.out. The program then prompts "Enter the Number : " and the user enters "123456". The program outputs "12". The prompt then changes to 12~/DAALabSelva22MAI1004\$.

```
~/DAALabSelva22MAI1004$ g++ lab10.cpp
~/DAALabSelva22MAI1004$ ./a.out
Enter the Number : 123456
12~/DAALabSelva22MAI1004$
```