| | Marwari University | |
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| Marwaol | Faculty of Technology Department of Information and Communication Technology | |
| o ii i v c i s i v y | | |
| Subject: Design and Analysis of Algorithms (01CT0512) | Aim: Exponential Function with O(N) and O(logN). | |
| Experiment No: 03 | Date: Enrollment No: 92200133030 | |

<u>Aim:</u> Exponential Function with O(N) and O(logN)

<u>IDE:</u> Visual Studio Code

I. Exponential Function using Iterative (Naive) Approach :-

Theory: -

This approach calculates the exponential function x^n by multiplying x by itself n times in a loop. Starting from an initial value of 1, each iteration multiplies the result by x, continuing until we've multiplied x n times. This approach is straightforward and easy to implement, but it has a time complexity of O(n) since it requires n multiplications, making it inefficient for large values of n.

| <u>Algorithm: -</u> | | | |
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Programming Language: - C++

Code :-

```
#include <bits/stdc++.h>
using namespace std;

long long Expotential(long base, long power) {
    if (power == 0) {
        return 1;
    }
    if (power == 1) {
        return base;
    }
    return base * Expotential(base, power - 1);
}
```



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```
int main() {
    long base;
    long power;
    cout << "Enter the Base of the Ecpotentail :- ";
    cin >> base;
    cout << "Enter the Power of the Expotential :- ";
    cin >> power;

    long long result = Expotential(base, power);

    cout << "The " << base << " raised to " << power << " is " << result << " ." << endl;
    return 0;
}</pre>
```

Output :-

PS D:\Aryan Data\Usefull Data\Semester - 5\Design-and-Analysis-of-Algorithms\Lab - Manual\Experiment - 3> cd "d:\Aryan Data\Usefull Data\Semester - 5\Design-and-Analysis-of-Algorithms\Lab - Manual\Experiment - 3\"; if (\$?) { g++ Expotentail_Using_Naive.cpp -o Expotentail_Using_N aive }; if (\$?) { .\Expotentail_Using_Naive }

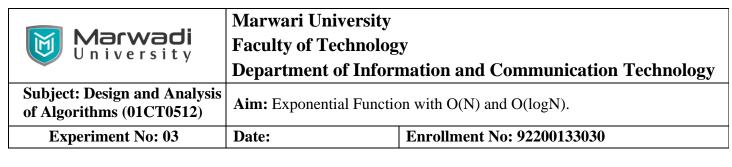
Enter the Base of the Ecpotentail :- 25

Enter the Power of the Expotential :- 5

The 25 raised to 5 is 9765625 .

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| Space Complexity: | |
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| Time Complexity: | |
| Best Case Time Complexity: Justification: - | |
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| Worst Case Time Complexity:- Justification: - | | |
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II. Exponential Function with O(N) using Divide and Conquer Approach:

Theory: -

This recursive method improves upon the naive approach by leveraging the properties of exponentiation through division:

- If n is even, the function computes $x^{(n/2)}$ and squares the result.
- If n is odd, it computes $x^{(n-1)/2}$, squares it, and then multiplies by x. Using divide and conquer

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Programming Language: - C++

Code :-

```
#include <bits/stdc++.h>
using namespace std;

long long Expotential(long base, long power) {
   if (power == 0) {
      return 1;
   }
}
```



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```
else if (power % 2 == 0) {
        return Expotential(base, power / 2) * Expotential(base, power / 2);
    }
    else {
        return base * Expotential(base, power / 2) * Expotential(base, power / 2);
    }
}
int main() {
    long base;
    long power;
    cout << "Enter the Base of the Ecpotentail :- ";</pre>
    cin >> base;
    cout << "Enter the Power of the Expotential :- ";</pre>
    cin >> power;
    long long result = Expotential(base, power);
    cout << "The " << base << " raised to " << power << " is " << result << " ." << endl;</pre>
    return 0;
```

Output:-

PS D:\Aryan Data\Usefull Data\Semester - 5\Design-and-Analysis-of-Algorithms\Lab - Manual\Experiment - 3> cd "d:\Aryan Data\Usefull Data\Semester - 5\Design-and-Analysis-of-Algorithms\Lab - Manual\Experiment - 3\"; if (\$?) { g++ Expotentail_Using_DandC.cpp -o Expotentail_Using_D andC }; if (\$?) { .\Expotentail_Using_DandC }

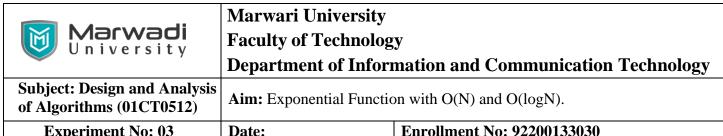
Enter the Base of the Ecpotentail :- 25

Enter the Power of the Expotential :- 5

The 25 raised to 5 is 9765625 .

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| Space Complexity: | | |
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| Theor This | y: - optimized divide-and If n is even, the fun If n is odd, it comp O(logN). This app | l-conquer method also levenction computes x^(n/2) aroutes x^[(n-1)/2], squares in | a, and then multiplies by x. By dividing n by 2 on dideal for large values of n as it minimizes the number |
| Algorith | <u>m: -</u> | | |
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Code:-

```
#include <bits/stdc++.h>
 using namespace std;
 long long Expotential(long base, long power) {
     if (power == 0) {
         return 1;
     }
     if (base == 0) {
         return 0;
     }
     if (power < 0) {
         return 1 / Expotential(base, power * -1);
     }
     if (power == 1) {
         return base;
     }
     long long Half_Power = Expotential(base, power / 2);
     if (power % 2 == 0) {
         return Half_Power * Half_Power ;
     }
     else {
         return base * Half_Power * Half_Power ;
     }
 }
 int main() {
     long base;
     long power;
     cout << "Enter the Base of the Expotentail :- ";</pre>
     cin >> base;
     cout << "Enter the Power of the Expotential :- ";</pre>
     cin >> power;
     long long result = Expotential(base, power);
     cout << "The " << base << " raised to " << power << " is " << result << " ." << endl;</pre>
     return 0;
}
```

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|--|
| The 25 raised to 5 is 9765625 . PS D:\Aryan Data\Usefull Data\Semester - 5\Design-and-Analysis-of-Algorithms\Lab - Manual\Experiment - 3> |
| Space Complexity:- |
| Justification: - |
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| Time Complexity: |
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| Conclusion:- |
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