

Tribonacci Numbers

The **tribonacci series** is a generalization of the Fibonacci sequence where each term is the sum of the three preceding terms.

2.6

The Tribonacci Sequence :

0, 0, 1, 1, 2, 4, 7, 13, 24, 44, 81, 149, 274, 504, 927, 1705, 3136, 5768, 10609, 19513, 35890, 66012, 121415, 223317, 410744, 755476, 1389537, 2555757, 4700770, 8646064, 15902591, 29249425, 53798080, 98950096, 181997601, 334745777, 615693474, 1132436852... so on

General Form of Tribonacci number:

$$a(n) = a(n-1) + a(n-2) + a(n-3)$$

with

$$a(0) = a(1) = 0, a(2) = 1.$$

Given a value N, task is to print first N Tribonacci Numbers.

Examples:

Input : 5
Output : 0, 0, 1, 1, 2

Input : 10
Output : 0, 0, 1, 1, 2, 4, 7, 13, 24, 44

Input : 20
Output : 0, 0, 1, 1, 2, 4, 7, 13, 24, 44,
81, 149, 274, 504, 927, 1705, 3136,
5768, 10609, 19513

Recommended: Please try your approach on [{IDE}](#) first, before moving on to the solution.

A **simple solution** is to simply follow recursive formula and write recursive code for it,

```
// A simple recursive CPP program to print  
// first n Tribonacci numbers.
```

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

int printTribRec(int n)
{
    if (n == 0 || n == 1)
        return 0;
    else if (n == 2)
        return 1;
    else
        return printTribRec(n - 1) +
               printTribRec(n - 2) +
               printTribRec(n - 3);
}

void printTrib(int n)
{
    for (int i = 1; i < n; i++)
        cout << printTribRec(i) << " ";
}

// Driver code
int main()
{
    int n = 10;
    printTrib(n);
    return 0;
}
```

[Run on IDE](#)

Output:

```
0 0 1 1 2 4 7 13 24 44
```

Time complexity of above solution is exponential.

A **better solution** is to use **Dynamic Programming**.

```
// A DP based CPP program to print
// first n Tribonacci numbers.
#include <iostream>
using namespace std;

int printTrib(int n)
{
    int dp[n];
    dp[0] = dp[1] = 0;
    dp[2] = 1;

    for (int i = 3; i < n; i++)
        dp[i] = dp[i - 1] + dp[i - 2] + dp[i - 3];

    for (int i = 0; i < n; i++)
        cout << dp[i] << " ";
}

// Driver code
int main()
{
    int n = 10;
    printTrib(n);
    return 0;
}
```

[Run on IDE](#)

Output:

```
0 0 1 1 2 4 7 13 24 44
```

Time complexity of above is linear, but it requires extra space. We can **optimizes space** used in above solution using three variables to keep track of previous three numbers.

```
// A space optimized based CPP program to
// print first n Tribonacci numbers.
#include <iostream>
using namespace std;

void printTrib(int n)
{
    if (n < 1)
        return;

    int first = 0, second = 0, third = 1;

    cout << first << " ";
    if (n > 1)
        cout << second << " ";
    if (n > 2)
        cout << third << " ";

    for (int i = 3; i < n; i++) {
        int curr = first + second + third;
        first = second;
        second = third;
        third = curr;

        cout << curr << " ";
    }
}

// Driver code
int main()
{
    int n = 10;
    printTrib(n);
    return 0;
}
```

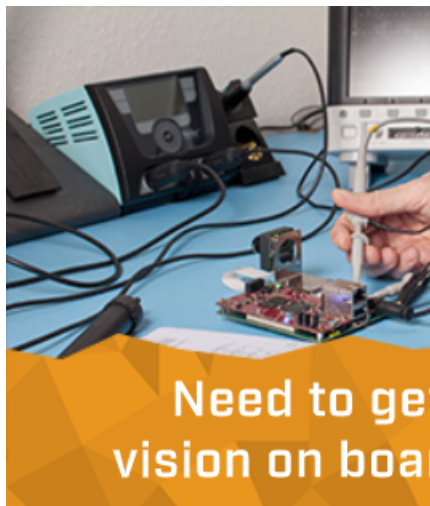
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Output:

```
0 0 1 1 2 4 7 13 24 44
```

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