

## Space and time efficient Binomial Coefficient

Write a function that takes two parameters n and k and returns the value of Binomial Coefficient C(n, k). For example, your function should return 6 for n = 4 and k = 2, and it should return 10 for n = 5 and k = 2.

We have discussed a  $O(n*k)$  time and  $O(k)$  extra space algorithm in [this](#) post. The value of C(n, k) can be calculated in  $O(k)$  time and  $O(1)$  extra space.

$$C(n, k) = n! / (n-k)! * k!$$

$$= [n * (n-1) * \dots * 1] / [(n-k) * (n-k-1) * \dots * 1] * [k * (k-1) * \dots * 1]$$

After simplifying, we get

$$C(n, k) = [n * (n-1) * \dots * (n-k+1)] / [k * (k-1) * \dots * 1]$$

Also,  $C(n, k) = C(n, n-k)$  // we can change r to n-r if r > n-r

Following implementation uses above formula to calculate C(n, k)

```
// Program to calculate C(n ,k)
#include <stdio.h>
```

```
// Returns value of Binomial Coefficient C(n, k)
int binomialCoeff(int n, int k)
{
    int res = 1;

    // Since C(n, k) = C(n, n-k)
    if ( k > n - k )
        k = n - k;

    // Calculate value of [n * (n-1) *---* (n-k+1)] / [k * (k-1) *---*
```

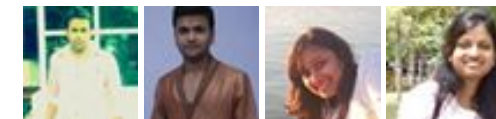
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```

for (int i = 0; i < k; ++i)
{
    res *= (n - i);
    res /= (i + 1);
}

return res;
}

/* Driver program to test above function */
int main()
{
    int n = 8, k = 2;
    printf ("Value of C(%d, %d) is %d ", n, k, binomialCoeff(n, k) );
    return 0;
}

```

Value of C(8, 2) is 28

Time Complexity:  $O(k)$

Auxiliary Space:  $O(1)$

This article is compiled by [Aashish Barnwal](#) and reviewed by GeeksforGeeks team. Please write comments if you find anything incorrect, or you want to share more information about the topic discussed above.



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The infographic is a circular diagram with 'IDEAL SERVER' at the center. It branches out into several categories of server specifications, each with a list of options and their associated costs. The categories include:
 

- Processor:** Intel Xeon E5-2680 v4 (€1,200), Intel Xeon E5-2690 v4 (€1,500), Intel Xeon E5-2699 v4 (€2,500).
- Memory:** 64GB DDR4 (€1,200), 128GB DDR4 (€2,000), 256GB DDR4 (€3,500).
- Storage:** 1TB SSD (€100), 2TB SSD (€180), 4TB SSD (€350).
- Network:** 10GbE (€150), 25GbE (€300), 40GbE (€450).
- Power:** 1000W (€100), 1500W (€150), 2000W (€200).
- Chassis:** 1U (€100), 2U (€150), 4U (€250).
- Operating System:** Linux (€0), Windows Server (€1,000), VMware (€1,500).
- Support:** 24x7 (€500), 9x5 (€250), 9x5 (€100).

 The total cost for each configuration is calculated and shown at the bottom of the diagram.

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**Alok Kumar** · a month ago

Good to know, but not practical. In most of the cases overflow is certain.

^ | v ·



**K.kaushik** · 11 months ago

The above program gives negative result for 100 C 15 or 100 C 18 or 100 C 19 or 100 C 20 or 100 C 25. Why this strange behaviour ?

/\* Paste your code here (You may **delete** these lines **if not** writing code)



**GeeksforGeeks** → K.kaushik · 11 months ago

The reason for negative values seems to be integer overflow. The prog

^ | v .



**geekguy** → GeeksforGeeks · 11 months ago

Use Java's BigInteger ! :)

Easiest Solution !

^ | v .



**Aashish** → K.kaushik · 11 months ago

This is because  $100 \text{ C } 15 > 100 \text{ C } 25$ . The former shows the negative  
Please do some paper work.

^ | v .



**Anuj Siroi** → Aashish · 11 months ago

```
How is  $100 \text{ C } 15 > 100 \text{ C } 25$  ?? If so then  
 $100 \text{ C } 15 > 100 \text{ C } 25$   
 $\Rightarrow 100! / 15! * 85! > 100! / 25! * 75!$   
 $\Rightarrow 15! * 85! < 25! * 75!$   
 $\Rightarrow 85 * 84 * \dots * 76 < 25 * 24 * \dots * 16$ 
```

Is it possible ????

^ | v .



**K.kaushik** → Aashish · 11 months ago

yes obviously  $10 \text{ C } 15 < 10 \text{ C } 25$ . So  $10 \text{ C } 25$  may show negati  
15 is showing negative, not  $10 \text{ C } 25$ . In java iterative implement

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datatype `&#039;long&#039;` instead of `&#039;int&#039;`. But still I  
positive. Please clear the confusion.

^ | v .



**Aashish** → K.kaushik · 11 months ago

Apologies. Please see the updated comment.

^ | v .

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**Swapnil** · 2 years ago

Just a small error.You can't define int inside for(). you need to define it before t

```
/* Paste your code here (You may delete these lines if not writing c
```

^ | v .



**Aashish** → Swapnil · 2 years ago

According to c-99 standard, you can define a variable inside loops also

Check here: <https://ideone.com/pOWZM>

^ | v .



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