

Power of N

This C++ program calculates the power of a given number using a recursive approach. It computes the result by recursively multiplying the number by itself 'pow' times.

Recursive function to calculate the power of a number

1. The program starts by including the necessary header file for input/output.
2. The **power** function is defined, which takes two integers, **num** (the base number) and **pow** (the exponent), and returns the result of raising 'num' to the power of 'pow'.
3. Inside the **power** function, there are three cases:
 - Base Case 1: If **pow** is 1, the function returns **num** itself since any number raised to the power of 1 is the number itself.
 - Base Case 2: If **pow** is 0 or **num** is 1, the function returns 1. This is because any number raised to the power of 0 is 1, and any number raised to the power of 1 is the number itself.
 - Recursive Case: If **pow** is greater than 1 and **num** is not 1, the function multiplies **num** by the result of **power(num, pow - 1)** recursively. This way, it calculates the power by reducing the exponent by 1 in each recursive call.

Time Complexity:

The time complexity of the power calculation algorithm is $O(n)$, where n is the value of the exponent (pow). In the worst case, the function makes 'pow' recursive calls, each reducing the exponent by 1. Therefore, the time complexity is linear with respect to the value of the exponent.

Space Complexity:

The space complexity of the program is $O(n)$, where n is the value of the exponent (pow). This is because the recursive calls are stored on the call stack, and in the worst case, the stack can have 'pow' frames, each corresponding to one recursive call. However, since the recursive calls do not store any additional data apart from the parameters (**num** and **pow**), the space consumption is relatively small compared to the actual computation of the power.

Recursive call stack for the approach:

① Recursive call stack for power of 12 (num^{pow}) (5^4)

$\text{power}(5, 4) \rightarrow 625$

- | - $\text{power}(5, 3) \rightarrow 125$
 - | - $\text{power}(5, 2) \rightarrow 25$
 - | - $\text{power}(5, 1) \rightarrow 5$
 - | - return 5
 - return $5 * 5 = 25$
 - return $5 * 25 = 125$
 - return $5 * 125 = \underline{\underline{625}}$