



Experiment-2

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1. **Aim:** Code implement power function in $O(\log n)$ time complexity.
2. **Objective:** To write a C++ program that finds the power of a number x^n using a fast method called Exponentiation by Squaring. This method makes the program run faster in $O(\log n)$ time instead of the slower $O(n)$ time. The program takes input for base and exponent, calculates the result, and shows the output.
3. **Procedure:**
 1. Start the program and take input for base x and exponent n .
 2. Define a function $\text{power}(x, n)$ to calculate x raised to the power n .
 3. Inside the function, if n is 0, return 1.
 4. Initialize a variable output to 1.
 5. Use a while loop that continues as long as n is greater than 0.
 6. If n is even, square the base x and divide n by 2.
 7. If n is odd, multiply output by x and decrease n by 1.
 8. Repeat the loop until n becomes 0.
 9. Return the final value of output.
 10. In the main function, call the $\text{power}(x, n)$ function and display the result.

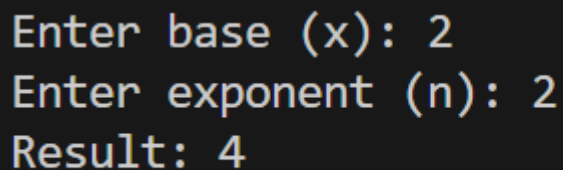
4. Code:

```
#include <iostream>
using namespace std;
int power(int x, int n) {
    if (n == 0) return 1;

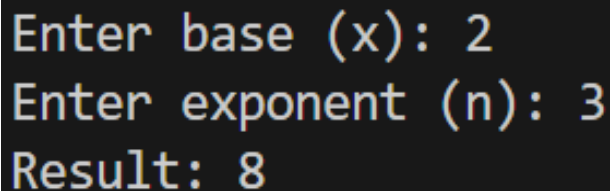
    int output = 1;
    while (n > 0) {
        if (n % 2 == 0) {
            x = x * x;
            n = n / 2;
        }
    }
}
```

```
        } else {  
            output = output * x;  
            n--;  
        }  
    }  
    return output;  
}  
  
int main() {  
    int x, n;  
    cout << "Enter base (x): ";  
    cin >> x;  
    cout << "Enter exponent (n): ";  
    cin >> n;  
    int result = power(x, n);  
    cout << "Result: " << result << endl;  
    return 0;  
}
```

5. Observations:



```
Enter base (x): 2  
Enter exponent (n): 2  
Result: 4
```



```
Enter base (x): 2  
Enter exponent (n): 3  
Result: 8
```

6. Time Complexity: $O(\log n)$

7. Learning Outcome:

- ❖ Learned how to calculate the power of a number using efficient logic (Exponentiation by Squaring).



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- ❖ Understood how to reduce time complexity from $O(n)$ to $O(\log n)$ using a better algorithm.
- ❖ Practiced using loops and conditional statements to solve mathematical problems.
- ❖ Gained experience in writing clean and fast iterative programs in C++.
- ❖ Learned how to take user input, perform calculations, and display the result.