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(Power in Modular

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Arithmetic) Given three numbers x, y and p, compute (xy) % p.

Examples

Агг

```
Input: x = 2, y = 3, p = 5
Output: 3
Explanation: 2^3 % 5 = 8 % 5 = 3.
Input: x = 2, y = 5, p = 13
Output: 6
Explanation: 2<sup>5</sup> % 13 = 32 % 13 = 6.
```

Students

Stack

C++

Hash

Q

We strongly recommend you to minimize your browser and try this yourself first.

We have discussed recursive and iterative solutions for power.

Below is discussed iterative solution.

```
/* Iterative Function to calculate (x^y) in O(logy) */
int power(int x, unsigned int y)
    int res = 1; // Initialize result
    while (y > 0)
       // If y is odd, multiply x with result
       if (y & 1)
           res = res*x;
       // n must be even now
       y = y >> 1; // y = y/2
       x = x*x; // Change x to x^2
    return res;
}
```

The problem with above solutions is, overflow may occur for large value of n or x. Therefore, power is generally evaluated under modulo of a large number.

Below is the fundamental modular property that is used for efficiently computing power under modular arithmetic.

```
(a \mod p) (b \mod p) \equiv (ab) \mod p
or equivalently
((a mod p) (b mod p)) mod p = (ab) mod p
For example a = 50, b = 100, p = 13
50 mod 13 = 11
100 mod 13 = 9
11*9 ≡ 1500 mod 13
11*9 mod 13 = 1500 mod 13
```

Below is C implementation based on above property.

```
// Iterative C program to compute modular power
#include <stdio.h>
/* Iterative Function to calculate (x^n)%p in O(logy) */
int power(int x, unsigned int y, int p)
    int res = 1; // Initialize result
    x = x \% p; // Update x if it is more than or
               // equal to p
    while (y > 0)
       // If y is odd, multiply x with result
       if (y & 1)
           res = (res*x) % p;
       // y must be even now
       y = y >> 1; // y = y/2
       x = (x*x) \% p;
    return res;
// Driver program to test above functions
int main()
  int x = 2;
  int y = 5;
  int p = 13;
  printf("Power is %u", power(x, y, p));
  return 0;
```

Output:



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type which can store such large value which will result in overflow. This method is

used for computing calculation of (a^b)%c eg (2^999)%1000000007 which could be stored in long long. If you perform a naive method on (a^b)%c, loop will execute b times and b times multiplication will perform which time complex will be O(b). But above method give the result in O(log(b)) time. ∧ V - Reply - Share > aashi - 2 months ago



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That's because in that case we never go into while loop and default value of res is returned. we can use a if condition outside while loop if(x==0) return 0; else res=1;

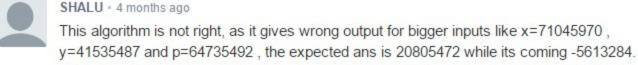
BTW 0^o0 is not defined. Reply - Share > Sridhar Addagatla - 3 months ago simple recursive solution in c can be found here: http://ideone.com/vPt3OB



A V - Reply - Share gauri shankar gaur - 3 months ago



In the above mentioned example a=50 and b=100. Shouldn't the result be 11*9 = 5000 mod 13?? A V - Reply - Share



I tried to solve with this algorithm n submit the solutn on different site but its showing wrong



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