L9 : Modulo Arithmetic Practice Questions

1-Tut : Number Of Balanced BTs

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You are given an integer h, find and print the count of all possible balanced binary trees of height h.

This number can be huge, so return the output modulus 10^9 + 7.

Input Format :

The first line of input contains an integer that denotes the value of the number of test cases. Let us denote it with the symbol T.

Each test case consists of a single integer h, that denotes height of the binary tree, in a separate line.

Output Format :

For each test case, there is a single line of output, which prints the count of all possible balanced binary trees of height h, modulus 10^9 + 7. The output for each test case is printed in a separate line.

Constraints :

1 <= T <= 10

1 <= h <= 20

Time Limit: 1 second

Sample Input 1:

1

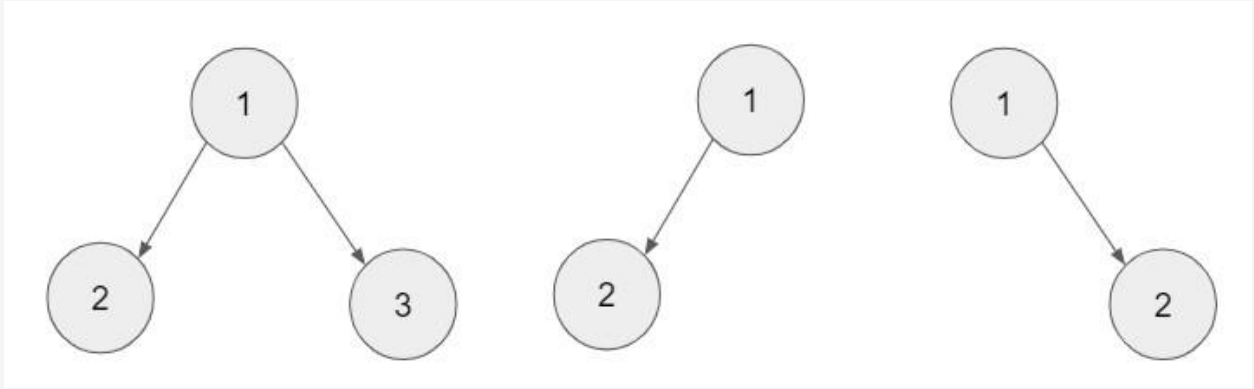
2

Sample Output 1:

3

Explanation:

Following are the three balanced binary trees that can be formed with height = 2.



Sample Input 2:

2

3

4

Sample Output 2:

15

315

```
#include<bits/stdc++.h>
using namespace std;
#define mymodulo 1000000007
long long int noofBBT(int h){
    if(h == 0 || h == 1){
        return 1;
    }
    long long int x = noofBBT(h-1);
    long long int y = noofBBT(h-2);
    x = x % mymodulo;
    y = y % mymodulo;

    return ( (x*x) % mymodulo + (2*x*y) % mymodulo ) % mymodulo;
}


int main(){

    // write your code here
    int T; cin >> T;
    while(T--){
        int h; cin >> h;
        long long int output = noofBBT(h);
        cout << output << endl;

    }
    return 0;
}
```

2-Ass : Product of first N natural numbers

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You are given an integer N and you have to calculate the product of the first N natural numbers.

As the answer will be large, print the answer modulo 10^9+7.

Input Format :

The first line of input contains an integer that denotes the value of the number of test cases. Let us denote it with the symbol T.

Each test case consists of a single integer N in a separate line.

Output Format :

For each test case, print the product of the first N natural numbers modulus 10^9 + 7 in a separate line.

Constraints :

1 <= T <= 100

1 <= N <= 10^5

Time Limit: 1 second

Sample Input 1:

2
3
4

Sample output 1:

6

24

```
#include<bits/stdc++.h>
using namespace std;
#define modu 1000000007
int prod_1_to_n(int N){
    int i = 1;
    long long int prod = 1;
    while(i <= N) {
        prod = prod % modu;
        prod = (prod*i) % modu;
        i++;
    }
    return prod;
}

int main(){

    // write your code here
    int T; cin >> T;
    while(T--){
        int N; cin >> N;
        long long int output = prod_1_to_n(N);
        cout << output << endl;

    }

    return 0;
}
```

3-Ass : Power Function

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You are given two integers, X and Y. You have to compute X^Y.

Example:

2^3 evaluates to 8.

Since the result can be large, so calculate the X^Y % M, where M is 10^9 + 7.

Note: Apply the brute force method to solve the problem.

Input Format:

The first line of input contains an integer that denotes the value of the number of test cases. Let us denote it with the symbol T.

Each test case consists of two space separated integers that denote the value of X and Y. Each test case is given in a separate line.

Output Format:

For each test case, print the answer modulo 10^9 + 7 in a separate line.

Constraints:

1 <= T <= 50

1 <= X, Y <= 10^5

Time Limit: 1 second

Sample Input 1:

2

2 3

3 2

Sample Output 1:

8

9

```
#include<bits/stdc++.h>
using namespace std;
#define modulo 1000000007
long long int power(int x, int y){
    int i = 1;
    long long int prod = 1;
    while(i <= y){
        prod = prod % modulo;
        prod = (prod * x ) % modulo;
        i++;
    }
    return prod;
}


int main(){

    // write your code here
    int T; cin >> T;
    while(T--){
        int x,y;
        cin >> x >> y;
        long long int result = power(x,y);
        cout << result << endl;
    }
    return 0;
}
```