Problem A
Binary Tree

Time limit: 2 seconds
Memory limit: 2048 megabytes

Problem Description

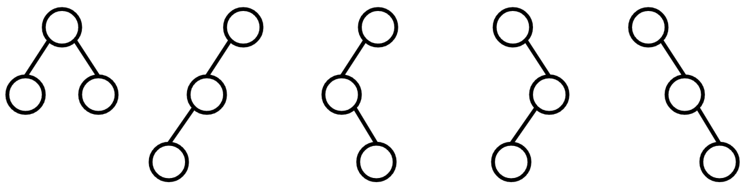
Given an integer n, representing the number of nodes in a binary tree, the task is to calculate the number of different structures of binary trees that can be constructed. A binary tree is a tree data structure in which each node has at most two children, referred to as the left child and the right child.

Two binary trees, T_1 and T_2, are considered structurally identical if one of the following conditions is satisfied:

1. Both T_1 and T_2 are empty.
2. Both T_1 and T_2 are not empty, and
    - The left subtrees of T_1 and T_2 are structurally identical.
    - The right subtrees of T_1 and T_2 are structurally identical.

Two binary trees are structurally different if and only if they are not structurally identical.

The following diagram illustrates the 5 different binary tree structures for $n = 3$:



Input Format

Input a positive integer n, representing the number of nodes required.

Output Format

Output the number of binary trees with n nodes. Since the answer may be large, output the answer modulo $10^9 + 7$.

Technical Specification

- $1 \le n \le 10^4$

Sample Input 1

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3
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Sample Output 1

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5
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Hint

You can solve this problem using dynamic programming. Define dp_i to represent the number of different shapes of binary trees with i nodes. Enumerate all possible distributions of nodes for left and right subtrees to obtain $\mathrm{dp}_i = \sum_{j=0}^{i-1} \mathrm{dp}_j \times \mathrm{dp}_{i-j-1}$

Here are some properties of modulo operations:

1. $(a + b) \mod m = ((a \mod m) + (b \mod m)) \mod m$
2. $(a \times b) \mod m = (a \mod m) \times (b \mod m) \mod m$

Note

The sequence associated with this problem is known as the Catalan numbers sequence.