Introduction

Dynamic programming is a multi-stage decision-making optimal solution model, which is generally used to solve the optimal problem. In most cases, it can use bottom-up recursion to get the optimal solution of each subproblem (that is, the optimal substructure), and then naturally get the optimal solution of the original problem that depends on the subproblem。

Red-black Tree, R-B Tree for short, is a kind of non-strict balanced binary search Tree. Nodes in a red-black tree, one class is marked black and the other class is marked red. In addition, a red-black tree also needs to satisfy several requirements: 1)The root node is black; 2)Every leaf node is black NIL, that is, the leaf node does not store data (black, empty leaf nodes are omitted); 3)No neighboring nodes can be red at the same time, that is, red nodes are separated by black nodes; 4)Each node, and all paths from that node to its reachable leaf node, contains the same number of black nodes.

According to the rules, Red-black trees can form many different shapes for the number of points given. In this project, we need to use dynamic programming, find the correct recursive relations and calculate the final answer with given number of points. We will give a integer N, and than counting how many forms of RB trees can they constitute. Since the answer may be too large, we output the answer divided by 1000000007.

Analysis

Time complexity: The main time complexity calculation for this project is the running of three for loops. The time complexity of “for(int i=3;i<=n;i++)” and “for(int k=1;k<i-1;k++) ” is O(N), and for “for(int j=low;j<high;j++)” is O(logN). Thus the time complexity of the program is O(N2logN).

Space complexity: the elements that need to be stored are BlackRoot[][] and RedRoot[][], so the space complexity is O(1);

Comments: The core of dynamic programming is to find the optimal solution of the problem and recursively define the optimal values. In this project our team successfully discover the recursive formulas for the optimal solution, realizing our goal.