

# Assignment #6: Recursion and DP

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2024 fall, Compiled by 陈俊逸, 工学院

## 说明:

- 1) 请把每个题目解题思路（可选），源码Python, 或者C++（已经在Codeforces/Openjudge上AC），截图（包含Accepted），填写到下面作业模版中（推荐使用 typora <https://typoraio.cn>，或者用 word）。AC 或者没有AC，都请标上每个题目大致花费时间。
- 3) 提交时候先提交pdf文件，再把md或者doc文件上传到右侧“作业评论”。Canvas需要有同学清晰头像、提交文件有pdf、“作业评论”区有上传的md或者doc附件。
- 4) 如果不能在截止前提交作业，请写明原因。

## 1. 题目

### sy119: 汉诺塔 (20min左右)

recursion, <https://sunnywhy.com/sfbj/4/3/119>

思路：递归，先把n-1全放到b上，把第n个放到c上，再把n-1全放到c上即可

代码：

```
def hannuota(n,a,b,c):#a is begin,b is fuzhu,c is target
    step=[]
    if n==1:
        s=a+'->'+c
        step.append(s)
        return step
    else:
        step.extend(hannuota(n-1,a,c,b))
        s = a + '->' + c
        step.append(s)
        step.extend(hannuota(n-1,b,a,c))
    return step
n=int(input())
step=hannuota(n,'A','B','C')
print(len(step))
for i in step:
    print(i)
```

代码运行截图 (至少包含有"Accepted")

问答

课程

训练营

算法笔记

题库

语言入门教程

考研算法大特训

本期速递

入门篇 (2) — 算法初步

递归

吓得我抱起了我的小龙虾

从前有座山

序列求最大值

反转字符串

阶乘

斐波拉契数列

数塔

回文字符串

上楼

汉诺塔

棋盘覆盖问题

数字螺旋矩阵

盒形

谢尔宾斯基地毯

自然数分解之最大积

自然数分解之方案数

递归深度

递归构造

分串

题目

题解

汉诺塔

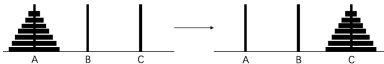
通过数 1391 提交数 3432 难度 中等 显示标签 ☆

题目描述

汉诺塔（又称河内塔）问题源于印度一个古老传说的益智玩具。大梵天创造世界的时候做了三根金钢石柱子，在一根柱子上从下往上按照大小顺序摞着64片黄金圆盘。大梵天命令婆罗门把圆盘从下面开始按大小顺序重新摆放在另一根柱子上。并且规定，在小圆盘上不能放大圆盘，在三根柱子之间一次只能移动一个圆盘。

抽象成模型就是说：

有三根相邻的柱子，标号分别为A、B、C，A柱子按金字塔状叠放着n个不同大小的圆盘，现在要把所有圆盘一个一個移动到柱子C上，并且任何时候同一根柱子上都不能出现大盘子在小盘子上方，请问至少需要多少次移动，并给出具体的移动方案。



输入描述

一个正整数n (1≤n≤16)，表示圆盘的个数。

输出描述

代码书写

Python

```
1 def hannuota(n,a,b,c):#a is begin,b is fuzhu,c is target
2     step=[]
3     if n==1:
4         s=a+'->'+c
5         step.append(s)
6         return step
7     else:
8         step.extend(hannuota(n-1,a,c,b))
9         s = a + '-'>' + c
10        step.append(s)
11        step.extend(hannuota(n-1,b,a,c))
12        return step
13 n=int(input())
14 step=hannuota(n,'A','B','C')
15 print(len(step))
16 for i in step:
17     print(i)
```

测试输入

提交结果

历史提交

完美通过

100% 数据通过测试

运行时长: 0 ms

查看题解

```
for i in s:
    print(i)
```

代码运行截图 == (至少包含有"Accepted") ==

The screenshot shows a coding competition interface. On the left is a sidebar with a navigation menu. The main area displays a problem statement in Chinese, followed by sample inputs and outputs. On the right is a code editor with a Python solution. Below the code editor, there are buttons for 'Test Input', 'Submit Result', and 'History Submit'. The status bar at the bottom indicates 'Perfect Pass' (完美通过), '100% Data Passed Test' (100% 数据通过测试), and 'Runtime: 0 ms' (运行时长: 0 ms).

**题目** 题解

将主序列A优先输出（例如1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100,101,102,103,104,105,106,107,108,109,110,111,112,113,114,115,116,117,118,119,120,121,122,123,124,125,126,127,128,129,130,131,132,133,134,135,136,137,138,139,140,141,142,143,144,145,146,147,148,149,150,151,152,153,154,155,156,157,158,159,160,161,162,163,164,165,166,167,168,169,170,171,172,173,174,175,176,177,178,179,180,181,182,183,184,185,186,187,188,189,190,191,192,193,194,195,196,197,198,199,200,201,202,203,204,205,206,207,208,209,210,211,212,213,214,215,216,217,218,219,220,221,222,223,224,225,226,227,228,229,230,231,232,233,234,235,236,237,238,239,240,241,242,243,244,245,246,247,248,249,250,251,252,253,254,255,256,257,258,259,260,261,262,263,264,265,266,267,268,269,270,271,272,273,274,275,276,277,278,279,280,281,282,283,284,285,286,287,288,289,290,291,292,293,294,295,296,297,298,299,300,301,302,303,304,305,306,307,308,309,310,311,312,313,314,315,316,317,318,319,320,321,322,323,324,325,326,327,328,329,330,331,332,333,334,335,336,337,338,339,340,341,342,343,344,345,346,347,348,349,350,351,352,353,354,355,356,357,358,359,360,361,362,363,364,365,366,367,368,369,370,371,372,373,374,375,376,377,378,379,380,381,382,383,384,385,386,387,388,389,390,391,392,393,394,395,396,397,398,399,400,401,402,403,404,405,406,407,408,409,410,411,412,413,414,415,416,417,418,419,420,421,422,423,424,425,426,427,428,429,430,431,432,433,434,435,436,437,438,439,440,441,442,443,444,445,446,447,448,449,450,451,452,453,454,455,456,457,458,459,460,461,462,463,464,465,466,467,468,469,470,471,472,473,474,475,476,477,478,479,480,481,482,483,484,485,486,487,488,489,490,491,492,493,494,495,496,497,498,499,500,501,502,503,504,505,506,507,508,509,510,511,512,513,514,515,516,517,518,519,520,521,522,523,524,525,526,527,528,529,530,531,532,533,534,535,536,537,538,539,540,541,542,543,544,545,546,547,548,549,550,551,552,553,554,555,556,557,558,559,560,561,562,563,564,565,566,567,568,569,570,571,572,573,574,575,576,577,578,579,580,581,582,583,584,585,586,587,588,589,590,591,592,593,594,595,596,597,598,599,600,601,602,603,604,605,606,607,608,609,610,611,612,613,614,615,616,617,618,619,620,621,622,623,624,625,626,627,628,629,630,631,632,633,634,635,636,637,638,639,640,641,642,643,644,645,646,647,648,649,650,651,652,653,654,655,656,657,658,659,660,661,662,663,664,665,666,667,668,669,670,671,672,673,674,675,676,677,678,679,680,681,682,683,684,685,686,687,688,689,690,691,692,693,694,695,696,697,698,699,700,701,702,703,704,705,706,707,708,709,710,711,712,713,714,715,716,717,718,719,720,721,722,723,724,725,726,727,728,729,730,731,732,733,734,735,736,737,738,739,740,741,742,743,744,745,746,747,748,749,750,751,752,753,754,755,756,757,758,759,760,761,762,763,764,765,766,767,768,769,770,771,772,773,774,775,776,777,778,779,780,781,782,783,784,785,786,787,788,789,790,791,792,793,794,795,796,797,798,799,800,801,802,803,804,805,806,807,808,809,810,811,812,813,814,815,816,817,818,819,820,821,822,823,824,825,826,827,828,829,830,831,832,833,834,835,836,837,838,839,840,841,842,843,844,845,846,847,848,849,850,851,852,853,854,855,856,857,858,859,860,861,862,863,864,865,866,867,868,869,870,871,872,873,874,875,876,877,878,879,880,881,882,883,884,885,886,887,888,889,890,891,892,893,894,895,896,897,898,899,900,901,902,903,904,905,906,907,908,909,910,911,912,913,914,915,916,917,918,919,920,921,922,923,924,925,926,927,928,929,930,931,932,933,934,935,936,937,938,939,940,941,942,943,944,945,946,947,948,949,950,951,952,953,954,955,956,957,958,959,960,961,962,963,964,965,966,967,968,969,970,971,972,973,974,975,976,977,978,979,980,981,982,983,984,985,986,987,988,989,990,991,992,993,994,995,996,997,998,999,1000,1001,1002,1003,1004,1005,1006,1007,1008,1009,1010,1011,1012,1013,1014,1015,1016,1017,1018,1019,1020,1021,1022,1023,1024,1025,1026,1027,1028,1029,1030,1031,1032,1033,1034,1035,1036,1037,1038,1039,1040,1041,1042,1043,1044,1045,1046,1047,1048,1049,1050,1051,1052,1053,1054,1055,1056,1057,1058,1059,1060,1061,1062,1063,1064,1065,1066,1067,1068,1069,1070,1071,1072,1073,1074,1075,1076,1077,1078,1079,1080,1081,1082,1083,1084,1085,1086,1087,1088,1089,1090,1091,1092,1093,1094,1095,1096,1097,1098,1099,1100,1101,1102,1103,1104,1105,1106,1107,1108,1109,1110,1111,1112,1113,1114,1115,1116,1117,1118,1119,1120,1121,1122,1123,1124,1125,1126,1127,1128,1129,1130,1131,1132,1133,1134,1135,1136,1137,1138,1139,1140,1141,1142,1143,1144,1145,1146,1147,1148,1149,1150,1151,1152,1153,1154,1155,1156,1157,1158,1159,1160,1161,1162,1163,1164,1165,1166,1167,1168,1169,1170,1171,1172,1173,1174,1175,1176,1177,1178,1179,1180,1181,1182,1183,1184,1185,1186,1187,1188,1189,1190,1191,1192,1193,1194,1195,1196,1197,1198,1199,1200,1201,1202,1203,1204,1205,1206,1207,1208,1209,1210,1211,1212,1213,1214,1215,1216,1217,1218,1219,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代码运行截图 (至少包含有"Accepted")

CS101 / 计概2024fall每日选做

[题目](#)[排名](#)[状态](#)[提问](#)

#46876345提交状态

查看提交统计提问

状态: Accepted

源代码

```
num=int(input())
height=list(map(int,input().split()))
h=sorted(height)
d=max(height)
row,col=num+1,len(h)+1
dp=[[0 for _ in range(col)]for _ in range(row)]
#print(dp)
for i in range(1,row):
    for j in range(col-1,0,-1):
        if height[i-1]==h[j-1]:
            dp[i][j]=max(dp[i-1][j]+1,dp[i][j-1])
        elif height[i-1]>h[j-1]:
            dp[i][j]=max(dp[i][j+1],dp[i-1][j])
        else:
            dp[i][j]=dp[i-1][j]
print(dp[-1][1])
```

基本信息

#: 46876345  
题目: 02945  
提交人: 24n2400011257  
内存: 3648kB  
时间: 23ms  
语言: Python3  
提交时间: 2024-11-01 13:28:47

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[English](#)[帮助](#)[关于](#)

## 23421: 小偷背包 (10min)

dp, <http://cs101.openjudge.cn/practice/23421>

思路：一件一件商品考虑，一格一格容量出发，每一格对应的最优解为，考虑拿取当前商品后剩余容量在上一行的最优解，和不拿取在上一行的最优解，二者进行取max，得到最终的最优解。（详细打一遍思路强化一下印象）

代码：

```
n,b=map(int,input().split())
price=list(map(int,input().split()))
weight=list(map(int,input().split()))
dp=[[0 for _ in range(b+1)]for _ in range(n+1)]
for i in range(1,n+1):
    for j in range(1,b+1):
        if weight[i-1]<=j:
            dp[i][j]=max(dp[i-1][j-weight[i-1]]+price[i-1],dp[i-1][j])
        else:
            dp[i][j]=dp[i-1][j]
print(dp[-1][-1])
```

代码运行截图 (至少包含有"Accepted")

OpenJudge

题目ID, 标题, 描述

24n2400011257

信箱

账号

CS101 / 题库 (包括计概、数算题目)

题目

排名

状态

提问

#46875070提交状态

查看

提交

统计

提问

状态: Accepted

源代码

```
n,b=map(int,input().split())
price=list(map(int,input().split()))
weight=list(map(int,input().split()))
dp=[[0 for _ in range(b+1)] for _ in range(n+1)]
for i in range(1,n+1):
    for j in range(1,b+1):
        if weight[i-1]<=j:
            dp[i][j]=max(dp[i-1][j-weight[i-1]]+price[i-1],dp[i-1][j])
        else:
            dp[i][j]=dp[i-1][j]
print(dp[-1][-1])
```

基本信息

#: 46875070

题目: 23421

提交人: 24n2400011257

内存: 3648kB

时间: 21ms

语言: Python3

提交时间: 2024-11-01 11:28:16

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English

帮助

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## 02754: 八皇后 (两小时左右)

dfs and similar, <http://cs101.openjudge.cn/practice/02754>

思路:

函数t用来判断放完一个queen后哪些格子不能用了

search第一个递归, 让它去找能放queen的可能位置

s用于记录位置, answer用于存储符合条件 (长度为8) 的s

代码:

```
import copy
def t(row,col,pp):
    p=copy.deepcopy(pp)
    for i in range(1,9):
        p[i][col]=False
        if 0<col+(i-row)<9:
            p[i][col+(i-row)]=False
        if 0<col-(i-row)<9:
            p[i][col-(i-row)]=False
    for i in range(1,9):
        p[row][i]=False
        if 0<row+(i-col)<9:
            p[row+(i-col)][i]=False
        if 0<row-(i-col)<9:
            p[row-(i-col)][i]=False
    return p
def search(a,p,s,answer):
    for i in range(1,9):
        if p[a][i]:
            s+=str(i)
            #print(s)
            if a==8:
                answer.append(s)
            else:
```

```

        search(a + 1,t(a, i, p), s, answer)
    s=s[:-1]
    return answer
s=''
p=[[True for i in range(9)] for j in range(9)]
answer=[]
answer=search(1,p,s,answer)
#print(answer)
n=int(input())
for i in range(n):
    shuru=int(input())
    print(answer[shuru-1])

```

代码运行截图 (至少包含有"Accepted")

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题目

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#46878726提交状态

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状态: Accepted

源代码

```

import copy
def t(row,col,pp):
    p=copy.deepcopy(pp)
    for i in range(1,9):
        p[i][col]=False
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            p[i][col+(i-row)]=False
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            p[i][col-(i-row)]=False
    for i in range(1,9):
        p[row][i]=False
        if 0<row+(i-col)<9:
            p[row+(i-col)][i]=False
        if 0<row-(i-col)<9:
            p[row-(i-col)][i]=False
    return p
def search(a,p,s,answer):
    for i in range(1,9):
        if p[a][i]:

```

基本信息

#: 46878726

题目: 02754

提交人: 24n2400011257

内存: 3700kB

时间: 118ms

语言: Python3

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## 189A. Cut Ribbon (一个半小时)

brute force, dp 1300 <https://codeforces.com/problemset/problem/189/A>

思路:

本题思路自己想的时候一直没想明白, 借助ai后恍然大悟

一维数组, 坐标表示现有长度, 从1遍历到n, 假设剪了a (或b, c), 看是否符合条件 (即剩下的长度是否有解), 不断dp即可。

代码:

```
shuru = list(map(int, input().split()))
n = shuru[0]
a, b, c = sorted(shuru[1:4])
dp = [-1] * (n + 1)
dp[0] = 0
for i in range(1, n + 1):
    if i >= a and dp[i - a] != -1:
        dp[i] = max(dp[i], dp[i - a] + 1)
    if i >= b and dp[i - b] != -1:
        dp[i] = max(dp[i], dp[i - b] + 1)
    if i >= c and dp[i - c] != -1:
        dp[i] = max(dp[i], dp[i - c] + 1)
print(dp[n])
```

代码运行截图 (至少包含有"Accepted")

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## 2. 学习总结和收获

如果作业题目简单，有否额外练习题目，比如：OJ“计概2024fall每日选做”、CF、LeetCode、洛谷等网站题目。

初次尝试递归，尤其是自己独立想出汉诺塔的代码后，我真真切体会到了递归的优雅，真是太优雅了，华丽又简洁，朴素却暗含力量，太有意思了（而且真正想懂了思路也不用过于费时间，我是第一次尝试时间较长可能是因为有点生疏）

全排列一题感觉思路不是很难想，但是代码实现起来总是会出现各种问题，最后ac了，也算是一种提升。并且在看完题解后很受启发。

八皇后，通过ai，我学会了深浅拷贝的区别，以及回溯的用法。

最后一题收获也比较大，写了一个半小时左右，做不出来，问了ai，它给出了只有一维数组的解法，很简洁，很优雅，很牛，而且是正确的（我用二维数组也没想明白，但是他这个代码就很明了），同时也让我学会了一些初始化list的小技巧。

dp的最后几题太难了（对我来说），刚刚接触完全不会，下来又花了很大的功夫，读了算法图解以及很多例题以及问室友问了两天多，才开始理解一些。

至于题目，我真的没什么思路，后面的每道题都本想着尝试自己写出来，但基本都在试了2个小时左右后失败了，最后靠着ai一点一点理解做法。虽然收获很大，但这是我开学以来第一次感到学编程力不从心了：（