Comp 526

Programming Assignment 1

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The problem.

The bamboo fence cutting problem consists of bamboo that grow at different rates per day. It is required to find a repeating sequence to cut these bamboo shoots in a way that minimizes the quality factor (DH/H, H: the lower bound on the daily height in the limit; DH: the height of the currently tallest bamboo) over all time with the restriction that can only cut 1 bamboo a day.

My General Strategy.

For Distribution 1:

The strategy works in the following way, due to the H= GrowthRate[0]+...+GrowthRate[n-1] (a constant) and the quality factor is always greater or equal to 1, it is required to define a "max height restriction" for each bamboo shoot. This is a value that we are sure can be achieved for example, in the integer bamboo shoot problem we can guarantee that we can find an ordering which could make DH bigger than 42 but not too bigger, due to the H of these bamboos is 42.

0	1	2	3	4	5	6	7		
3	3	3	5	5	7	7	9	1	
		6		10		14	18	2	H=42
		9		15		21	27	3	DH/H>=1
		12		20		28	36	4	
		15		25		35	45	5	
		18		30		42	54	6	
		21		35		49	63	7	
		24		40		56	72	8	
		27		45		63		9	
		30		50		70		10	
		33		55				11	
		36		60				12	
		39		65				13	
		42		70				14	
		45		75				15	
		48		80				16	
		51		85				17	
		54		90				18	
		57		95				19	
		60						20	
		63						21	
		66						22	
		69						23	

Figure1. Integer bamboo shoot problem

According to the figure, the max height restriction is used to reduce the search space in the following way. We conduct a normal brute force algorithm trying to find a non-repeating sequence that maintains our height restriction for a set number of cuts. The period of cutting 7^{th} ,6^{th},$4^{th}$and 2^{nd} bamboo is more than 5, 6, 9 and 15 respectively. According to these periods, we could get the optimal sequence (7)->(4)->(3)->(6) ->(5) ->(7) ->(0)

->(6) ->(5) ->(4) ->(7) ->(1) ->(3) ->(0) ->(5) ->(7) ->(2).

For Distribution 2:

It is hard to use the normal brute force algorithm to find the optimal perque for the second problem. Thus, we try to use a method, called ReduceMax, a greedy method which each day cuts the tallest bamboo, regardless of the growth rates distribution. For example, the first day we get the height of bamboos (1,1,2,3,5,8,13,21), so we chose the 7th one to cut because it is the tallest one. Then we cut 6th bamboo as the height of bamboos increased to 2, 2, 4, 6, 10, 16, 26, 21. Thereby, we obtain one perque, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 5, 7, 1, 6, 7, 3, 5, 7, 6, 4, 7, 2, 6, 7, 5, 7, 6, 7, 4, 1, 7, 6, 5, 7, 3, 6, 7, 4, 5, 7, 6, 1, 7, 1, 6, 7, 5, 2, 7, 6, 4, 7, 3, 5, 6, 7, 0, but we think this is not the optimal perque. Due to the operating time, we do not find the repeating part of this sequence, although the result is already close to the optimal value.

For Distribution 3:

We can see that the growth rates distribution of 3rd problem is showing the multiple relationship. It is easy to use normal brute force algorithm to find the optimal sequence. Because the H is 766, 768 is chose to be the max height restriction for all bamboos.

0	1	2	3	4	5	6	7			
3	6	12	24	48	96	192	384	1		
6	12	24	48	96	192	384	768	2		H=766
9	18	36	72	144	288	576	1152	3		DH/H>=1
12	24	48	96	192	384	768	1536	4		
15	30	60	120	240	480	960	1920	5		
18	36	72	144	288	576	1152	2304	6		
21	42	84	168	336	672	1344	2688	7		
24	48	96	192	384	768	1536	3072	8		
27	54	108	216	432	864	1728	3456	9		
30	60	120	240	480	960	1920	3840	10		
33	66	132	264	528	1056	2112	4224	11		
36	72	144	288	576	1152	2304	4608	12		
39	78	156	312	624	1248	2496	4992	13		
42	84	168	336	672	1344	2688	5376	14		
45	90	180	360	720	1440	2880	5760	15		
48	96	192	384	768	1536	3072	6144	16		
51	102	204	408	816	1632	3264	6528	17		
54	108	216	432	864	1728	3456	6912	18		
57	114	228	456	912	1824	3648	7296	19		
60	120	240	480	960	1920	3840	7680	20		
63	126	252	504	1008	2016	4032	8064	21		
66	132	264	528	1056	2112	4224	8448	22		
69	138	276	552	1104	2208	4416	8832	23		
72	144	288	576	1152	2304	4608	9216	24		
		300	600					25		
		312	624					26		
		324	648					27		
		336	672					28		
		348	696					29		
		360	720					30		
		372	744					31		
		384	768					32		

Figure2. Distribution 3 Bamboo Problem

According to the max height restriction, the periods of cutting each bamboo is 256, 128, 64, 32, 16, 8, 4 and 2 respectively. Thus, we could get one sequence by using brute force algorithm, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 2, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 1, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 2, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 2, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 1, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 2, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 0.

Results.

Distribution 1、

The Perque is (7)->(4)->(3)->(6) ->(5) ->(7) ->(0) ->(6) ->(5) ->(4) ->(7) ->(1) ->(3) ->(0) ->(5) ->(7) ->(2)

Using the Strategy described above I managed to reduce my results to

Quotient= 1.2142857 MaxHeight= 51 H= 42

Distribution 2

The Perque is 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 5, 7, 1, 6, 7, 3, 5, 7, 6, 4, 7, 2, 6, 7, 5, 7, 6, 7, 4, 1, 7, 6, 5, 7, 3, 6, 7, 4, 5, 7, 6, 1, 7, 1, 6, 7, 5, 2, 7, 6, 4, 7, 3, 5, 6, 7, 0

Using the Strategy described above I managed to reduce my results to

Quotient= 1.5555556 MaxHeight= 84 H= 54

Distribution 3

The Perque is 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 2, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 1, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 2, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 2, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 1, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 2, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 3, 7, 6, 7, 5, 7, 6, 7, 4, 7, 6, 7, 5, 7, 6, 7, 0.

Using the Strategy described above I managed to reduce my results to

Quotient= 1.0039216 MaxHeight= 768 H= 765