Report for Etude 9 Lights On To Off

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GENERAL SOLUTION

The problem with Lights On To Off is turning all the lights off from the beginning. This problem is complicated because a single light switch can control multiple lights. This can cause light to be turned off and then indirectly turned back on by other switches. If we want to switch off all the lights, we should find a general solution, because we do not confirm the number of lights and switches.

Firstly, we should check all the switches, and confirm how many lights have been controlled via the same light switch. In this step, we need to define a relationship between switches and lights. We know that each switch control how many lights, and then, it can be made a matrix. For example, there are four switches and four lights A, B, C, D. Furthermore, we should test all switches, and get that switch A controls lights A, C, and D, switch B controls lights B and D, and switch C controls lights A and C, and switch D only control the light D. And then, we make a matrix, which makes the relationship between lights and switches more clear:

	A	B	C	D
A	1	0	1	1
B	0	1	0	1
C	1	0	1	0
D	0	0	0	1

Next step, we should define a relationship between switches and all bright lights. After the first step, we tested all the switches, and some lights should be off. We assume the rest of bright lights is 1 in the matrix, and we would like to turn off them, assuming the lights off is 0 as well. To stick with the above example, after the first example, we make a new matrix:

	A	B	C	D
A	0	0	0	0
B	0	0	0	1
C	1	0	1	0
D	0	0	0	0

In the example, we test the switch A first, and then the switch A turns lights A, C, and D off, and then testing the switch B, the switch B turns the light B off and the light D on. Furthermore, testing the switch C as well, the switch C turns lights A and C on. Lastly, switch D turns the light D off, and only lights A, C, and D on. Hence, we get the above new matrix.

Besides, we would like to turn off the most lights at once, which we need to confirm the relationship between switches and all bright lights. In the example, only lights A, C, and D are on, and we know that the switch A controls lights A, C, and D, and the switch B controls lights C and D, and then the switch C controls lights A and C, and the switch D only controls the light D. Exactly, we choose to turn off the switch A, because it has the highest correlation with the rest of bright lights.

In the real case, we do not know how many switches and lights there are, so we prefer to use the greedy algorithm in this step. The greedy algorithm can find the local optimal so that getting global optimization. The correlation between the switches and bright lights should be updated, and we need to find the highest correlation and switch if off when we press a switch each time.