2014-AUS-01-EN Birthday cake

0 ----	I: ----	II: ----	III: hard	IV: medium

☐ ALG	☒ INF	☐ STRUC	☐ PUZ	☐ SOC	☐ USE

Answer Type: Multiple Choice Mandatory for: Group IV

Body

Beaver Beatrix gives her birthday party and wants to buy a birthday cake. The cake shop has 8 kinds of cakes to choose from. Beatrix knows that there is one cake in the shop that all beavers are allergic to, but she forgot which one it is. If the beavers eat this particular cake, they get red spots all over their body 24 hours after they ate the cake. Obviously Beatrix does not want to buy this cake for her party so she needs to find out in the next 24 hours which cake she must avoid. Luckily the best friends of Beatrix agreed to help her taste the cakes.

Question

What is the minimum number of beavers needed to find out in 24 hours which cake the beavers are allergic to?

Answer

A. 3
B. 4
C. 6
D. 8

Explanation

The answer is A.
Let's label the beavers 1, 2 and 3. Each beaver will taste every cake his number is on:

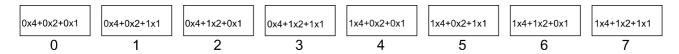|	1	2	1,2	3	1,3	2,3	1,2,3
0	1	2	3	4	5	6	7

This way, when we know which beavers get spots, we can say that the cake eaten exactly by these beavers is the one they are allergic to. In fact, we established a correspondence between each combination of ill beavers and each cake.

For instance, if Beaver 2 and Beaver 3 get spots, then it means that the cake to avoid is cake 6.

It's informatics

To each beaver we can assign a weight which is a power of 2: 1, 2, or 4.
Also, each beaver has a value: 1 if they get spots, else 0. Every combination of beavers (those who have spots and the others) leads to a number: we just make the sum of the value of the beavers multiplied by their weight like this:

0x4+0x2+0x1	0x4+0x2+1x1	0x4+1x2+0x1	0x4+1x2+1x1	1x4+0x2+0x1	1x4+0x2+1x1	1x4+1x2+0x1	1x4+1x2+1x1
0	1	2	3	4	5	6	7

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If we just keep the values of the beavers, we obtain what we call the binary representation of the numbers 0 to 7:

000	001	010	011	100	101	110	111
0	1	2	3	4	5	6	7

Binary representation is very much used in informatics, since all data are stored into bits, and each bit can take either 0 or 1 as value.

Keywords

Binary numbers

Websites

http://en.wikipedia.org/wiki/Binary_number

Internal Use

Wording

Comments

Reviewed by Alexandre Talon (alexandre.talon@ens-lyon.fr, France) and Emil Kelevedjiev (keleved@gmail.com, Bulgaria)
Maybe declined in interactive version: we say that we need 3 beavers, and we ask student to assign each beaver to some cakes so that afterwards we can determine the cake.
TODO: improve at least the second picture of it's informatics (I'm sorry, I'm really bad at drawing...)

Graphics
Boxes by Alexandre Talon (alexandre.talon@ens-lyon.fr, France), do whatever you want with them :)

Files

All additional files for this task (graphics, scripts, etc.)
2014-AUS-01-EN.odt (this file)
2014-AU-01-EN_beatrixwithredspots.svg
2014-AU-01-EN_explanation.svg
2014-AU-01-EN_informatics-1.svg
2014-AU-01-EN_informatics-2.svg

Authorship

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