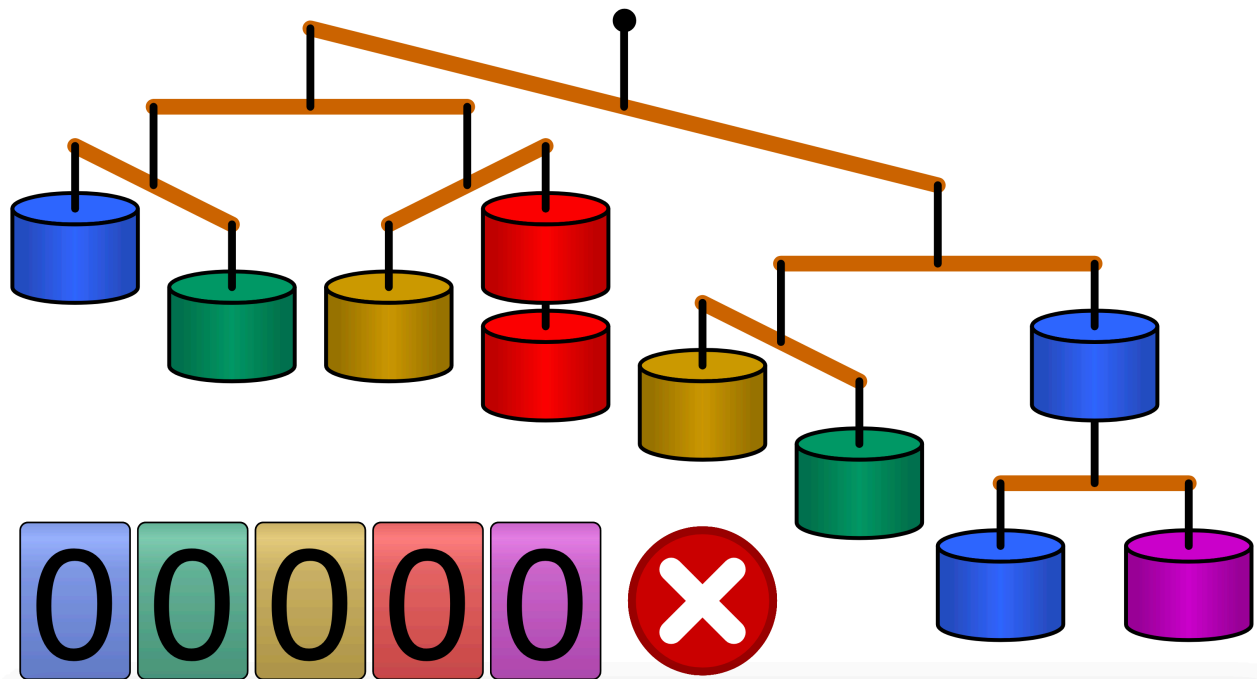


Mathematical Escape Game, Sample Riddle



This is the wonderful balance problem https://upload.wikimedia.org/wikipedia/commons/4/44/Balance_puzzle_SMIL.svg

A typical feature of escape games riddles is that the players have to figure out by themselves what is expected from them. In the given riddle, one has to enter in the frame integers from 0 to 9 that represent the weights of the shapes of the corresponding colours (with respect to some unknown unit of measure). The configurations with balance provide an equation for some of the weights, while the configurations with no balance provide an inequality. Warning: an uncommon interpretation of the picture is seeing everywhere balance configurations (with a 3D-perspective).

Provided that the players have understood the riddle, they can try to solve it. Hints can be provided (the full list of hints could amount to the list of equations and inequalities that the picture provides). Afterwards, solving this system of equalities and inequalities is an exercise (for example, its resolution can be a homework assignment).

Luckily the solution is unique, and it can be easily entered in the frame (within the provided link), so that players know when they got a correct answer. One small thing: educators should have ready an alternative version of the riddle for colourblind people.

Educators could consider presenting a smaller riddle in class so that pupils understand what is to be done. In this case, the original riddle can be presented as further challenge that needs no guidance. Notice that hints can be obtained on request (for example scanning QR codes).

After presenting the given riddle, educators can challenge pupils to invent their own balance riddle: after checking that the riddle is nicely solvable and that it has a unique solution, the best riddles can be recommended to the class (possibly to be solved at home on a voluntary basis).

Technical aspect: If a nicely coded file is provided for pupils to modify, then obtaining the riddle in its final interactive form can also become a small programming exercise. In any case, the riddle only requires a picture and it is very possible to neglect the feature of entering/checking the solution.

Reward: educators can let pupils work in team, the first team presenting the correct solution being the winner. However, if this is a homework activity, the reward should be very minor for fairness (pupils may have time constraints that put them to a disadvantage, for example a dentist appointment).

SOLUTION TO THE RIDDLE.

WARNING! THIS TEXT SPOILS THE RIDDLE. ONLY FOR THE CONVENIENCE OF EDUCATORS.

Call ABCDE the unknown code, with the letter corresponding to the weight of the shape of the corresponding colour.

We have the following information:

- 1) $B > A$
- 2) $A = E$
- 3) $2D < C$
- 4) $B > C$
- 5) $3A = B + C$ (right in the picture)
- 6) $A + B = C + 2D$ (left in the picture)
- 7) $2(A + B) < 2(C + B)$ (top in the picture)

$$5) \Rightarrow C = 3A - B$$

$$6) \Rightarrow D = B - A$$

Thus we only need to find A and B (we may deduce the values of C, D, E).

$$4) \Rightarrow 2B > 3A$$

$$3) \Rightarrow 3B < 5A$$

$$7) \Rightarrow B < 2A \text{ (we do not need this weaker inequality)}$$

$$\text{Thus } (3/2)A < B < (5/3)A$$

For $A=1,2,3,4$ there is no integer B in the given interval. For A equal to 6 or larger we would have $B > 9$, which is impossible.

Finally, $A=5$ works and gives the solution 5 8 7 3 5.