

## Car Sorting

### Statement

Various algorithms for sorting numbers are studied in computer science courses. But in fact, problems of sorting emerged and were resolved much earlier, together with advent of railroad services. These were the problems of sorting cars and assembling trains from them. For this purpose, so-called *sorting humps* are used, from which the cars are pushed down and directed to the desired tracks by means of switches. If the required sorting cannot be performed at once, a locomotive pushes a train back on the hump and the sorting procedure is repeated. Cars slide down one by one, but only entire trains can be driven up on the hump.

Initially there are 20 cars of four different types on the hump, five cars of each type; each type has its own color. You must assemble four trains, each consisting of cars of the same type, in the smallest possible number of moves. Each train should be placed on the track of the same color as the train. Not only that, the cars in a train must be arranged in the order of their numbers, with car 1 in front, car 2 after it, and so on.

If all the cars of a train are on the track of their own color, then the best solution will be the one in which the number of pair of cars arranged in the wrong order (called *inversions*) is the smallest. For example, if the train is formed by cars in the reverse order, 54321, then there are 10 pairs altogether: (5; 4), (5; 3), ..., (2; 1), and all of them form inversions; if the cars are in the order 32154, then the number of inversions is smaller, only 4: (3; 2), (3; 1), (2,1), (5; 4).

If all the cars are on their tracks in the correct order, then the best solution is the one that has been obtained by a smaller number of uphill moves, which make use of locomotive.

Finally, all else being equal, the solution with the smallest number of downhill slides is considered to be the best.

### Controls (Help)

Each numbered (green) button in the center of the screen slides the leftmost car on the hump down to the track with the number of this button. Red buttons start the locomotive on the corresponding track to push all the cars on this track onto the hump.

The *Undo* button annuls the result of the last move in your solution; in particular, it allows you to "scroll back" a saved and loaded solution. The *Animation On/Off* button switches the mode of car movement from smooth to instantaneous (the mode is indicated by the arrow on the icon to the left of the button). In a smooth (animated) mode, the semaphores will show when the next move, upward or downward, can be performed (it cannot be performed until the previous maneuver has been ended).

The *Clear* button returns the cars to their original positions. It must be used carefully so as not to lose the current solution. However, intermediate solutions can be saved, and the best solution is saved automatically.

### Reporting Solution

To submit your solution to the jury, make the browser window completely visible on the computer display and press Ctrl+Alt+S key combination.