The Goal

Compute all possible future states of an ongoing game of *Mark Steere's* Cephalopods in the **shortest time possible**.

Rules

Cephalopods is an abstract two player game played with dice on a grid.

Your objective is to find **all the possible board states** after a given number of turns by **simulating all possible moves** from a given board state.

This version of Cephalopods is played on a **3x3** board, on which players take turns adding dice of their own color, one die per turn.
A newly placed die must show a **one**, unless it's a **capturing placement**, more information below.
Once the board is full, the game **ends**, and the winner is the player with the most dice showing a six.

Note: In this exercise, you will **not** be required to compute the winner of the game, nor will you need to track whose dice is whose.

Capturing placement

If a die is placed adjacent to two or more dice, and any combination of these adjacent dice has a sum of displayed values **less than or equal to six**, then the player must remove that combination from the board. The played die must then display the sum of the values of the removed dice.

If **multiple combinations** are possible, the player **chooses** which one to apply.

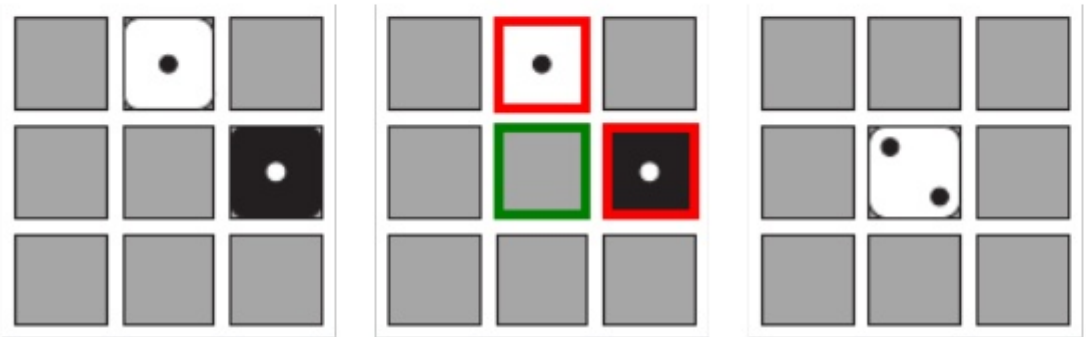
Captures are **mandatory** when placing a die where a capture is possible.

Non-capturing placement

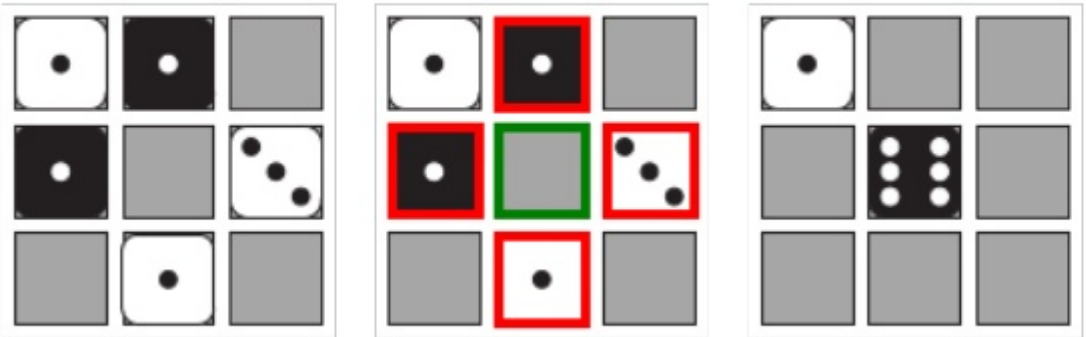
If a die is placed on a space where no captures are possible, its value will be **one**.

Move examples

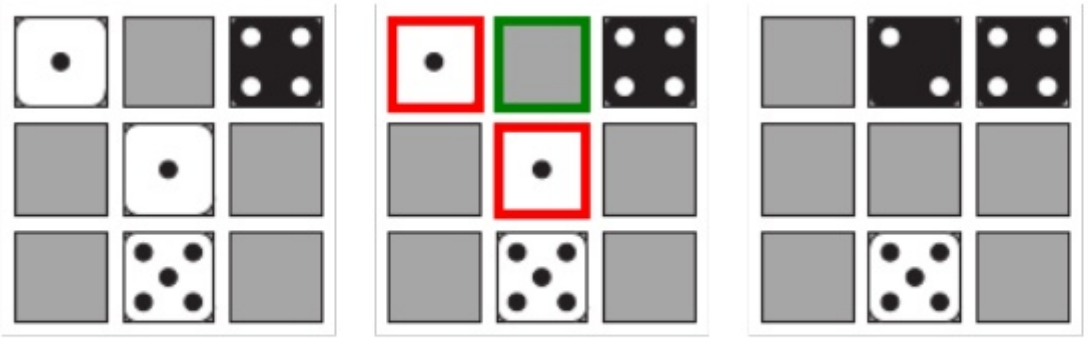
Capture



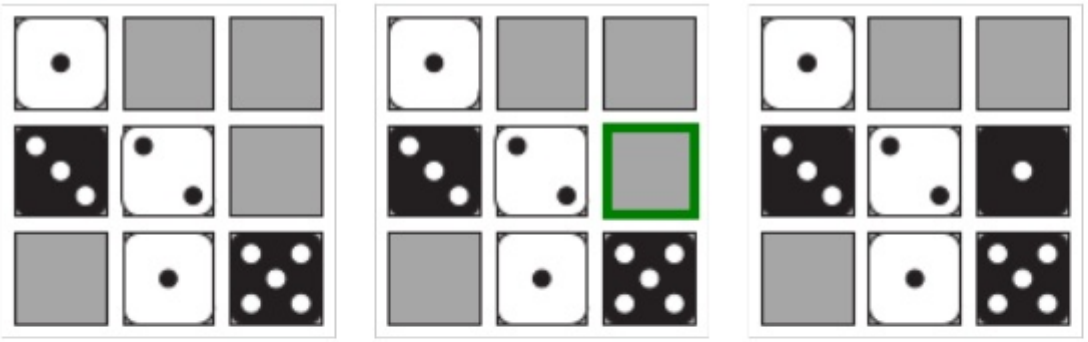
Capture



Capture with multiple possible dice combinations



Non-capture



Your mission

Your program must read from the **standard input** the initial state of the board and **maximum number of turns** to simulate, then compute all possible board states **after** the given number of turns, including games that have ended before the maximum depth was reached.

See input protocol for more details.

Board state hashes

Each board state is represented as `32-bit` integer using a simple algorithm. Here's how the hashing works:

- The board is treated as a grid where each square is encoded with a single piece of information: the **value of the die** on that square (`1–6` or `0` for empty).
- The hash is built by iterating over all squares from **left to right** then **top to bottom**. The integer is **shifted left** by 1 digits and the die value is added.
  Essentially, **each square is a digit** in the integer.

As an example, here is the encoding for the following board.


```
1 0 0
3 2 1
0 1 5
```

= 100321015

= 100321015

Expected output

Simulate all possible games and calculate the hash of the final board state at the end of the given number of turns for each game.
Then, **sum all these hashes**.
To avoid overflow, the sum is calculated **modulo 2^{30}**.

For instance, if you have the following hashes:

```
656010333
 4022100
551401012
...
```

Then the final sum should be calculated like this:

```
final_sum 0
final_sum (final_sum 656010333) % 2^30
final_sum (final_sum 4022100) % 2^30
final_sum (final_sum 551401012) % 2^30
etc...
```

How is my score calculated?

We will run your code **ten** times per validation test. After removing the **two** best and worst times, we will calculate the average of the remaining **6**. This average will be your score for that test, and the total sum of each will be your final score, given in **milliseconds**.

Note

You can run the tests by launching them from the "Test cases" window. Submit your code to enter the leaderboard. **Each validation tests you pass will earn you some points**.

Warning: the tests provided are similar to the validation tests used to compute the final score **but remain different**. This is a "harcoding" prevention mechanism. Harcoded solutions will not get any points.

Moreover, the validation tests **will change again** after the event ends for the ranking computation. Your last submission and the submission with the best score during the event will be compared for this final run.

Game Input

Input

First line: one integer `depth` for the max number of player moves to simulate.
Next `3` lines: `3` `die_value` integers representing each space of one row of the board.
- `die_value`: the value of the die on this space or `0` if this space is empty

Output

One integer: `final_sum`, the sum of all board hashes for possible game states after at most `depth` turns.

Constraints

$1 \leq$ depth ≤ 40

Response time to output: **10 seconds** for most test cases.
The last two validators have a max response time of **30** and **40** seconds respectively.