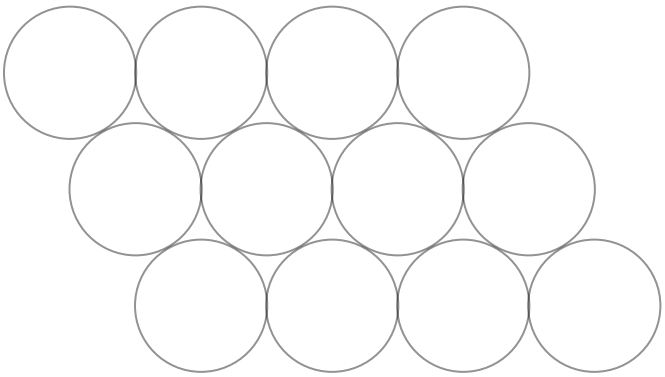
UVAMT 2025 - Optimization Round

O1. Distinct Products

In the grids below, let three cells form a *triplet* if every cell is adjacent to the other two cells, and let the *value* of a triplet be the product of the three numbers written in its cells.

Your task is to fully full in the grid below with positive integers such that no two triplets in the same grid have the same value.

Given these constraints, **minimize** the sum of the values of all triplets in the grid below.



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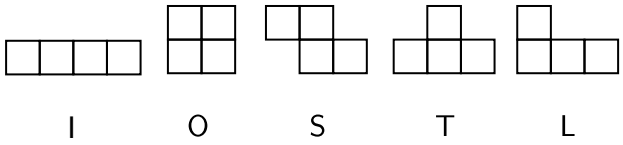
O2. Tetrominoes



These are the five distinct tetrominoes, up to rotation and reflection. Your task is as follows: First, assign a distinct number from 1 to 5 to each of the five distinct tetrominoes. Then, fill in an 8x8 grid with digits 1-5 (not every cell has to be filled). The following condition must be satisfied:

- For each tetromino, if it was assigned a number n, then however you place it on the grid (rotations and reflections included), at least one of the cells that it covers must contain a number at least n.

Given these constraints, your job is to **minimize** the sum of the numbers on your grid.

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O3. p(p(x))

Isaac needs help choosing a polynomial, along with a point to evaluate it at! His only hard requirement is that it have integer coefficients.

His main requirement is for the polynomial and evaluation point to be *accurate*, in that $p(p(x_0))$ should be as close to 2025 as possible.

However, he also wants the polynomial to be *simple* in a sense:

- The degree d of the polynomial should be relatively small.
- The maximum absolute value c of all the coefficients shouldn't be too large.
- The evaluation point x_0 shouldn't be too large in absolute value.

He gives each polynomial an accuracy score: $|p(p(x_0)) - 2025|$, and a simplicity score: $d + c + |x_0|$.

Your task is to submit a polynomial with integer coefficients, along with an evaluation point x_0, such that the sum of the simplicity and accuracy scores is as **small** as possible.