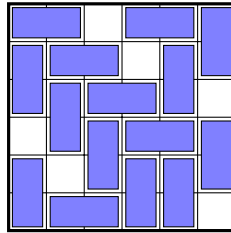
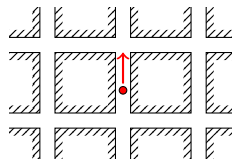


Solve three out of five problems. You must work alone.

1. Can you tile a 6×6 board with 15 dominoes so that the six empty squares are all in different rows and columns? For example, here's an attempt that *almost* works, but there are two empty squares in the last column.

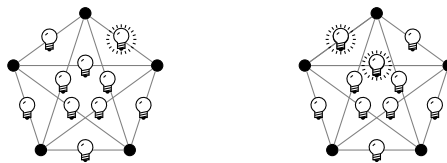


2. You are driving in an infinite city whose blocks form a square lattice. At every intersection, you must turn left or right—you can't go straight. You start from the red point driving north. Is it possible to return to the red point while driving south?



3. Five pillars are arranged in a circle, and between every pair of pillars is a string with a light bulb on it. You are allowed to make the following move, as many times as you want: pick three pillars, then turn the three light bulbs on the strings connecting those pillars on (if they're off) or off (if they're on). For example, if you pick the top three pillars in the picture on the left, you would end up with the picture on the right.

In the beginning, one light bulb is on and all the rest are off. Is it possible to turn all the light bulbs off?



4. At some point during the quarter, Jonah's attendance record is less than 90%. Later on in the quarter, it's above 90%. Is there necessarily some time when his attendance record is exactly 90%?

(Note that attendance doesn't vary continuously. If Jonah has attended 3 out of 5 classes, and then misses another one, his attendance drops directly from 60% to 50%.)

5. Your apartment contains a long hallway with 10,000 light bulbs, numbered 1 through 10,000. Originally, all of the light bulbs are off.

On the first day, you pull the chain on every light bulb, turning them all on. On the second day, you pull the chain on every even-numbered light bulb, turning them off. On the third day, you pull the chain on every light bulb that's a multiple of three. This continues: on the n th day, you toggle all the light bulbs that are multiples of n . After 10,000 days, which light bulbs are on?