Pairwise shortest distance of honeycomb

Zhihao Wang

February 6, 2019

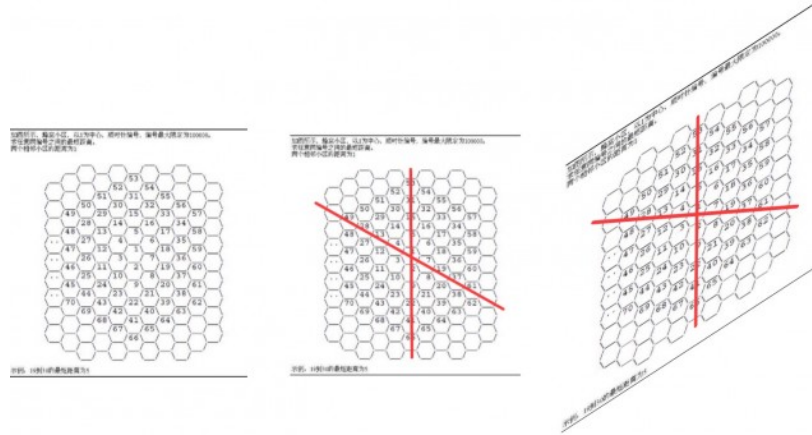## 1 Problem
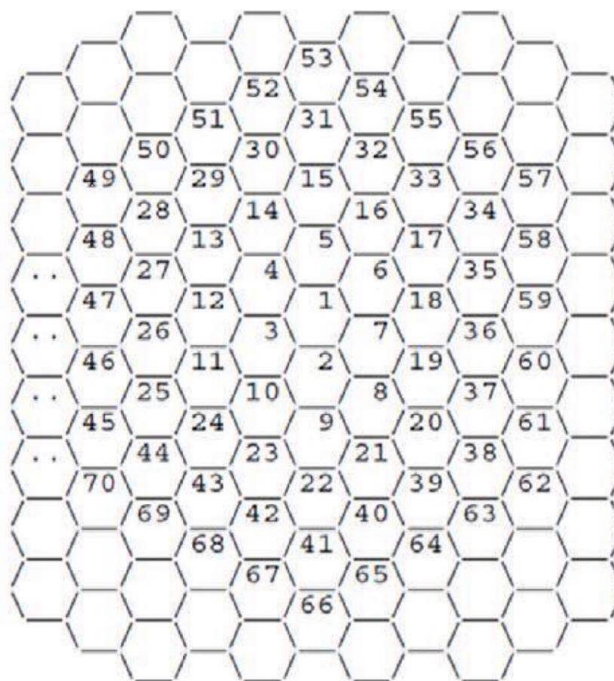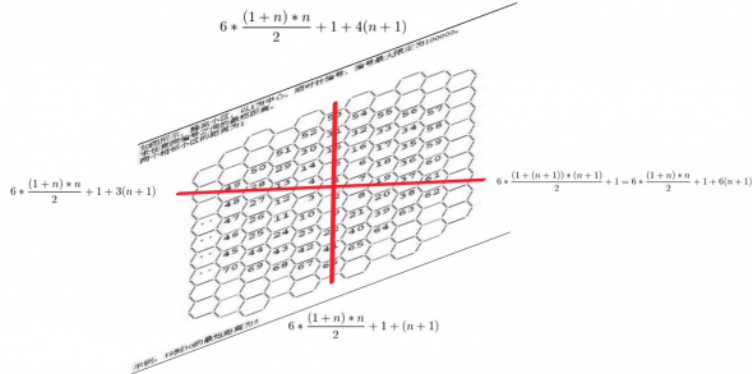
2 Solution

We can add two axies and skew the honeycomb to get a cartesian coordinate system.

Then we can calculate the coordinates as the following. Starting from some special coordinates, we can simulate the other coordinates case by case.
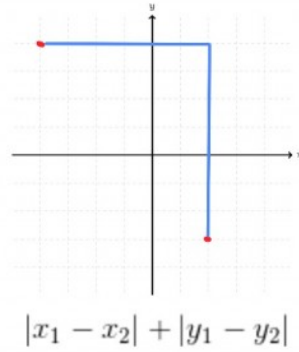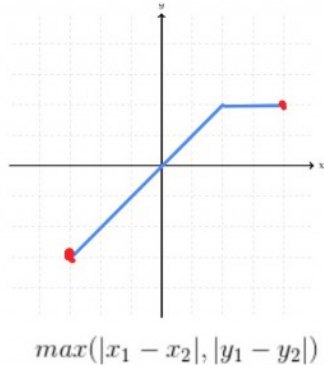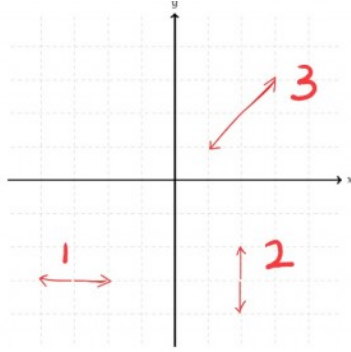

Find the mininum n and $0 \le p \le 5$ and $0 \le q \le n$

$$Number = 6 * \frac{(1+n)*n}{2} + 2 + p(n+1) + q$$

Then the coordinate will be

$$Coordinate = \begin{cases} (n-q,-1-q), & \text{for } p=0 \\ (-1-q,-1-n), & \text{for } p=1 \\ (-1-n,-n+q), & \text{for } p=2 \\ (-n+q,1+q), & \text{for } p=3 \\ (1+q,1+n), & \text{for } p=4 \\ (1+n,n-q), & \text{for } p=5 \end{cases}$$

We will have three operators in the new coordinate system, go horizontal, go veritical, and go 45 degree diagonal line, and there are two solutions.

$$max(|x_1 - x_2|, |y_1 - y_2|)$$

$$|x_1 - x_2| + |y_1 - y_2|$$

Thanks to xinyu, he told me the answer are actually a mixture of Chebyshev distance and Manhattan distance, which is quite interesting especially when I found out Chebyshev distance is L_∞ $distance$ and $Manhattan$ $distance$ is L_1 $distance$.