Situation

This work is about a topic that has been on the news quite often recently, the elections. To have elections, of course, there must be voters, but before they can even go to vote, they must be registered in constituencies ("districts", electoral zones). These in turn are made up of municipalities which are rather the administrative areas in which voters live and which may be more or less densely populated. In addition, populations change and move, therefore, electoral areas must be periodically redrawn so that they remain representative of the population. In Canada, at the federal and provincial levels, the various factors (of which the number of inhabitants is a major factor) which are taken into account in this redistribution are clearly established and it is carried out by organizations independent of the various political parties. However, this redistribution of electoral zones can be misused, in order to favor one political party over another, for example, in countries where it is a little less well supervised, such as in the United States and this practice is widespread. calls it "gerrymandering". Here is the list of sources that were used for this paragraph and that you could consult if you want to know more about the subject:

https://www.elections.ca/content.aspx?section=res&dir=ces&document=part1&lang=e

https://www.elections.ca/content.aspx?section=res&dir=cir/list&document=index338&lang=f#list

https://fr.wikipedia.org/wiki/Circonscriptions_%C3%A9lectorales_du_Canada

https://www.elections.ca/content.aspx?section=res&dir=eim/issue6&document=p6&lang=f

https://www.washingtonpost.com/news/wonk/wp/2015/03/01/this-is-the-best-explanation-of-gerrymandering-you-will-ever-see/

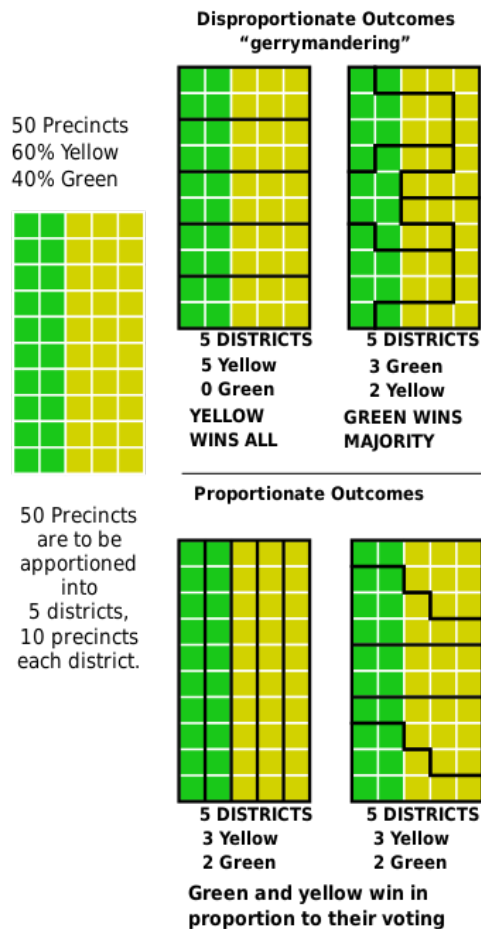https://www.nytimes.com/2019/06/27/us/what-is-gerrymandering.html

The practical work deals more specifically with "gerrymandering" and here are the details:

There are n square municipalities of 100 inhabitants each, for which we know the proportions of votes for the two parties, the green and the yellow. We must divide the municipalities into m constituencies which are made up of k municipalities each with floor (n / m) ≤ k ≤ ceiling (n / m). A constituency does not need to be connected, but the Manhattan distance between any pair of municipalities in the same constituency must be at most (n / 2m). A party wins a constituency if the majority of the voters within it have voted for it, in other words, the sum of the votes within all the municipalities in the constituency has a majority.

Your goal is to group the municipalities into ridings so as to maximize the number of ridings in which the Greens are in the majority, to help them win the election.

Gerrymandering: drawing different maps for
electoral districts produces different outcomes

**Disproportionate Outcomes
"gerrymandering"**

50 Precincts
60% Yellow
40% Green

5 DISTRICTS
5 Yellow
0 Green
**YELLOW
WINS ALL**

5 DISTRICTS
3 Green
2 Yellow
**GREEN WINS
MAJORITY**

50 Precincts
are to be
apportioned
into
5 districts,
10 precincts
each district.

Proportionate Outcomes

5 DISTRICTS
3 Yellow
2 Green

5 DISTRICTS
3 Yellow
2 Green

**Green and yellow win in
proportion to their voting**

Here is a figure that shows different divisions of
municipalities into constituencies in order to
change the election results. Note that the
situation is simplified in the figure, because we
disregard the number of electors in each
municipality, in other words, all the inhabitants of
a municipality vote either green or yellow.

Figure 1: Example of different election results depending on the district

source: M.boli - Own work. Derived from an image by Steven nAss, CC BY-SA 4.0,
https://commons.wikimedia.org/w/index.php?curid=64401739

Dataset

We provide you with an Item Generator that works as follows:

```
python[3] generator.py -x 5 -y 10
```

Arguments:

- x = The number of municipalities along the x axis

- y = The number of municipalities along the y axis

A file in the x_y_n.txt format (where n avoids overwriting an existing file) is saved in a "./exemplars" folder, such as:

Copy generated after executing the example line at the top of the page:

file 5_10_0.txt

```
          5_10_0.txt

1 5  10
2 67   46   84   26   15
3 100  85   74   58   78
4 79   37   59   17   100
5 61   50   82   27   94
6 98   20   100  79   41
7 4    26   22   76   58
8 94   37   2    82   53
9 21   23   94   27   94
10 84  8    83   21   52
11 54  3    62   42   98
```

The first line shows the number of municipalities along the x-axis and the number of municipalities along the y-axis. The following lines give a representation of the municipalities on a 2D plan, the element (i, j) of the matrix gives the number of electors who vote for the green party (reminder: there are 100 electors in all per municipality).

To simplify things for you, the coordinates of the different municipalities correspond to their indices i and j.

Format of the solution: For the same solution, it is necessary to display the different municipalities that are in the same electoral division on the same line, one after the other, separated by a space, then when we move to the next riding, we change lines. Then, when a better solution is found, we skip the line twice. In the display example below we first have a first solution with 3 ridings which have 3 municipalities each, then a second solution is displayed after the empty line when found. Note that both solutions respect the constraints, but the second is better (i.e. more ridings in total vote for the green party) than the first (and the third is

better than the second and so on) and that it is only the last solution provided that will be taken into account for the correction.

```
0 0 0 1 1 0
1 1 0 2 1 2
2 0 2 1 2 2

0 0 1 0 2 0
0 1 1 1 0 2
2 1 1 2 2 2
```

Each municipality in a constituency has its x and y coordinates separated by a space. Between each new solution found, you must leave an empty line.

You are provided with a solution verification script (check_sol.py, instructions for use are in the source code). This script will tell you if the display is correct, if your solution is valid, as well as the number of ridings that are voting for the Green Party. This is the script that will be used for the fix, so make sure it recognizes your solutions