Date: 18/04/2024

Problem:

I have currently 35-36 blocks of various shapely object multipolygon shapes as shown below. I would like to optimise the positions of each of the blocks by moving them one by one such that the point-to-point distance of the line and area is minimised. My end goal is that the amount of the white space is less on the space while there is no overlap between the shapely objects. The solution should work in cpu environment taking less than 120 seconds (ideally 60 seconds)

Transfer function:

1. Minimise overall Area taken by 35 blocks. Minimise the white space of the final solution.
2. Minimise Critical wire distance between the groups from where the wires are emanating.
3. Minimise misc wire distance between all 35 blocks.

Other constraints:

1. Some groups have edges which need to be at the border of the solution.
2. Some groups can be placed at the bottom side of the current board.
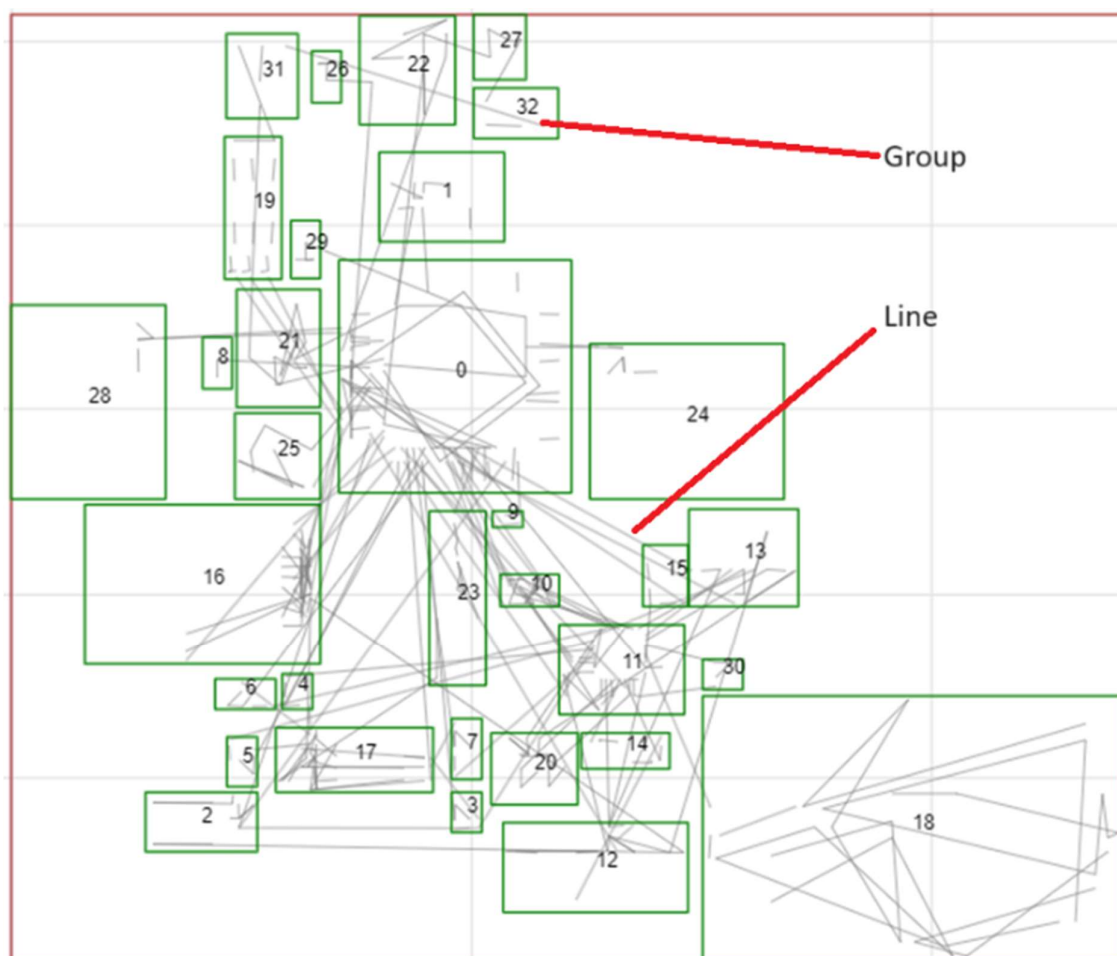
Solution:

Use an optimisation algorithm which uses input such as group width, height, points, distance constraints and rotates and moves it to locations which are area and net distance optimal.

Other Rules:

1. No Overlap between groups.
2. Distance between the groups should be programmable. Initially set the value as one unit.
3. Use genetic algorithm or a like algorithm (cvxpy, pymoo) to define these constraints and produce an optimal solution.
4. The generated solution on google colab CPU without multiprocessing in 60 seconds.
5. The solution is not complete if you generate a code which has transfer function specified as area*distance.
6. The solution should be global minimal or close to it

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Expected pictorial solution:

Approximate answer
Expected dimension around 80x80
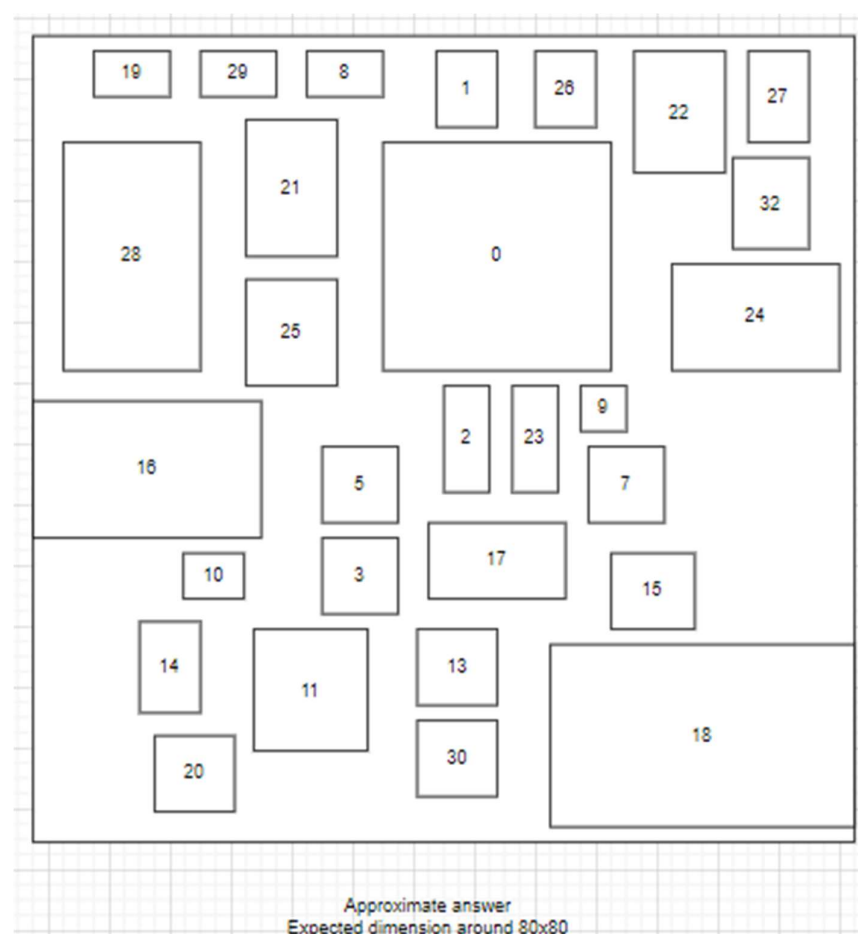
Data given:

How is the data shared for solving this problem:

1. GeoDataFrame is given in form of excel file having following items:
   a. Group ID
   b. Group X, Y, Width and Height
   c. Shapely MultiPolygon shape.
   d. Wire names which need to have minimal distance.
   e. Other net names which are present in the database.
2. Group contraints will be shared as lists or dictionaries in pickle file
   a. Critical wire distance: [[Net, Max distance between blocks]]
   b. Nodes with edge : [[Node number] ,['Left', 'right', 'top','bottom']]
   c. Place_restrict : [[Node number] , ['top','bottom','bot']]

Existing code:

Existing GA solution is present which generates above output which is needs more optimisation.
Code is written which uses shapely object to place them together.

Final Positions & Dist 1338.124779091879