# The Algorithms For Solving Task Of (r, p)-centroid On The Plane In L1-metric.

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## Problem

It's a Stackelberg facility location game on Euclidian plane. Two players, called a leader and a follower, open facilities to service clients.

- Leader 'p' facilities
- Follower '**r**' facilities

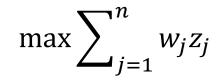
Each client chooses the closest facility. **Goal:** maximize own market share.

### **ILP Formulation**

 $y_k = \begin{cases} 1 & \text{follower opens facility inside } k \\ 0 & \text{otherwise.} \end{cases}$ 

$$z_j = \begin{cases} 1 & \text{follower captures client } j. \\ 0 & \text{otherwise.} \end{cases}$$

Follower problem:



Subject to:  $z_j \leq \sum_{k=1}^{n^2+n} a_{kj} y_j, j = 1, ..., n, \qquad \sum_{k=1}^{n^2+n} y_k = r, y_k, z_j \in \{0, 1\}$ 

## **Current solution**

We have the solution – a local search heuristic:

- 1. Leader places his facilities;
- 2. Follower replies;
- 3. Solve follower's problem **n** times for leader and follower;
- 4. Try to improve solution with local search.

## What we do not like

- 1. Circles are hard to compute and operate with;
- 2. Finding all the intersections is also not nice problem to solve (NP-hard).

3. Calculus and non-linear constraints

# Our feelings

- 1. Helly's **Theorem** can be improved in case of R2 and squares
- 2. Clusterization can be done more efficiently with graph representation
- 3. Solving problem in L1-metric can make everyone a little happier
- 4. We can improve max. estimate number of clusters  $n^2 + n$

# What I'm doing

Developing an algorithm which can improve alternating heuristic of (r|p)-centroid problem on a plane and proving or disproving our guesses about the possible solution.

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