A Basic Variable Neighborhood Search for the planar Obnoxious Facility Location Problem

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- Algorithm Proposal
- Results
- Future Work and Conclusions

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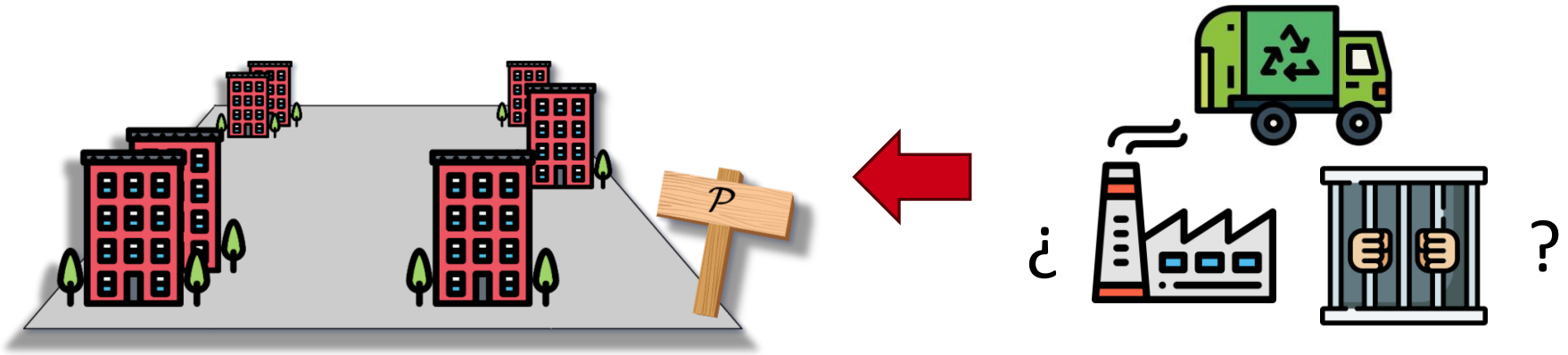
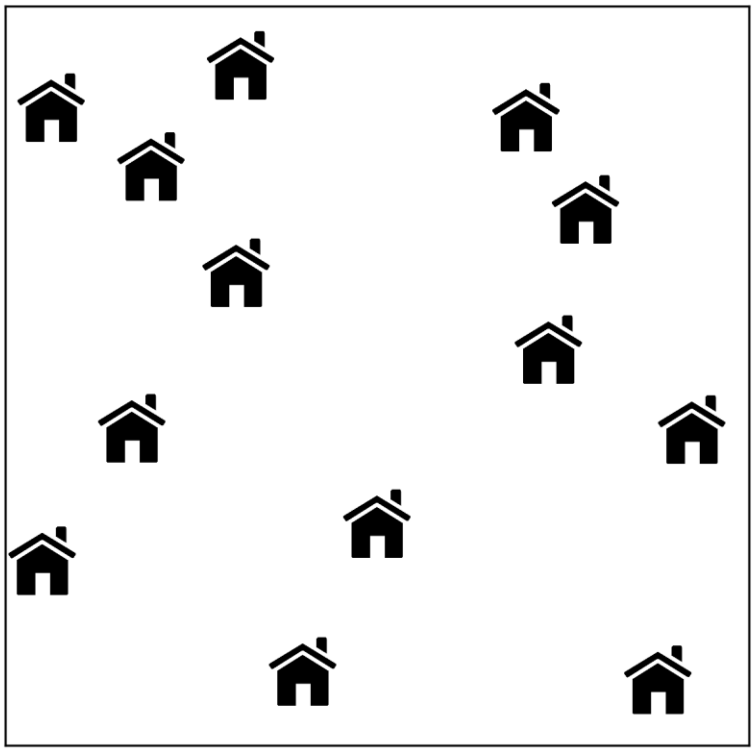
The MOFL problem

- The **M**ultiple **O**bnoxious **F**acility **L**ocation Problem



The MOFL problem

$Sites: X = \{x_1, \ldots, x_n\}$



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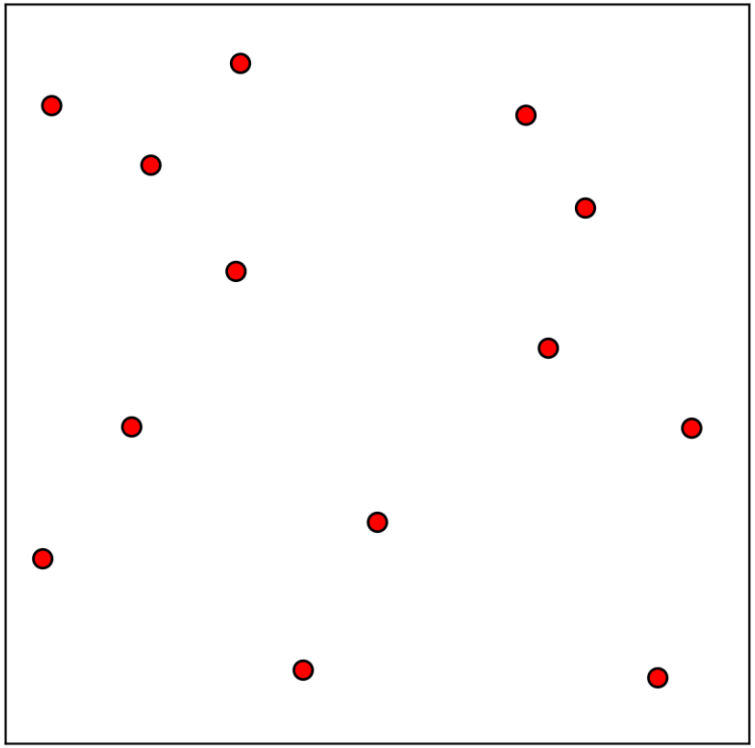
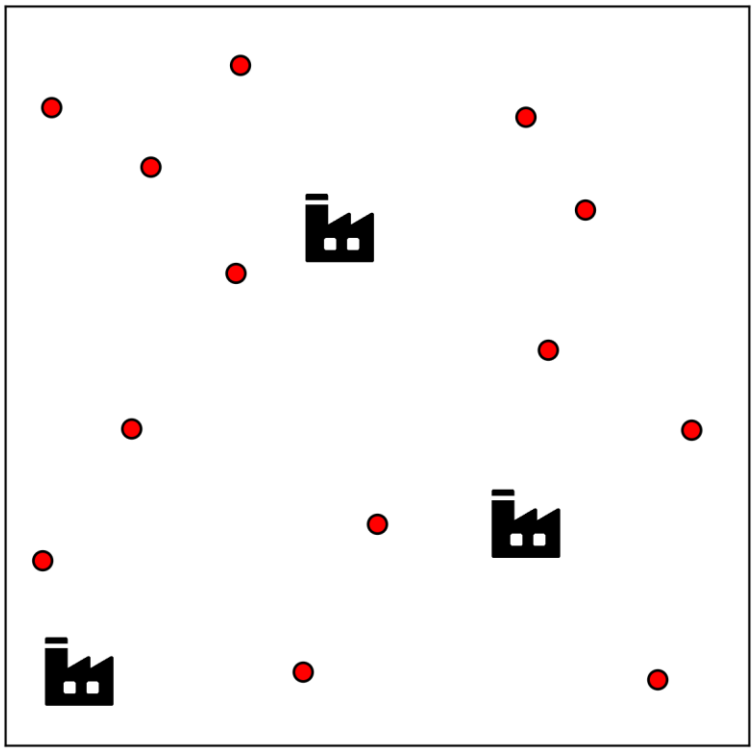


The MOFL problem

$Sites: X = \{x_1, \dots, x_n\}$
$Facilities: S = \{a_1, \dots, a_p\}$



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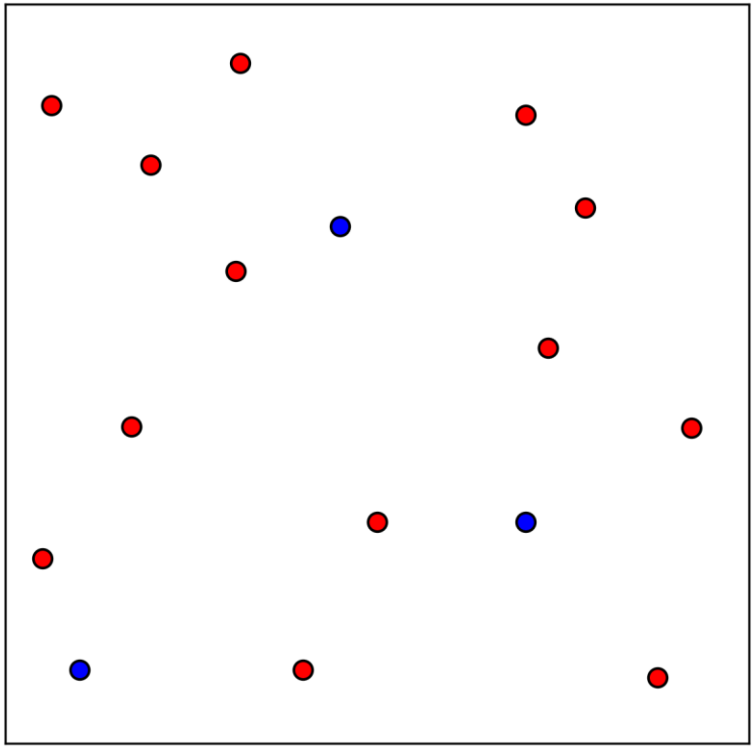

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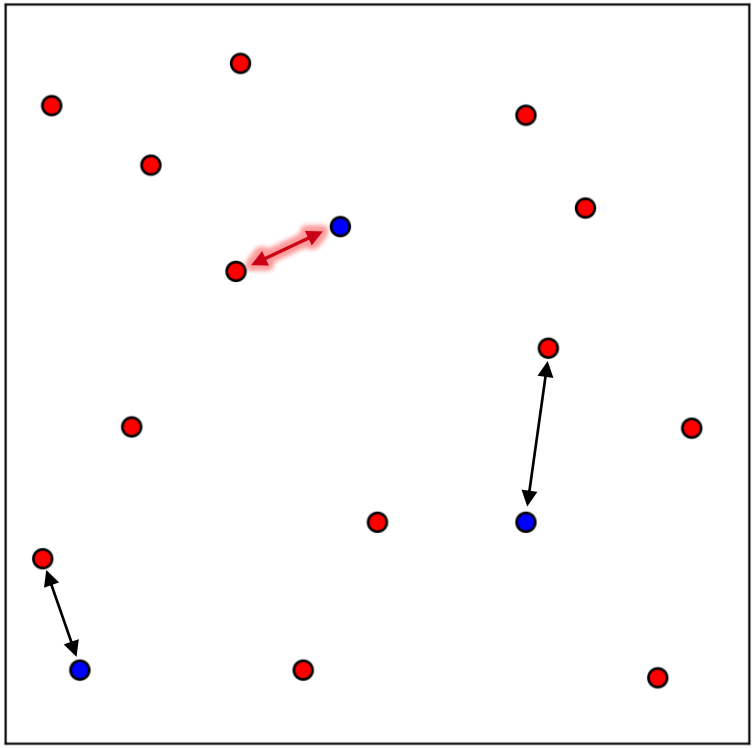
$$\max \mathcal{F}(S) = \min_{\substack{a_i \in S \\ x_i \in X}} d(a_i, x_j)$$



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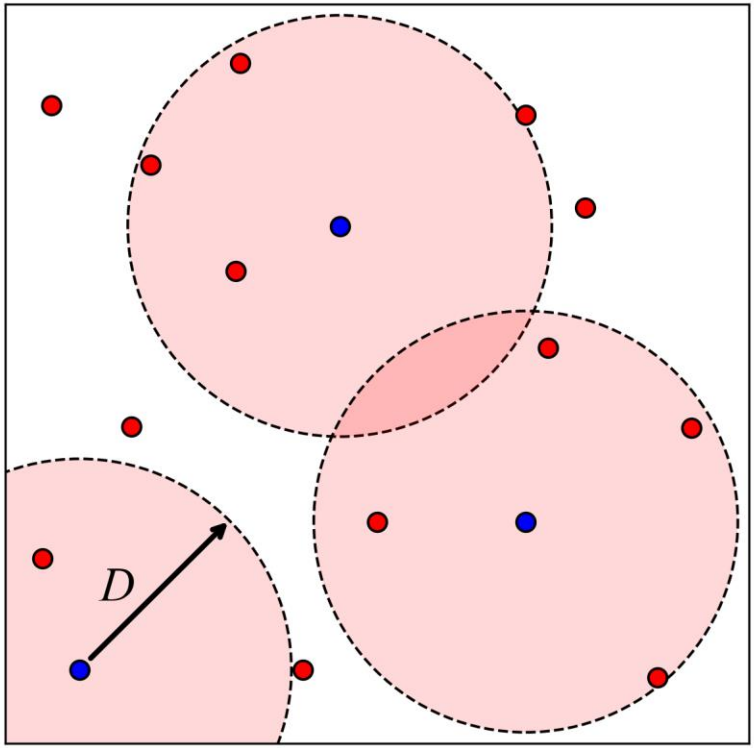
$$d(a_i, a_j) \geq D \; \forall \; i \neq j$$



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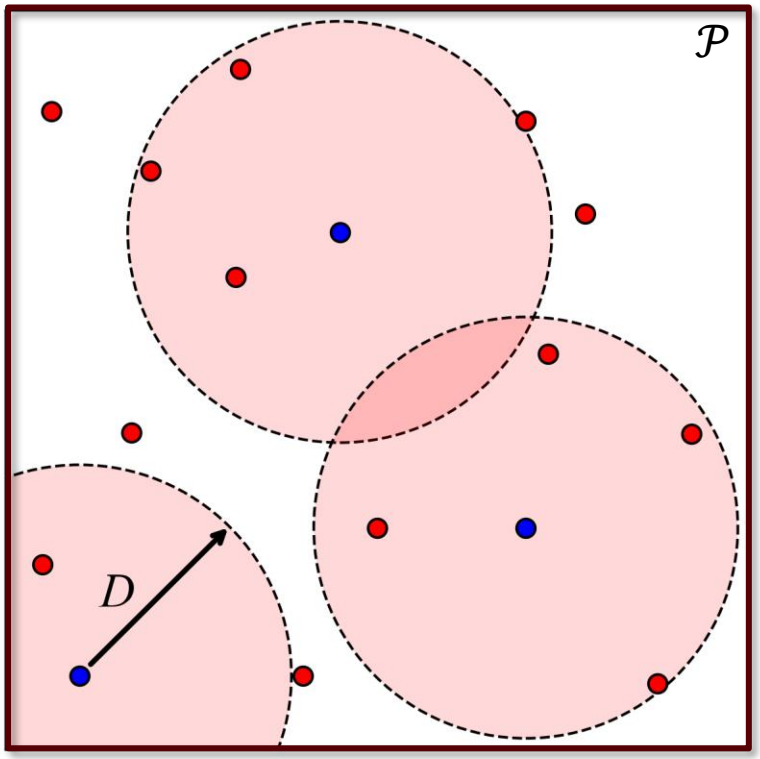
$d(a_i, a_j) \geq D \; \forall \; i \neq j$
$a_i \in \mathcal{P}$

$\mathcal{P} = [0,1] \times [0,1]$



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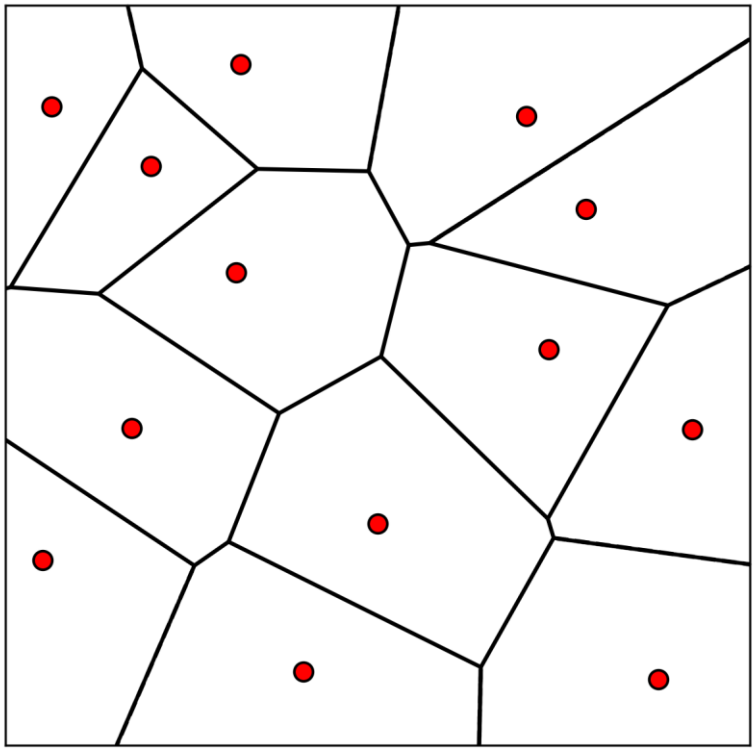
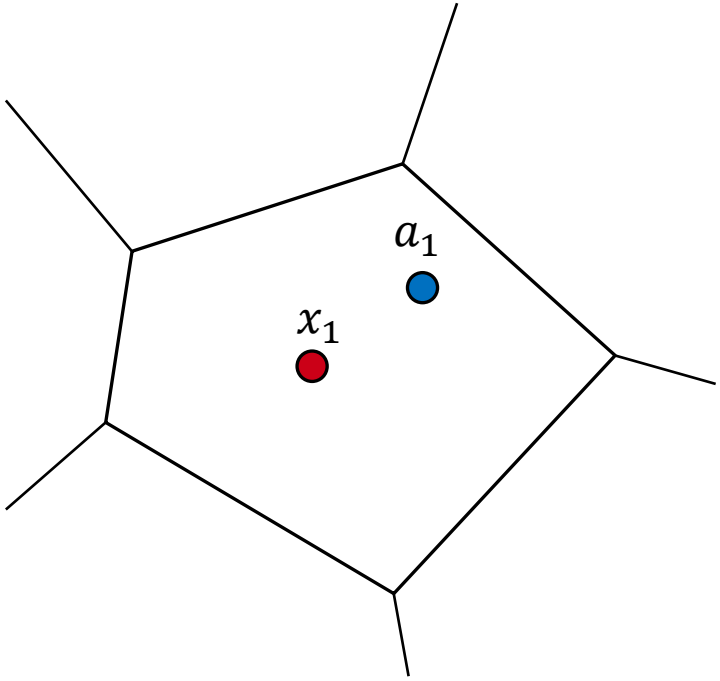
Algorithm Proposal – Voronoi Discretization

$$Voronoi(X)$$





$$\min_{x_i \in X} d(a_1, x_i) = d(a_1, x_1)$$

Algorithm Proposal – Voronoi Discretization

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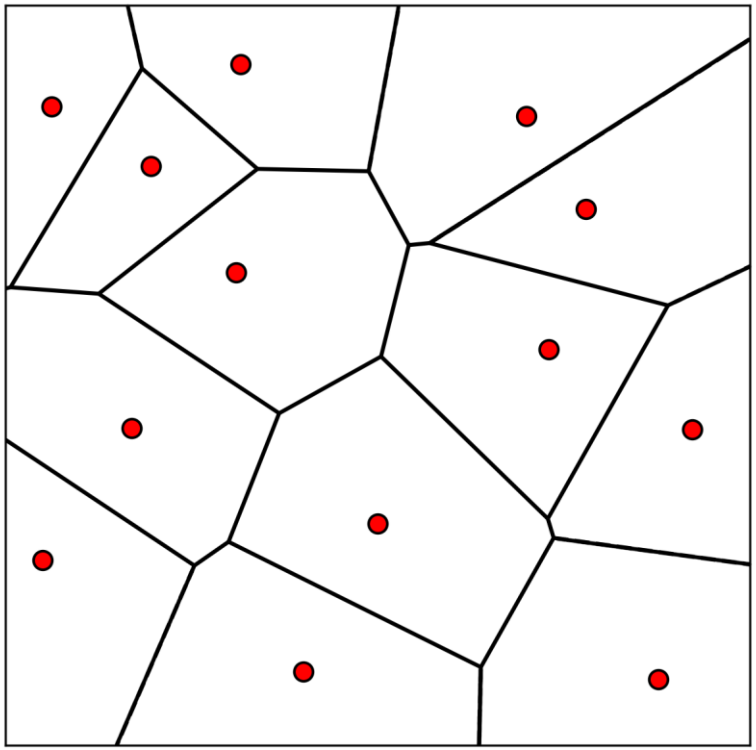
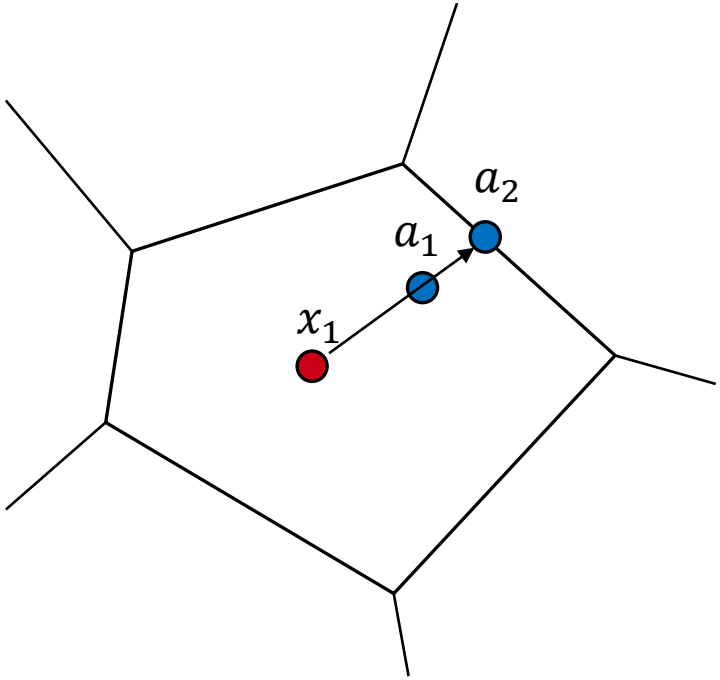


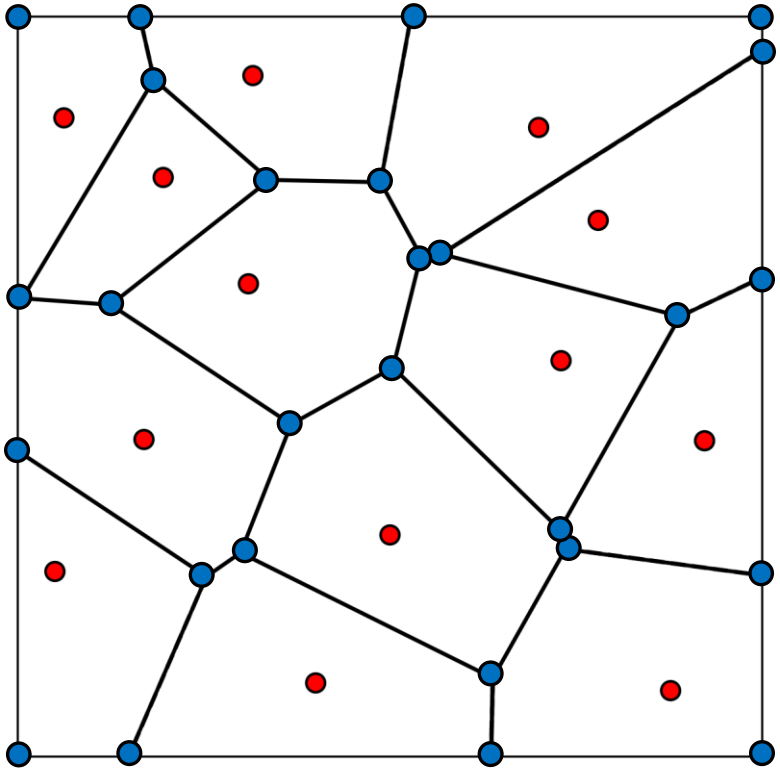


$$\min_{x_i \in X} d(a_1, x_i) = d(a_1, x_1)$$

$$d(a_1, x_1) < d(a_2, x_1)$$

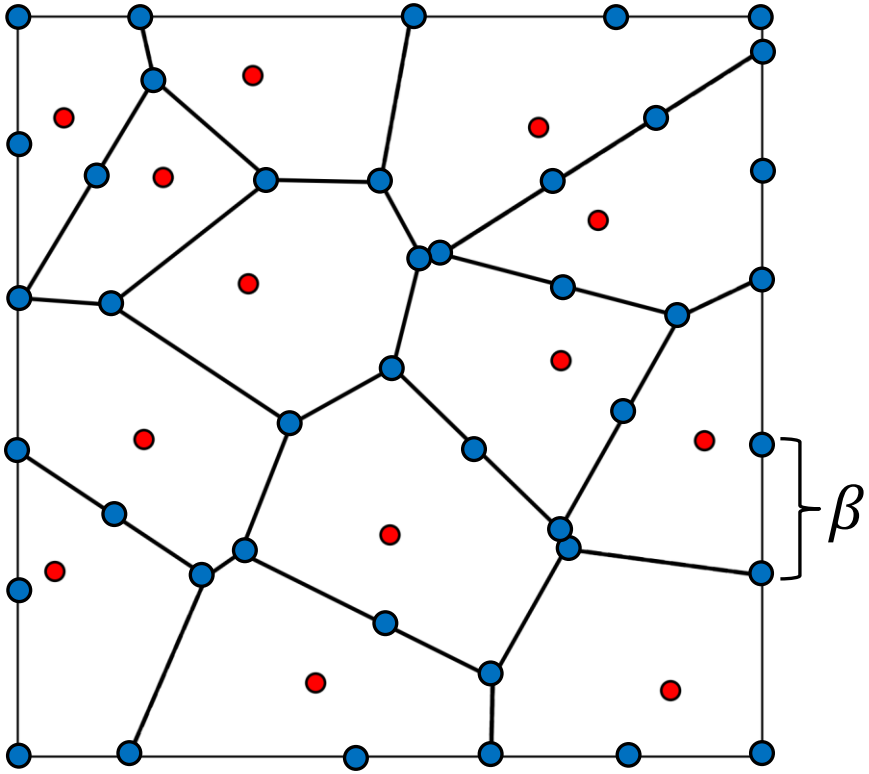
Algorithm Proposal – Instance Discretization

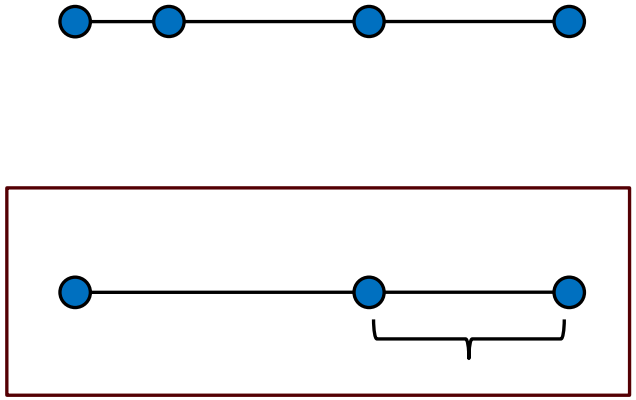
$$I_D = Voronoi(X)$$



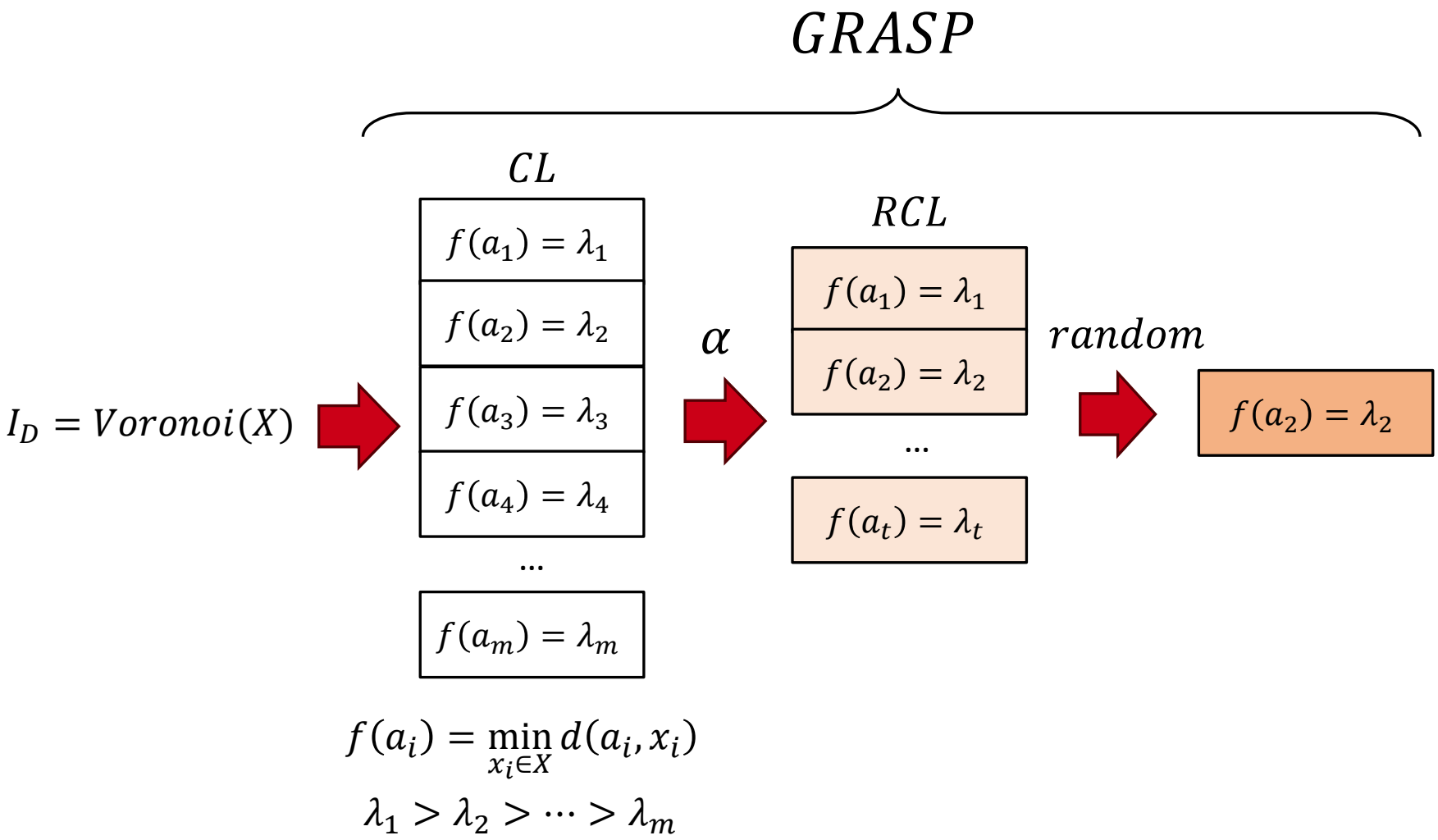
Algorithm Proposal – Instance Discretization

$$I_D = Voronoi(X)$$





Algorithm Proposal – Build initial solutions (GRASP)



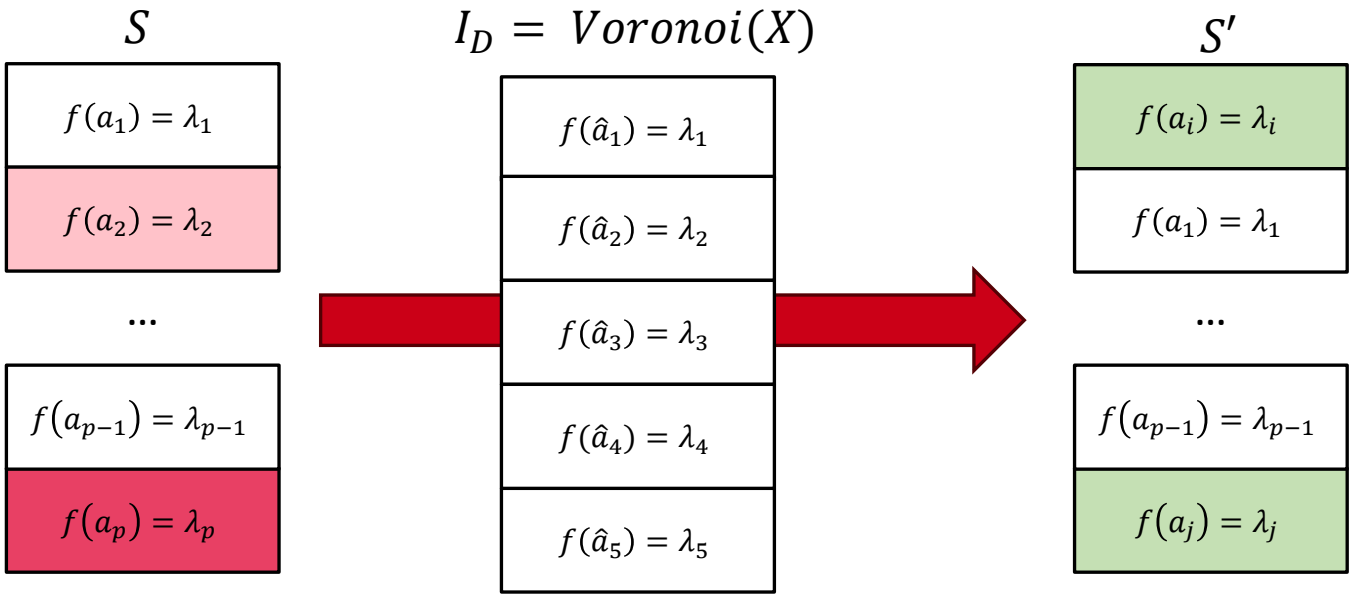
Algorithm Proposal – Improve solutions (BVNS)

Algorithm 1: $BVNS(S_0, I_D, k_{max})$

```
1:  k ← 1
2:  while k < k_max do
3:    S' ← Shake(I_D, k, S)
4:    improve ← true
5:    while improve do
6:      S'' ← LocalSearch(S', I_D)
7:      if F(S'') > F(S') then
8:        S' ← S''
9:      else
10:       improve ← false
11:     end if
12:   end while
13:   if F(S') ≥ F(S) then
14:     S ← S'
15:     k ← 1
16:   else
17:     k ← k + 1
18:   end if
19: end while
20: return S
```

Algorithm Proposal – Improve solutions (BVNS)

Shake

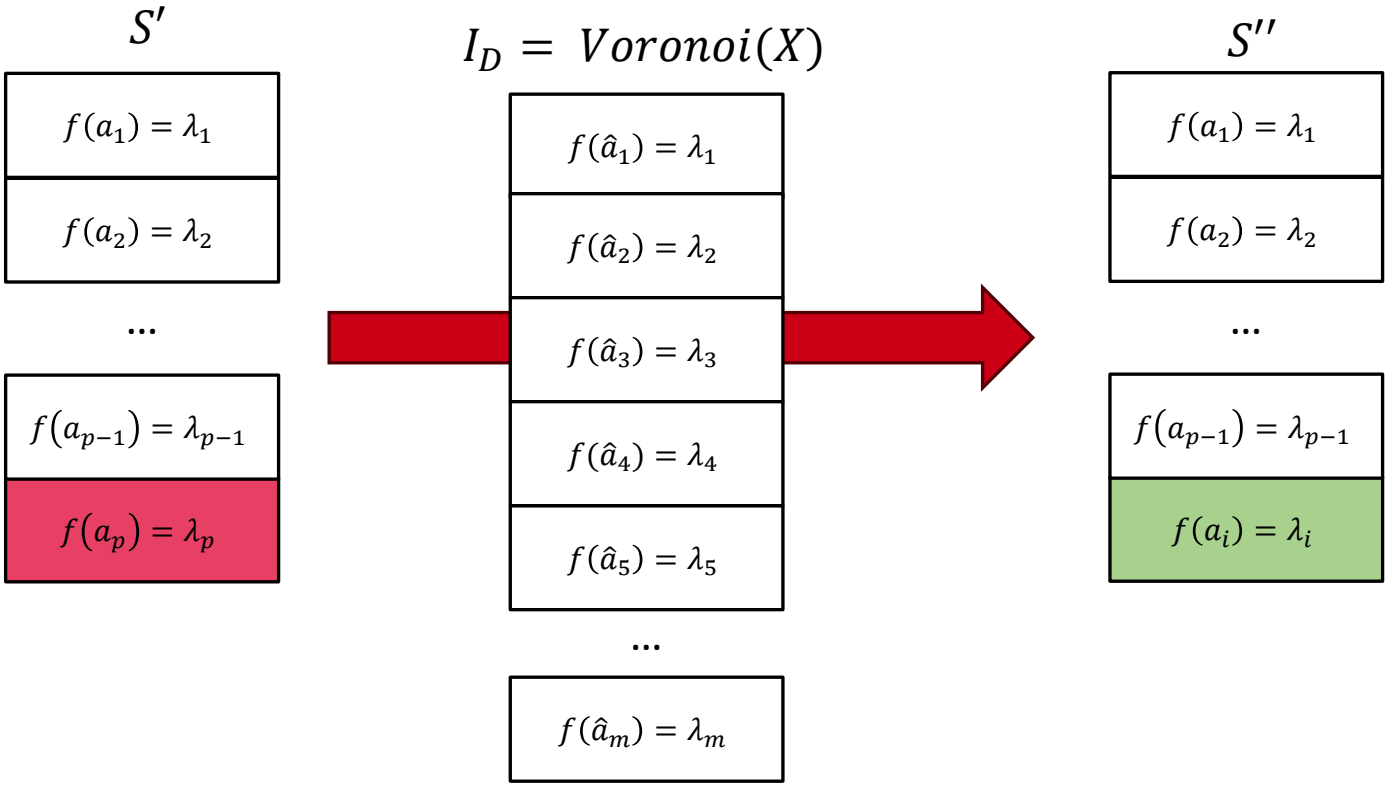


$$f(a_i) = \min_{x_i \in X} d(a_i, x_i)$$

$$\lambda_1 > \lambda_2 > \cdots > \lambda_m$$

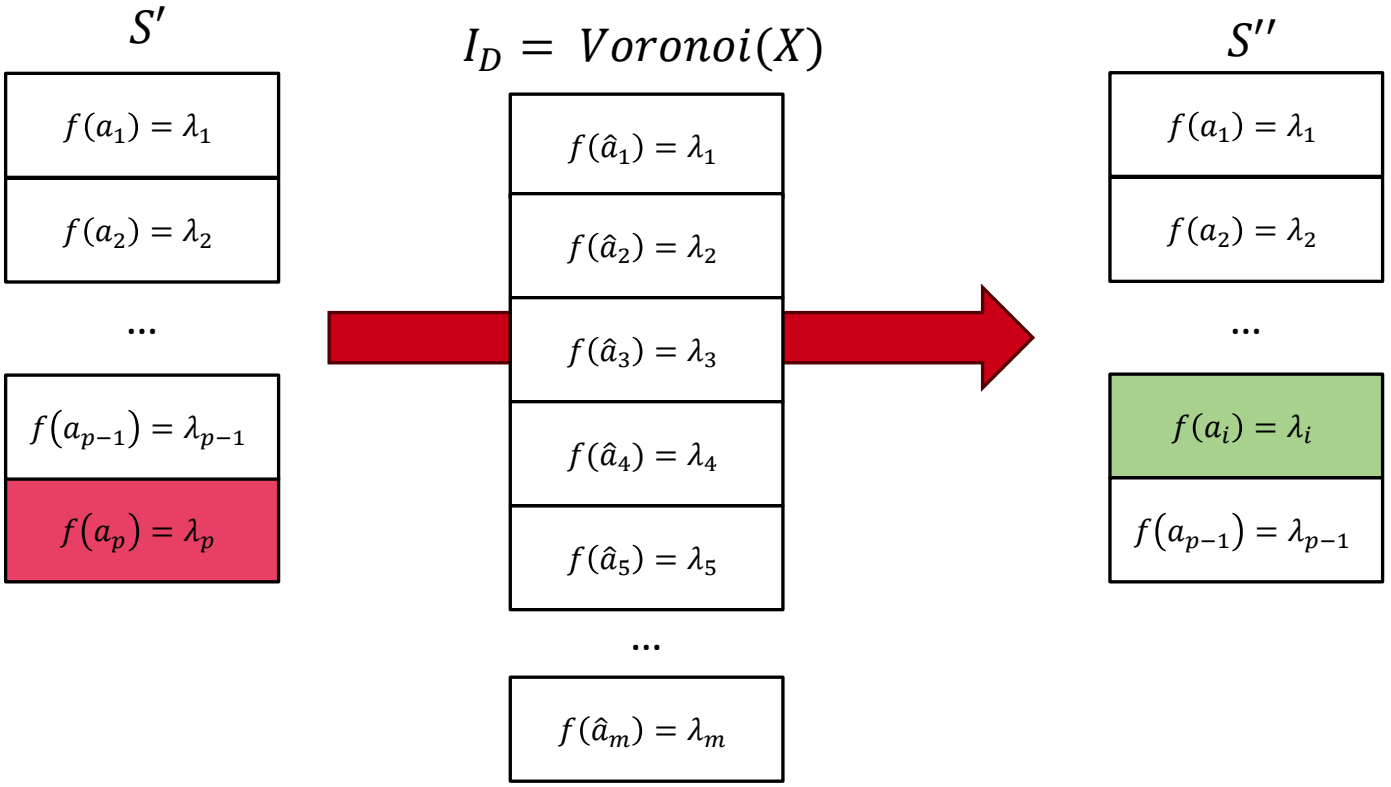
Algorithm Proposal – Improve solutions (BVNS)

Local Search – Swap



Algorithm Proposal – Improve solutions (BVNS)

Local Search – Swap



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Results – Parameter Selection

Parameters

Iterations	β	α	k_{max}
$n/10$	$n/10^4$	0.5	$p/2$

Final Values

Algorithm	F(S)	Dev.	Time (s)	#Best (76)*
BVNS	**0.074499**	**0.003812**	3.3614	**57**
Kalczynski 1	0.073589	0.013699	**0.0013**	46
Kalczynski 2	0.074262	0.006309	7.7189	53
Kalczynski 3	0.074355	0.005358	10.0993	56

*76 known instances from Kalczynski, P., & Drezner, Z. (2022). Extremely non-convex optimization problems: The case of the multiple obnoxious facilities location. *Optimization Letters*, 1-14.

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Future (and current) Work

- A competitive algorithm for the MOFLP is designed
  - Three times faster than the best state-of-art proposal
  - Better Values Obtained

And now?

- Different Local Search Strategies to take advantage of the continous space
- Study other variants of VNS

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