Visualization and Analysis of Geographic Information

Algorithms and Data Structures

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Motivation

- Reduce visual information when displaying large numbers of geographic points

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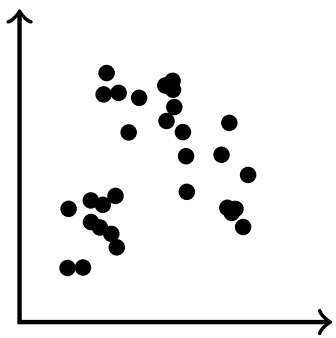
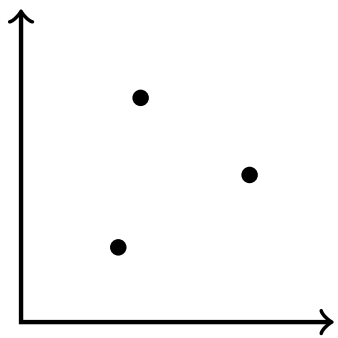
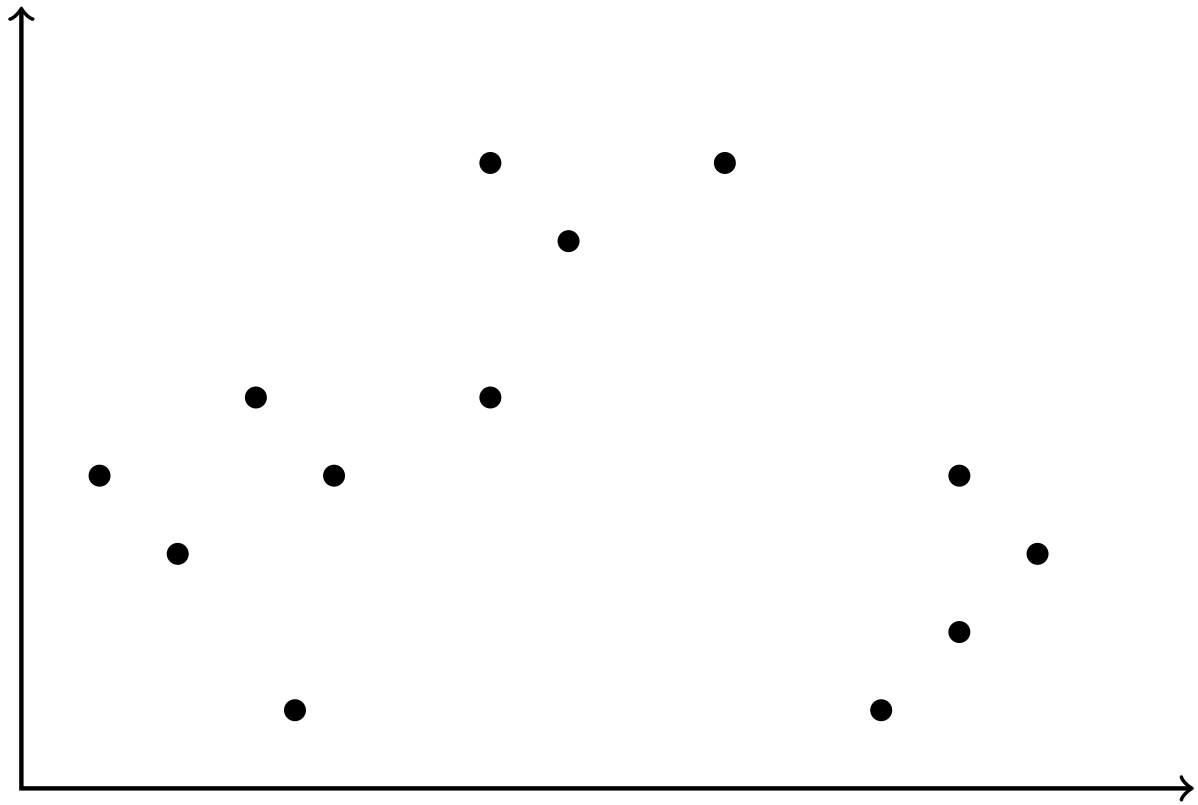


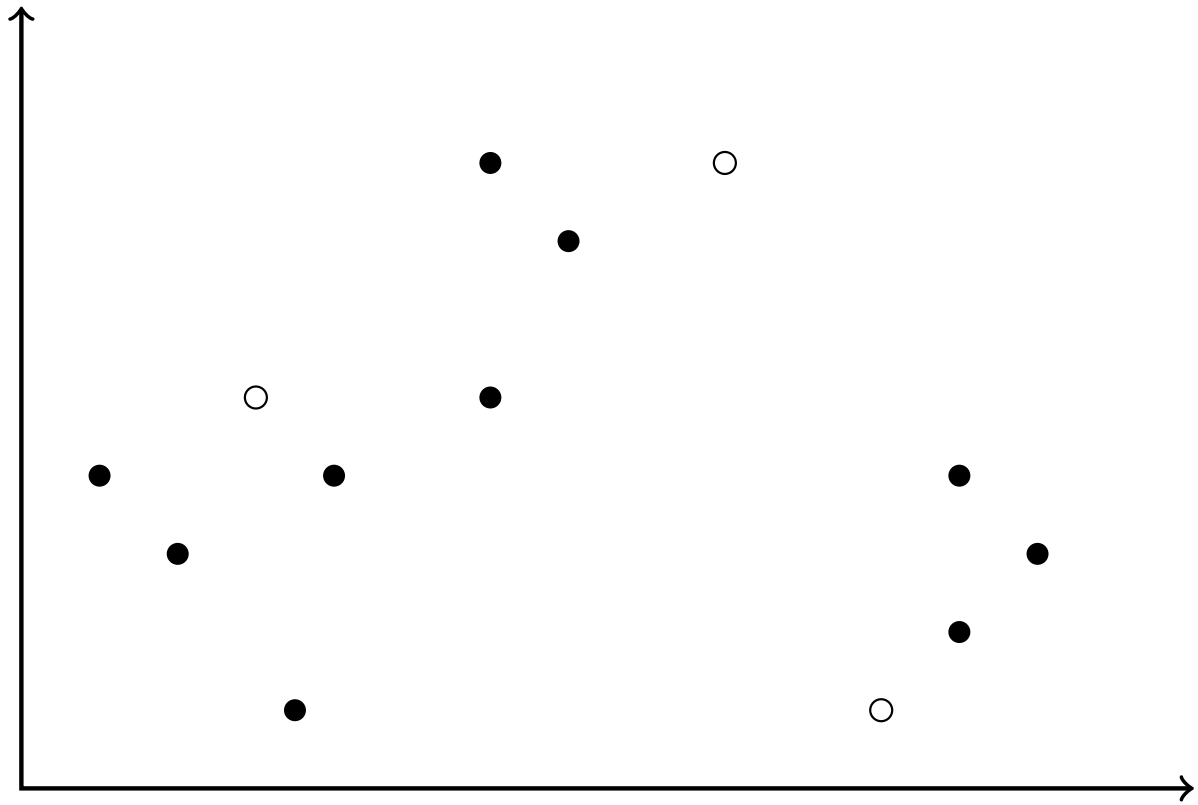


Problem



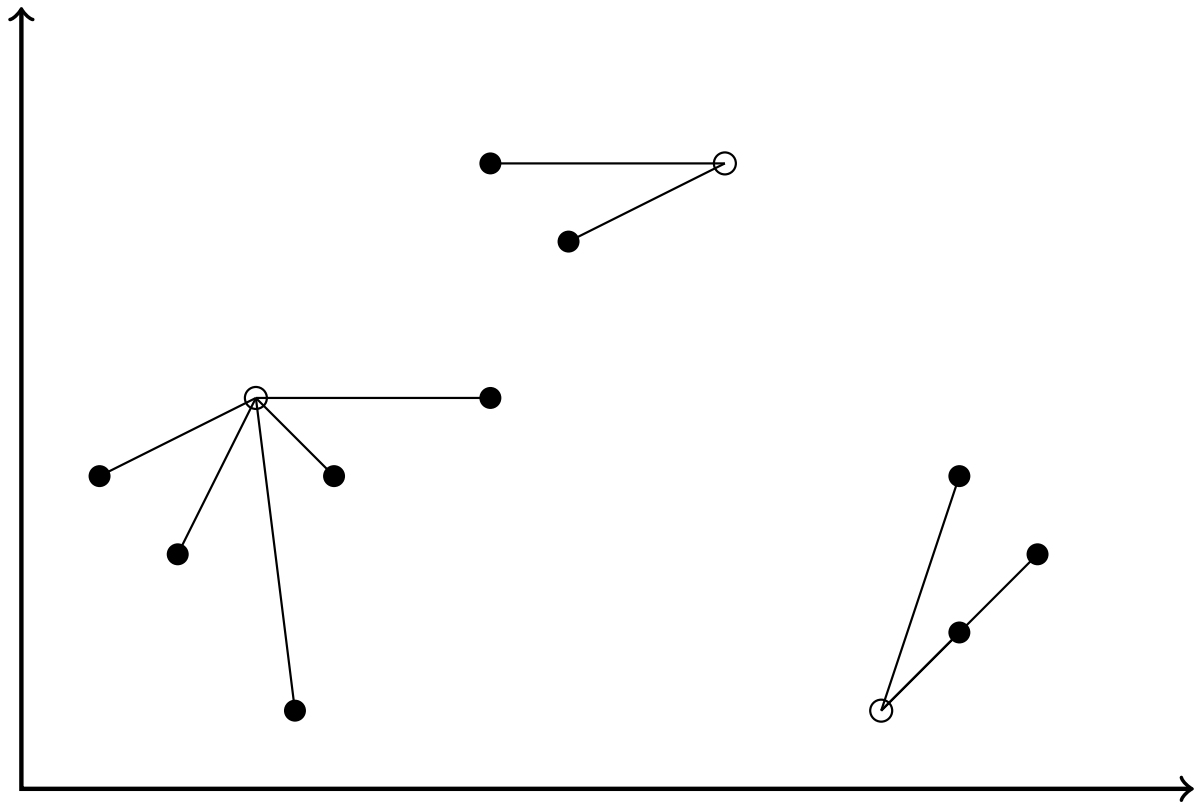
Given a set of points P and an integer $k \leq |P|$

Problem



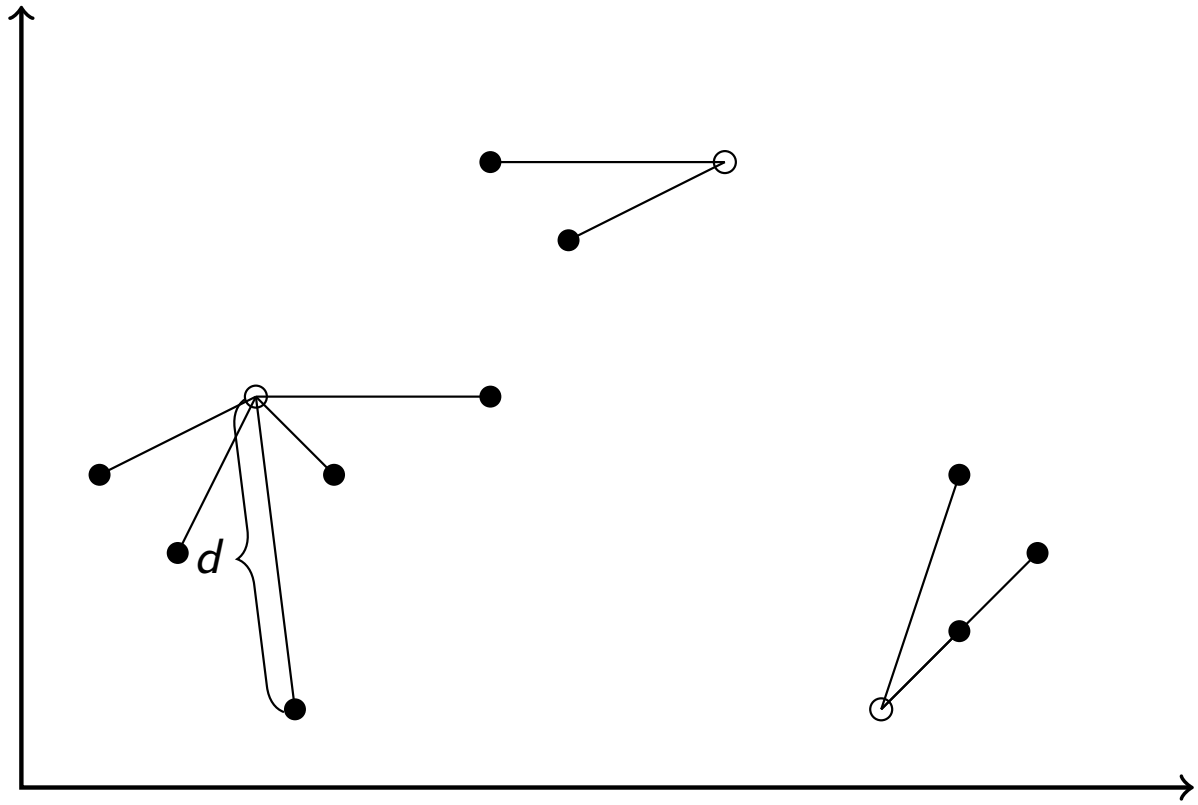
Find a subset of points $S \subseteq P, |P| = k$ that is "representative" of P

Problem



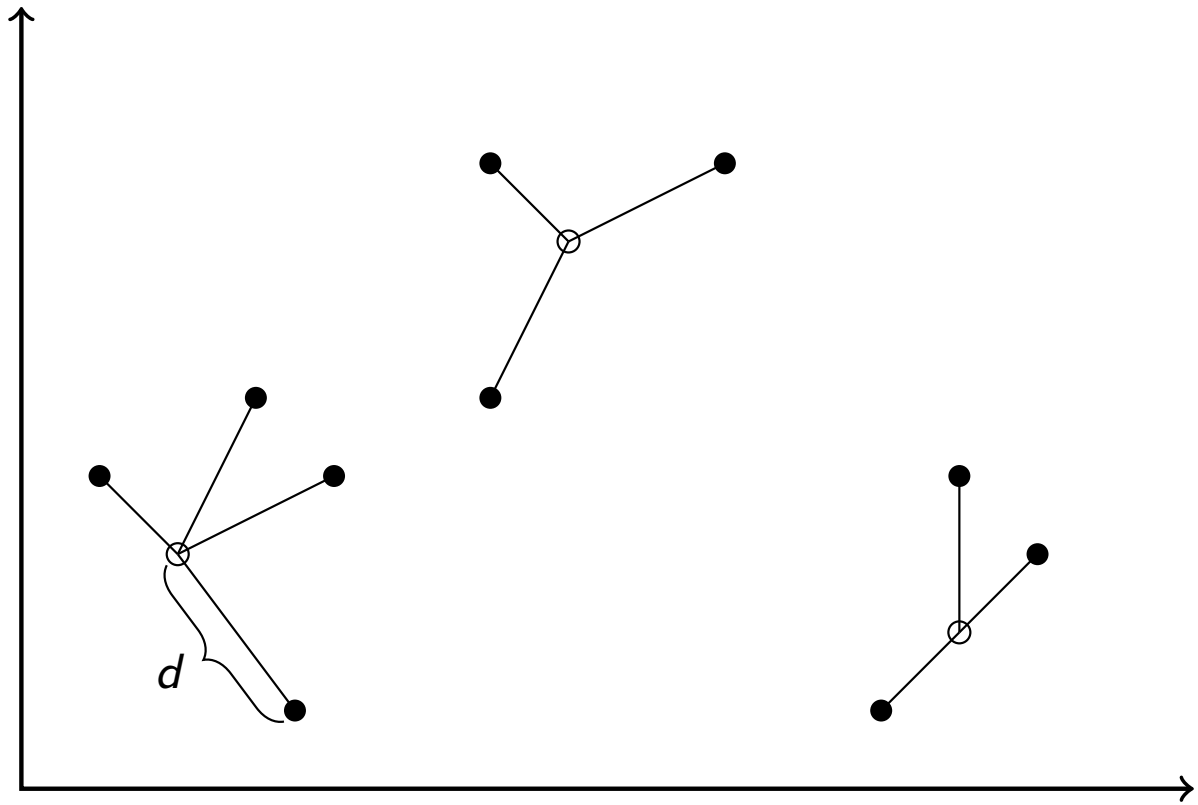
Consider the distance between every point in P S and its closest point in S

Problem



k-center problem: Find subset S that minimizes the largest distance

Problem



Optimal solution

Work Plan

- 1^{st} Semester
  - Literature Review: Geographic Information Systems, OGC Standards WMS, WFS, Map Projections, algorithms and heuristics for clustering and facility-location problems.
  - Development of a Branch-and-Bound approach.
- 2^{nd} Semester
  - Development of heuristic approaches.
  - Experimental analysis of the algorithms.
  - Comparison between different approaches using Open Street Map data.
  - Integration of the algorithms in the visualisation framework through web-mapping standards (WMS/WFS).

Deterministic Approach

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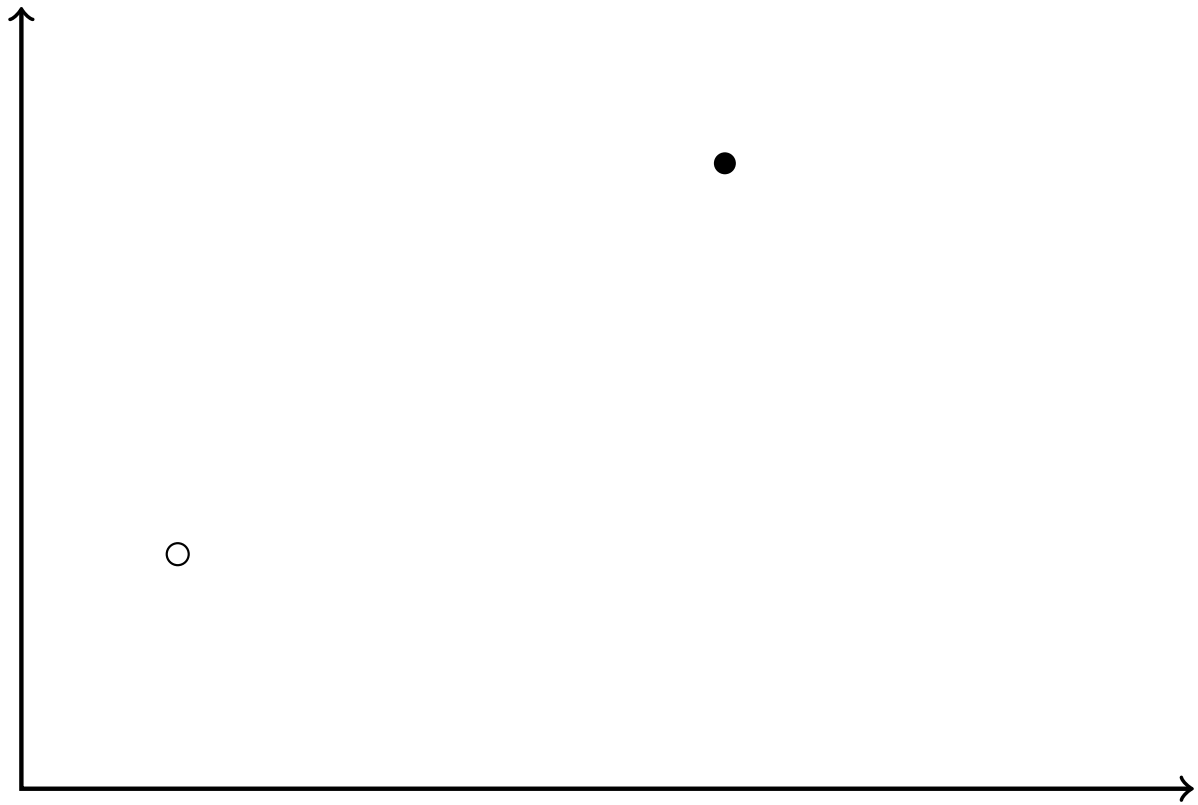
- Use bounds to discard branches that do not contribute to the optimal solution.

Deterministic Approach

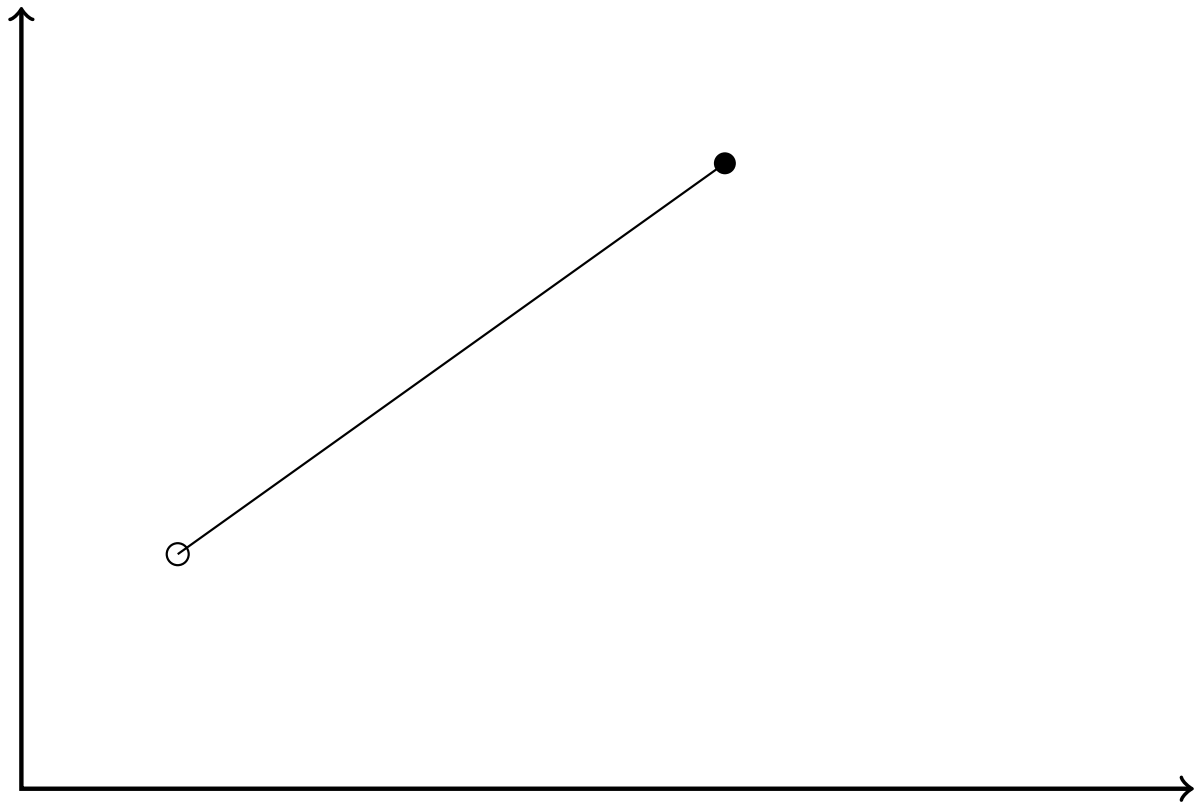
Building a solution.

Deterministic Approach



Adding non-centroid points.

Deterministic Approach



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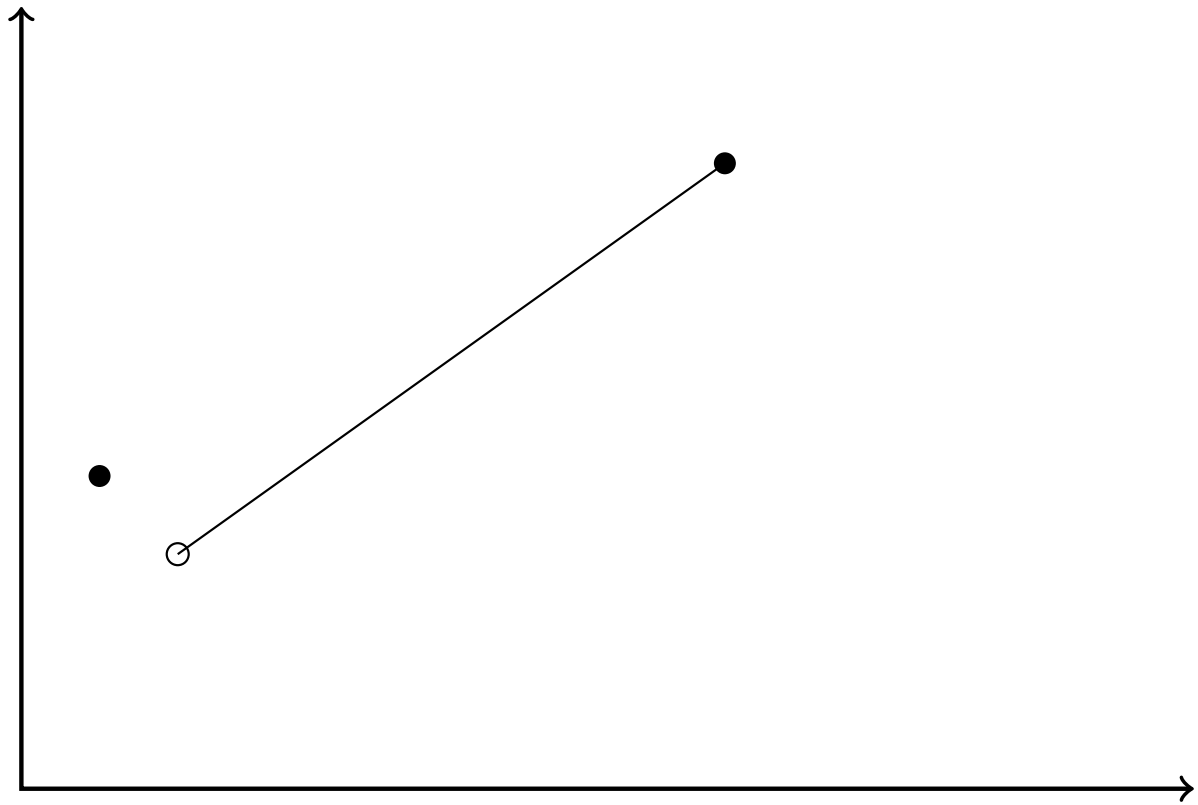

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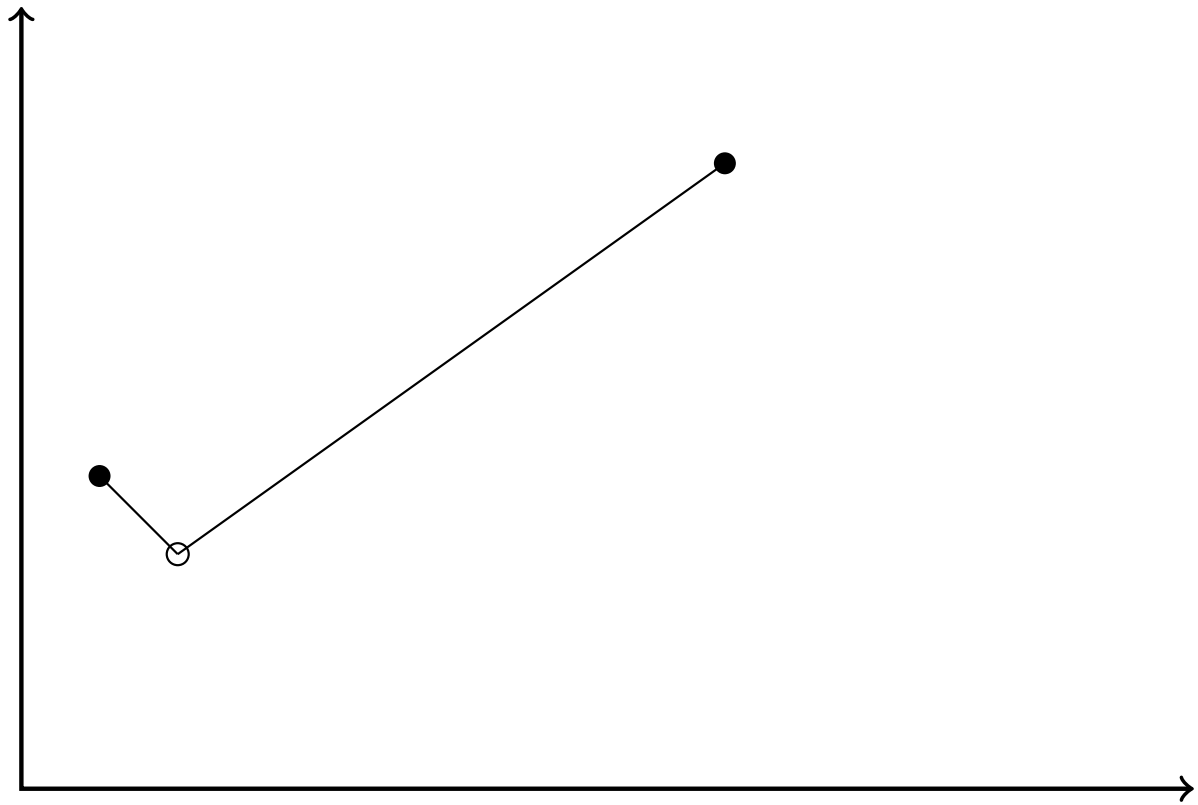

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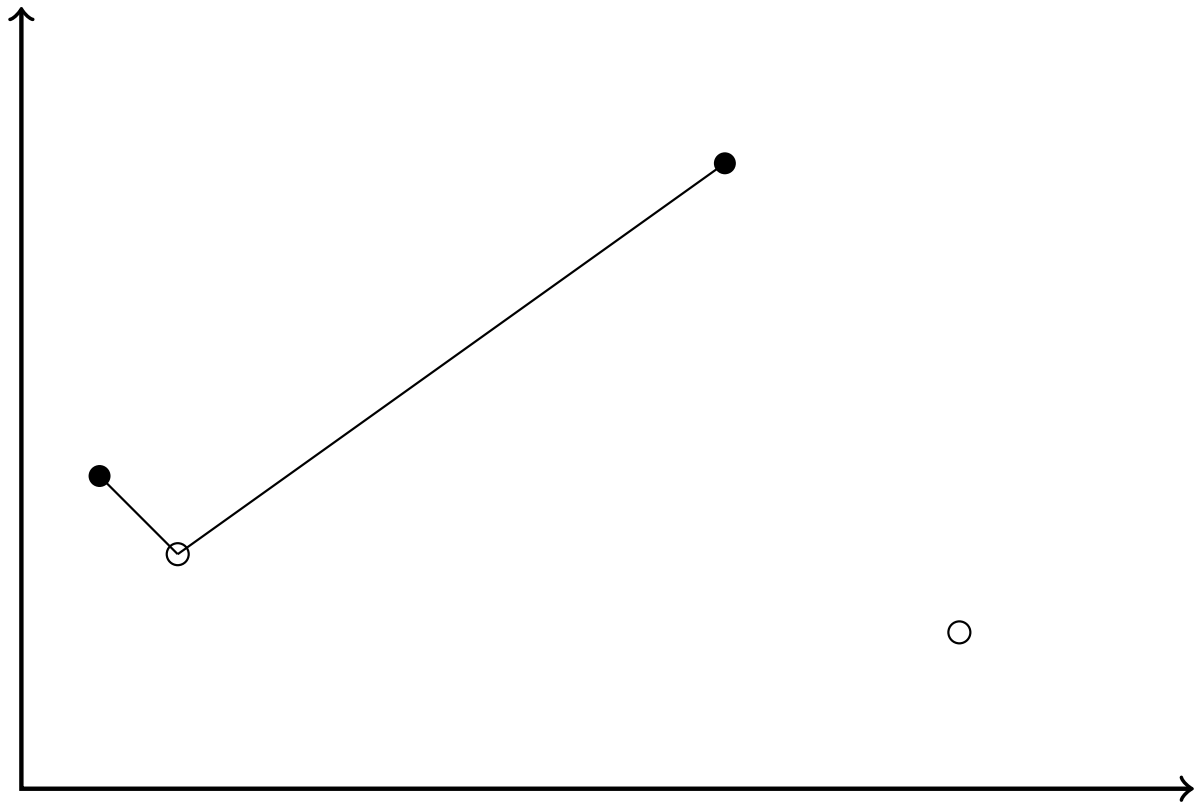

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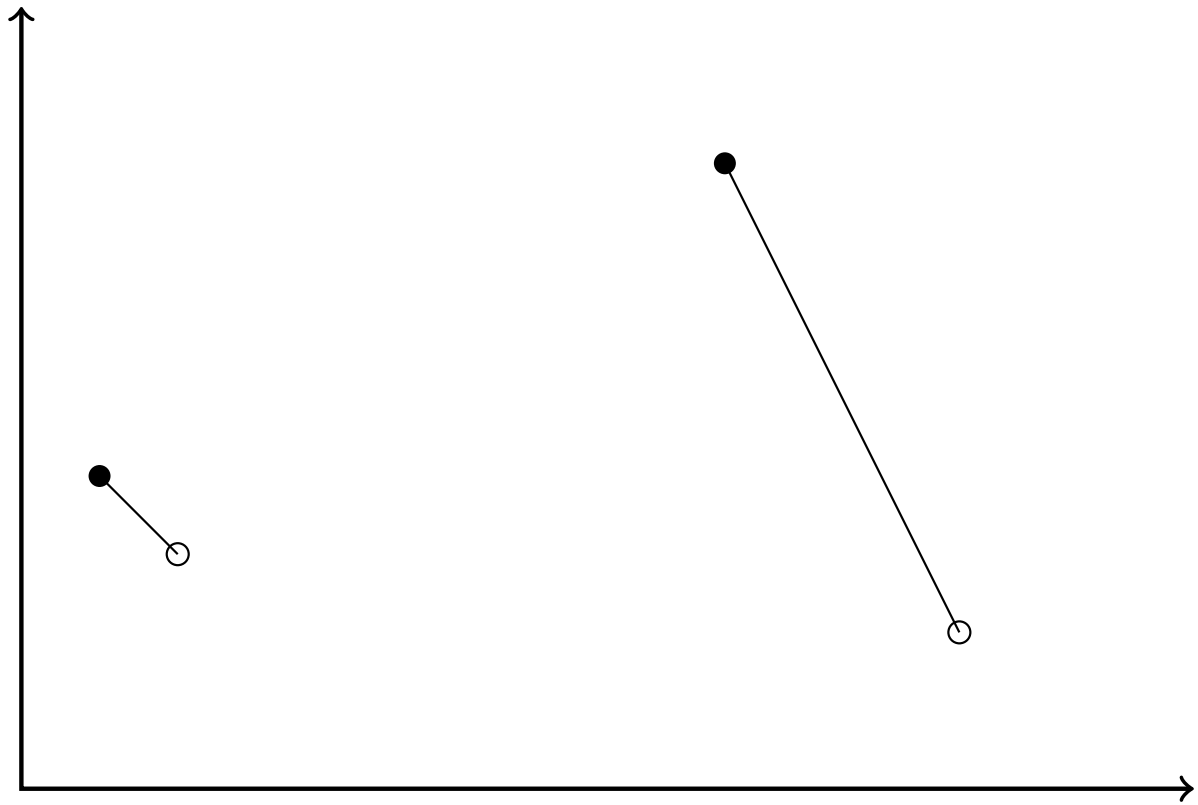

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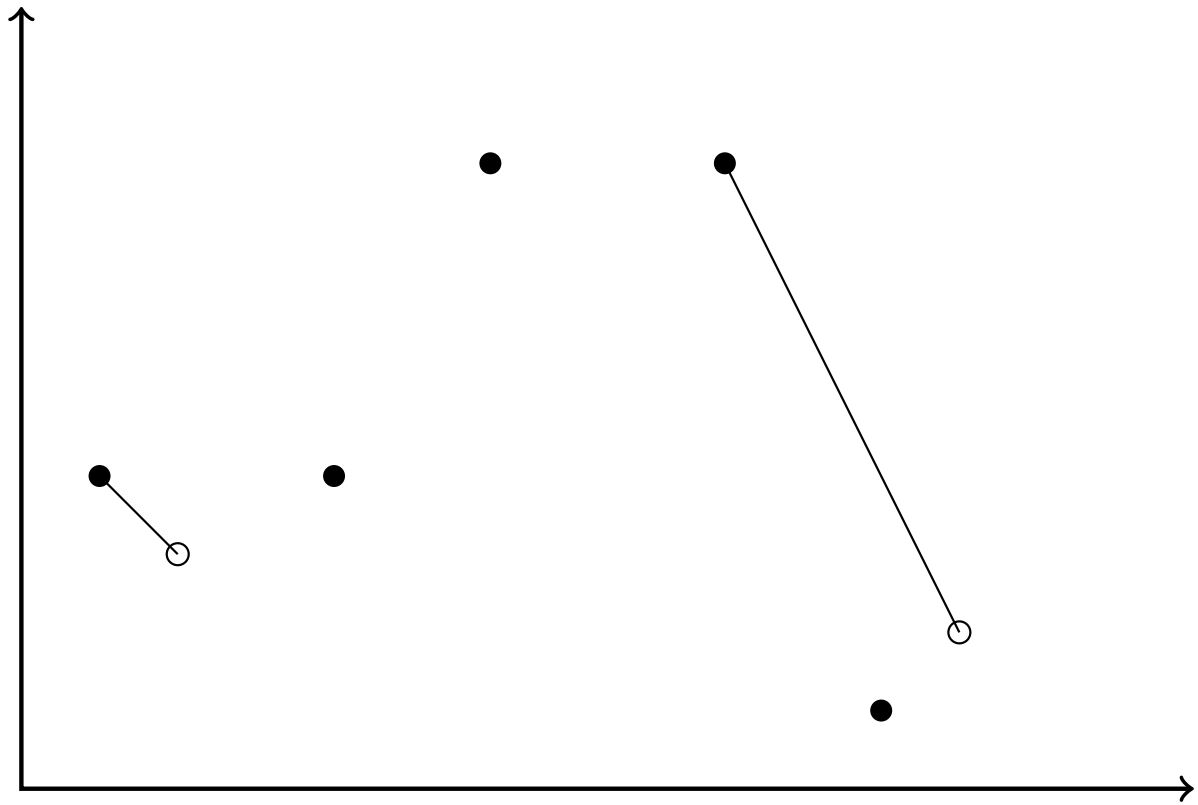
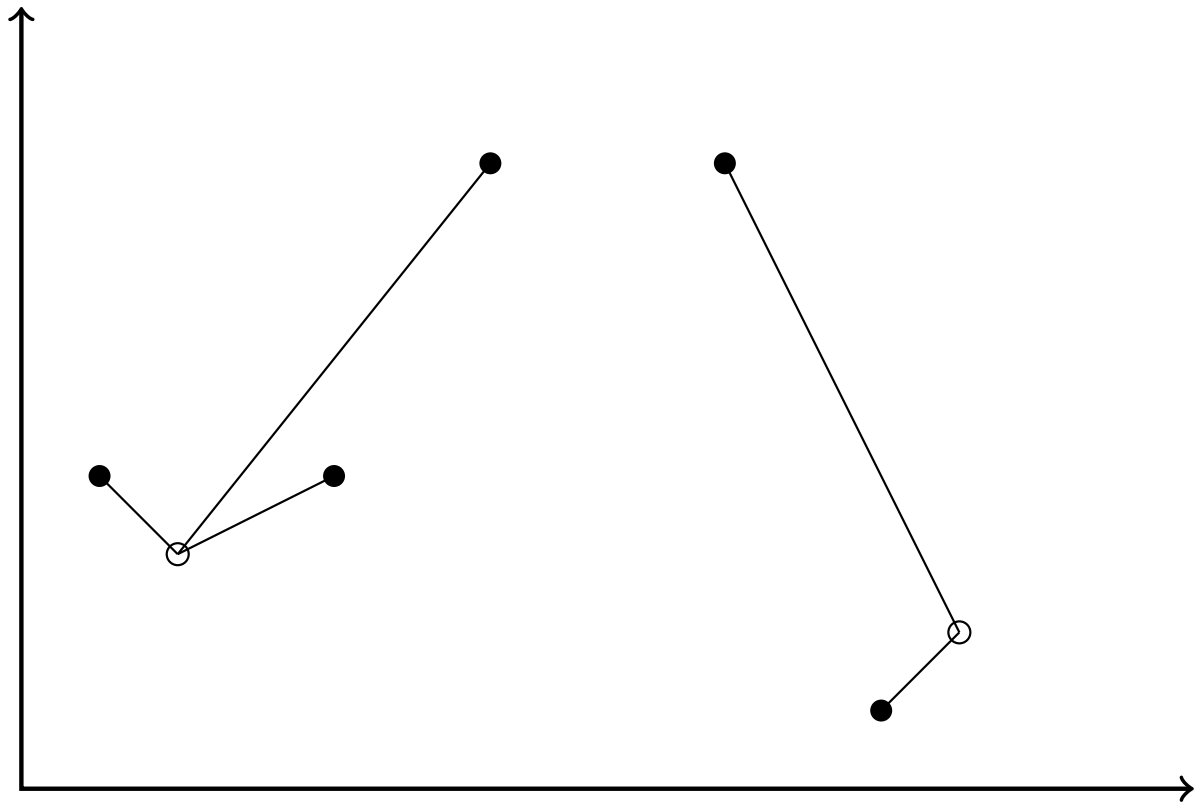


Adding more non-centroid points.

Deterministic Approach



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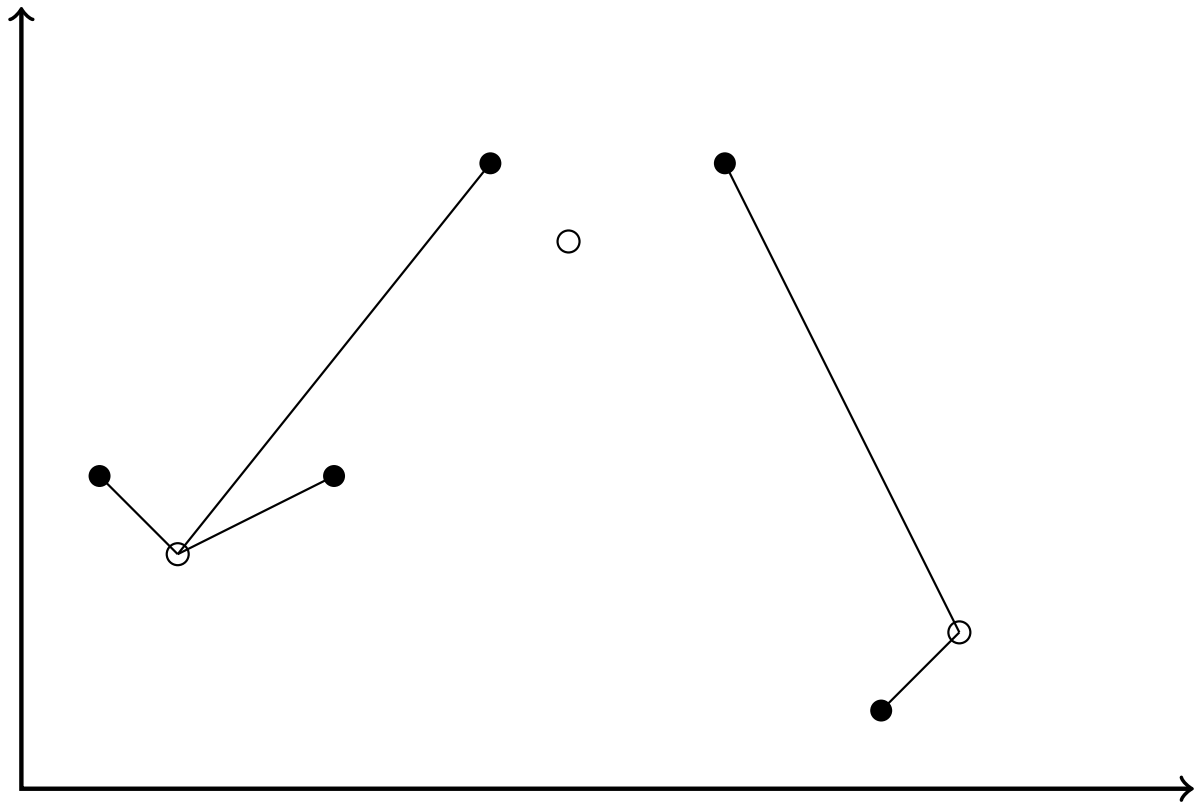

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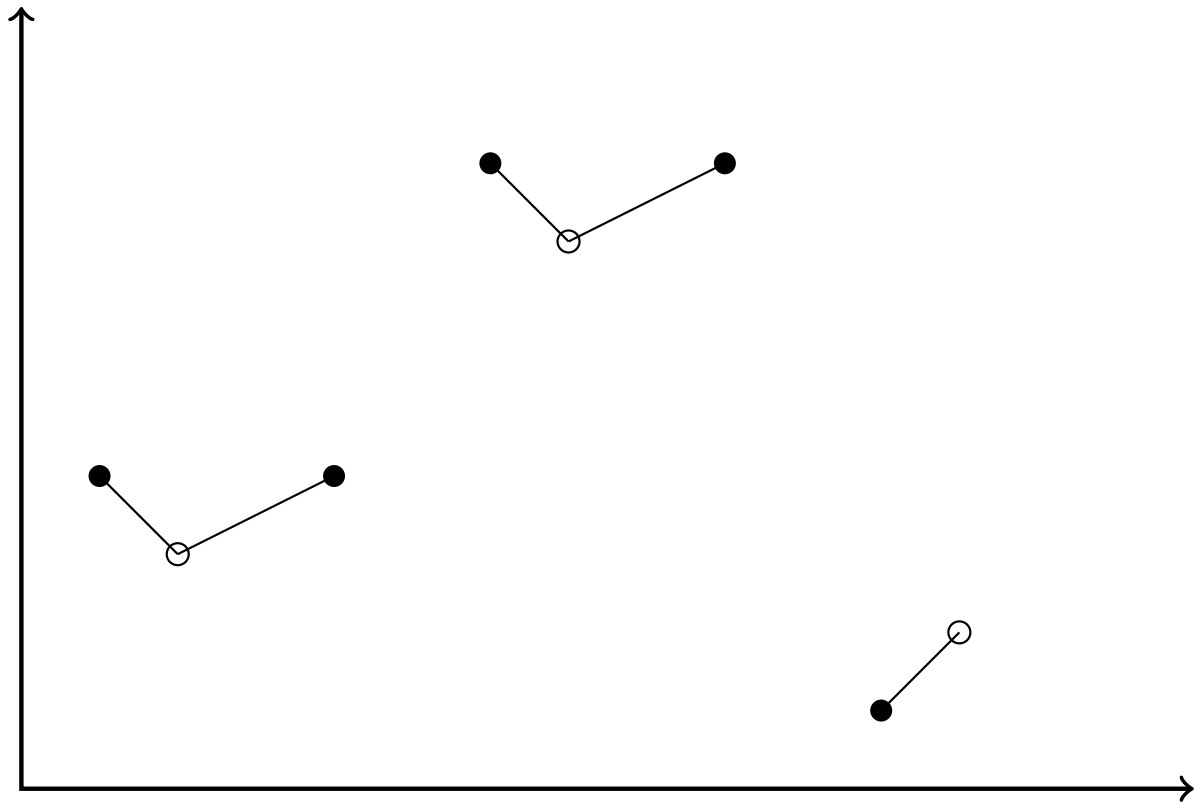

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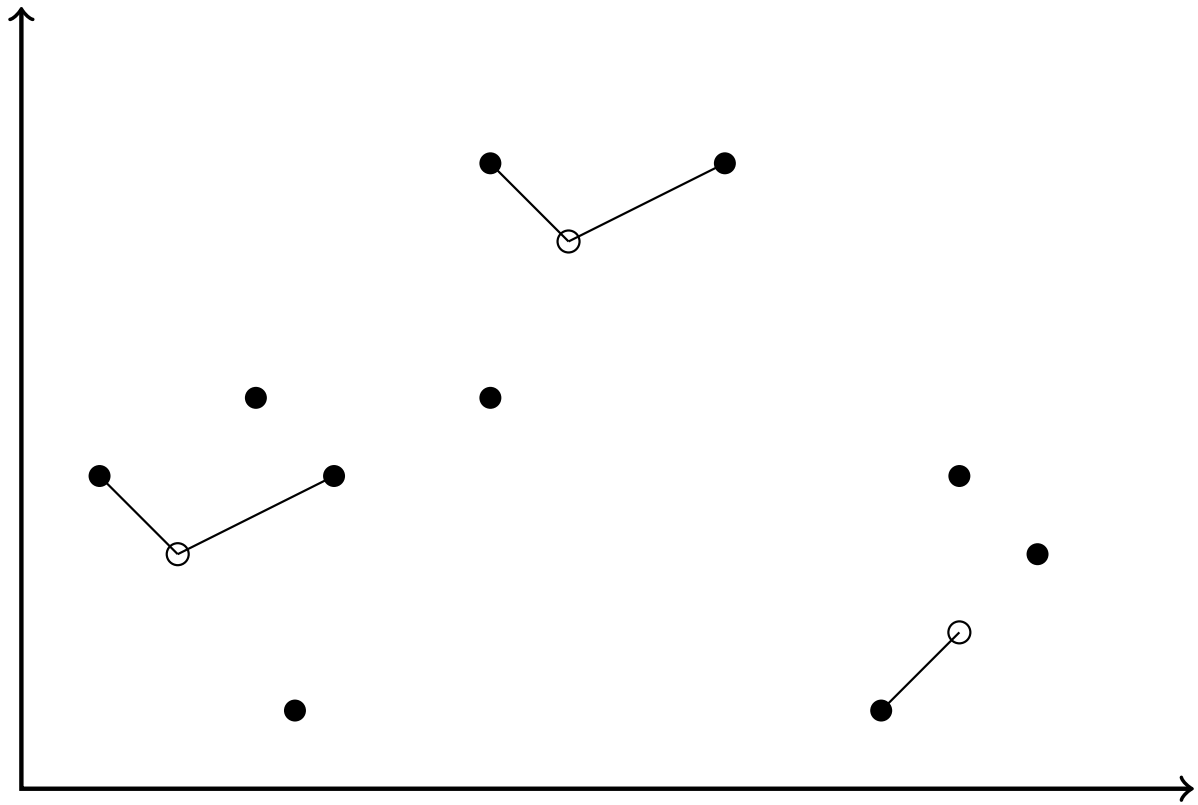

Finishing the solution branch.

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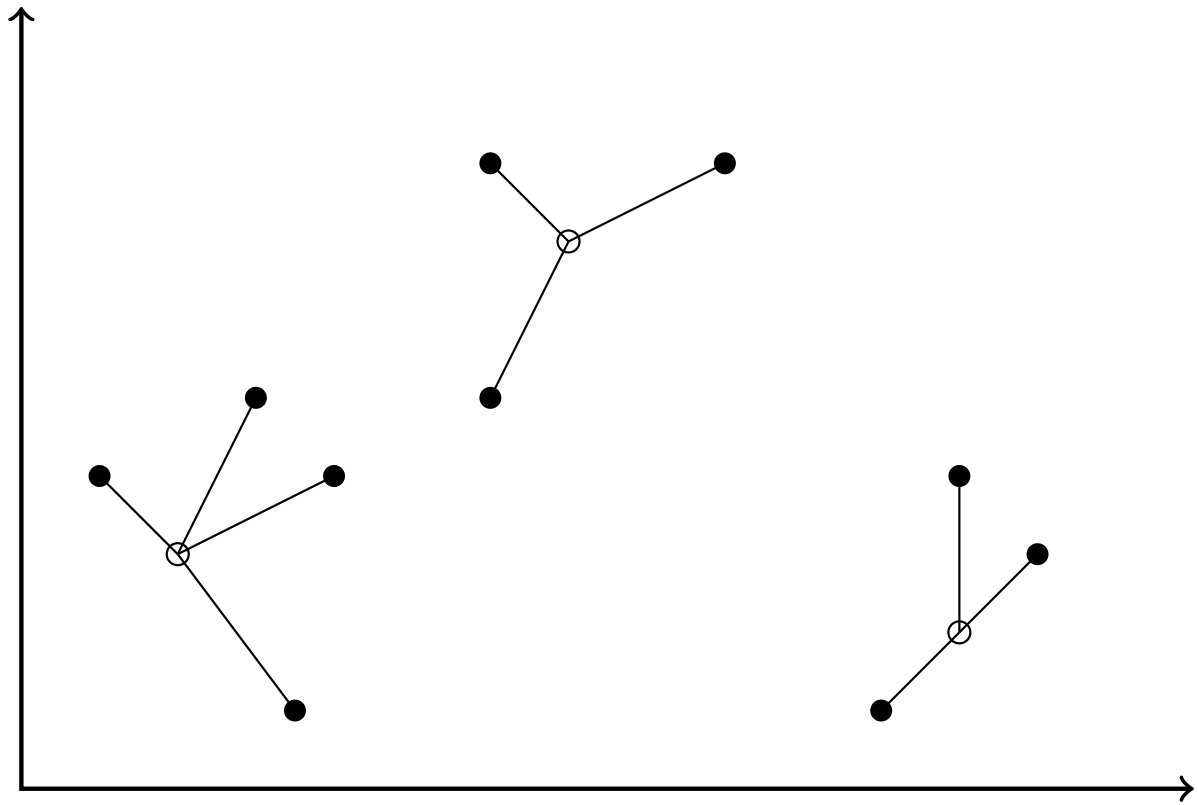

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Future Work

- Implement a planar location data structure to allow Voronoi diagrams to speed insertions and deletions from the solutions up from $\mathcal{O}(n)$ to $\mathcal{O}(\log n)$
- Explore bounds to cut the recursive tree.
- Explore heuristic approaches to generate acceptable non-optimal solutions for larger problems.
- Apply and benchmark approaches with real-life data.