Discrete Optimization

Greedy Algorithms: Part I

Goals of the Lecture

- What is a greedy algorithm
- How do we go beyond greedy?

What is Greedy?

- Assume the it's "easy" to build a feasible solution
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- Key Idea:
  - Build a solution by picking the value of one decision variable at a time
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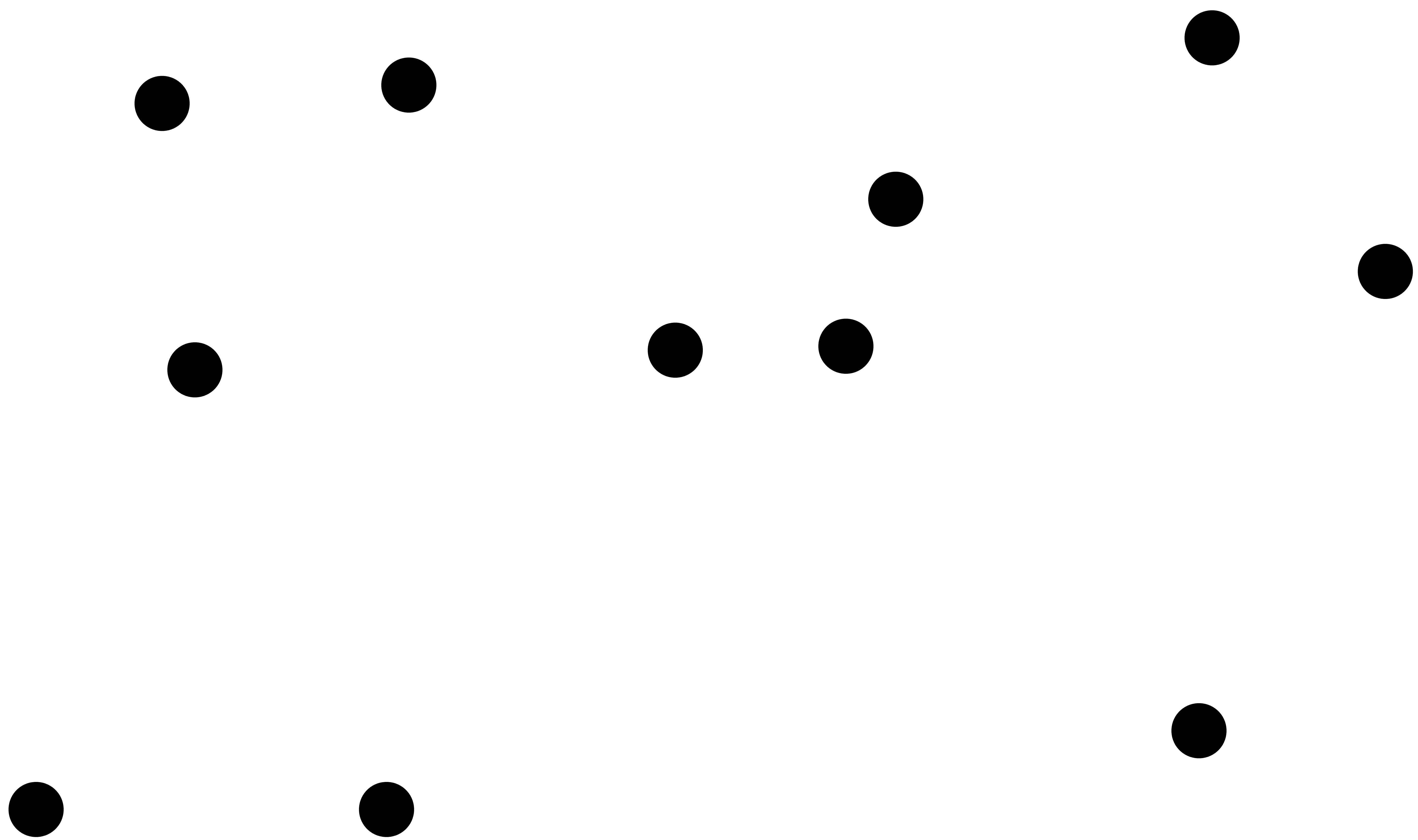
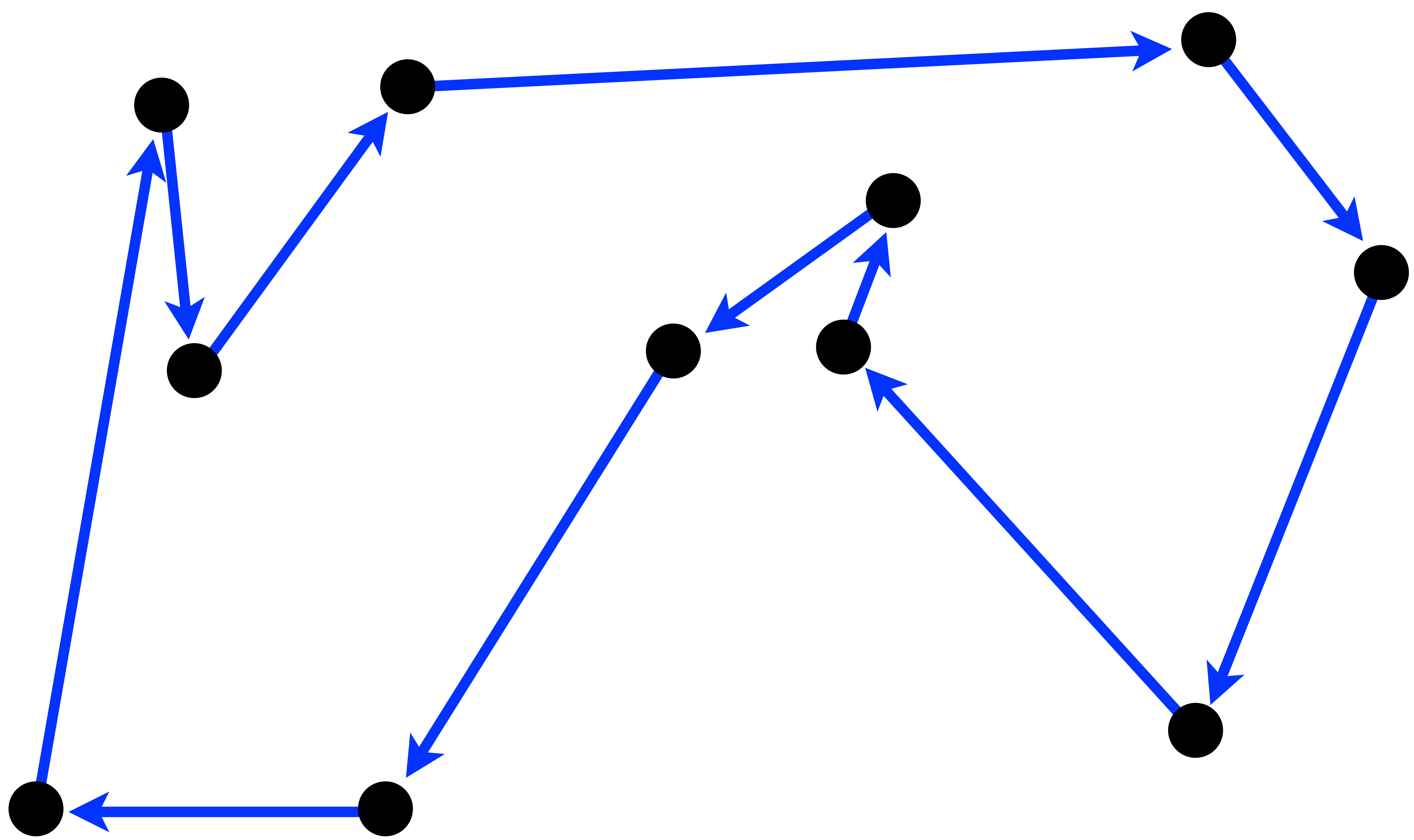
- Key Idea:
  - Build a solution by picking the value of one decision variable at a time
  - At each step, pick the value that is best for the objective
- Called: greedy algorithms or heuristics

Greedy by Example

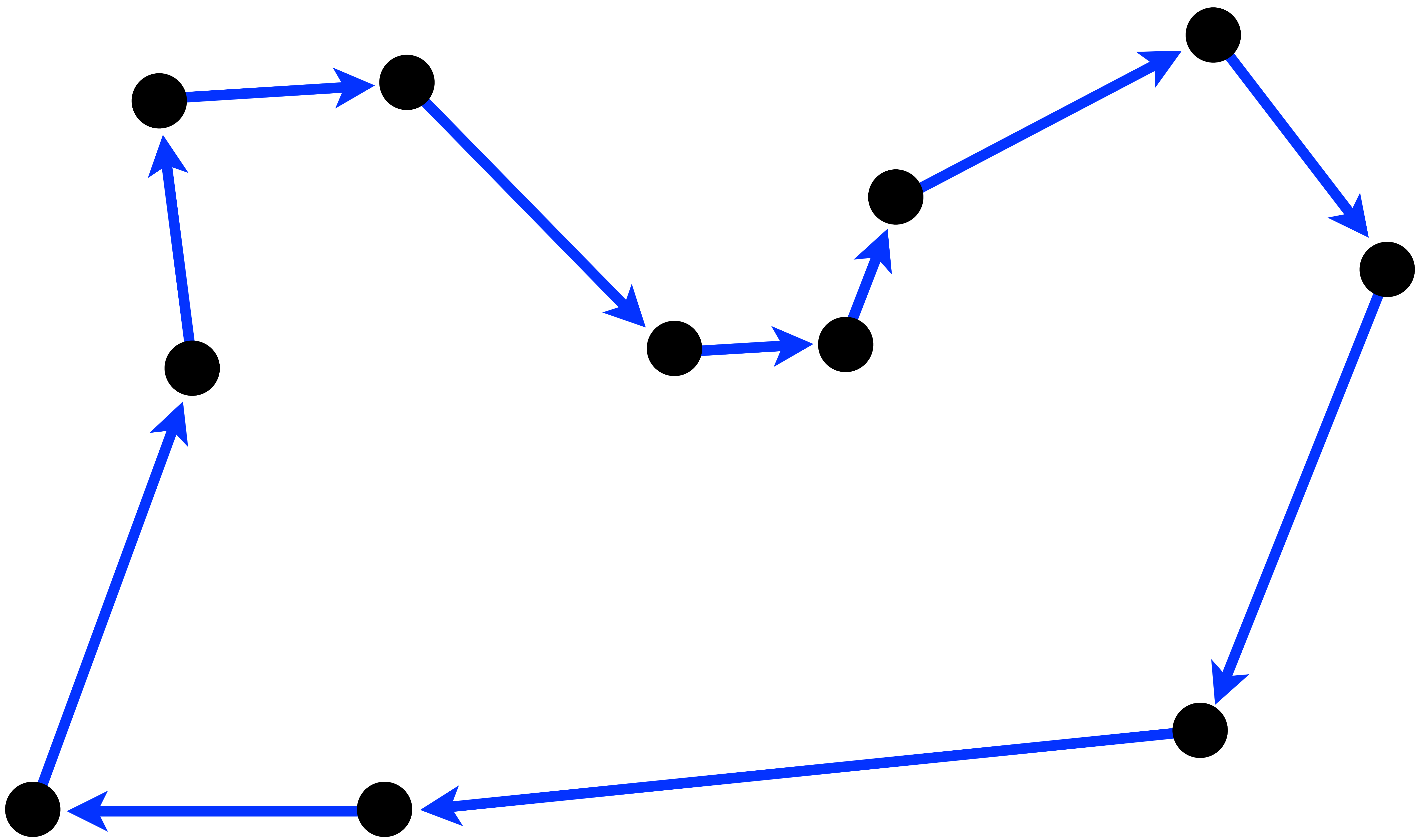
- The Traveling Salesman Problem (TSP)



TSP Solution 1

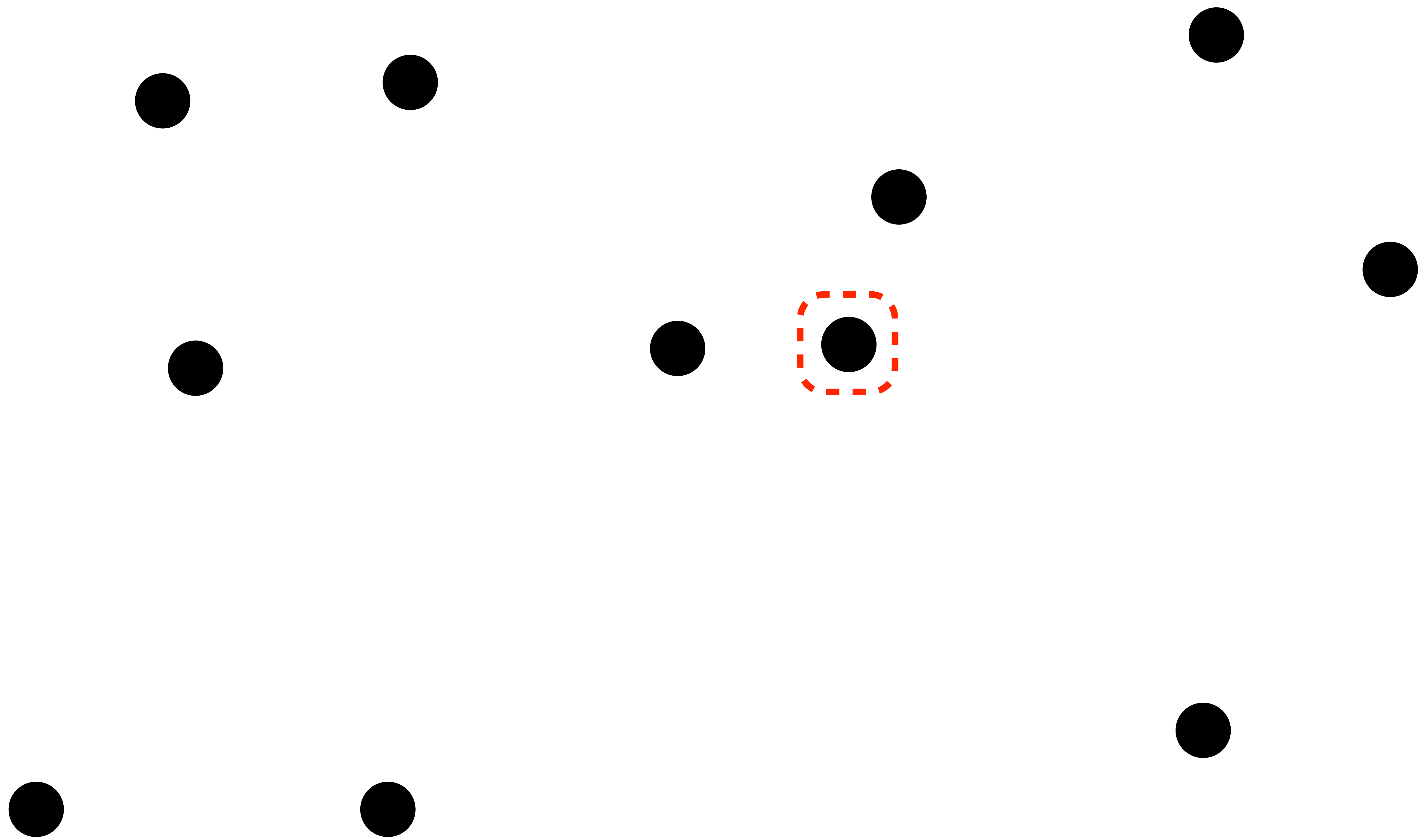


TSP Solution 2



Greedy TSP

- Idea: Nearest Neighbor



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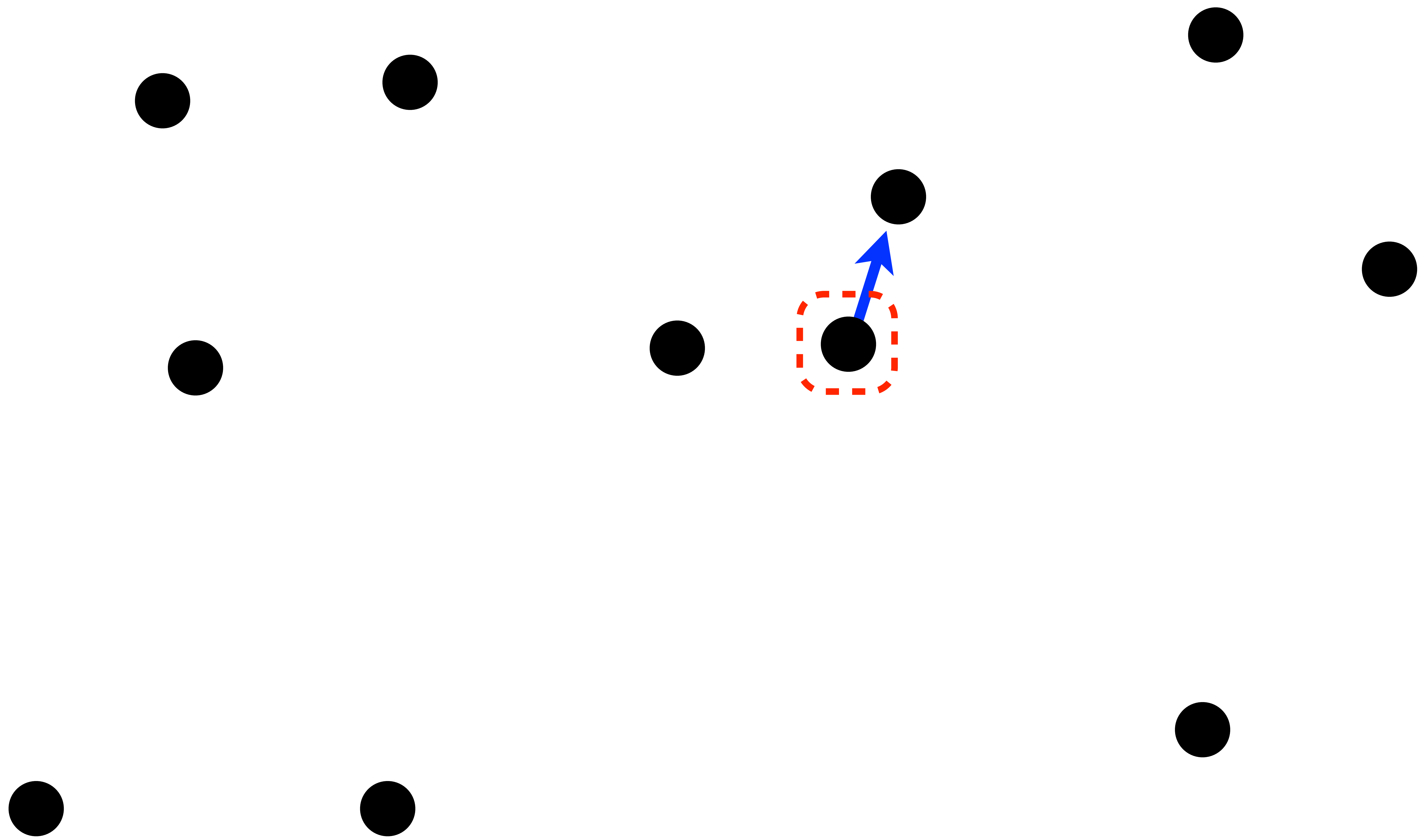

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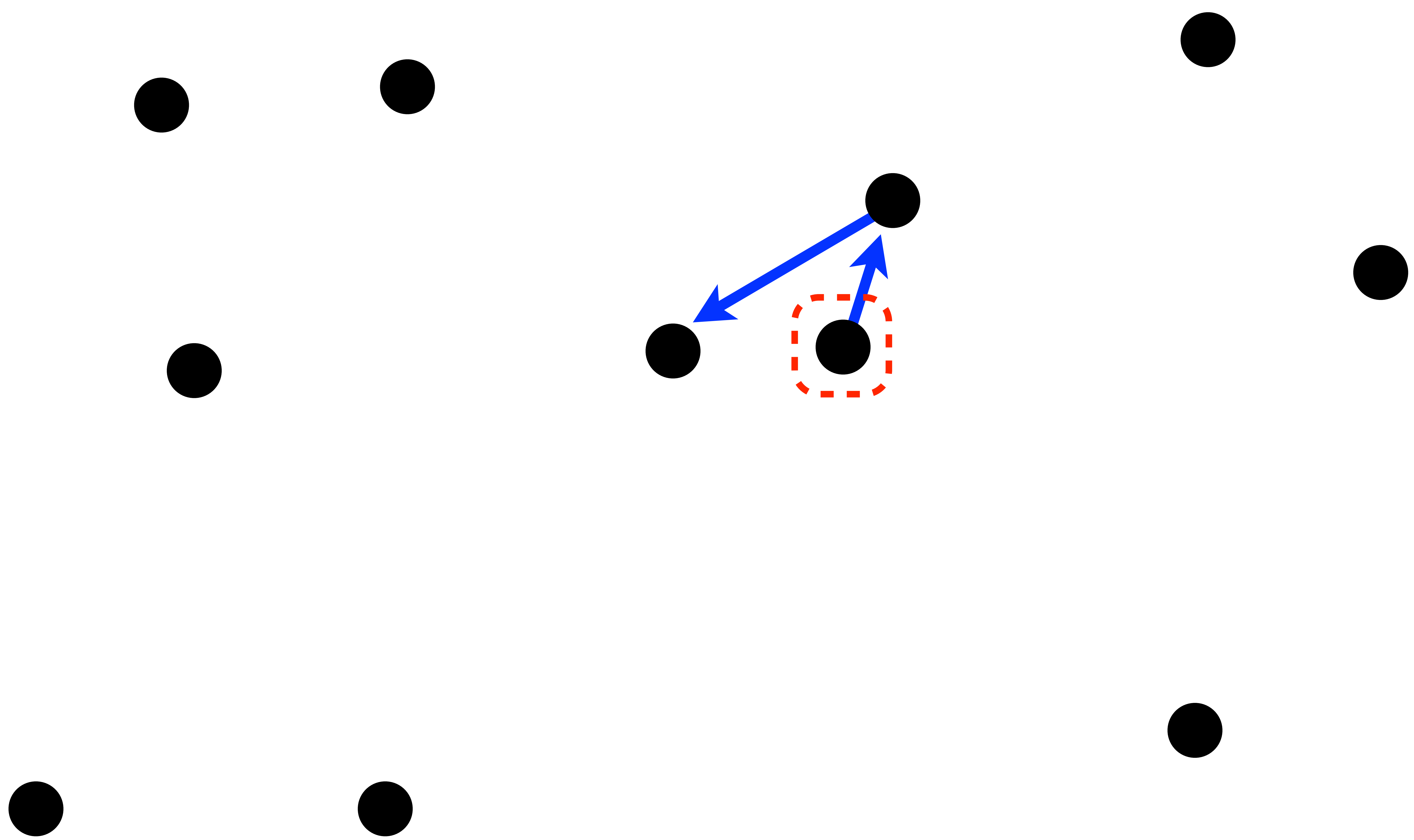

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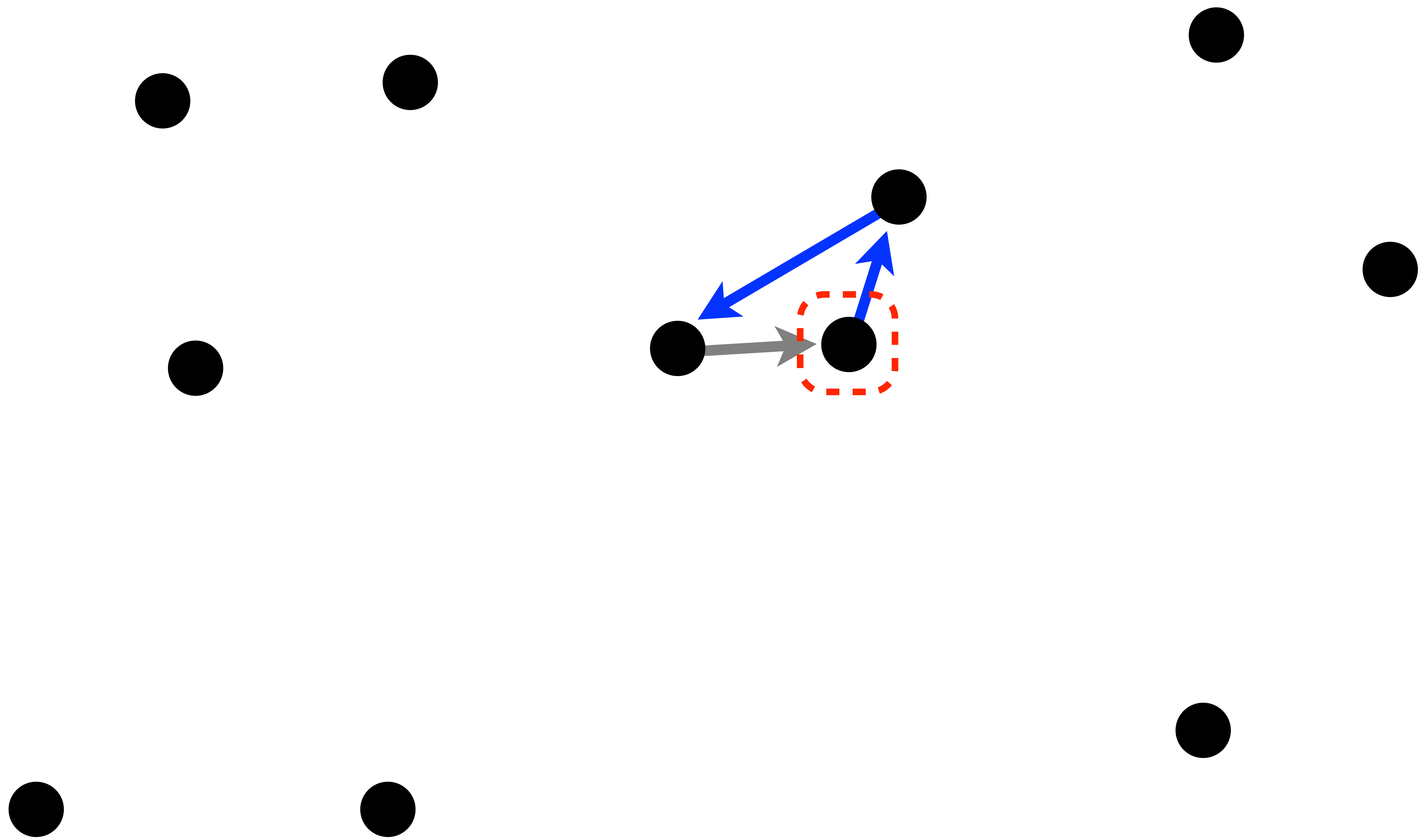

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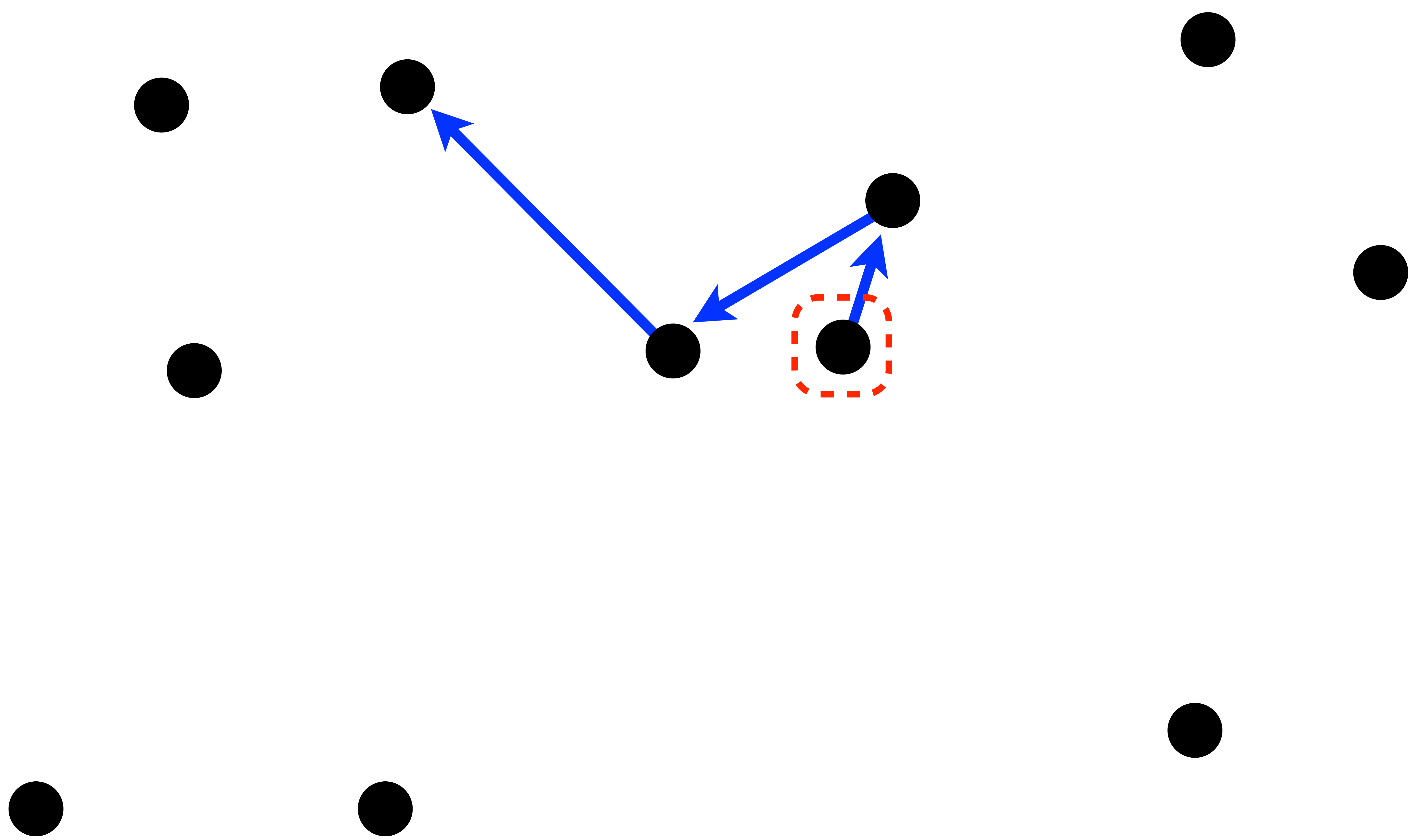

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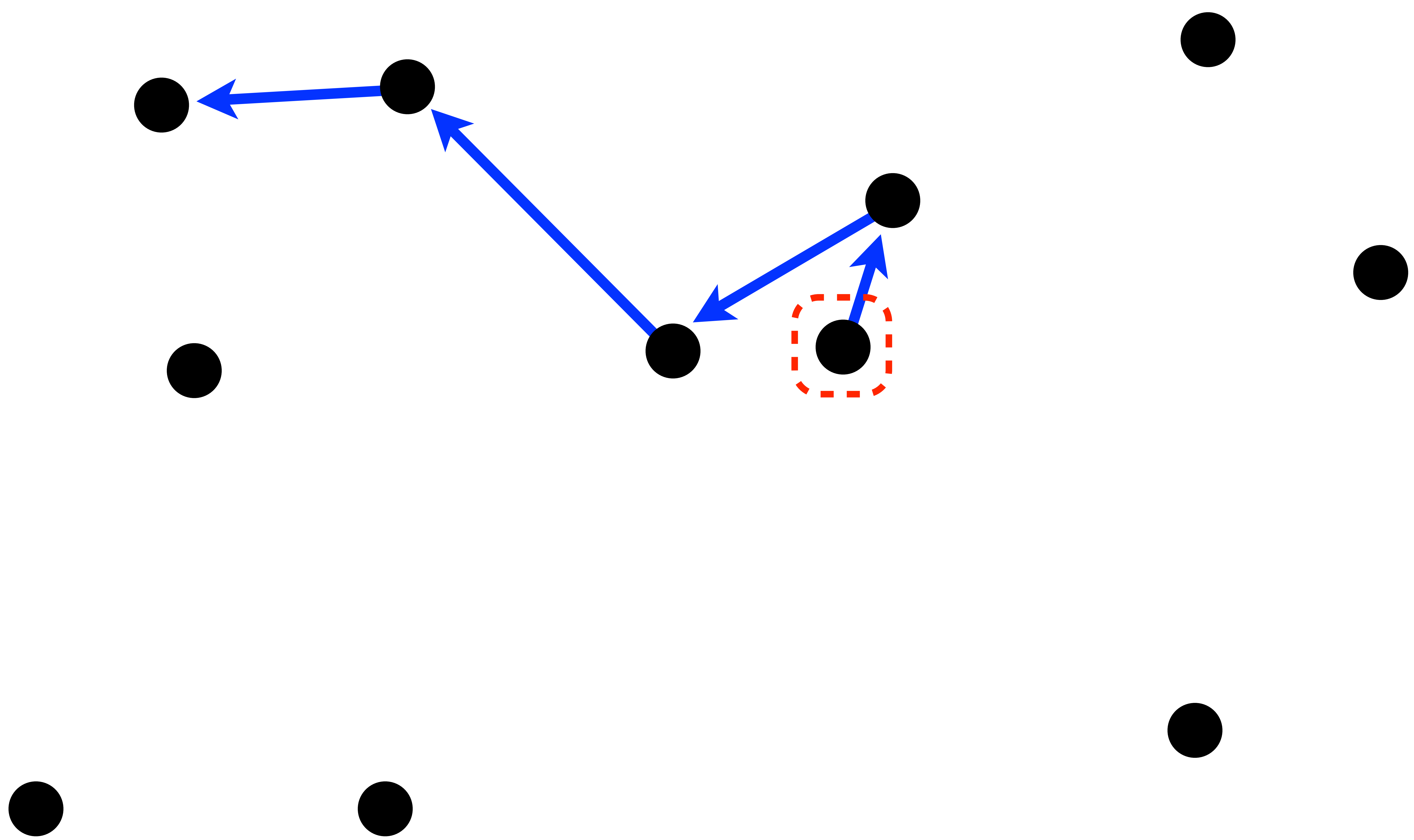

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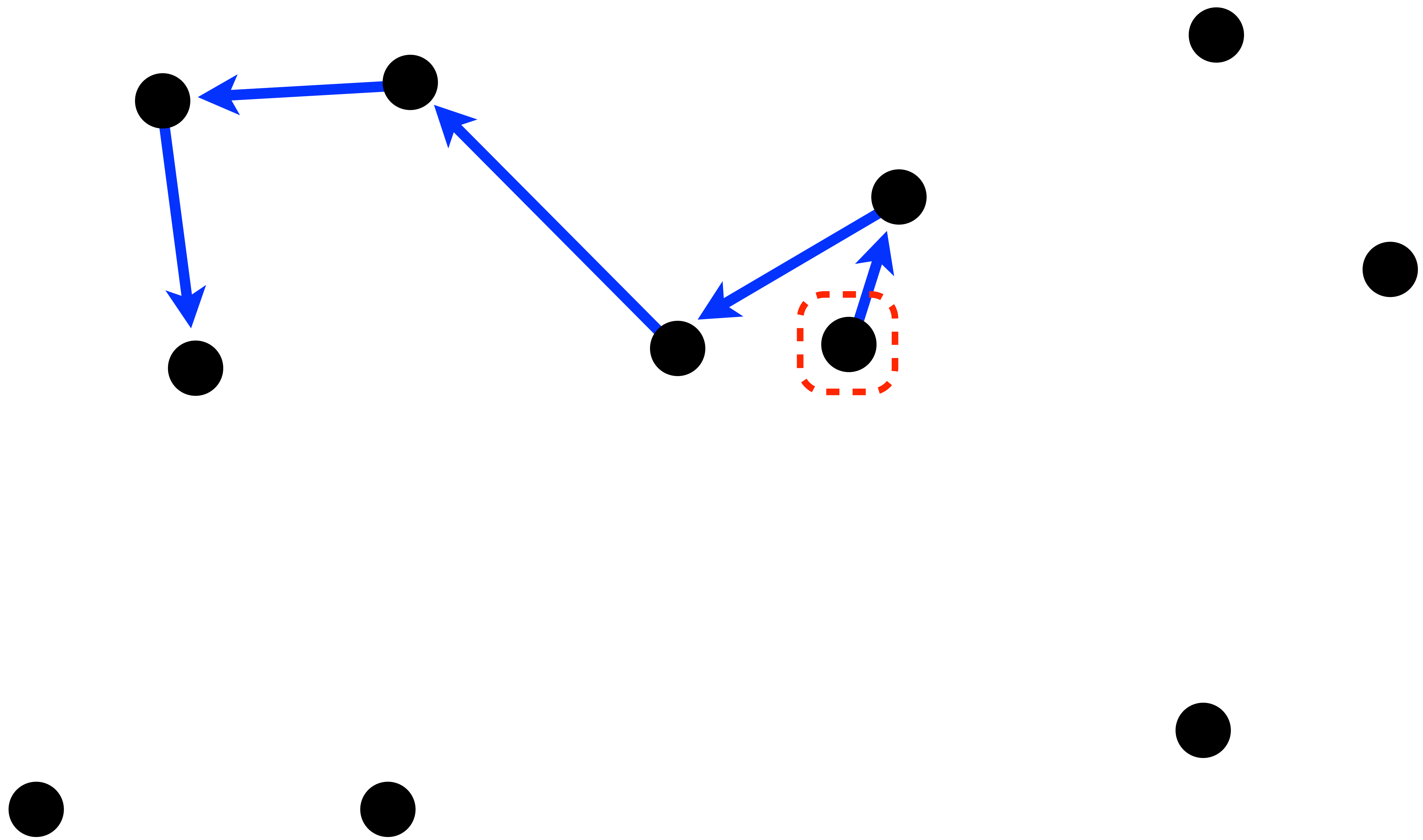

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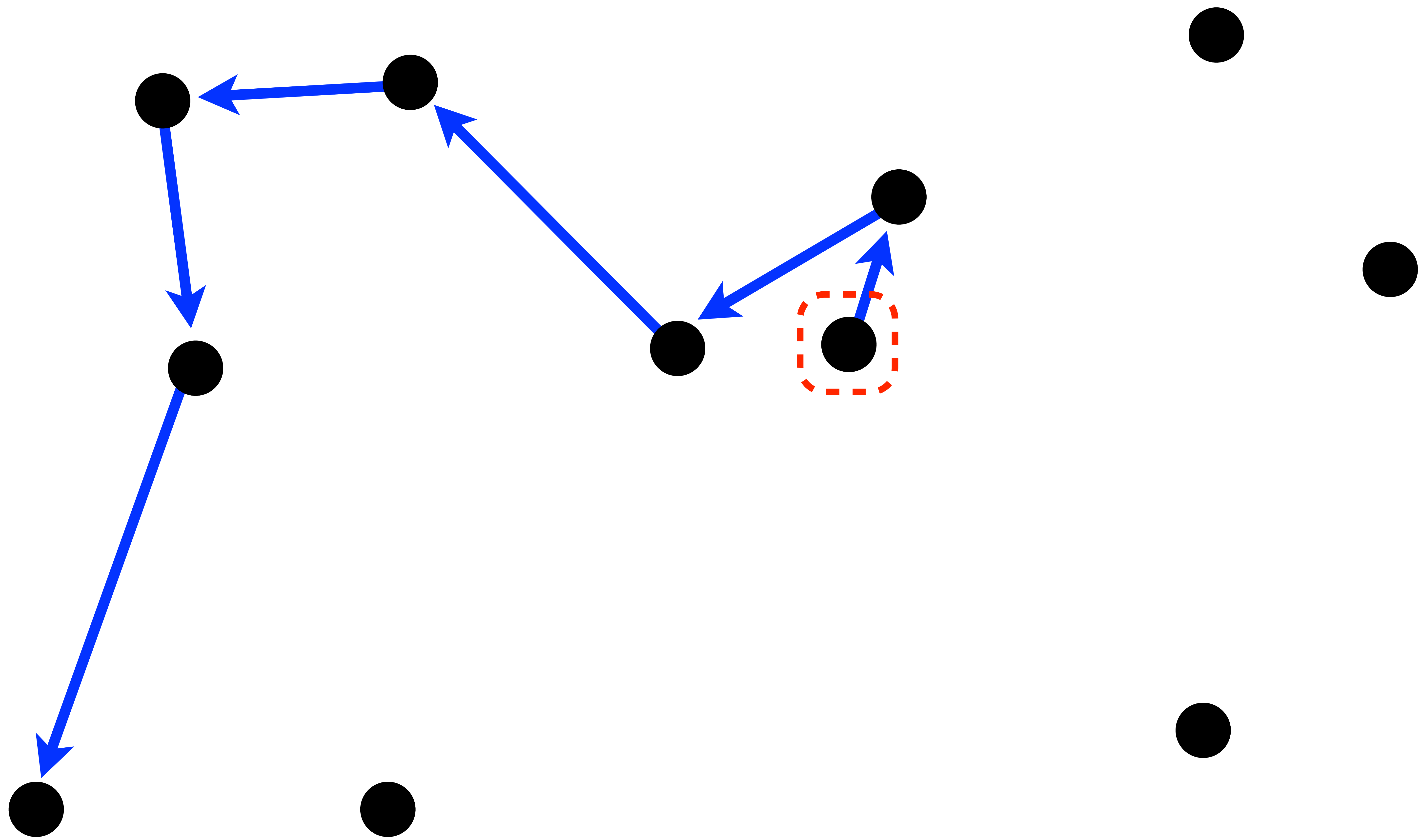

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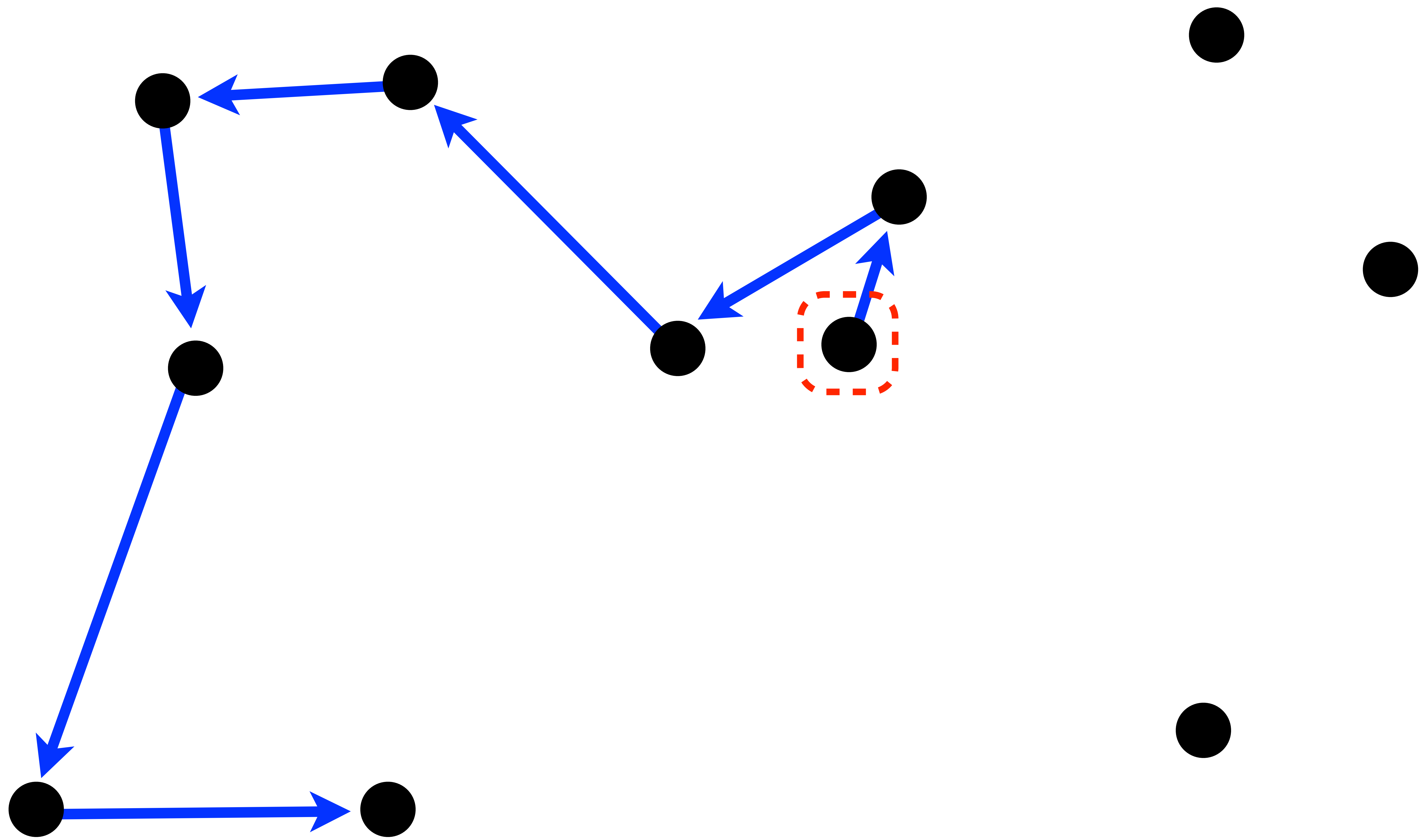

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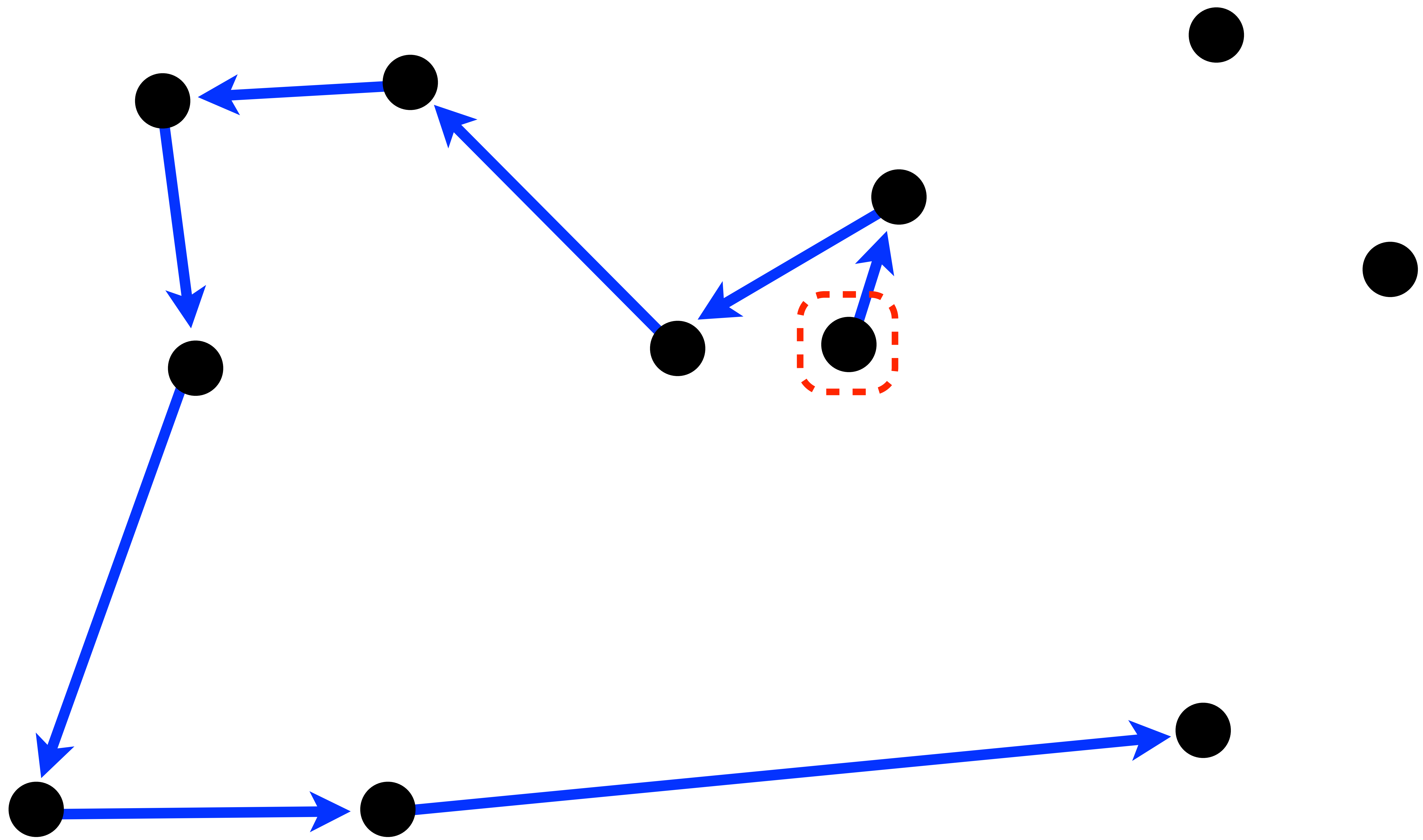

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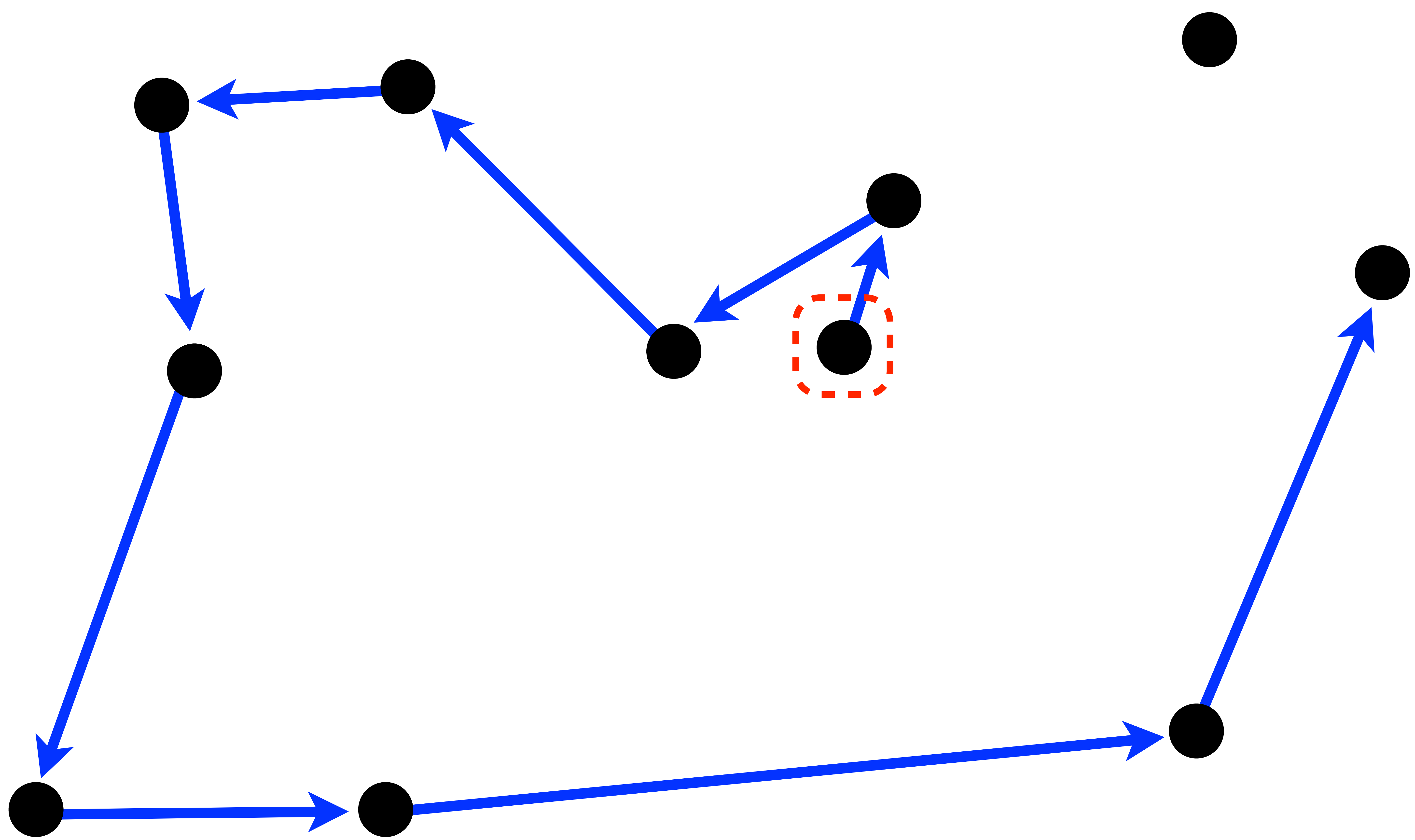

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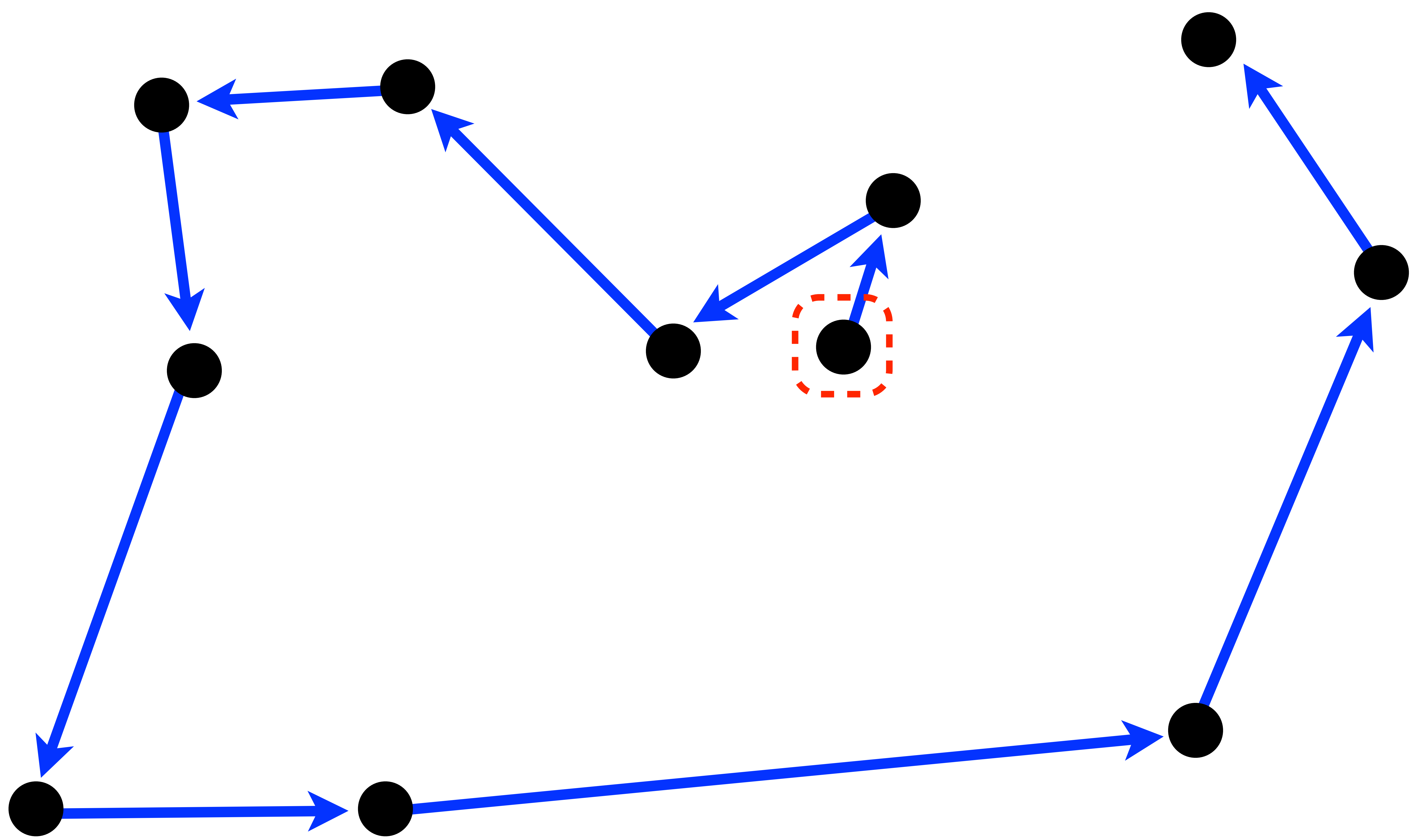

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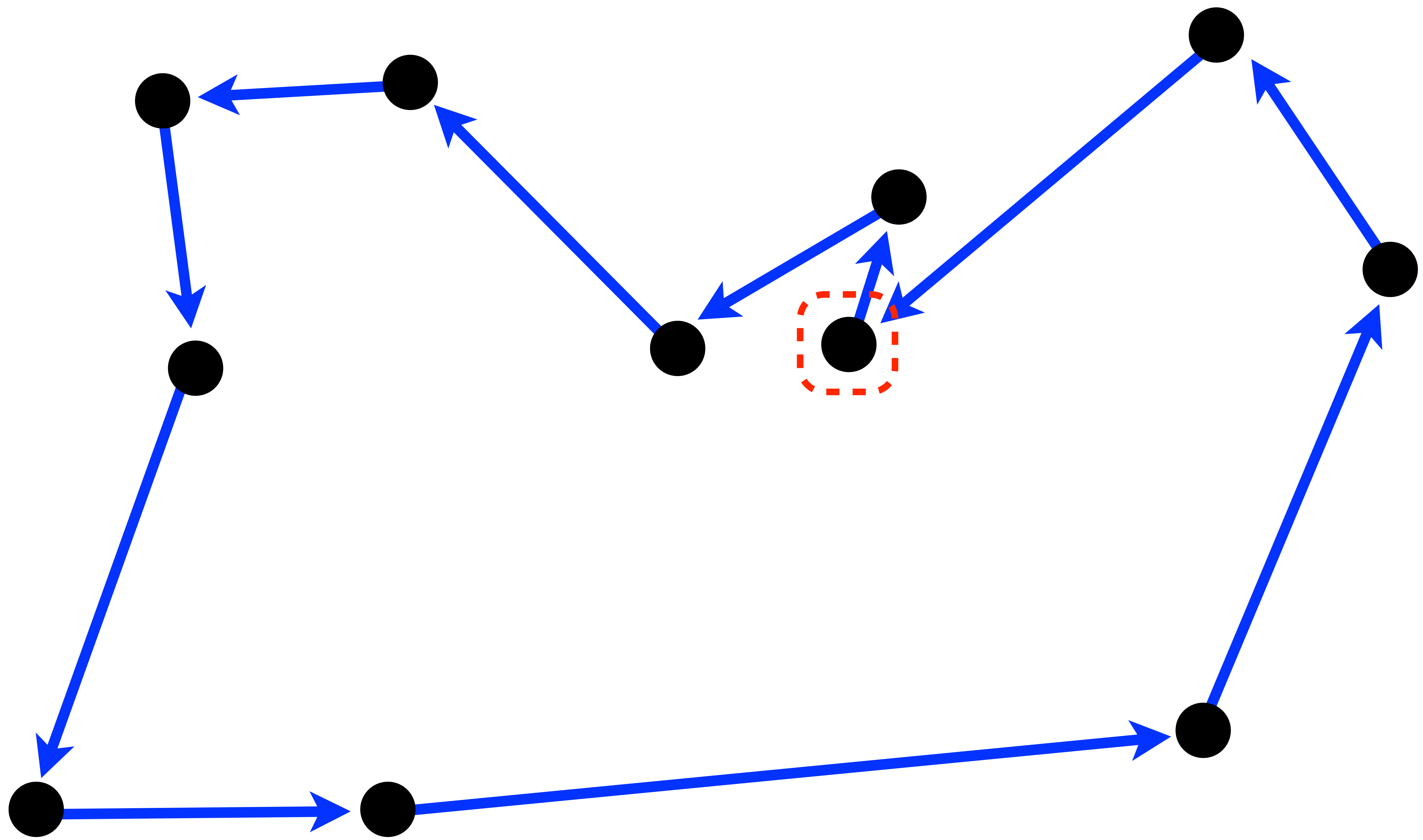

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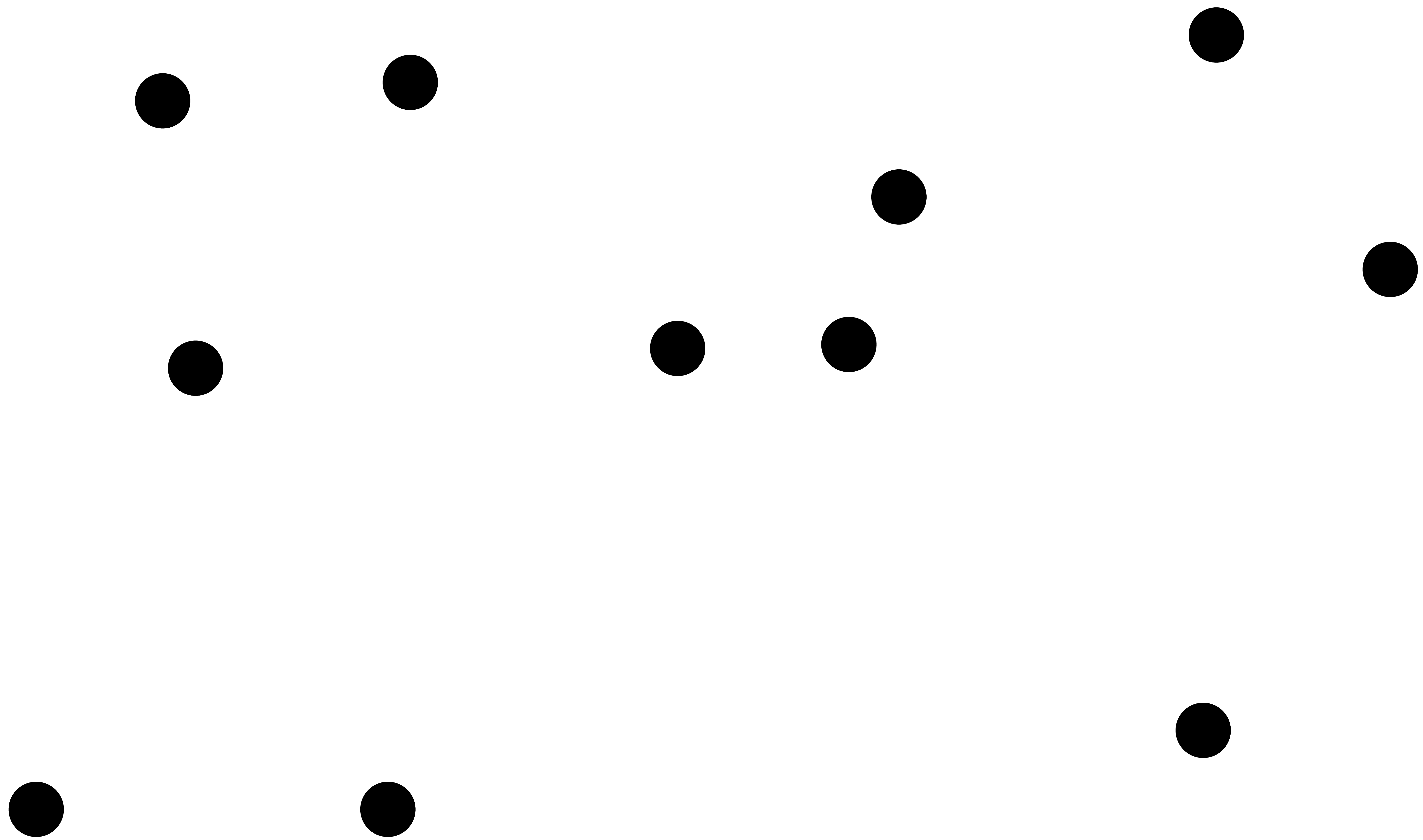

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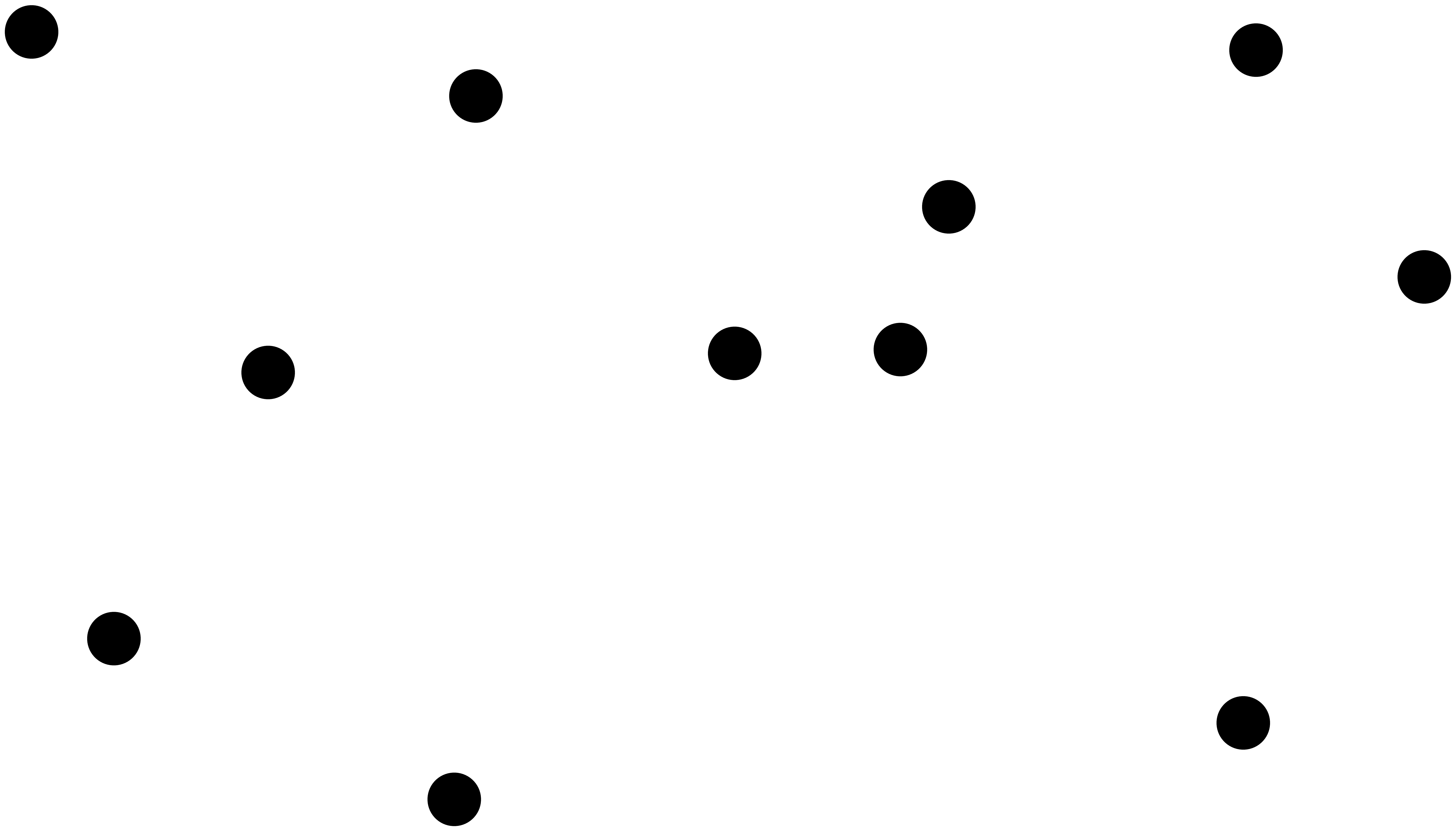

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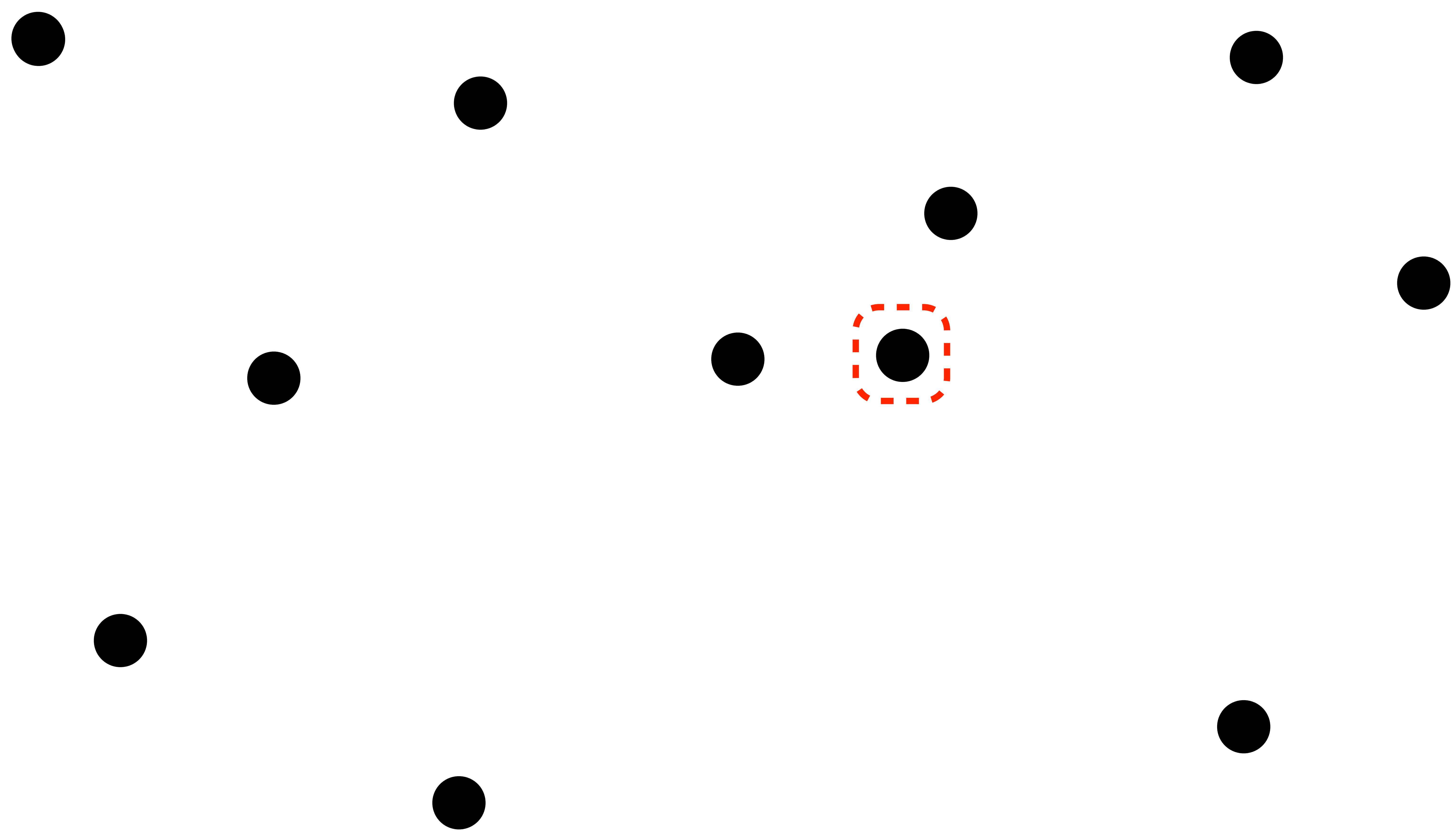

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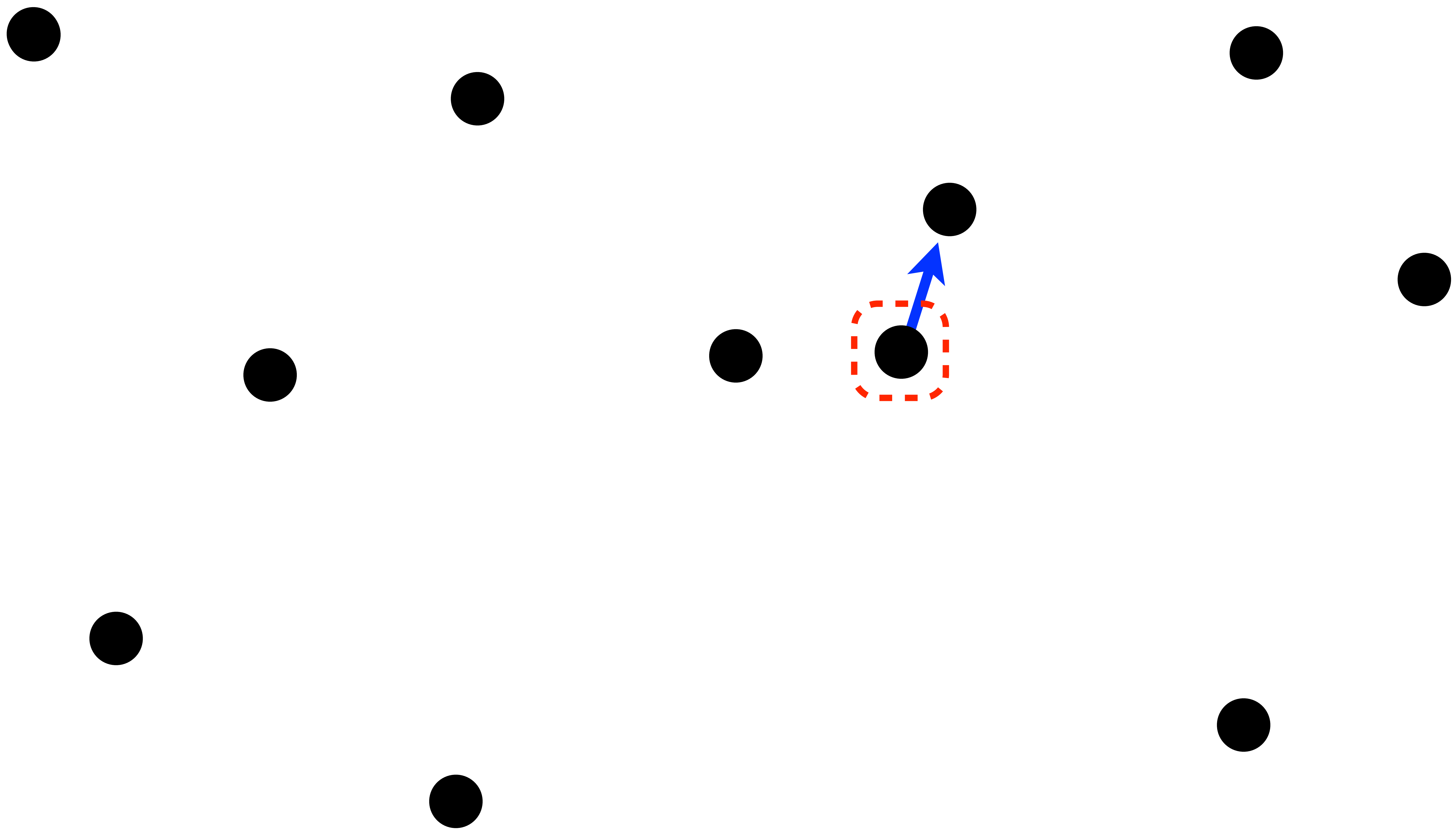

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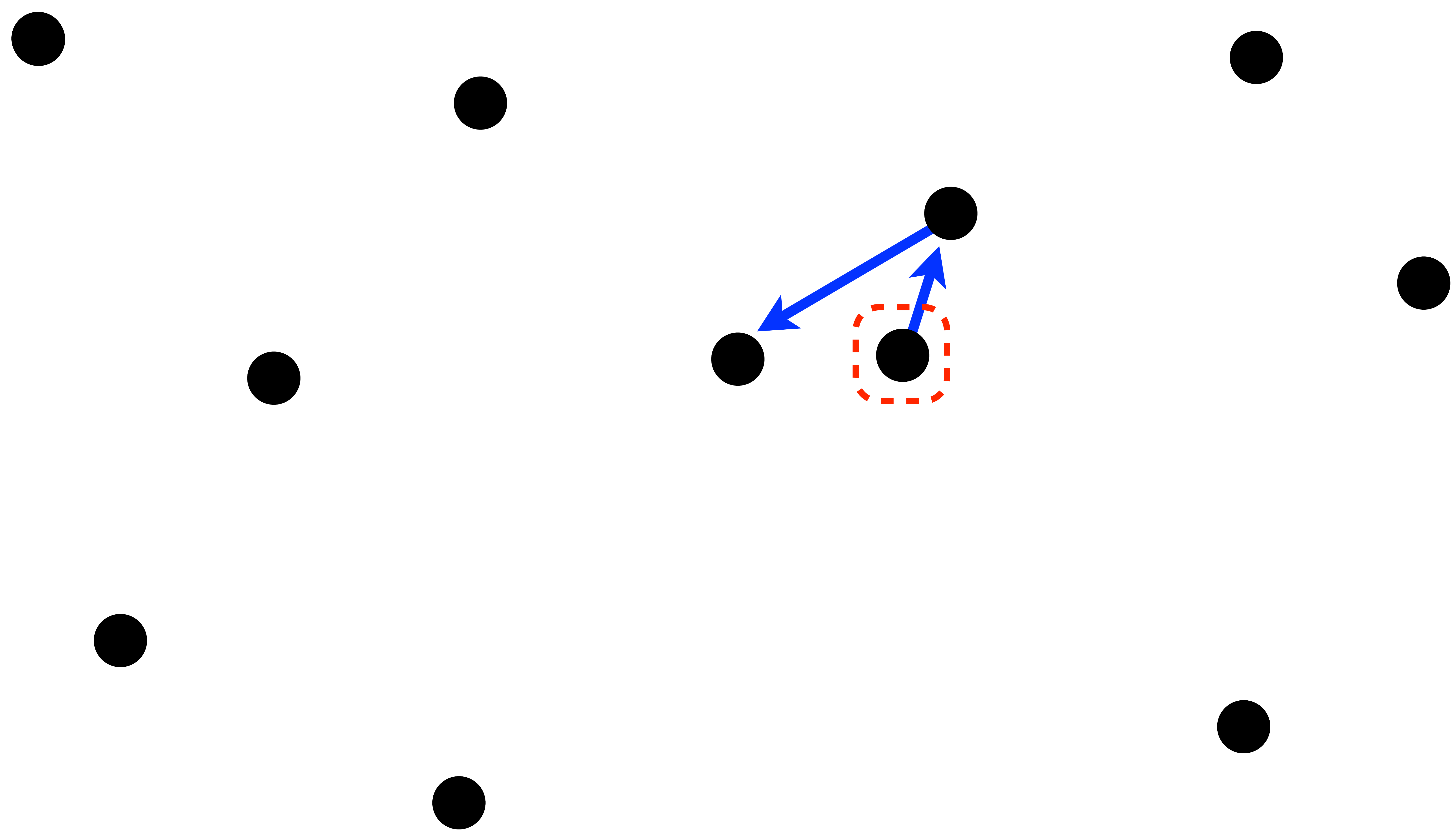

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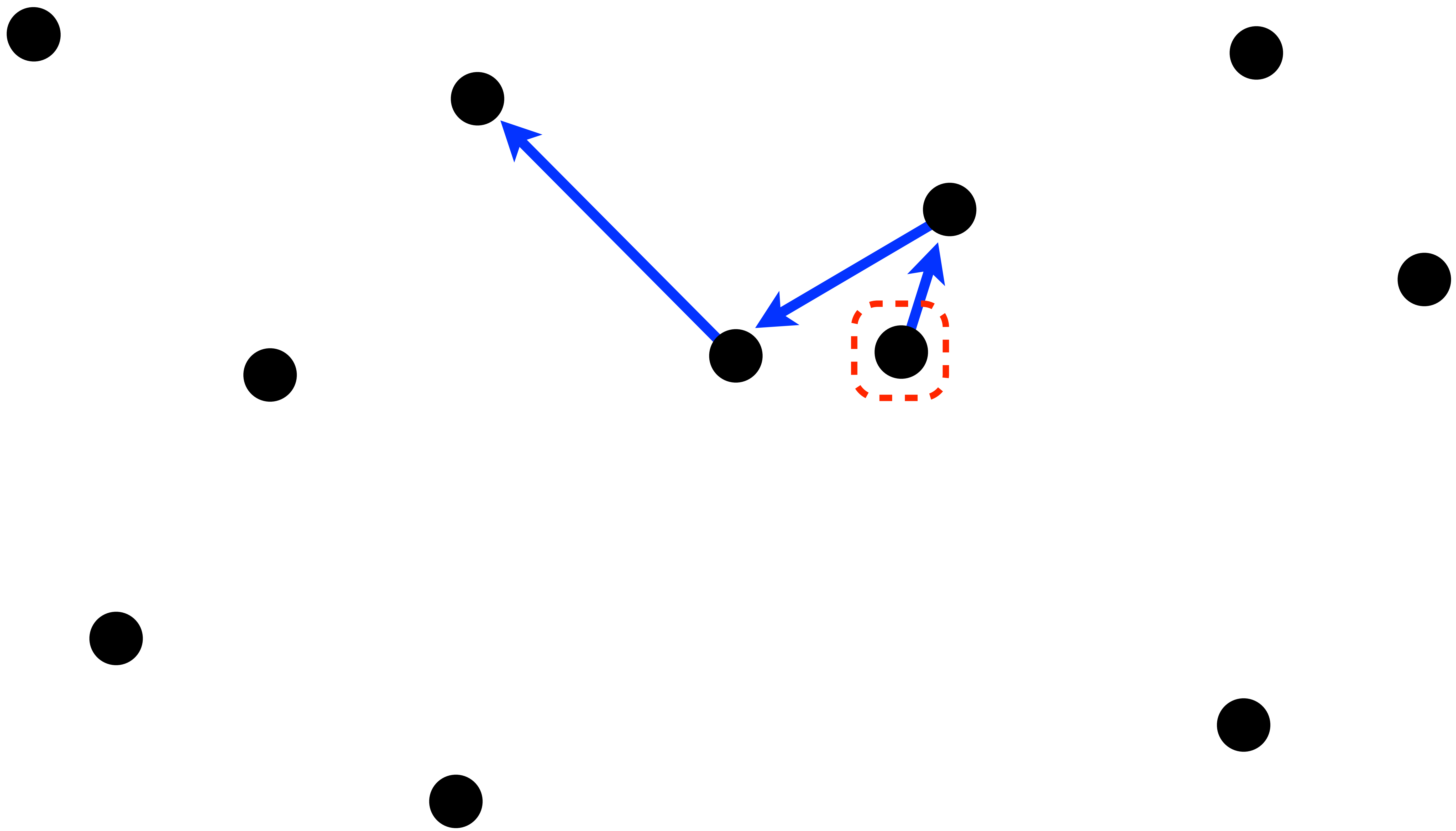

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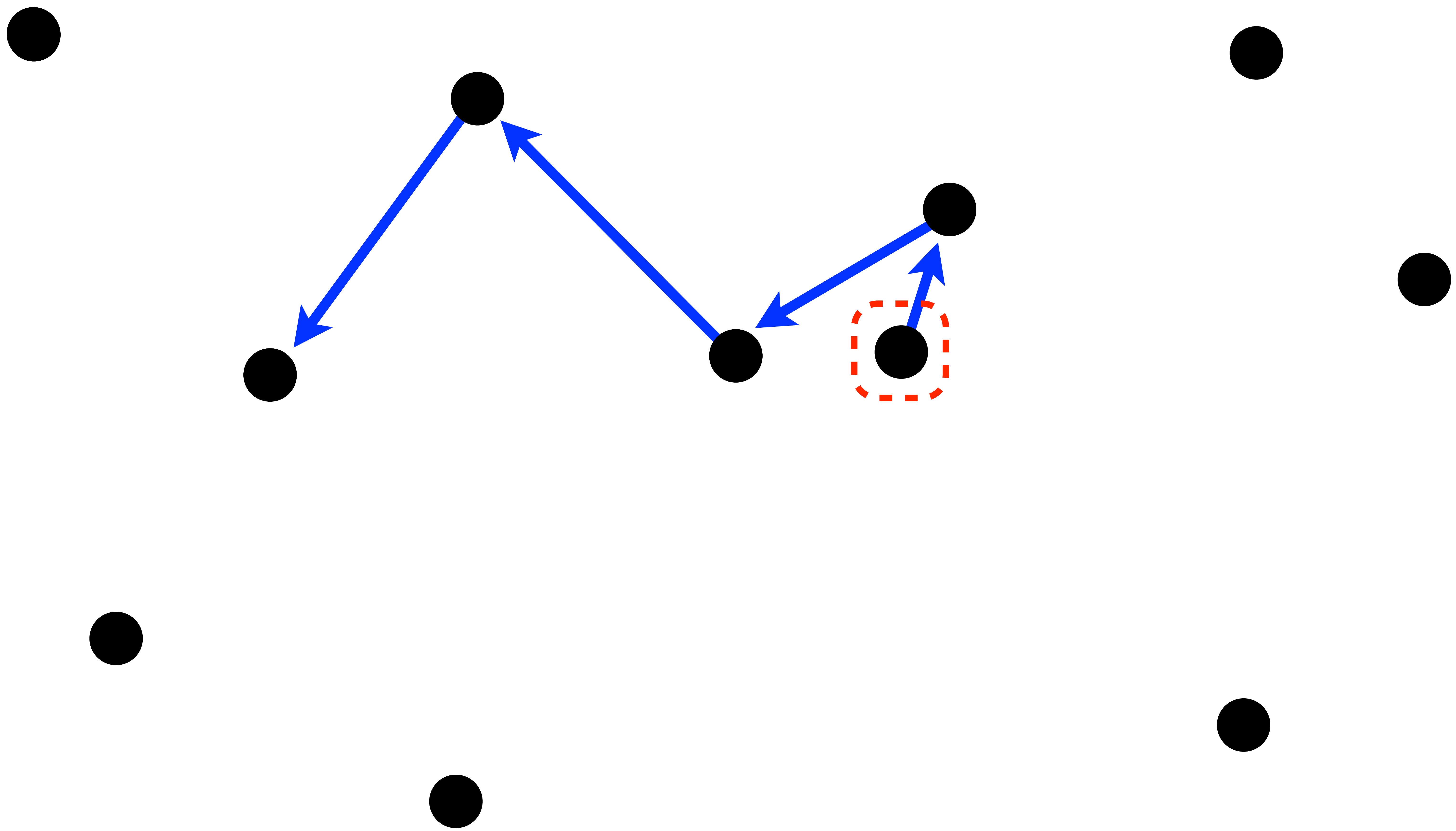

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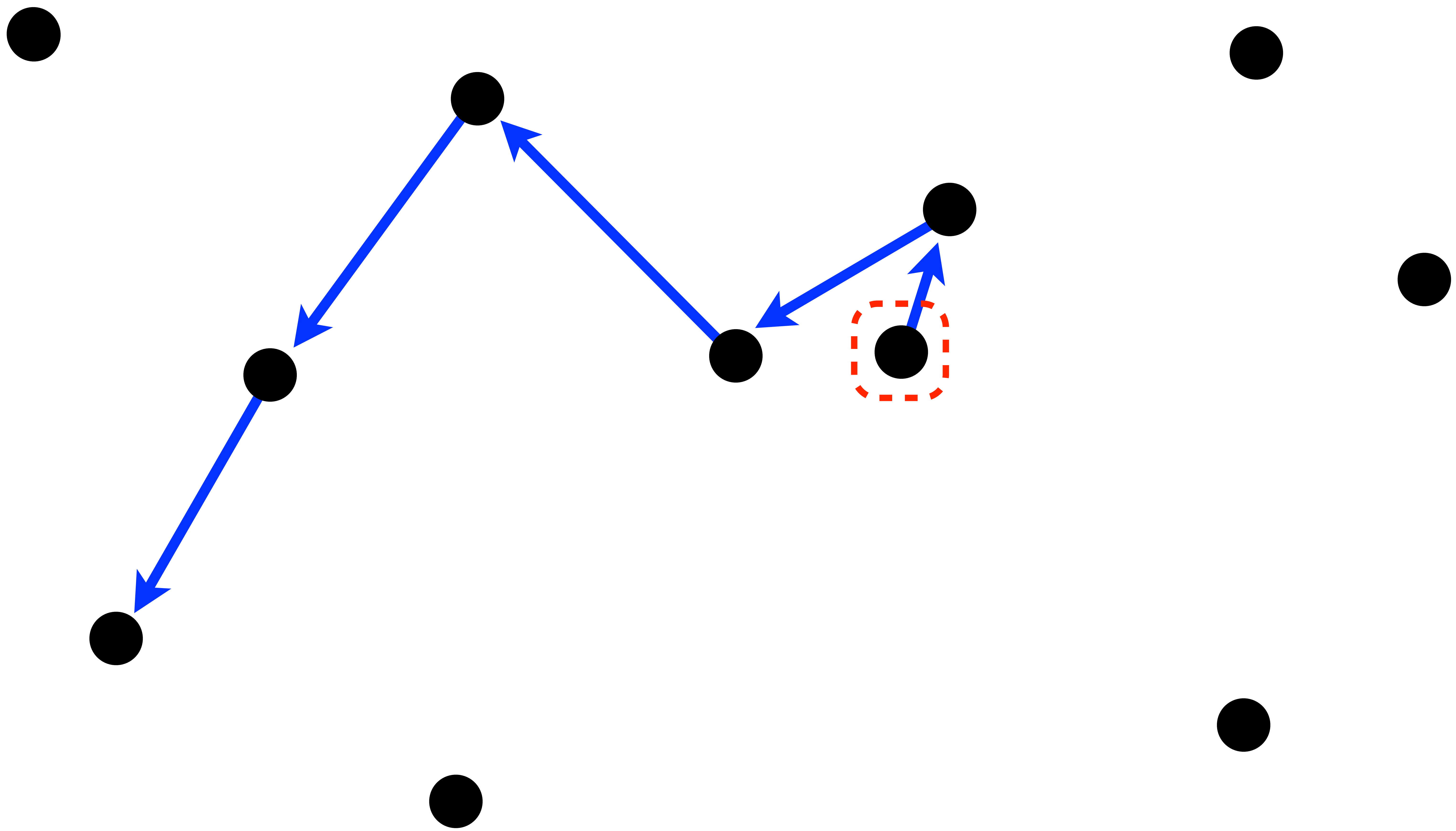

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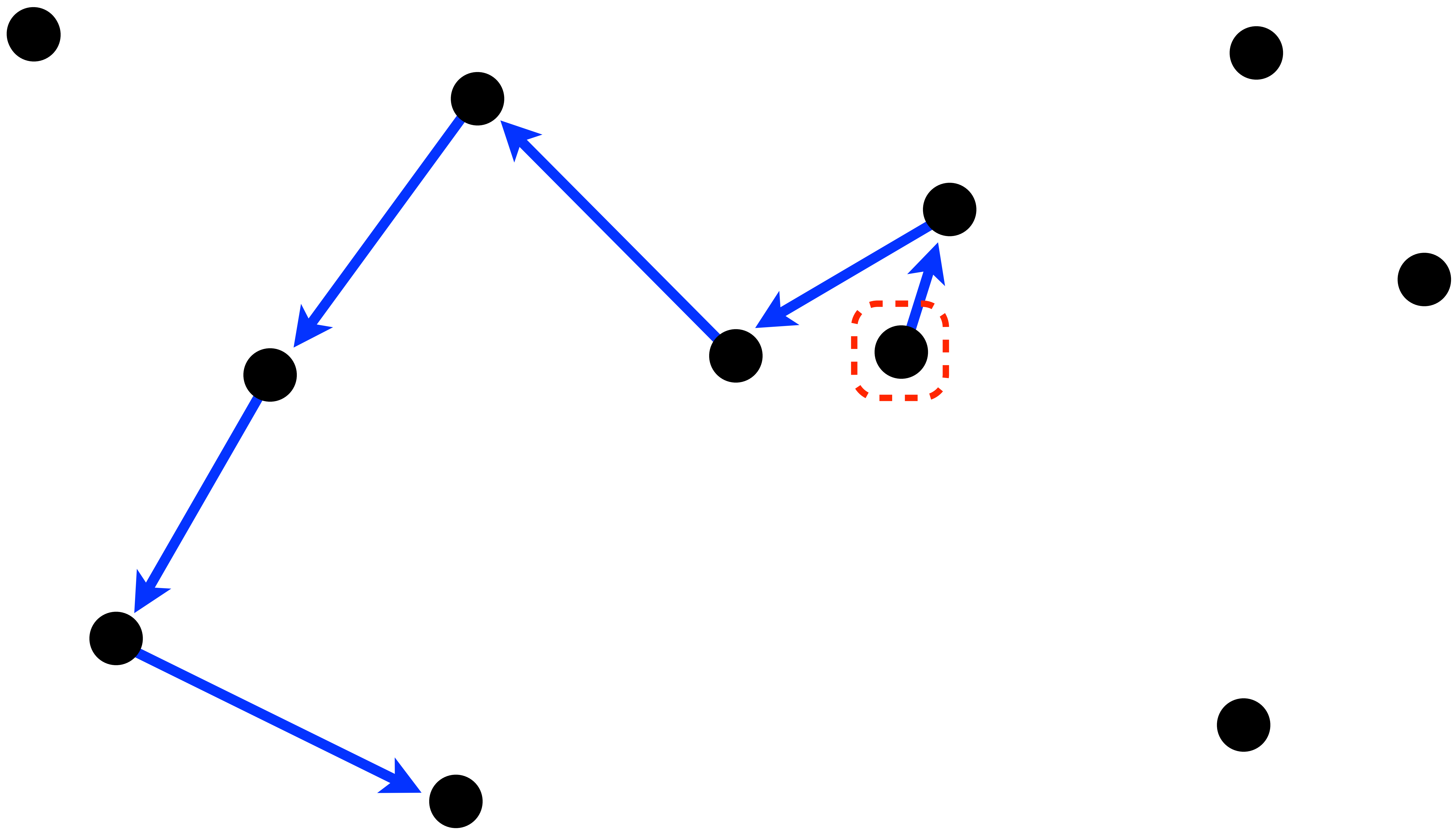

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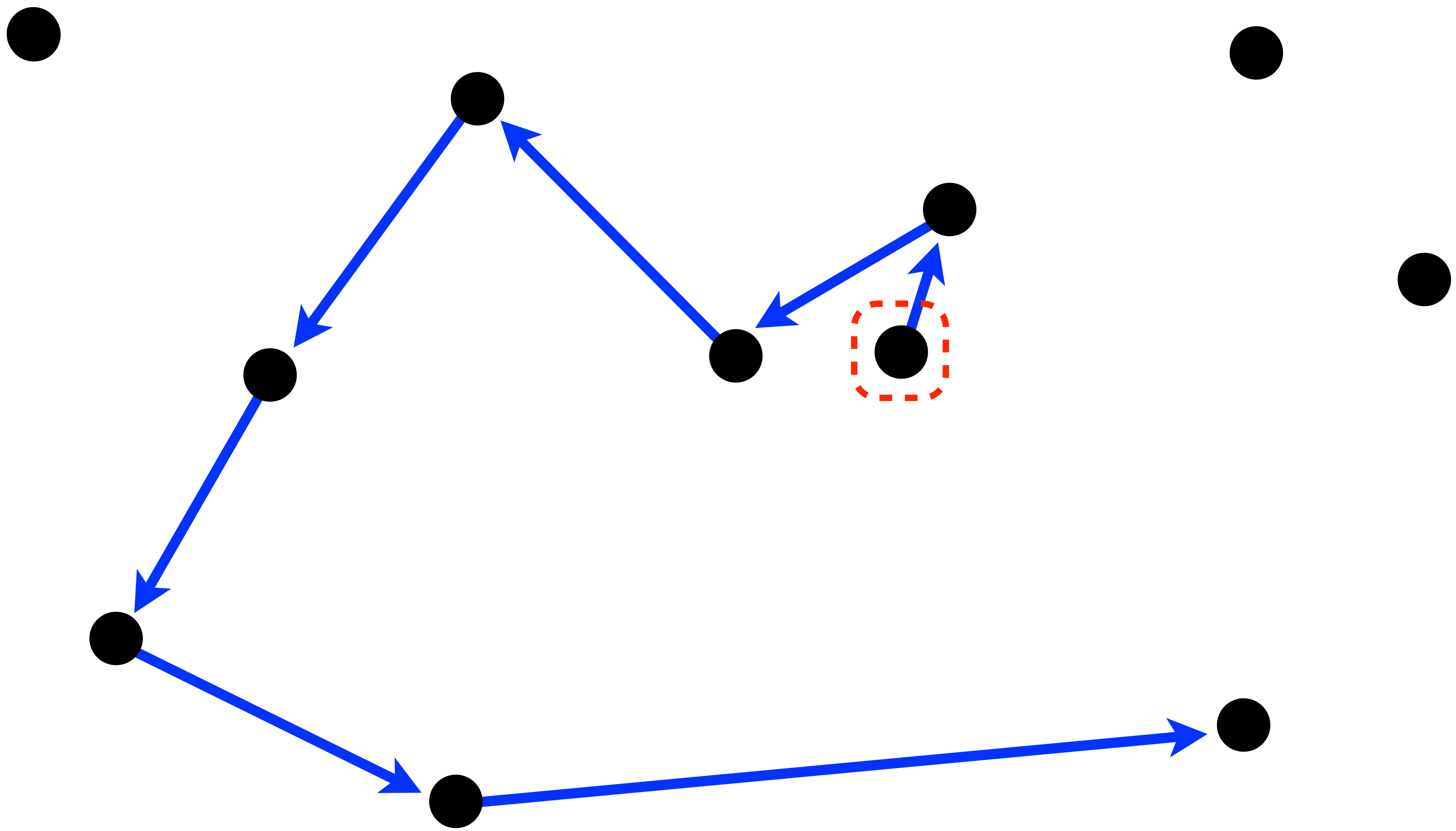

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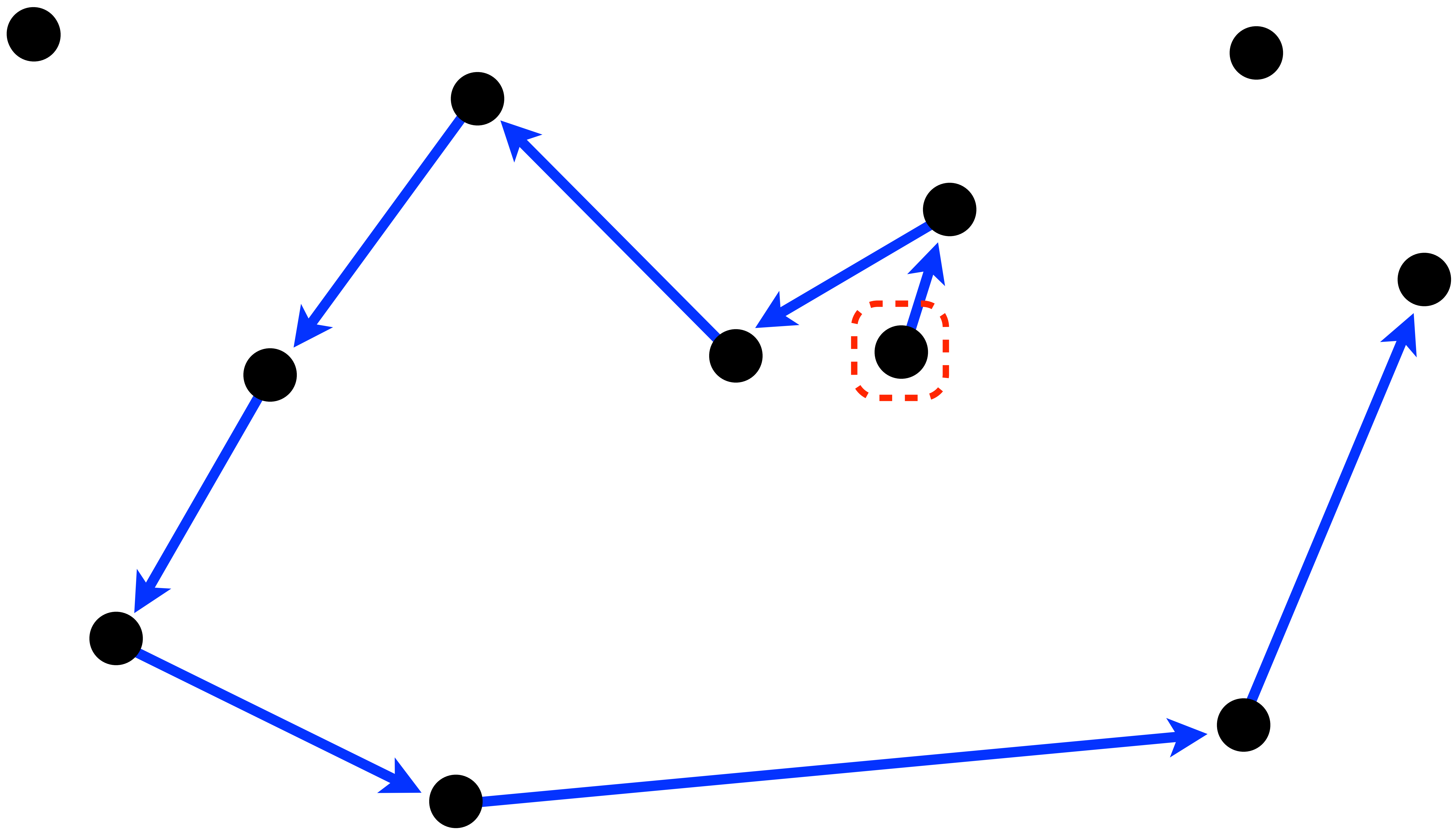

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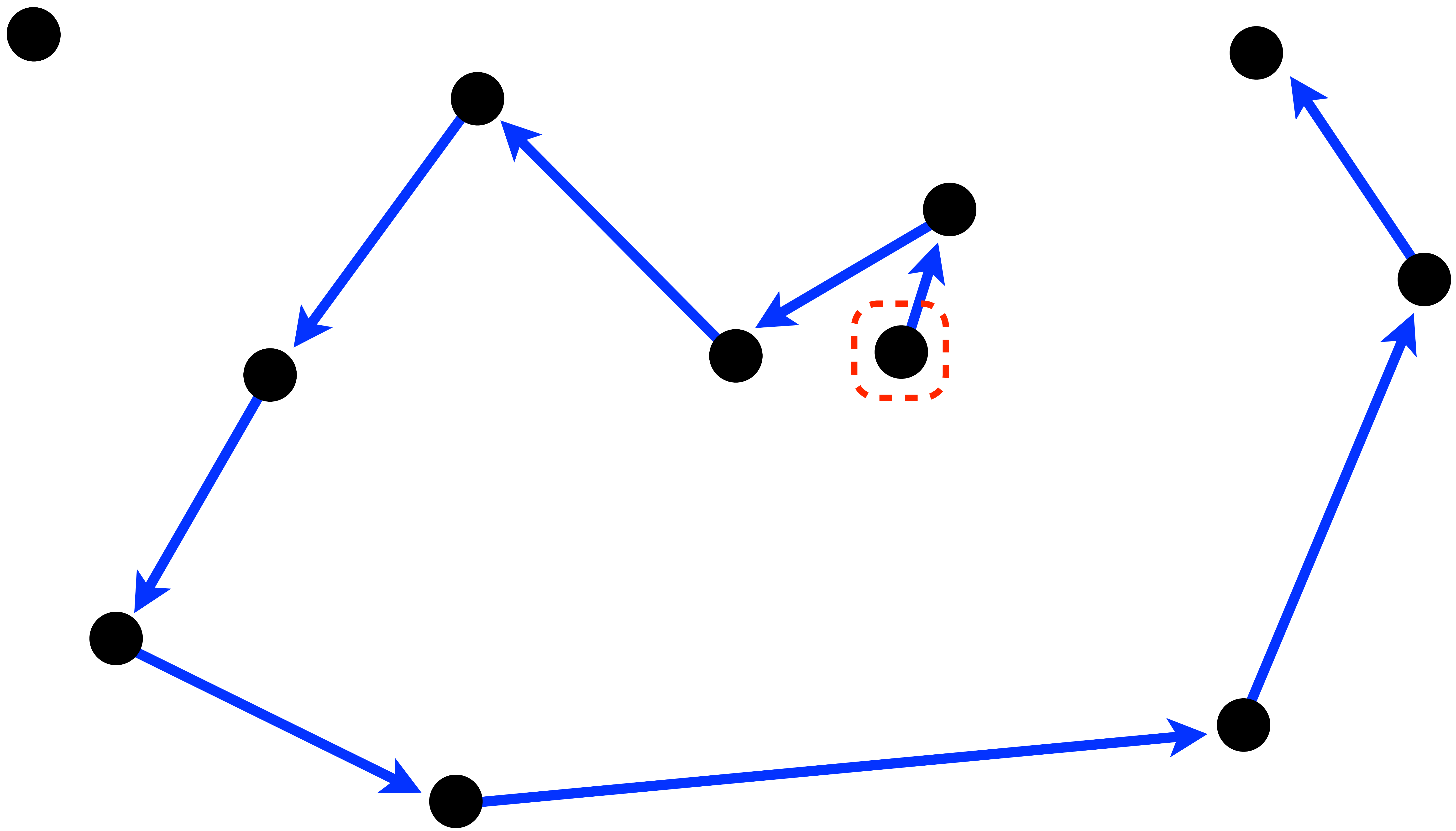

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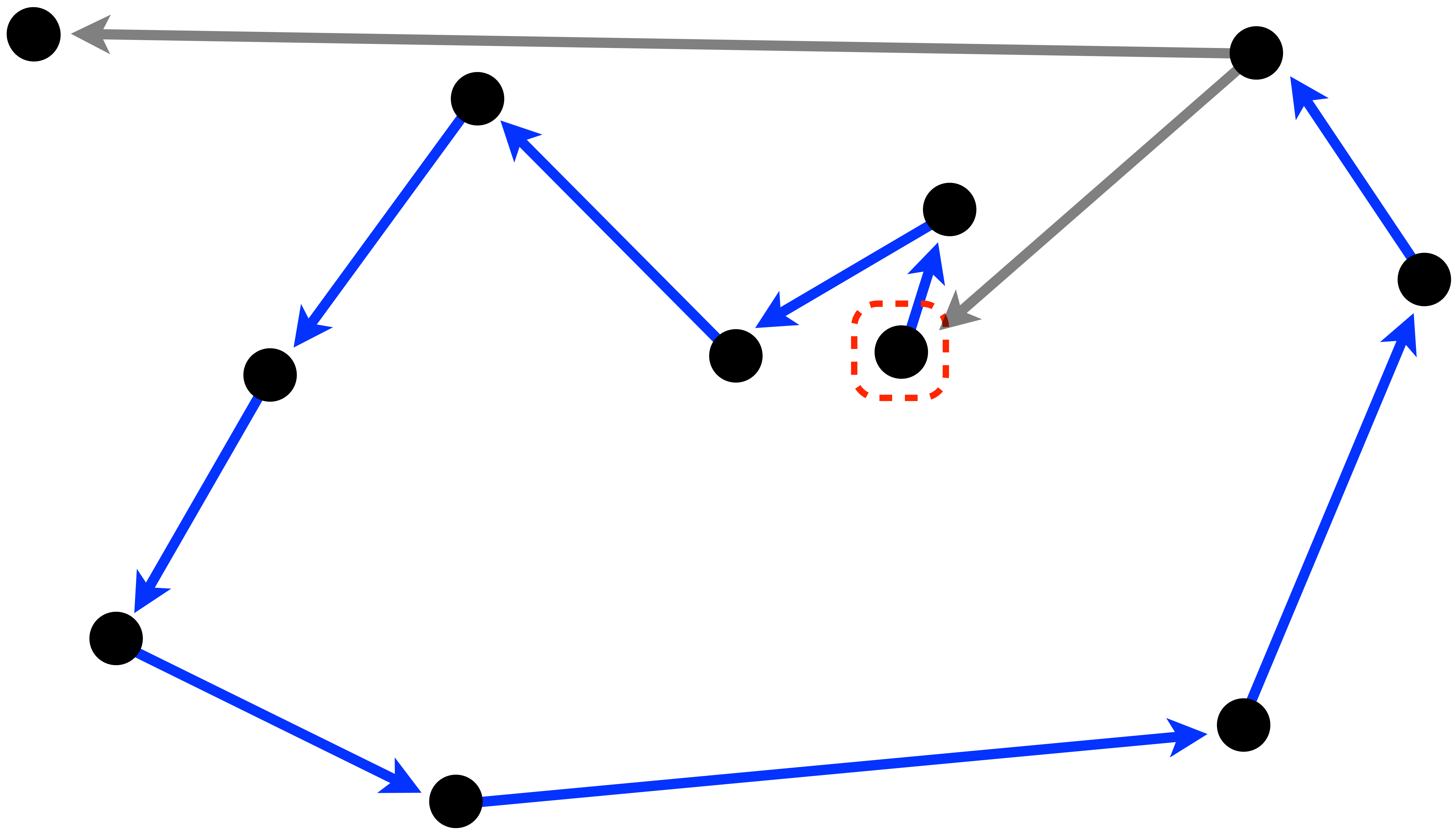

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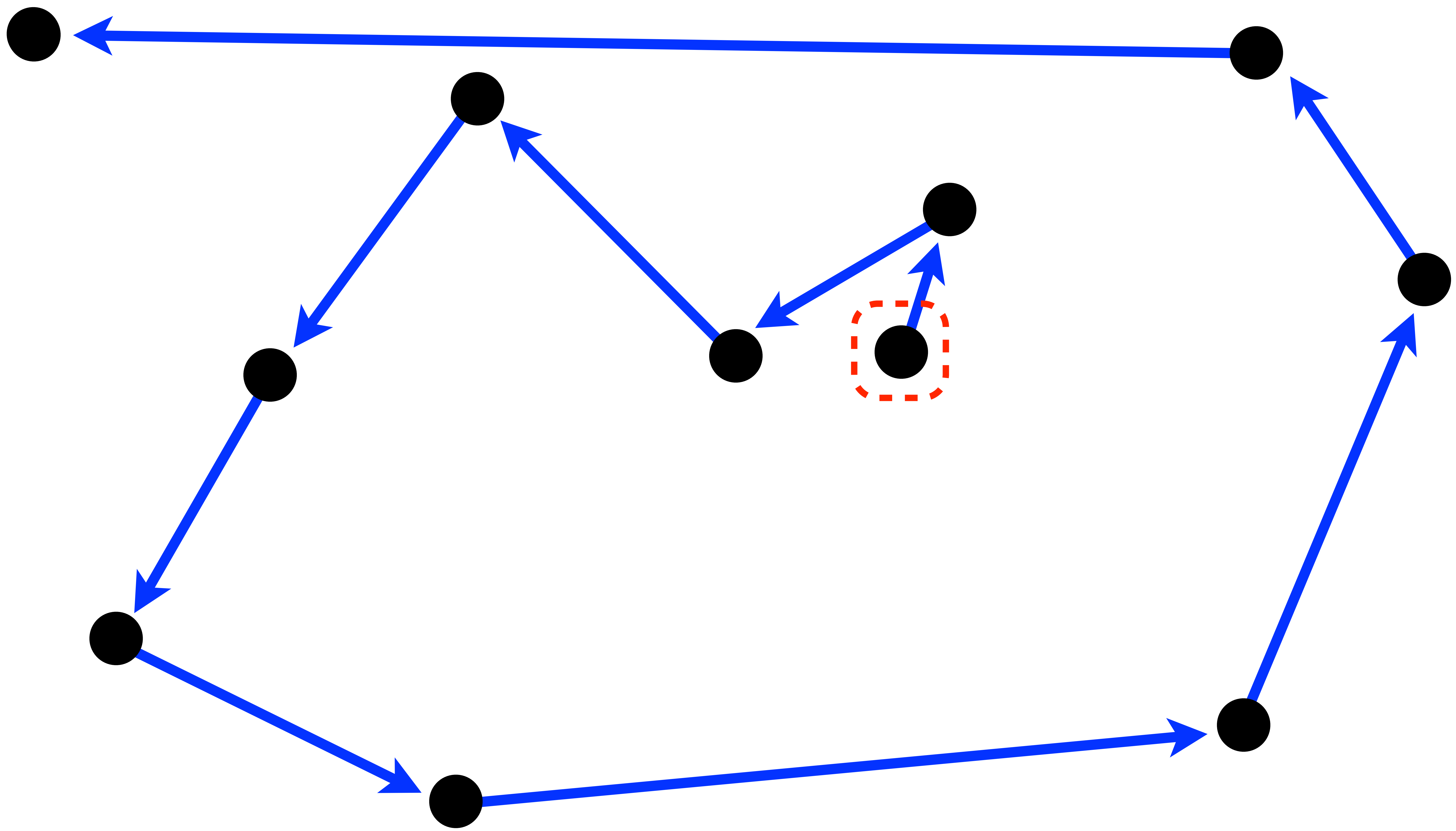

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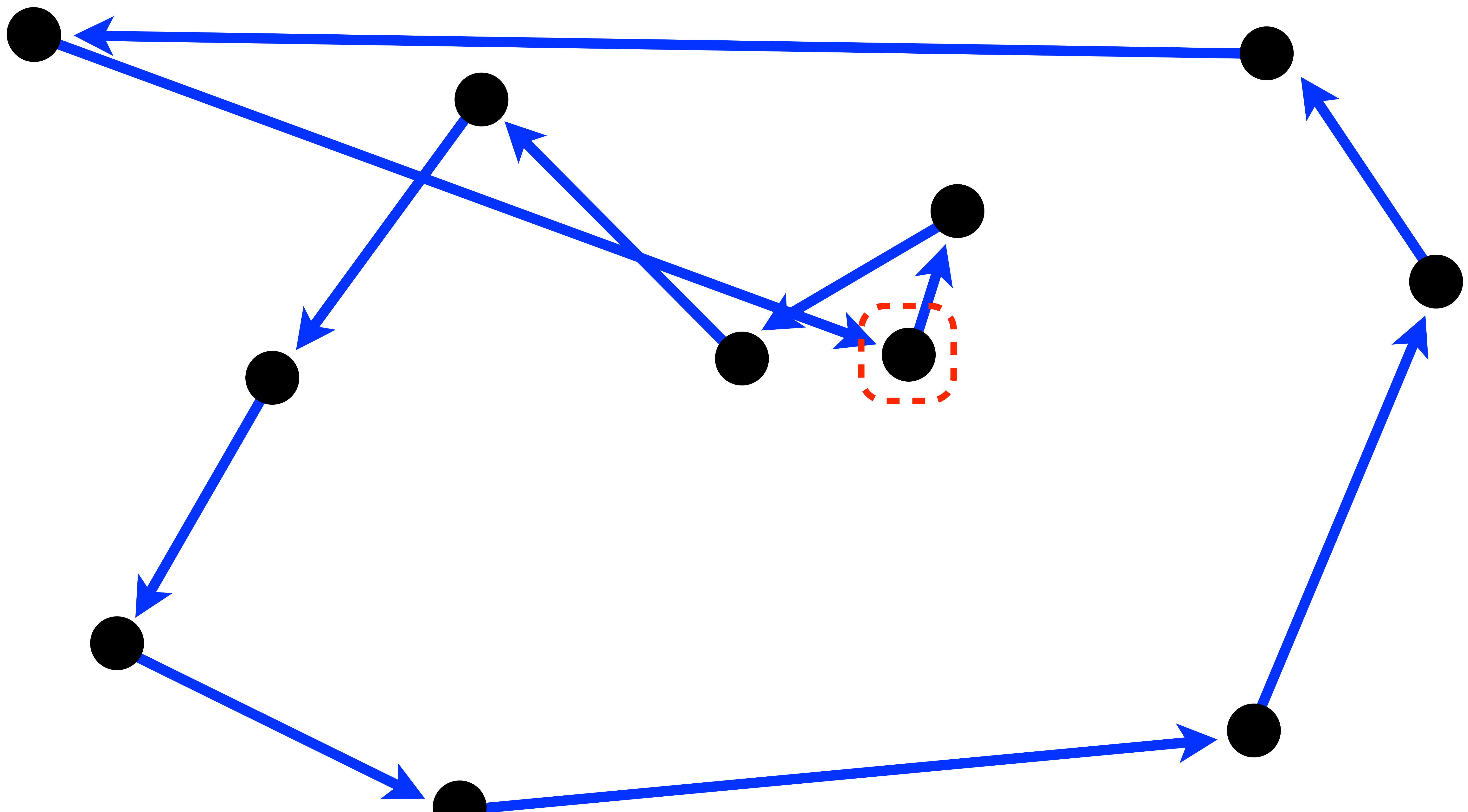

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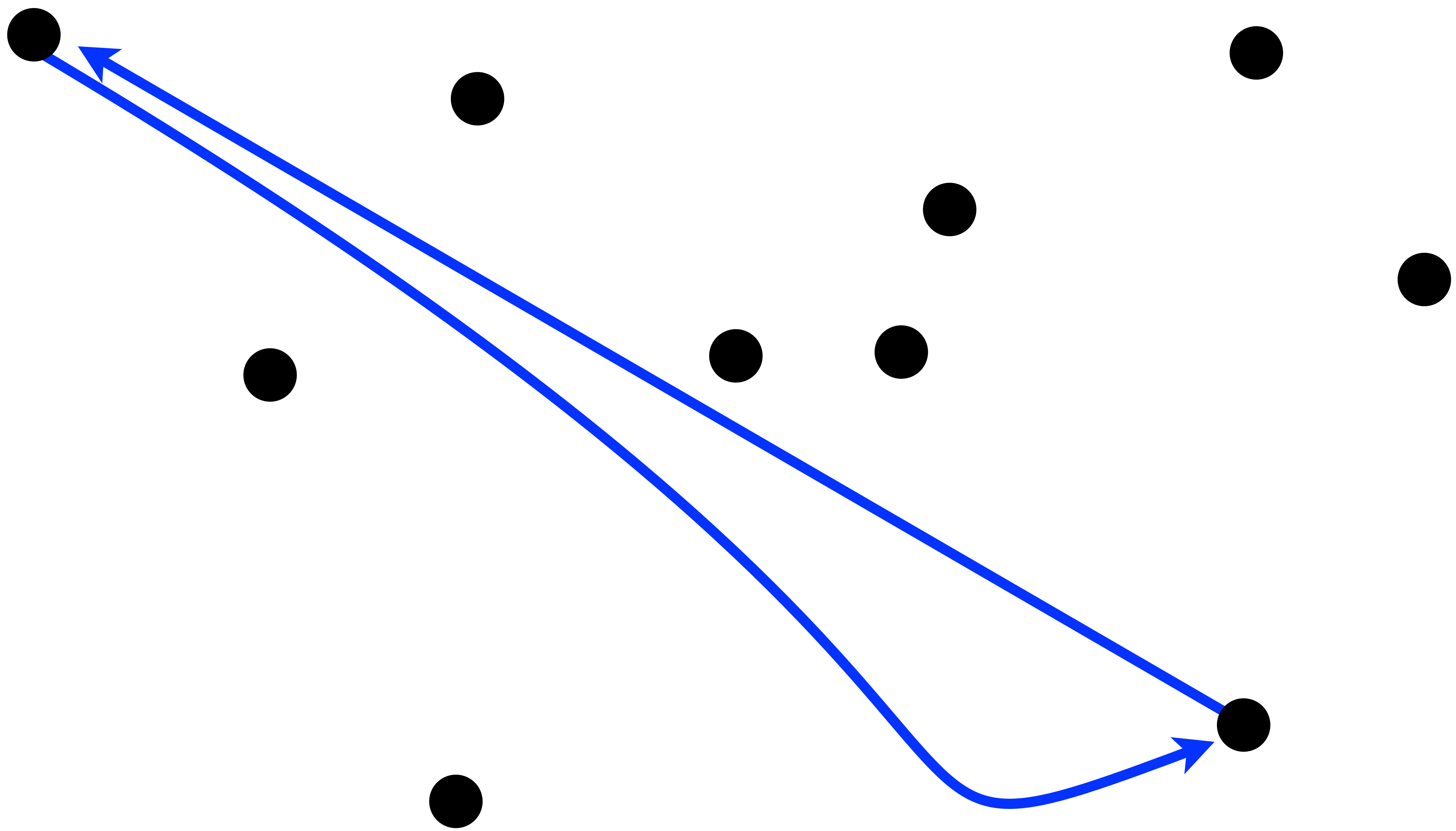

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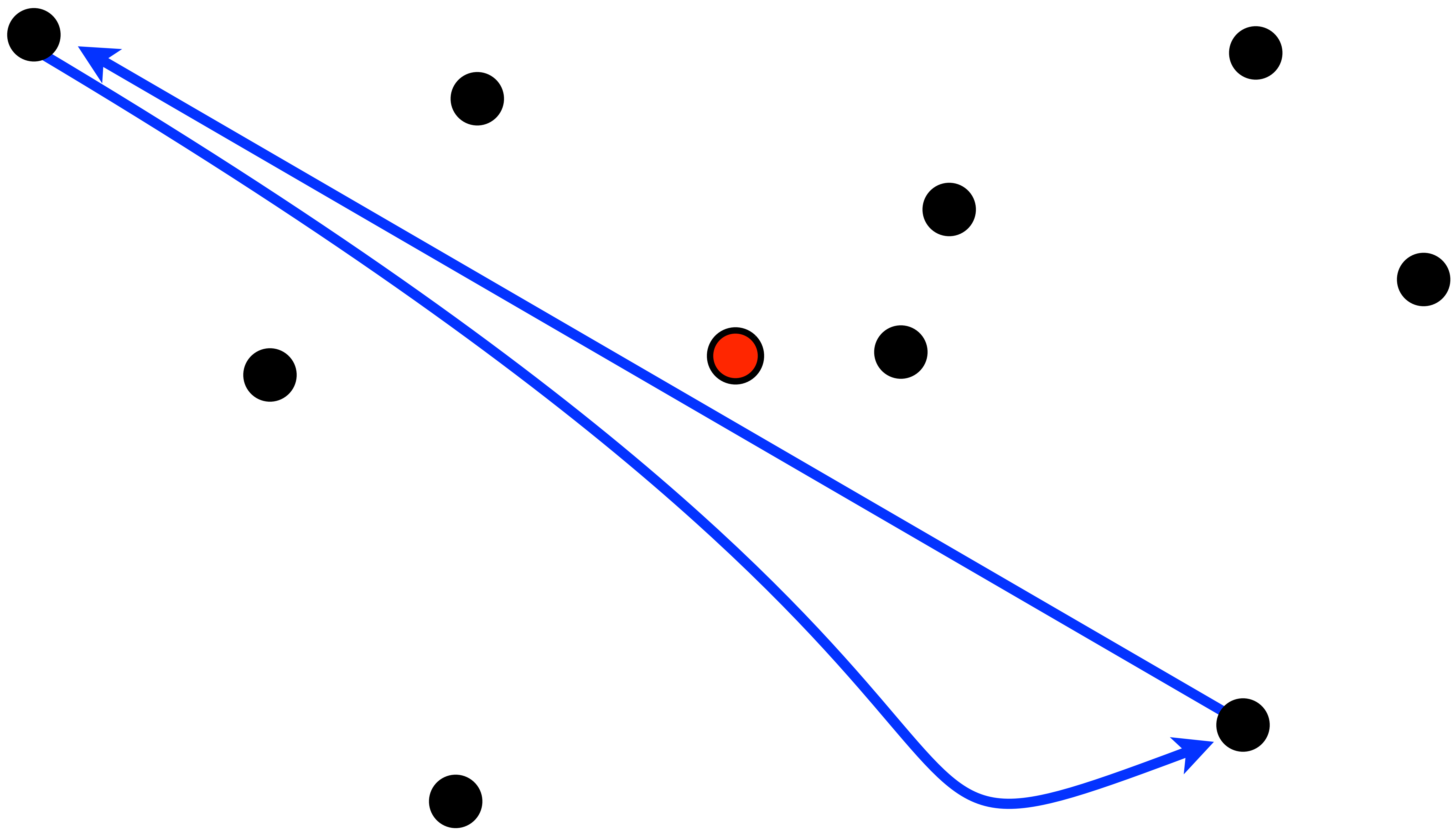

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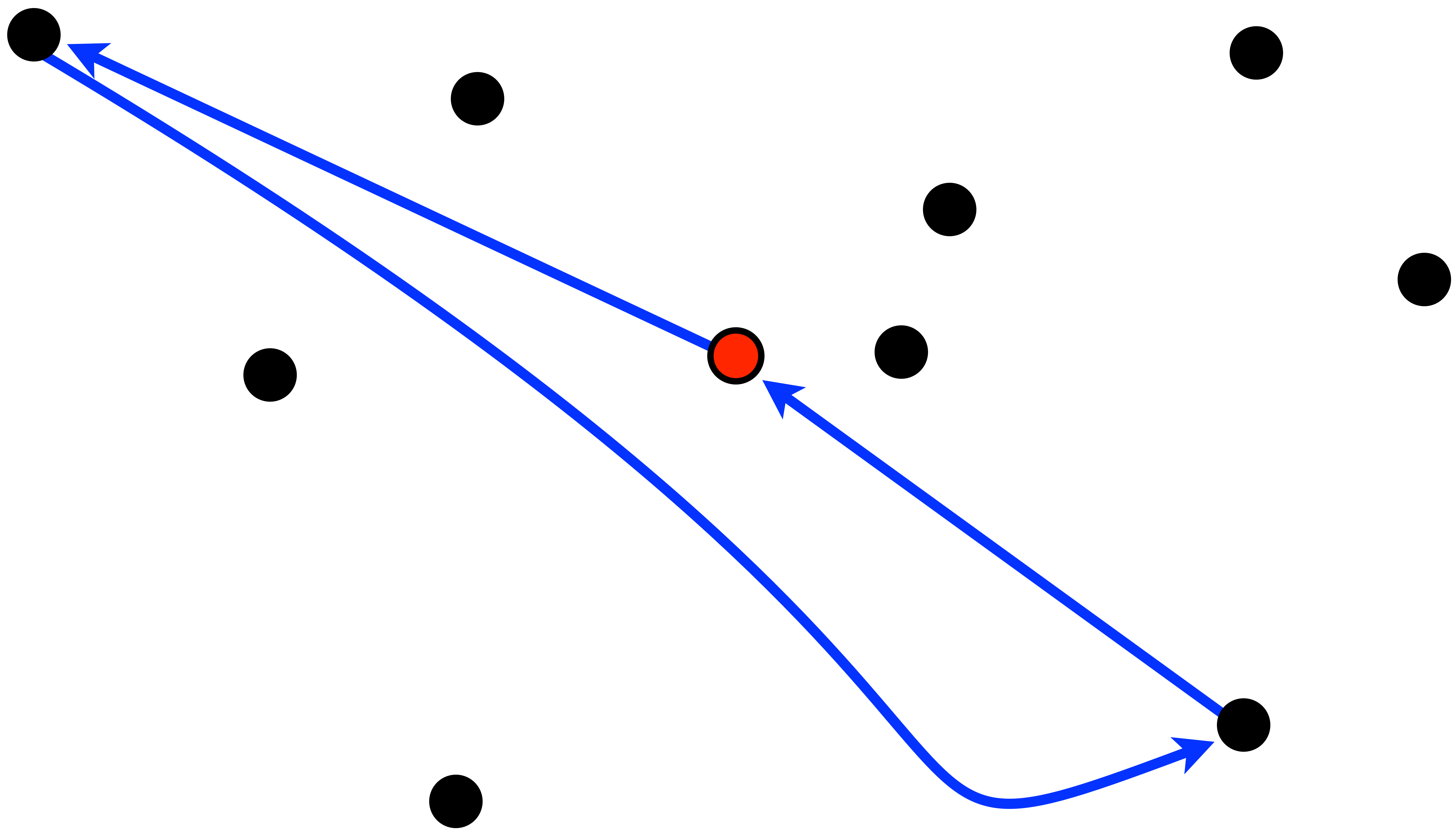

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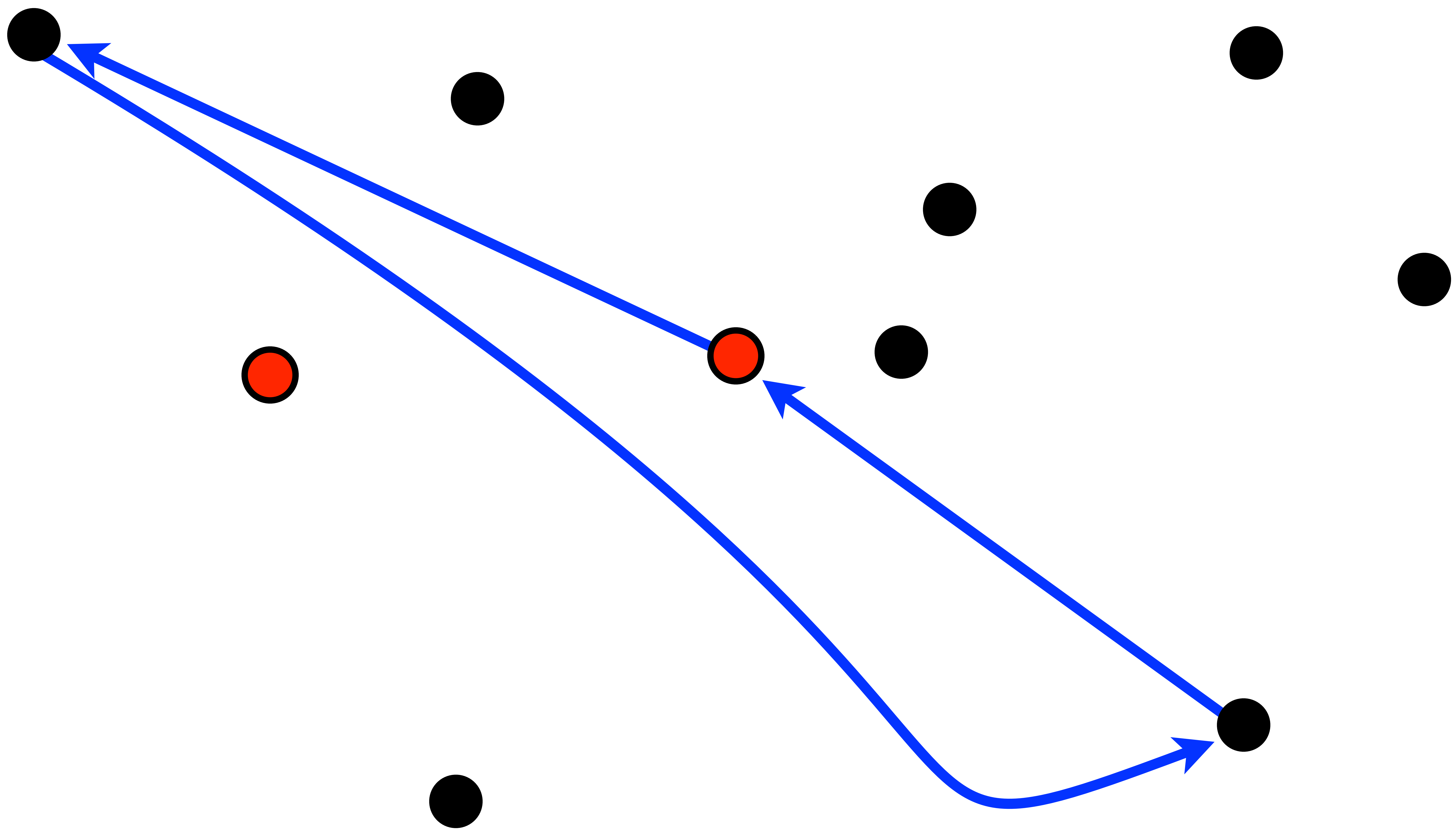

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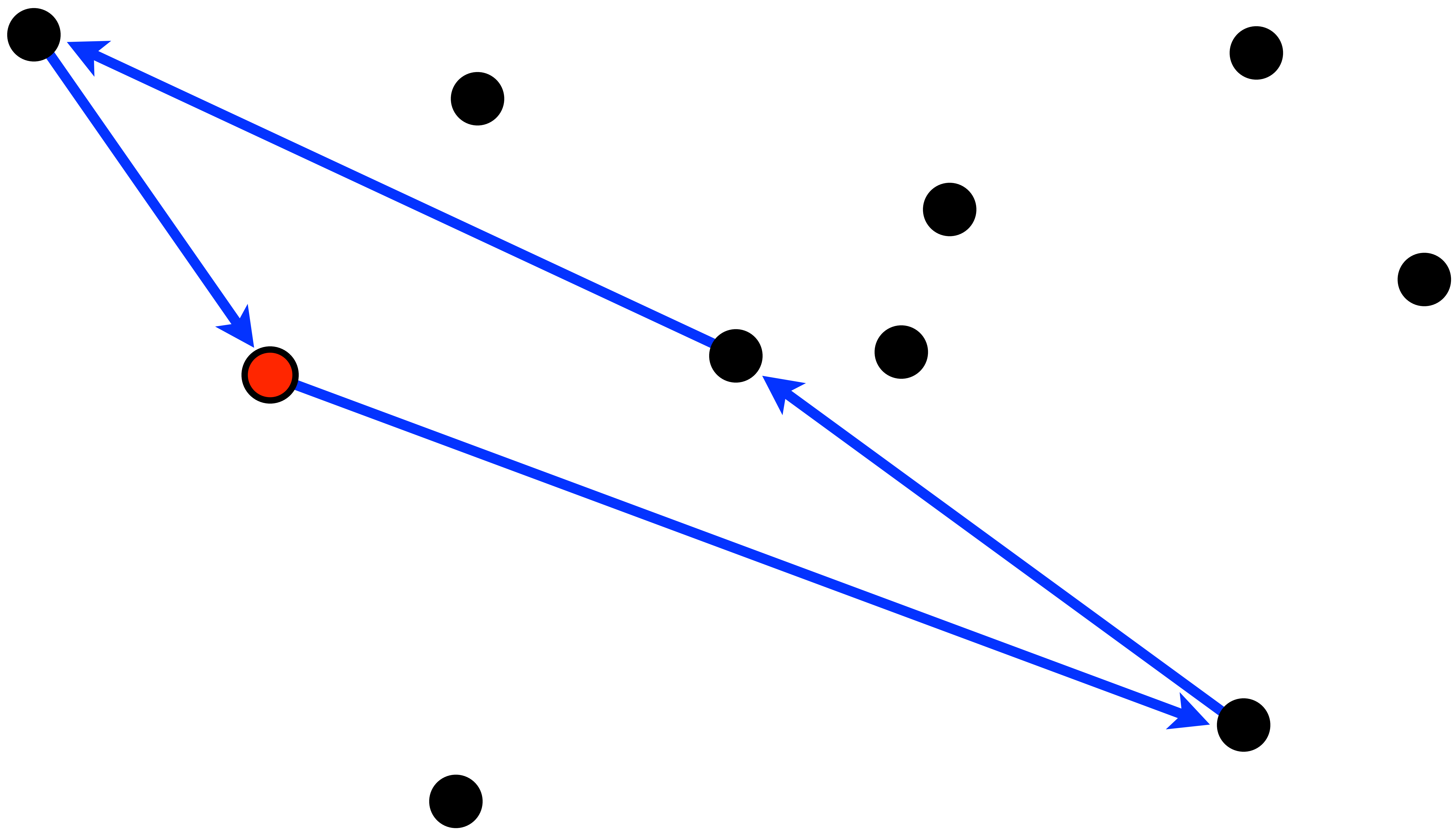

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- Advantages
  - quick to design and implement
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- Problems
  - no quality guarantees (in general)
  - quality can vary widely on the input
  - problem feasibly needs to be "easy"

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- Ways to
  - reliably find feasible solutions
  - reliably build high-quality solutions
    - robust to different inputs
  - ideally, proving those solutions are the best

Until Next Time