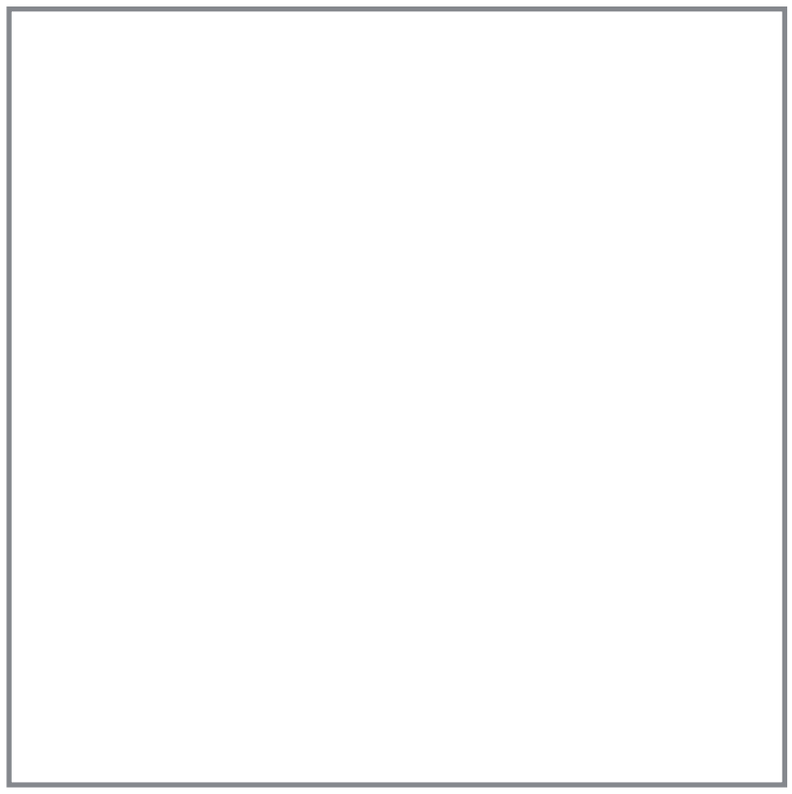
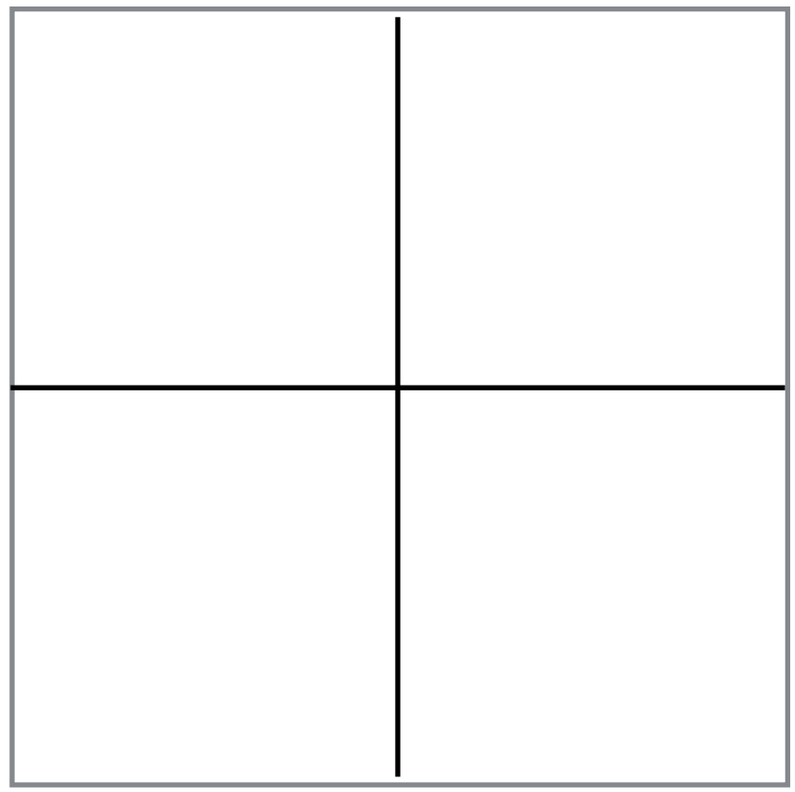
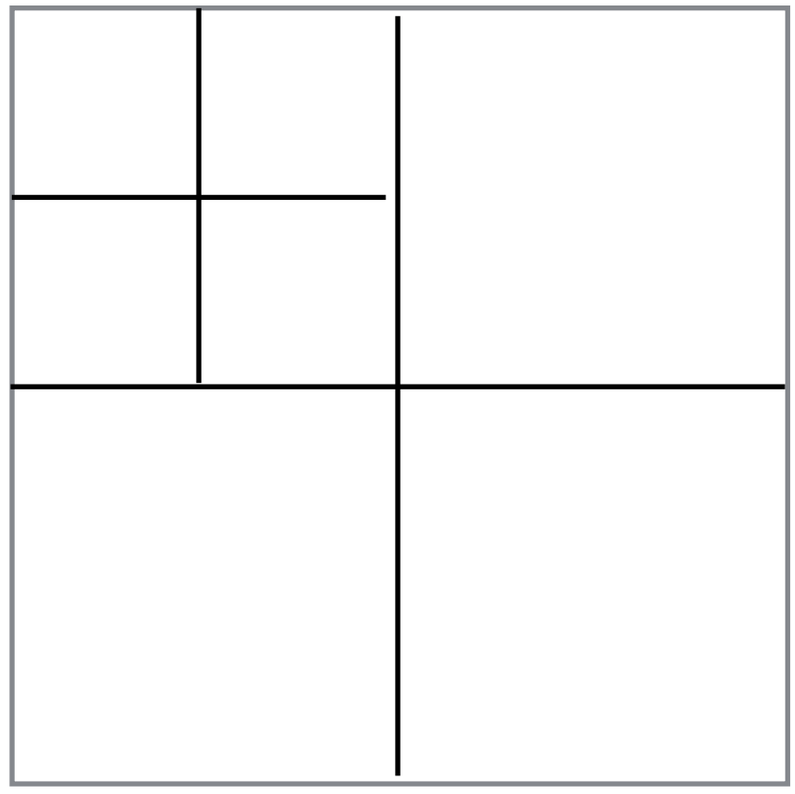
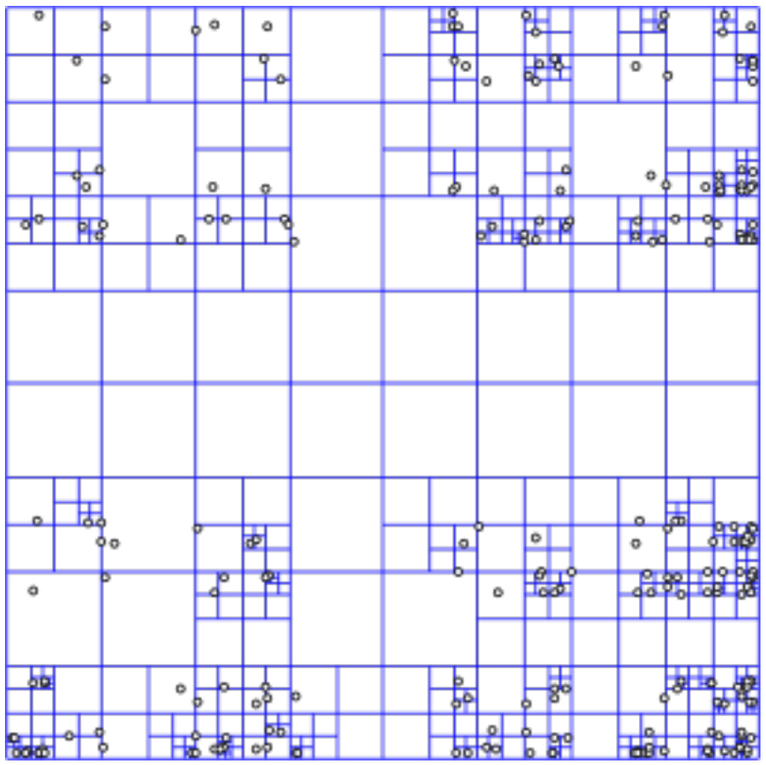
Quadtree

- A data structure that corresponds to a hierarchical subdivision of the plane
- Start with a square (containing inside input data)
  - Divide into 4 equal squares (quadrants)
  - Continue subdividing each quadrant recursively
  - Subdivide a square until it satisfies a stopping condition, usually that a quadrant is “small” enough
    - for e.g. contains at most 1 point



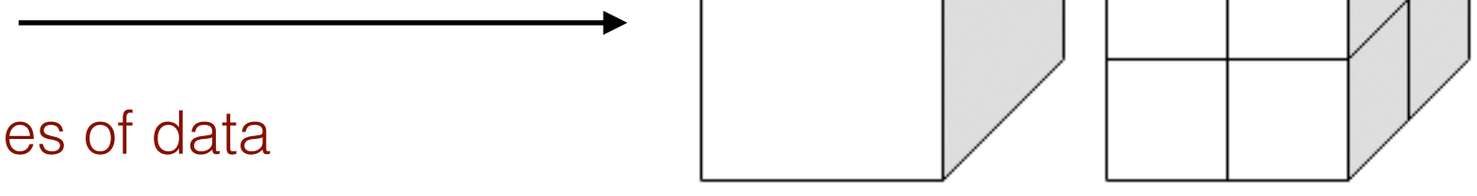






Quadtrees

- Conceptually simple
- Generalizes to >2 dimensions
  - d=3: octree



- Can be built for many types of data
  - points, edges, polygons, images, etc
- Can be used for many different tasks
  - search, point location, neighbors, etc
  - dynamic
- Theoretical bounds not great, but widely used in practice
- LOTS of applications
  - Many variants of quadtrees have been proposed
  - Hundreds of papers

Point quadtree

Let P = set of n points in the plane

Problem: Store P in a quadtree such that every square has <= 1 point.

Questions:

1. Size? Height?
2. How to build it and how fast?
3. What can we do with it?

Let P = set of n points in the plane

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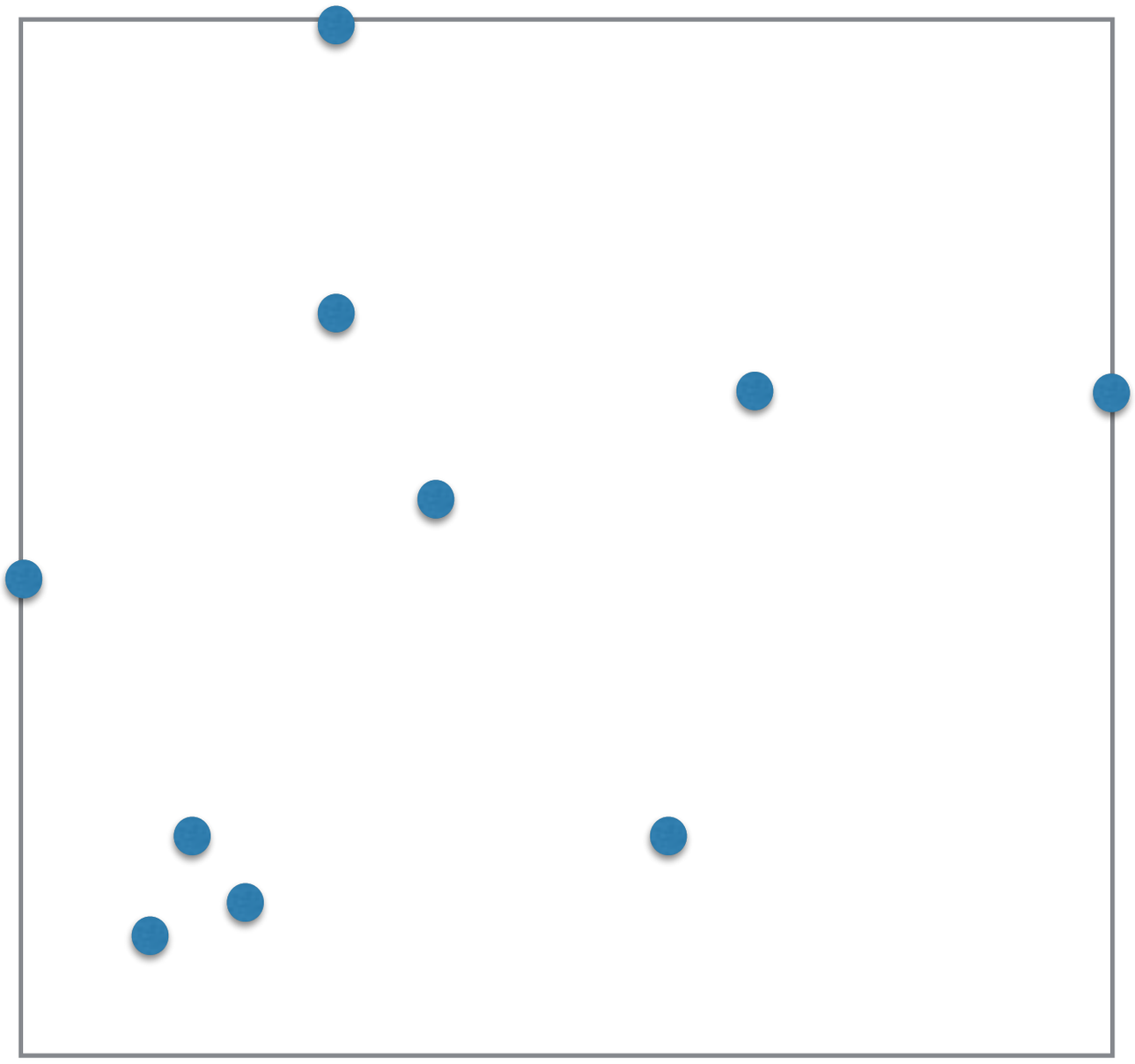

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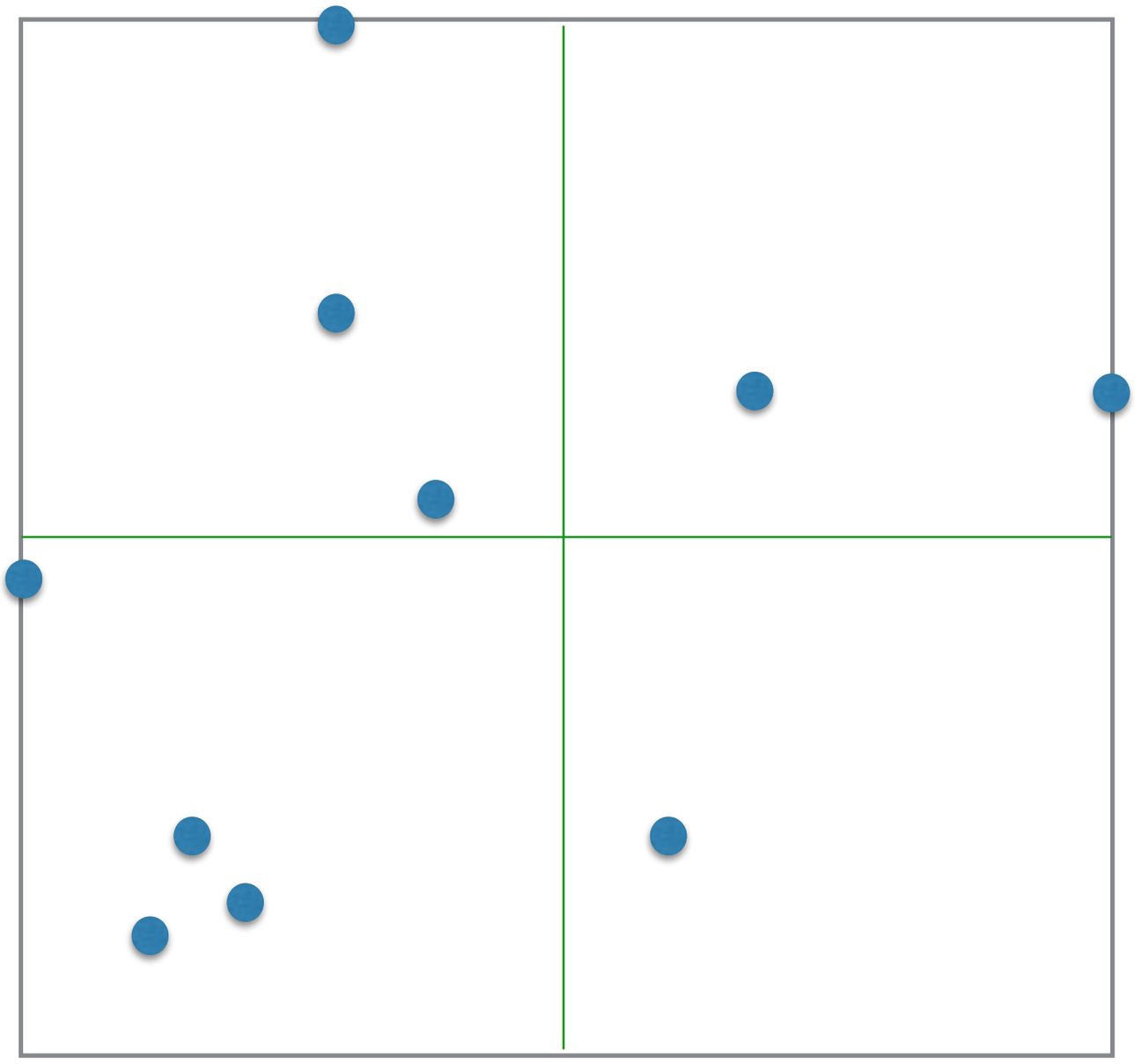

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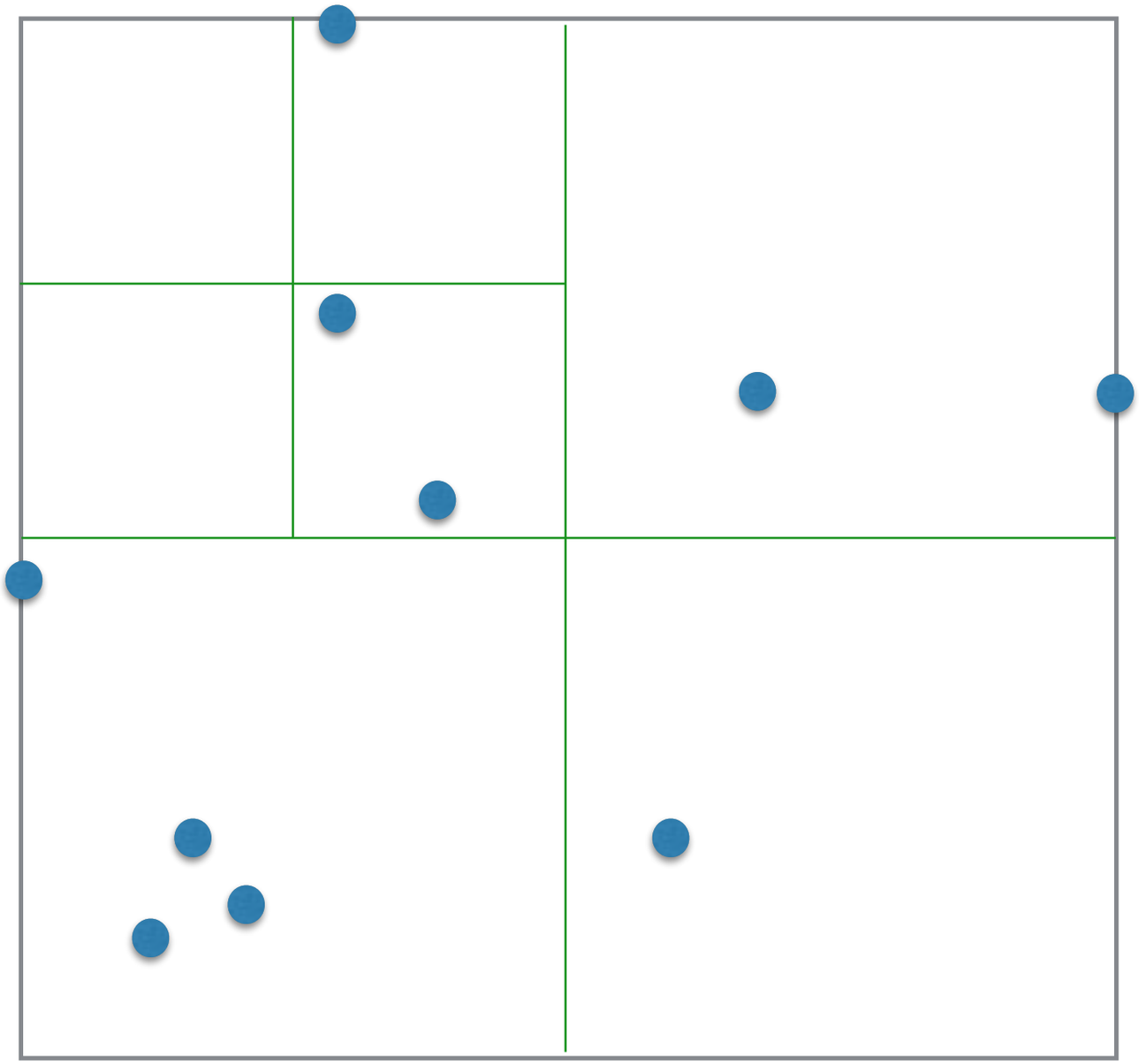

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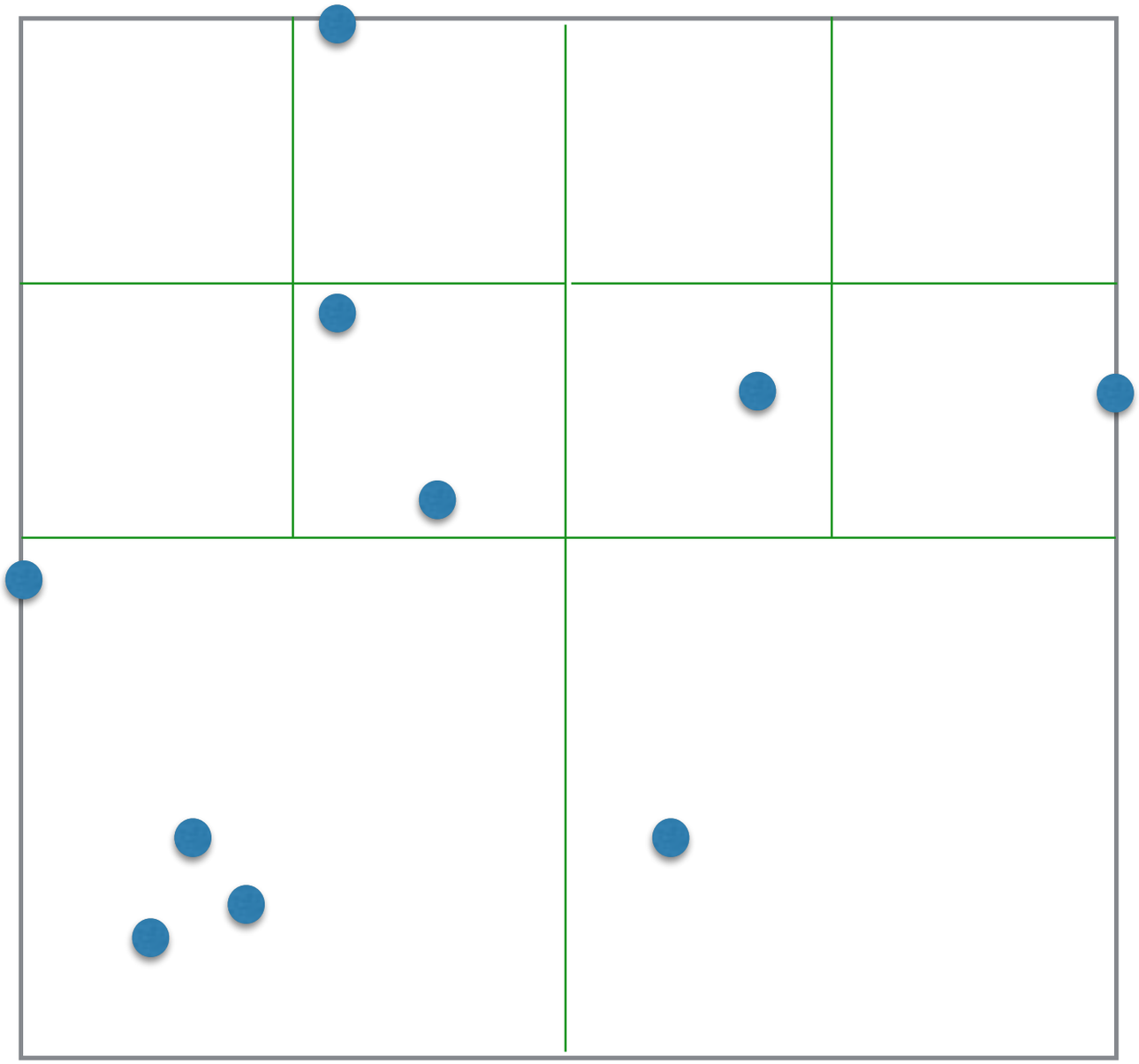

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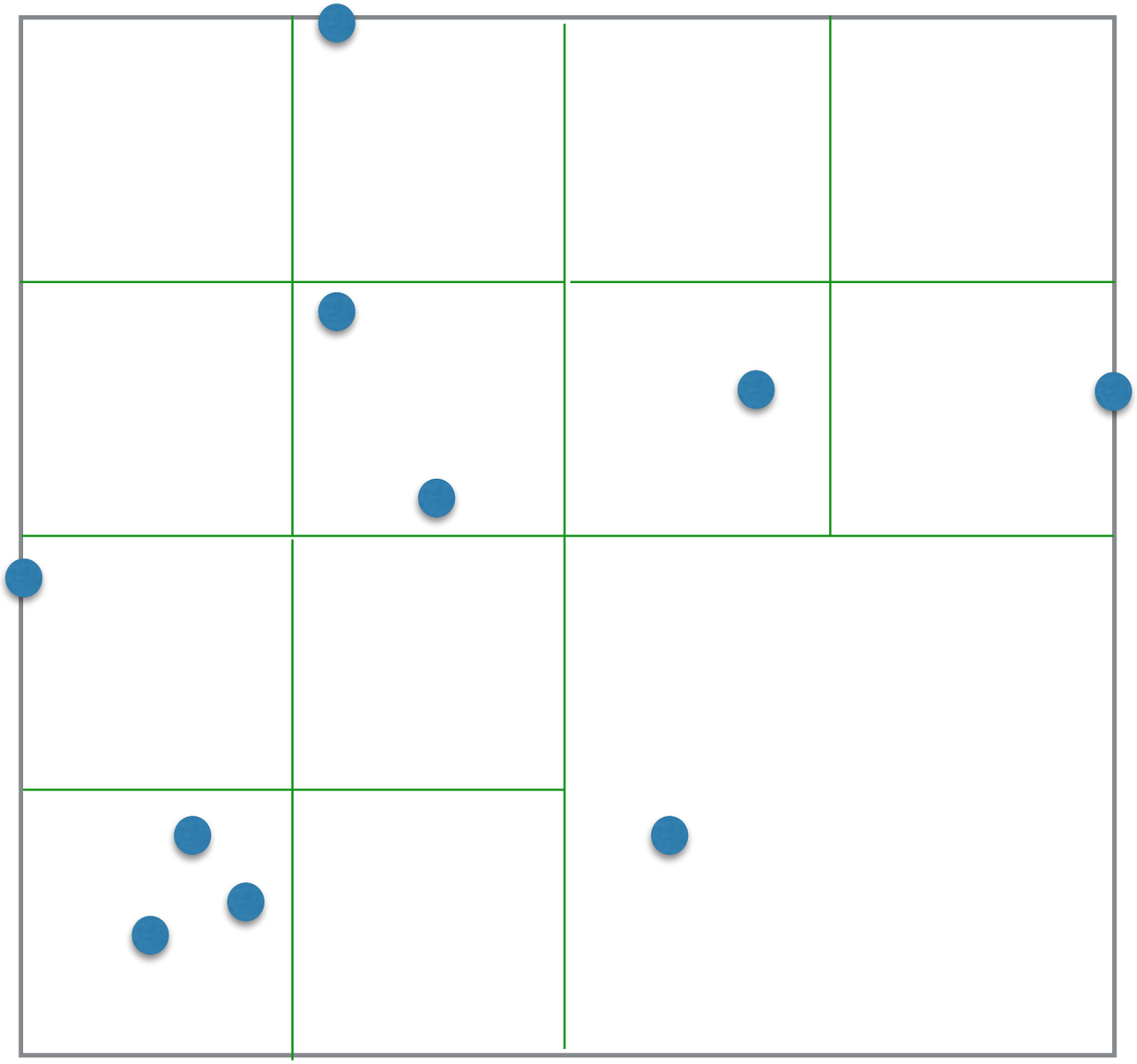

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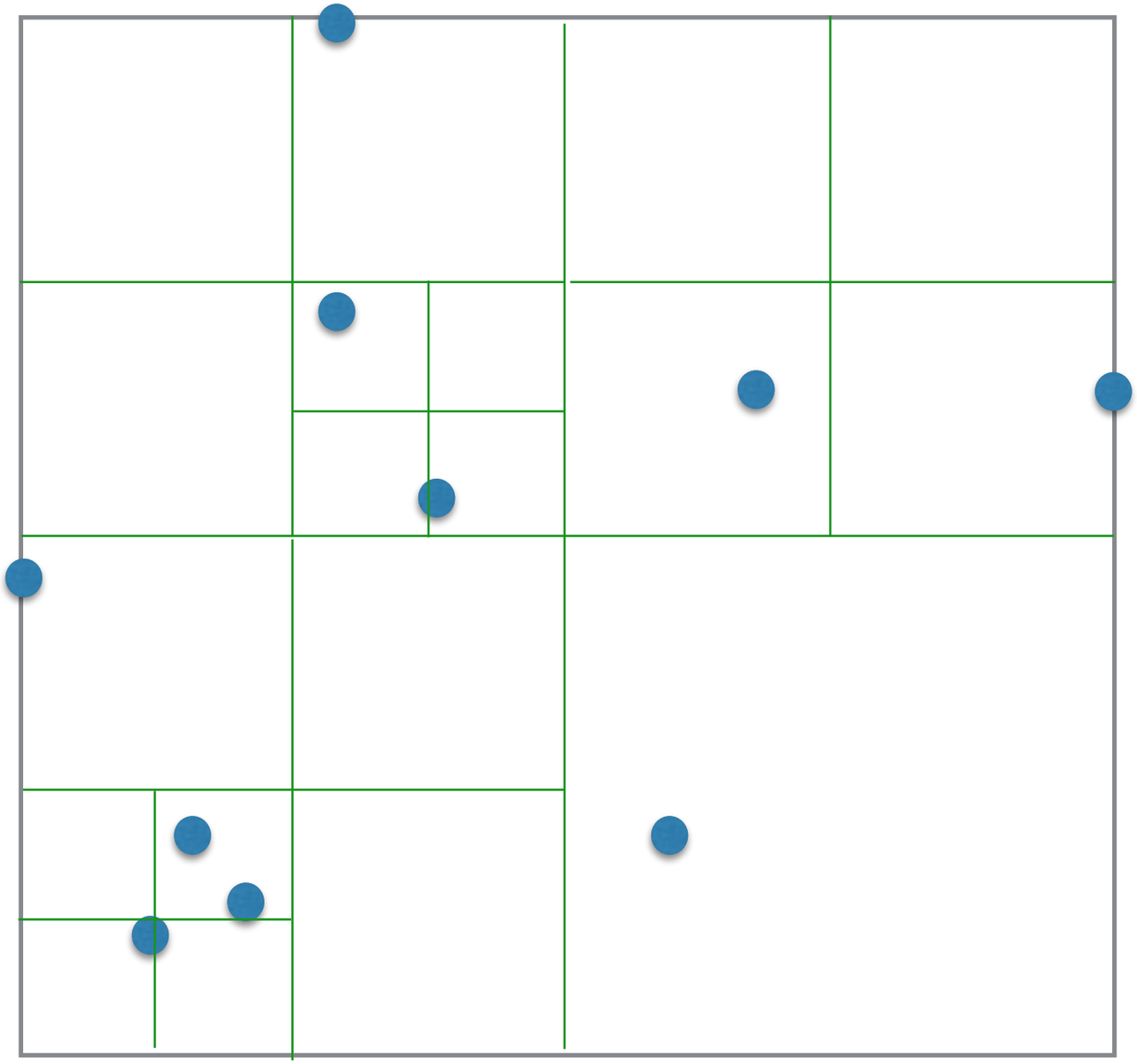

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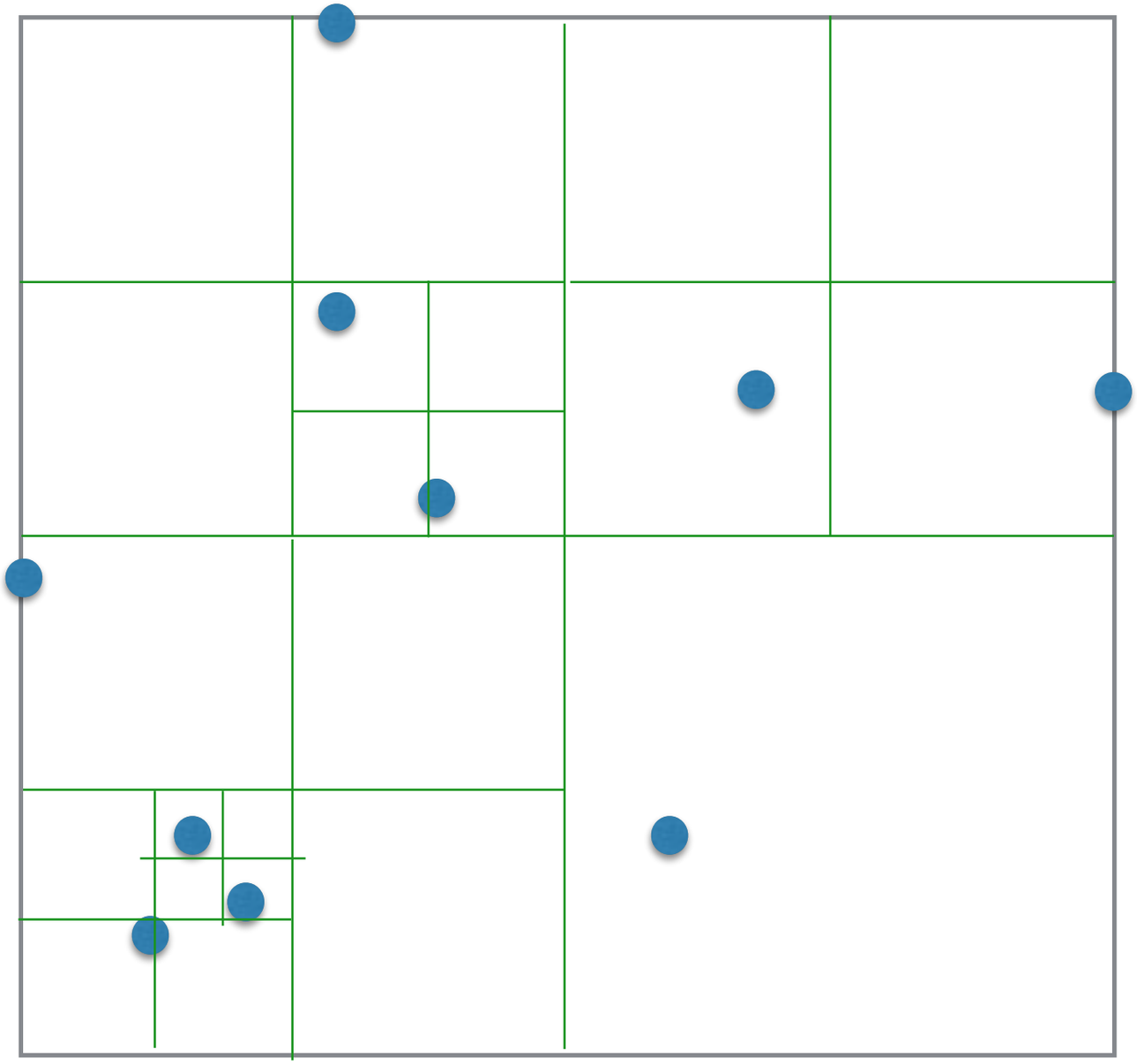

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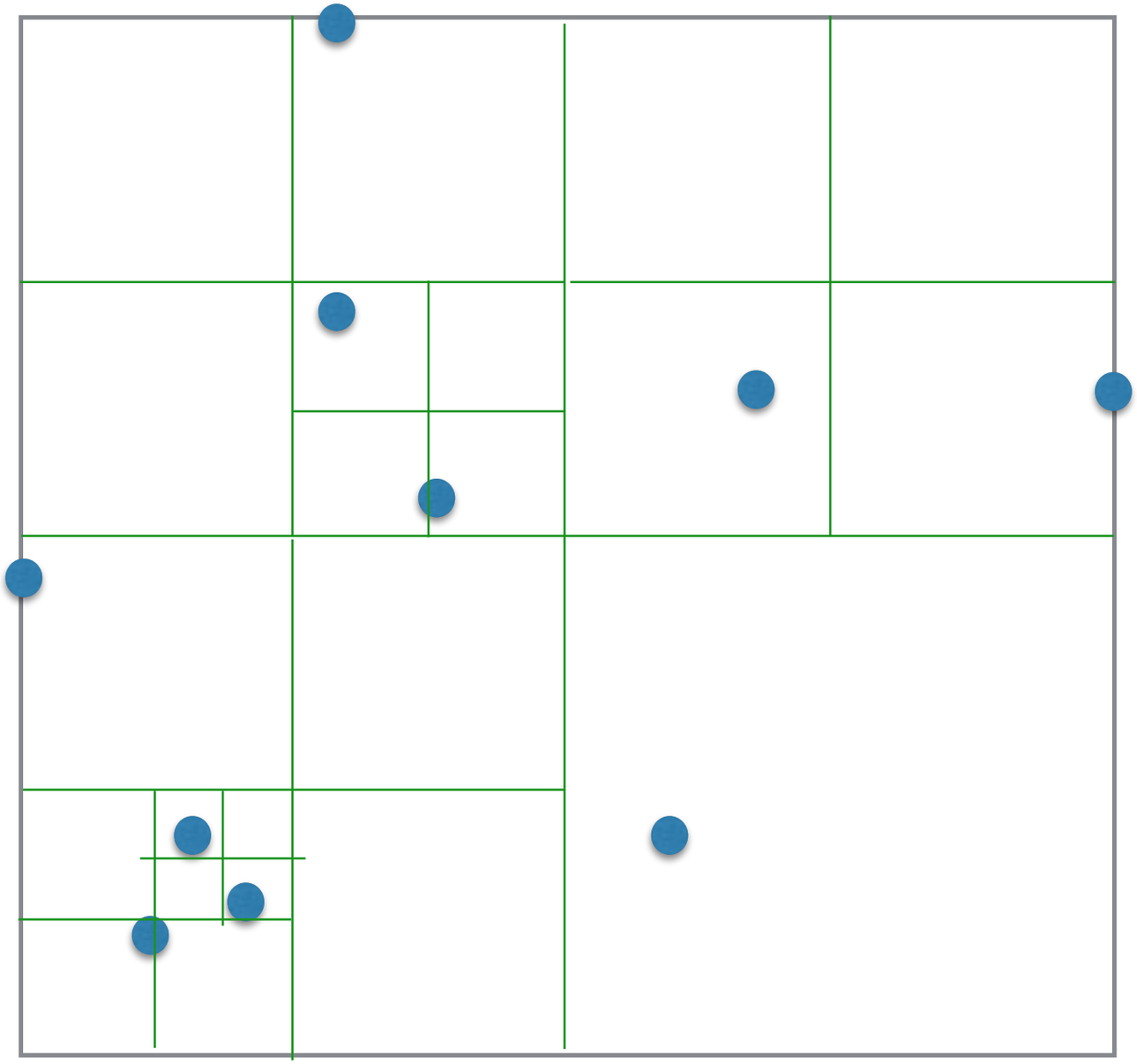

Quadtree: tree corresponding to the subdivision

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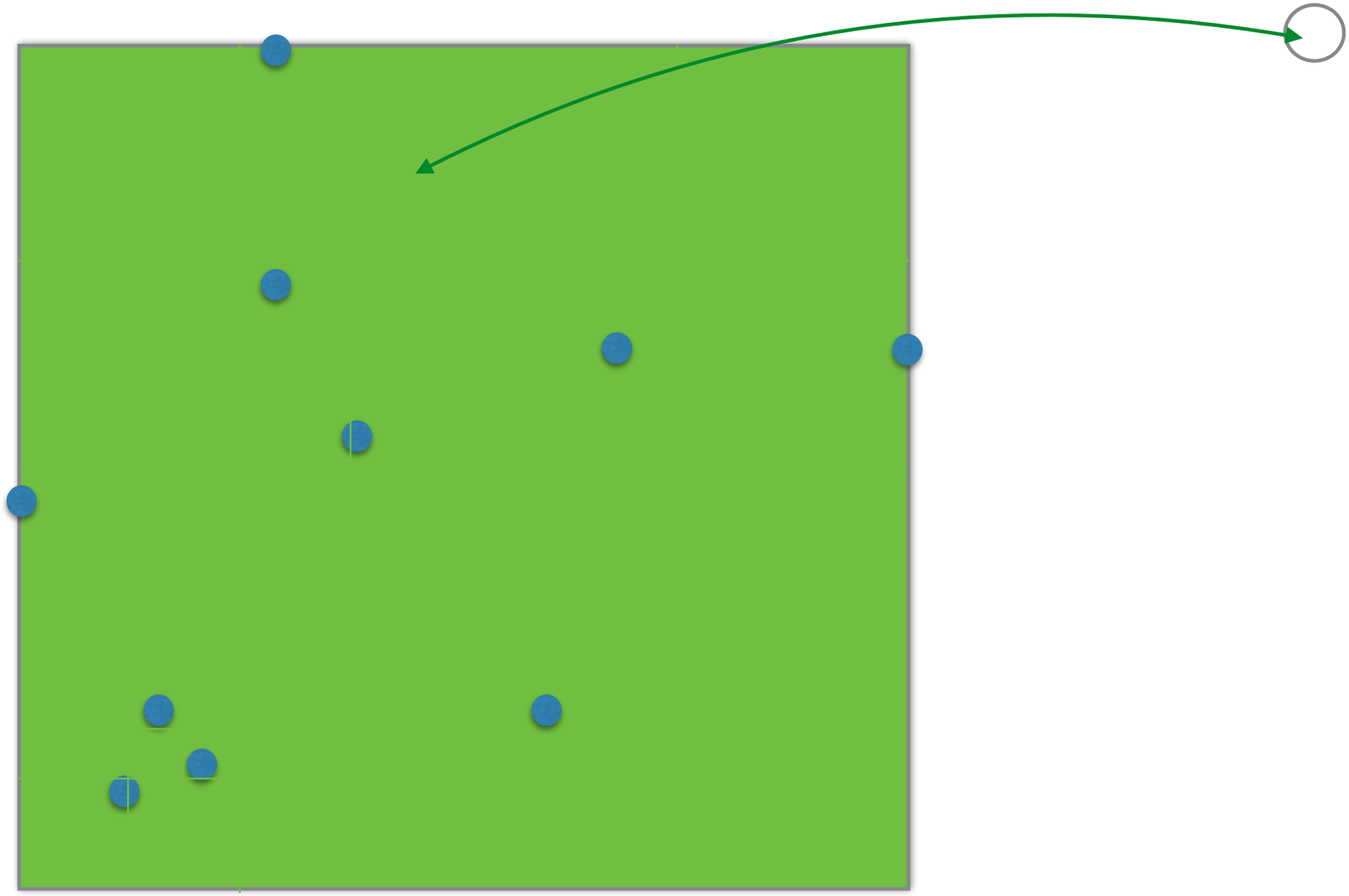

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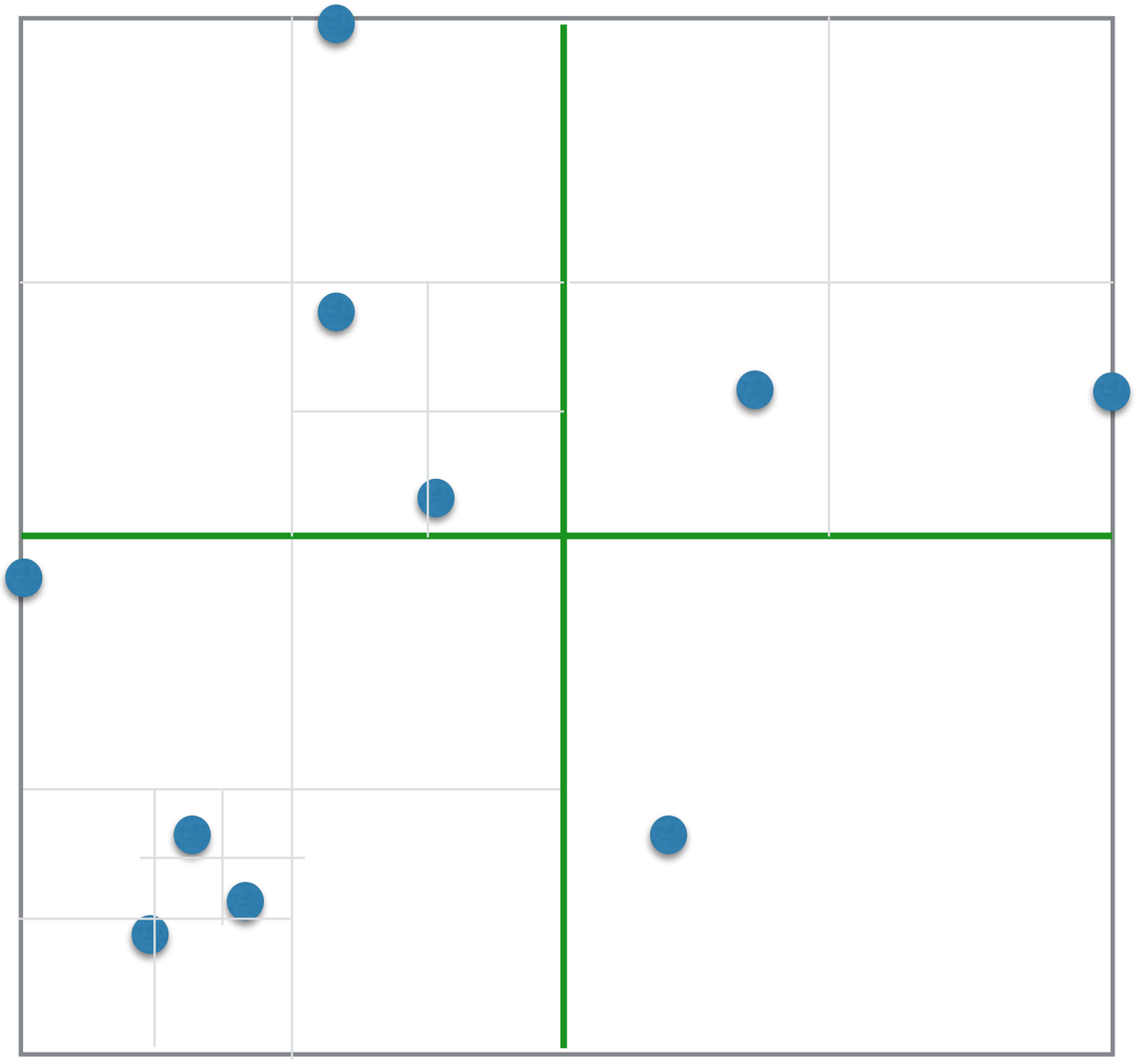

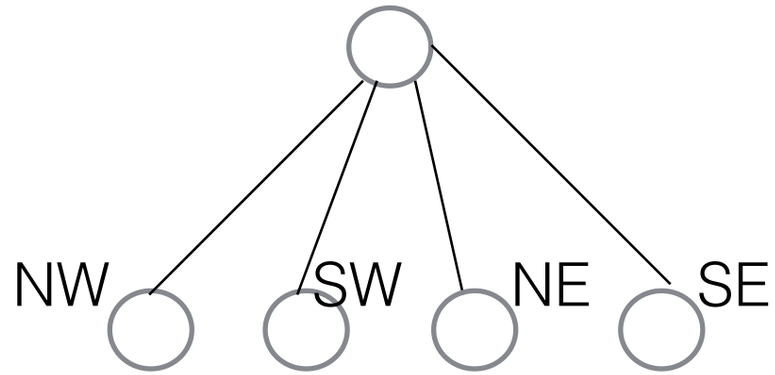

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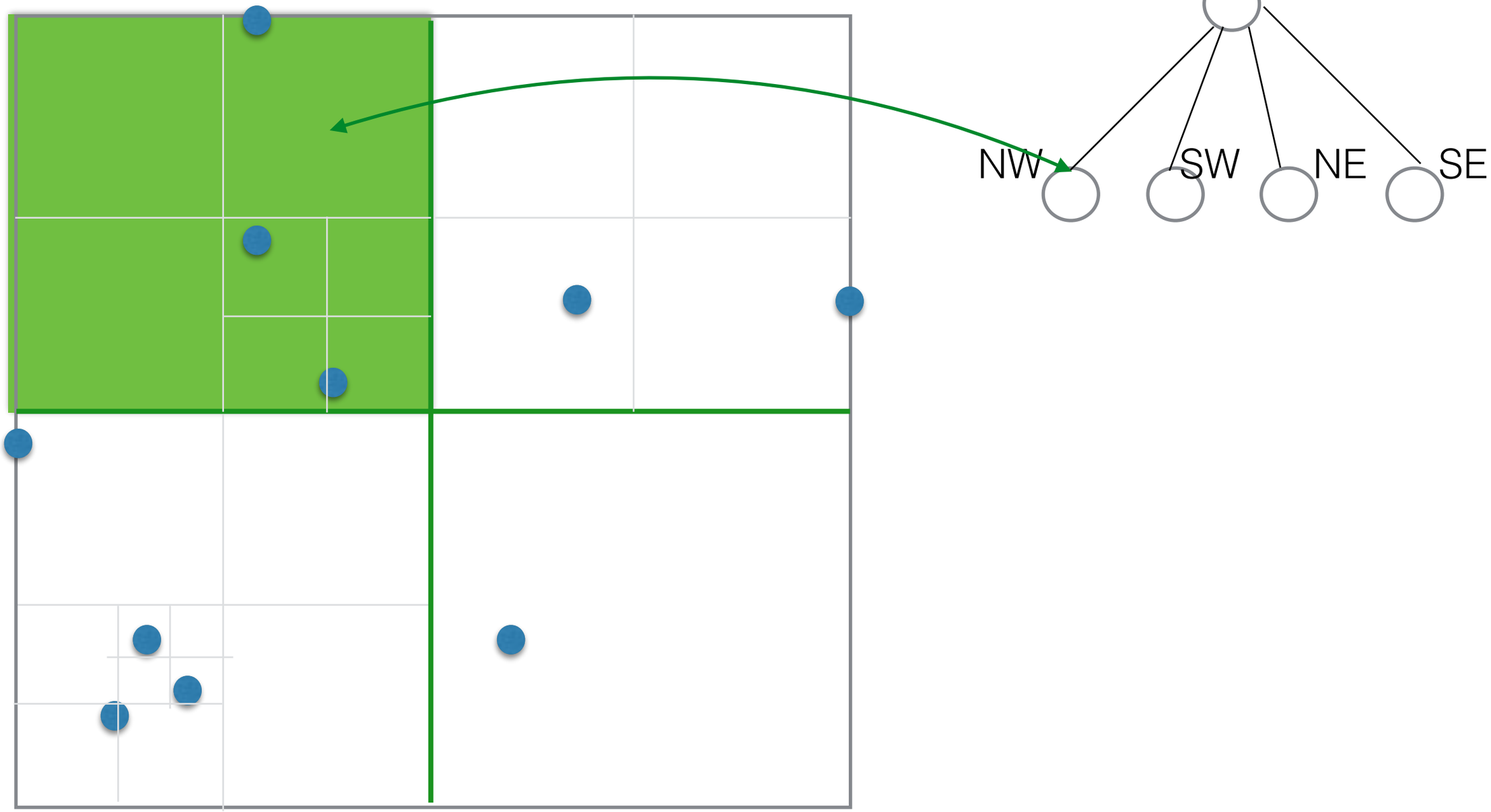

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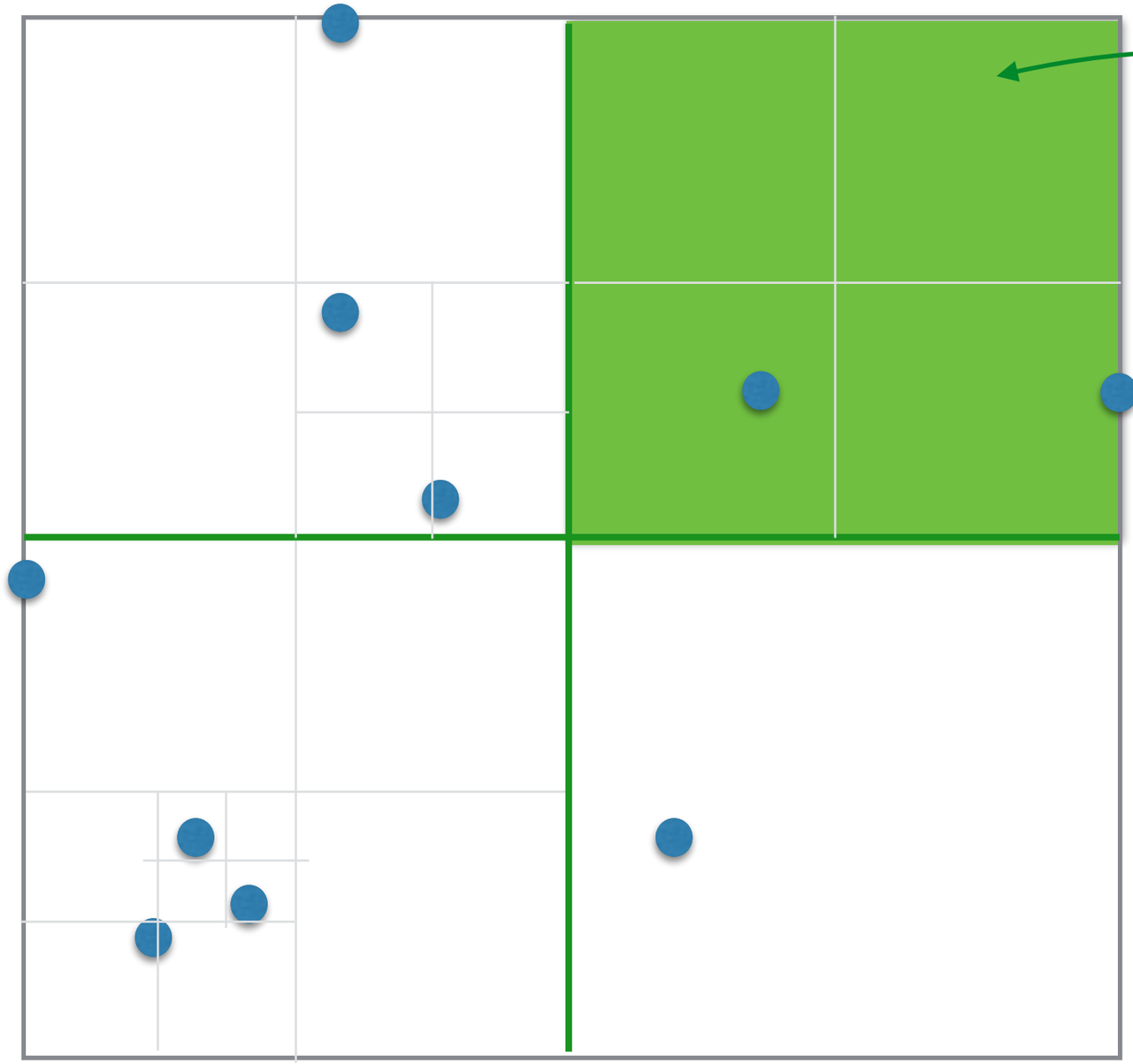

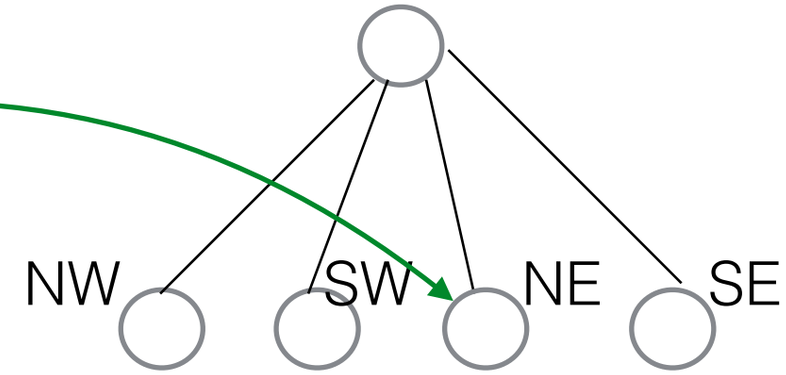

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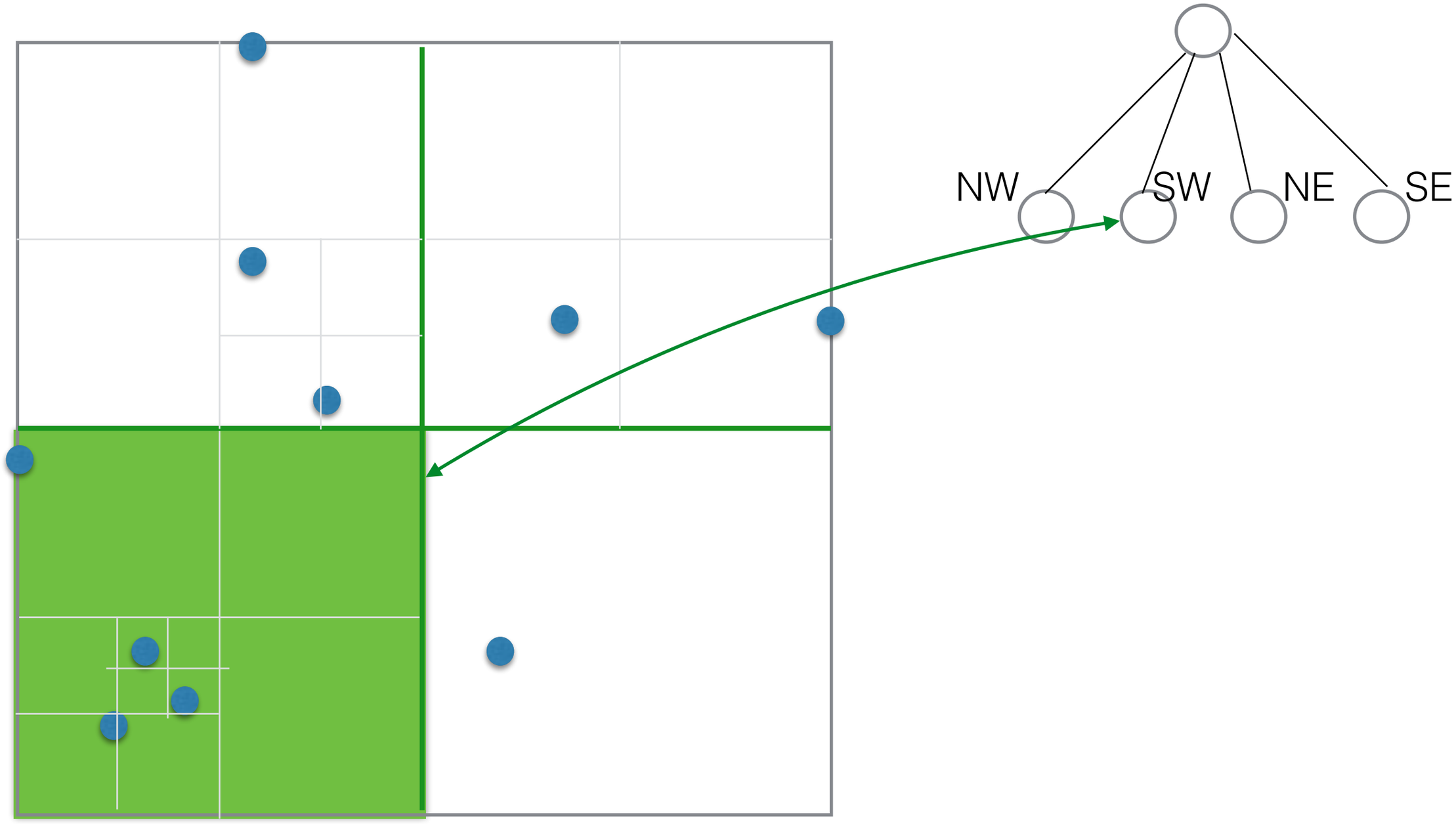

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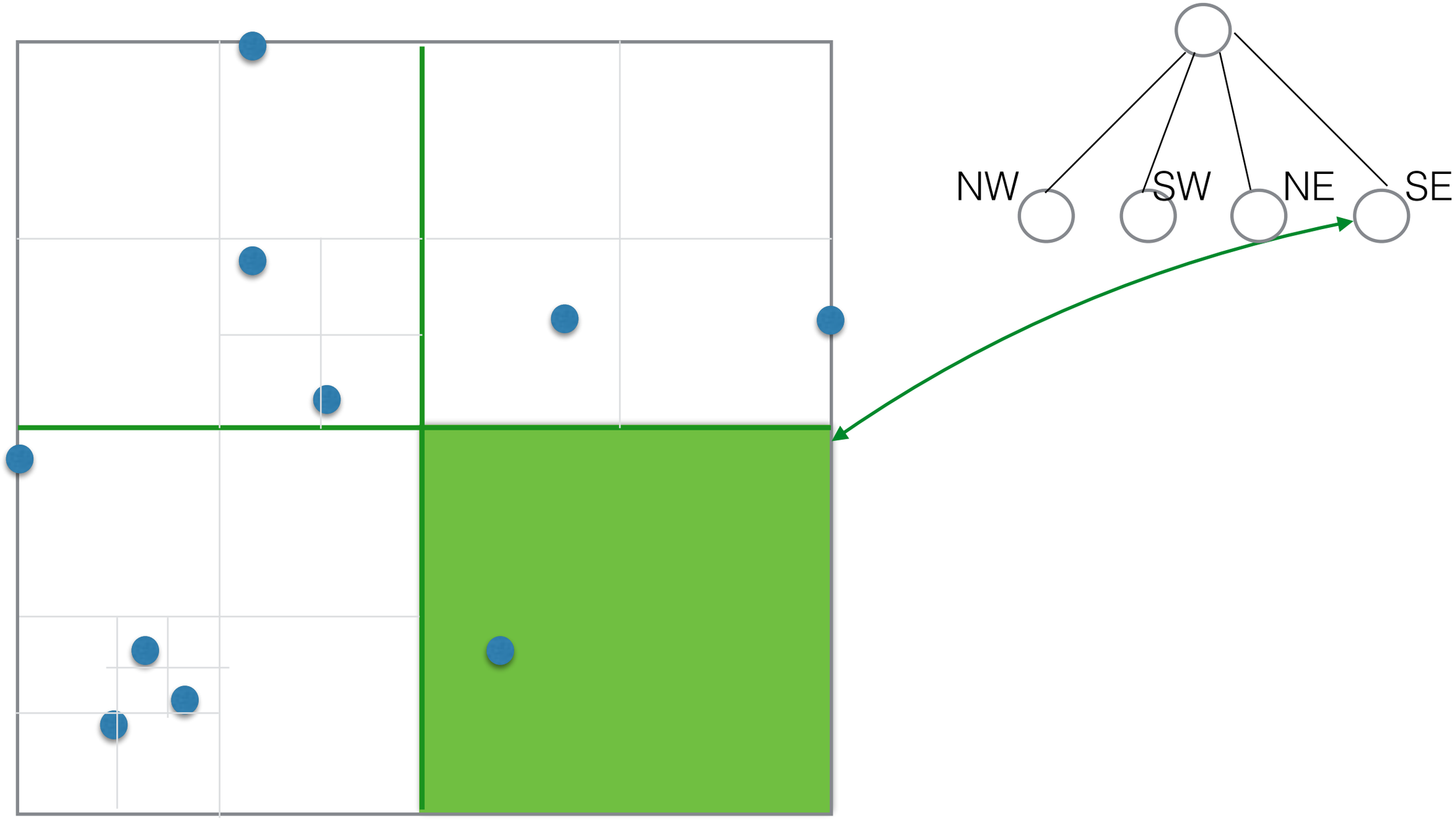

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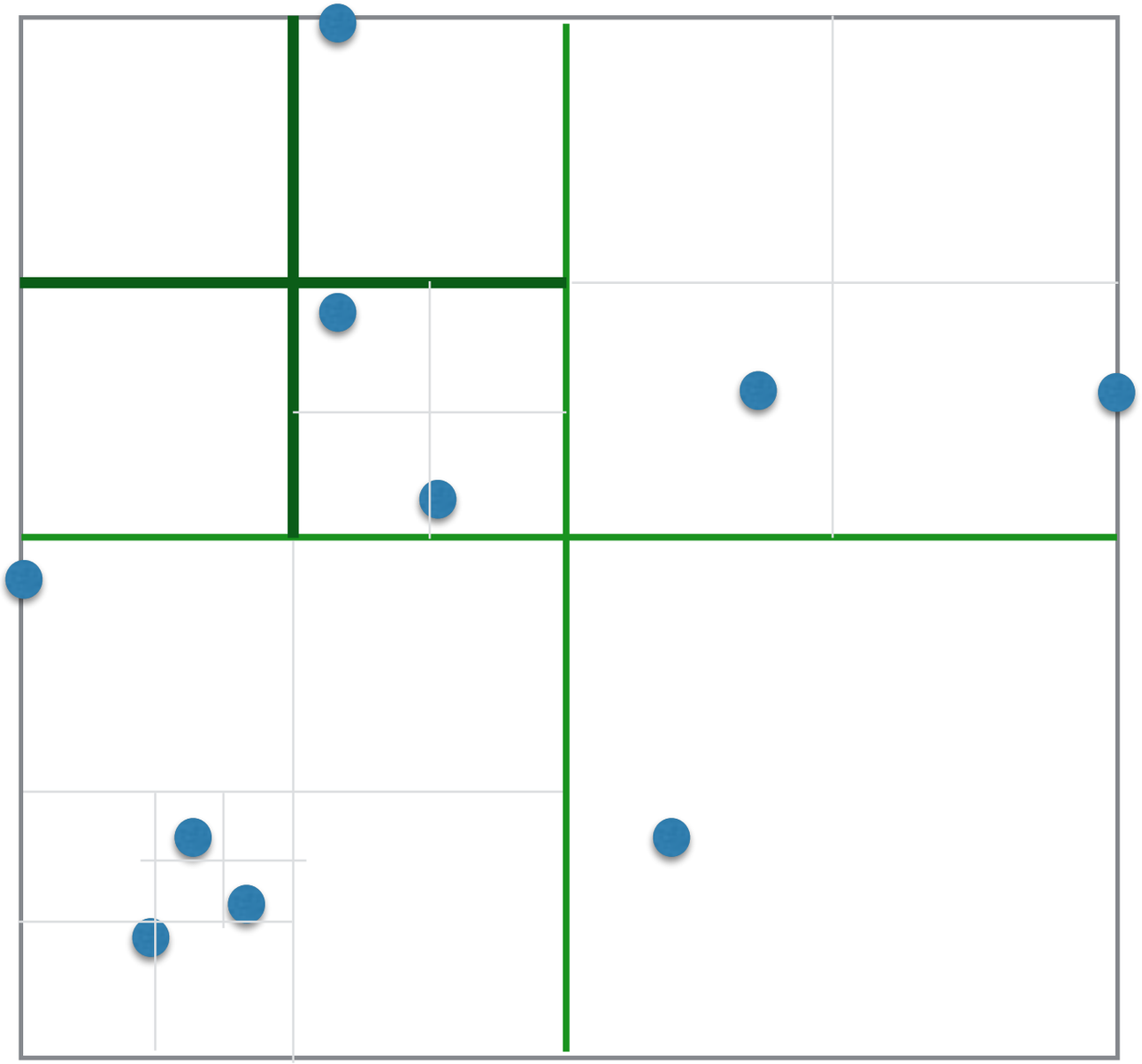

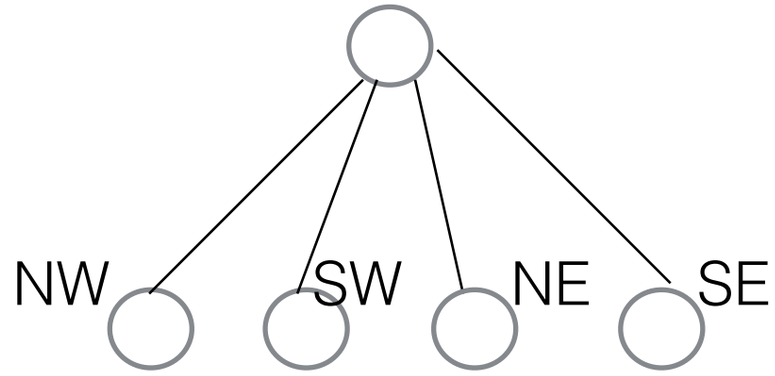

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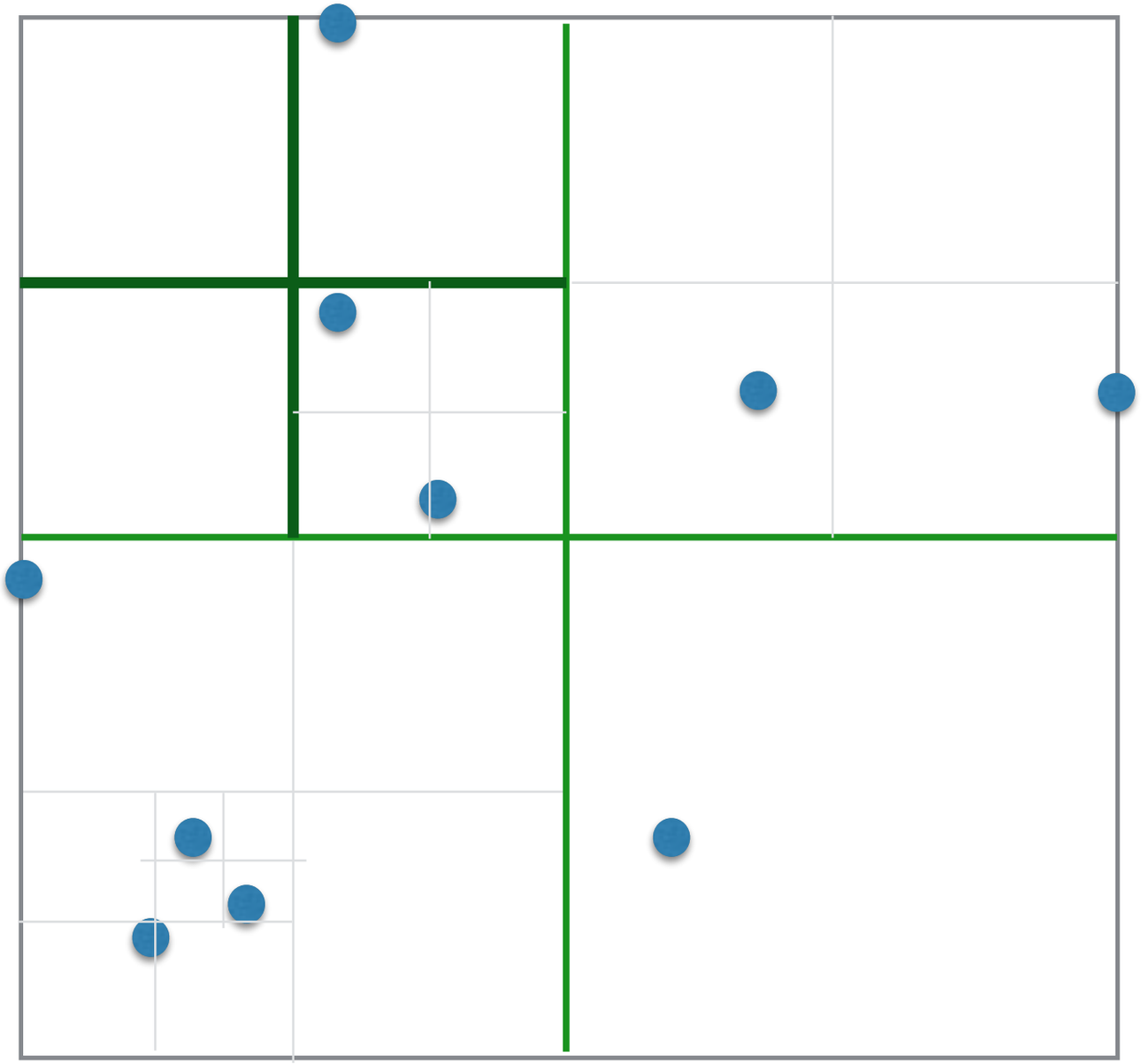

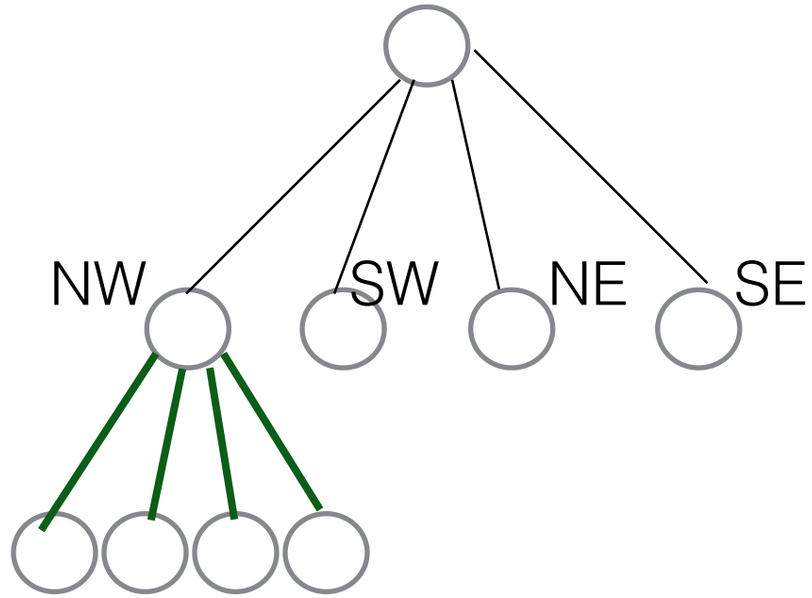

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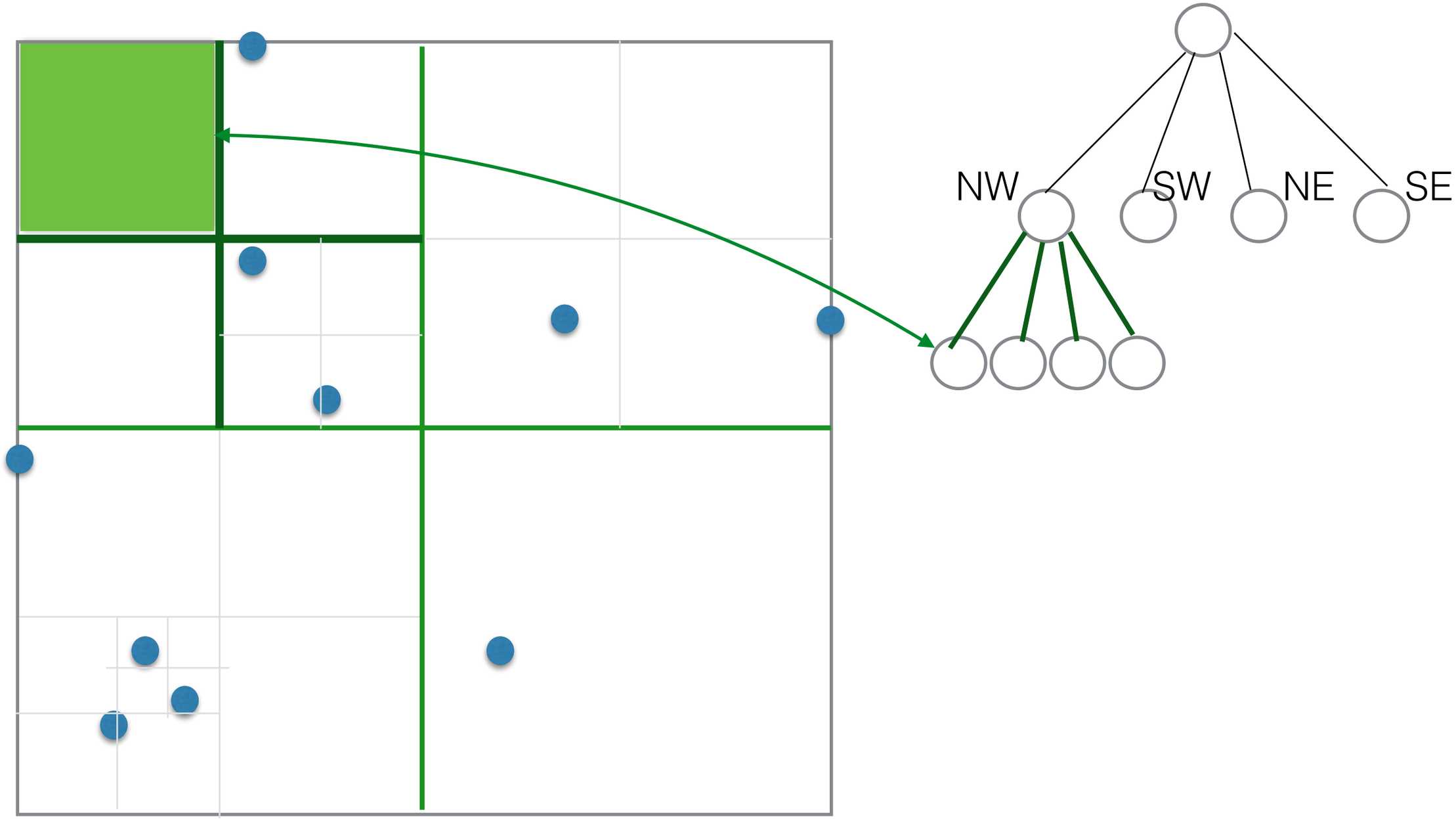

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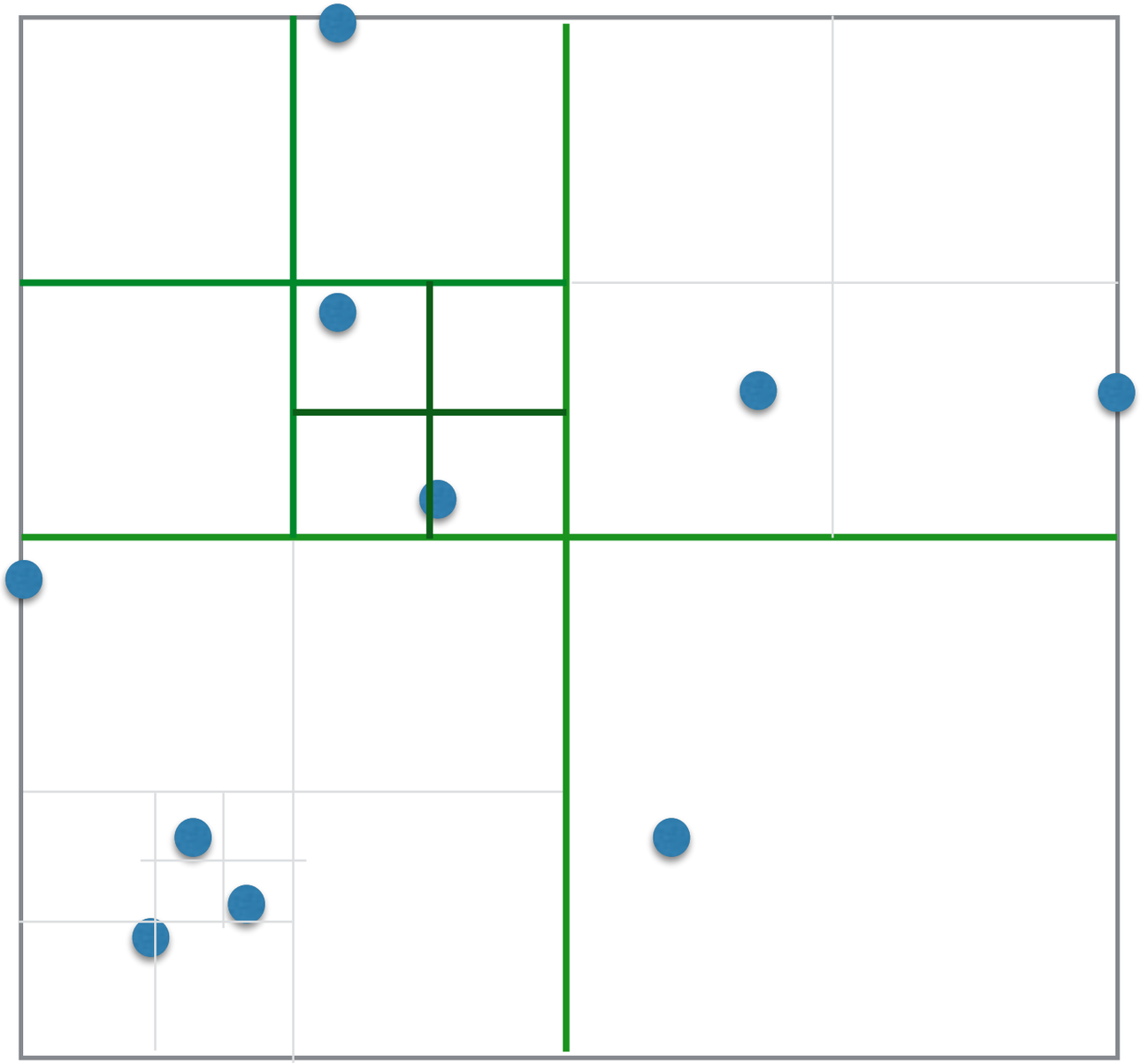

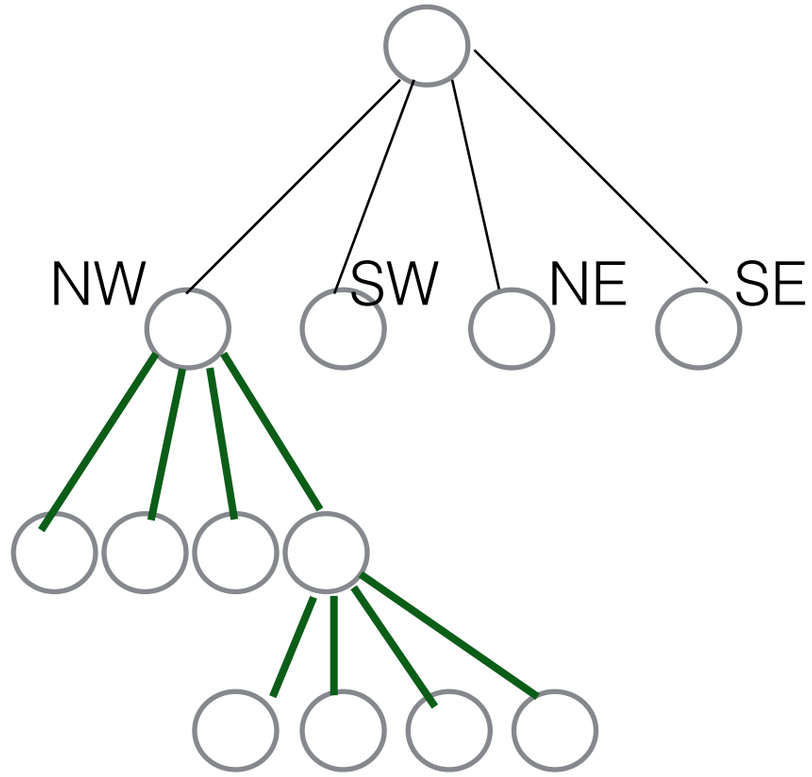

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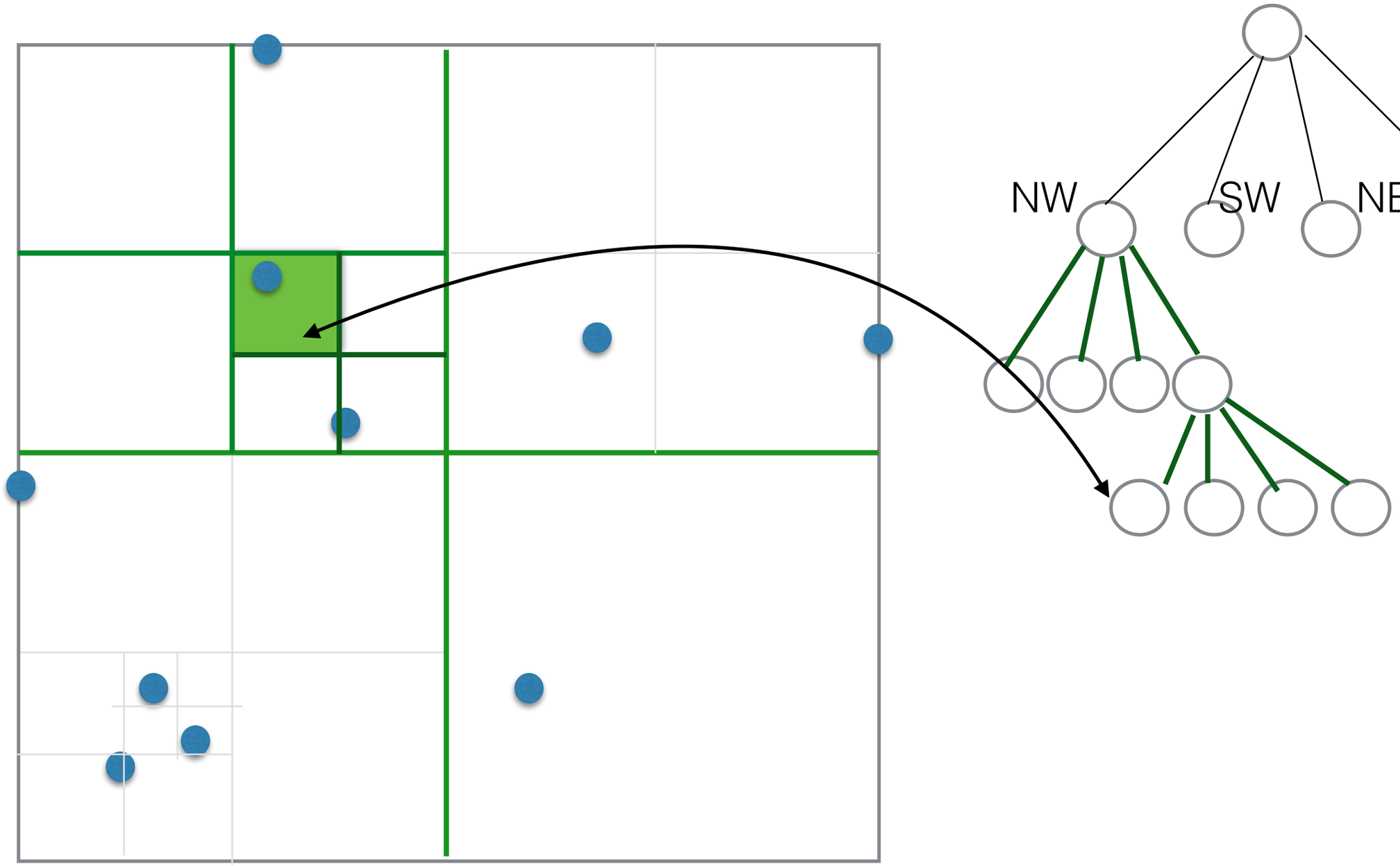

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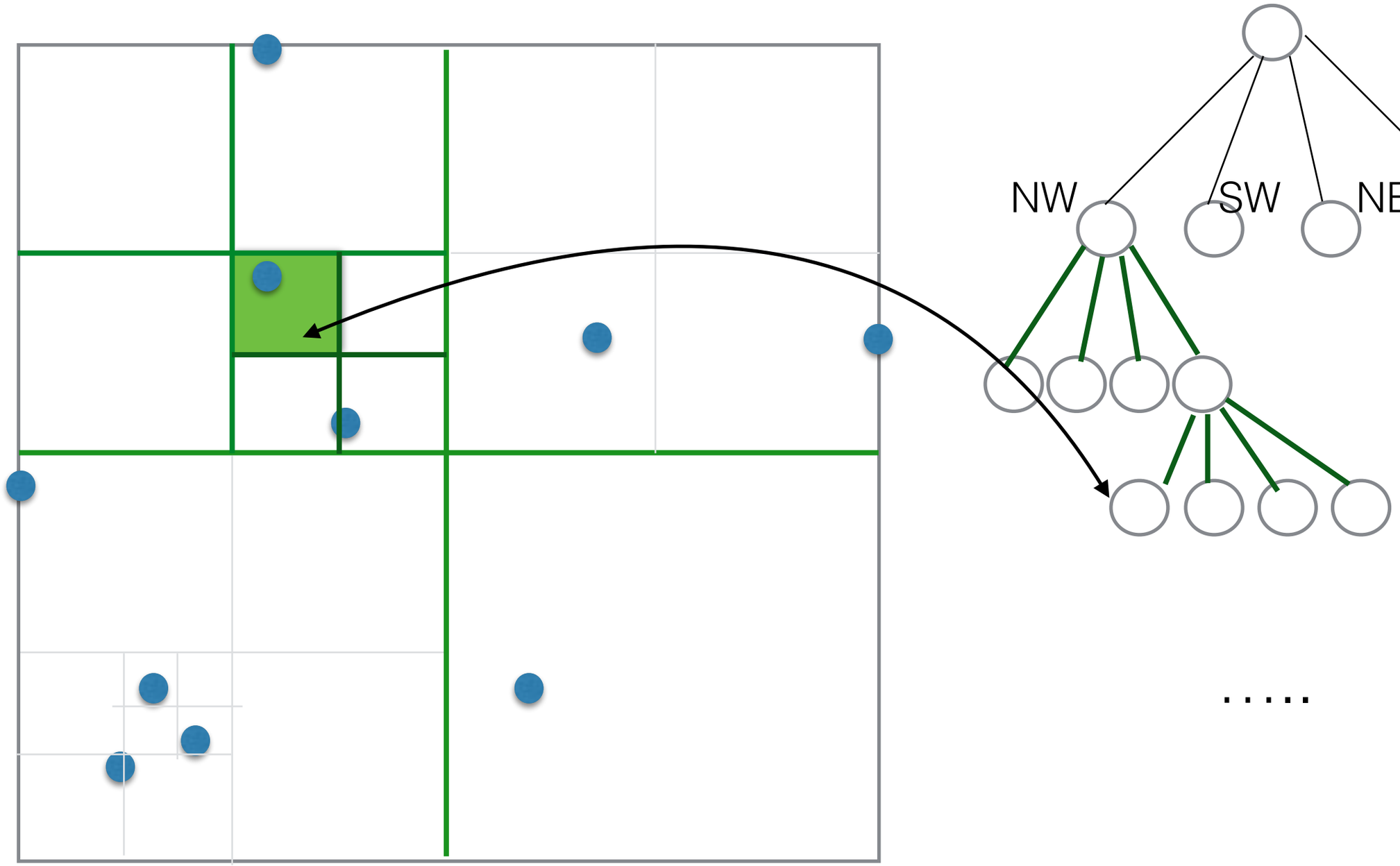

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