Kd Tree Demo

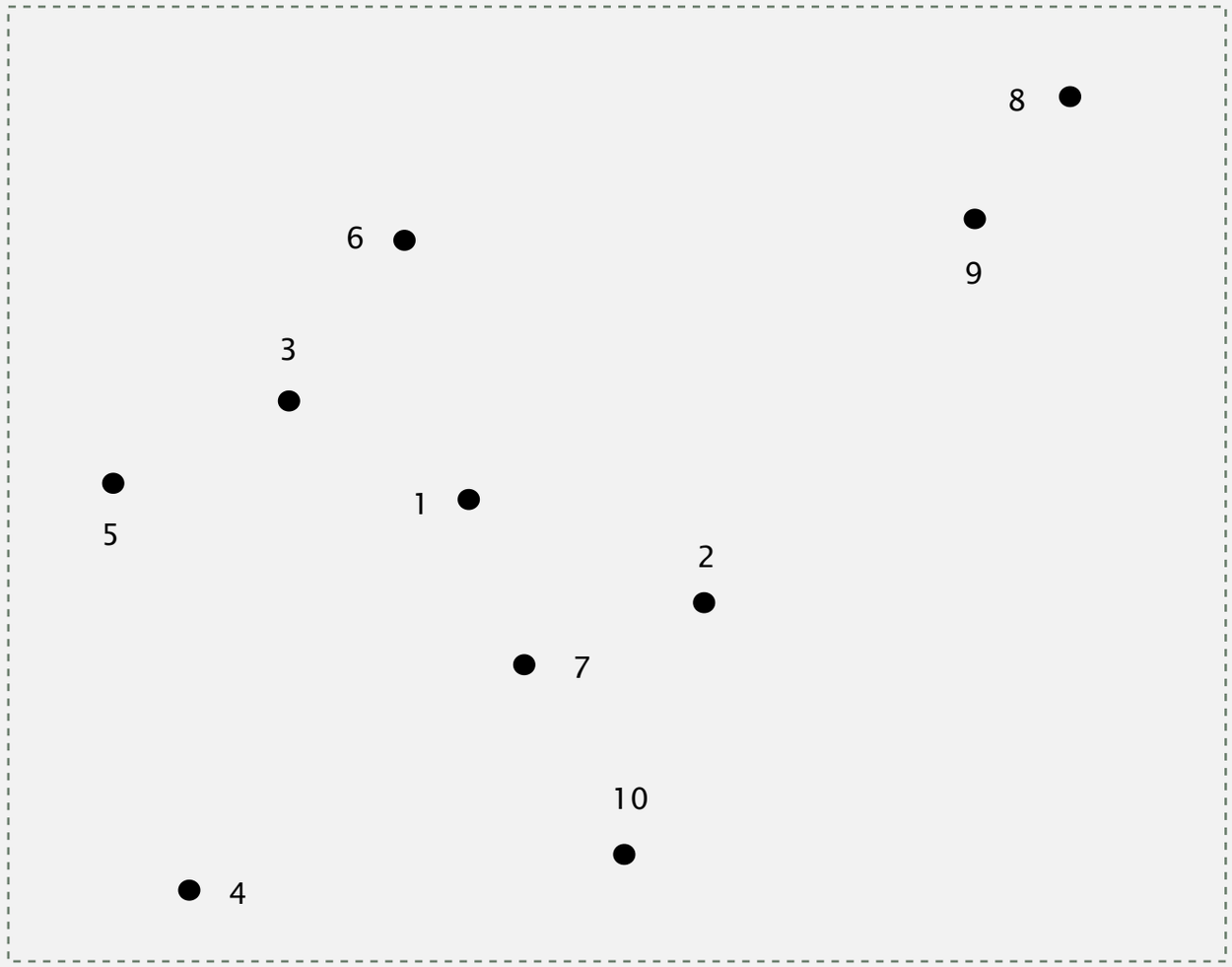
- insertion
- range search
- nearest neighbor search

click to begin demo

- insertion
- range search
- nearest neighbor search

Insertion in a 2d tree

Recursively partition plane into two halfplanes.



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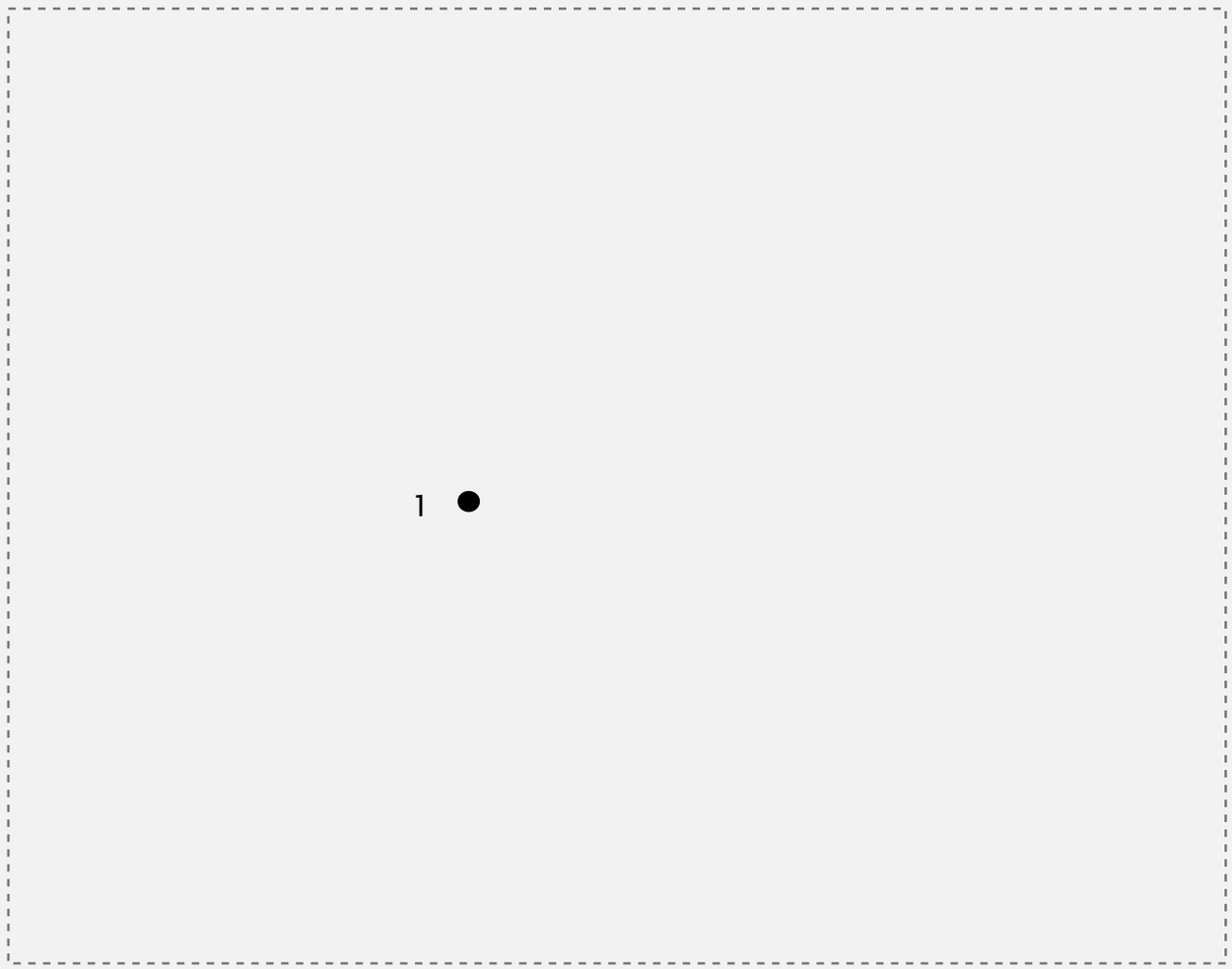

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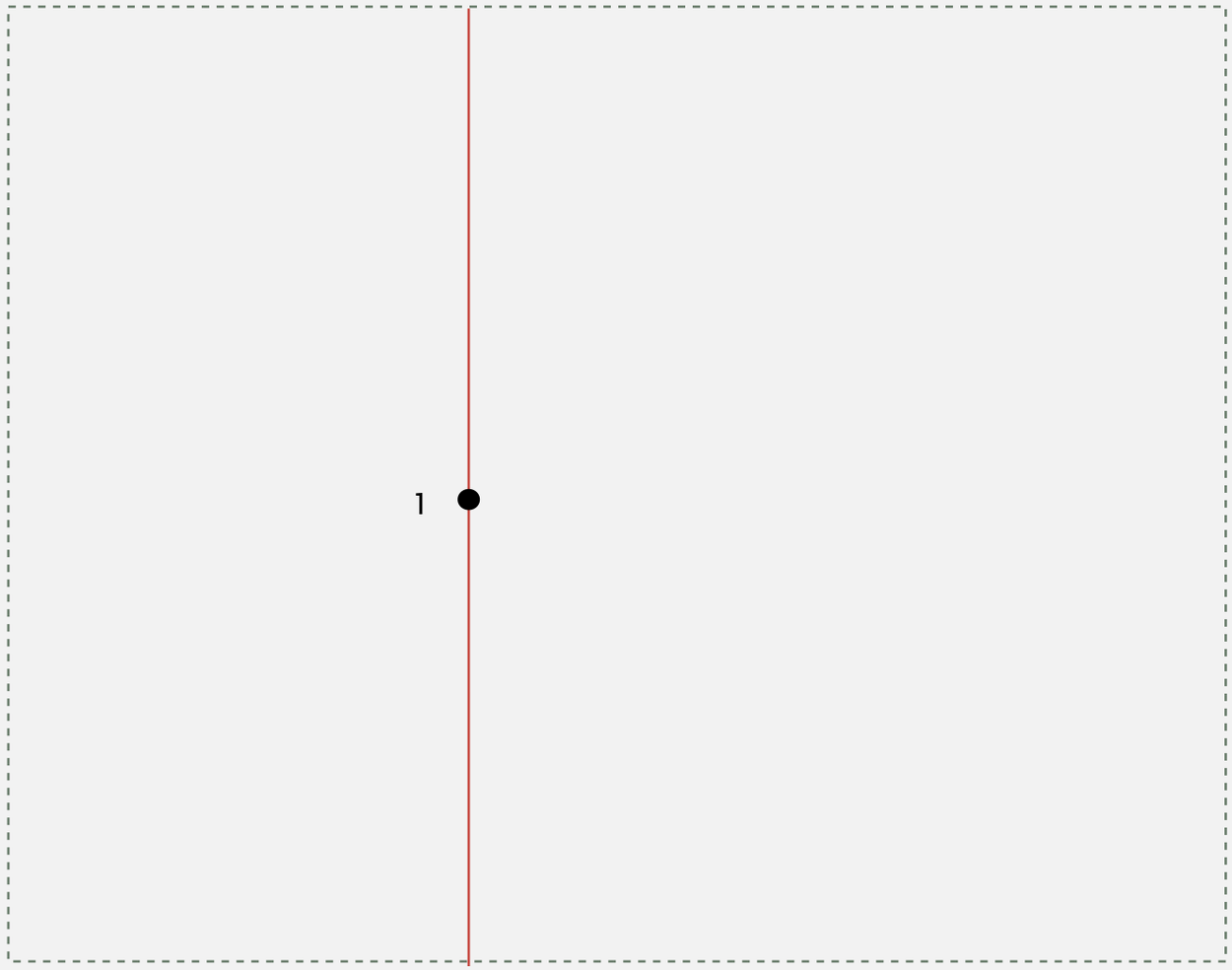

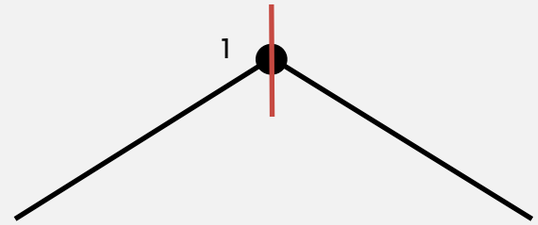

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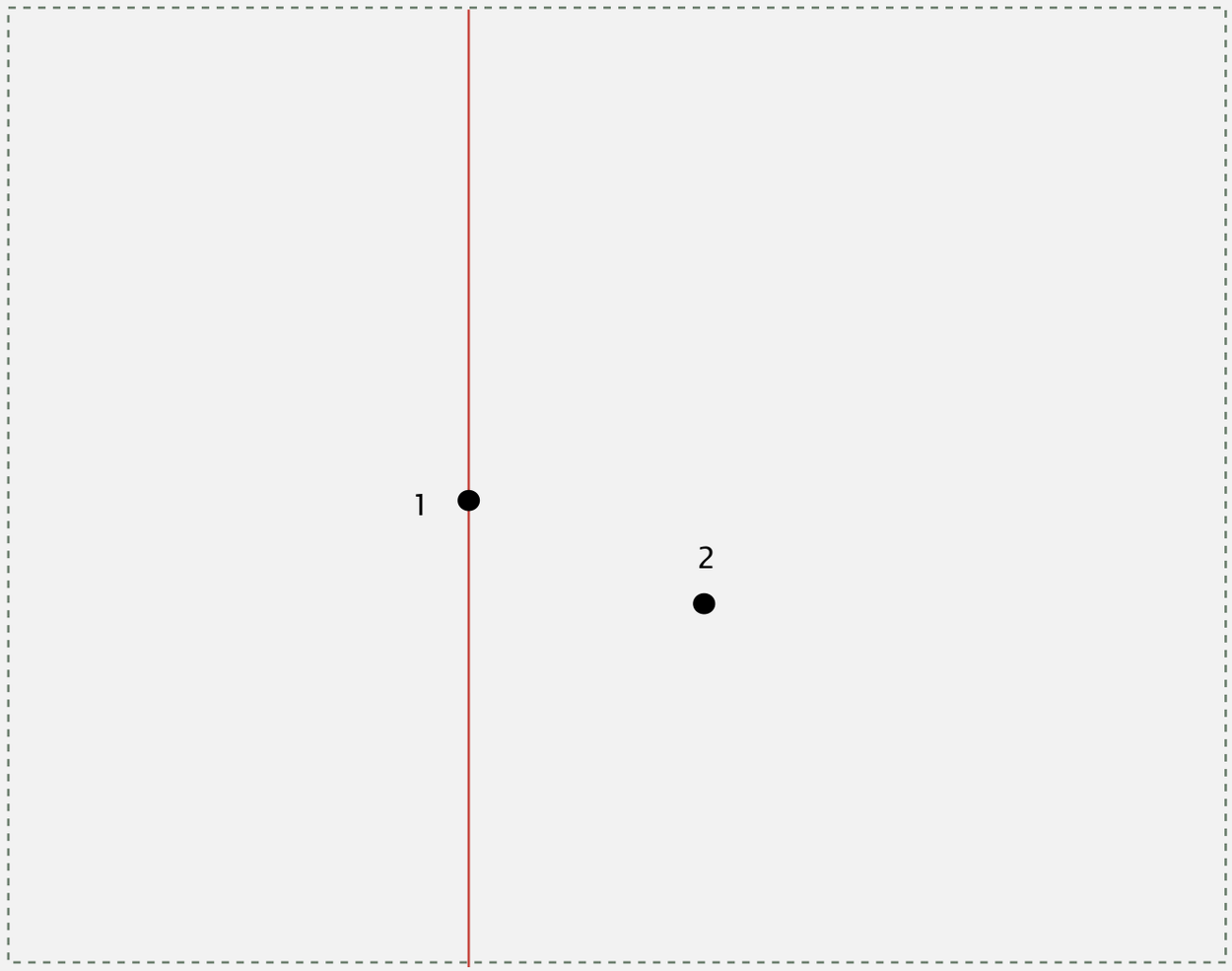

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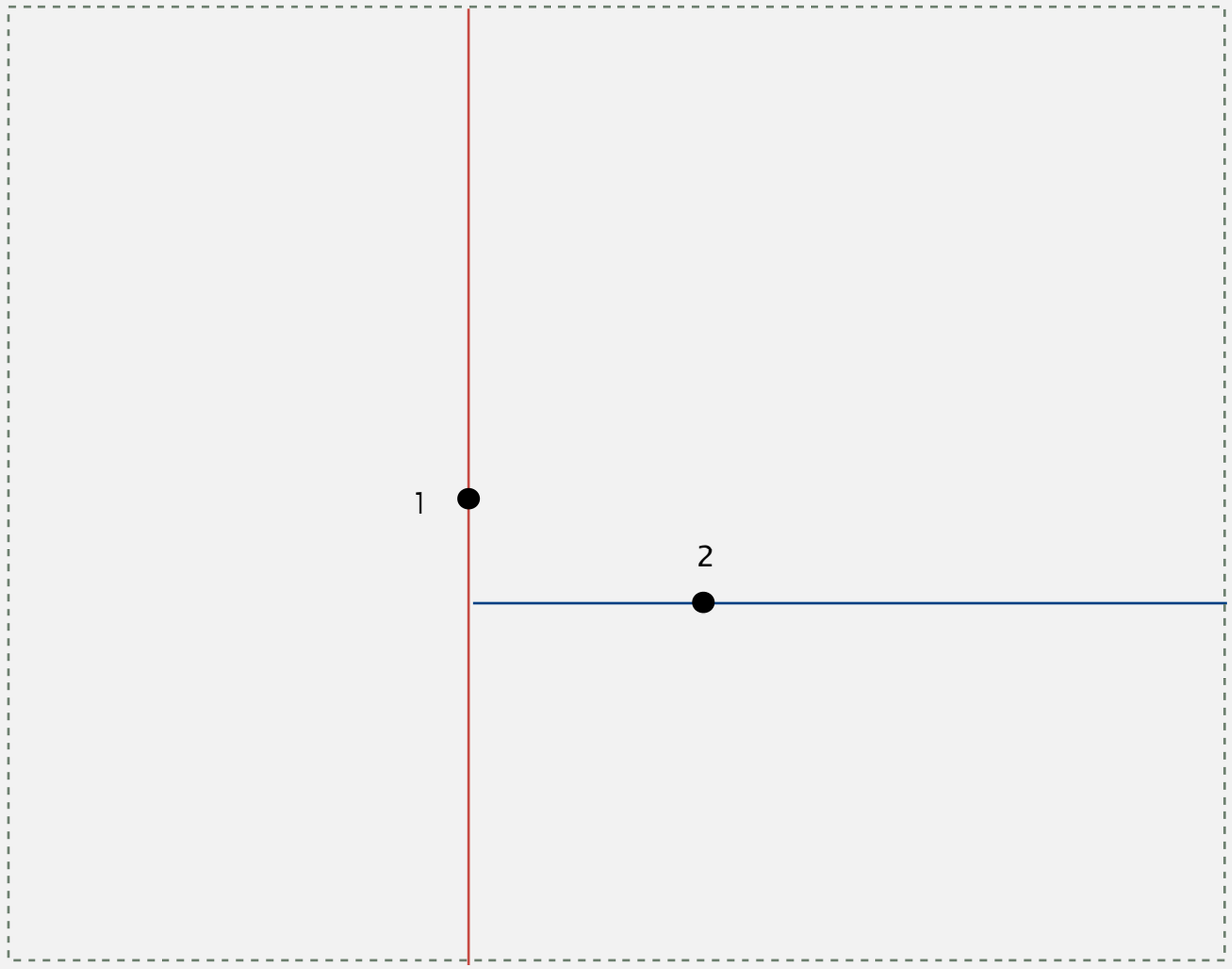

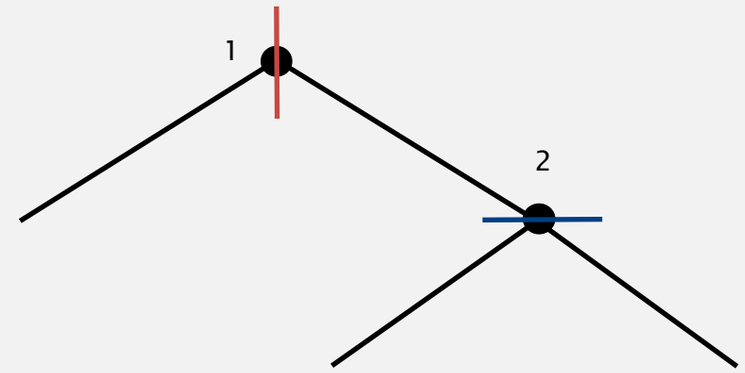

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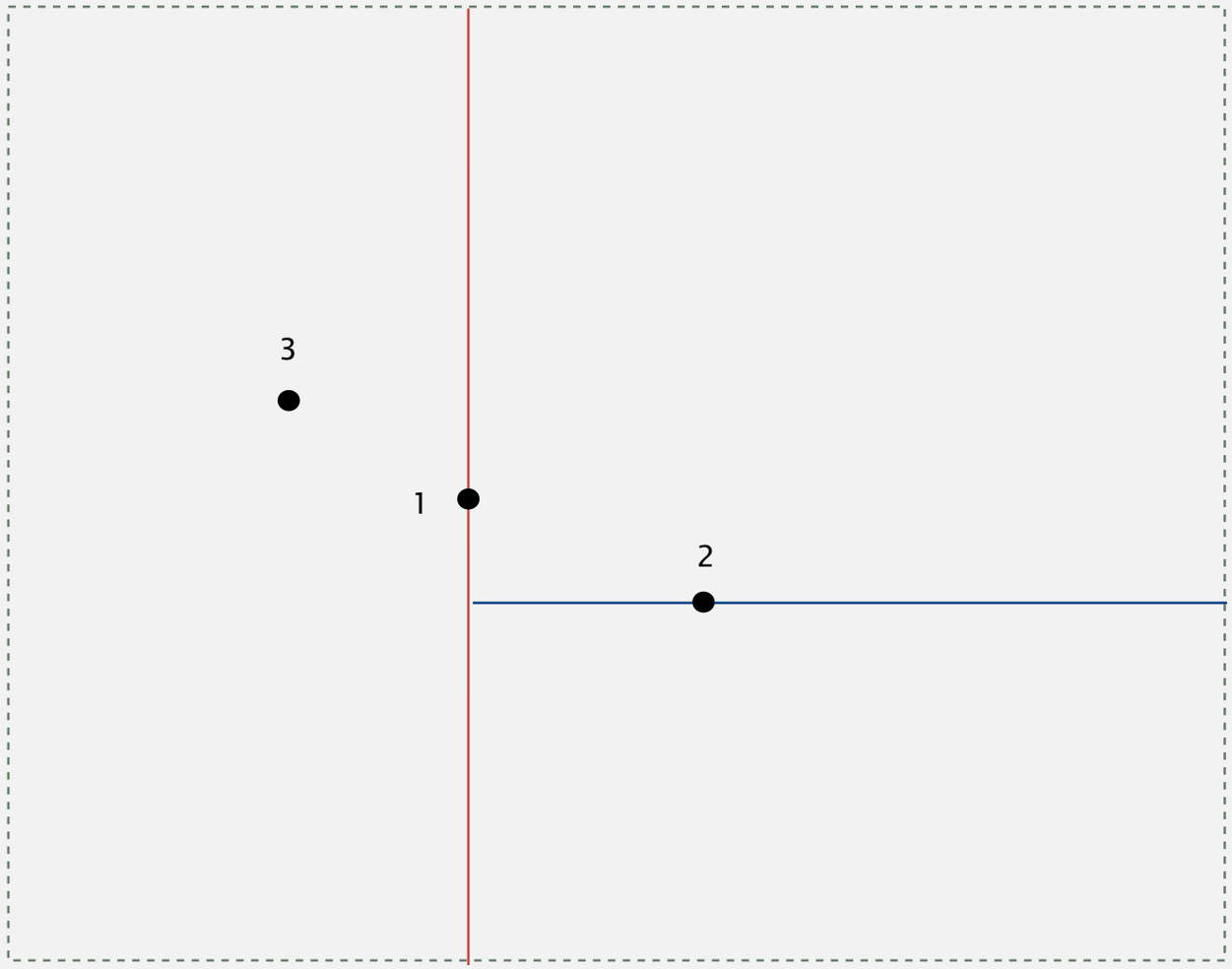

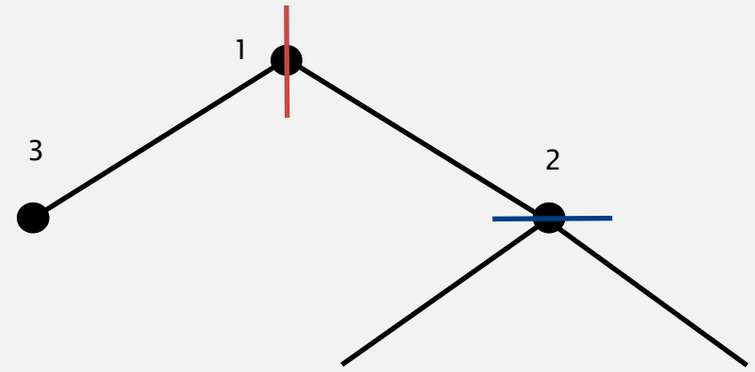

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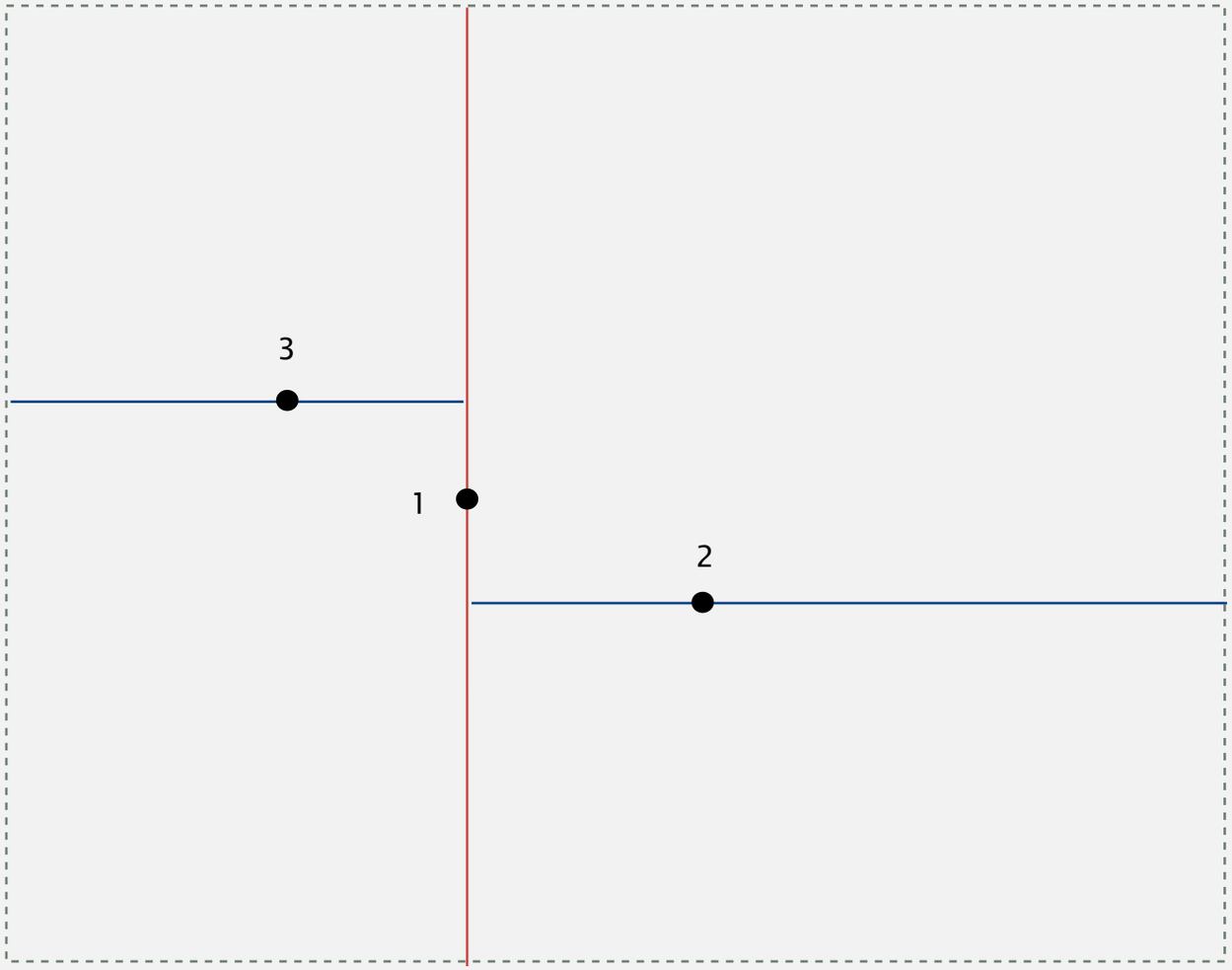

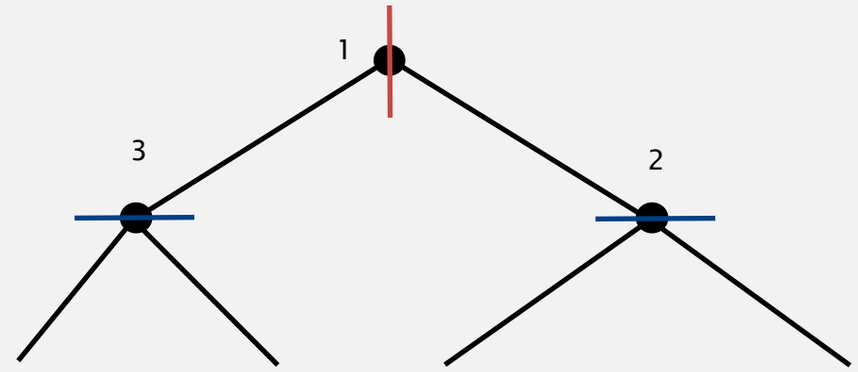

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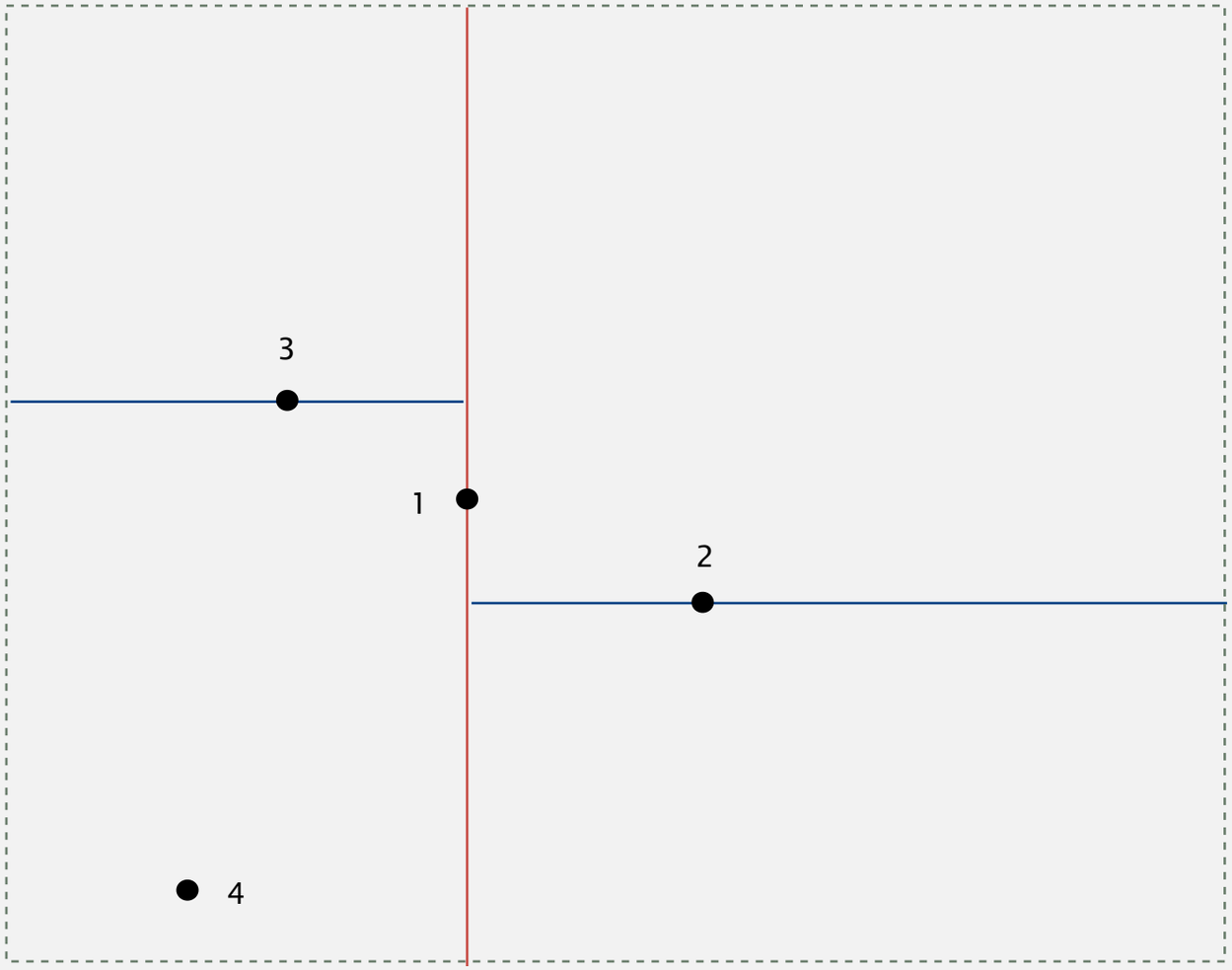

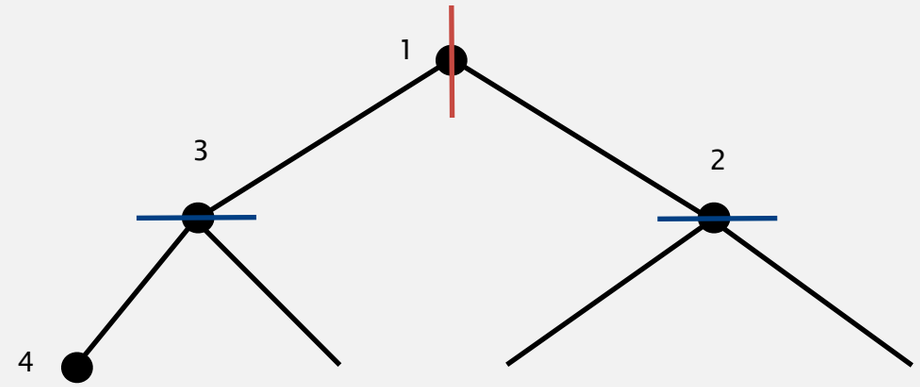

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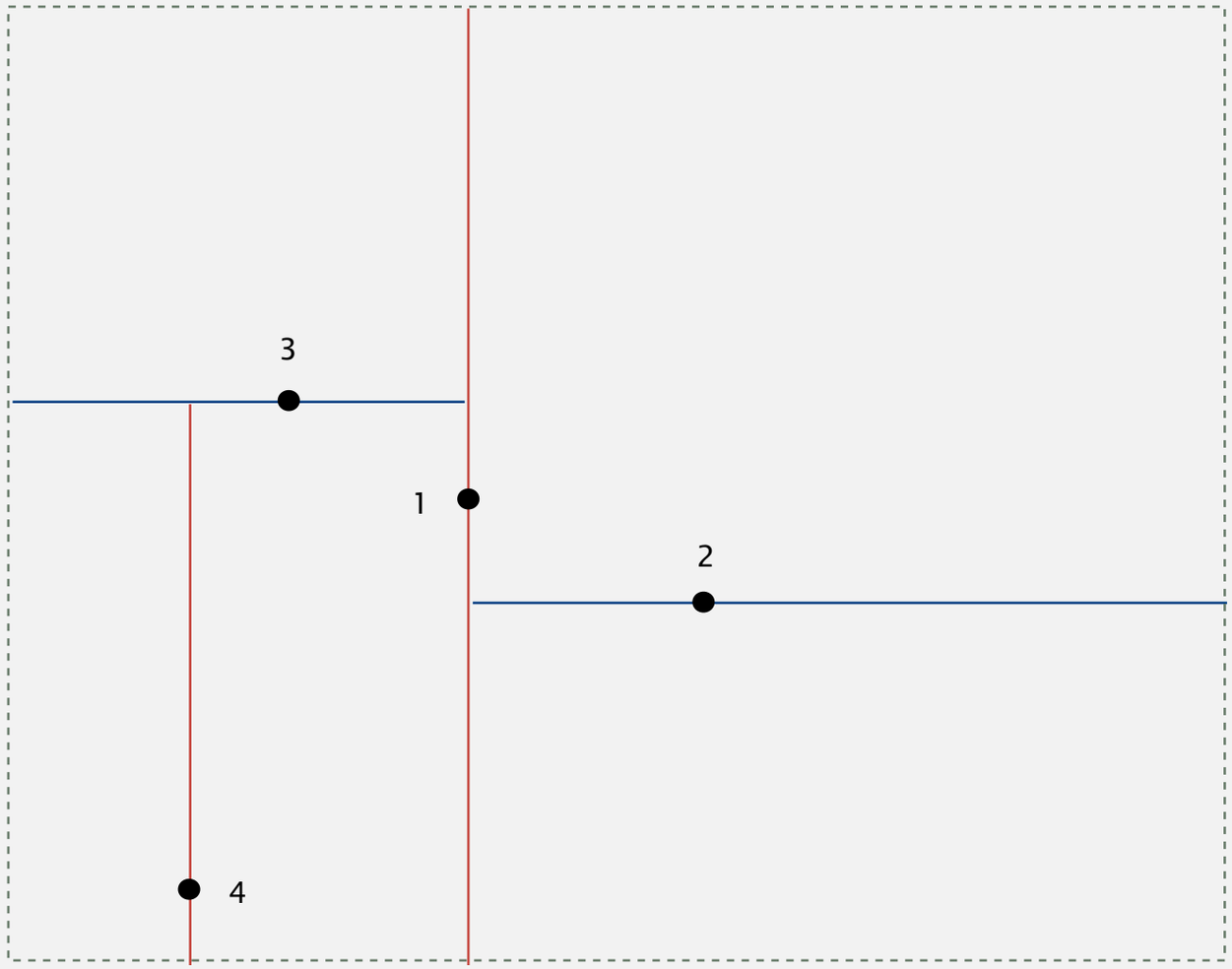

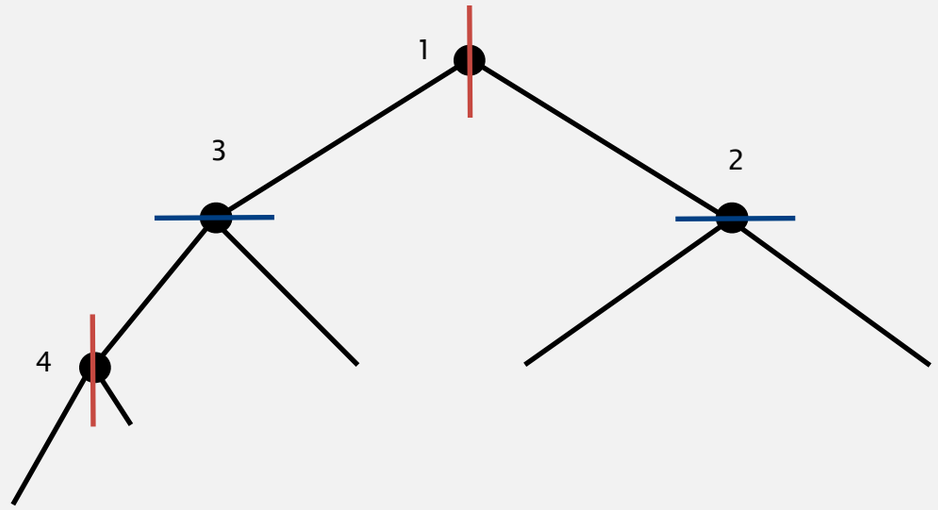

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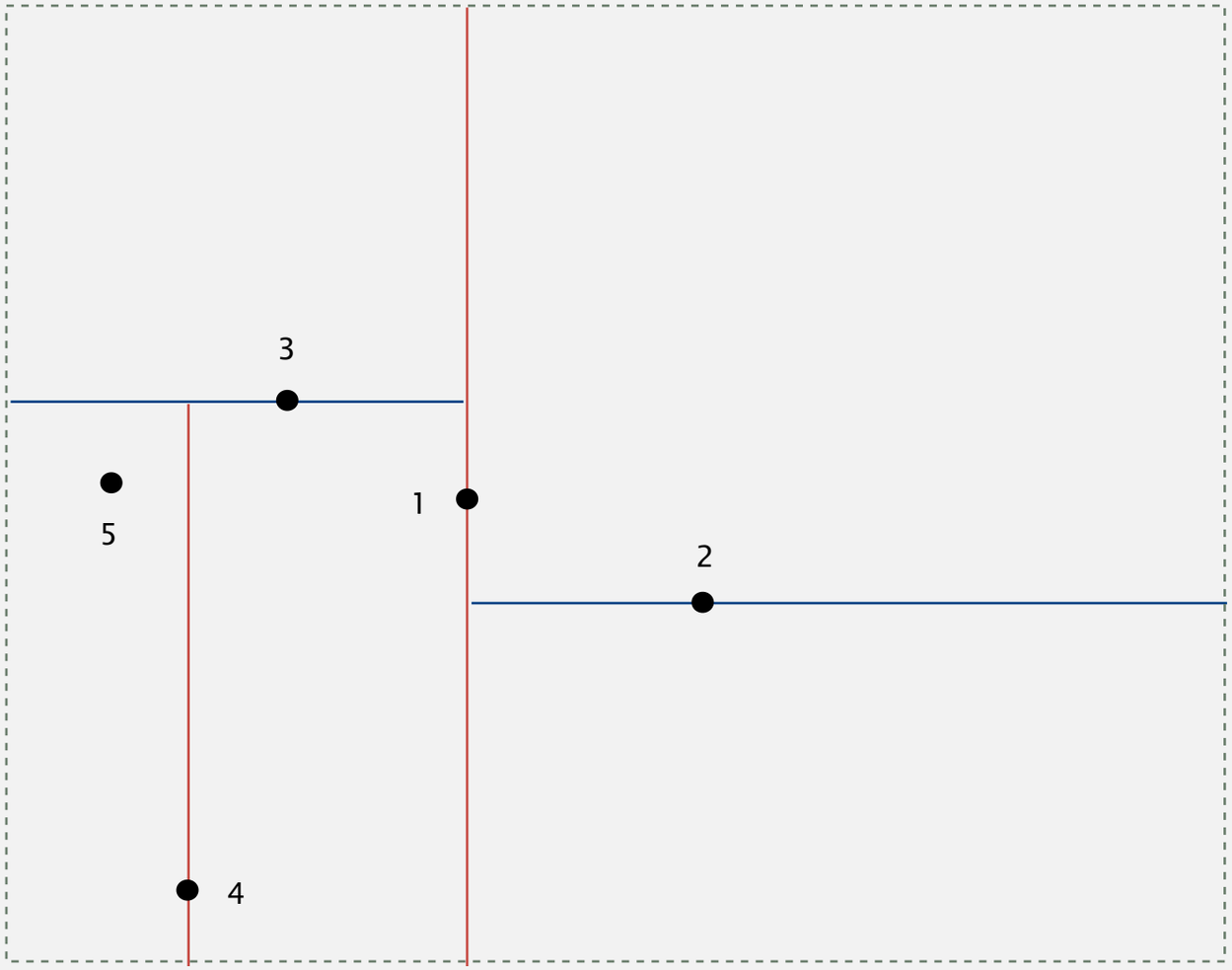

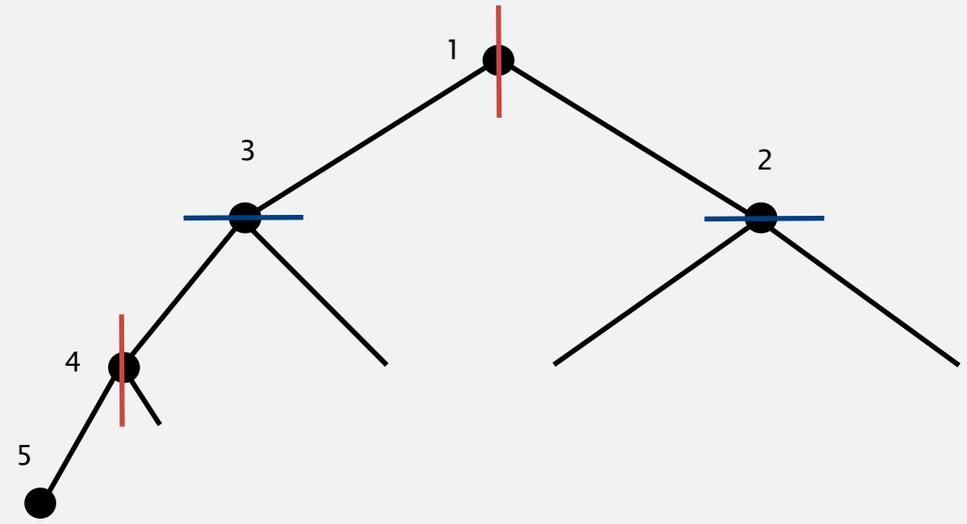

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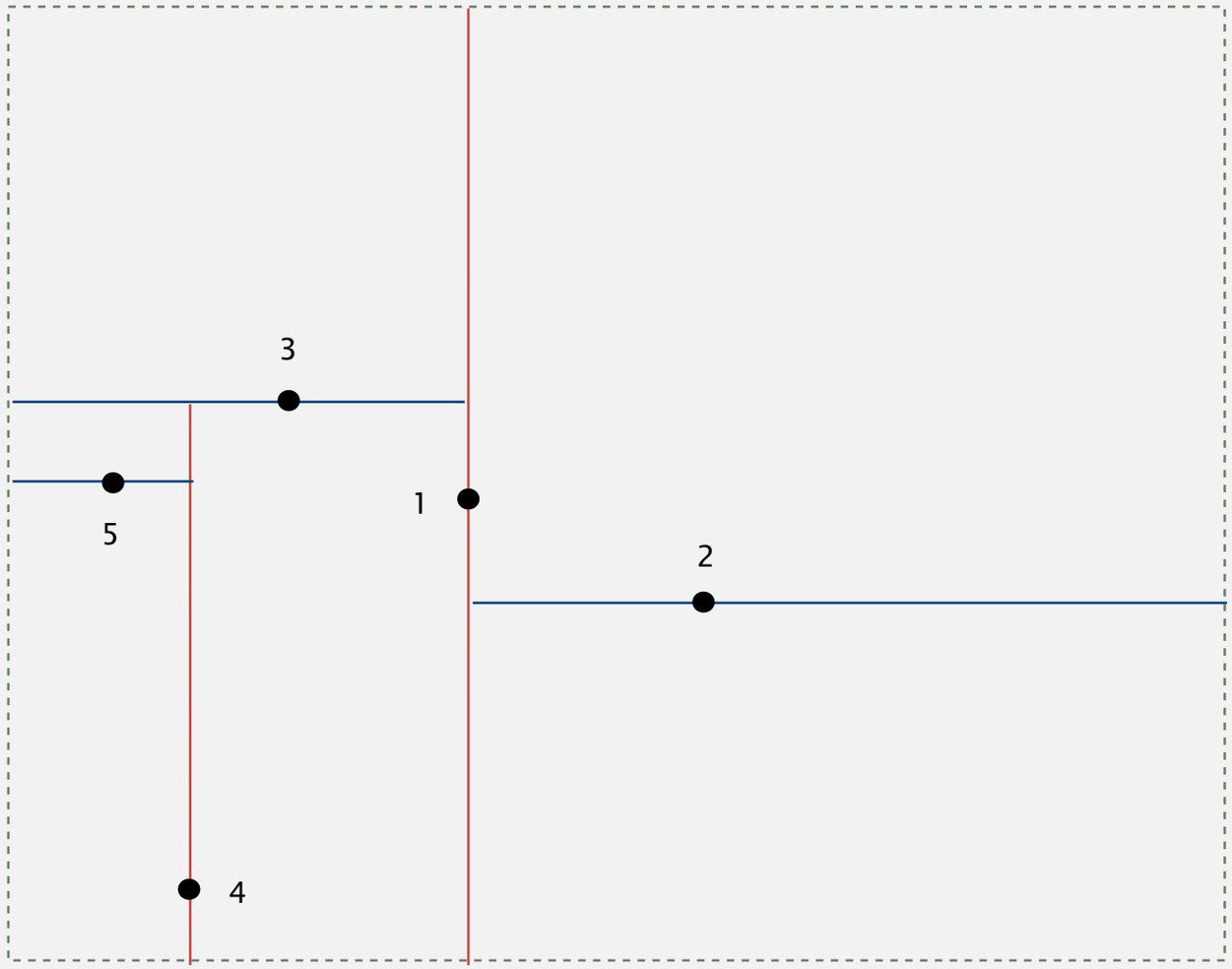

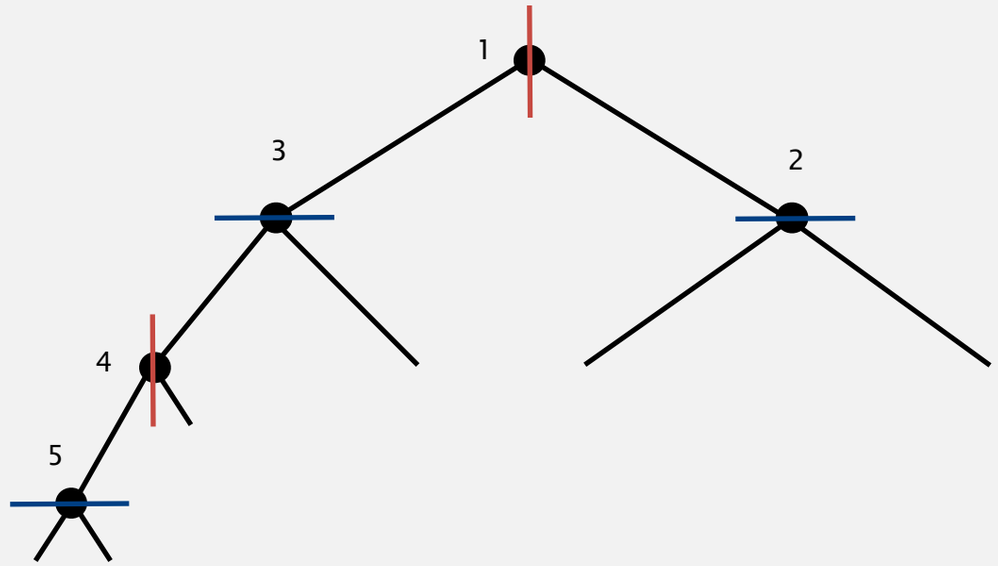

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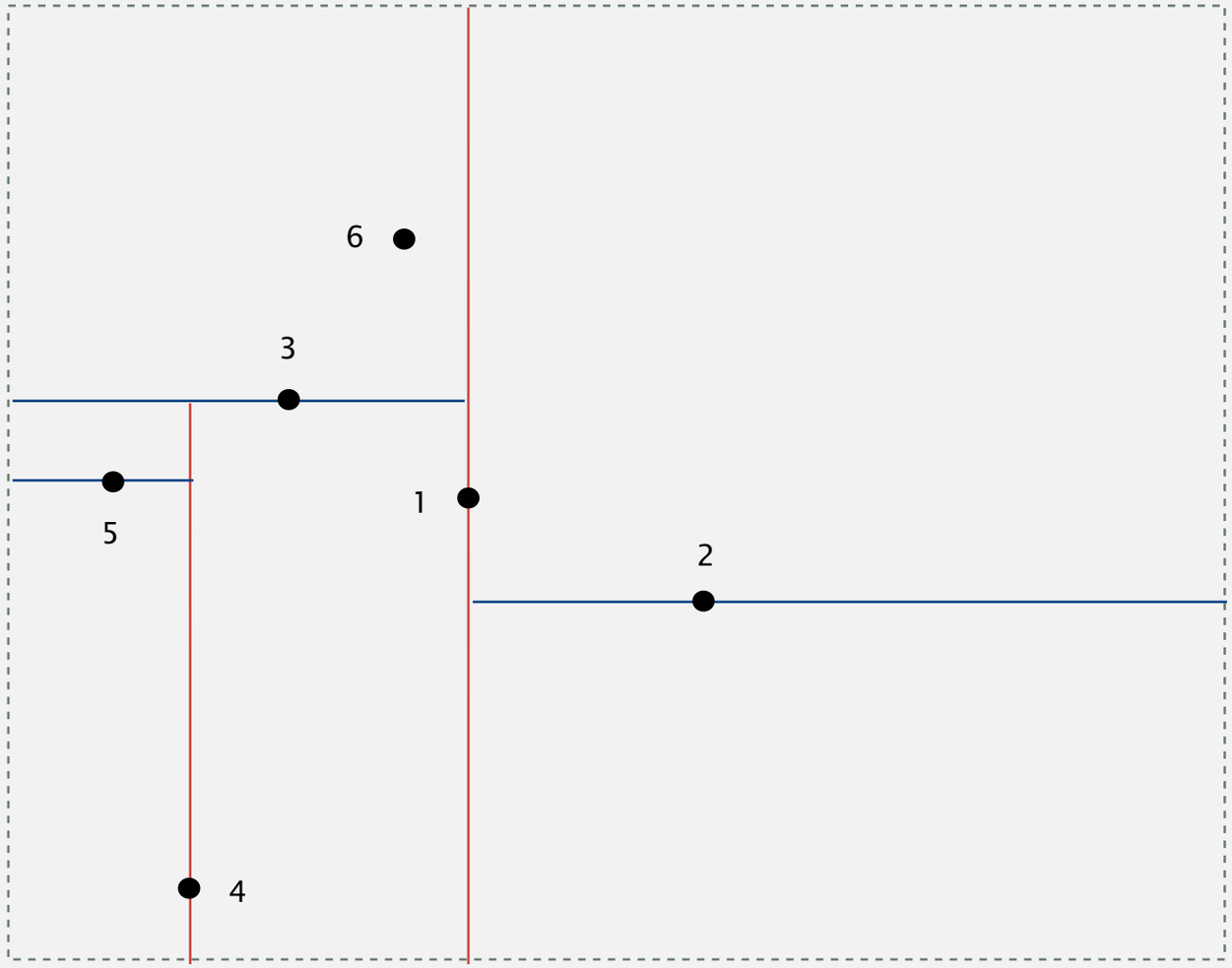

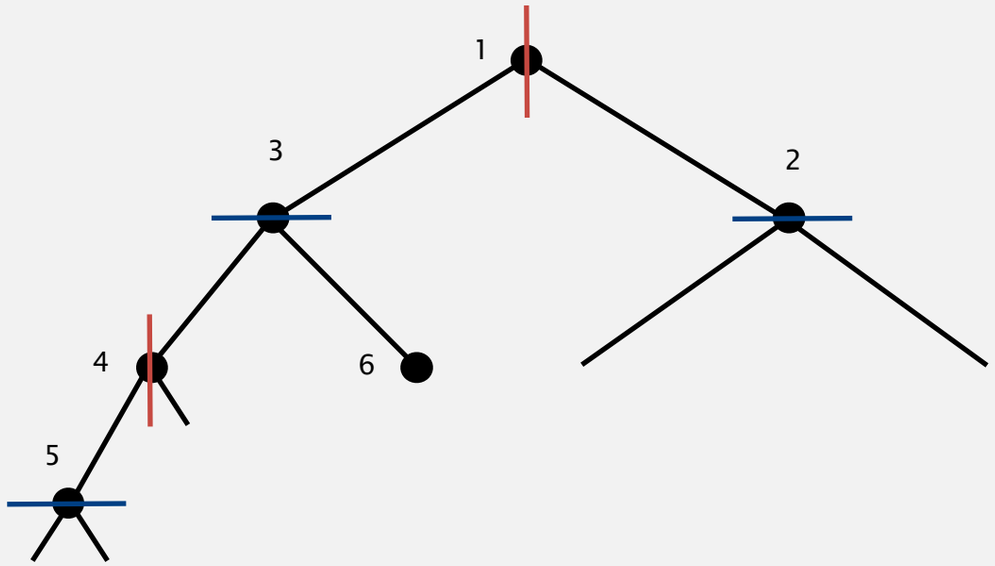

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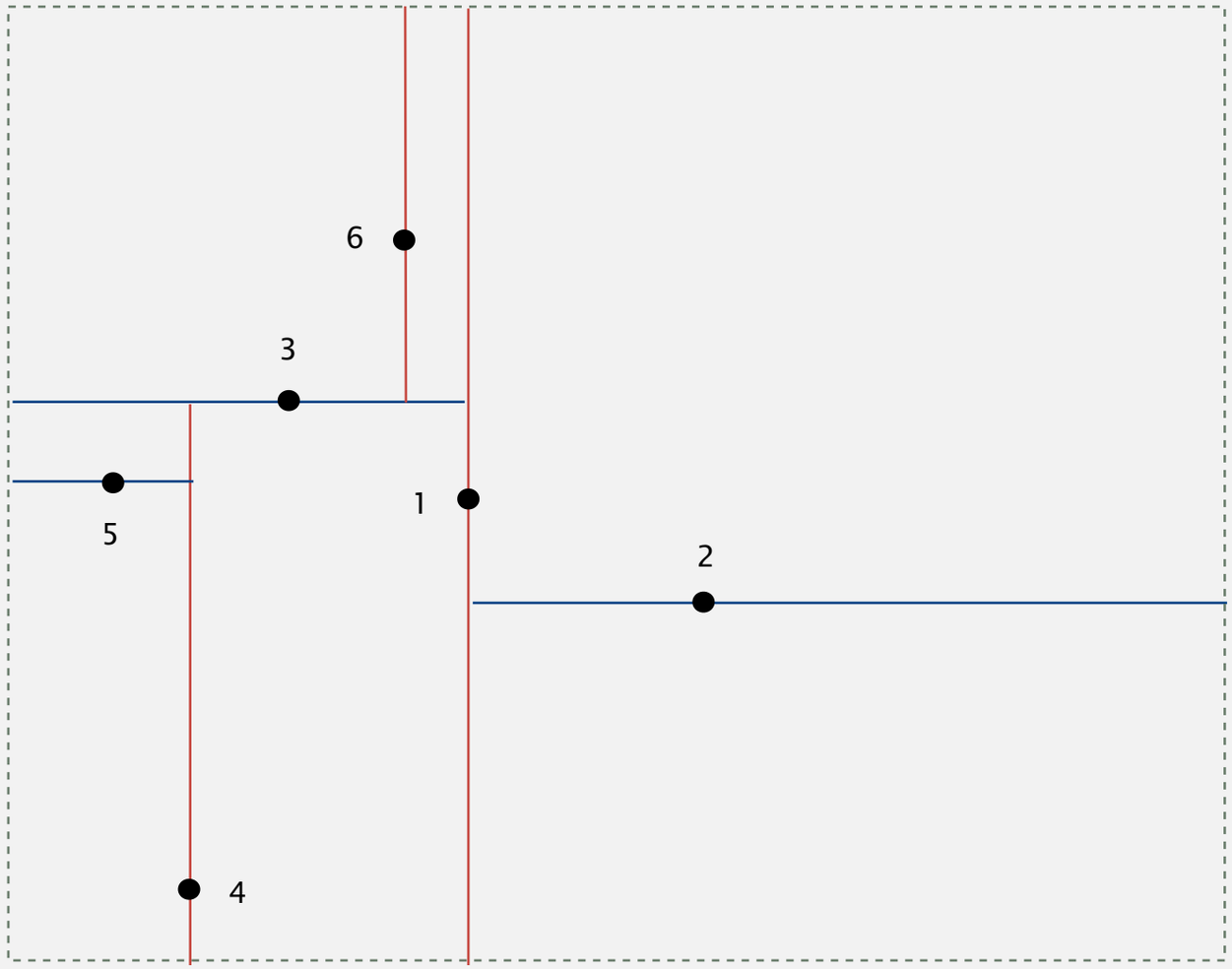

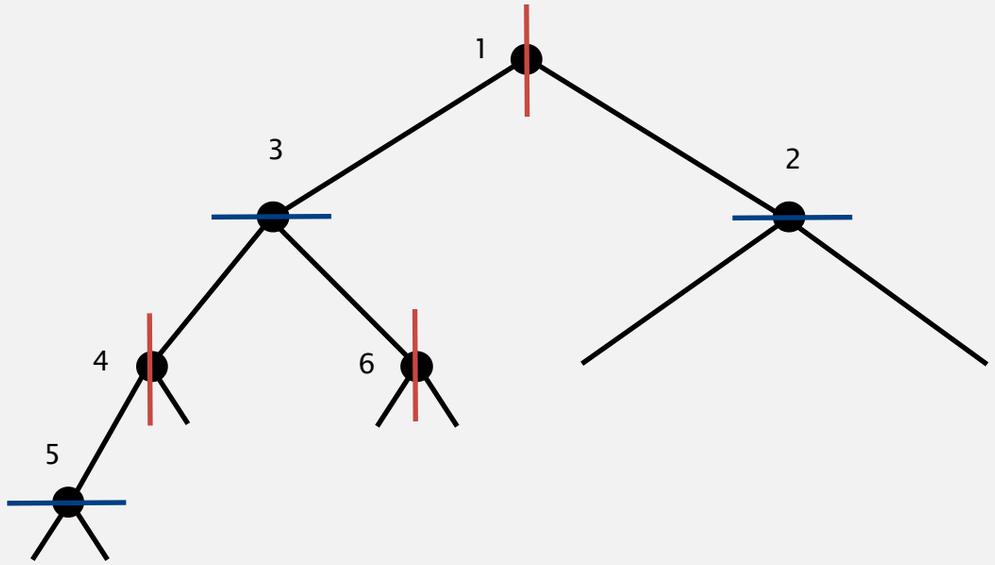

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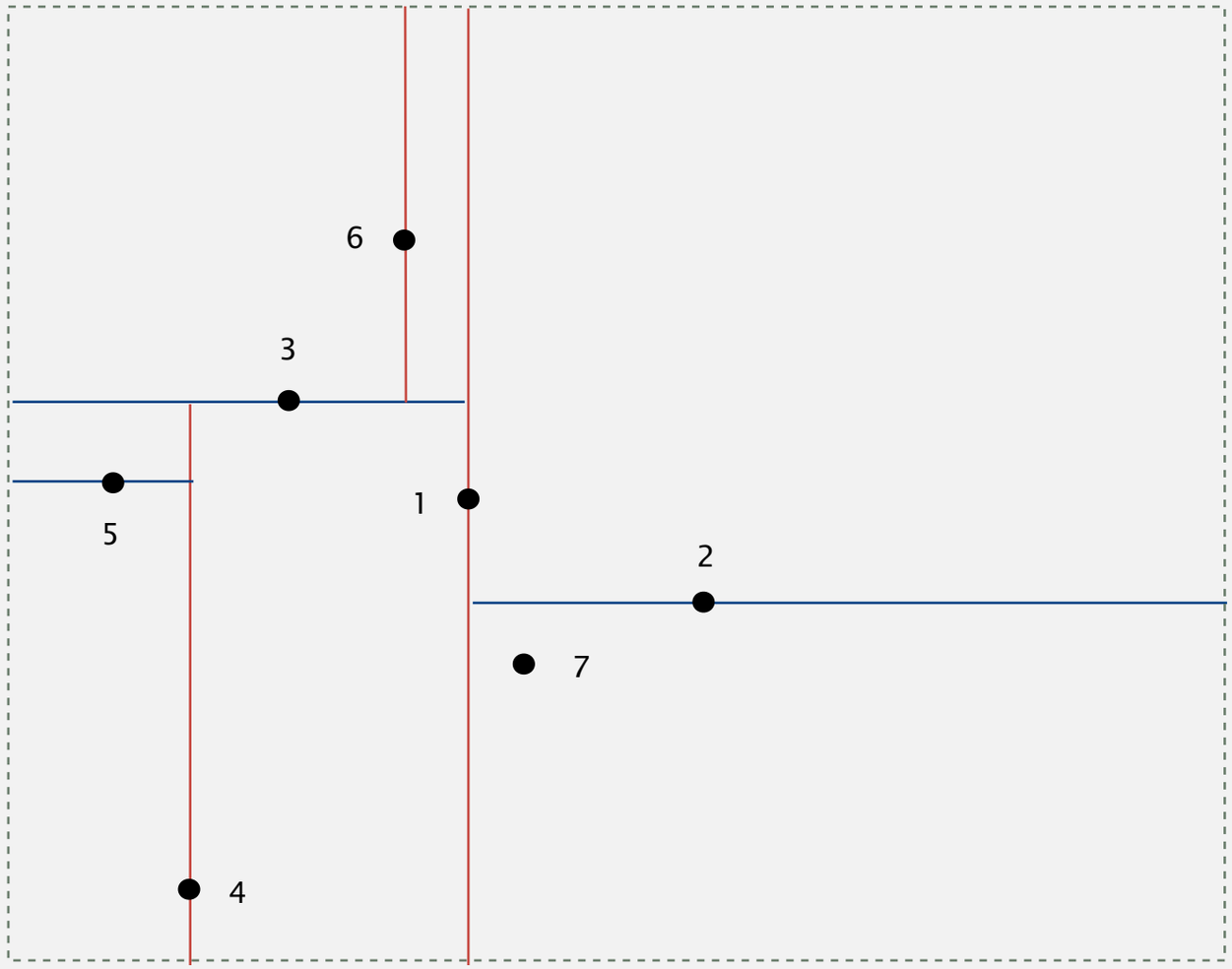

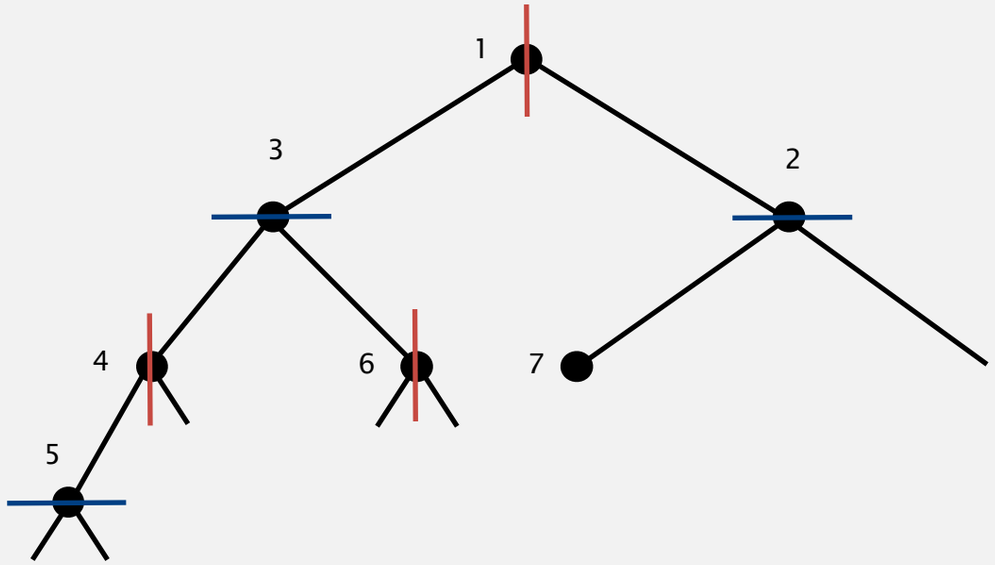

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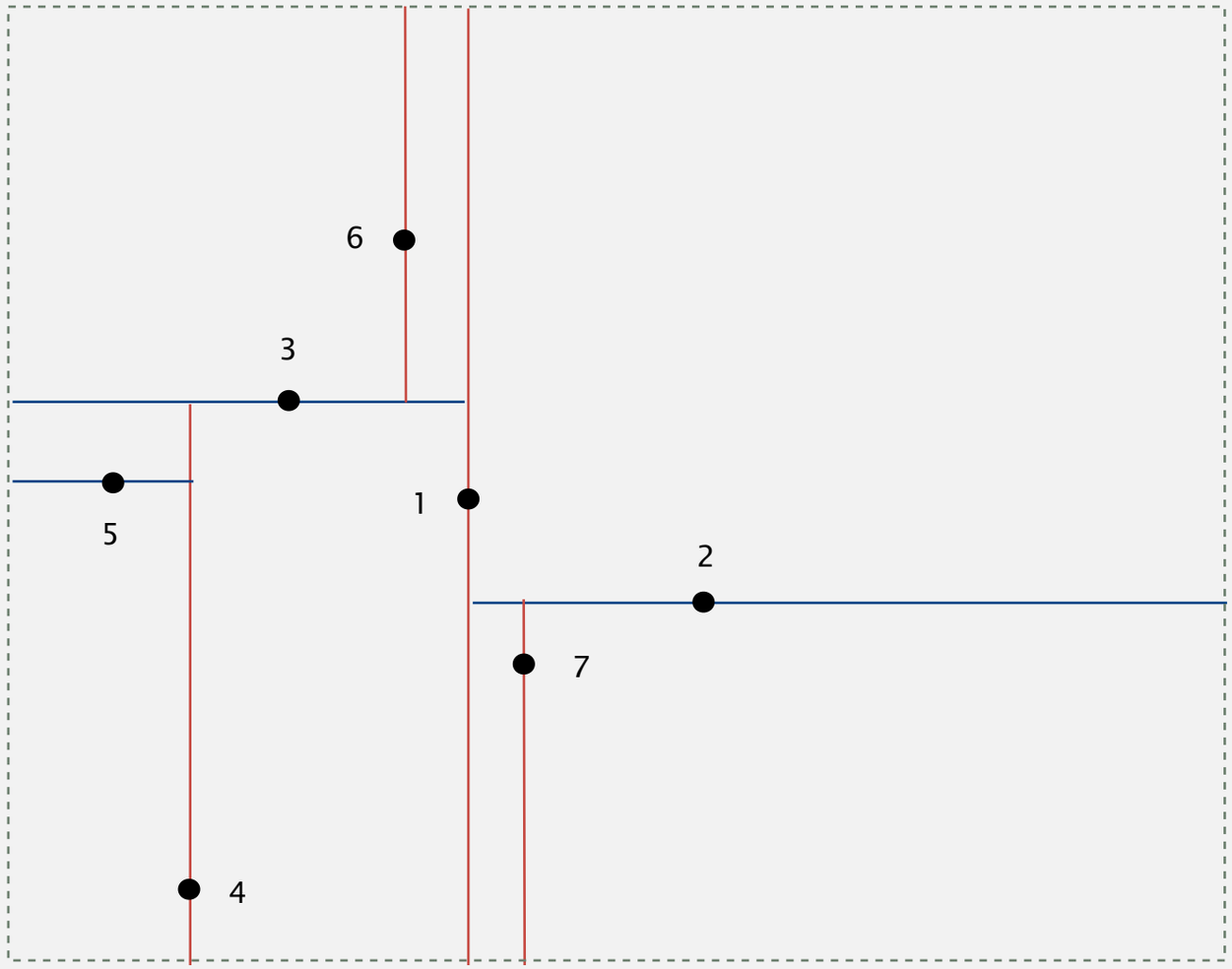

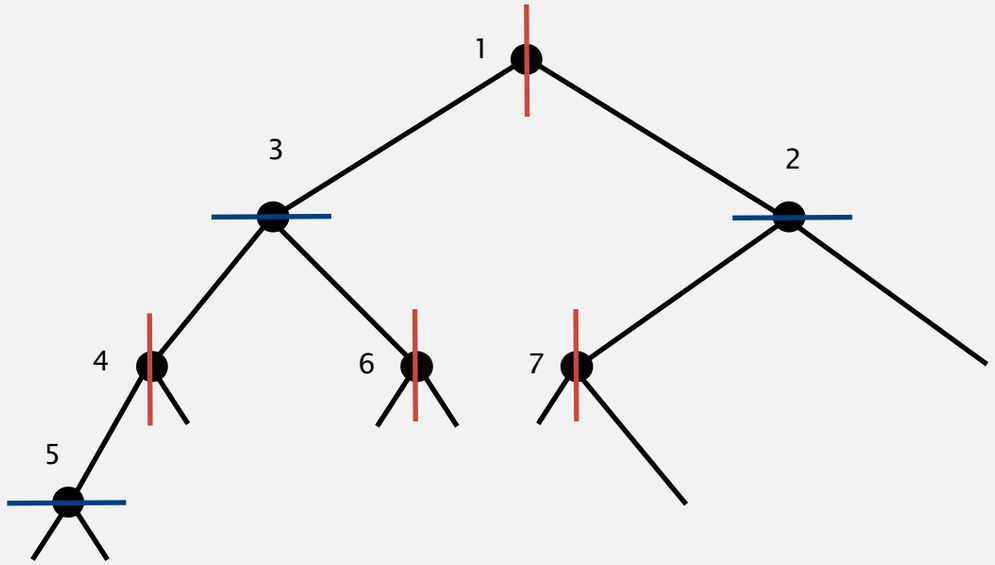

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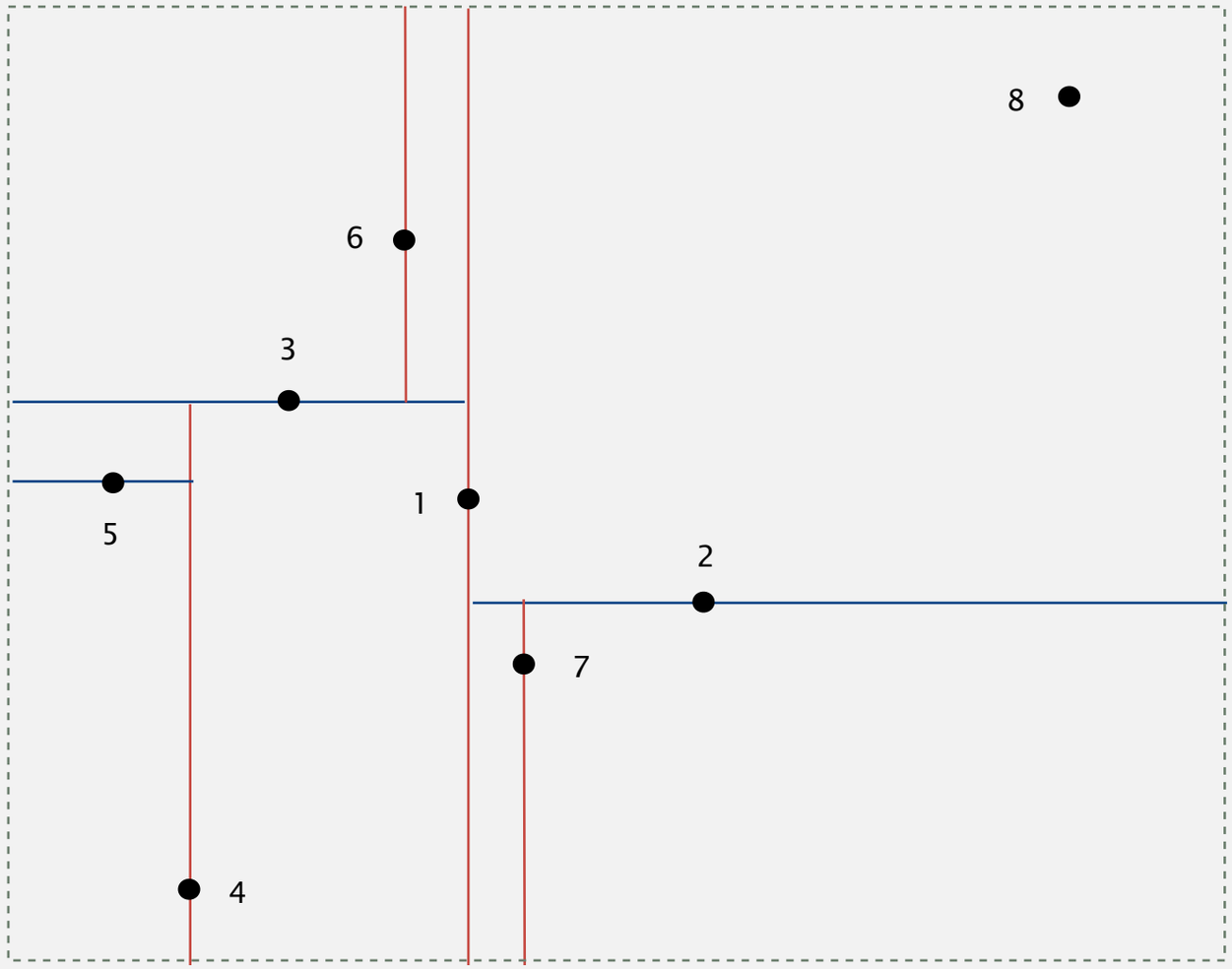

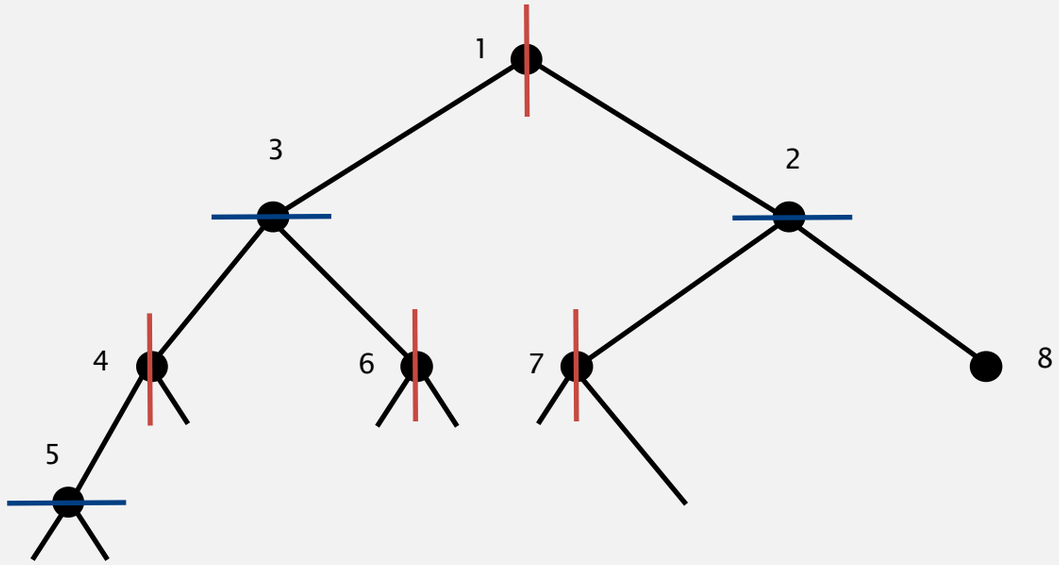

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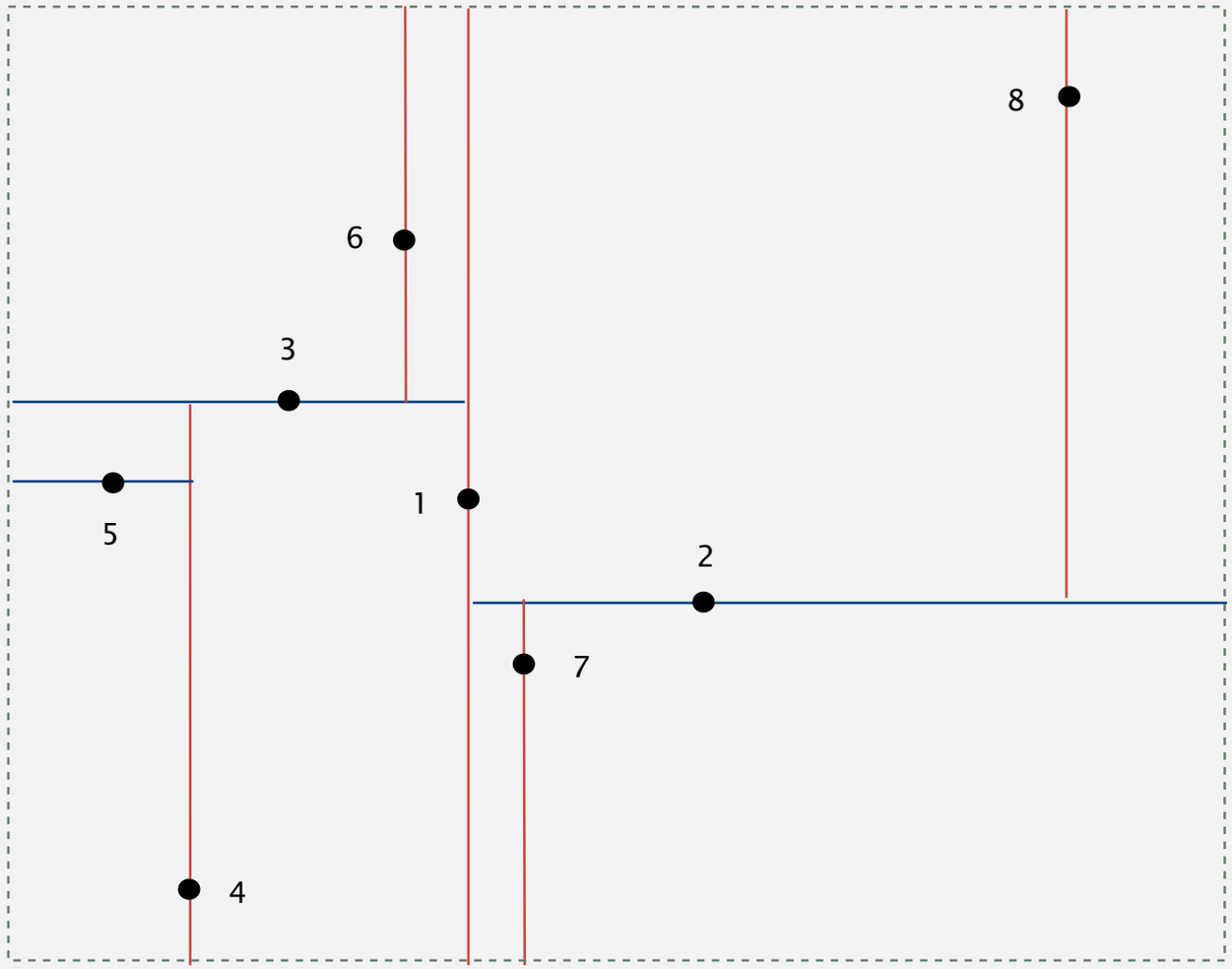

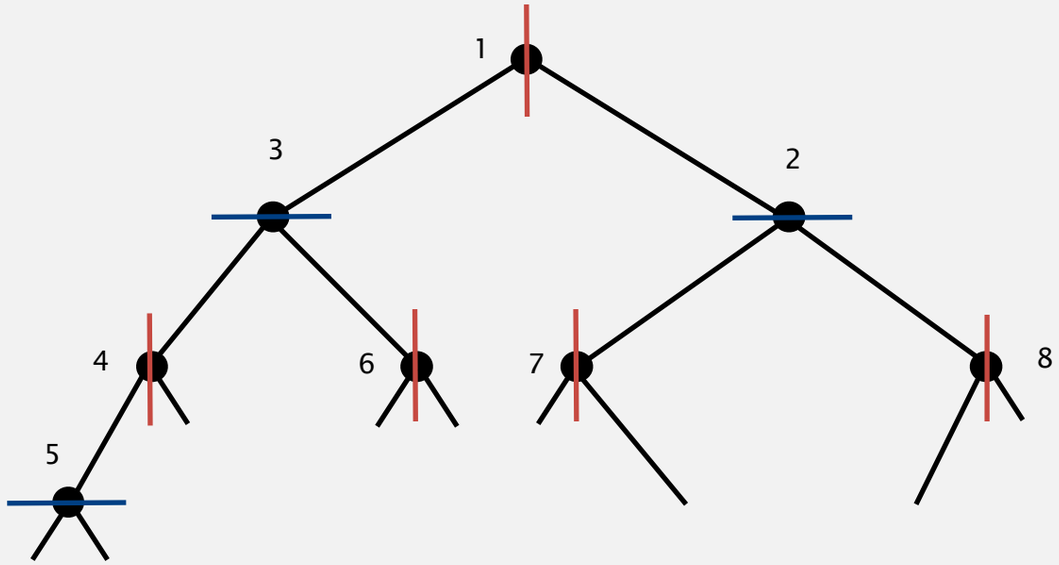

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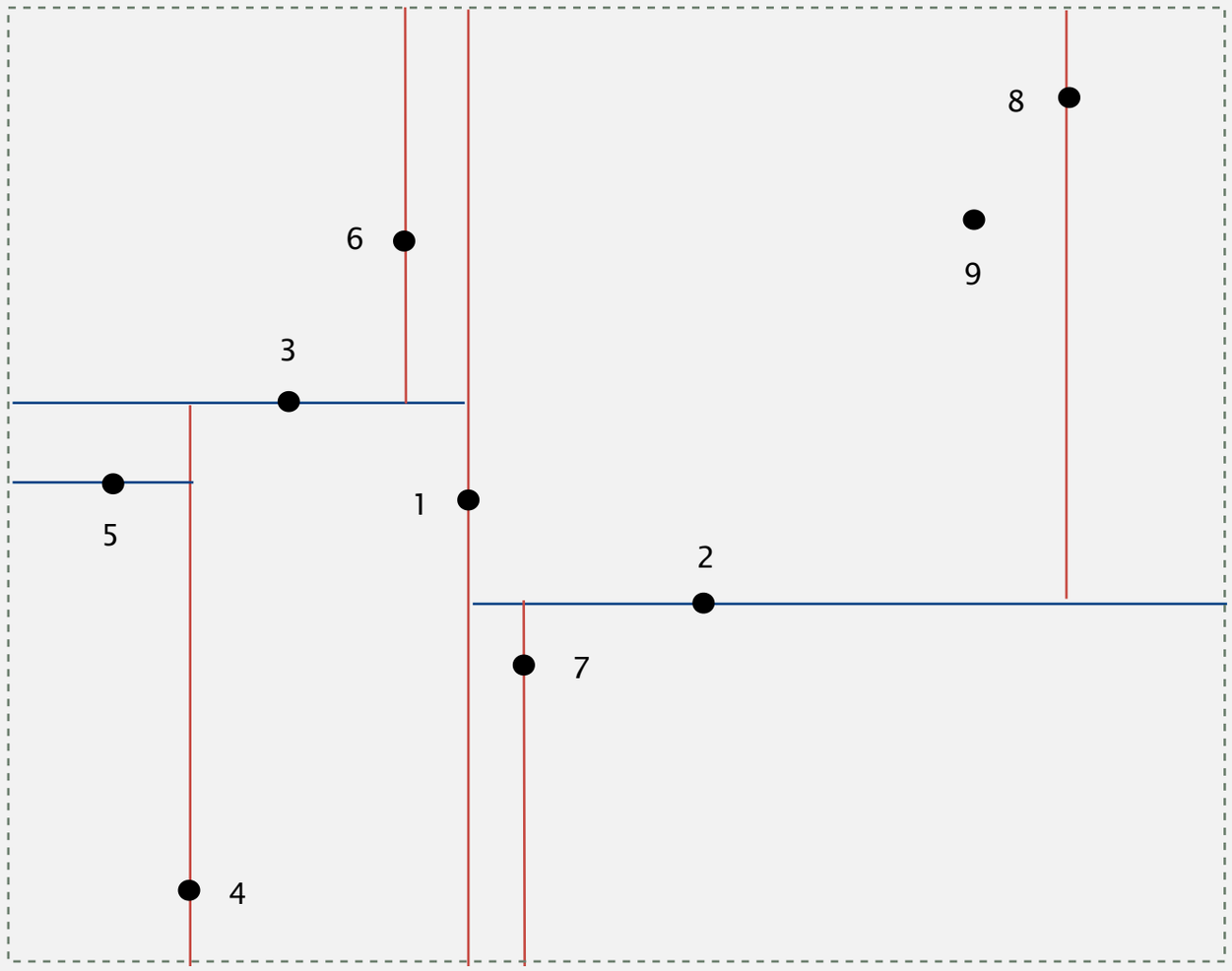

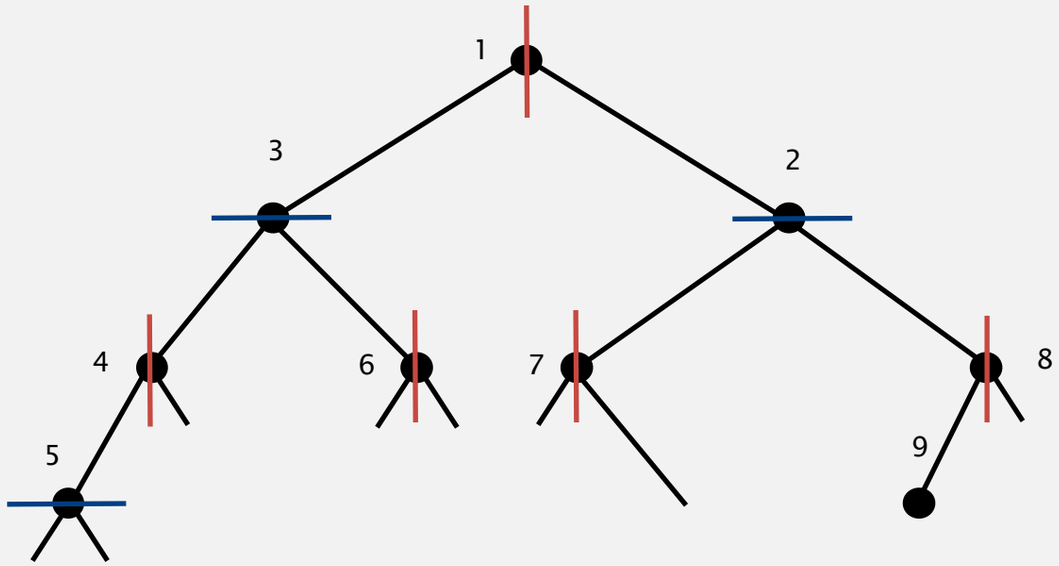

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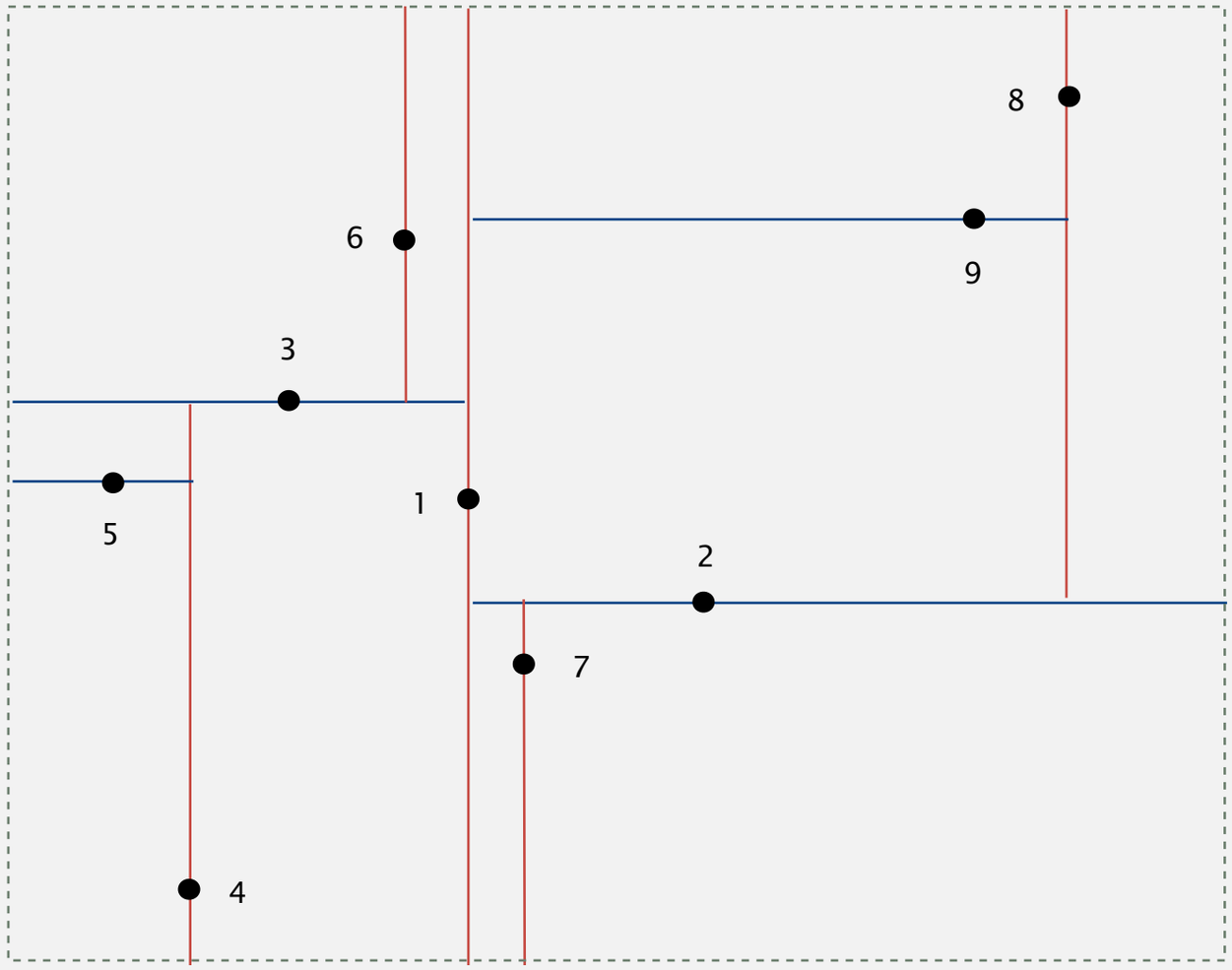

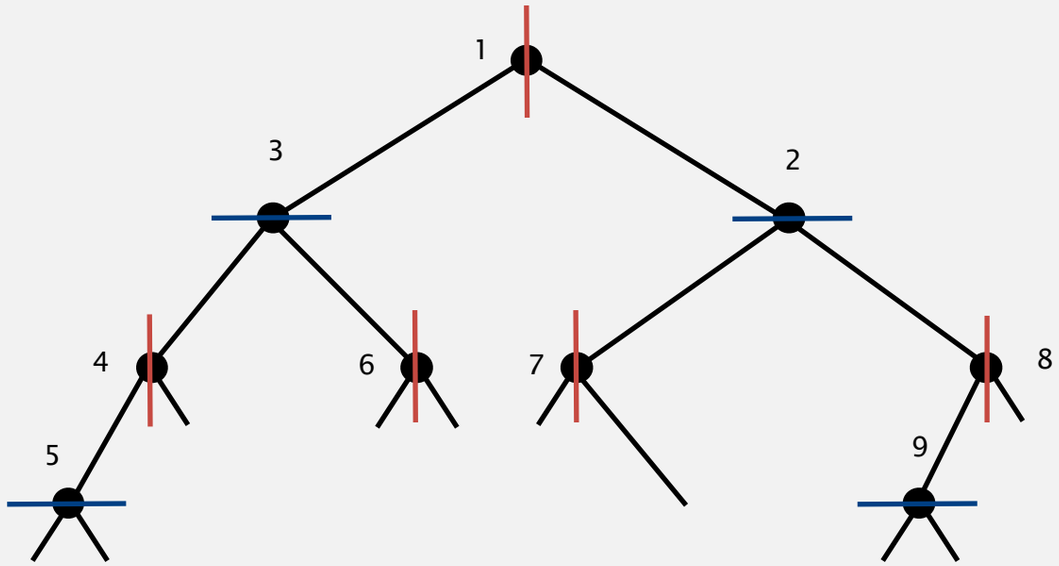

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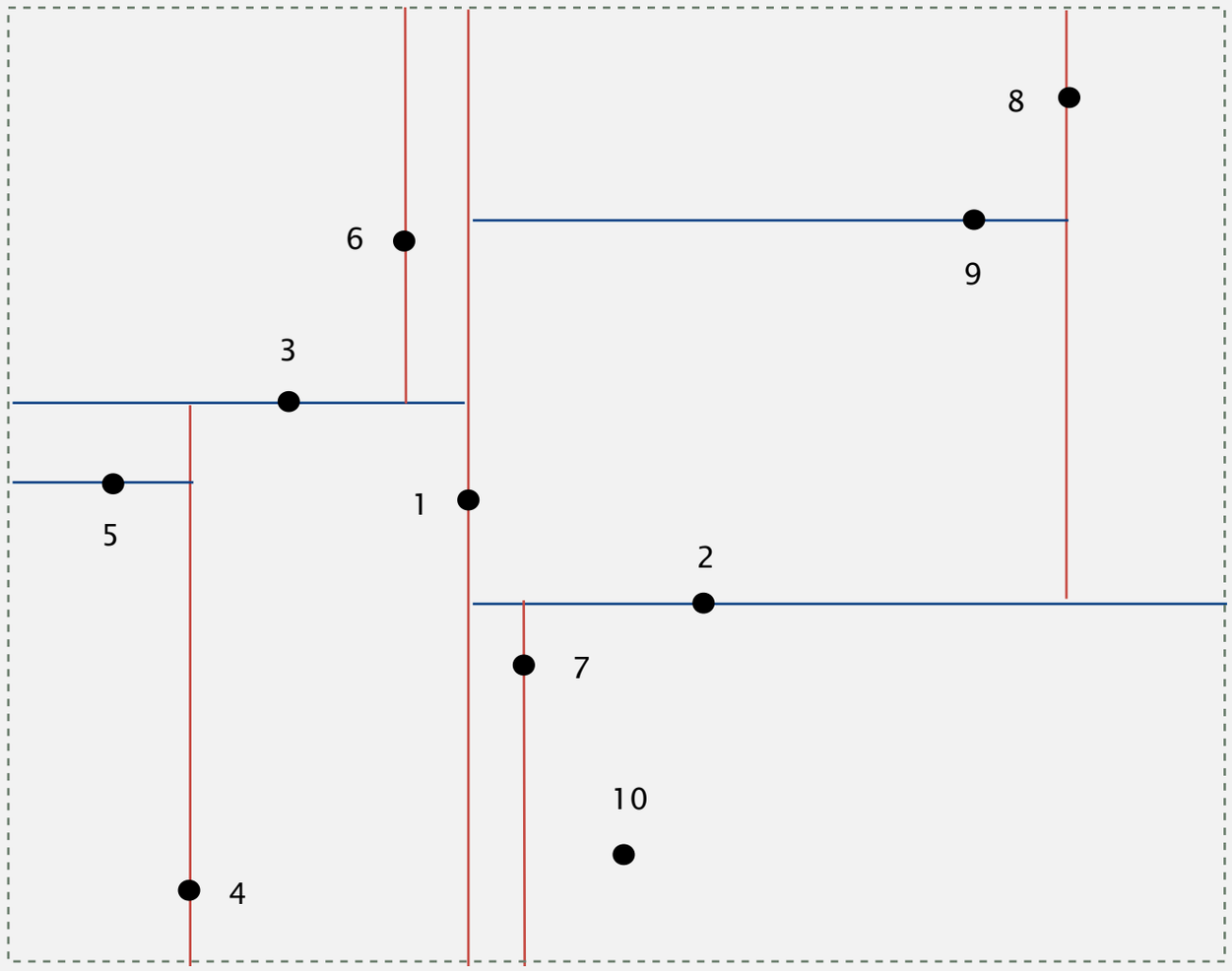

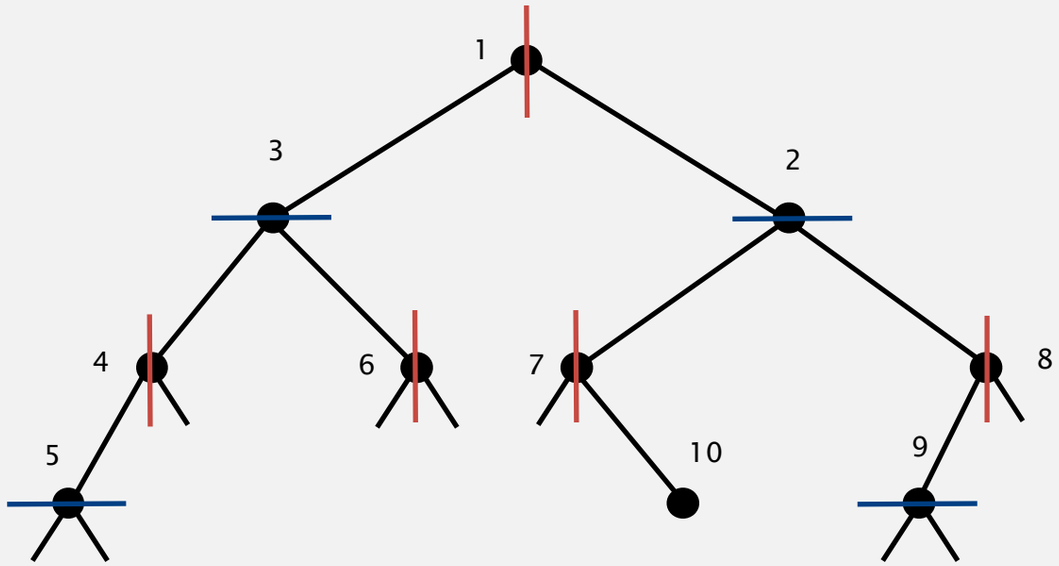

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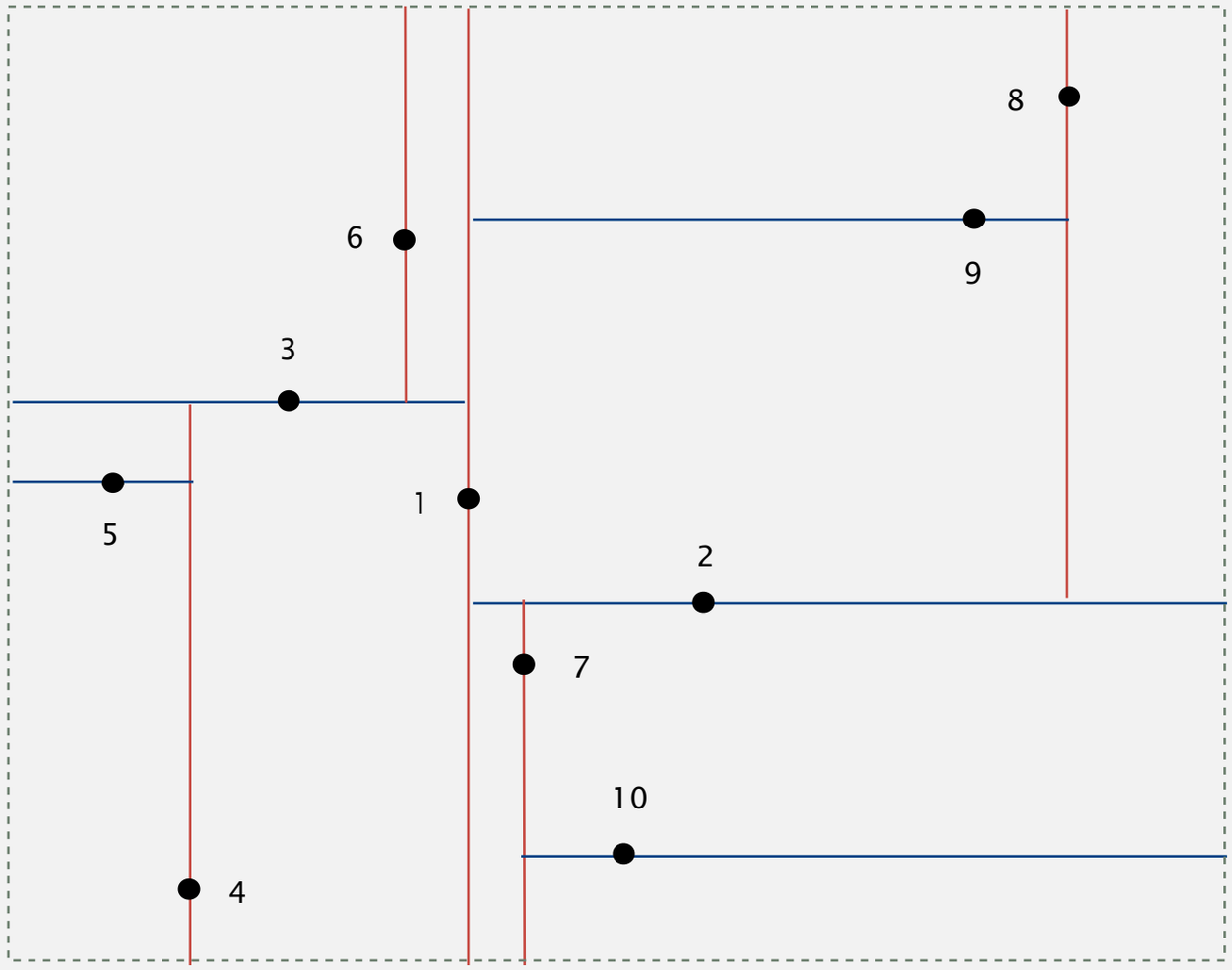
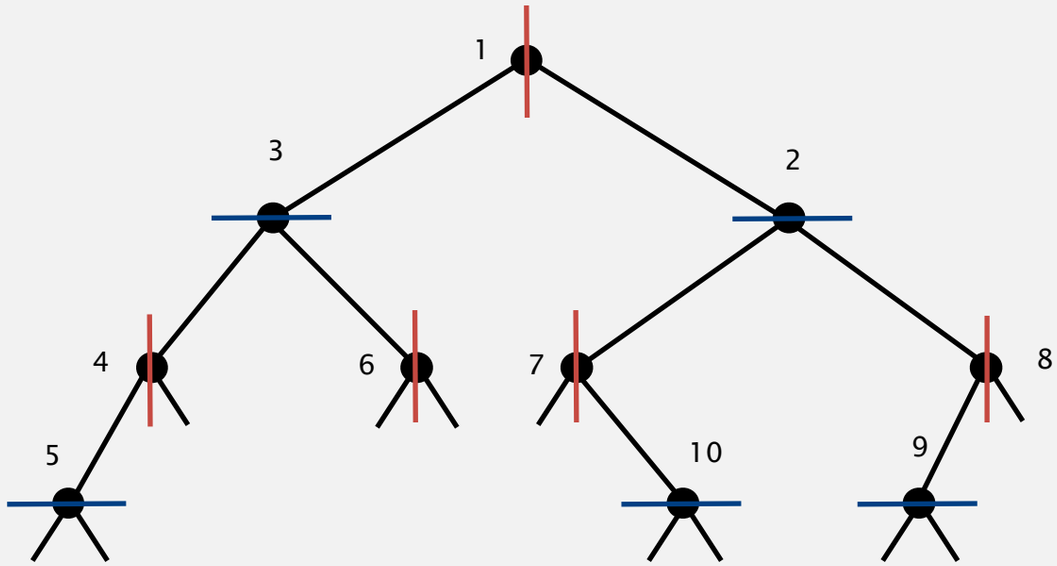
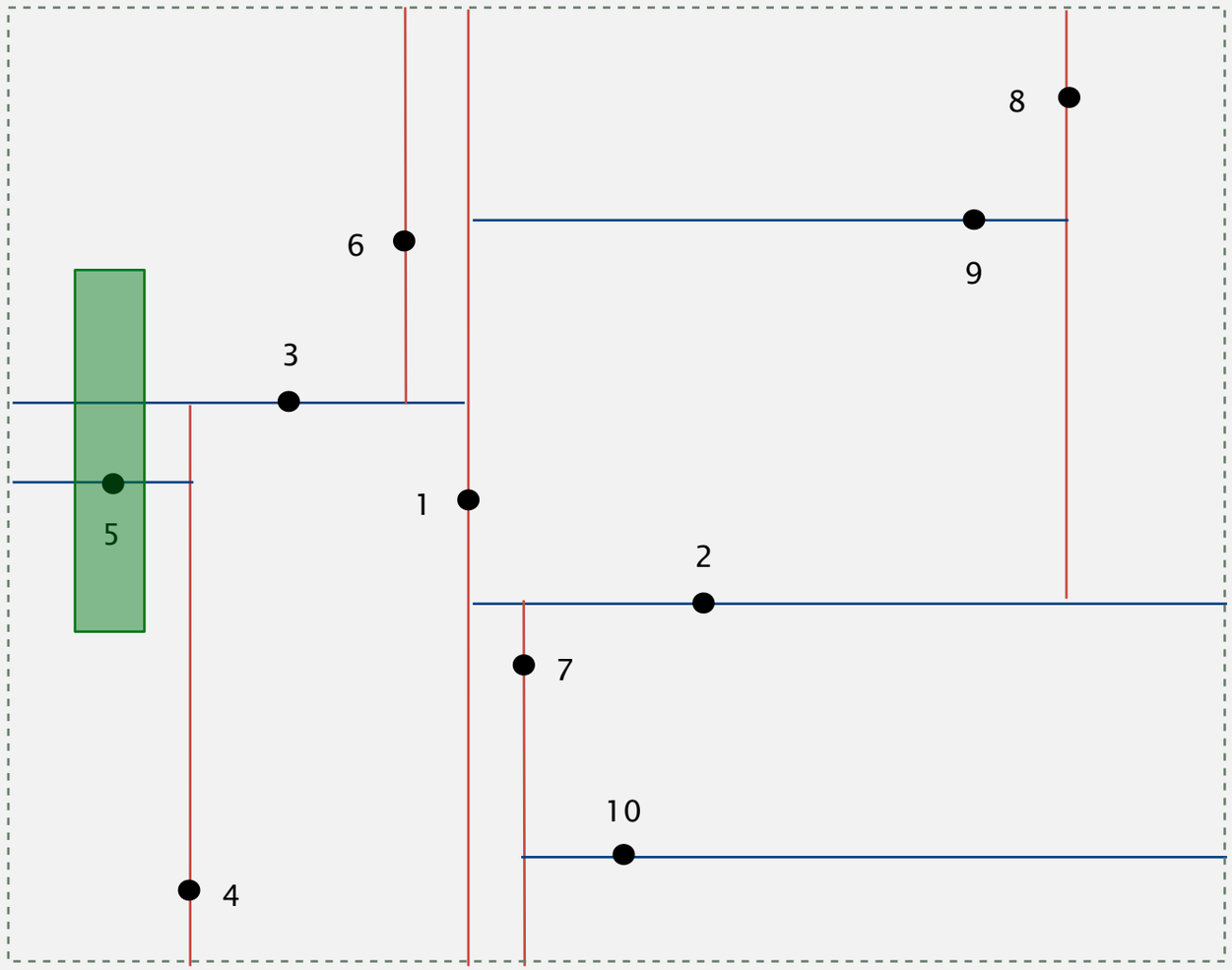


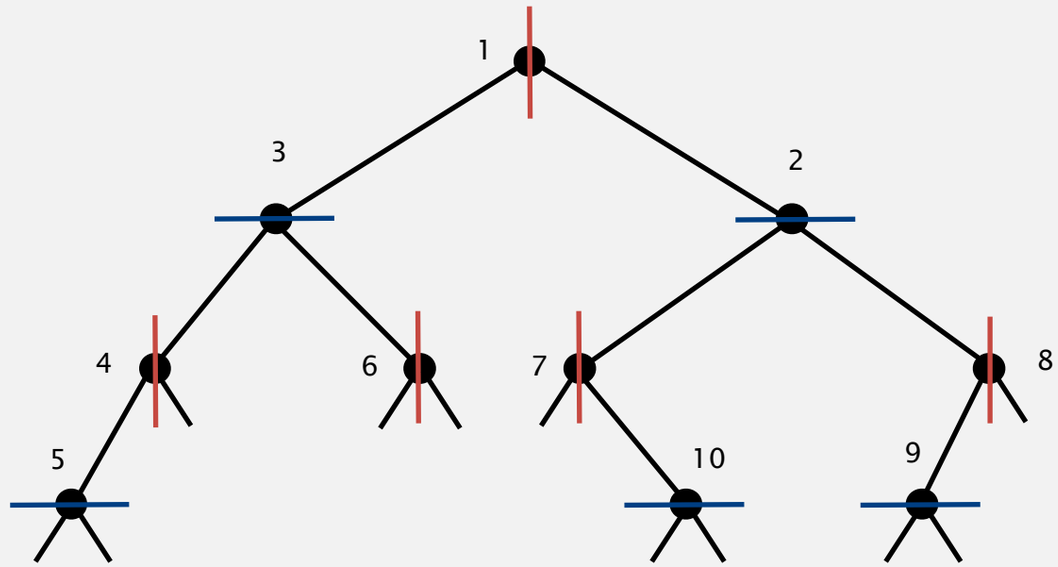


- insertion
- range search
- nearest neighbor search

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

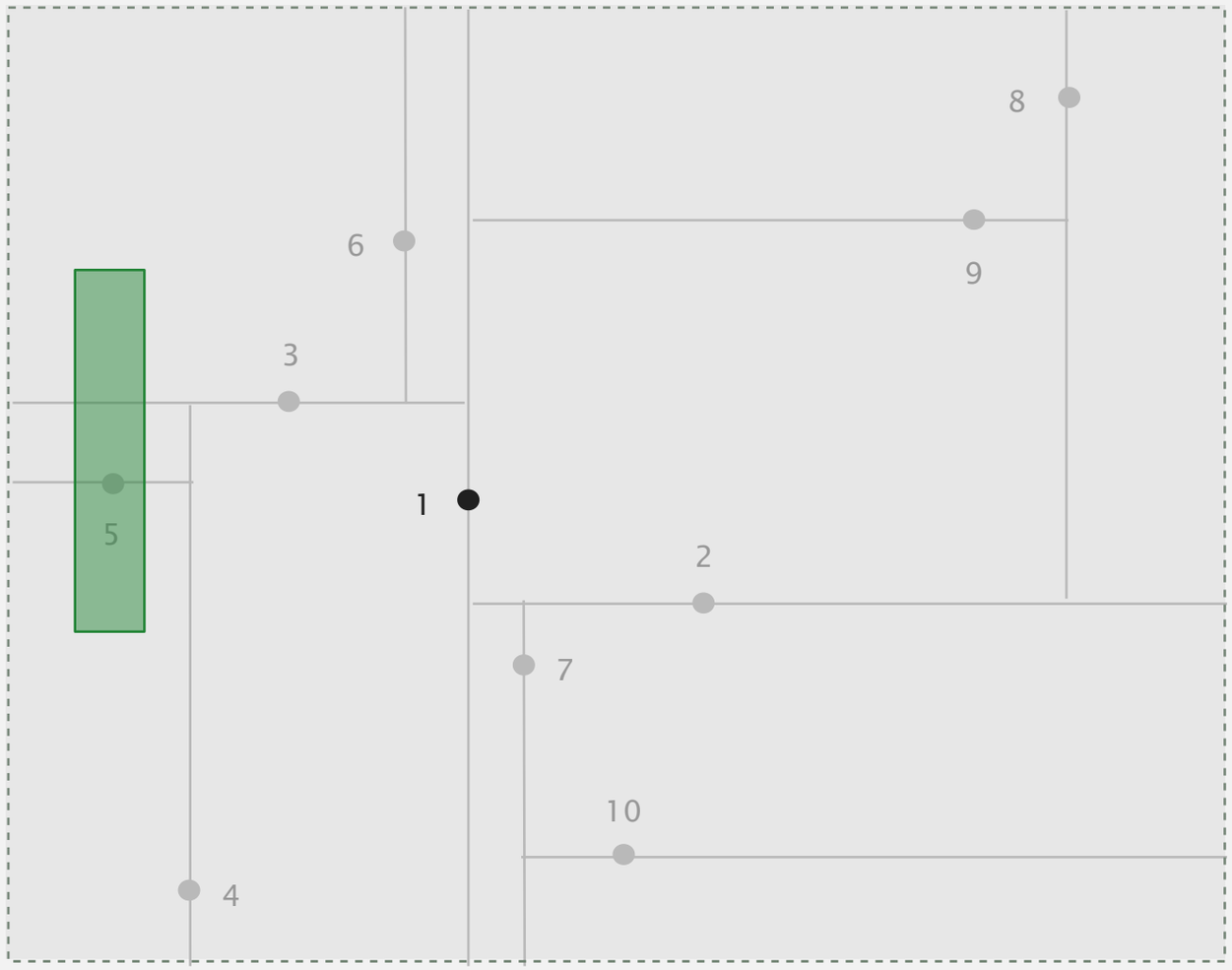


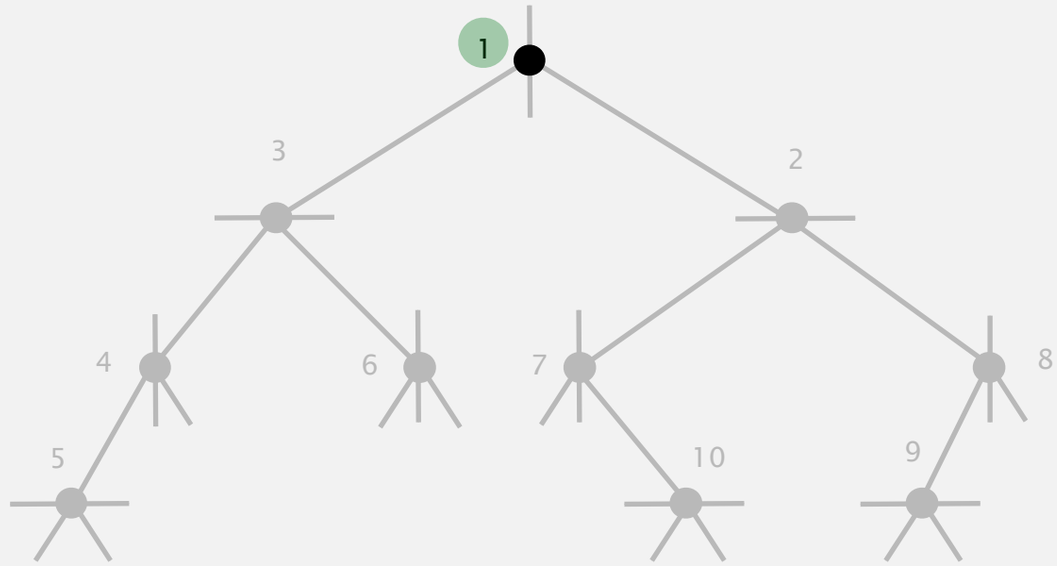


find all points in 2d tree that are contained in green query rectangle

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).



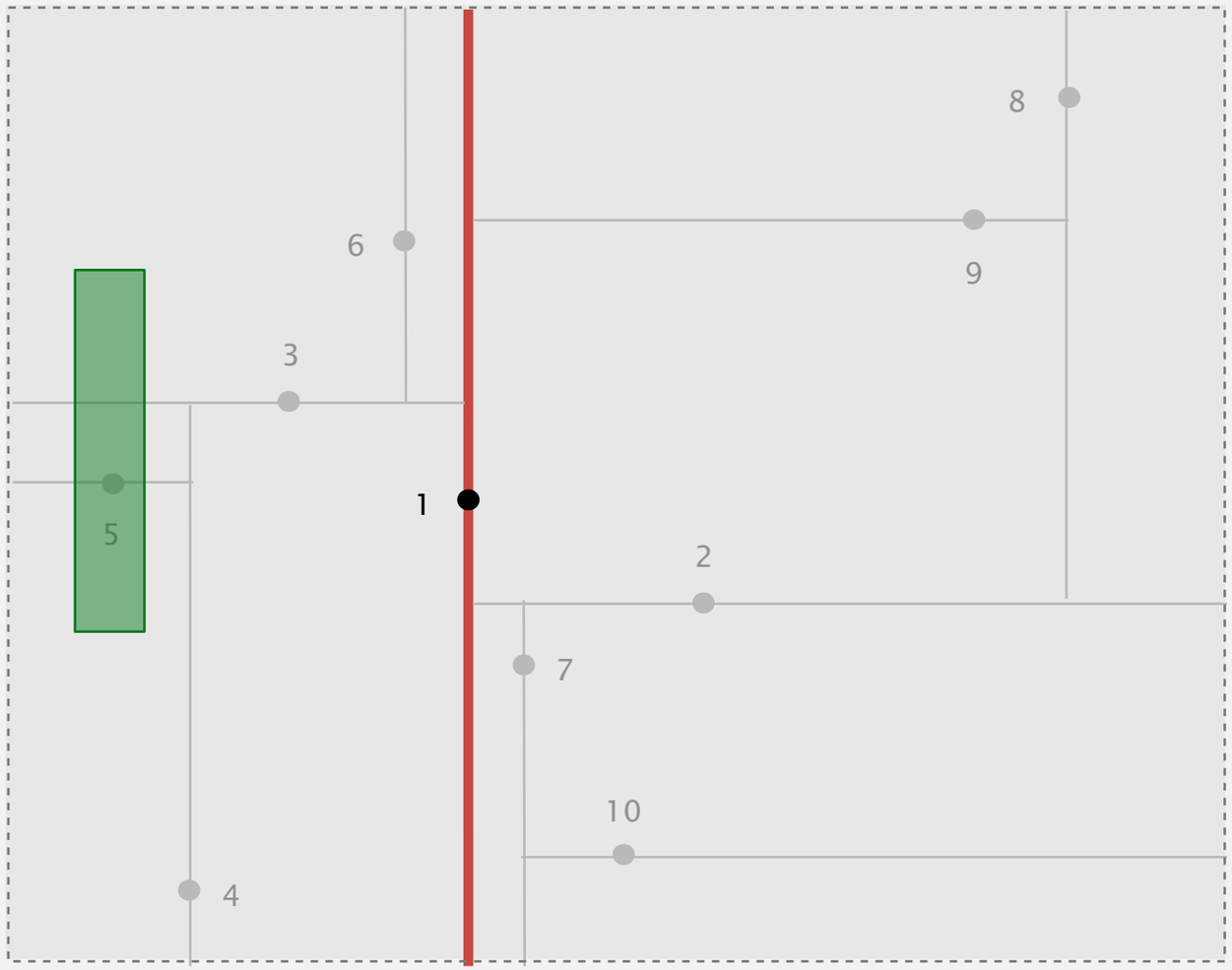


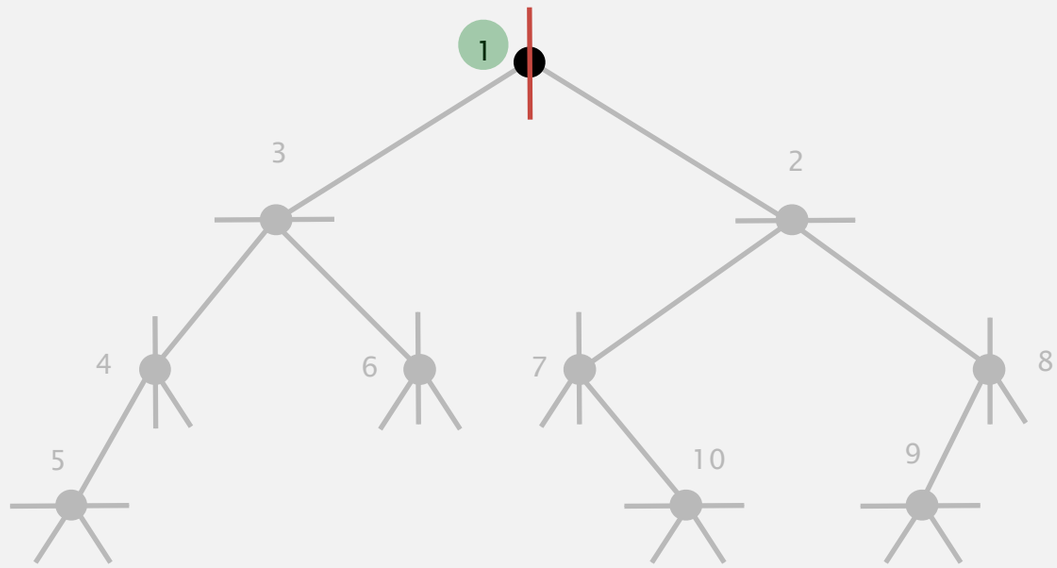
search root node

check if query rectangle contains point 1

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

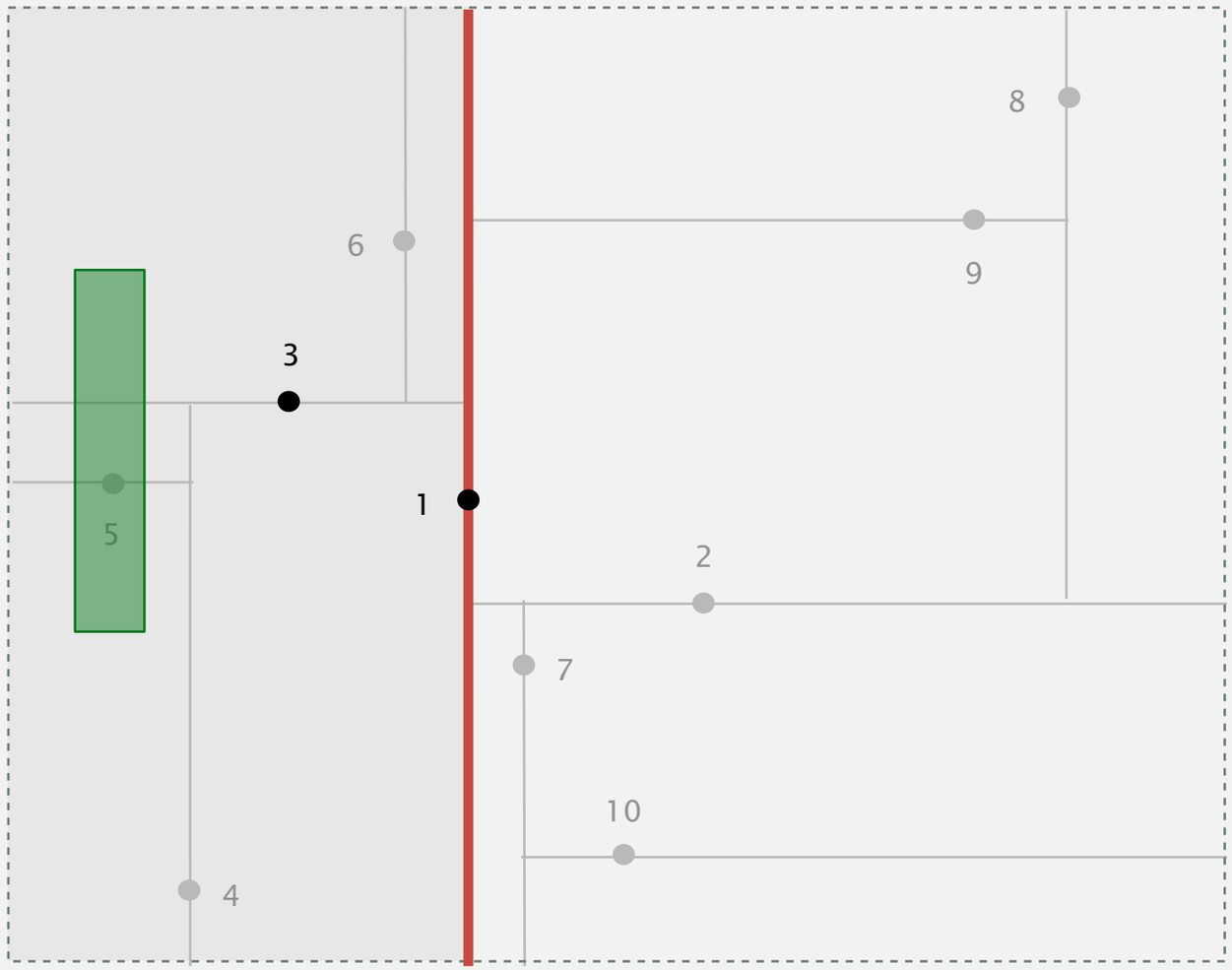


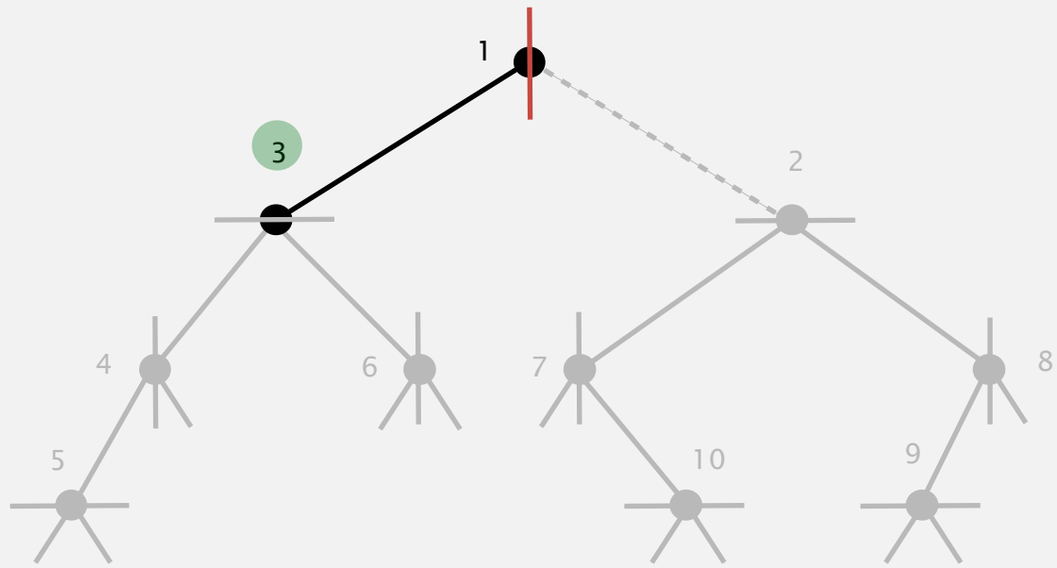


query rectangle to left of splitting line
search only in left subtree

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).



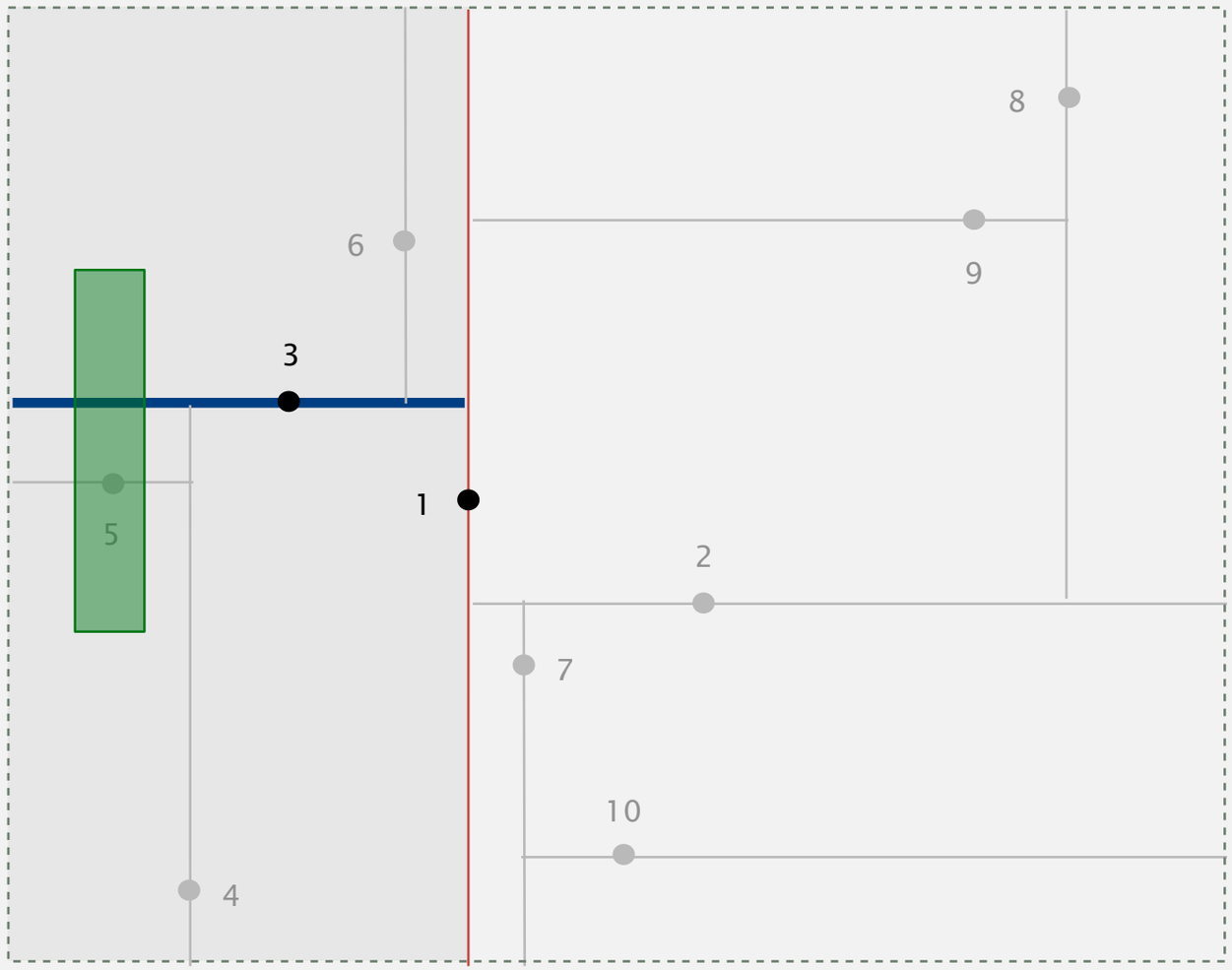


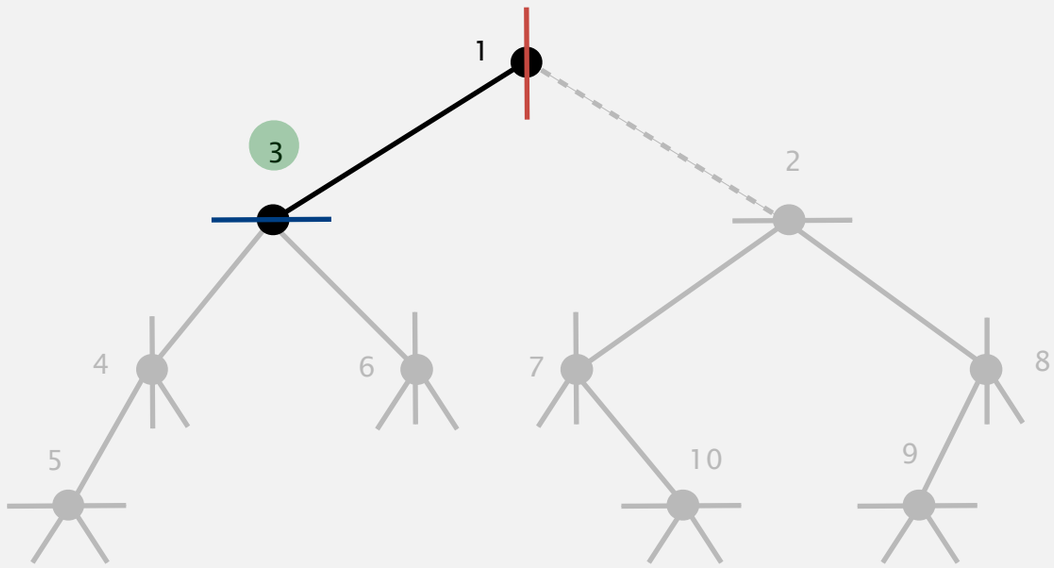
search left subtree

check if query rectangle contains point 3

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

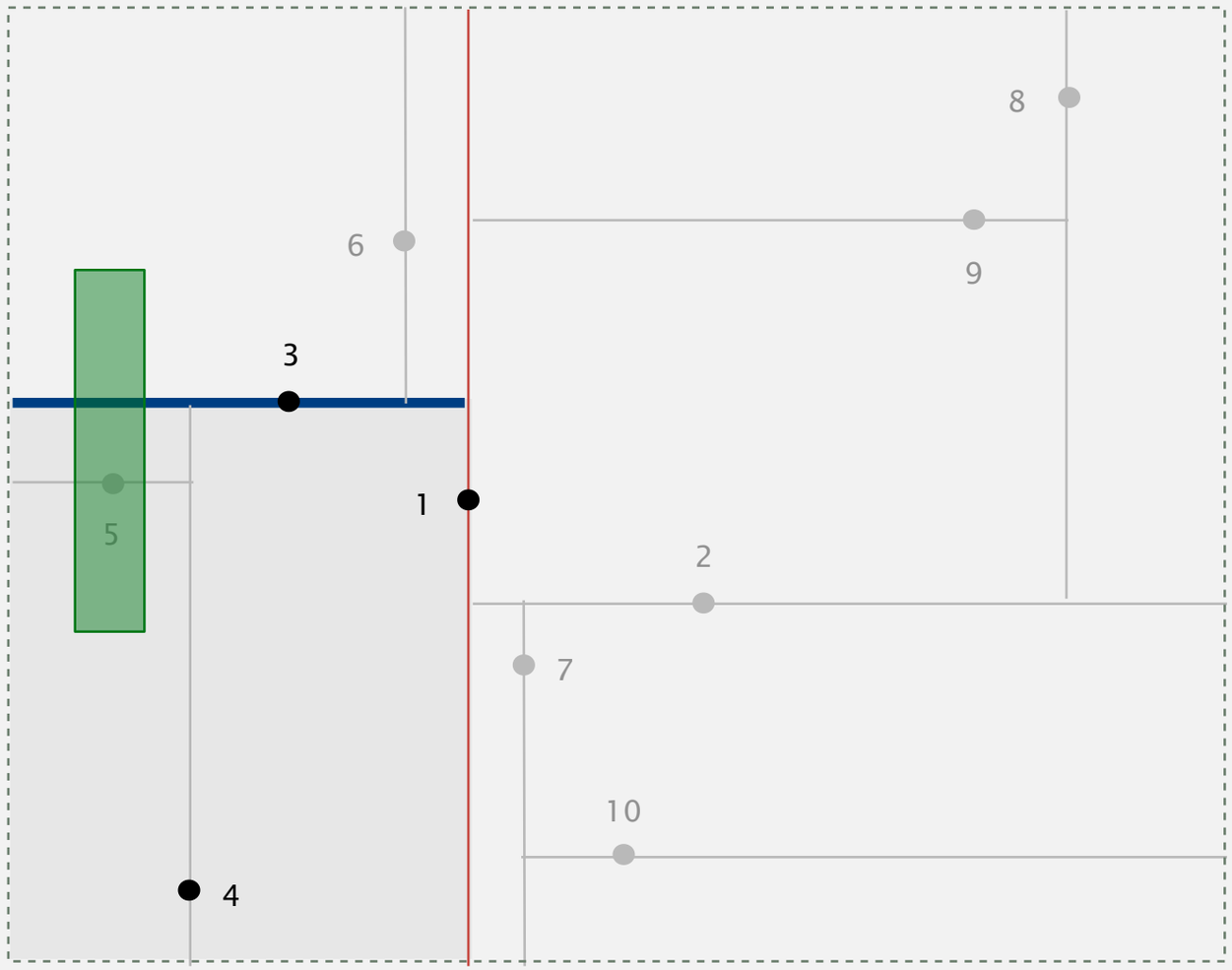


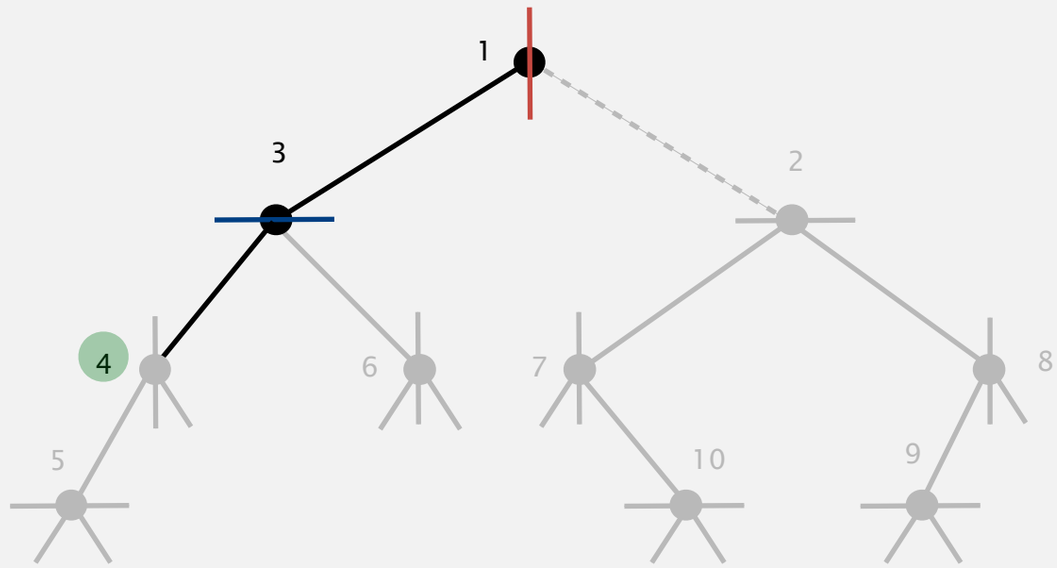


query rectangle intersects splitting line
search bottom and top subtrees

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).



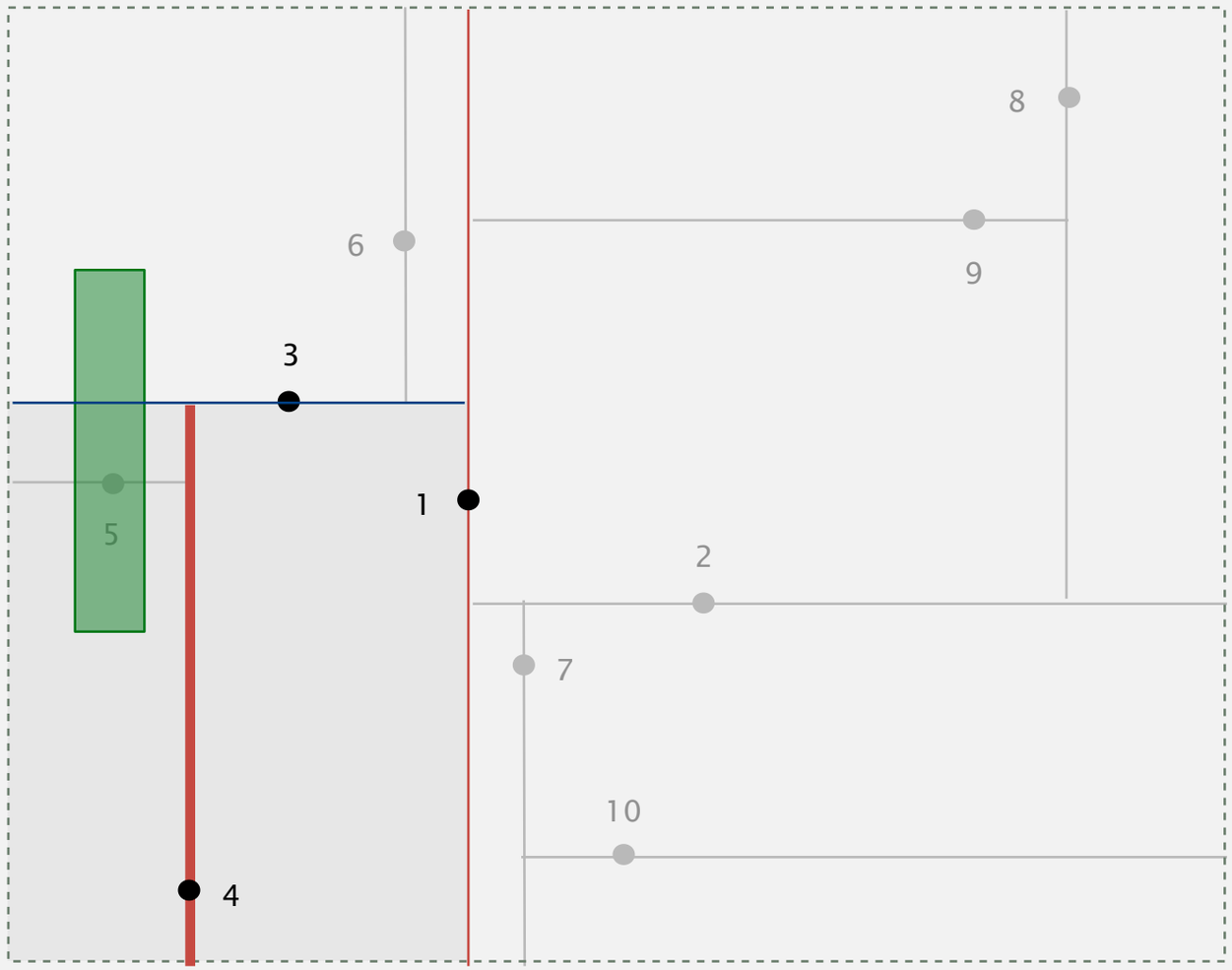


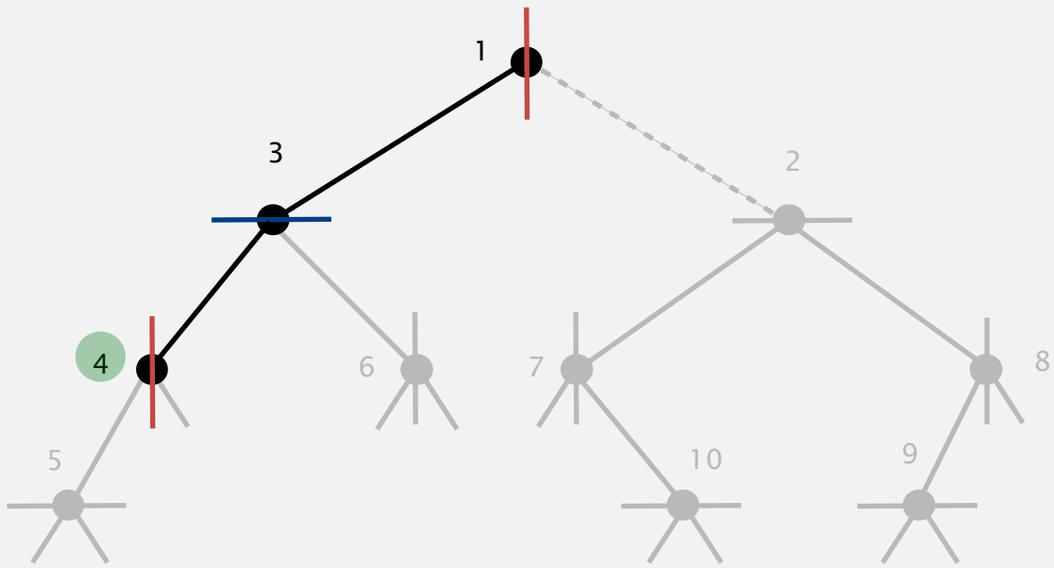
search left subtree

check if query rectangle contains point 4

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

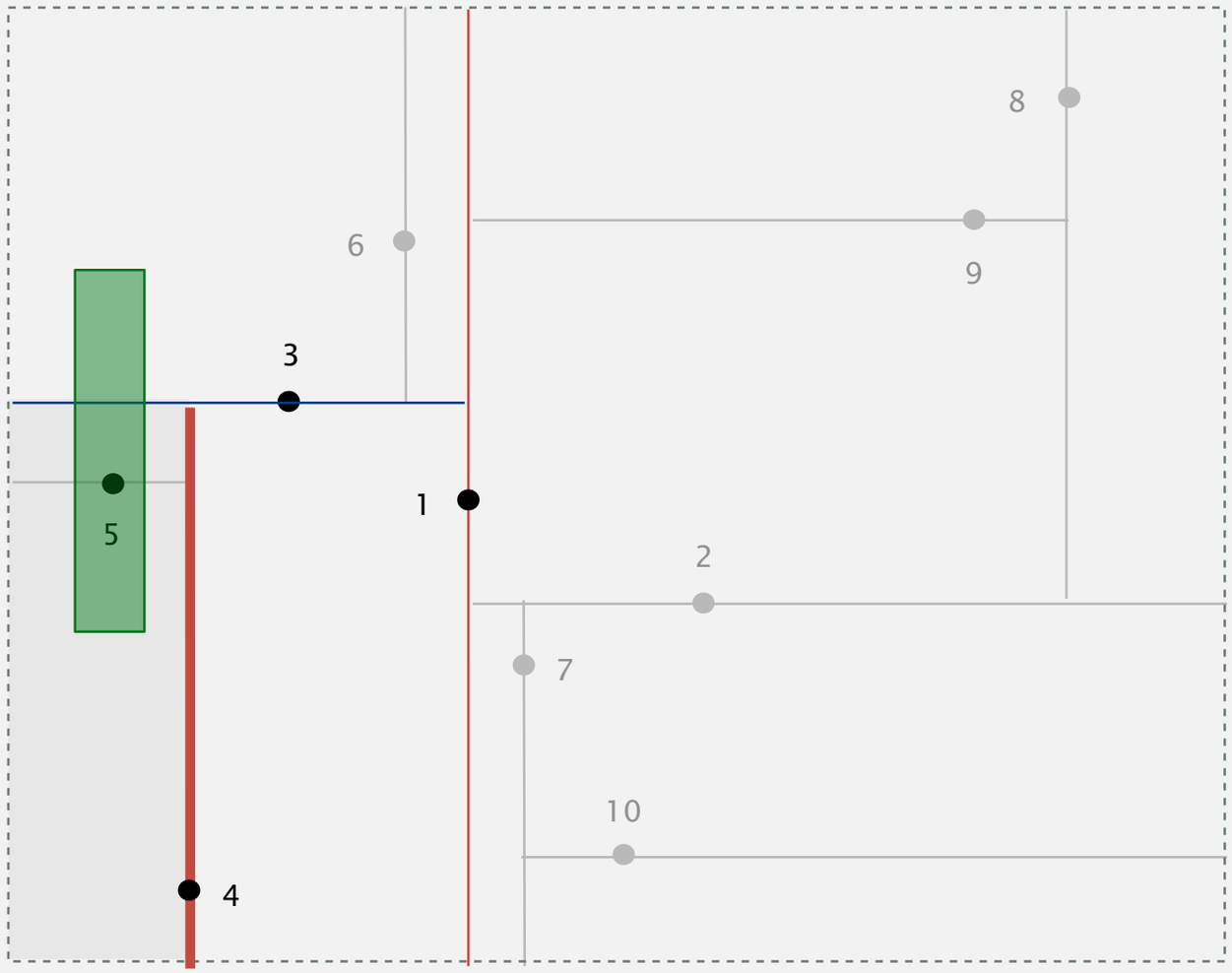


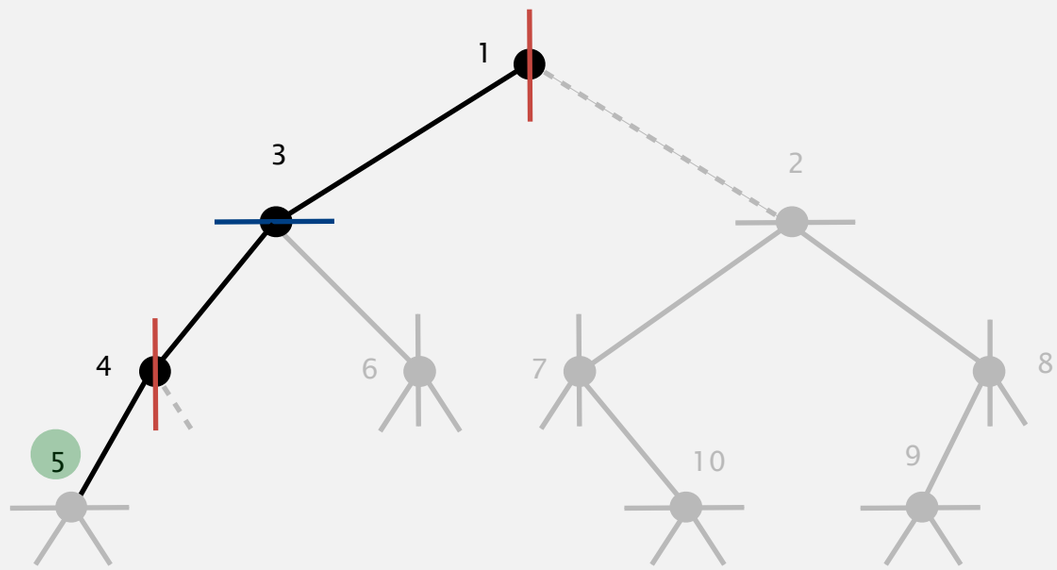


query rectangle to left of splitting line
search only in left subtree

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

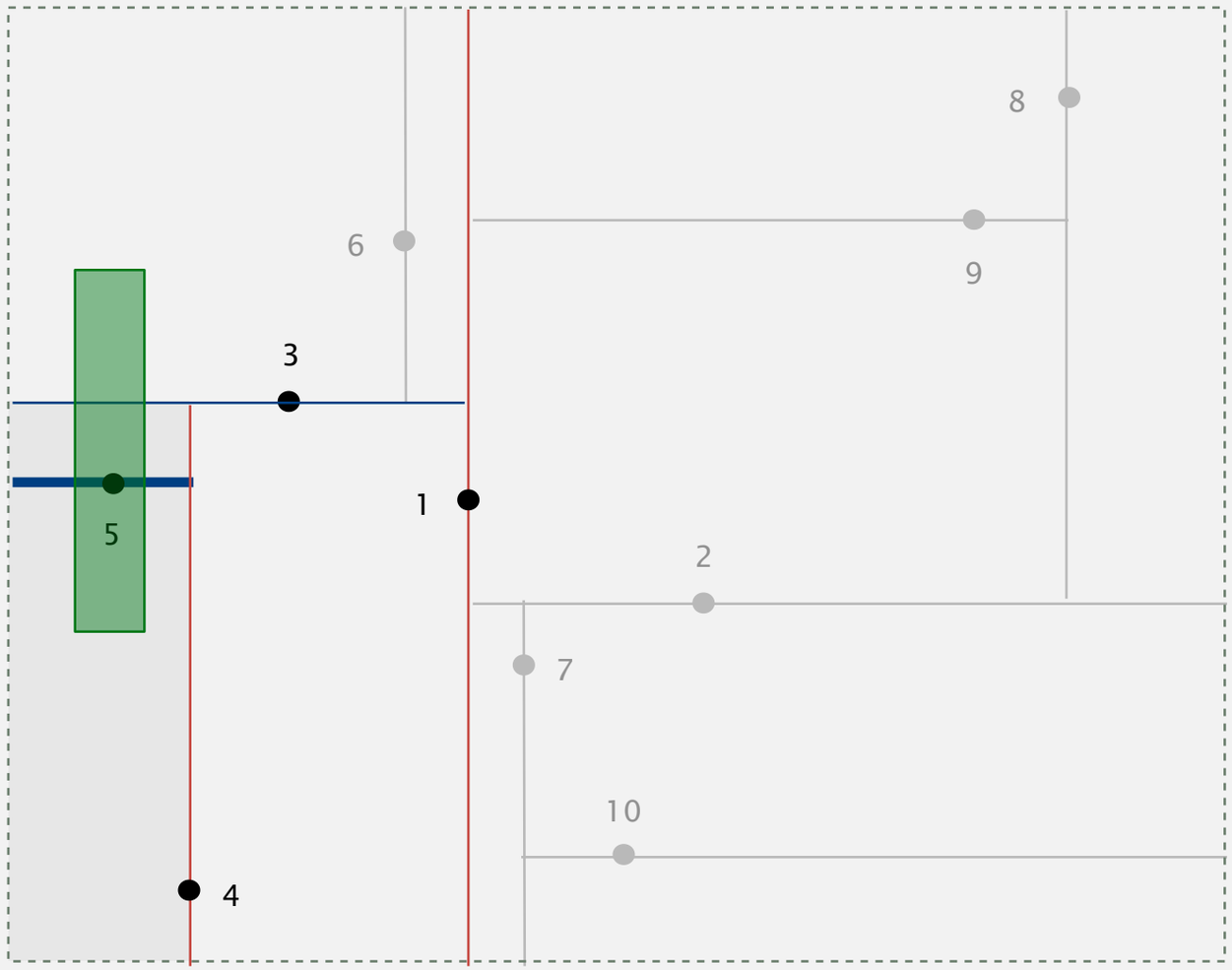


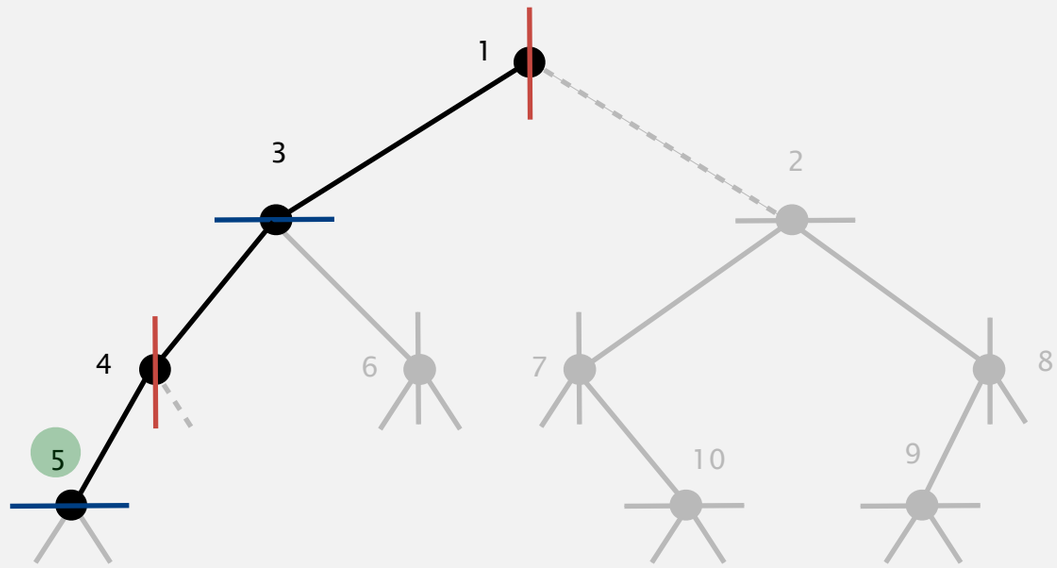


search left subtree
check if query rectangle contains point 5
(search hit)

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

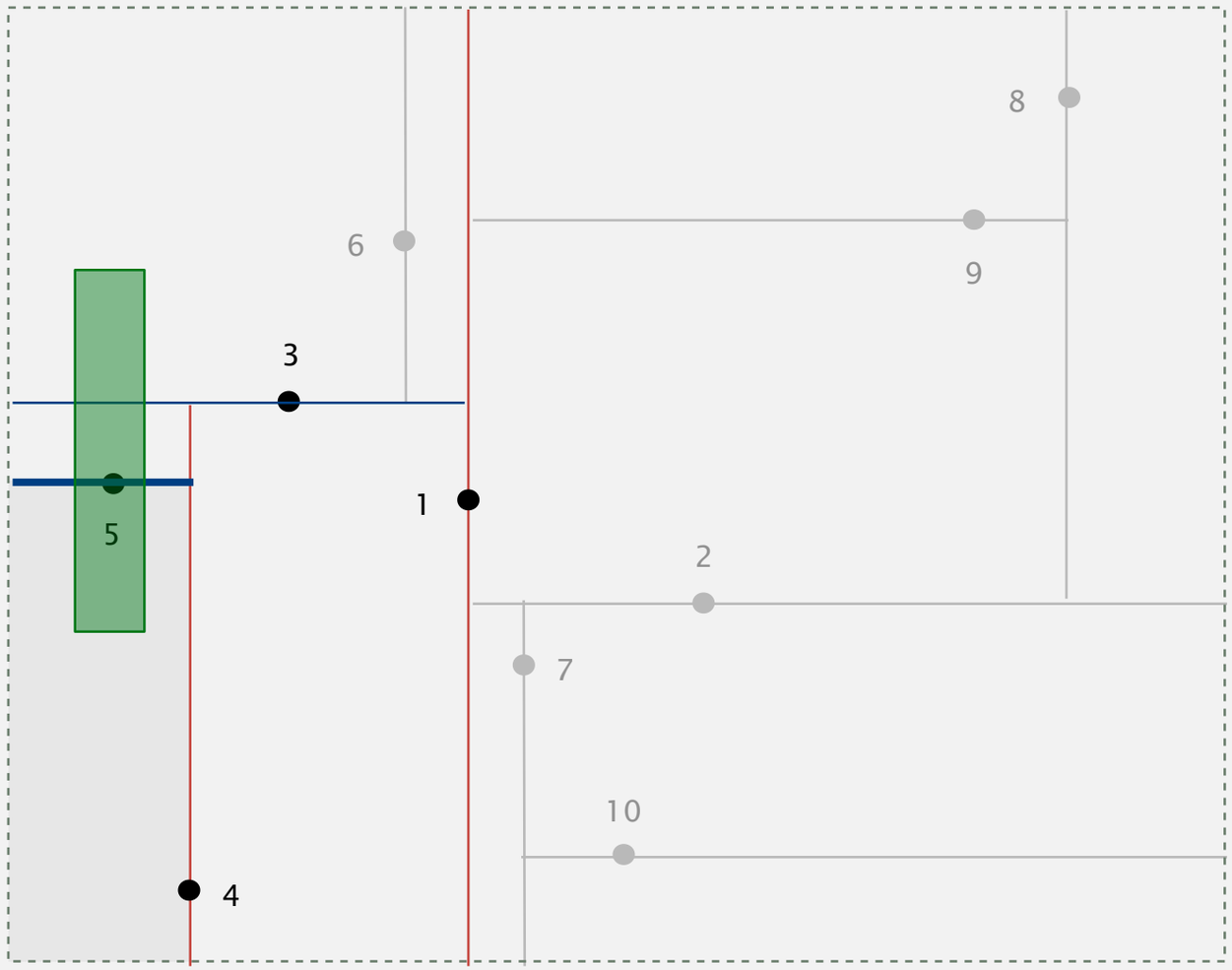


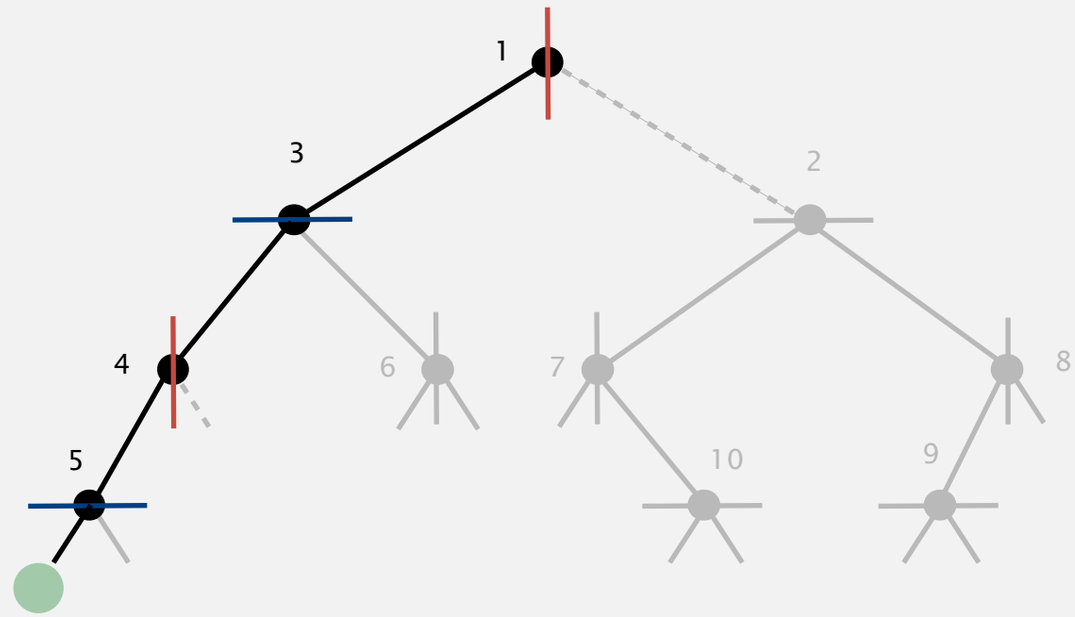


query rectangle intersects splitting line
search bottom and top subtrees

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).



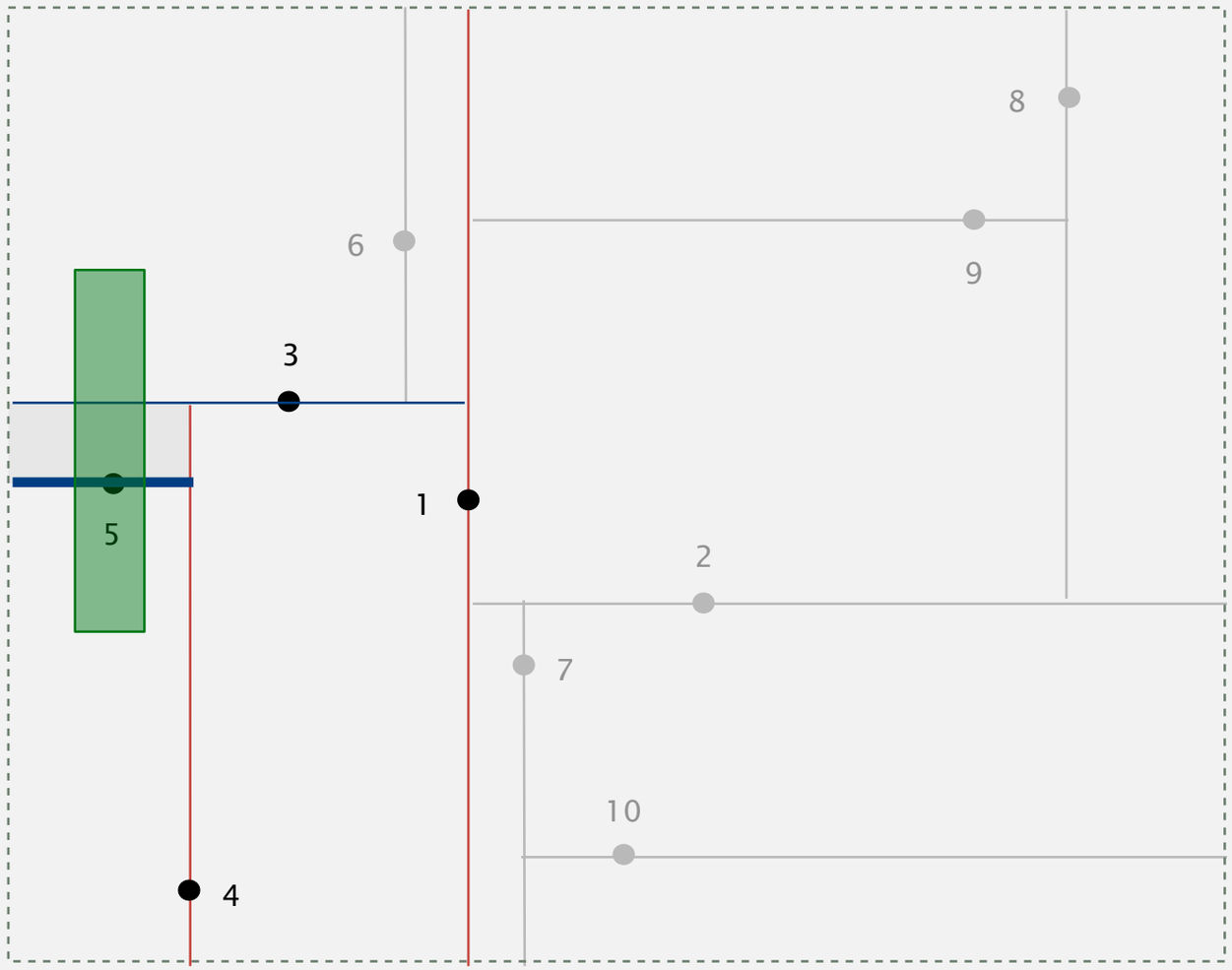


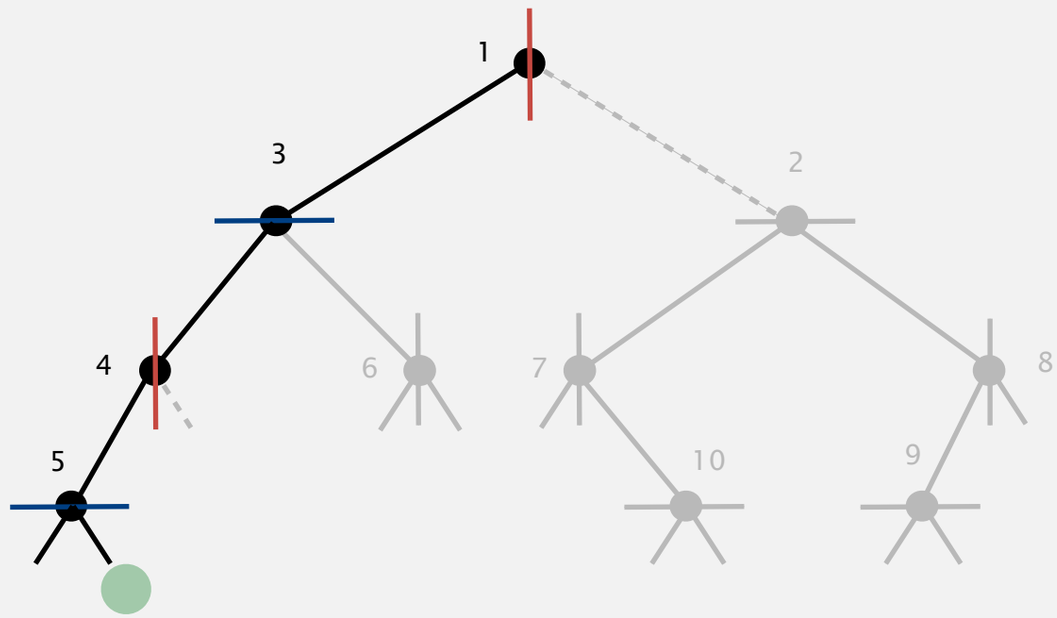
search bottom subtree

stop since empty

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).



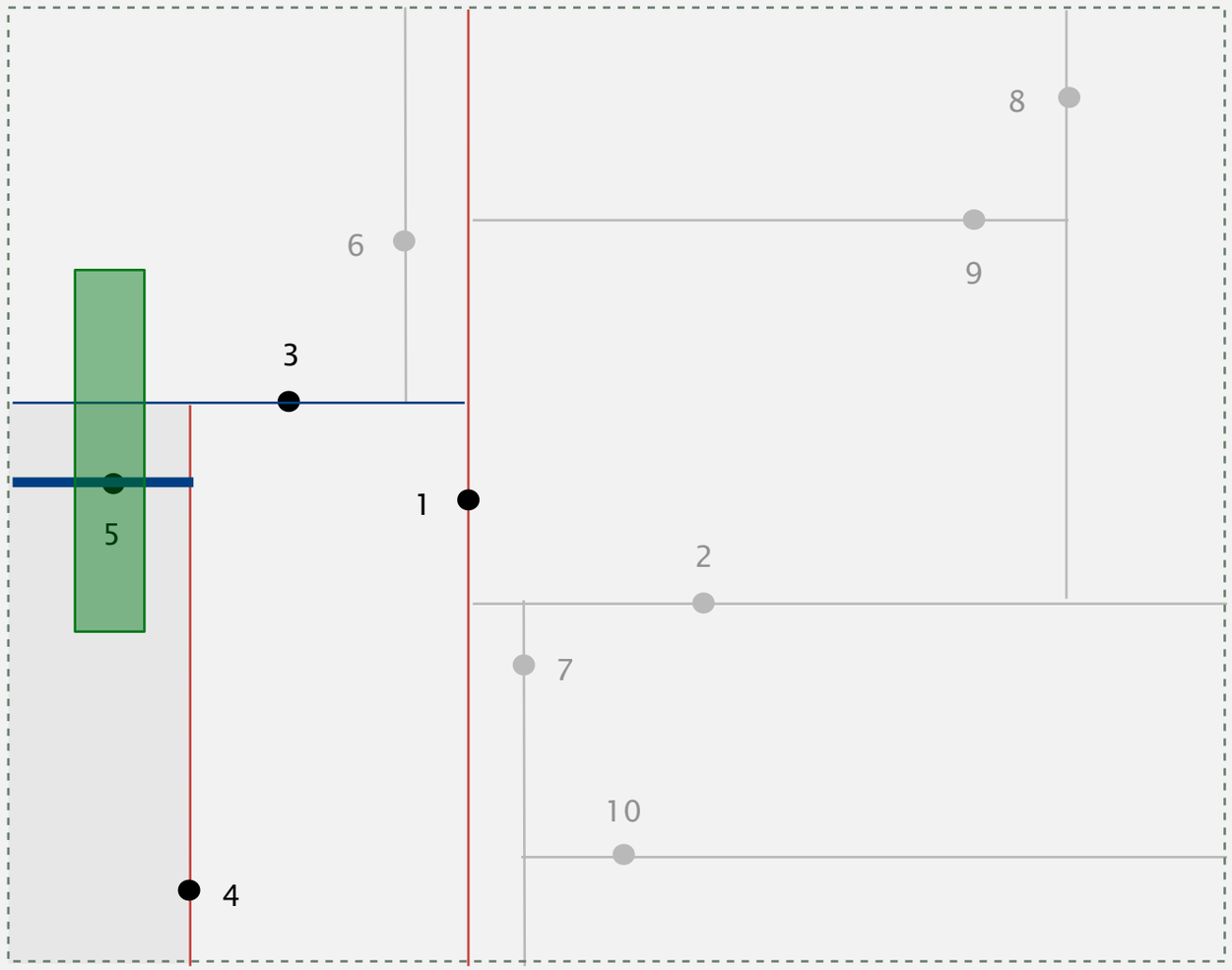


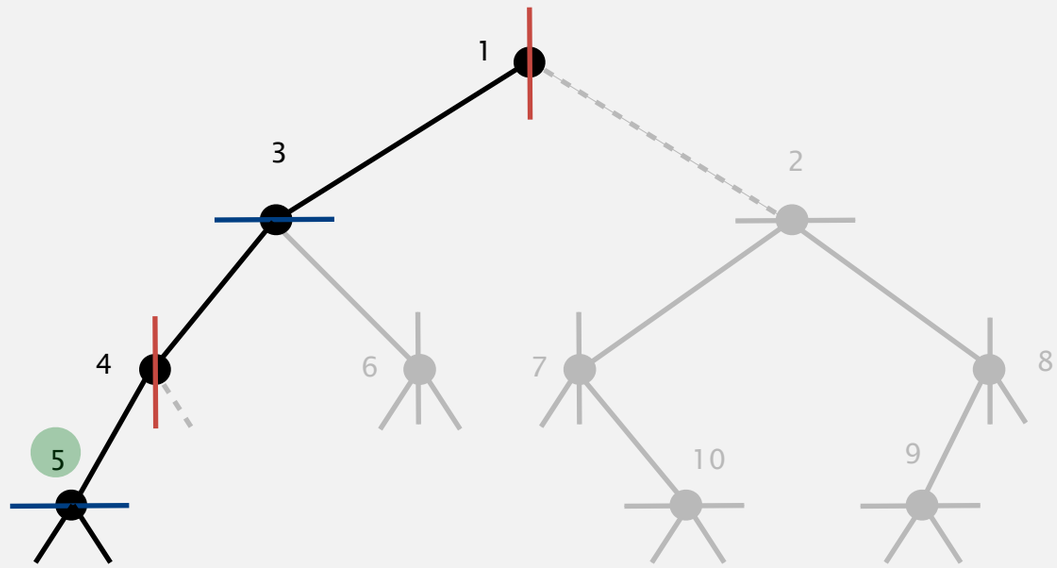
search top subtree

stop since empty

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

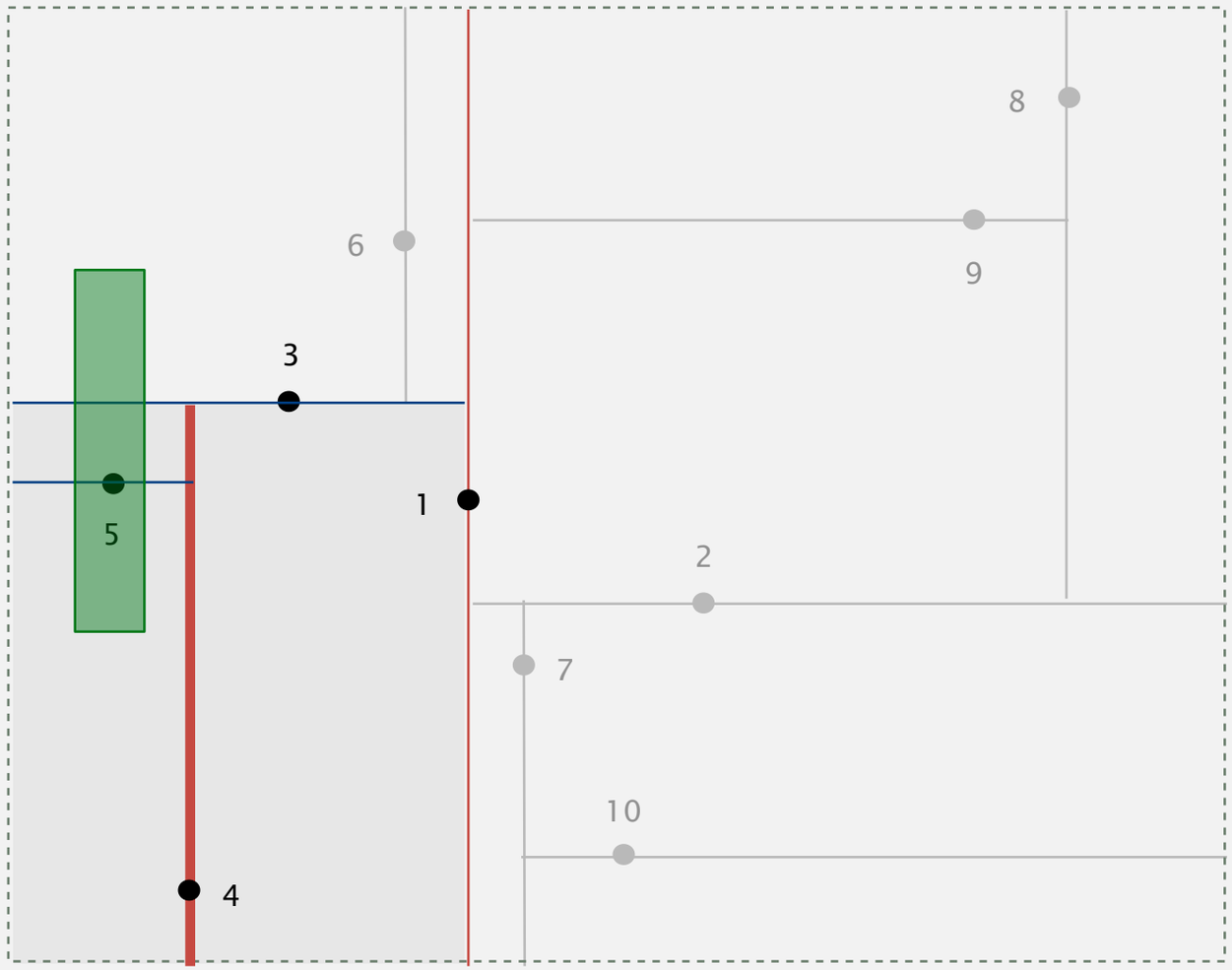


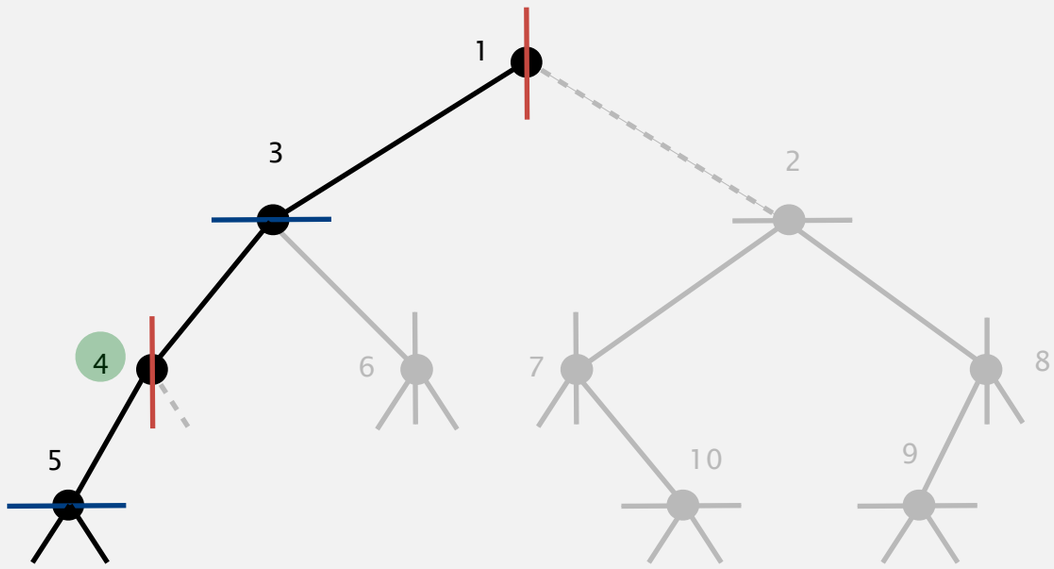


return from function call

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

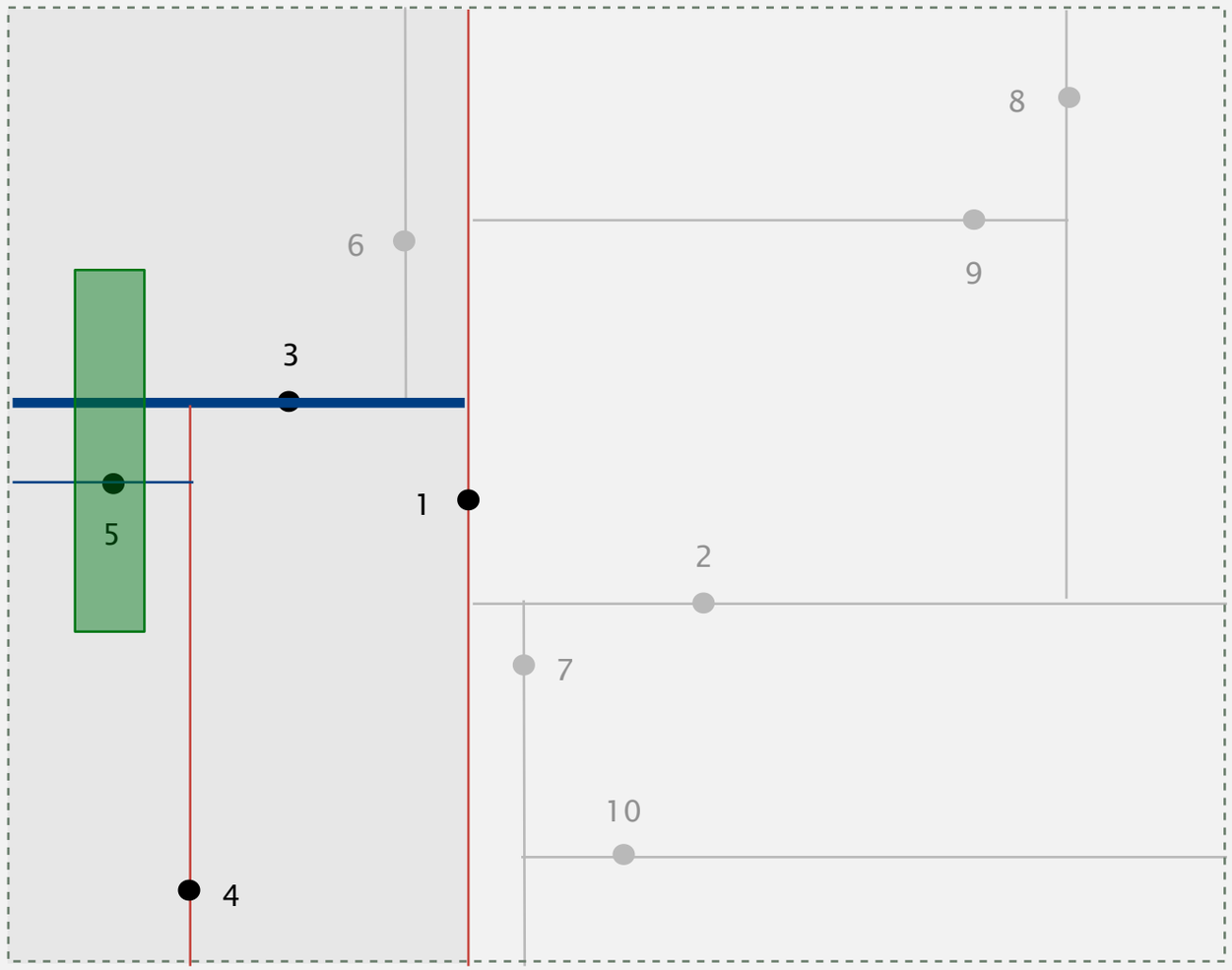


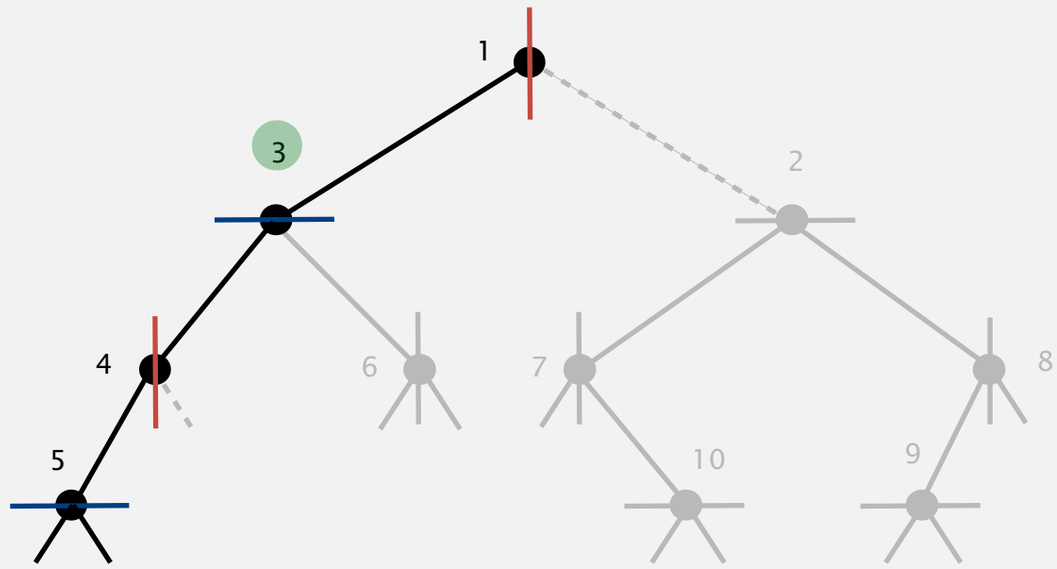


return from function call

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

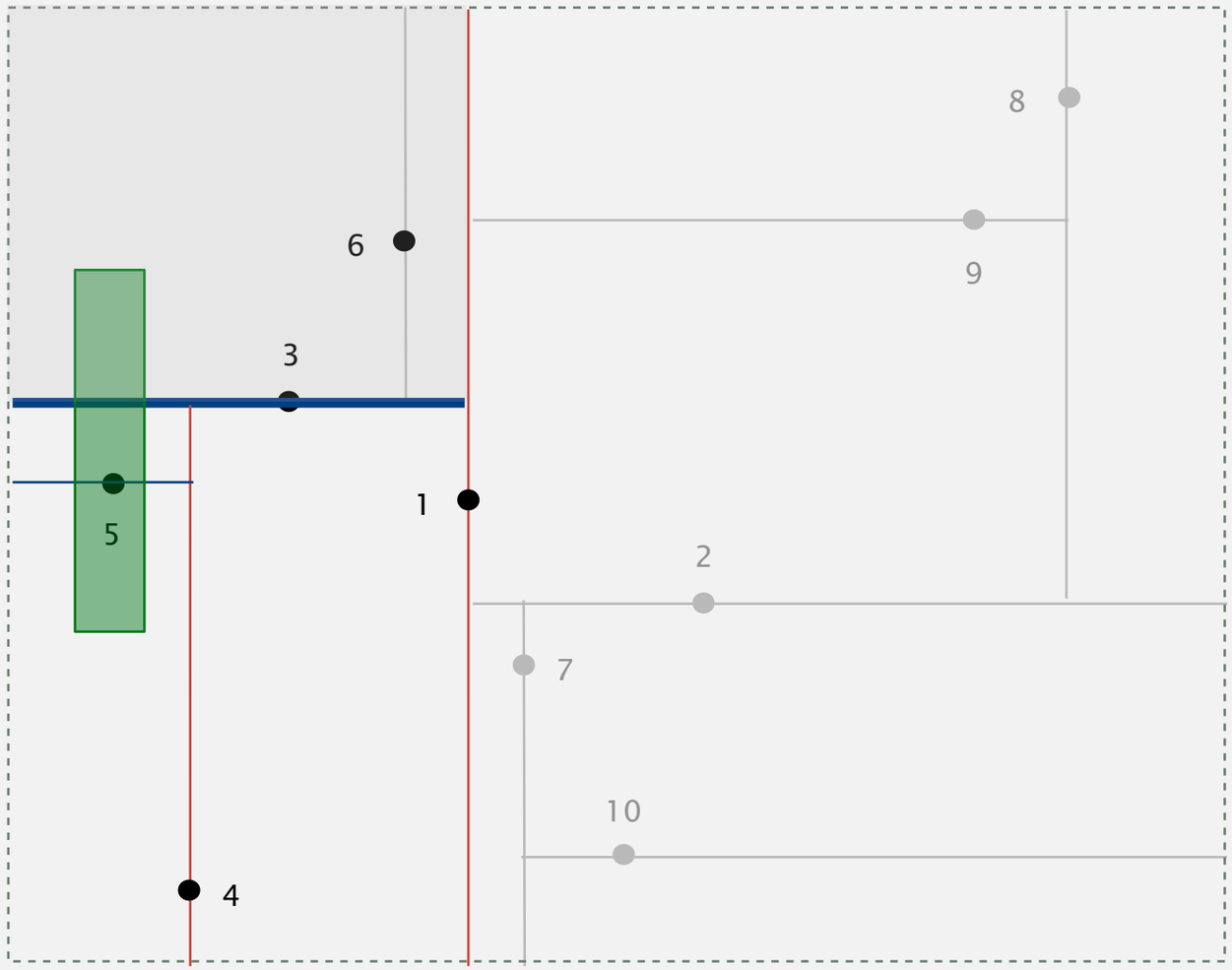


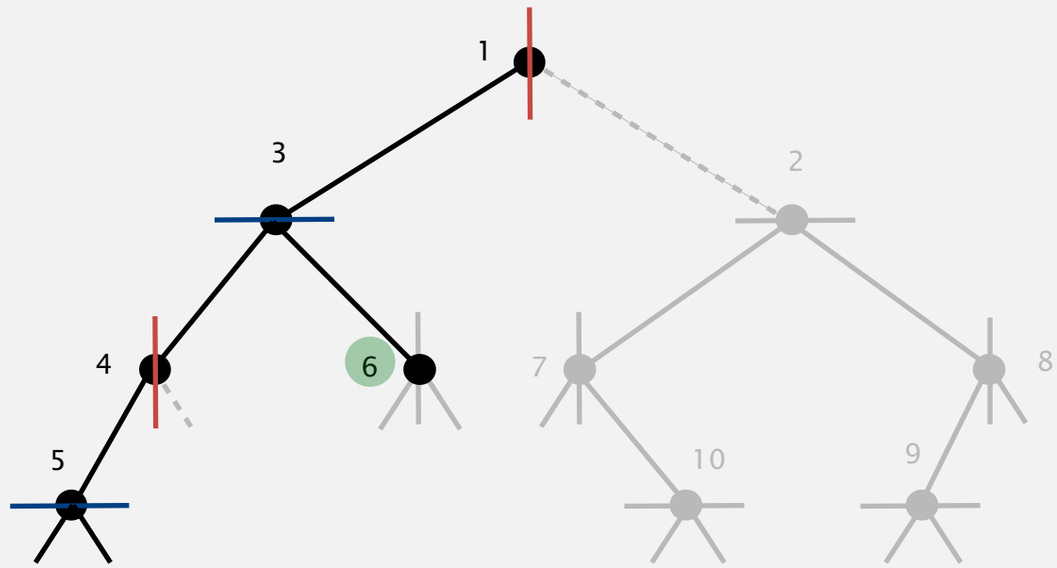


return from function call

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).



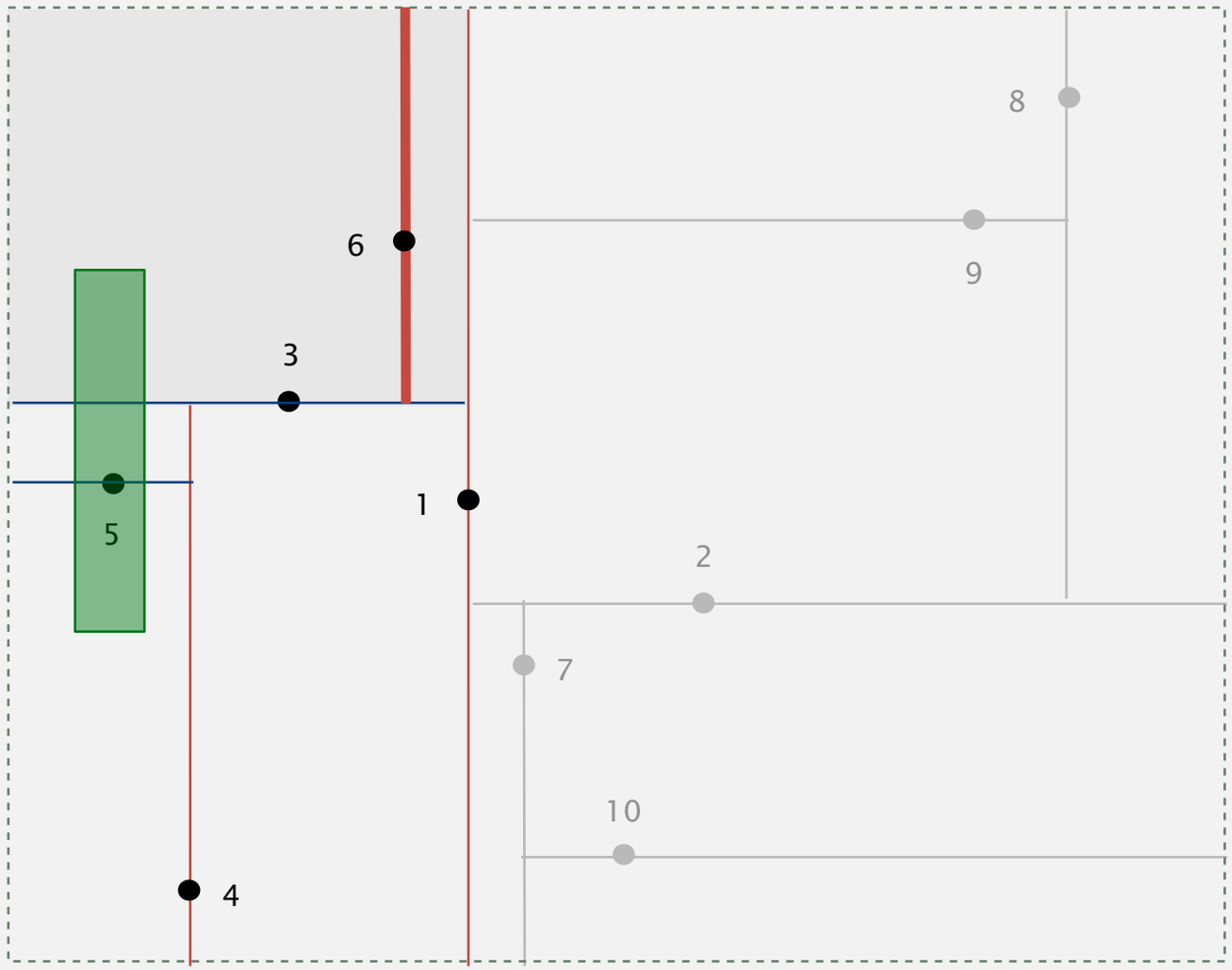


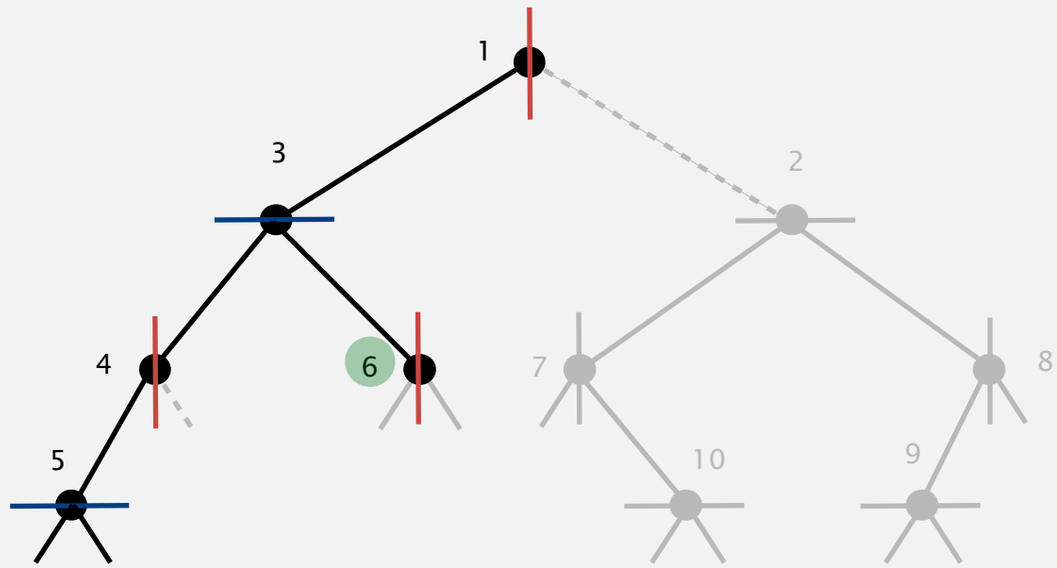
search top subtree

check if query rectangle contains point 6

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

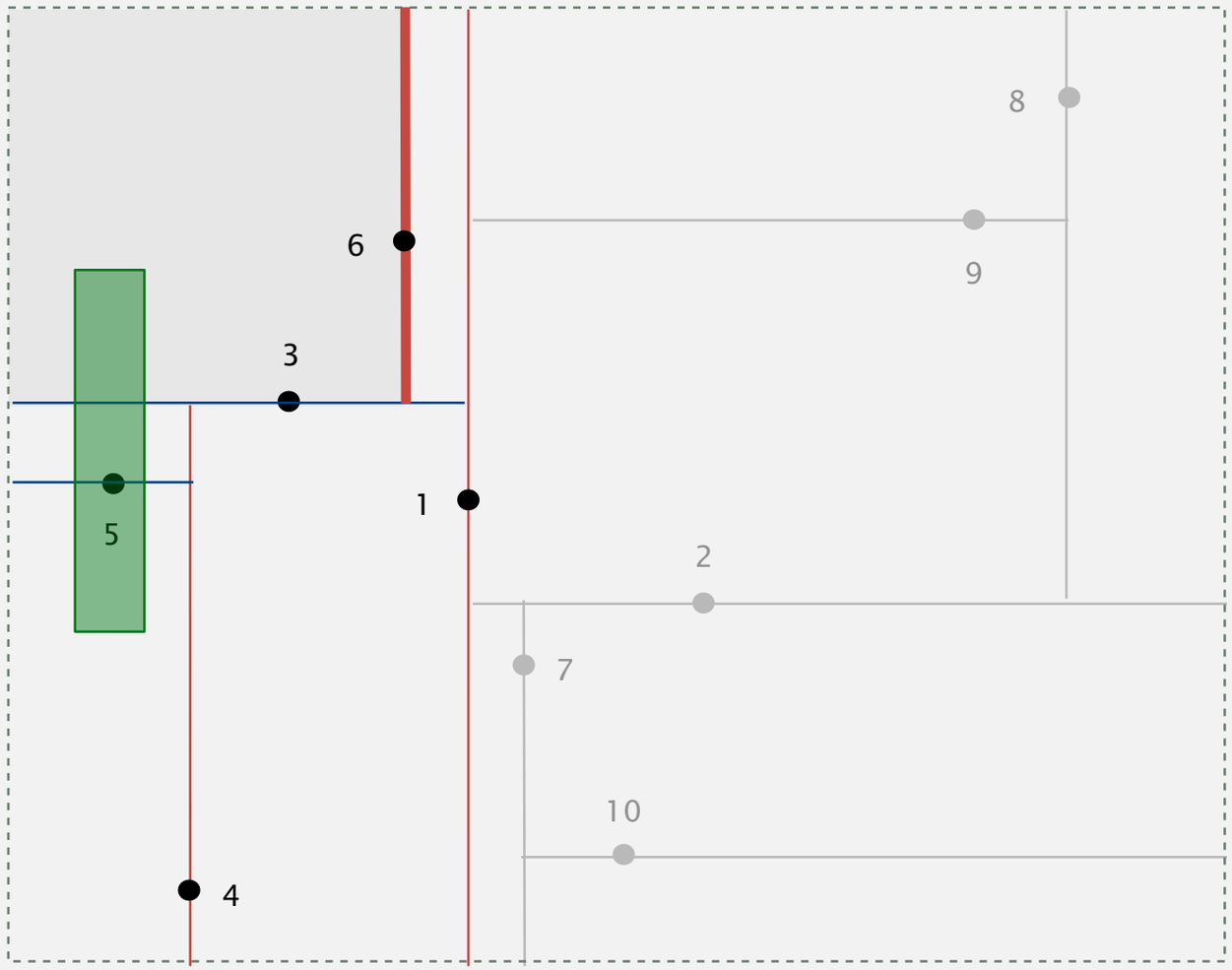


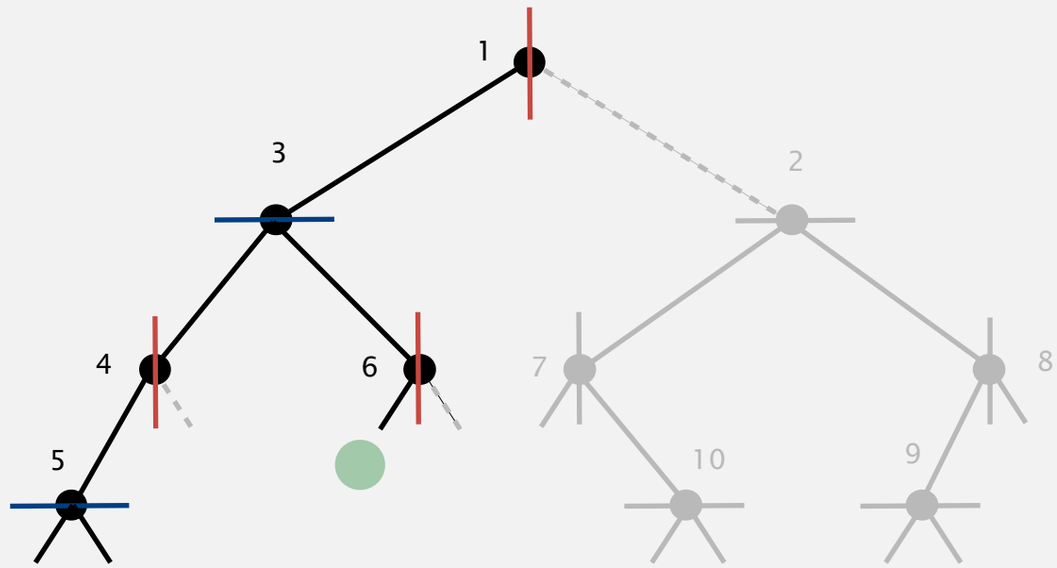


query rectangle to left of splitting line
search only in left subtree

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).



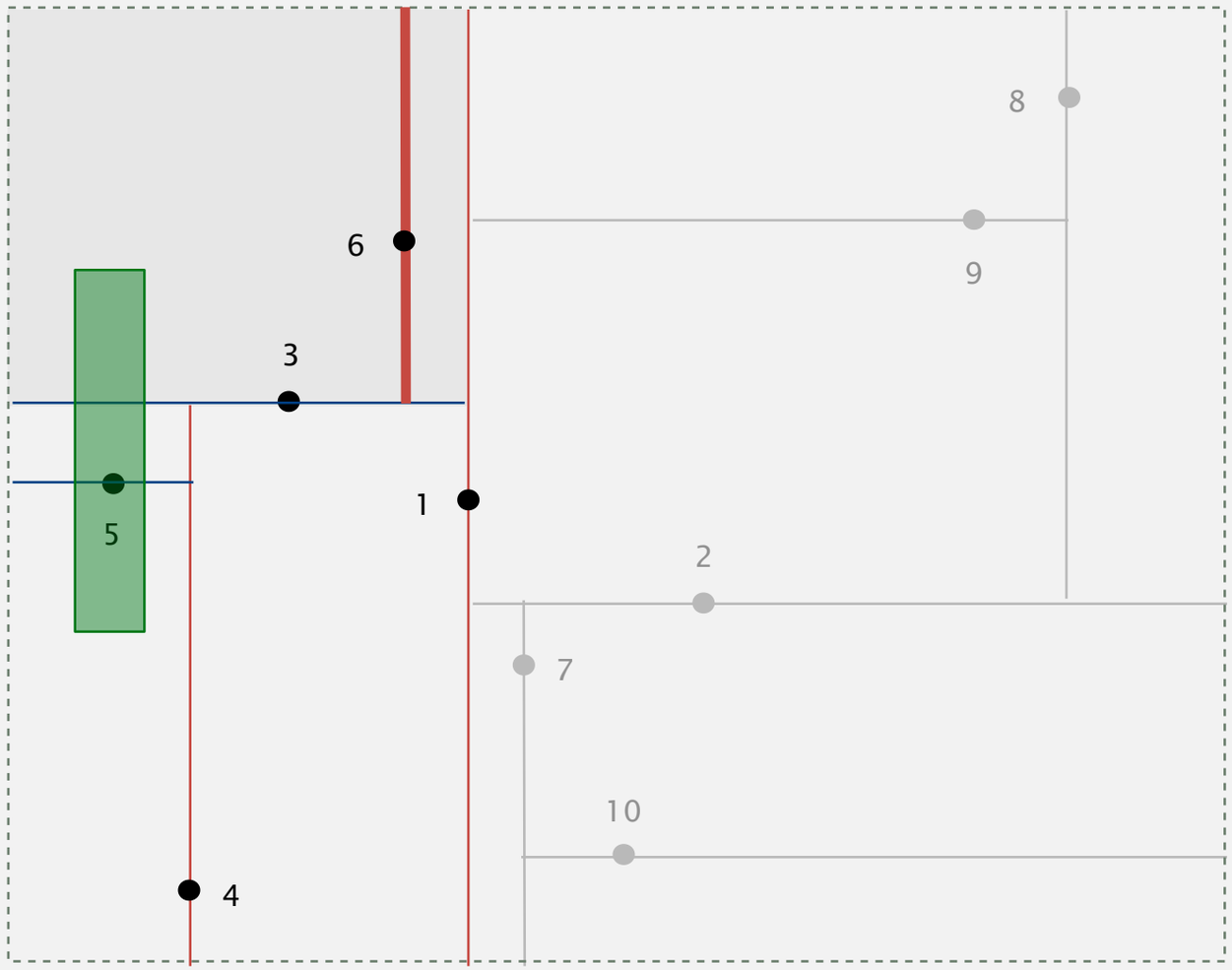


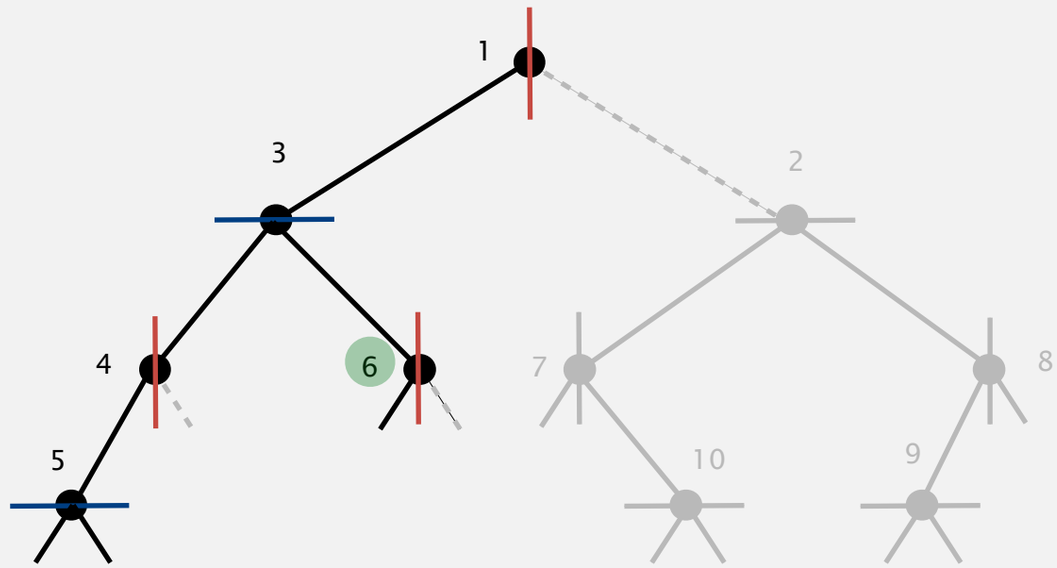
search left subtree

stop since empty

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

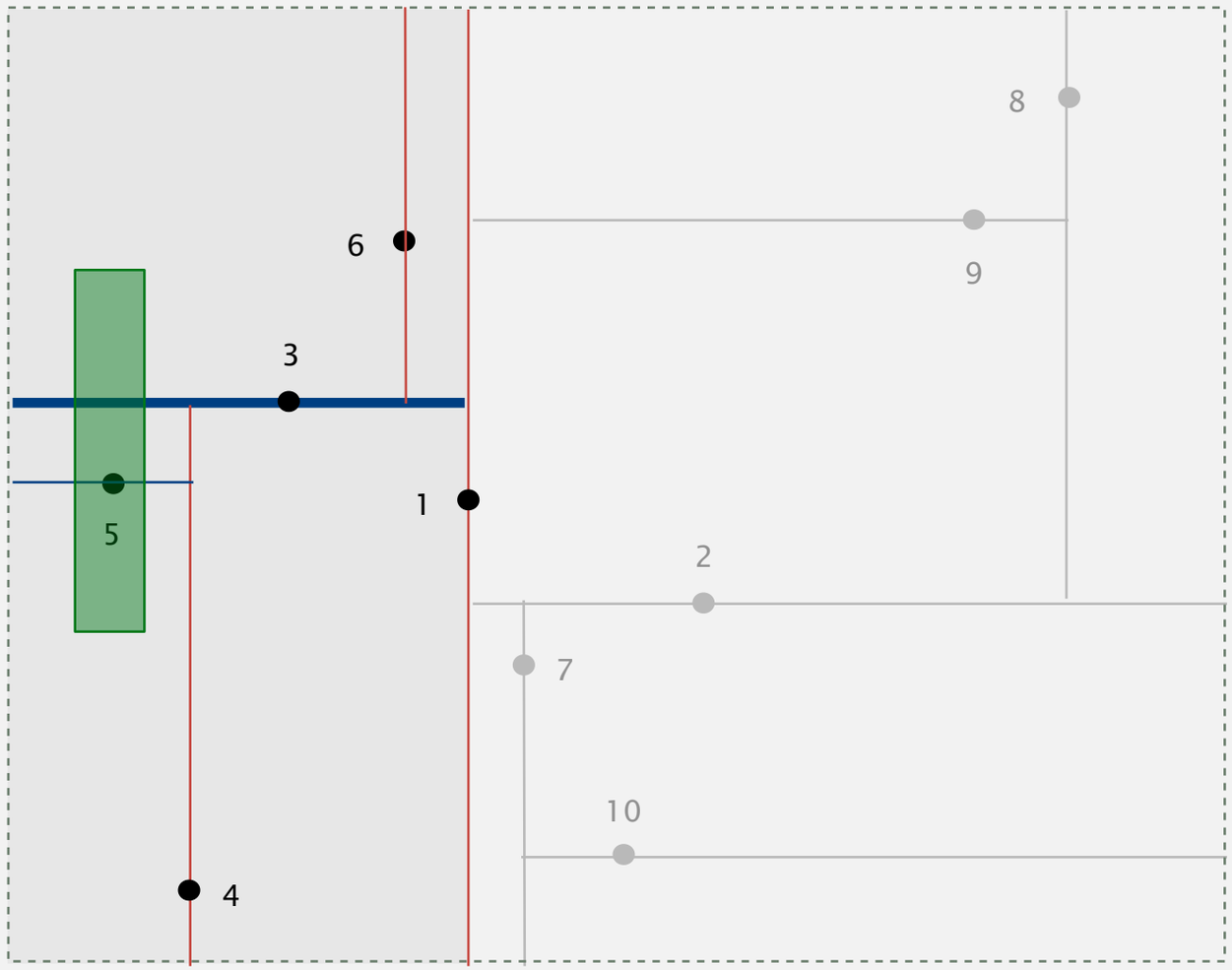


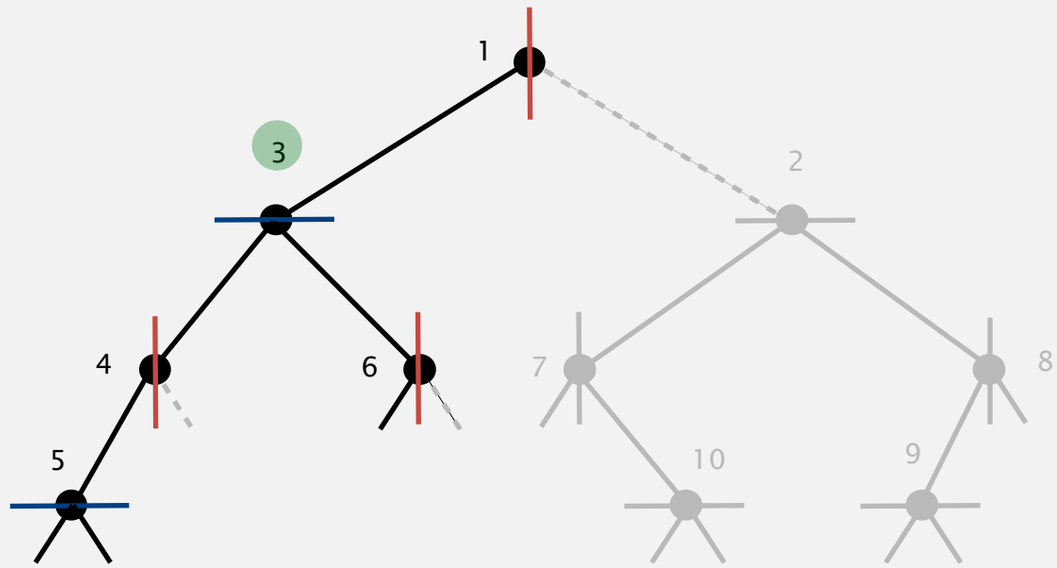


return from function call

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

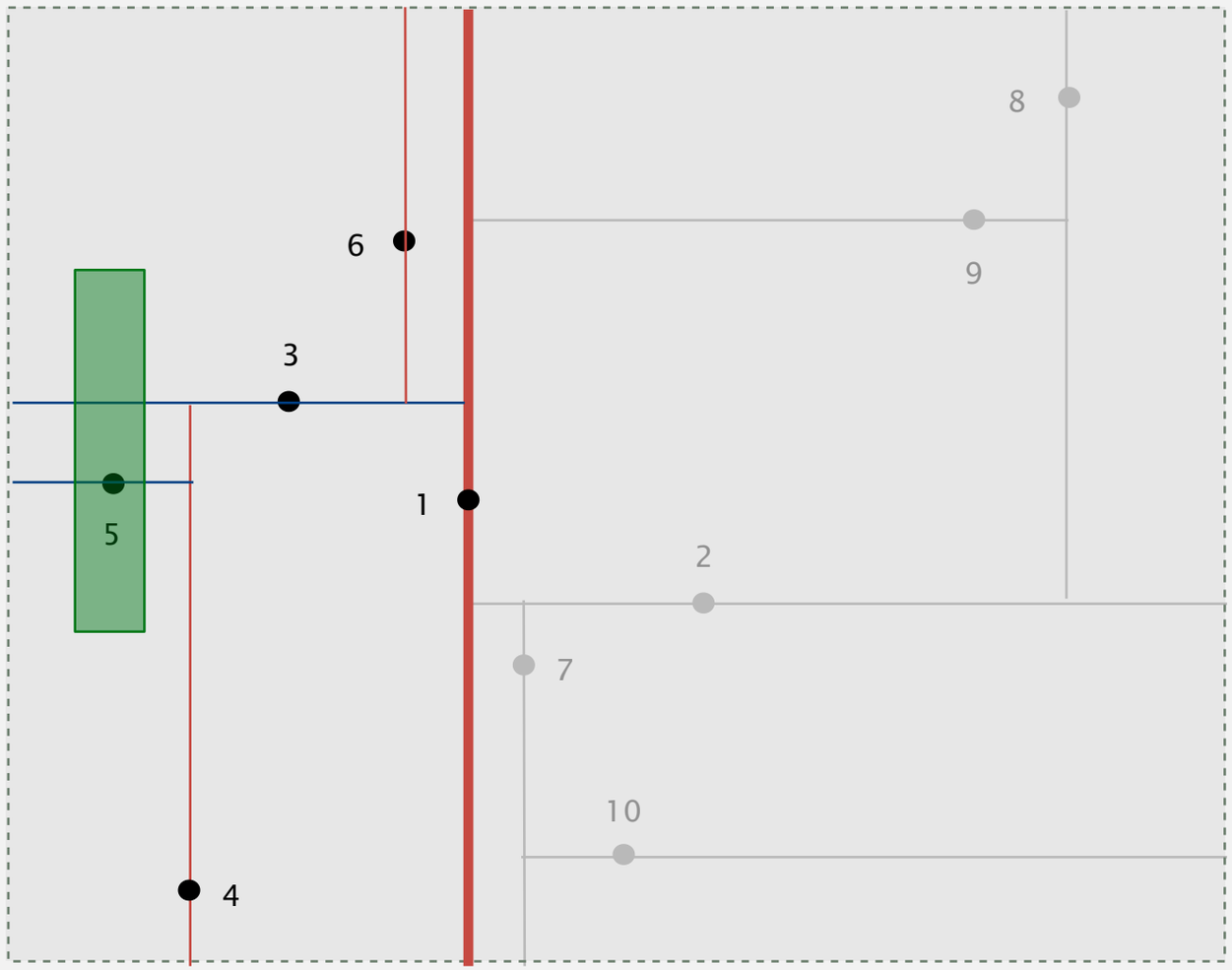


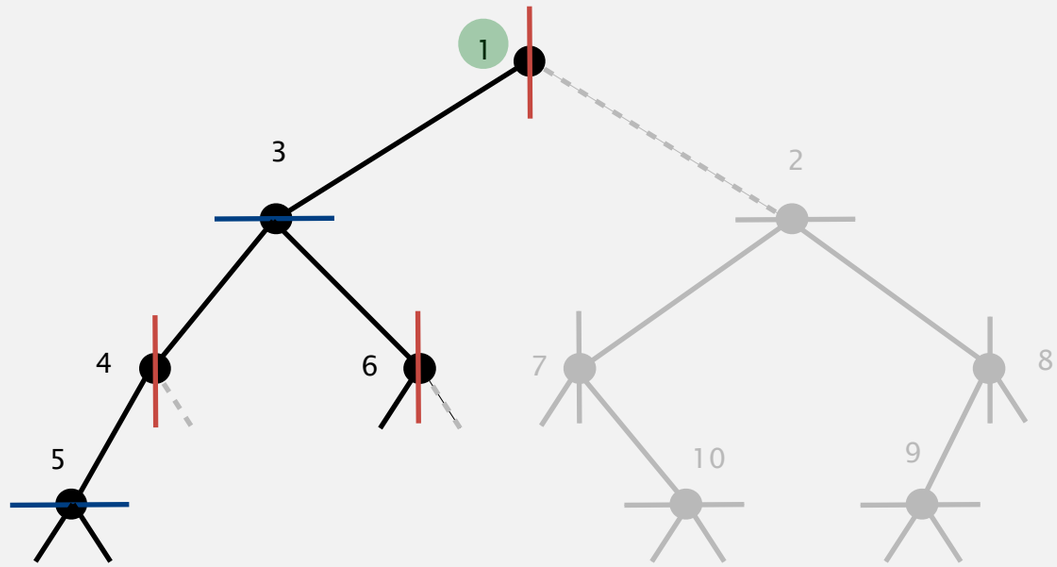


return from function call

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).

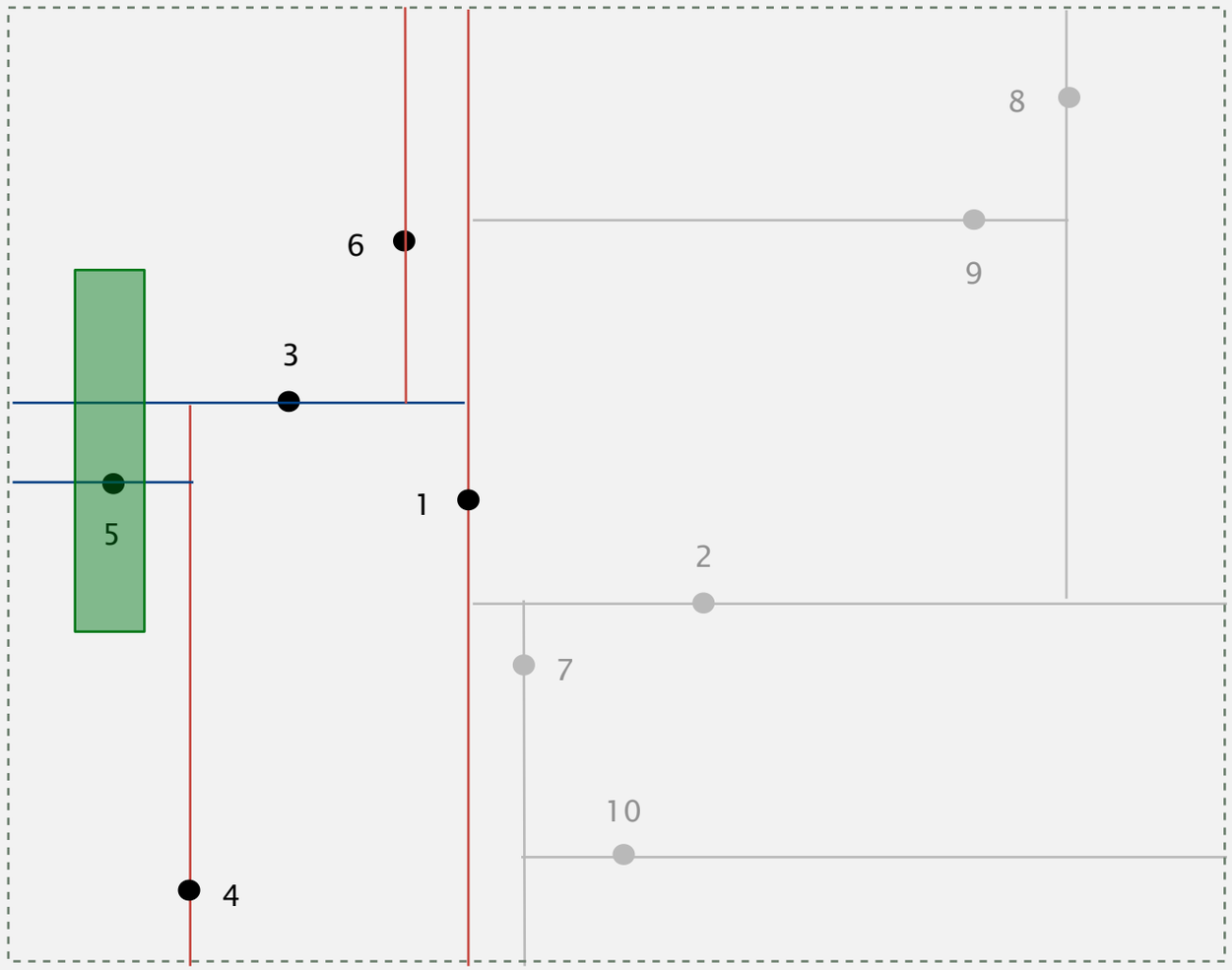


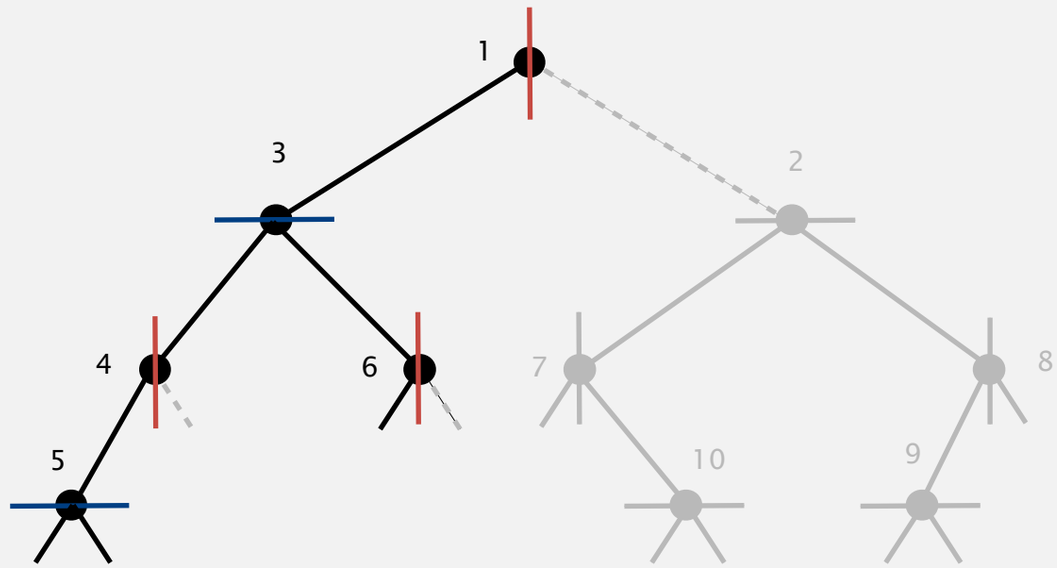


return from function call

Range search in a 2d tree

- Check if point in node lies in given rectangle.
- Recursively search left/bottom subdivision (if any could fall in rectangle).
- Recursively search right/top subdivision (if any could fall in rectangle).



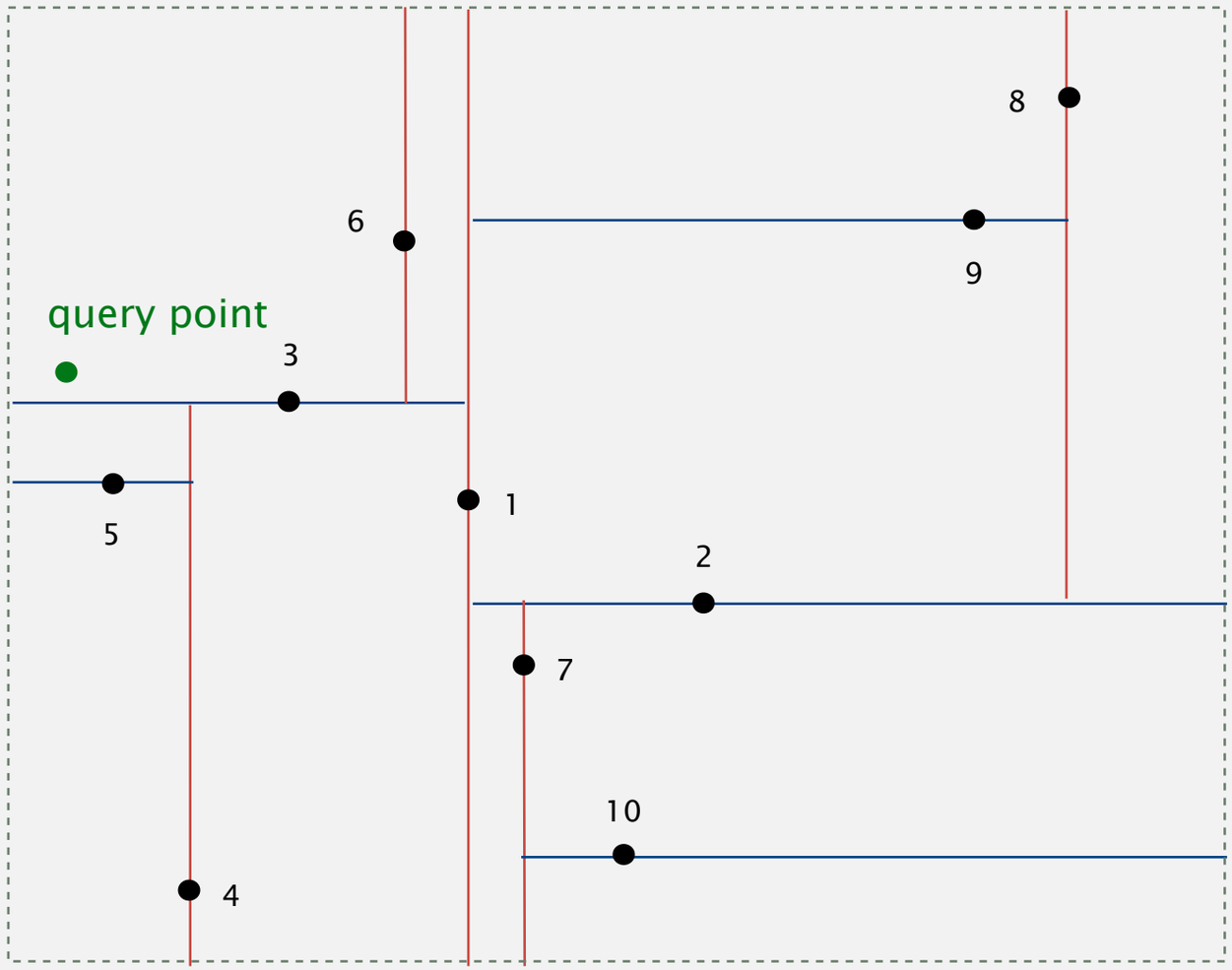


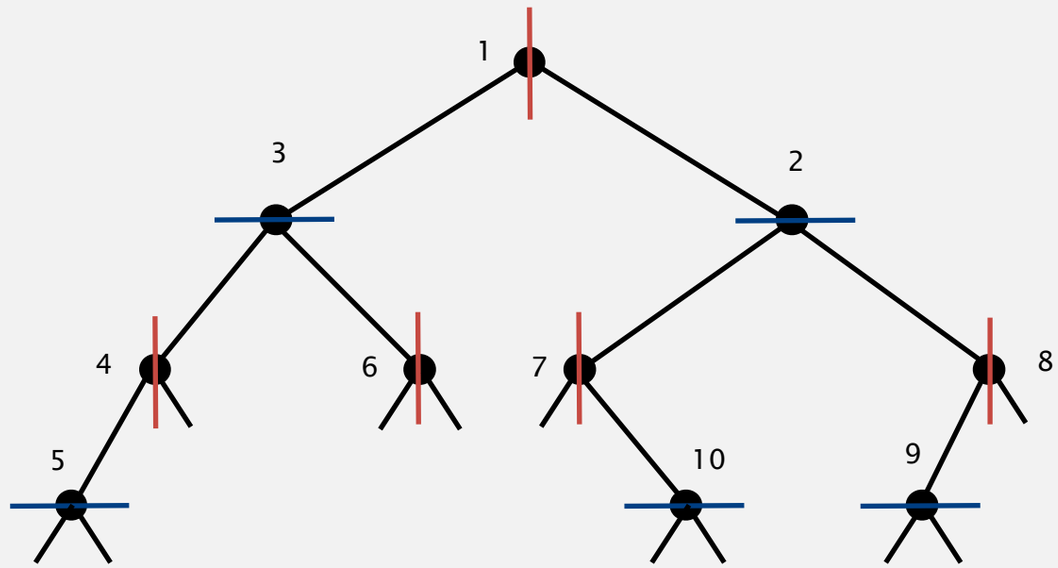
done

- insertion
- range search
- **nearest neighbor search**

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

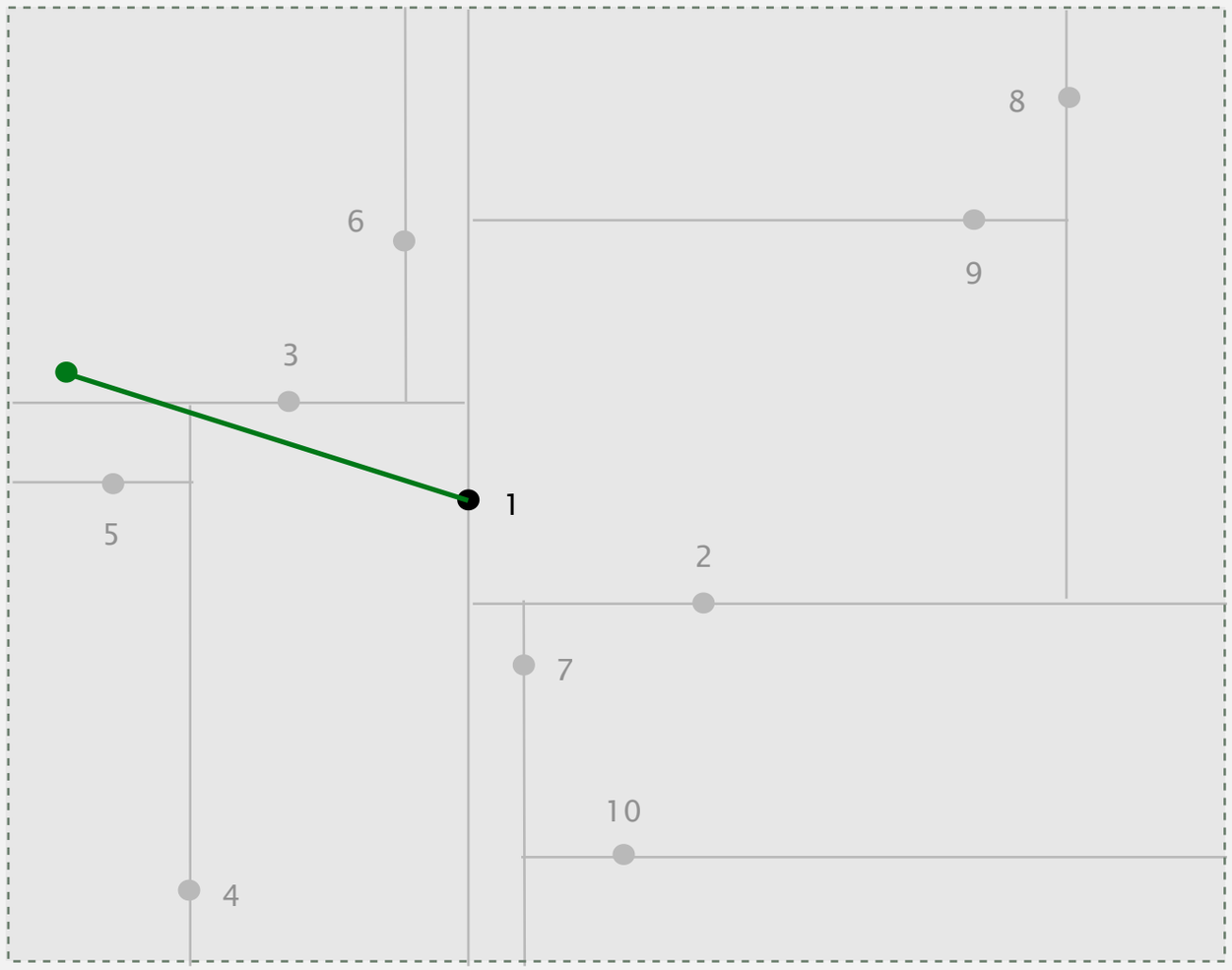


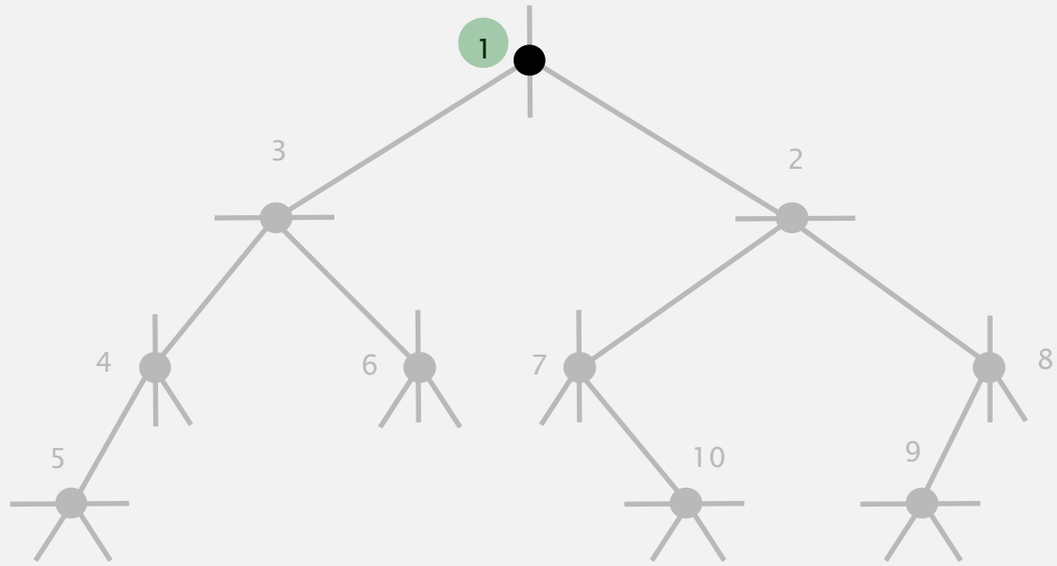


find closest points in 2d tree to green query point

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

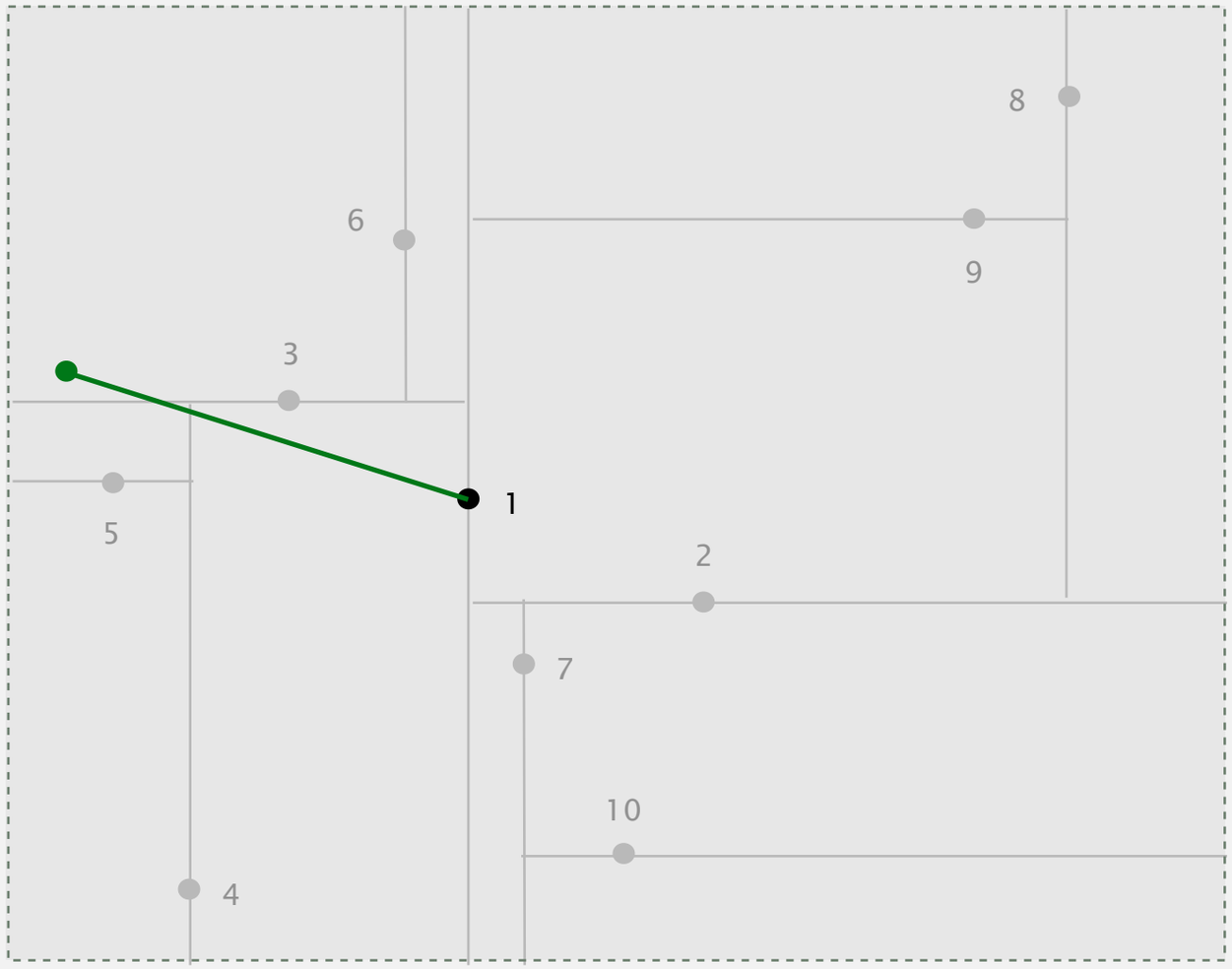


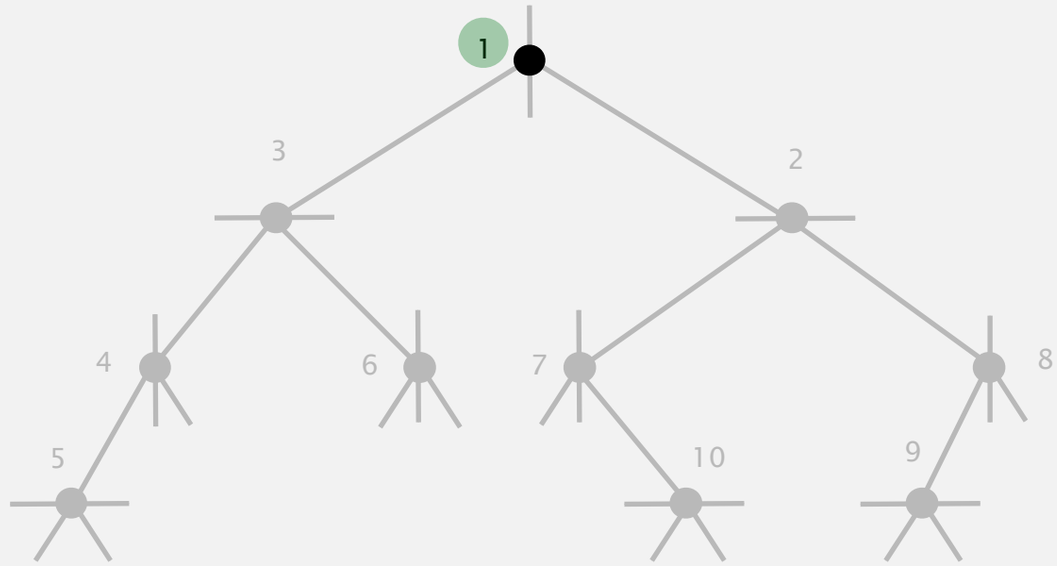


search root node
compute distance from query point to 1
(update champion nearest neighbor)

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

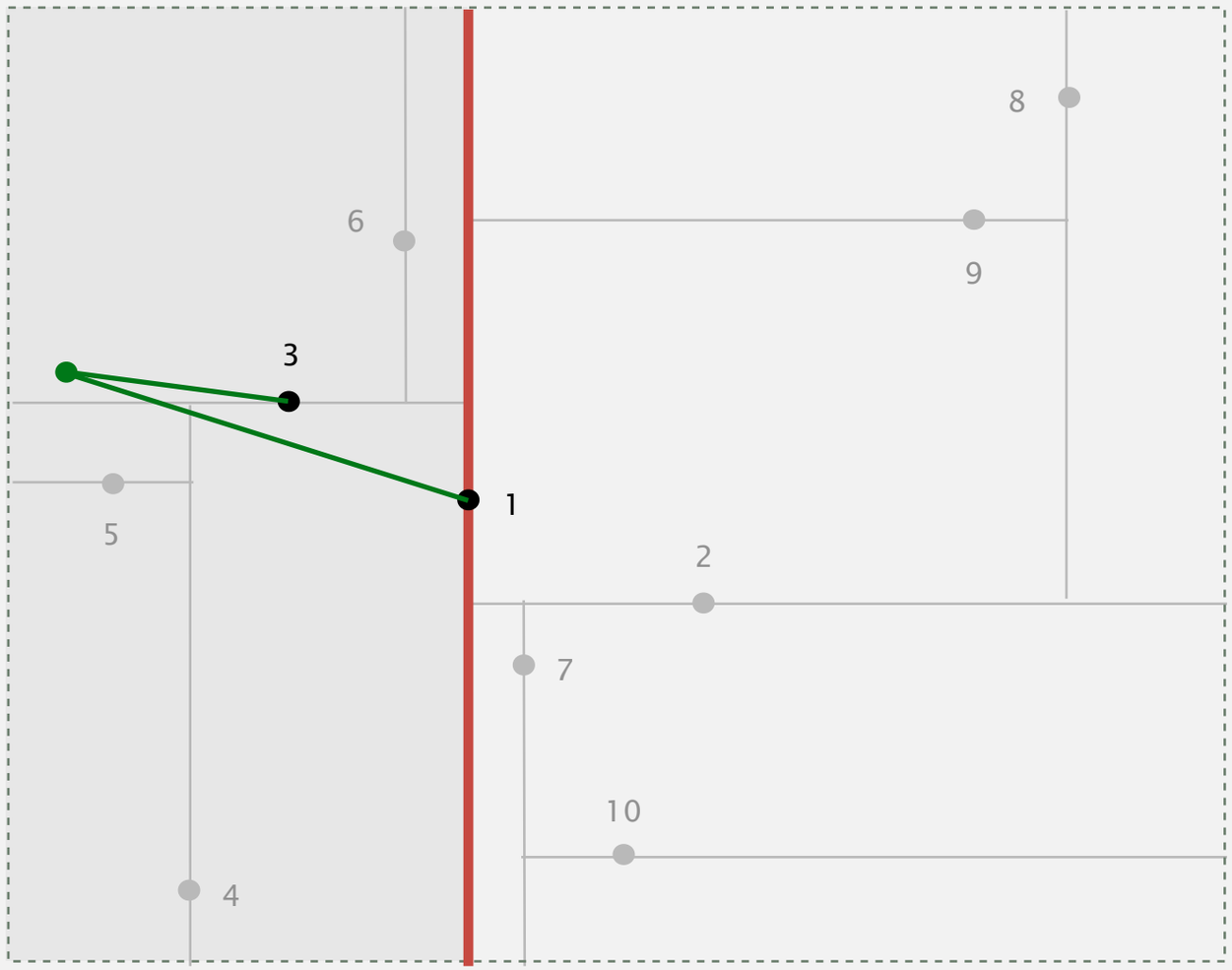


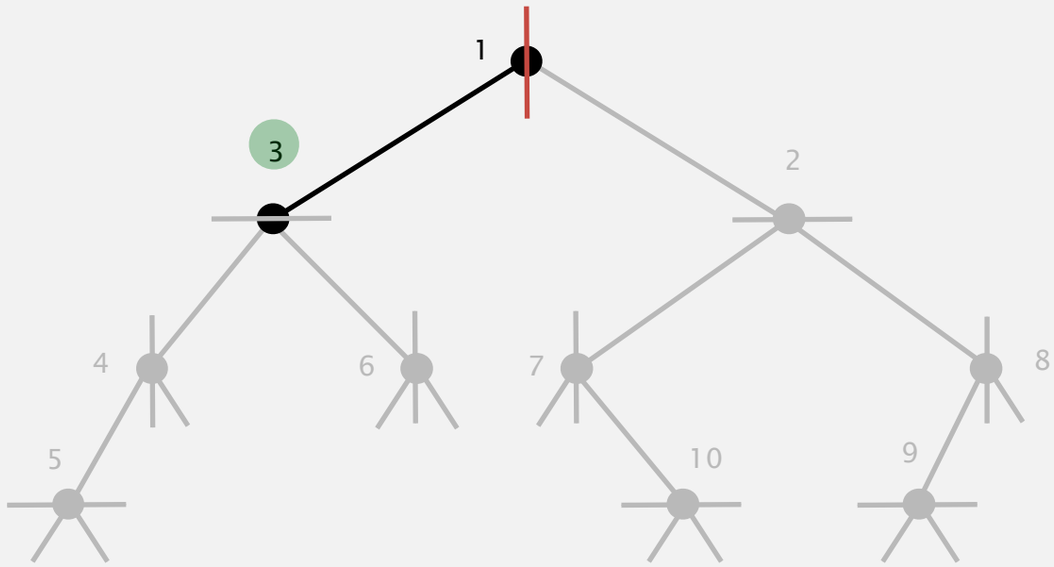


query point is to the left of splitting line
search left subtree first

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

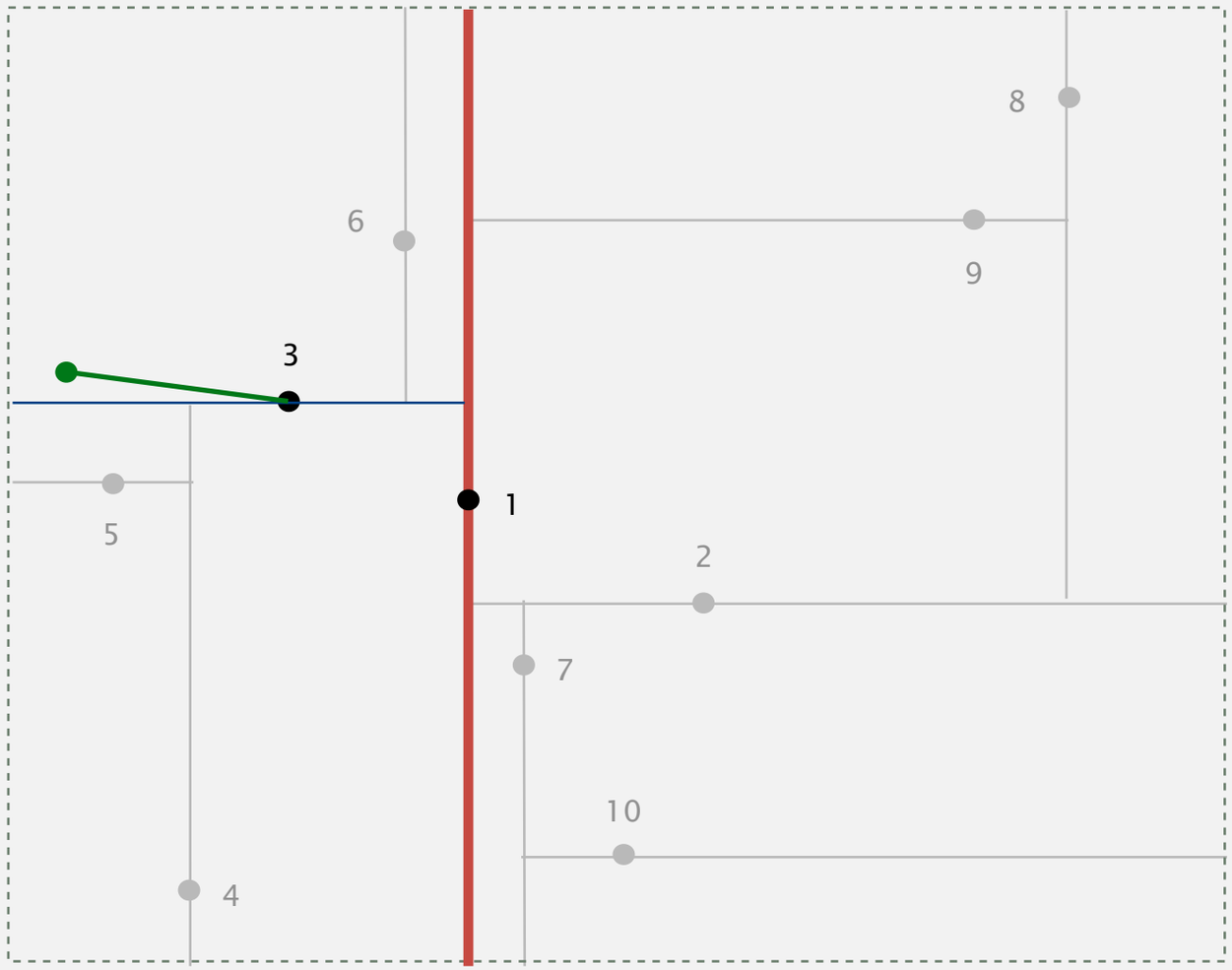


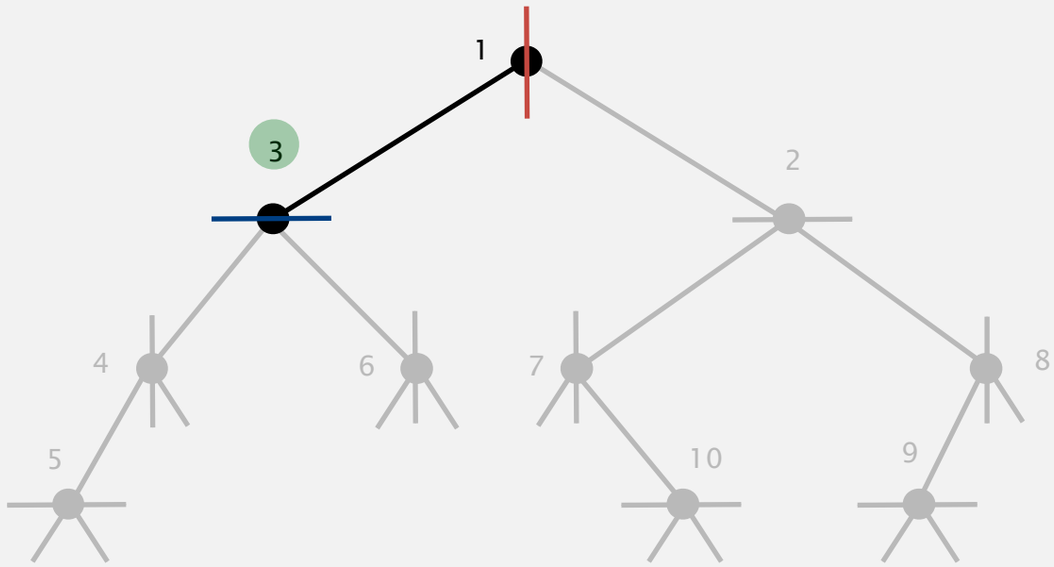


search left subtree
compute distance from query point to 3
(update champion)

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

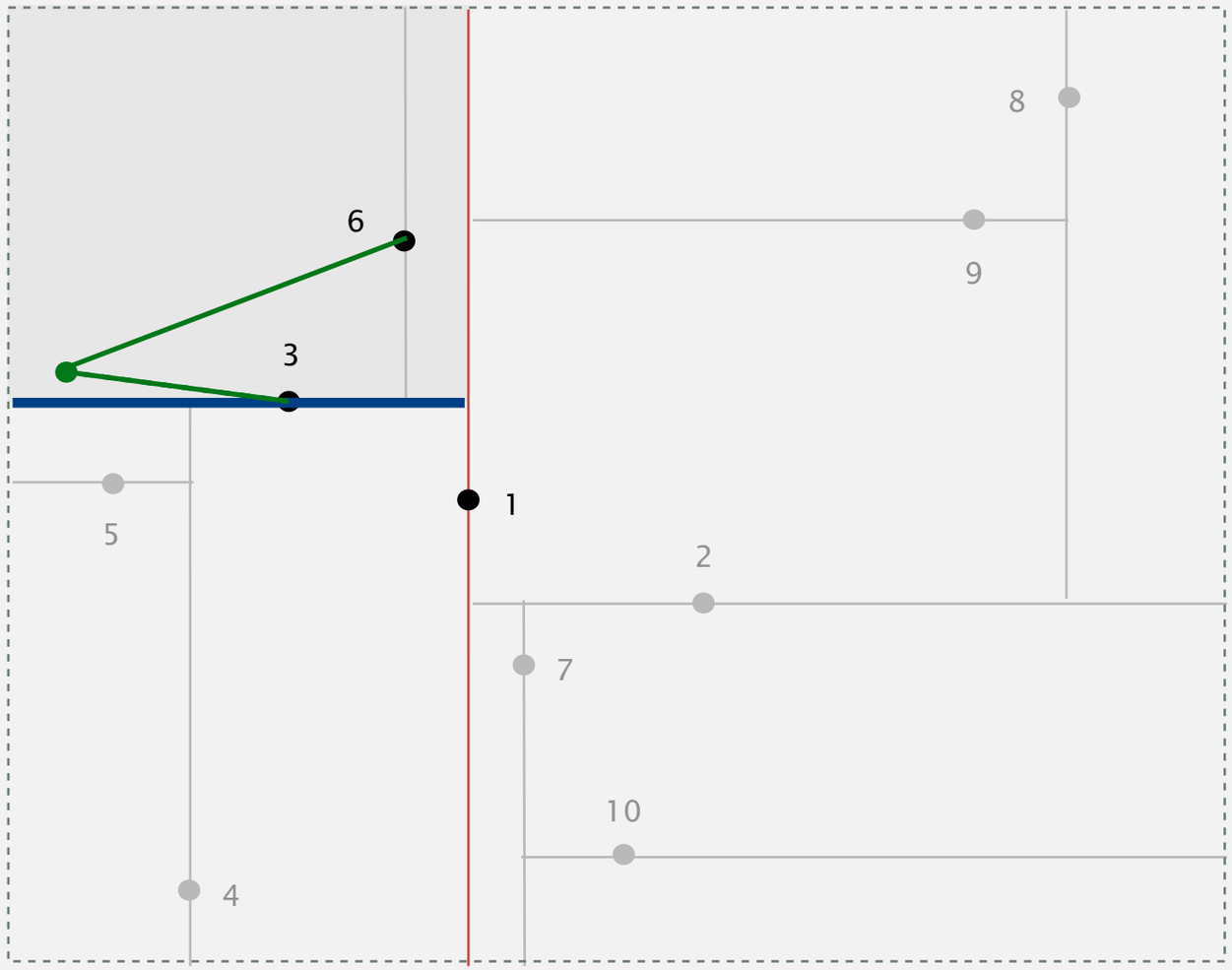


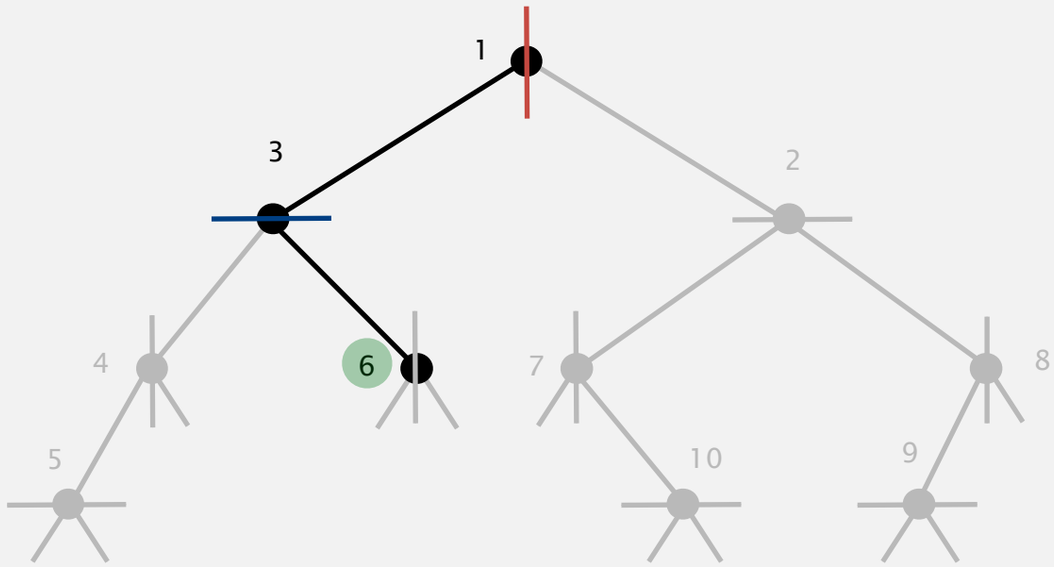


query point is above splitting line
search top subtree first

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

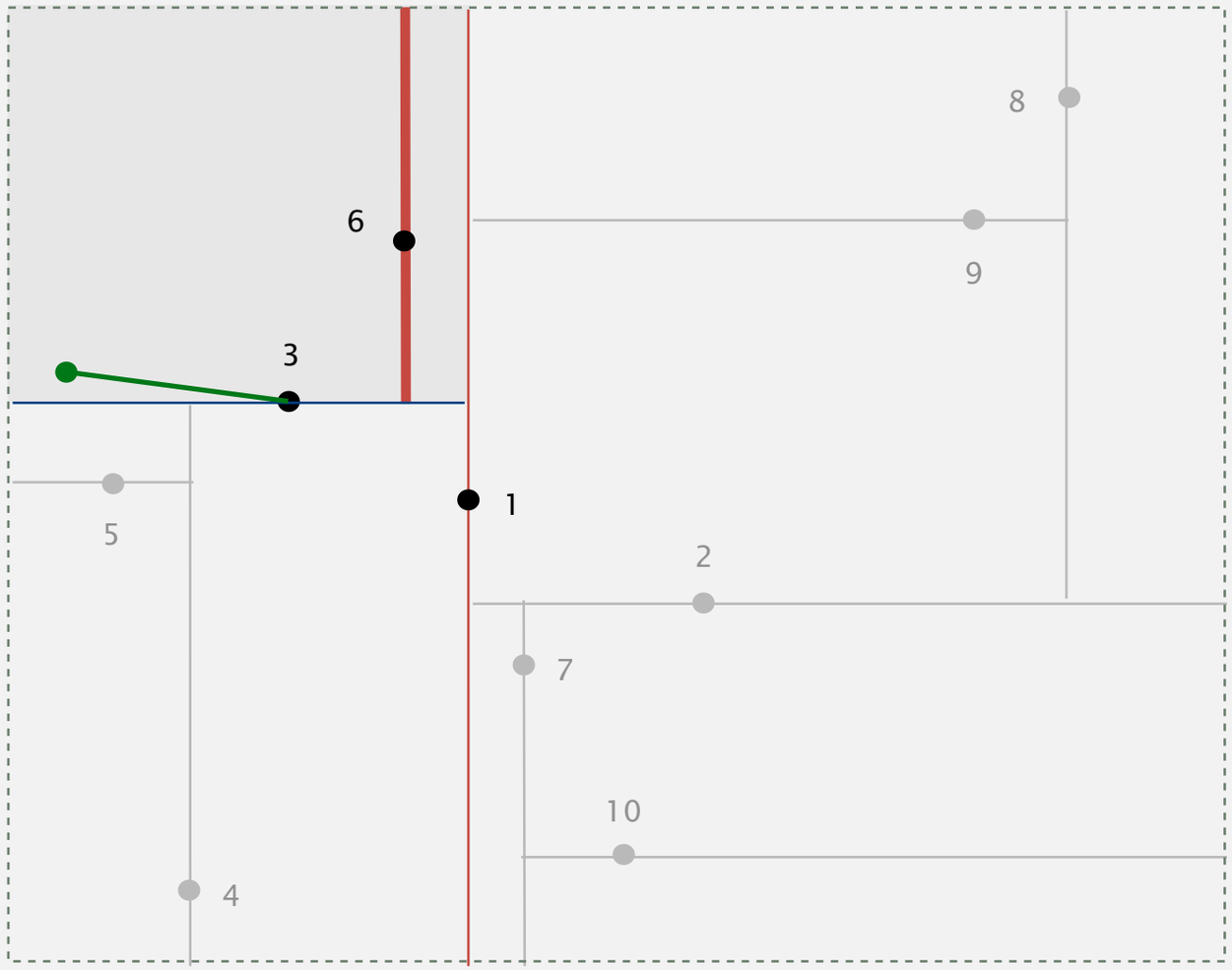


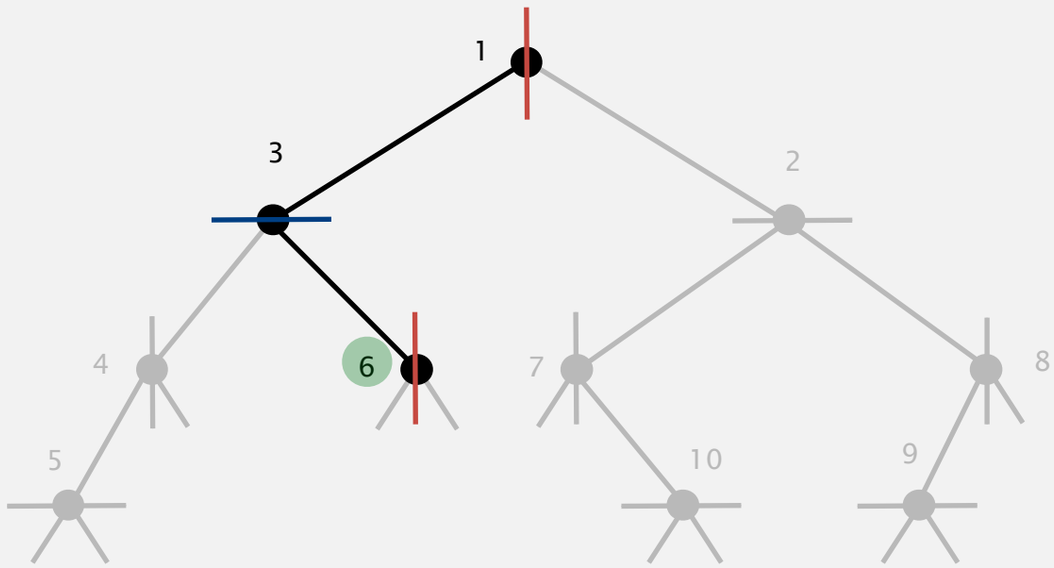


search top subtree
compute distance from query point to 6

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

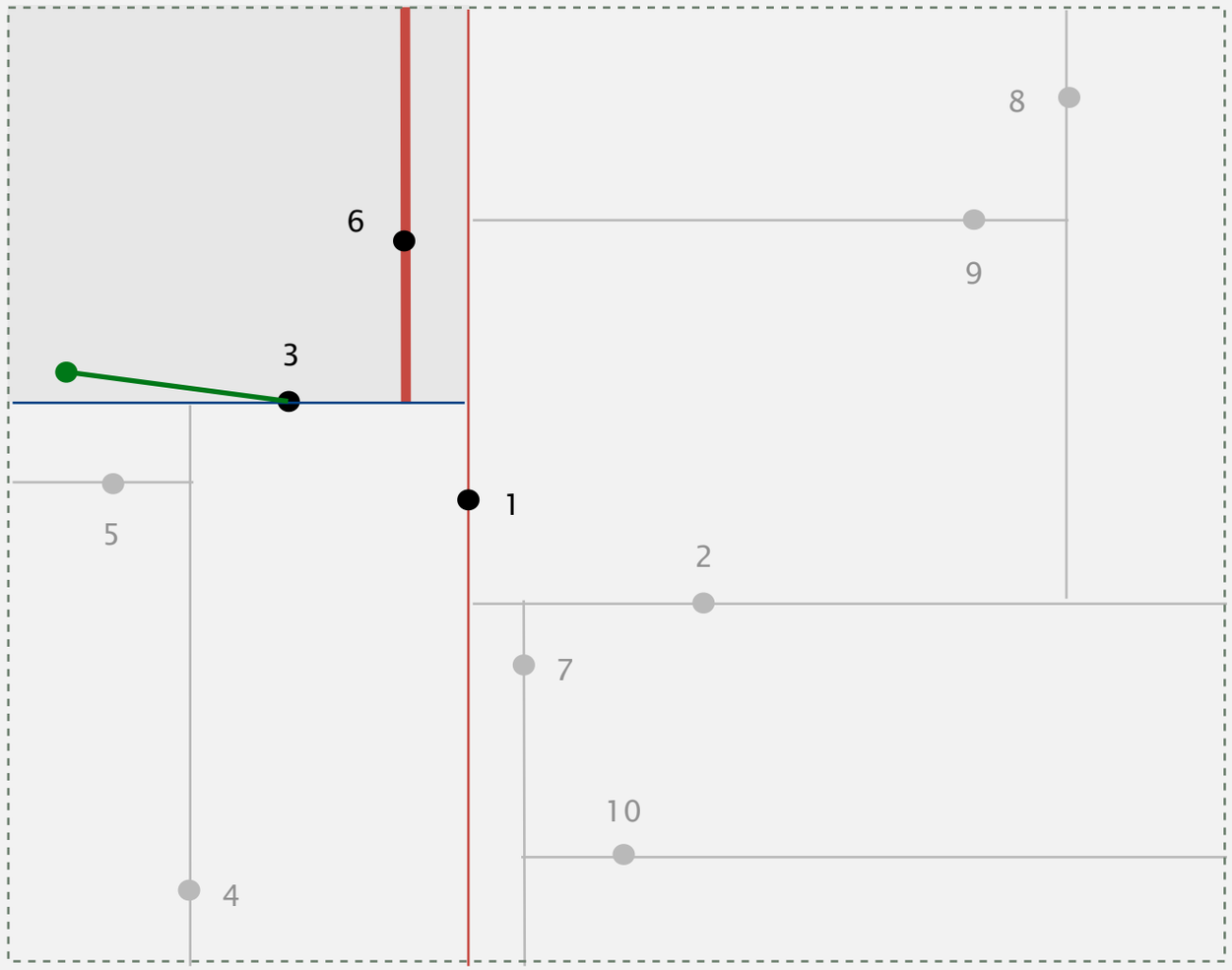


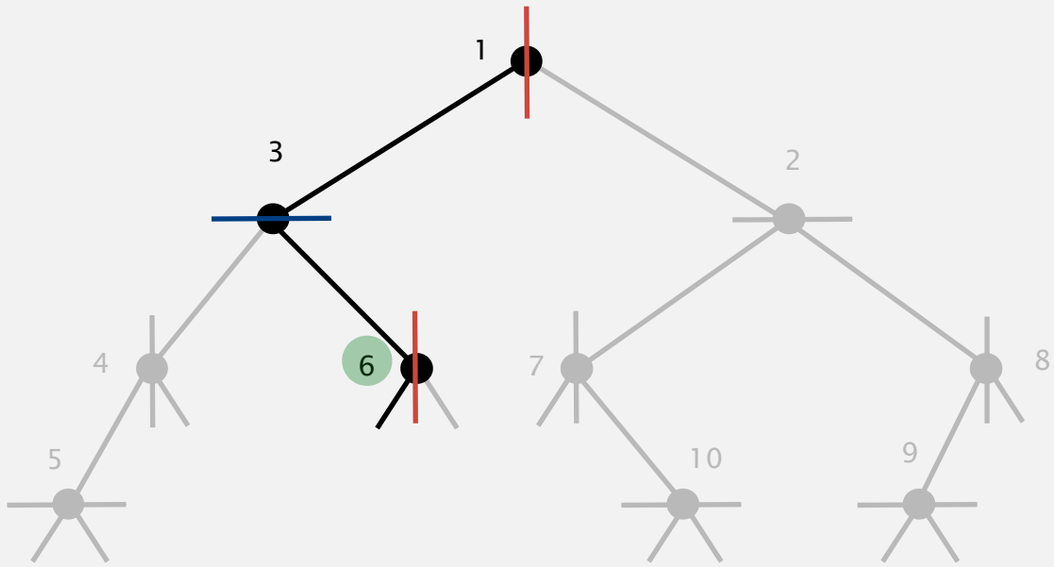


query point is to left of splitting line
search left subtree first

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.



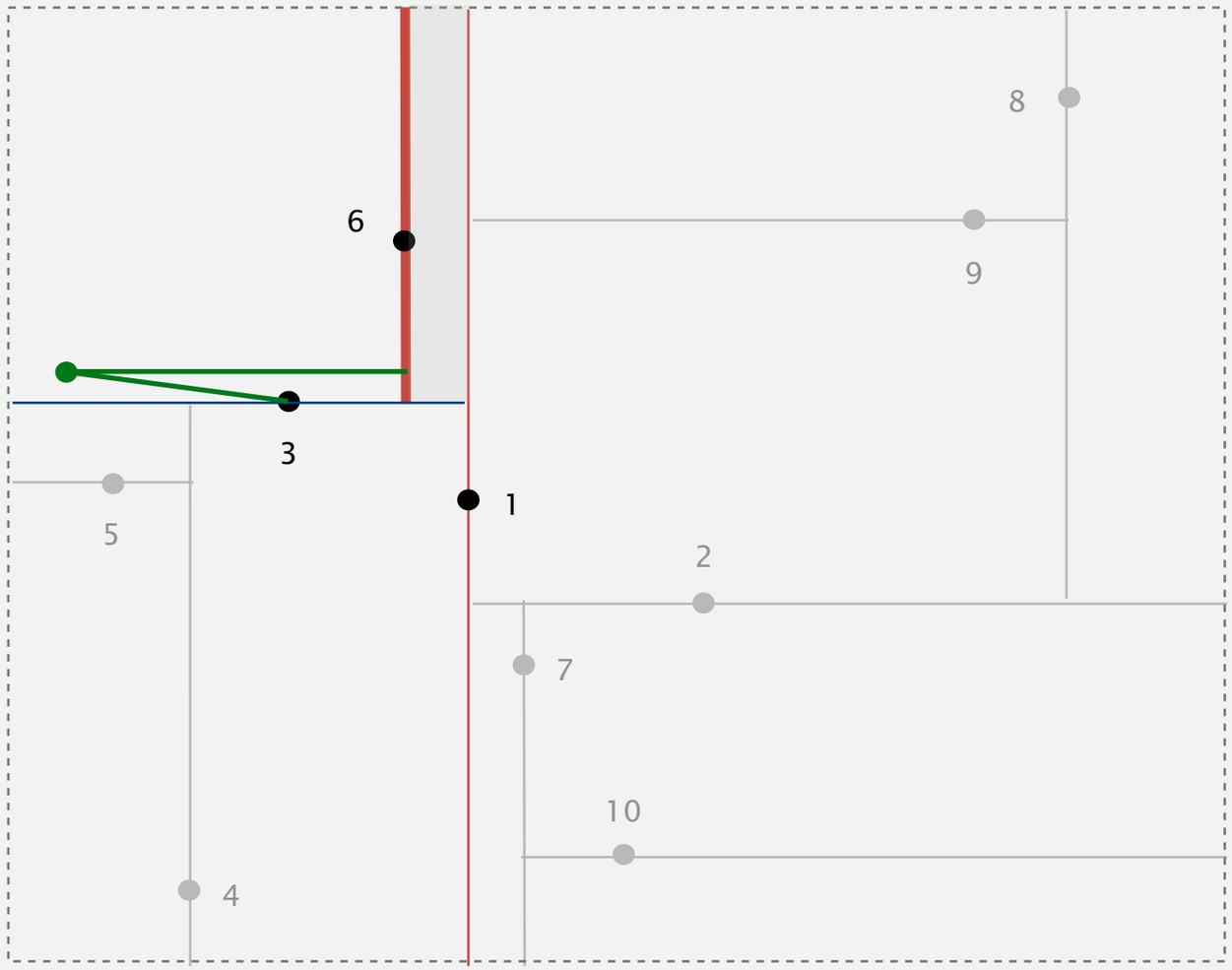


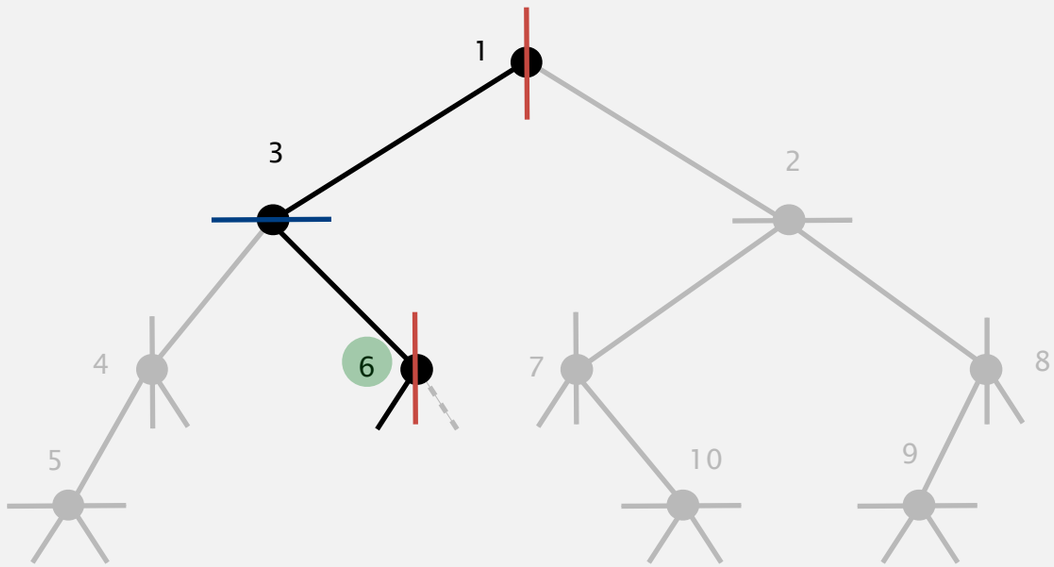
search left subtree

return since empty

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

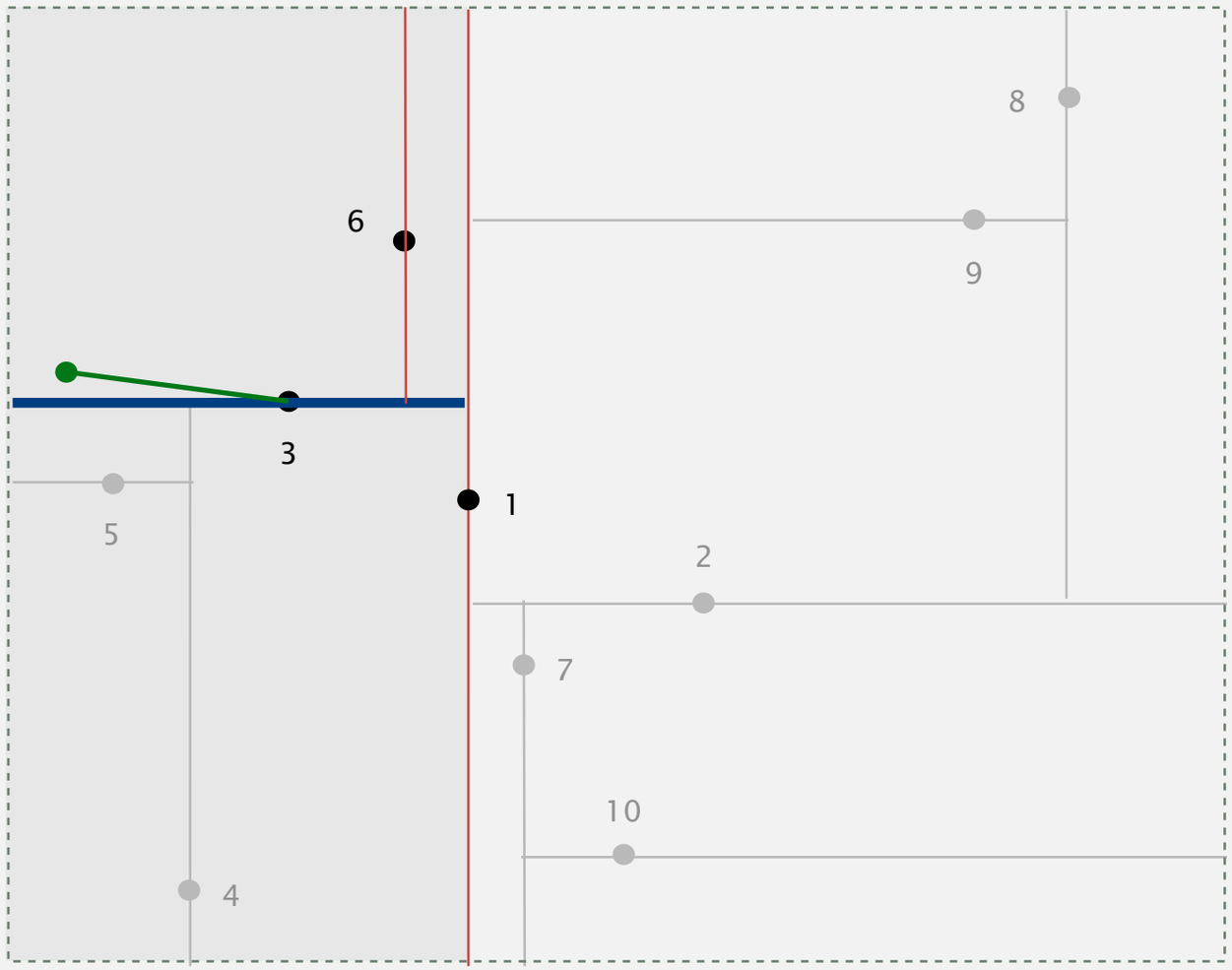


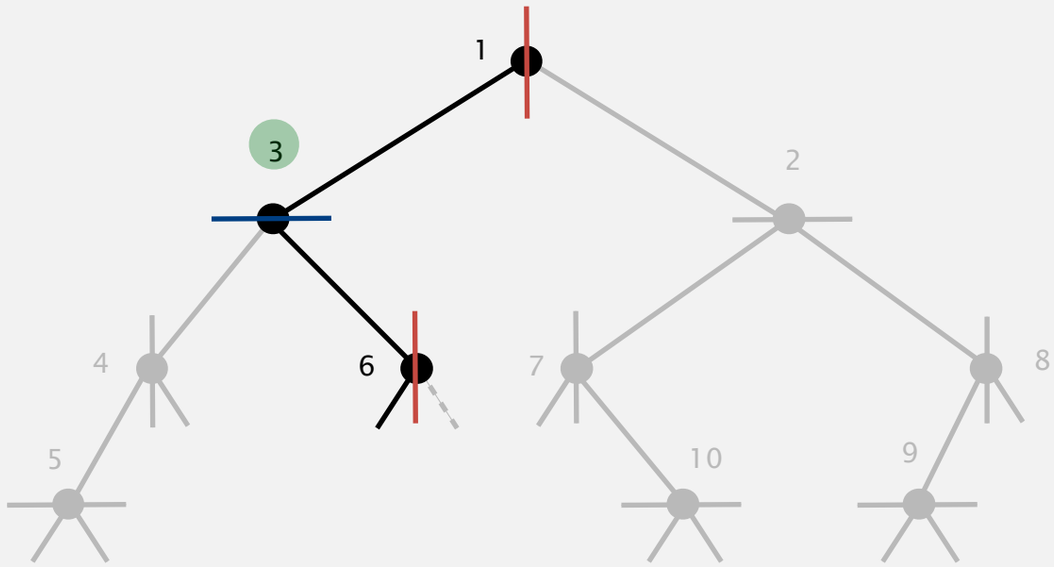


search right subtree
prune since nearest neighbor
can't be in subdivision

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

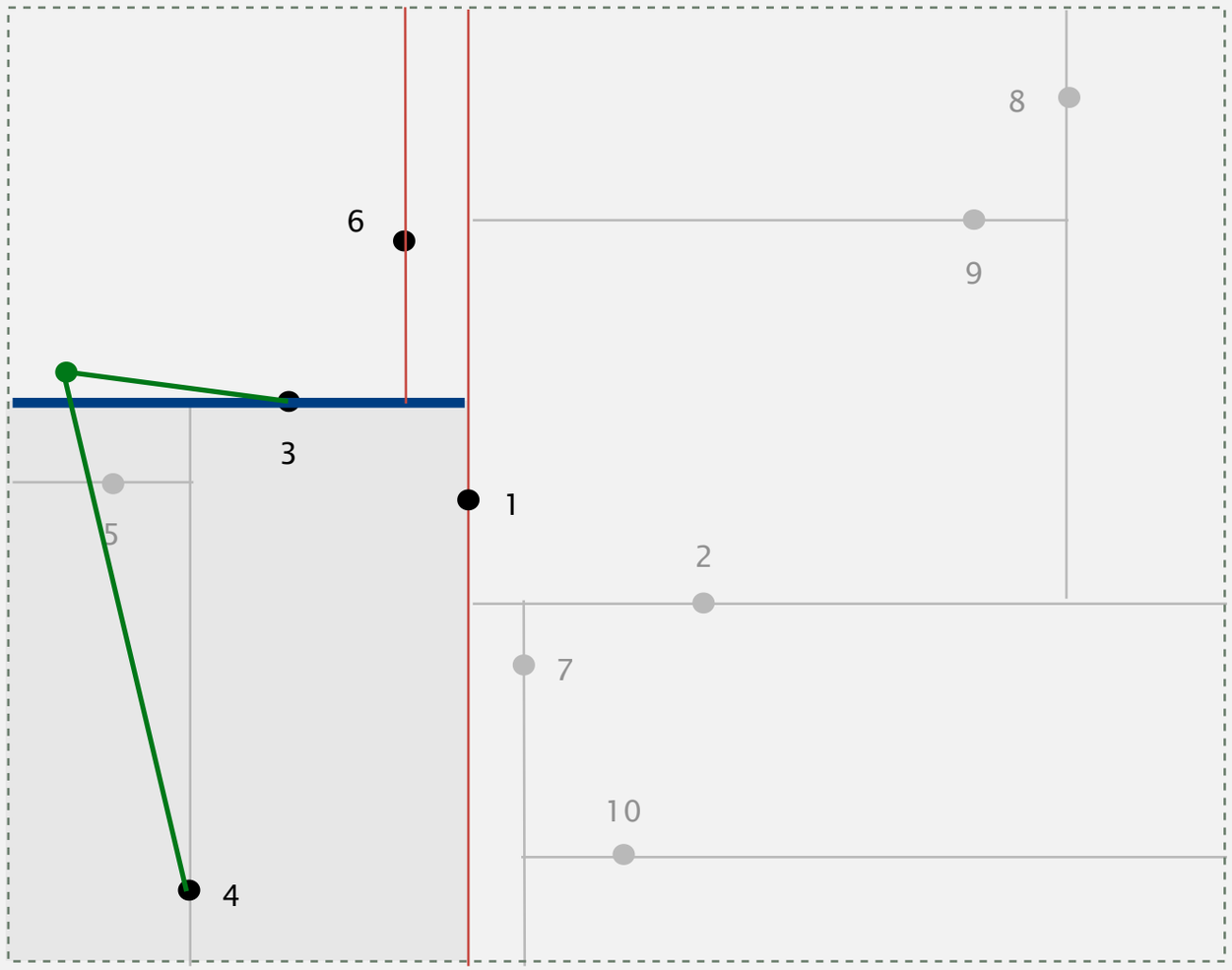


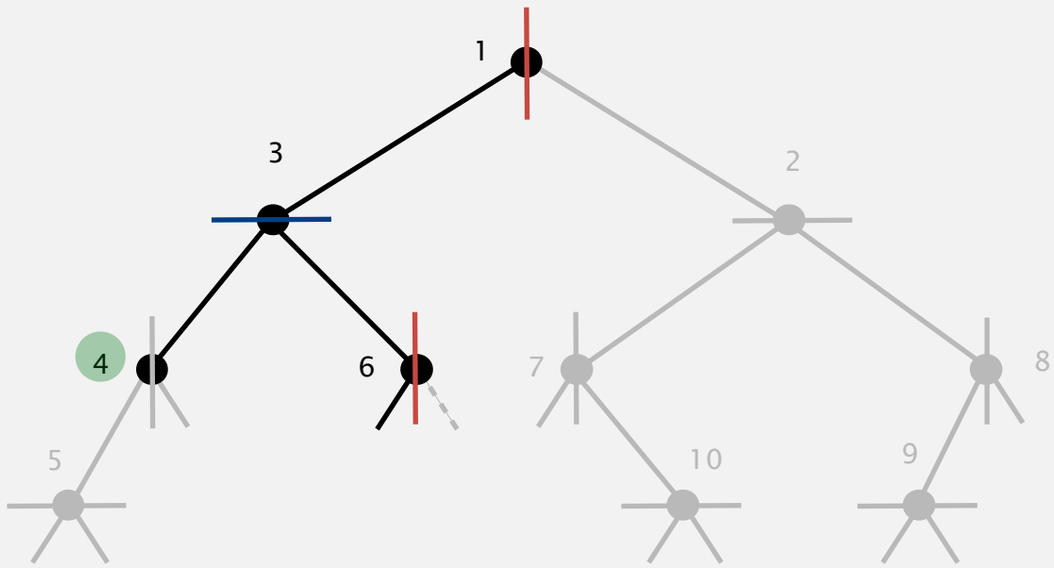


return from function call
search bottom subtree next

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

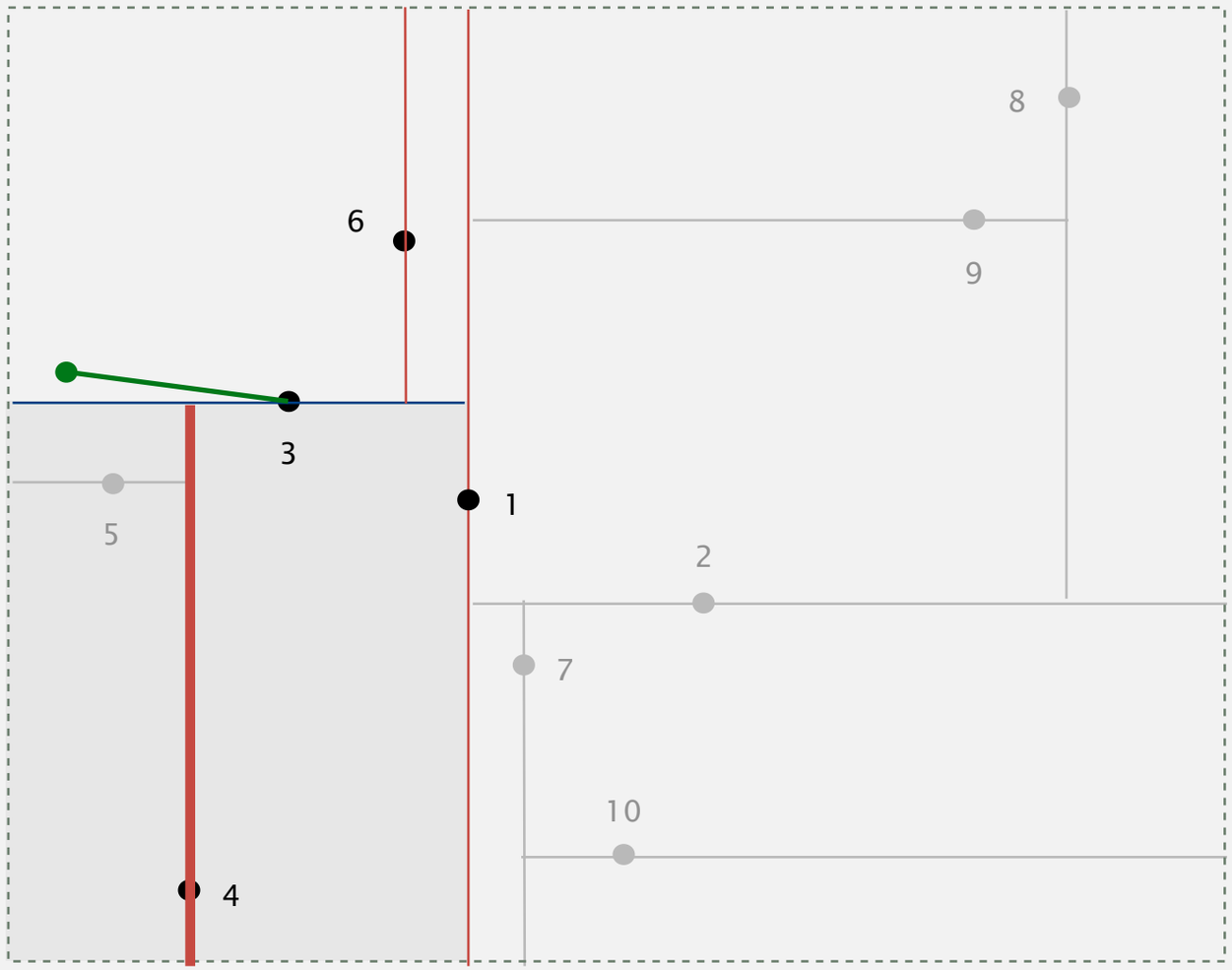


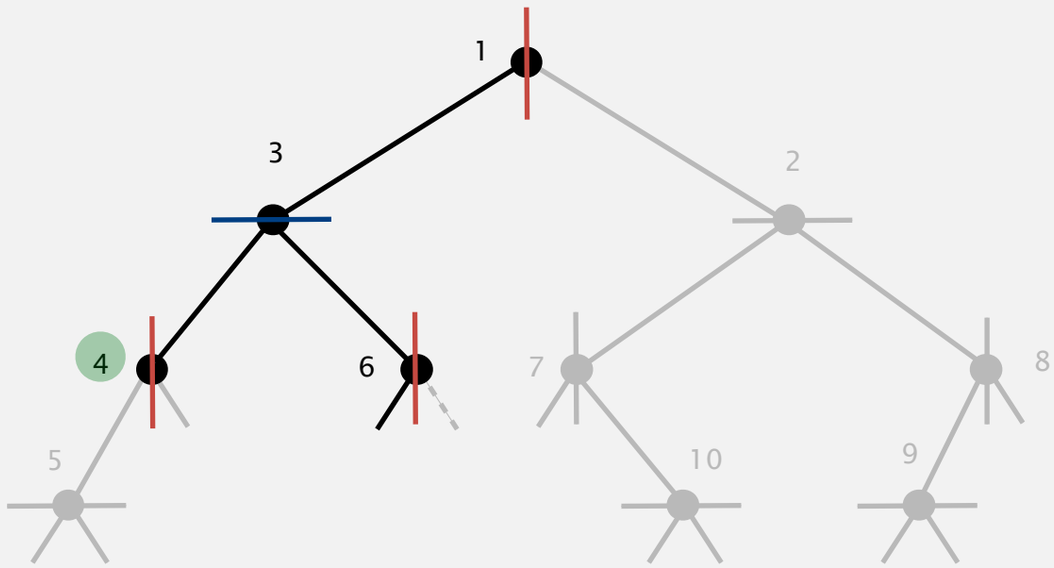


search bottom subtree
compute distance from query point to 4

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

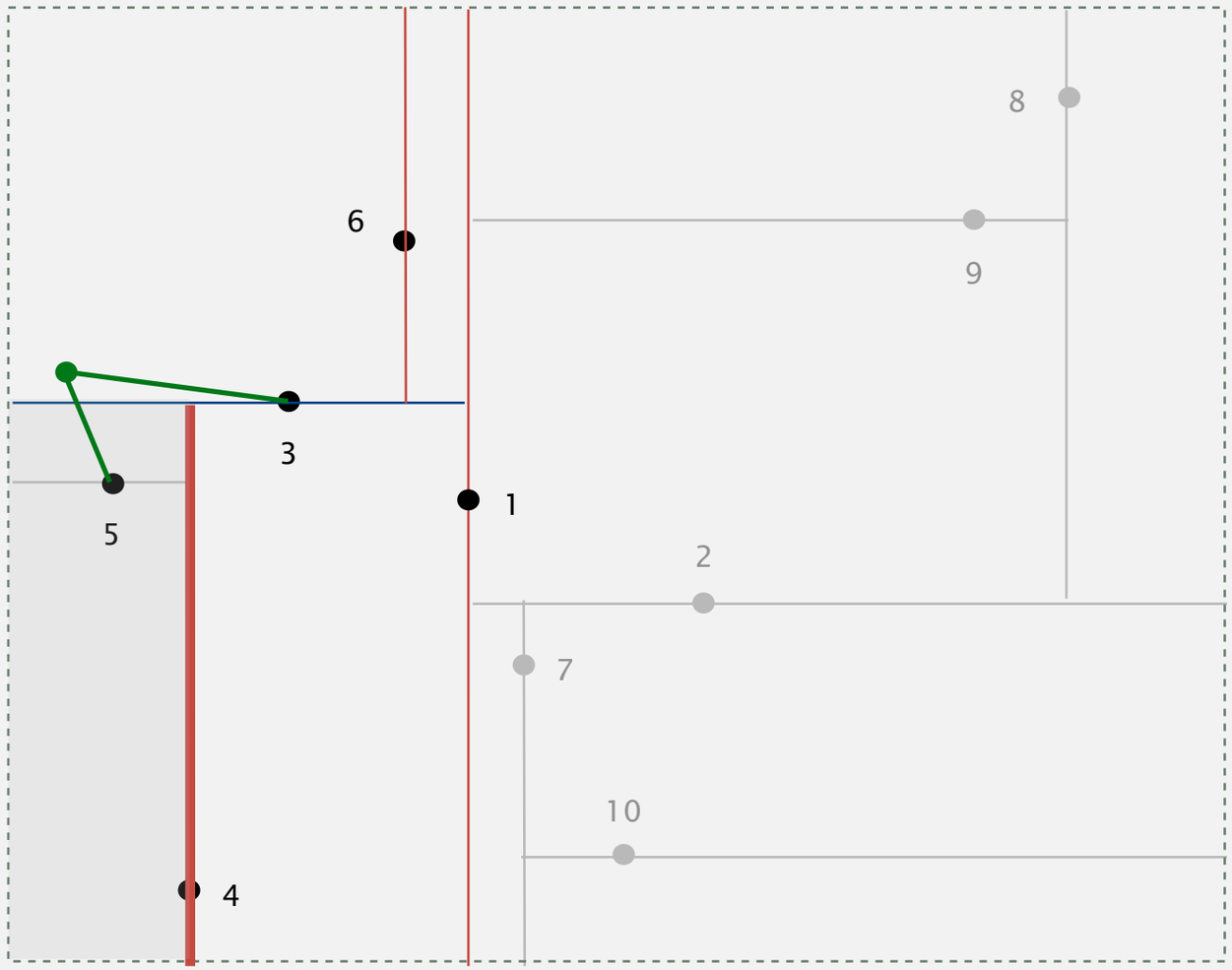


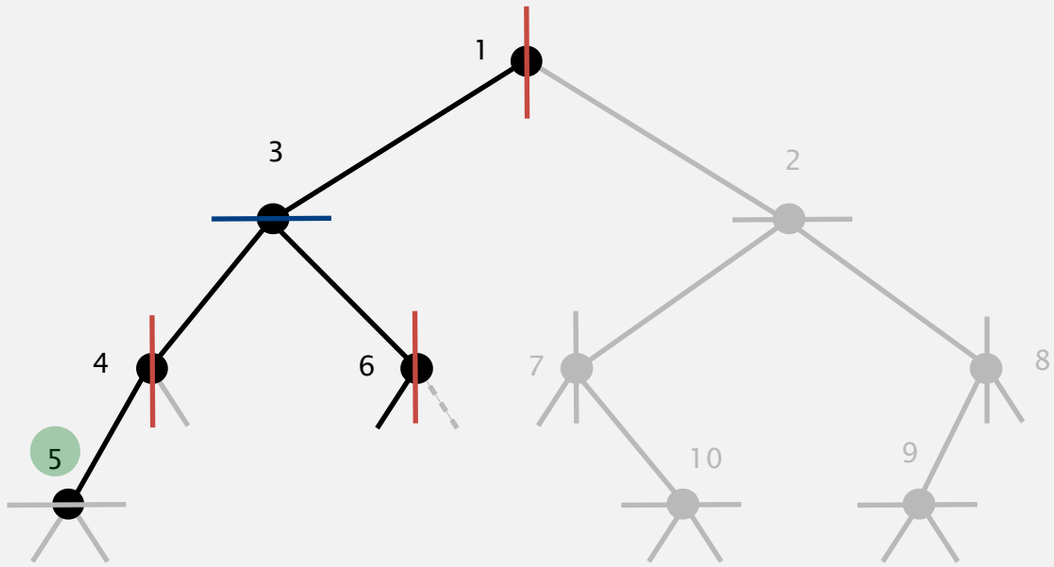


query point is to left of splitting line
search left subtree first

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

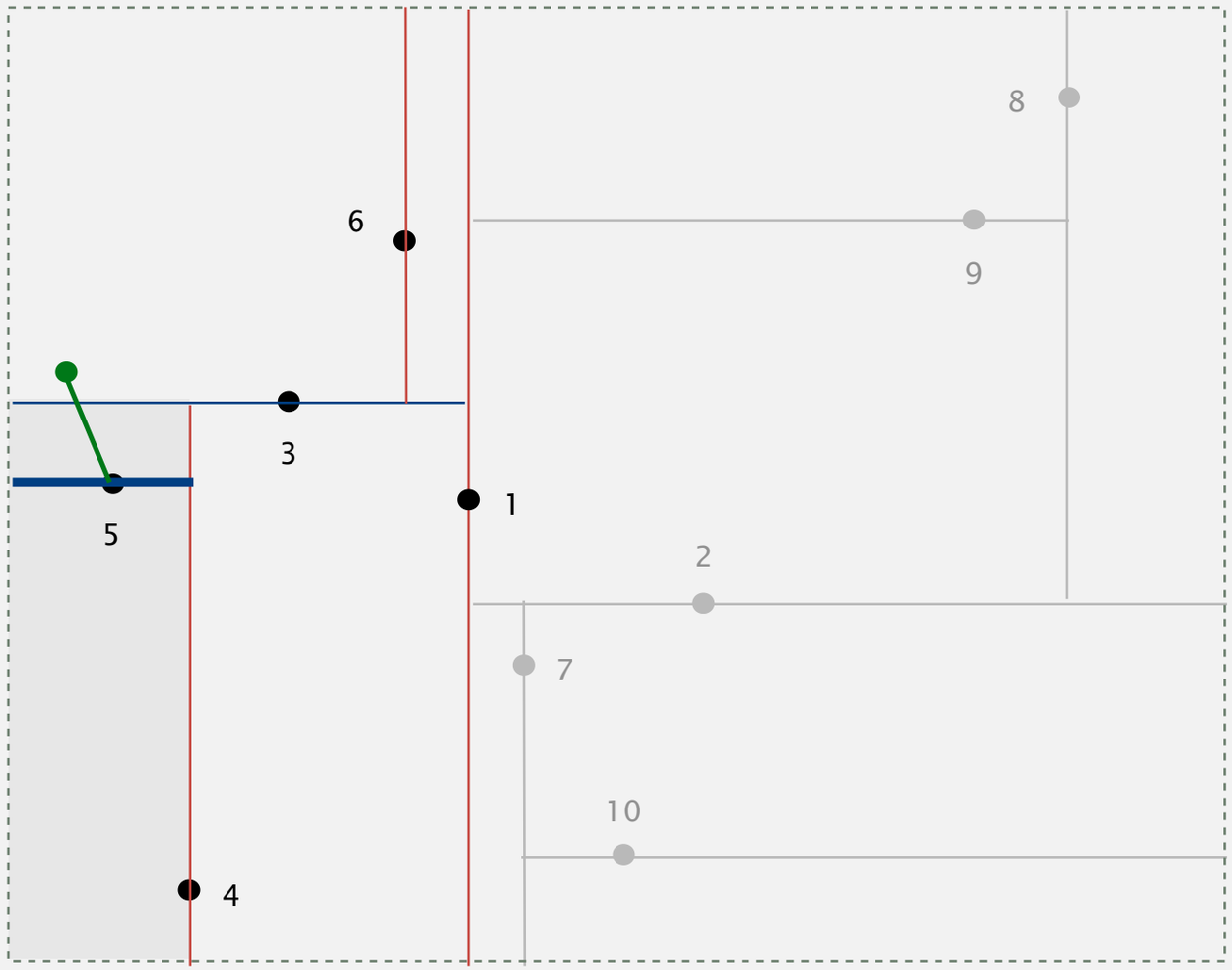


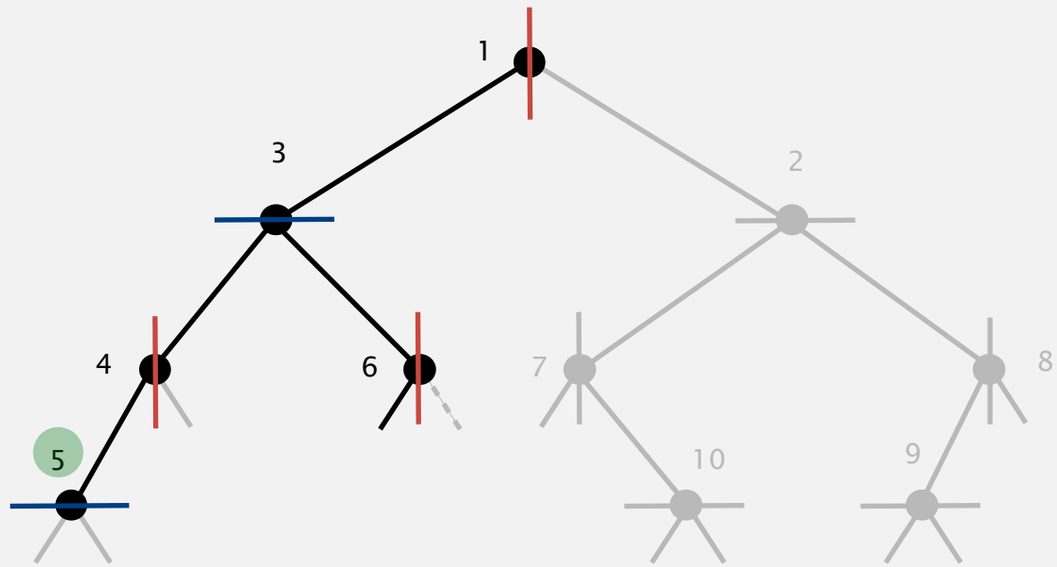


search left subtree
compute distance from query point to 5
(update champion)

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

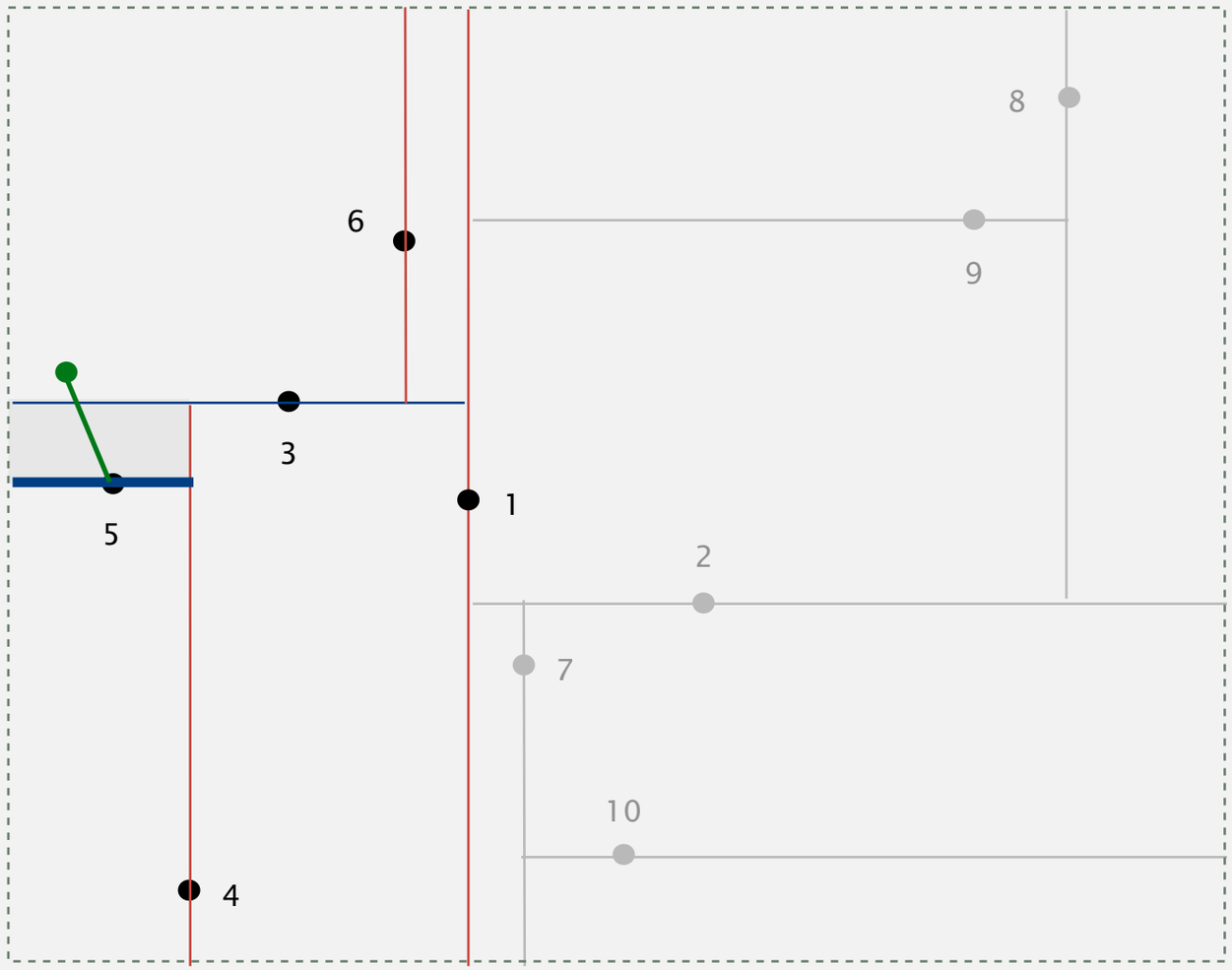


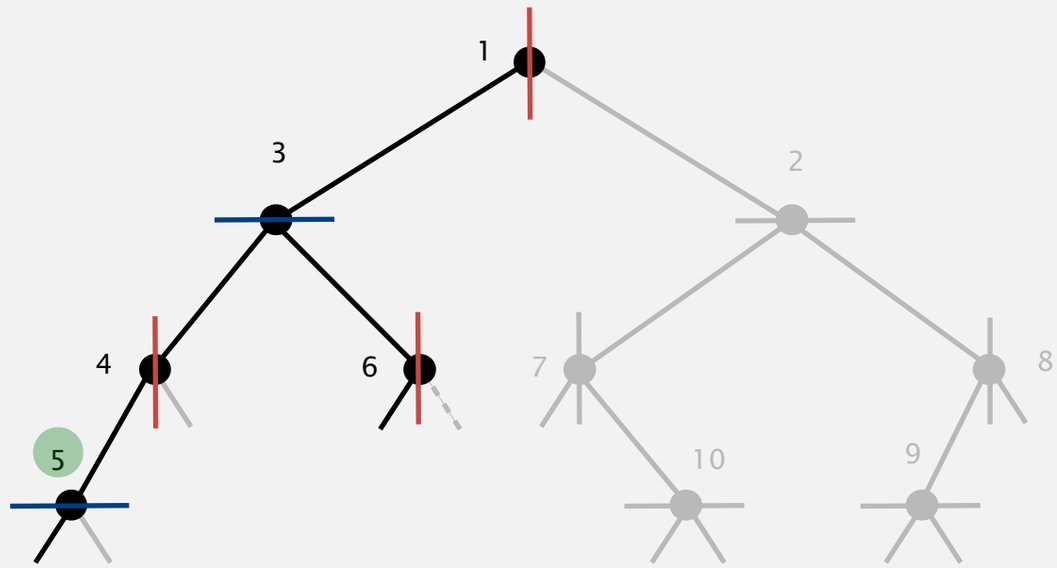


query point is above splitting line
search top subtree first

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.



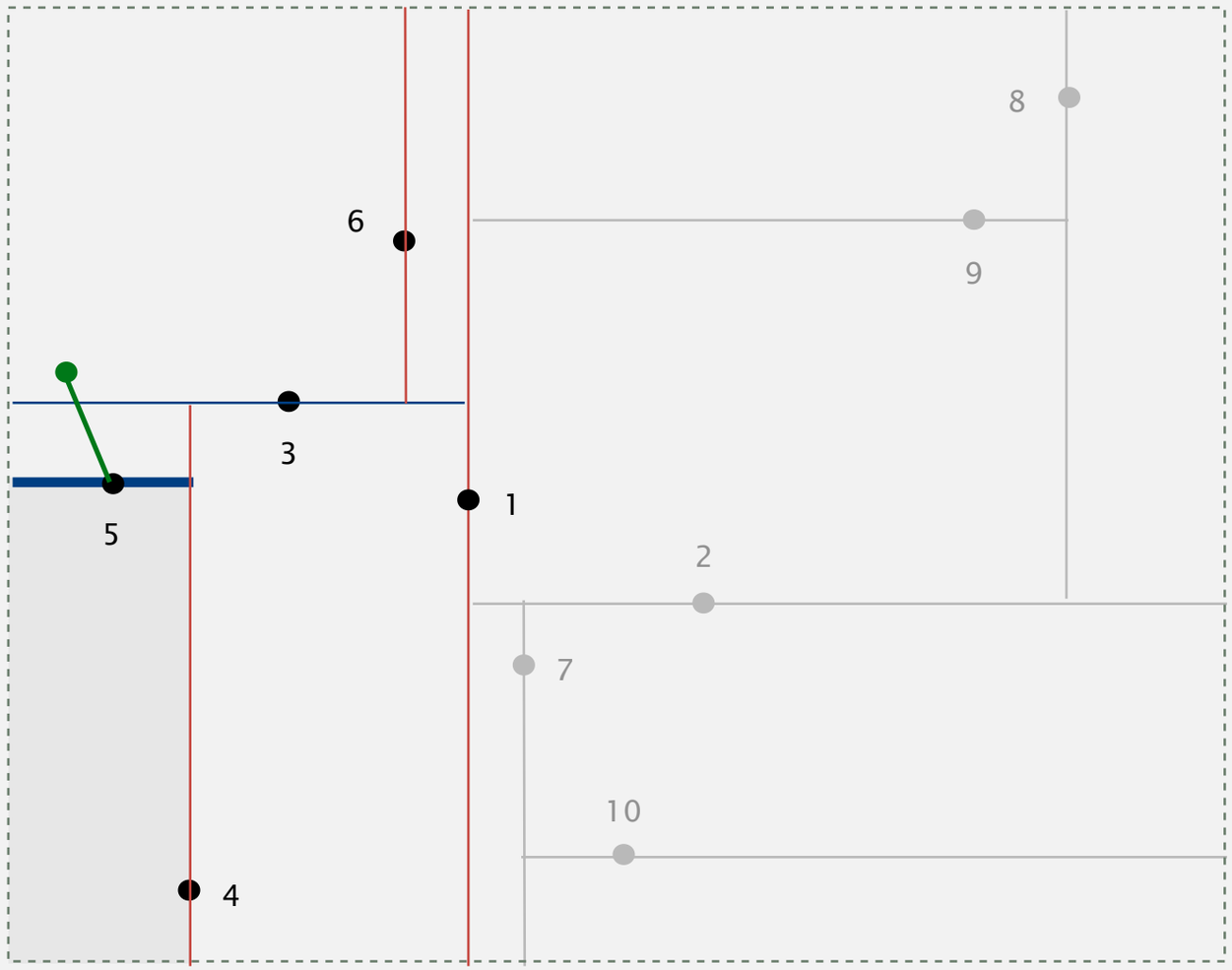


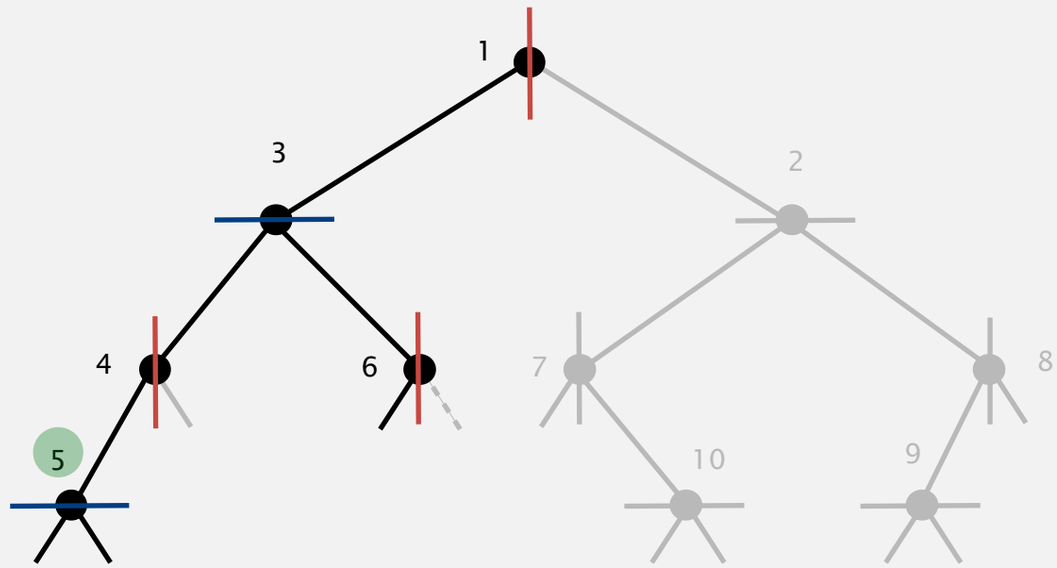
search top subtree

return since empty

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

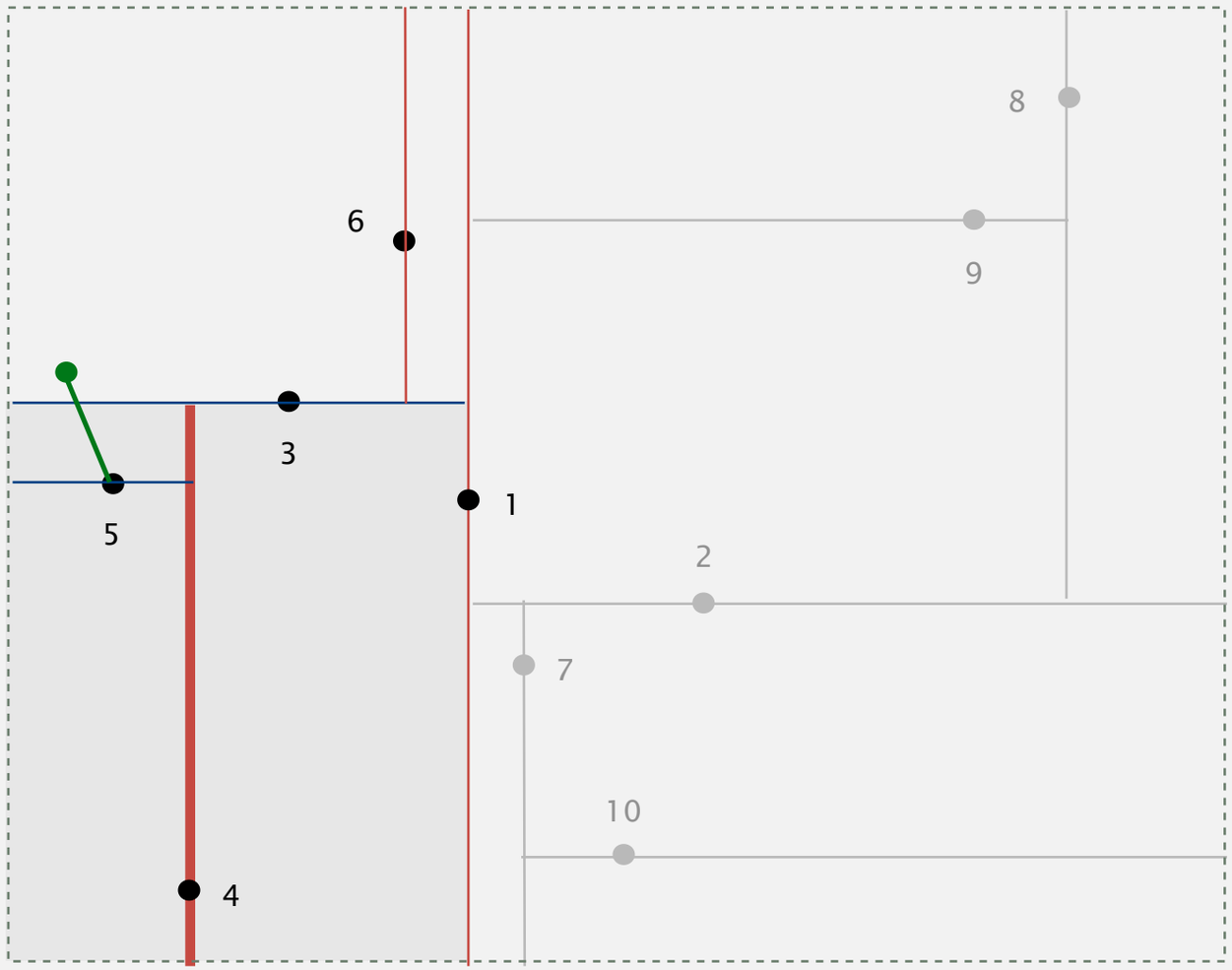


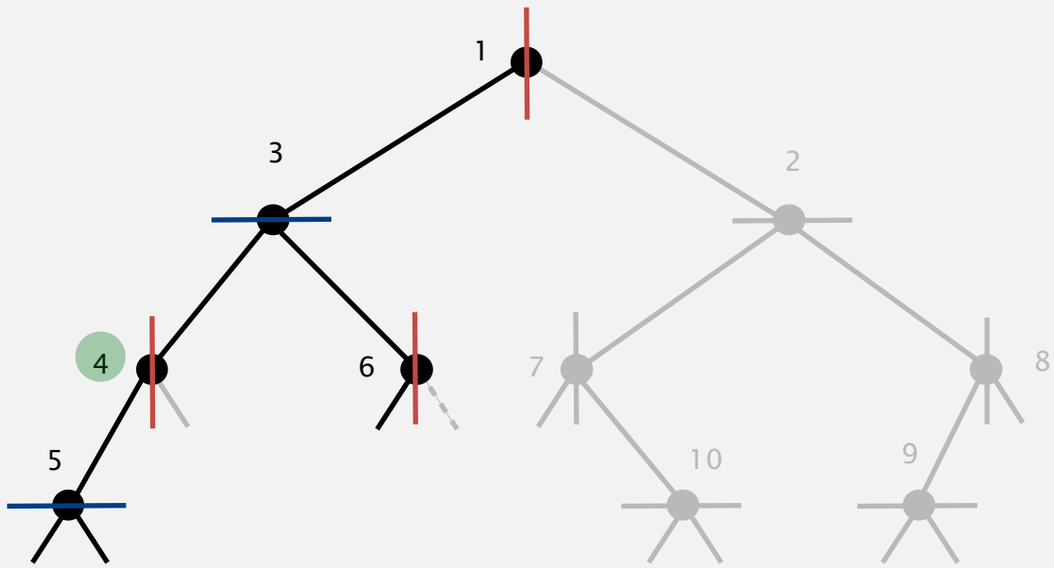


search bottom subtree
return since empty

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

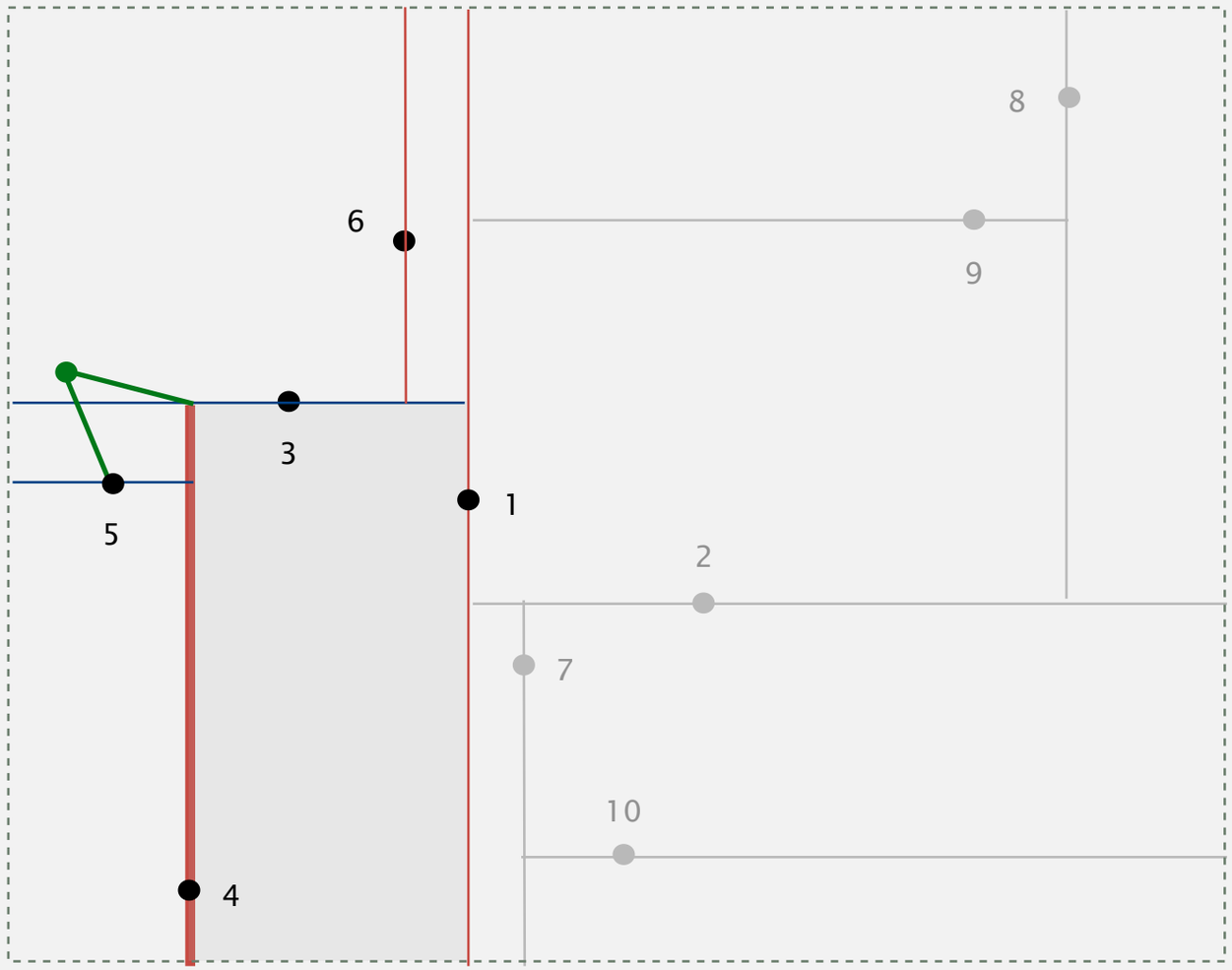


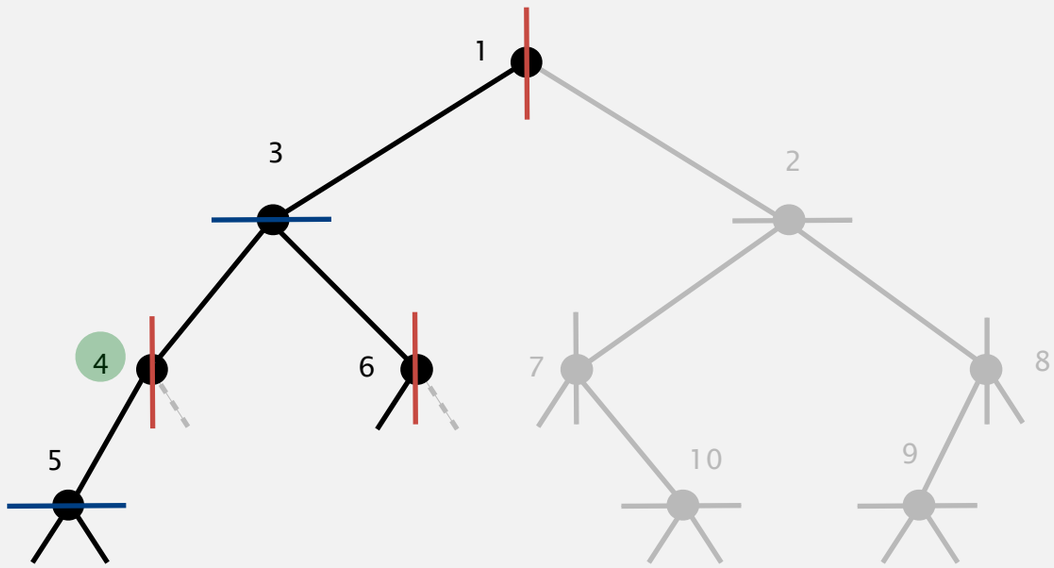


return from function call
search right subtree next

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

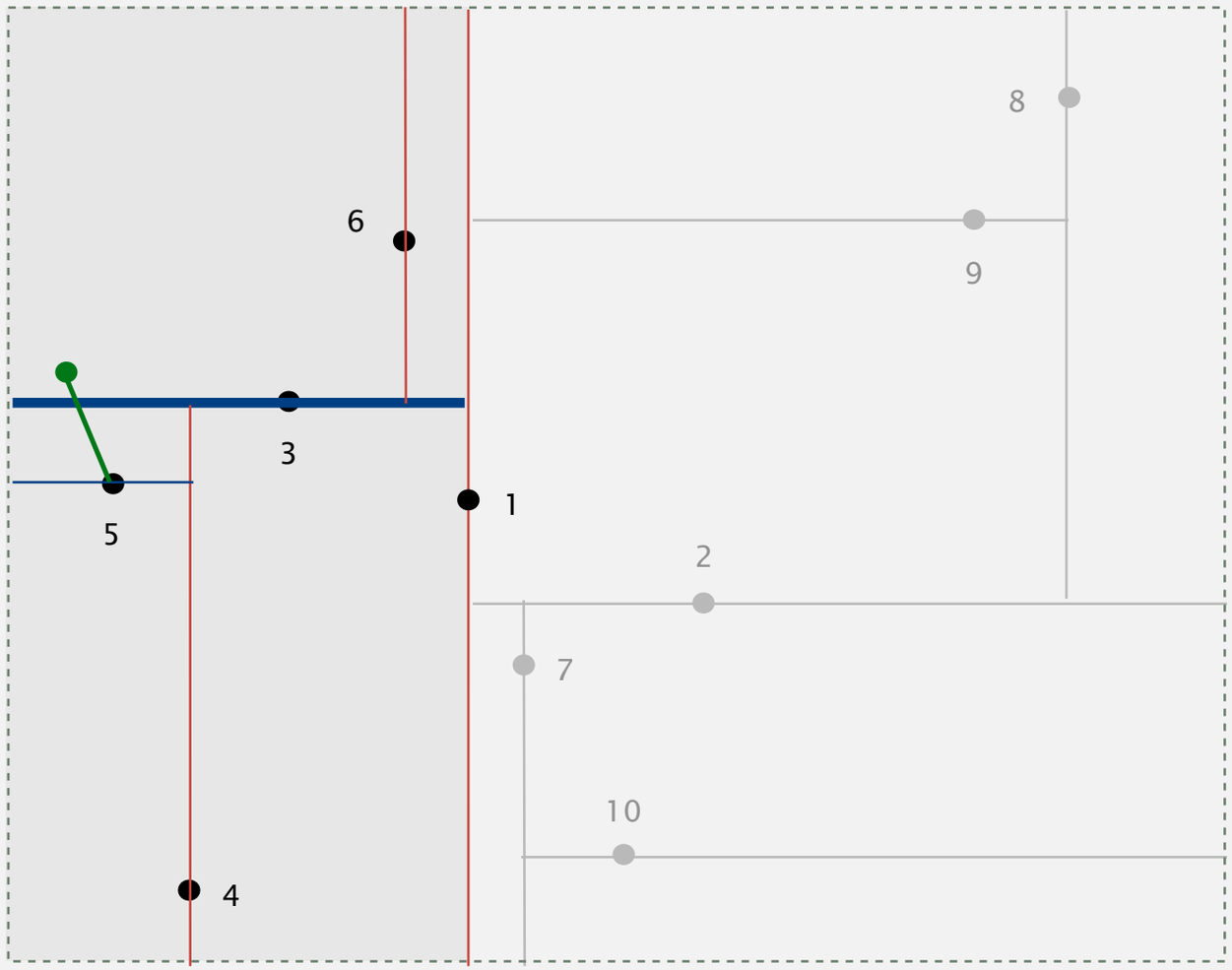


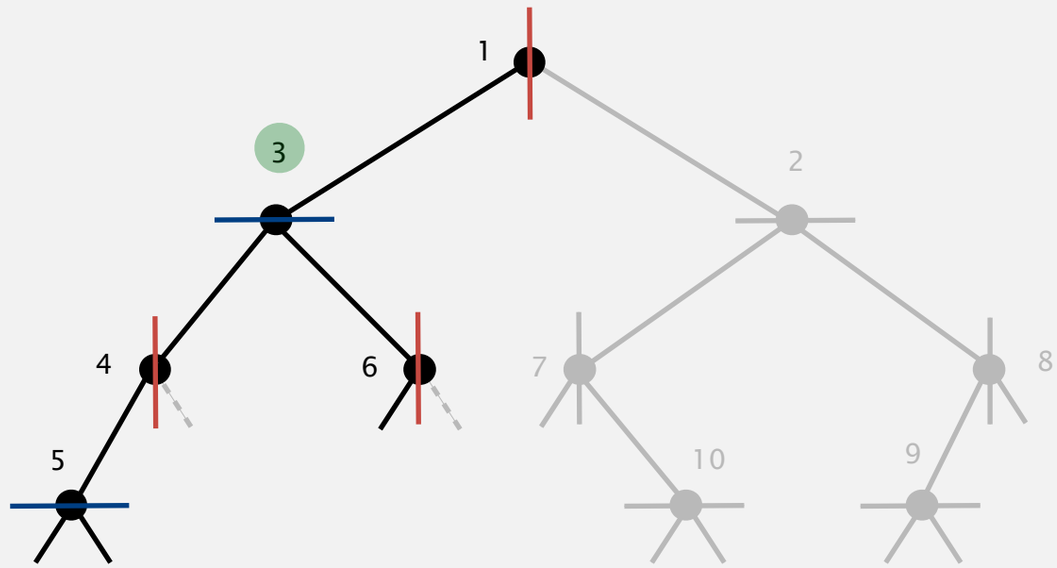


search right subtree
prune since nearest neighbor
can't be in subdivision

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

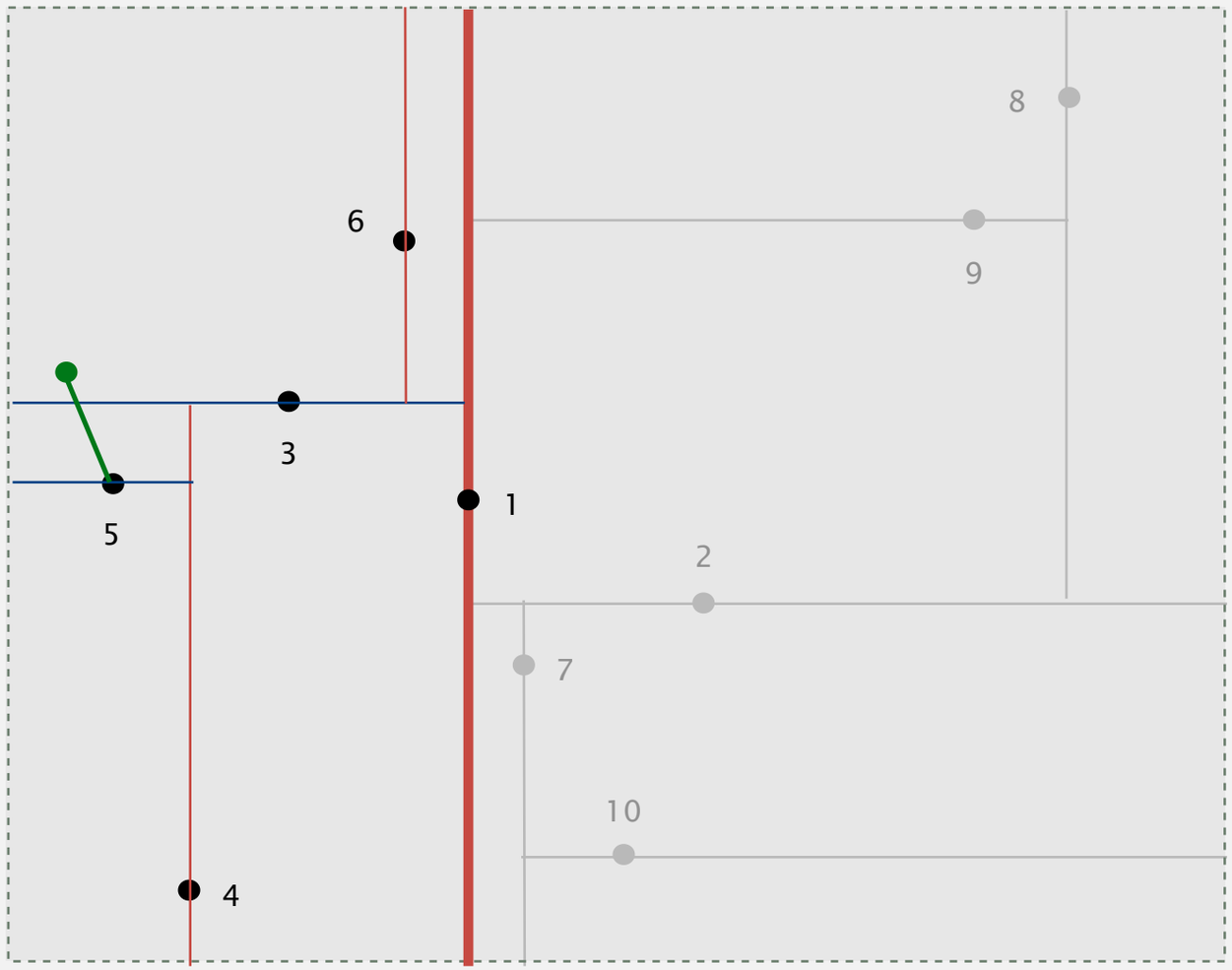


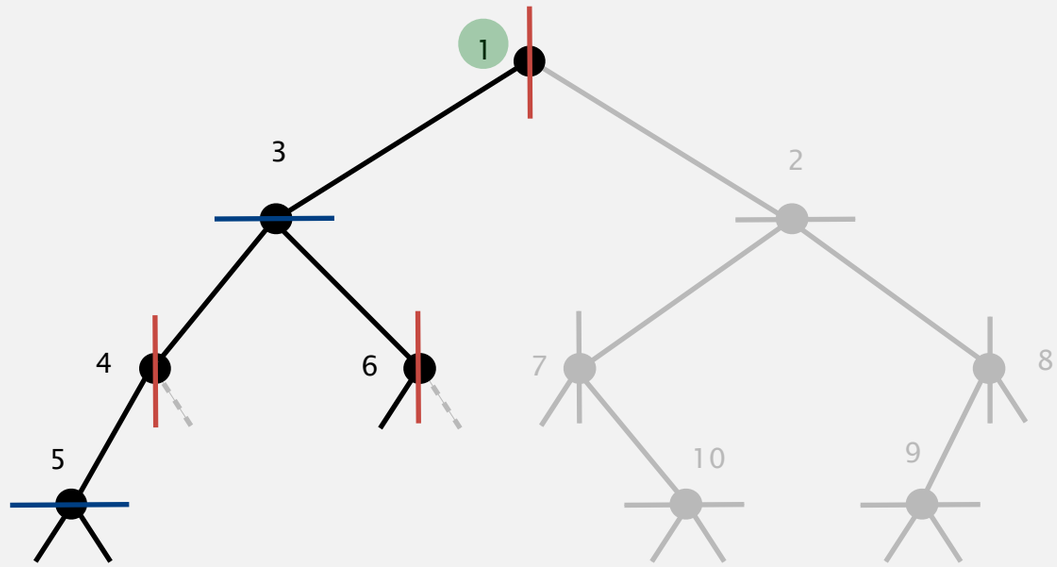


return from function call

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

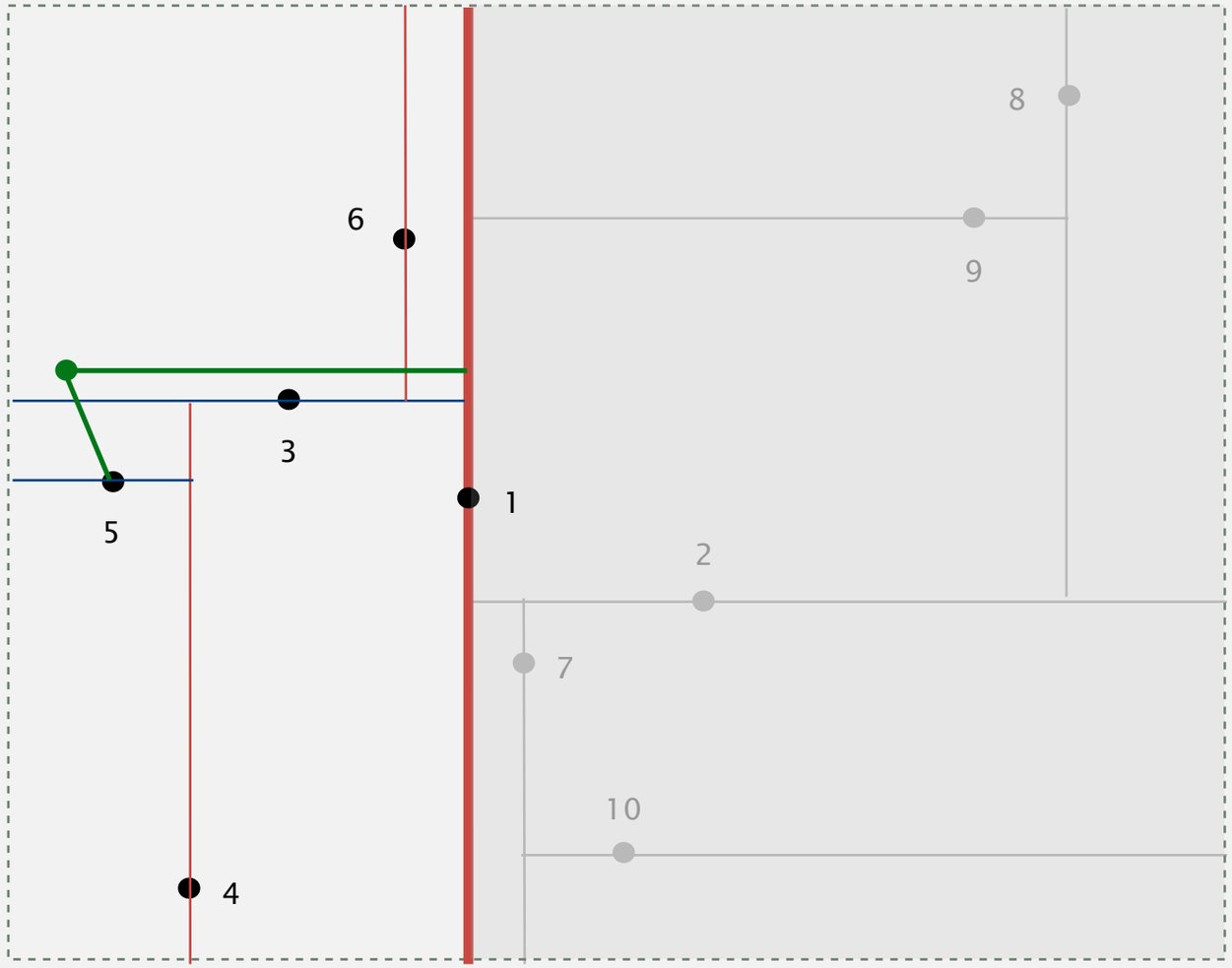


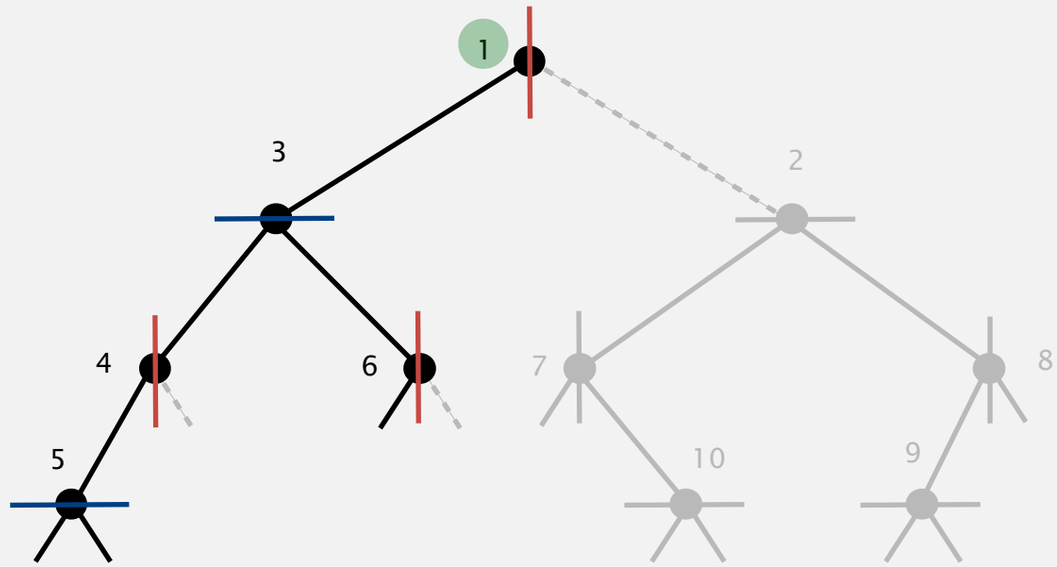


return from function call
search right subtree next

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.

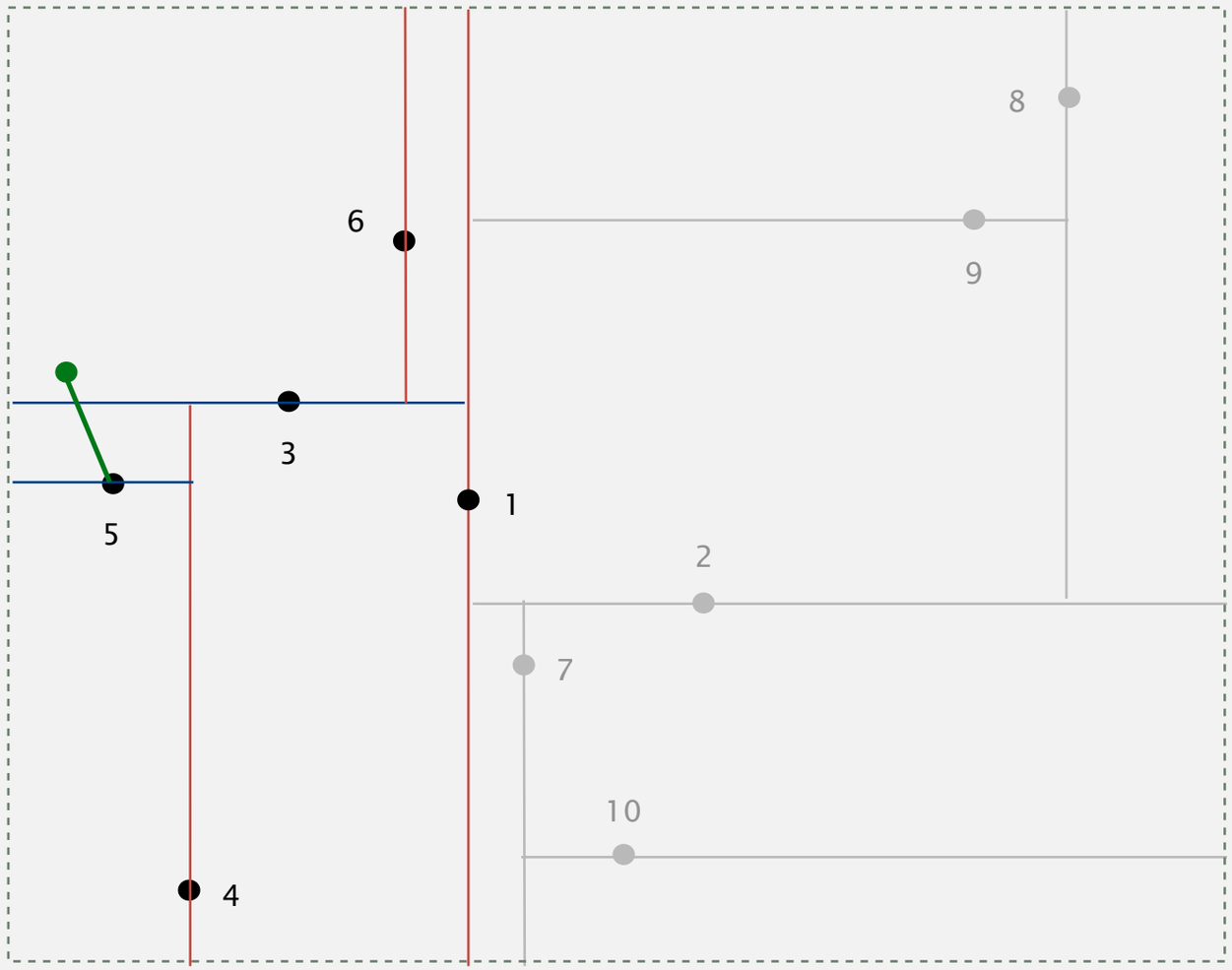


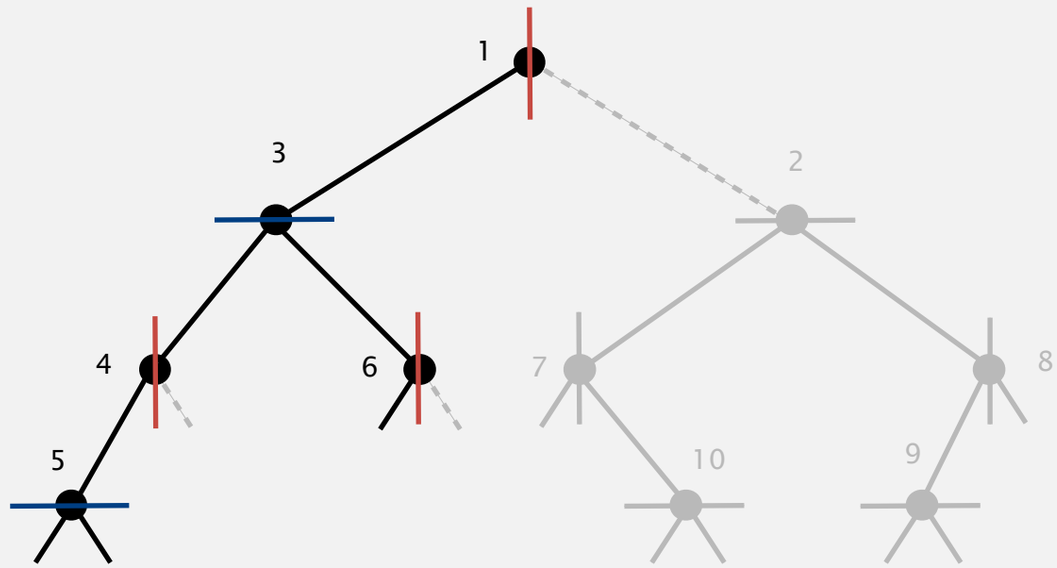


search right subtree
prune since nearest neighbor
can't be in subdivision

Nearest neighbor search in a 2d tree

- Check distance from point in node to query point.
- Recursively search left/bottom subdivision (if it could contain a closer point).
- Recursively search right/top subdivision (if it could contain a closer point).
- Organize recursive method so that it begins by searching for query point.





nearest neighbor = 5