

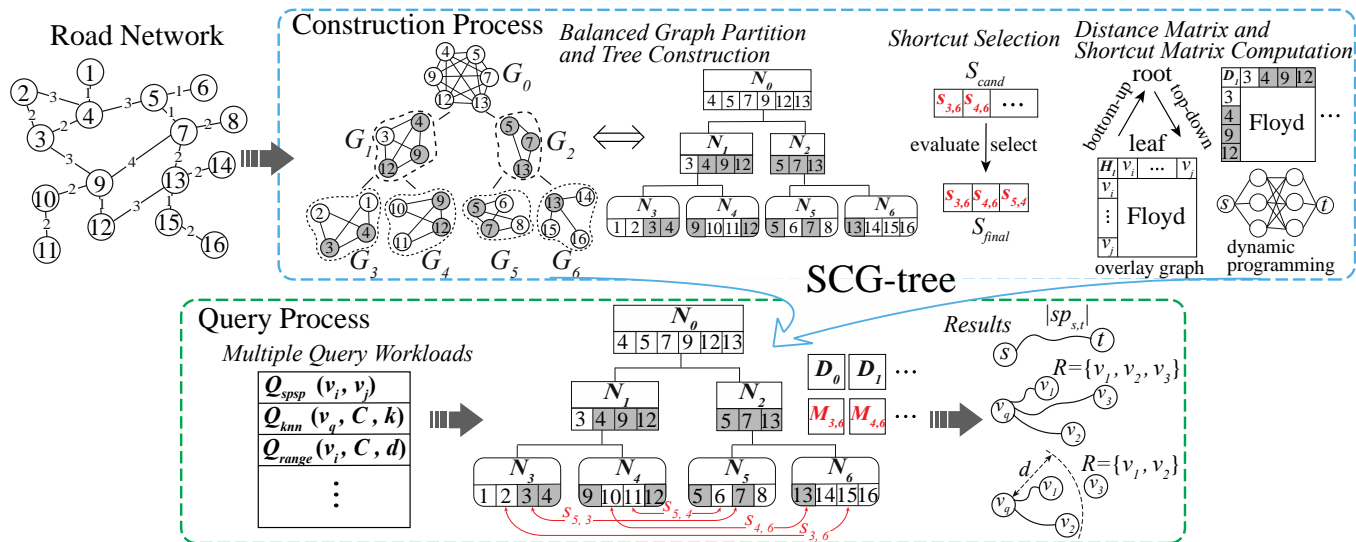
SCG-tree: Shortcut Enhanced Graph Hierarchy Tree for Efficient Spatial Queries on Massive Road Networks

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Problems & Ideas

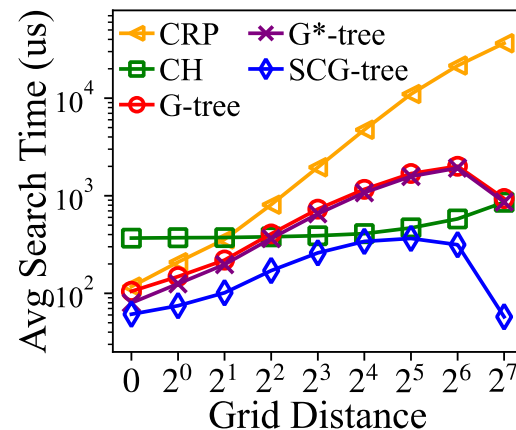
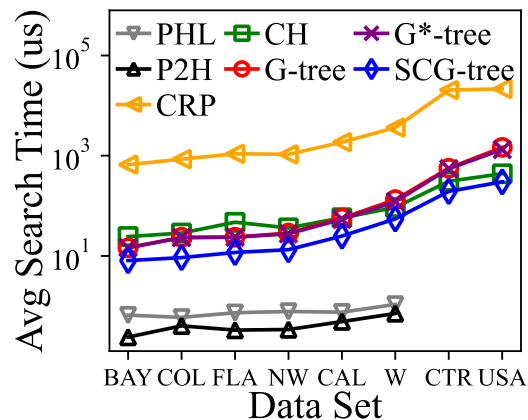
- Problems of existing indices for spatial queries on massive road networks :
 - Most existing approaches fail to speed up multiple spatial queries simultaneously.
 - Partition-based hierarchical approaches require large search space on massive road networks , especially for long-distance queries.
- Ideas: Leveraging shortcuts and shortcut-based query methods on hierarchical structure can enhance overall efficiency.



The overview of SCG-tree workflow. Given a road network, we construct SCG-tree with balanced graph partition, shortcut selection, and matrix computation, and then we perform multiple spatial queries upon it.

Main Contributions

- Contributions:
 - A new index SCG-tree that can simultaneously support SPSP, k NN, and range queries on massive road networks, which is efficient and scalable, especially for long-distance queries;
 - A new shortcut selection strategy based on a series of proposed metrics, e.g., gain, probability, and storage of shortcuts;
 - A pruned shortcut-based method for SPSP query, a two-phase expansion strategy for k NN and range queries, and the corresponding query algorithms.



Evaluation on SPSP query by varying dataset (left) and distance (right). SCG-tree is approximately two to five times faster than G-tree and G*-tree, two or three times faster than CH, and one or two orders of magnitude faster than CRP, which achieves the best query performance among hierarchical methods.