Segment Trees

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What Is A Segment Tree

A segment tree is a binary tree that stores data of

intervals (or segments) of a collection. A segment tree starts with the root node which stores data from the entire collection. If possible, the root node will have a left and right child that contains the left and right half of its parent node's interval respectively.

Those child nodes will have their own left and right child nodes (if possible) which will hold their parent's left and right half interval respectively.

This keeps going until a node's interval is of length one. This node will be the leaf node and have no more child nodes.
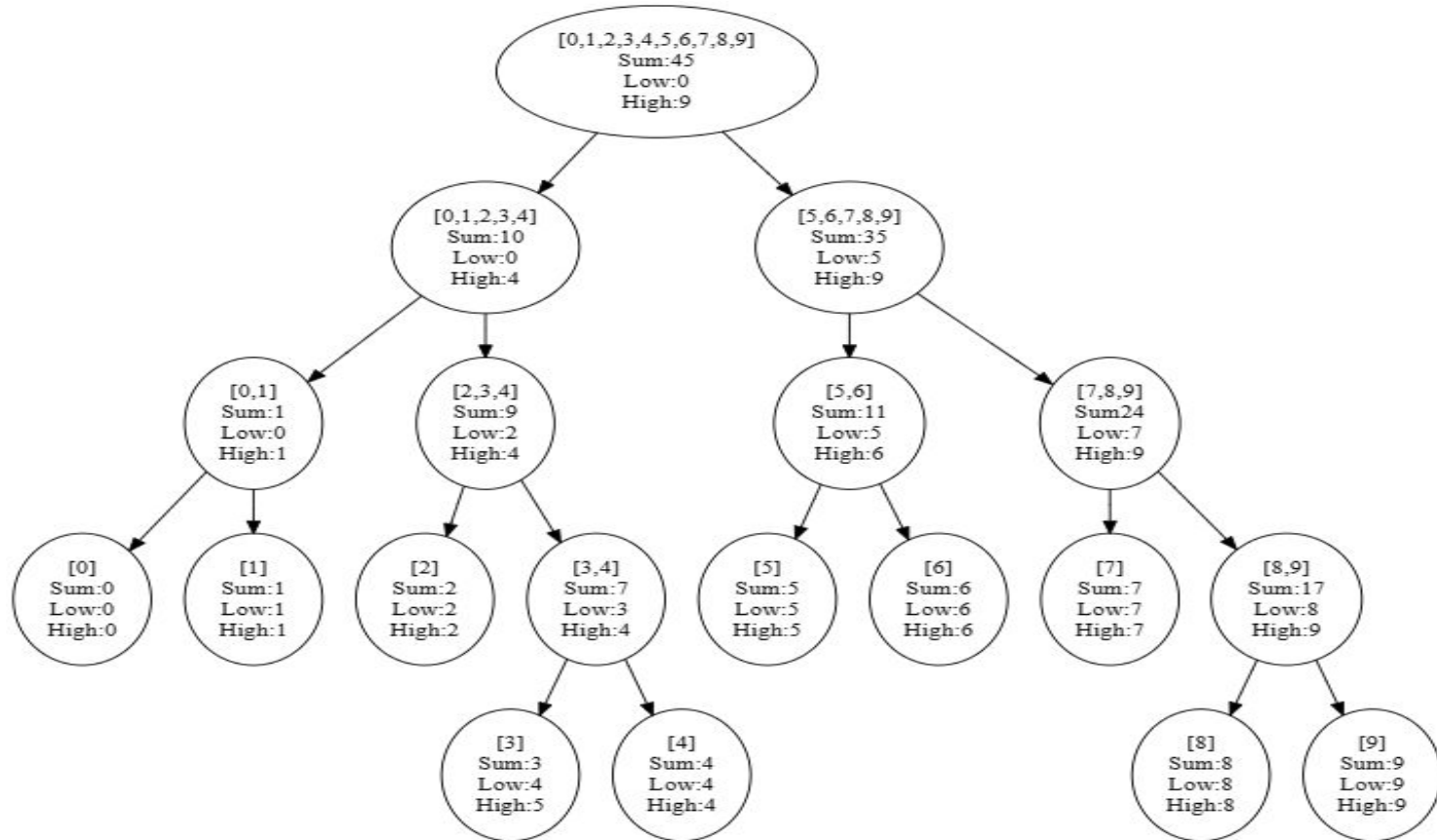
Dot File Visualization Of A Segment Tree's Intervals
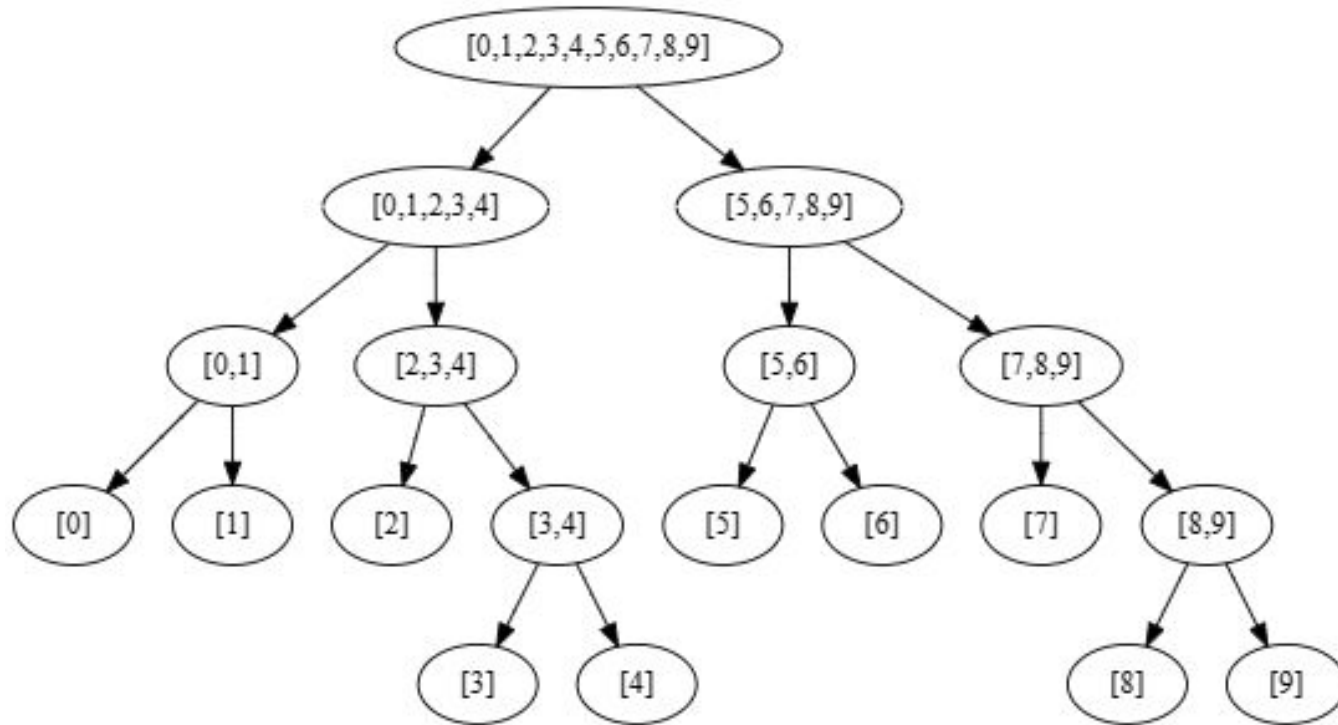
What Kind Of Data Is Stored In The Nodes?

The nodes will hold some kind of data that is relevant to its interval, such as the highest/lowest value, summation of all element, or average of all elements in its interval.

Dot File Visualization Of A Segment Tree With Data

What Problem Does This Solve?

Interval queries on just a regular collection like an array for an example would happen in linear time O(n) as you would have to go through each element in the interval in order to get the information you need.

Using a segment tree for these interval queries would be more efficient as it would have a logarithmic time complexity of O(logn).

Specific Segment Tree uses

Segment trees are used in the following applications/fields
- Computational geometry
- Geographic information systems
- Image processing
- Range sum, min, and max queries
- Range updates

Our Implementation

Our implementation is a program that takes in a text file. This text file's first line contains a longitude latitude coordinate that will be a starting position. All following lines contain a list of gas stations current gas prices and their longitude latitude coordinates.

The program will then calculate the distance between the starting point and each gas station, and create a vector that will hold each gas stations gas price, and distance.

This vector will then be sorted based off of distance. A segment tree will then be generated using the vector.

Our Implementation Continued

Once the segment tree is generated, the console will ask for user input in order to perform queries or changes to the segment tree.

The user will be able to update the price of gas at a specific gas station and change the segment tree accordingly.

The queries will be to find the average gas price or lowest/highest gas price in a specified area.
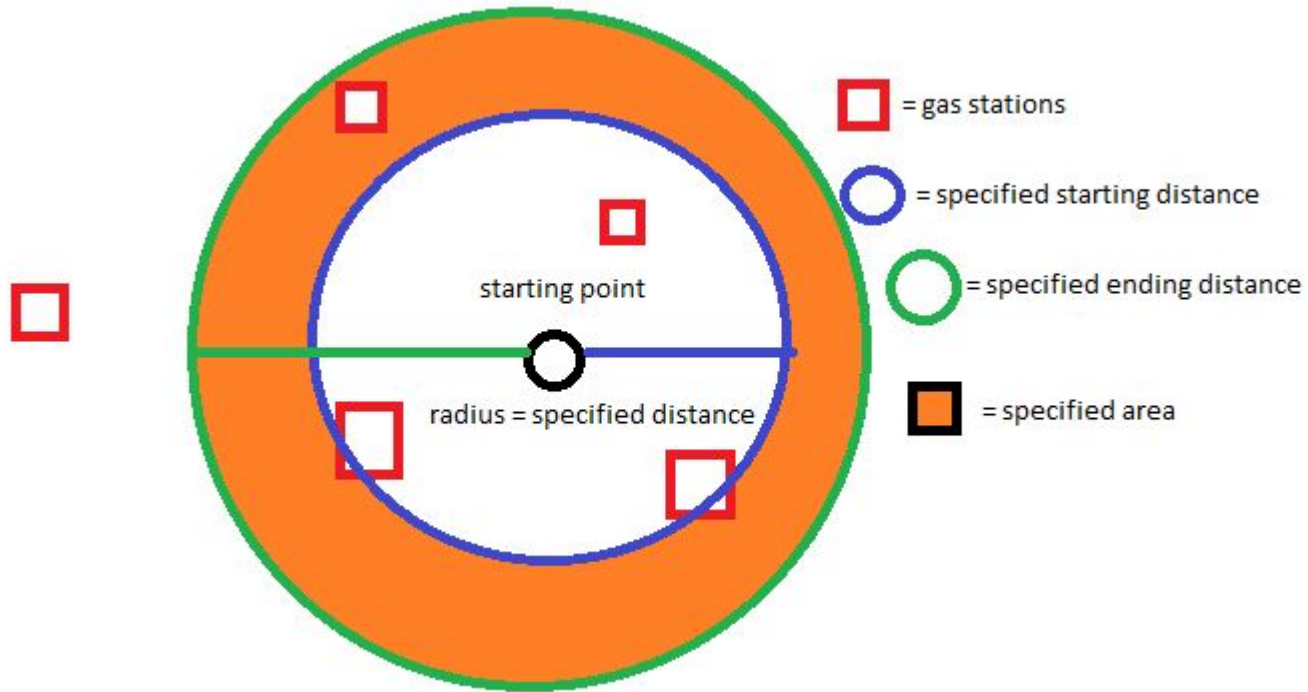
The specified area will either be from the starting position to a specified distance, or from a specified low distance to a specified high distance.

If the user chooses to end the program, a dot file will be written that visualizes the segment tree.
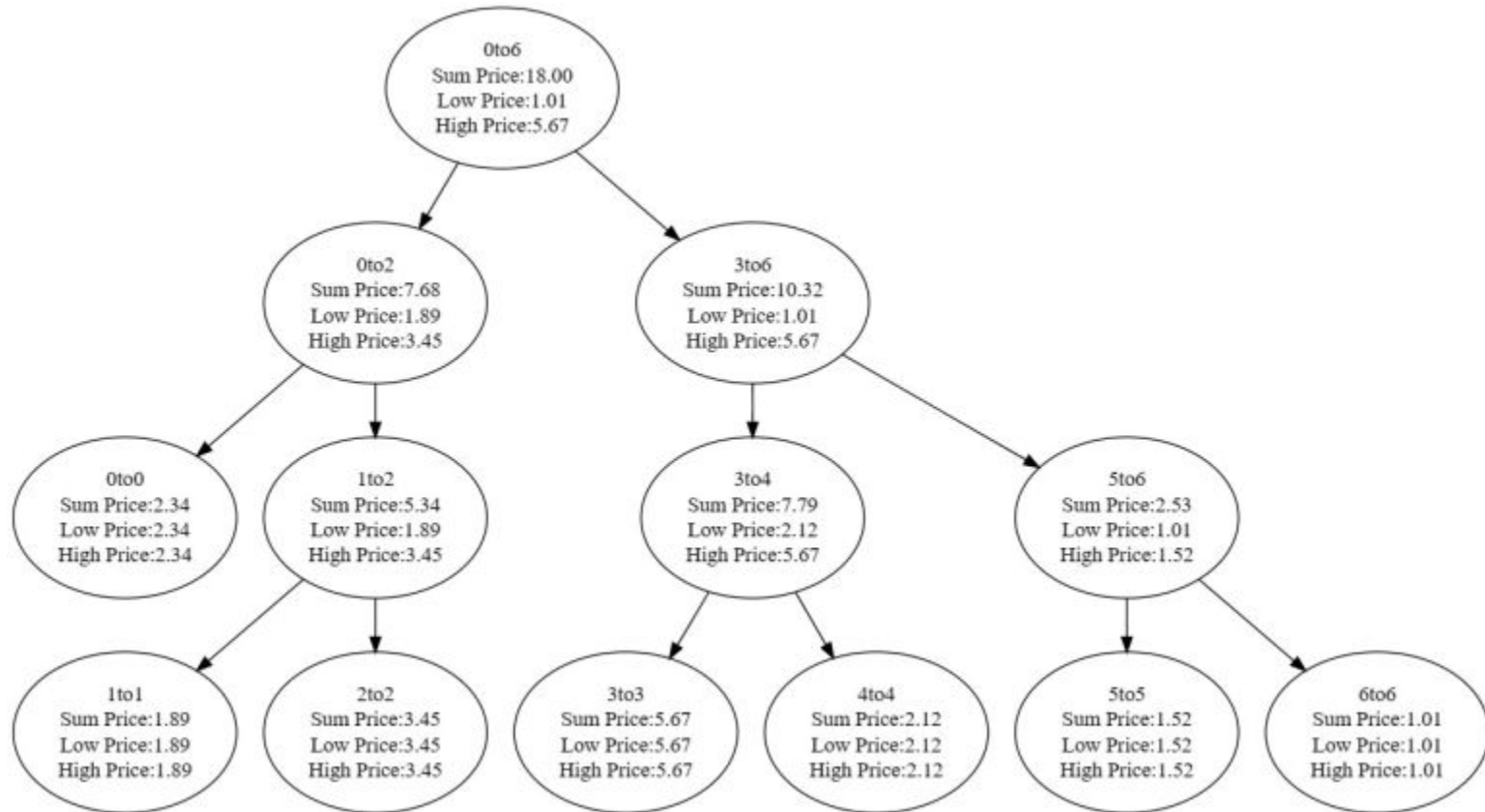
From Starting Point To Specified Distance Visualization
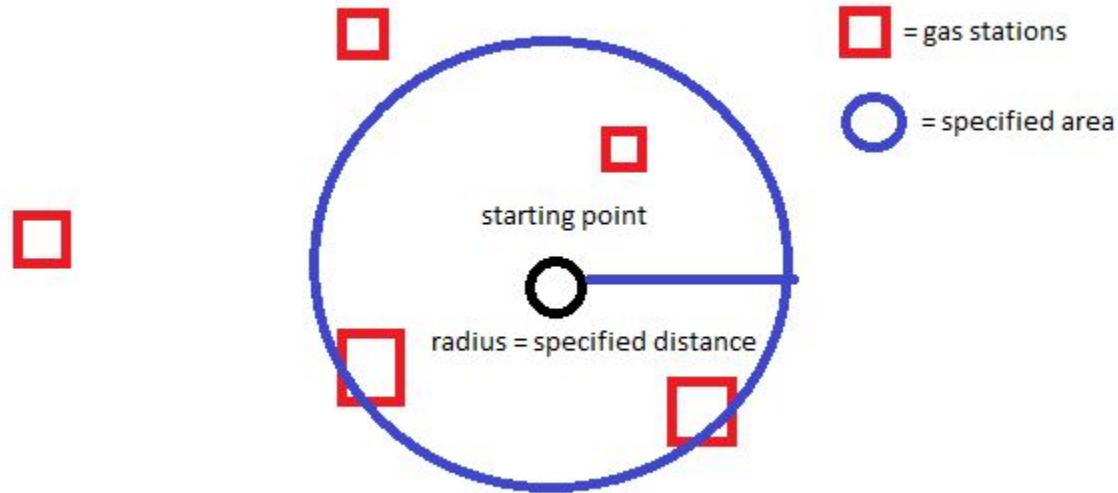
From Specified Distance To Other Specified Distance

Example Dot File Visualization

Works Cited

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