

DISTRIBUTED B+ TREE

An efficient key based distribution technique

Proneet Verma and Saurav Kumar

April 25, 2015

Indian Institute of Technology Kanpur

PROBLEM STATEMENT

- To implement a B+ Tree index structure over a distributed multi-node network

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- To devise an efficient distribution of nodes and analyze its performance

MOTIVATION

- In the age of ever increasing information collection and the need to look it up, there is a necessity to build systems which utilize the yet untapped and available compute resources.

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- The number of datasets being stored in a distributed manner, a scalable and efficient indexing approach is needed to locate the data.

APPROACH

Organization of index data

- Central Server:

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 - Book-keeping jobs

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Each server has its serverID, whose IP address and port are known.
Node pointers are pair of <serverID, fileName>.

Network calls

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Invariant: Each request made to a server returns only on completion, with response.

Scoring Technique

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Based on these two scores, we decide which data server to place this key on.

KEY DISTRIBUTION

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- Randomly
- Equal segmentation of key ranges and randomly assign each sub-range to a data server
- Using key and server scores to compute a mutual score

How the query is distributed?

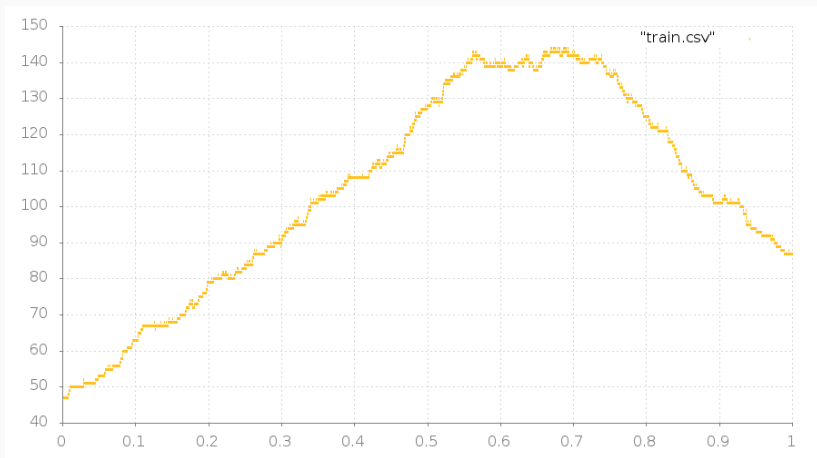


Figure: Plot showing the frequency of keys being returned

Random

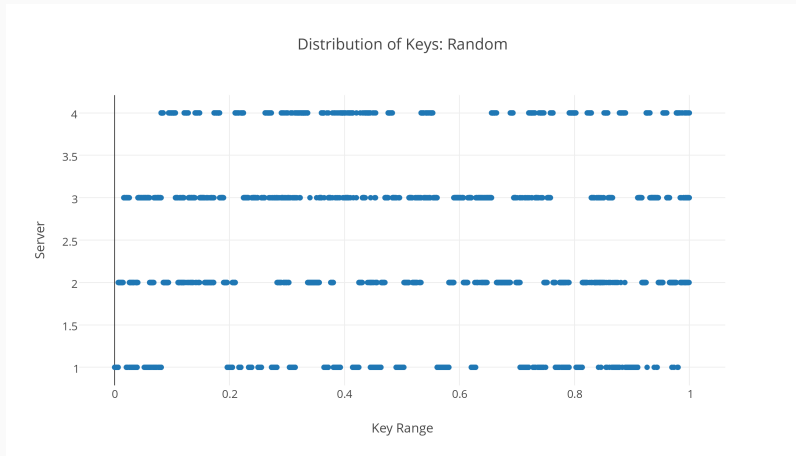


Figure: Distribution of keys among servers based on random strategy

Segmentation (Best Case)

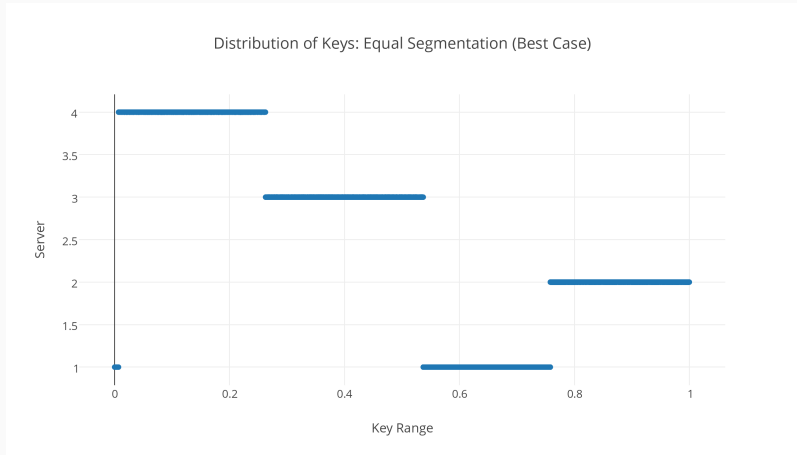


Figure: Distribution of keys among servers based on equal splitting of key range

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- Returns a high value when key score and server score are both high (or low)
- Returns a low value when key score and server score are opposite.

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One such function is:

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Demerit: It works good only for two data server system because it ignores any other scores other than high and low.

KEY DISTRIBUTION

Using

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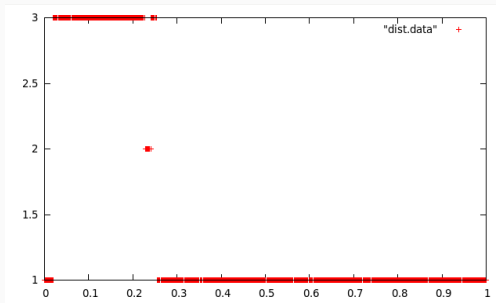


Figure: Skewed distribution of keys using this function

Mutual Score Calculation

Another function is:

$$f(x, y) = 1 - \text{abs}(x - y)$$

Merit: Very simple to compute and works very satisfactorily

RESULTS

Query Distribution

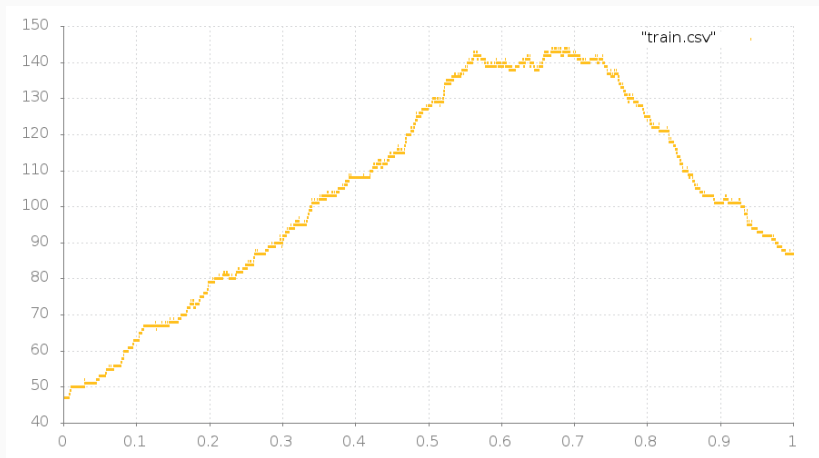


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Key Distribution using scoring

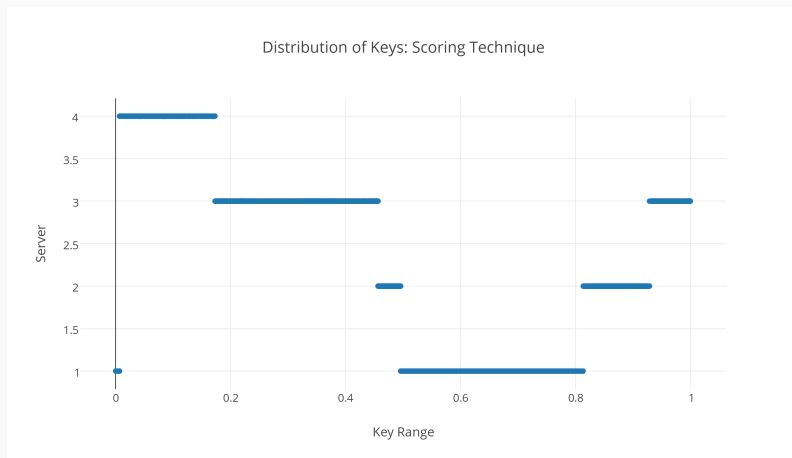


Figure: Distribution of keys among servers based on our scoring technique

Comparison

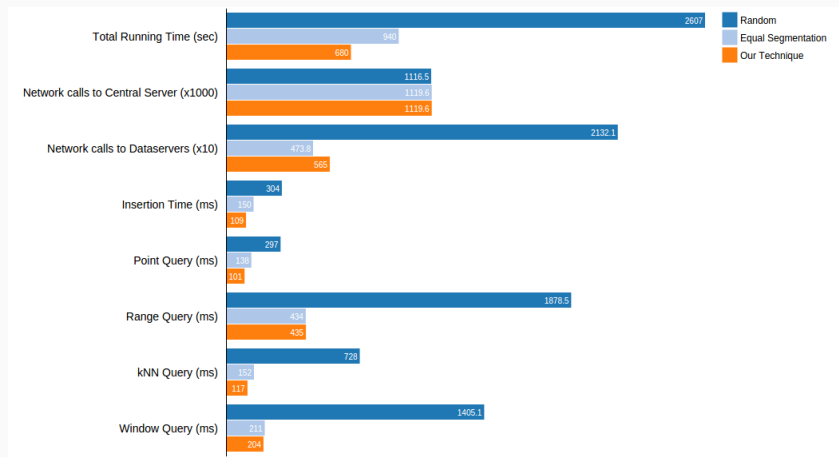


Figure: Comparison of key distribution techniques

Another Query Distribution

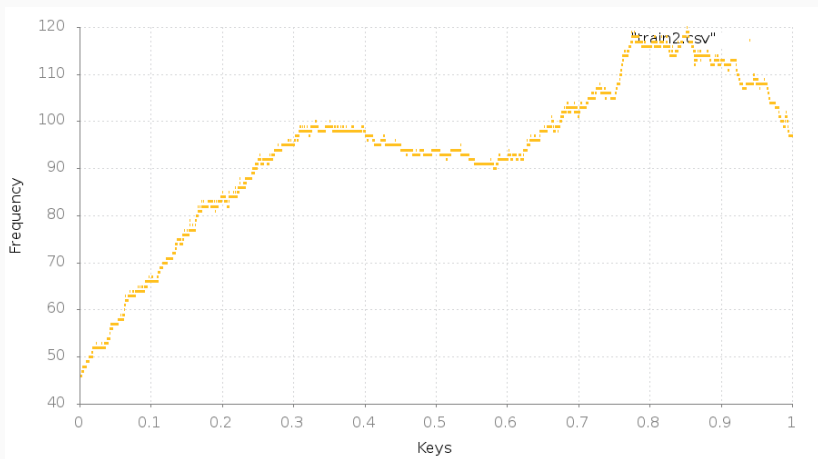


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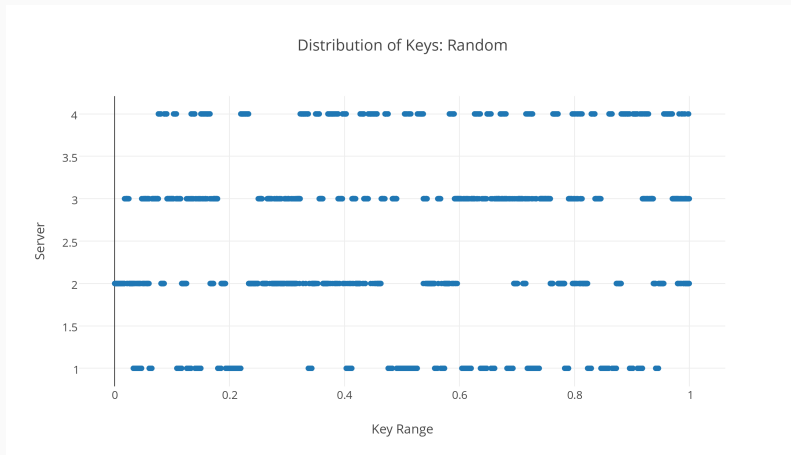


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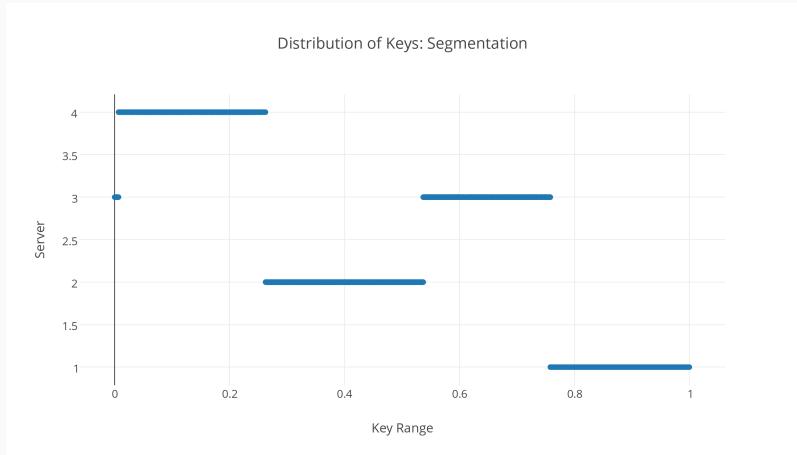


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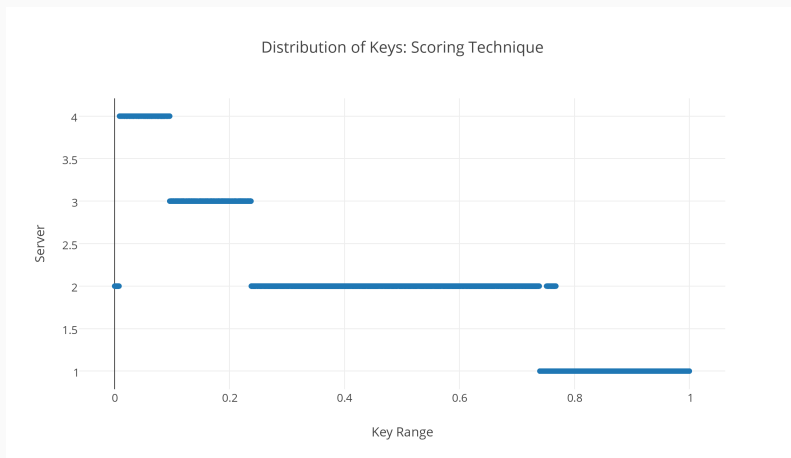


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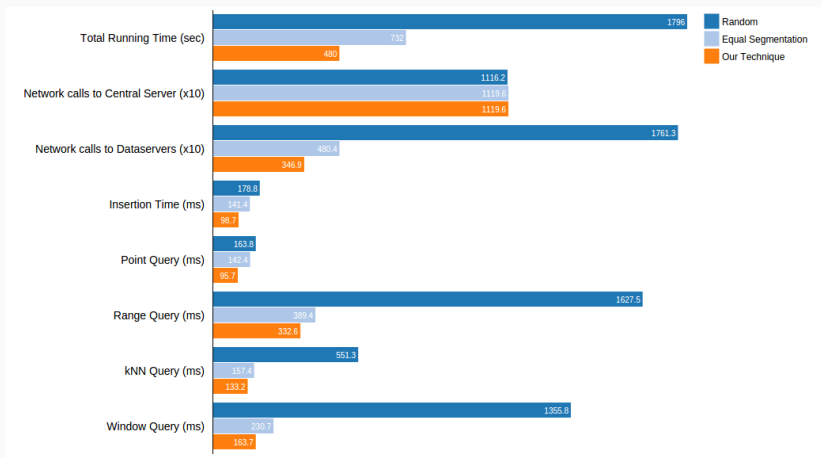


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- For queries which are more popular, there has been a considerable amount of reduction in their look up time.
- With the analysis that we have put forward, we can infer that this indexing approach can be widely used for faster look up of globally important terms.

QUESTIONS?

CREDITS: BEAMER(MTHEME), GNUPLOT, D3JS, SHARELATEX

THANK YOU