Clustered TDB: A Clustered Triple Store for Jena

Owens Alisdair, et al.

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Outline

• Definitions
• Clustered TDB Overview
• Considerations
• Evaluations
• IJCAI Review
Definitions

• Cluster
  – We consider a cluster to be a collection of closely related computation nodes acting as a whole.

• Hotspot
  – The event in which a machine is the bottleneck in a cluster as a result of handling a near uneven amount of data or computation load.
Clustered TDB Overview

- Distributed prototype-variant of the Jena Tuple Database (TDB).

- Supports virtual servers (aka v-nodes).
  - This improves fault tolerance and balancing

- Tuple data are accessed by triple indexes with 64-bit indexing on each RDF attribute (SPO, POS, OSP).
  - 8 bits reserved for datatype
  - Remaining 56 bits reserved for disk (address, v-node)-pair, or as inline.
Clustered TDB Overview

• Uses Query Coordinators
  – Decreases network congestion and improves routing logic to reduce hotspots.
    • Done by storing statistical information
    • Holds routing tables (using Node/NodeID mappings) of each physical node (Data Nodes)

• Borrows from Jena’s philosophy
  – Hopes to achieve fast read/write access compared to other standalone TDBs.
  – ARQ backend optimizes SQL query requests (via an execution plan) and performs variable-binding where possible.

• Extends Jena’s philosophy
  – Supports merging and splitting parallel operations.
Considerations

• The data used was synthetically generated.
  – 375 million tuples used
  – 4,000 unique properties
Evaluation

• Loading benchmarks
  – Datasets considered: Standalone, 1-machine cluster, 2-machine cluster, 3-machine cluster.

<table>
<thead>
<tr>
<th>System Type</th>
<th>Average Load Rate (triples/s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standalone</td>
<td>6,946</td>
</tr>
<tr>
<td>CTDB1</td>
<td>4,276</td>
</tr>
<tr>
<td>CTDB2</td>
<td>8,973</td>
</tr>
<tr>
<td>CTDB3</td>
<td>12,536</td>
</tr>
</tbody>
</table>

• Comments
  – Good scalability as more machines are added to cluster.
Evaluation

• Reading
  – Datasets considered: 1 and 5 users accessing the cluster simultaneously.

<table>
<thead>
<tr>
<th>System Type</th>
<th>SPO Index (ms)</th>
<th>POS Index (ms)</th>
<th>OSP Index (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standalone</td>
<td>439</td>
<td>21530</td>
<td>512</td>
</tr>
<tr>
<td>CTDB1</td>
<td>361</td>
<td>1733</td>
<td>483</td>
</tr>
<tr>
<td>CTDB2</td>
<td>187</td>
<td>1958</td>
<td>264</td>
</tr>
<tr>
<td>CTDB3</td>
<td>178</td>
<td>1821</td>
<td>363</td>
</tr>
</tbody>
</table>

Table 3. Reading individual triple patterns (5 users)

<table>
<thead>
<tr>
<th>System Type</th>
<th>SPO Index (ms)</th>
<th>POS Index (ms)</th>
<th>OSP Index (ms)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standalone</td>
<td>1904</td>
<td>65602</td>
<td>2205</td>
</tr>
<tr>
<td>CTDB1</td>
<td>1784</td>
<td>6648</td>
<td>2053</td>
</tr>
<tr>
<td>CTDB2</td>
<td>664</td>
<td>6879</td>
<td>672</td>
</tr>
<tr>
<td>CTDB3</td>
<td>647</td>
<td>5617</td>
<td>628</td>
</tr>
</tbody>
</table>

• Comments
  – Reading seems to scale well with more users.
IJCAI Review

• Relevance: 4
  – A scalable and efficient distributed TDB solution is desirable, but Clustered TDB includes too much complexity and requires more resources than may be necessary.

• Significance: 5
  – The author’s deserve credit for trying to think outside-the-box, however, I’m afraid that a lot of emphasis is being placed on increasing the hardware expense in favor of an effective software/algorithms solution. Also, it does not help that the authors’ have admitted that their index lookups can be larger than the data themselves—this could potentially lead to poor memory-cache coherency.

• Technical Soundness: 4
  – There are technical incompatibles in regards to the storing of attributes with high cardinalities, and also in regards to possible hotspot issues that their de-clustering technique were unable to address.

• Novelty: 4
  – Borrows a lot from current DBMS and TDB technologies.
IJCAI Review

• Quality of Evaluation: 5
  – Though the evaluation did not cover a broad scope of scalability issues, the assessments were acceptable enough for a Clustered TDB prototype.

• Clarity: 4
  – The paper was fairly-well presented: surveying various TDBs and techniques. However, I almost lost interest while reading through the evaluation section as it was becoming more technical and ambiguous in some sense.

• Confidence Score: 4
  – In my opinion, this paper was more useful as a refresher on various TDB and DBMS technologies but not as a viable distributed TDB solution.

• Overall Score: 4.29
References

• Owens, Alisdair et al. “Clustered TBD: A Clustered Triple Store for Jena.”
  <http://eprints.ecs.soton.ac.uk/16974/1/www2009fixedref.pdf>
Questions?