LogTM: Log-based Transactional Memory

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Motivation

- Release programmer's burden while achieving good performance by utilizing critical section parallelism.
- Functions like SLE but with some part implemented in software.
Implementation

- Log changes after transaction start, and recover from it if transaction abort.
- A processor send request to directory and receive either ack or nack
- Upon a nack, wait or abort, decide by handler
- Use priority to prevent deadlock
- May result in priority inversion
Performance
Performance

The chart illustrates the speedup for different benchmarks: Barnes, Cholesky, Ocean, Radiosity Base, Radiosity Opt, and Water. The speedup values range from 1.04 to 4.18, indicating significant performance improvements in the specified benchmarks.
# Performance

<table>
<thead>
<tr>
<th>Benchmark</th>
<th># Trans.</th>
<th>% Stalls</th>
<th>% Aborts</th>
<th>Stores/Trans.</th>
<th>% Read-Modify-Writes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barnes</td>
<td>3,067</td>
<td>4.89</td>
<td>15.3</td>
<td>5.50</td>
<td>27.9</td>
</tr>
<tr>
<td>Cholesky</td>
<td>22,309</td>
<td>4.54</td>
<td>2.07</td>
<td>1.68</td>
<td>82.3</td>
</tr>
<tr>
<td>Ocean</td>
<td>6,693</td>
<td>0.30</td>
<td>0.52</td>
<td>0.112</td>
<td>100</td>
</tr>
<tr>
<td>Radiosity</td>
<td>279,750</td>
<td>3.96</td>
<td>1.03</td>
<td>1.64</td>
<td>82.7</td>
</tr>
<tr>
<td>Raytrace-Base</td>
<td>48,285</td>
<td>24.7</td>
<td>1.24</td>
<td>1.96</td>
<td>99.9</td>
</tr>
<tr>
<td>Raytrace-Opt</td>
<td>47,884</td>
<td>2.04</td>
<td>0.41</td>
<td>1.97</td>
<td>99.9</td>
</tr>
<tr>
<td>Water</td>
<td>35,398</td>
<td>0.00</td>
<td>0.11</td>
<td>1.98</td>
<td>99.6</td>
</tr>
</tbody>
</table>

Bar chart showing performance metrics for Cholesky, Barnes, and Radiosity.
Comparison

• Advantage
  • When a conflict happen, do not have to abort, avoid wasting work.
  • Log is user visible, conflict handler is user defined, more flexible.

• Disadvantage
  • OS limitation
  • Cannot deal with paging and thread switching/migration
Discussion

• Compare to the SLE, demonstrate a trade off to have more software, which level of trade off is appropriate?
  • Hardware implements mechanism and software set policy?