Research in the Parallel Software Technologies Laboratory

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Motivation

- Why Parallel Computing?
  - Solve larger problems
  - Reduce the time to solution
How to use multiple processors

- **Functional parallelism**: each processor executes a different function

- **Data parallelism**: each processor executes the same function using a different portion of the overall problem
Open MPI

- Widely utilized public domain implementation of the Message Passing Interface (MPI)
- Jointly developed and maintained by numerous universities, research labs and companies

<table>
<thead>
<tr>
<th>Application</th>
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<tbody>
<tr>
<td>MPI layer</td>
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Modular Component Architecture

<table>
<thead>
<tr>
<th>BTL</th>
<th>COLL</th>
<th>I/O</th>
</tr>
</thead>
<tbody>
<tr>
<td>tcp</td>
<td>basic</td>
<td>ROMIO</td>
</tr>
<tr>
<td>sm</td>
<td>tuned</td>
<td>OMPIO</td>
</tr>
<tr>
<td>ib</td>
<td>sm</td>
<td></td>
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</tbody>
</table>

... Other framework

module

module

module
Abstract Data and Communication Library

- Auto-tuning of (collective) communication operations
  - Library of possible algorithms / implementations
- Runtime selection logic through
  - Brute force search
  - Orthogonal search
  - 2k factorial design search
- Historic learning
  - Incorporating knowledge of previous executions
- Support for asynchronous operations through timer-object