High performance tools to debug, profile, and analyze your applications

High-productivity development tools for science

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Industry Standard Tools
HPC means being able to work productively on remote machines

- Linux
- OS/X
- Windows
- Multiple hop SSH
- RSA + Cryptocard
- Uses server license
Submit to job queues or run interactively on any system
Today’s Challenge

Q: What is the impact of current trends in HPC on your application?

Q: How can you make your science run well on the available system?

A: Development.

Development implies both fixing problems and optimizing the computation.
Debugging in Practice, …

A cycle diagram showing the steps in the debugging process:
- Compile
- Run
- Crash
- Insert print statements
- Hypothesis

The cycle starts with Compile, moves to Run, then to Crash, then to Insert print statements, and finally to Hypothesis, returning to Compile.
Optimization in Practice, …

1. Insert timers
2. Run code
3. Analyse result
4. Change code

Process flow:
- Insert timers
- Run code
- Analyse result
- Change code
Simplified Code Optimization

- Small data files
- <5% slowdown
- No instrumentation
- No recompilation
While still connected to the server we switch to the debugger.
It’s already configured to reproduce the profiling run.
Our tools understand your version control system
Most new bugs are in or around recently changed code
We can visualize multidimensional data across all processes.
And generate statistical summaries of their contents
Variables are compared across all threads and processes automatically.
Verify our fix before committing it
A tracepoint shows the arrays pointers are swapping correctly now.
Debug with the Scientific Method
## Debugging While you Sleep

### Debugging Log


<table>
<thead>
<tr>
<th>#</th>
<th>Type</th>
<th>Time</th>
<th>Processes</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>i</td>
<td>0:00.000</td>
<td>0-3</td>
<td>Launching program /home/bpaisley/demo/ddt/cstartmpi/cstartmpi.exe</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2015.</td>
</tr>
<tr>
<td>2</td>
<td>i</td>
<td>0:01.649</td>
<td>0-3</td>
<td>Startup complete.</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>0:01.655</td>
<td>n/a</td>
<td>Select process group All</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>0:01.656</td>
<td>0-3</td>
<td>Add tracepoint for cstartmpi.c:109 Vars: x, y</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>0:01.658</td>
<td>n/a</td>
<td>Add Expression to Evaluate: my_rank</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>0:01.658</td>
<td>n/a</td>
<td>Add Expression to Evaluate: tables</td>
</tr>
</tbody>
</table>

### Additional Information

- **Stacks**
- **Current Stack**
- **Locals**

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>argc</td>
<td>1</td>
</tr>
<tr>
<td>argv</td>
<td>0x7fffffff548</td>
</tr>
<tr>
<td>beingMatched</td>
<td>32767</td>
</tr>
<tr>
<td>bigArray</td>
<td></td>
</tr>
<tr>
<td>dest</td>
<td>0</td>
</tr>
</tbody>
</table>
A Productive HPC Workflow
High performance tools to debug, profile, and analyze your applications

http://www.alcf.anl.gov/user-guides/allinea-ddt