TotalView Parallel Debugger as a Multi-Purpose Tool

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Support or any requests: ircshelp@seas.harvard.edu

Details on IRCS services: http://ircs.seas.harvard.edu/
Online documentation: http://ircs.seas.harvard.edu/USERDOCS/
TotalView Parallel Debugger

• Introduction

• Getting Started
  – Compiling debuggable code, Launching TotalView (on SEAS HPC systems), and Basic concepts (main GUI, stack trace, and execution, process and thread control)

• Examples
  – e.g. Variable queries, and data visualization, Message Queue Graphs, and Memory / Heap management
  – Live data visualization, and model parameter modification

• Resources for more information

• Summary and Discussion
TotalView Parallel Debugger – Intro

• Built from ground-up for debugging massively parallel codes
• MPI, pthread, and OpenMP process level support for program execution control (depending on the OS kernel support)
• Reverse debugging allows one to step backwards from any point in execution
  – Not available at SEAS due to additional licensing cost
• Supported on most *NIX platforms, but not on Windows
Start using TotalView

• Connect to ‘hpc’, and start an interactive session
  – ssh –AY hpc.seas.harvard.edu
  – qlogin –pe orte 8

• Load the necessary SW modules
  – module load compilers/intel/10.1
  – module load mpi/openmpi/1.2.8/intel
  – module load packages/totalview/8.6.1-1

• Compile a ‘debuggable’ executable
  – mpif90 –g –O0 –o mympicode.out mympicode.f90
Start using TotalView (continued)

• Start the program under TotalView’s control
  – `totalview mympicode.out`
  – Select ‘Parallel’ tab, and ‘Open MPI’ from the pull down menu.
  – Then select number of tasks (8 in this case). Click OK
  – The main TotalView GUI window shows the source code

• You are now ready to start debugging…
Main View

Control Buttons

All Processes

Stack Trace

Stack Frame

Breakpoint (red)

Current position
(yellow arrow)

Source code

Tabs for breakpoints, processes, and threads

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Using TotalView - Basics

• Control Buttons
  – Go – Run the code
  – Halt, Kill, and Restart – ‘Stop’, or ‘Kill’ execution, or ‘kill and restart’
  – Next – Step one line of code, stepping over subroutines
  – Step – Step one line of code, stepping into subroutines
  – Out – Execute code to the end of and exit from current subroutine

• Action points, e.g. breakpoints
  – Left click the line number to set or unset a simple breakpoint
  – Right click and ‘Properties’ for additional settings

• Variable values
  – Right click on top of variable, and choose ‘Dive’ or ‘Across Processes’
  – In the pop-up, try e.g. ‘Tools’ -> ‘Visualize’, or ‘Tools’ -> ‘Statistics’
Viewing Data and Basic Visualization

Data values (changed values are in yellow)

Data visualization

Data statistics

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Automated Actions, e.g. Visualization

Action point -> Evaluate

$v\text{visualize}(v, "[::4][::4]");$  
$v\text{visualize}(v, "[127:127]");$  
$\text{stop};$
Very Basic Data Manipulation, and Message Queue (Graph)

Action point -> Evaluate

ISEND = 3

Value of ISEND is changed and output looks correct, but the program never finishes??

Tools -> Message Queue Graph reveals the problem
More information

• IRCS TotalView documentation:
  – https://ircs.seas.harvard.edu/display/USERDOCS/How+to+use+the+TotalView+debugger

• Official TotalView documentation:
  – http://www.totalviewtech.com/support/documentation.html

• Using Evaluation Expressions:
Summary and Discussion

- **TotalView** Parallel Debugger is designed from ground-up to debug massively parallel codes with full MPI process, and pthread/OpenMP level control.

- **TotalView** is also useful as a multi-purpose SW development and modeling tool beyond debugging:
  - Visualize data structures and model evolution on the fly
  - Modify parameters on the fly and observe resulting changes
Instructional and Research Computing Services (IRCS)

- Next Workshop in two weeks Thursday 05/13 at 1:30PM
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