CS 280 Presentation:

Introduction to TotalView and DDT

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Contents:

1. Why we need parallel debugging – Problems with parallel debugging

Problems with debugging for Parallel programs:
All problems of serial programming
Additional problems
Difficult to verify correctness of program
Difficult to debug N parallel processes
New parallel problems: deadlocks, race conditions, irreproducibility

Parallel Debugging Tools:
TotalView
DDT

2. Introduction to TotalView

What is TotalView?
GUI-based debugging tool
full-featured, source-level, multi-process, multi-thread graphical debugger
Languages supported
C, C++, Fortran 77 & 90, UPC, PGI, HPF, assembler, and mixed codes
Parallel programming models supported

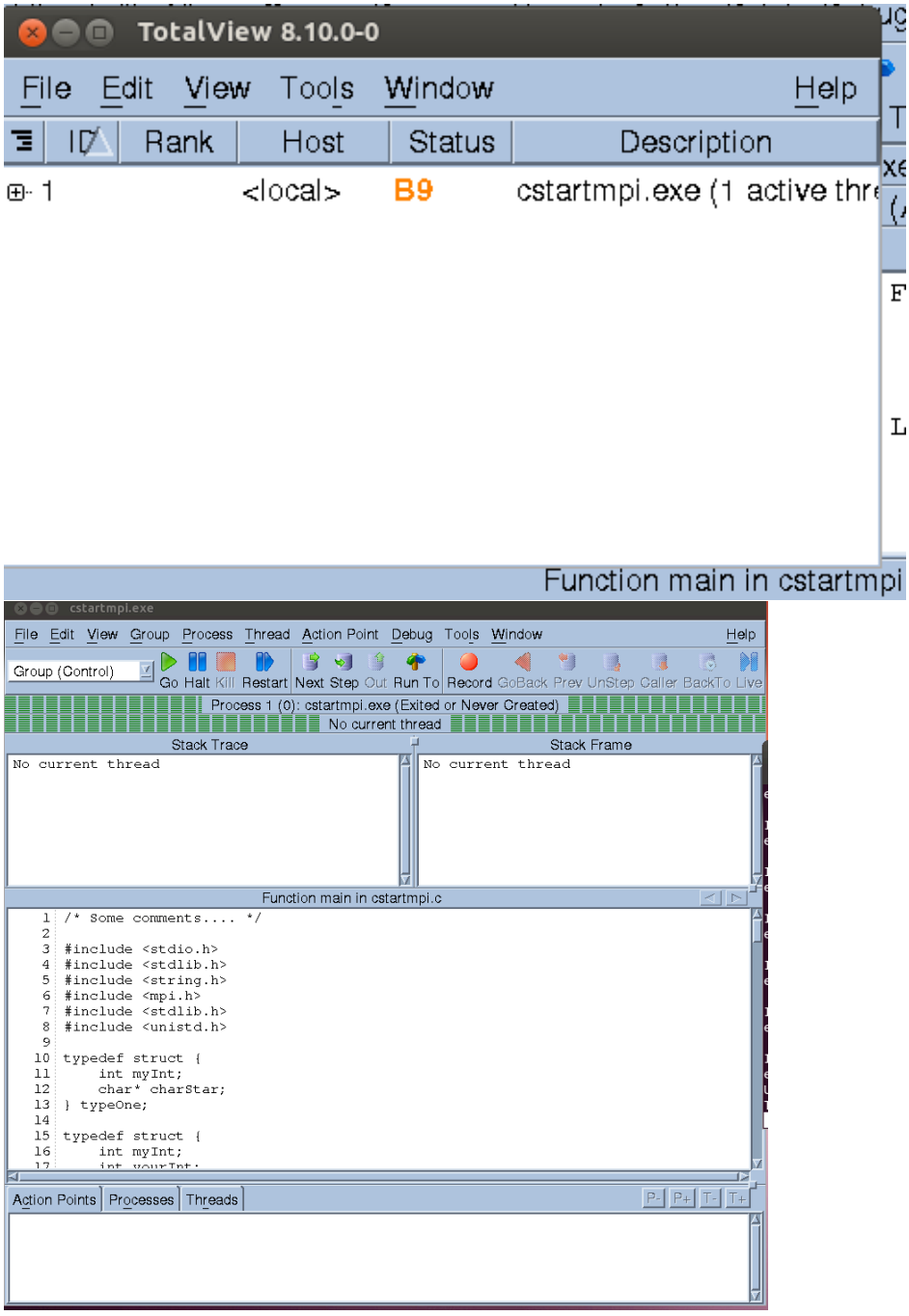
MPI, PVM, OpenMP, pthreads, SHMEM, CUDA GPU, Intel MIC, OpenACC, Intel Xeon Phi processor, and coprocessors

Systems and Platforms supported

Unix, Linux, OS X, Windows

Integrated Memory Debugging

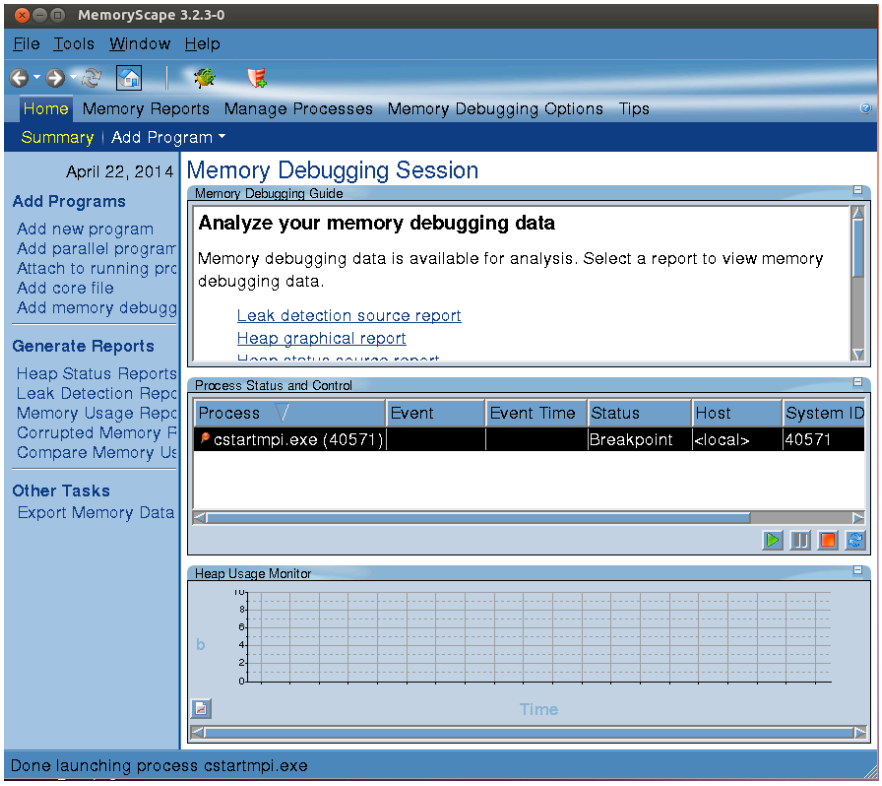
3. Usage of TotalView



```
82      MPI_Status status;  /* Return status for receive */
83
84      t2 = malloc(sizeof(typeThree));
85
86      for(p=0;p<100;p++)
87          bigArray[p]=80000+p;
88
89      MPI_Init(&argc, &argv);
        MPI_Comm_rank(MPI_COMM_WORLD, &my_rank);
STOP    MPI_Comm_size(MPI_COMM_WORLD, &p);
92
93      dynamicArray = malloc(sizeof(int)*100000);
94      sdim = malloc(sizeof(int) * p);
95
96      for(x=0;x<10000;x++)
97      {
```

Action Points | Processes | Threads

```
9  cstartmpi.c#90  main+0xaa
10 cstartmpi.c#91  main+0xbe
```



4. Introduction to DDT

What is DDT?
GUI-based debugging tool
Languages supported
C, C++, Fortran 90
Parallel programming models supported
pthreads, MPI, OpenMP, CUDA GPU, HMPP
Systems and Platforms supported
Unix, Linux, OS X, Windows
Good Visualization

Easy to use, intuitive

Overview

Compile code with -g flag

- On linux systems:

module load ddt

ddt &

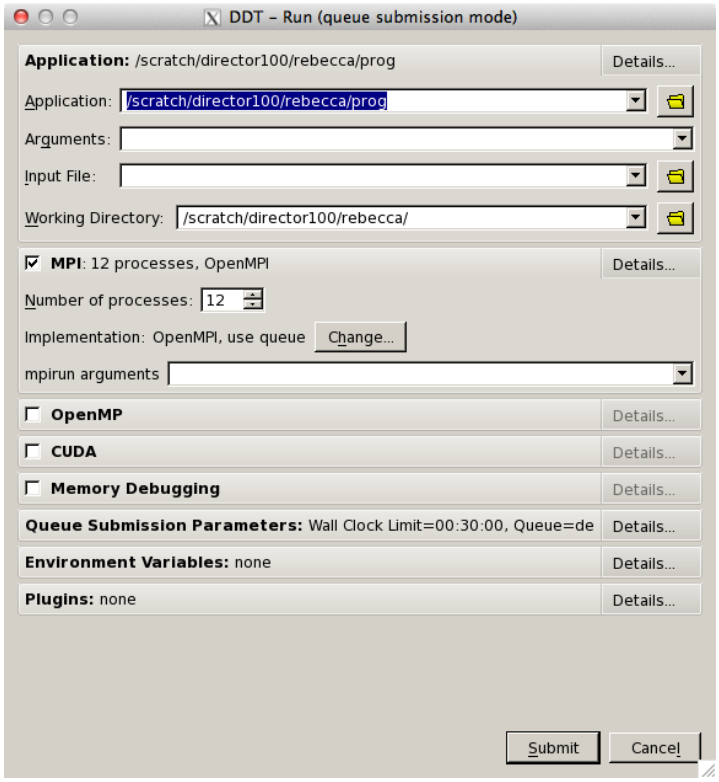
- Launch DDT from scratch directory
- Can run it within interactive job, or have DDT launch job

Running a job

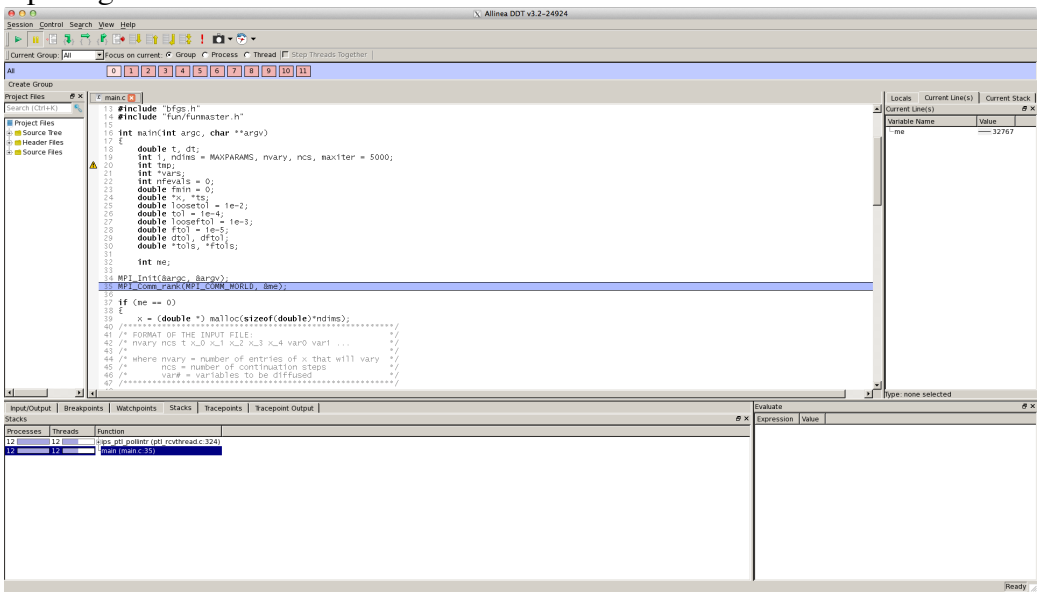
- Enter application

name

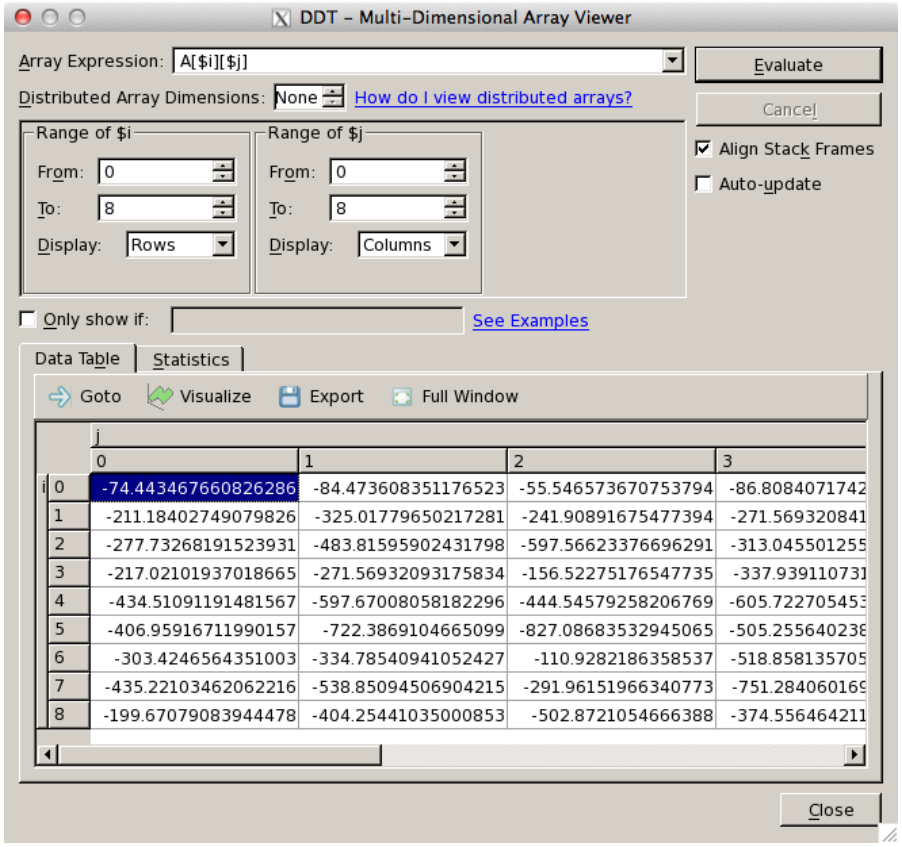
- Can have DDT launch job, or run interactive job
- Set arguments as necessary



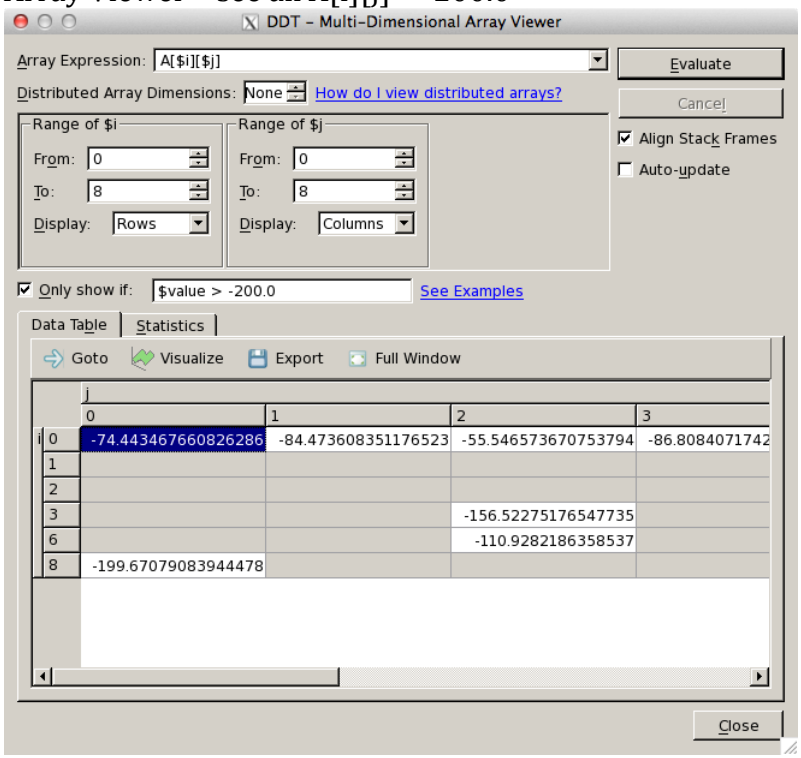
Opening Screen



Array Viewer



Array Viewer – see all A[i][j] > -200.0

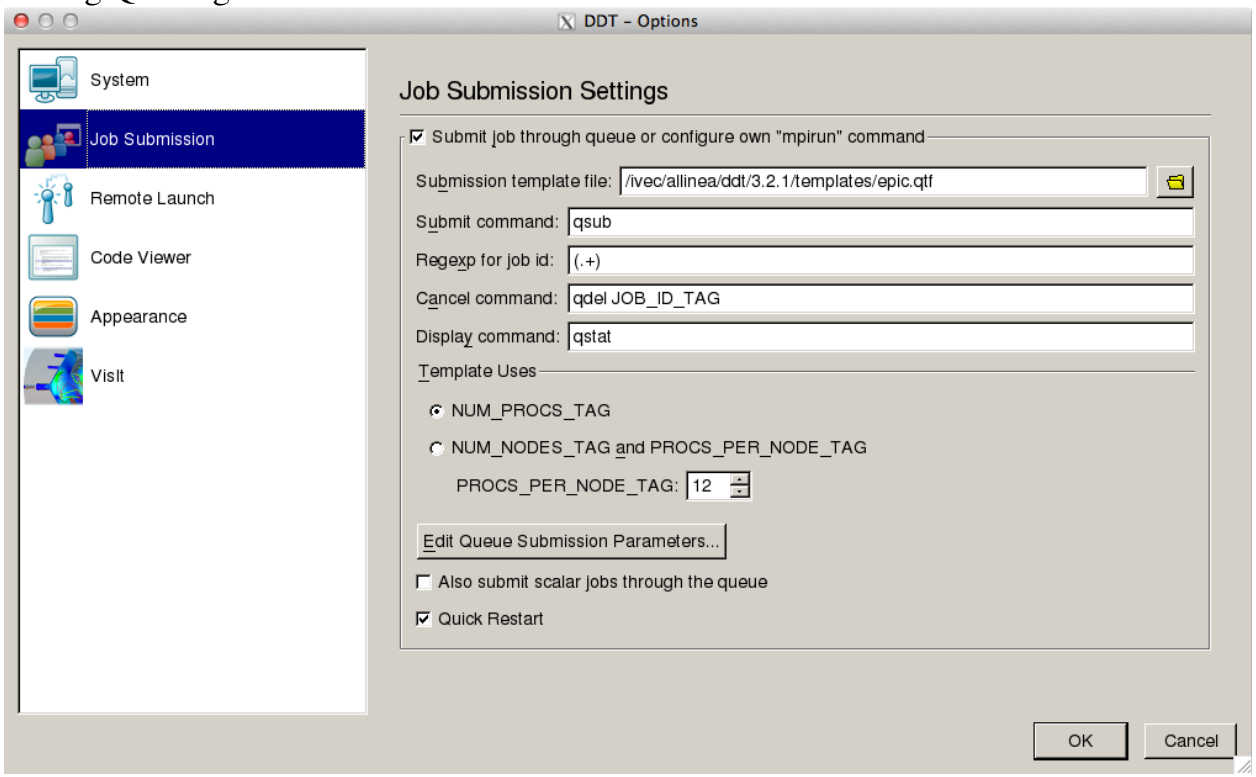


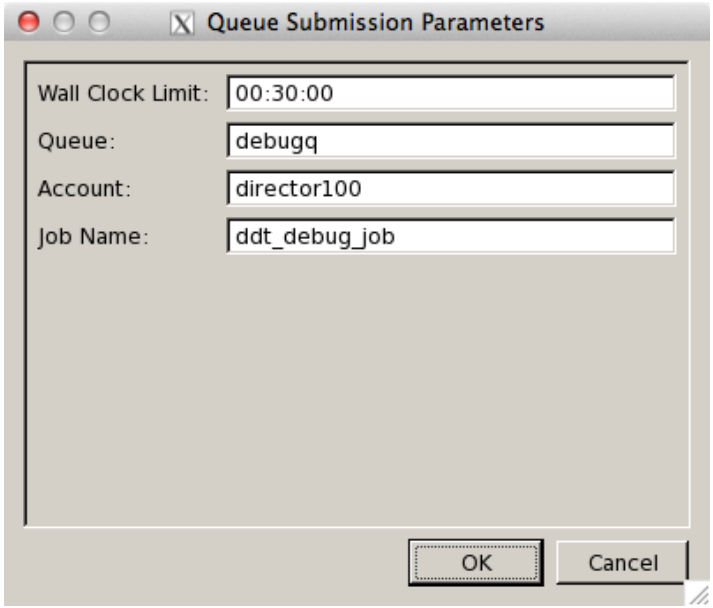
5. Usage of DDT

Using DDT: Step 1 -- Compiling
- Compile your code with the usual compiler and -g flag
- Works better if all optimizations turned off
- For some compilers, debug flag automatically turns off optimizations
- If optimizations are on, line numbers may be misaligned or inexact

Using DDT: Step 2 -- Running
- You must have logged in with flags to allow X-forwarding
- ssh -X user@epic.ivec.org (linux)
- ssh -Y user@epic.ivec.org (mac)
- Verify X-forwarding by invoking xterm & – if a terminal window appears, X-forwarding works (close it and proceed)
- module load ddt"
- DDT can launch parallel interactive jobs for you
- Or, you can launch the interactive job and run DDT inside (I prefer this)

Setting Queuing Parameters





Running from Interactive Job

- qsub -I -V -X -lwalltime=00:30:00 -W group_list=yourgroup -q debugq"
- -I = interactive
- -V = keep environment variables (useful if ddt

module already loaded) • -X = allow X-forwarding

- Once job is running, invoke ddt: ddt &"

Make sure to untick “Submit job through queue”

Using DDT: Step 3 -- Debugging

- Set breakpoints
- Start/Pause/restart
- Look at variables
- Look at state of program on each processor
- Run program until condition occurs (i.e., stop when x=6)

Reference:

http://www.roguewave.com/portals/0/products/totalview-family/totalview/docs/8.12/, TotalView online documentation.