

Debugging on the ALCF Theta and Cooley Systems

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OUTLINE

- Interactive jobs
- Core dumps ATP
- Snapshots STAT
- Starting up DDT / MAP



Interactive jobs for test runs (Theta, Cooley)

- Submit an interactive job to the queue, e.g.
 - qsub –I –t 30 –n 4 –A Comp_Perf_Workshop –q queue_name
- When the job "runs", the nodes are allocated, and you get a prompt from a new shell started on a "MOM" node (Theta) or job head node (Cooley)
 - This shell behaves like the one that executes a Cobalt script job
- Start your compute node run just like you would inside a Cobalt script job.
 - Theta: aprun –N 64 –d 1 –j 1 –cc depth a.out
 - Cooley: mpirun –f \$COBALT_NODE_FILE -n 12 a.out
 - Or just run your Cobalt job script: ./myjobscript.sh
- When you exit the shell, the Cobalt job will exit



Interactive jobs for test runs (Theta, Cooley)

- Note: When the Cobalt job runs out of time, the shell continues running.
 - There is no warning message
 - Telltale sign: aprun will fail
 - Check job status with "qstat \$COBALT_JOBID"
- Note: If you need X11 forwarding from your interactive job to display back to your laptop
 - Connect from your laptop to the login node using ssh -Y
 - Add the following to your ~/.ssh/config on Theta/Cooley (not on your laptop):
 - ForwardX11 yes
 - FowardX11Trusted yes
 - Submit your interactive job



Theta: ATP

ATP = Abnormal Termination Processing

- generates a STAT format merged stack backtrace (file atpMergedBT.dot)
- view the backtrace file with **stat-view** (module load stat)

Link your app with ATP

- Before linking, check that the "atp" module is loaded (module list)
- Cray and Intel compilers will link in ATP automatically

In your job script, set environment before running your app – export ATP_ENABLED=1

– aprun ...

- If your program crashes, ATP will invoke STAT to dump a backtrace file



Example code that fails

```
void branch3(int myrank, int nprocs) {
    if (myrank>0)
        sleep(600);
    else {
        sleep(5);
        abort();
    }
}
void branch2(int myrank,int nprocs) {
```

if (myrank < nprocs/8) branch3(myrank, nprocs); else sleep(600);

```
void branch1(int myrank, int nprocs) {
  if (myrank < nprocs/4)
    branch2(myrank,nprocs);
  else
    sleep(600);
}</pre>
```

int main(int argc, char *argv[]) {
...
if (myrank < nprocs/2)
 branch1(myrank,nprocs);
 else
 sleep(600);</pre>

...



STAT-VIEW

module load stat stat-view atpMergedBT.dot





THETA: STAT snapshot

- While program is running (e.g. deadlocked), you can generate a merged backtrace snapshot showing where your program is.
- Summary: on the MOM node, invoke "stat-cl pid" where pid is the aprun pid
- In an interactive job:

hostname	# identify the MOM node you are on
module unload xalt	# xalt wraps aprun resulting in 2 processes named "aprun"
aprun &	
echo "aprun pid is \$!"	

wait until you think the program is deadlocked module load stat DISPLAY="" stat-cl *pid*

 Snaphot files are placed in the subdirectory stat_results e.g. stat_results/stat-test.0000/



THETA: STAT snapshot (con't)

• Or in your job script:

hostname# identify the MOM node you are onmodule unload xalt# xalt wraps aprun resulting in 2 processes named "aprun"aprun ... &echo "aprun pid is \$!"wait

During the run, ssh to the same MOM node

ps –u *username* # Alternate way to determine pid of aprun module load stat DISPLAY="" stat-cl *pid*

 Snaphot files are placed in the subdirectory stat_results, e.g. stat_results/stat-test.0000/



Allinea DDT and MAP

- Environment
 - Theta: module load forge (/soft/environment/modules/modulefiles)
 - Cooley: Add key +ddt to ~/.soft.cooley (or soft add +ddt)
 - Other modules/keys available for specific versions
- Check version by typing ddt --version
 - ALCF is currently at version 19.1.2 (May 1, 2020)
- Compile with –g –O0
- See also:

https://www.alcf.anl.gov/support-center/theta/arm-ddt-theta



Aside: ssh ControlMaster

- If you enable ssh ControlMaster, you will only need to authenticate your first connection to a remote host.
 - Additional ssh connections to the same host will piggyback
 - Be mindful of what else on your laptop might invoke ssh
- Supported on Linux, Mac. For Windows only >= Windows 10 if enabled (?)
- In your laptop ~/.ssh/config add these lines:
 - ControlMaster auto
 - ControlPath <u>~/.ssh/master-%r@%h:%p</u>
- Note: If you need X11 forwarding (i.e. ssh -Y) then you must start the first ssh connection using -Y and also include -Y on any secondary ssh connections you make that need the forwarding.



Allinea DDT startup (likewise for MAP)

- Option 1: Run using remote client (RECOMMENDED)
 - For Mac or Windows, download and install "Remote client"
 - <u>https://developer.arm.com/tools-and-software/server-and-hpc/downloads/arm-forge</u>
 - For Linux download full version of Forge (no license required for use as remote client)
 - Note version must match between remote client and target machine
 - N.B. Remote Client downloads for older versions of Arm Forge
- Option 2: Run client on login node (Not recommended)
 - Start X11 server on your laptop and ssh –Y to login node
 - module load forge
 - ddt &



DDT Remote Client (1)

GUI looks just like the X11 Client



1/

DDT Remote Client (2,3)

Select "configure", then in dialog box "Add" to set up a new connection





DDT Remote Client (4)

Note: this remote installation directory is the system default version of DDT, corresponding to *module load forge*. Click "Test Remote Launch" to verify, then OK.

	Remote Launch Settings	
Connection Nar	e: user_name@theta.alcf.anl.gov	
Host Nar	ne: user_name@theta.alcf.anl.gov	
	How do I connect via a gateway (multi-hop)?	
Remote Installation Directo	ry: /soft/debuggers/ddt	
Remote Sc	ipt Optional	
	Always look for source files locally	
KeepAlive Packe	ts: Enable	
Interv	al: 30 seconds	Ĵ
	Proxy through login node	
		Test Remote Launch
Help		OK Cancel



DDT Remote Client (5)

Now that it is defined, select remote machine





DDT Remote Client (6)

Connected (note License info in lower left corner) From this point, remote GUI works same as local





DDT Startup - Reverse Connect

- Start remote client and connect to login node (or start client on login node displaying back via X11). Let this window sit for now.
- In an ssh session to the login node
 - Run an interactive job (qsub -I)
 - Theta: Instead of aprun ... myprog.exe
 - ddt --connect aprun ... myprog.exe
 - Cooley: Instead of mpirun –f \$COBALT_NODE_FILE -n 12 a.out
 - ddt --connect --n 12 --mpiargs "-f \$COBALT_NODEFILE" a.out
- Handy tip: edit your job script then run it from the interactive command line
- Likewise with Allinea MAP
 - Theta: map --connect aprun ... myprog.exe



DDT Reverse Connect (1)

When *ddt* --connect starts, a reverse connect request will appear. Click Accept.

	🕮 Arm DDT - Arm Forge 19.1.2
arm FORGE	A new Reverse Connect request is available from thetamom3 for Arm DDT. Command Line:connect aprun -n 8 -N 8 -d 1 -j 1 -cc depth /stat-test Do you want to accept this request? Help Accept Reject
arm DDT	Attach to an aready running program. OPEN CORE Open a corre file from a previous run. MANUAL LAUNCH (ADVANCED) Manually launch the backend yourself.
arm MAP	ортомs Remote Launch: theta.alcf.anl.gov
Support Tutorials arm.com Licence Serial: 9814 ?	

DDT Reverse Connect (2)

The connection will take a few seconds to establish.





DDT Reverse Connect (3)

Briefly it will display (via tunnel)



DDT Reverse Connect (4)

The Remote client is now connected to DDT running on the remote host. Make selections as desired then click *Run*.

arm	Run: aprun -n 8 -N 8 -d 1 -j 1 -cc depth ./stat-test	Details
FORGE	Command: aprun -n 8 -N 8 -d 1 -j 1 -cc depth ./stat-test	
TOROL	OpenMP	Details
		Details
017100	Memory Debugging Your current licence does not include CUDA support.	Details
arm	Plugins: none	Details
arm		
arm MAP	Help Options Run	Disconnect //
arm MAP	Remote Launch Help Options Run	Disconnect
arm MAP	Help Options Run	Disconnect Ir.
CIP MAP	Help Options Run	Disconnect
Comport Support Tutorials arm.com	Help Options Run	Disconnect



DDT Reverse Connect (5)

DDT on the remote host will now execute the aprun command and attach to it.

				Arm DDT	- Arm Forge	19.1.2				
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Current Group:		Focus on	current: 💿 Gr	oup 🔿 Proce	ess 🔵 Thre	ad 🗌 Ste	p Threads 1	Together	69	
Create Group										
Proje	ect Files	08						Locals	Current Line(s)	Current Stack
Search (%K)		Q							Current Line(s)	0 8
		arm	Connecting to	aprun -n 8 -	N 8 -d 1 -i 1	-cc depth	/stat-test			
Input/ B	Processes cor Processes rea	nnected:						(Cancel Output >>	0 8
Processes F	unction									



DDT Reverse Connect (6)

Progress of connecting to MPI processes.

				arm PORGE	Arm DDT - /	Arm Forge 19	.1.2				
	•		r) 🛛	•	t 🤳	\$!					
Current Group:		Focus	s on curre	nt: 💿 Group	Proces	s 🔿 Thread	Step	Threads To	ogether	€ €	
Create Group											
Proje	ect Files	08							Locals	Current Line(s)	Current Stack
Search (#K)		Q								Current Line(s)	0 8
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	Mailing for a		4. h								
	waiting for a	II processes	to be read	ıy							
	Processes of	onnected:	8/8							Cancel	
Input/ B	r Processes re	eady:	0/8							Output >>	0 8
Processes FL	unction 🔺									_	
						Arm Forge	19.1.2 Cor	nected to:	(via tunn	el) thetalogin6:4201	-> thetamom3

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DDT Reverse Connect (7)

Ready to debug!

•••				🎎 Arm DDT - A	rm Forge 19.1	1.2			
► II • 🗄	$\langle \mathbf{I} \rangle = \langle \mathbf{I} \rangle$	- (P) - [•		* !				
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All Create Group	0 1	2 3	4 5	6 7					
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Search (%K)	_	26 27	int r	et;				Current Line(s)	0 8
		29 30 31 32 33 34 35	ret = if(re { }	<pre>real PMPI Init t != MPI_SUCCESS) return (ret);</pre>	(argc, argv);		► argc ► argv		0x7fffffff 0x7ffffffff
Input/ Break	Watch	Stacks	Trace	Tracepoint	Logbook		Eva	luate	0 8
Processes Function	A					realine	Value		

Questions

See also

-<u>https://www.alcf.anl.gov/support-center</u>

-Email: support@alcf.anl.gov



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