LearnIT Express is on its way!

- The demonstration will start at 12:30 pm.
- To use the Live Chat:
  - Maximize your browser window so you can see the postings.
  - If you refresh the browser page, you'll need to log in again.
  - After the demonstration, staff will remain available in the chat for a few minutes to answer additional questions.

Today's topic: Mills HPC Cluster
LearnIT Express: Increase Matlab Throughput
Matlab and Threads

- Many Matlab native functions use a math multi-threaded library. This is called *implicit multiprocessing*.

- You can define workers to do *explicit multiprocessing* with the Matlab parallel toolbox.
Grid Engine and Threads

- Increase throughput of your jobs by telling Grid Engine the number of threads you will be using.

- `qlogin` now allows the thread parallel environment for interactive jobs.

  `qlogin -pe threads NSLOTS`
Threads and Cores

Goal: keep one thread per core

- Matlab does this, but it doesn't consider other jobs competing for the same cores.
- Use Grid Engine to reserve slots, so Matlab can utilized the cores effectively.
Reserving Slots

**qstatgrp**

<table>
<thead>
<tr>
<th>CLUSTER QUEUE</th>
<th>CQLOAD</th>
<th>USED</th>
<th>RES</th>
<th>AVAIL</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>it_css-dev.q</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>it_css-qrsh.q</td>
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<td>0</td>
<td>72</td>
<td>72</td>
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<tr>
<td>it_css.q</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>it_css.q+</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>72</td>
<td>72</td>
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</tbody>
</table>

**qlogin -pe threads 10**

<table>
<thead>
<tr>
<th>CLUSTER QUEUE</th>
<th>CQLOAD</th>
<th>USED</th>
<th>RES</th>
<th>AVAIL</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>it_css-dev.q</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>it_css-qrsh.q</td>
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<td>10*</td>
<td>0</td>
<td>62*</td>
<td>72</td>
</tr>
<tr>
<td>it_css.q</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>72</td>
<td>72</td>
</tr>
<tr>
<td>it_css.q+</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
<td>72</td>
<td>72</td>
</tr>
</tbody>
</table>

* 10 slots were moved from AVAIL to USED columns
Workers and Slots

matlabpool function will start Matlab workers that are scheduled by a local scheduler (12 for the parallel toolbox scheduler).

To make this work well with the Grid Engine Scheduler use:

    -pe threads 12

with qlogin, qsub or in the script file.
Implicit Threads and Slots

Matlab native functions use threads implicitly, but we can estimate the number of slots by timing a test run.

```
real    2m30.213s
user    25m51.183s
sys     0m1.544s
```

\[
\text{user/real} = \frac{1551.18}{150.21} = 10.32
\]

-\`pe threads 11\`
Matlab tic/toc commands

To measure the elapsed time inside a matlab function use the `tic` and `toc` commands.

Elapsed time is 3.276713 seconds.

Compare the times:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>real</td>
<td>0m5.776s</td>
</tr>
<tr>
<td>user</td>
<td>0m33.303s</td>
</tr>
<tr>
<td>sys</td>
<td>0m0.220s</td>
</tr>
</tbody>
</table>

Fraction of time between tic/toc 3.28/5.78
Summary

- Know your task and the number of cores you will need.
- Tell Grid engine by specifying a threads parallel environment.
- You and your cluster group can do many tasks on your nodes.
Demonstration Ainvb

The Matlab function Ainvb.m is in my matlab directory on lustre file system.

cd $MYWORKDIR/matlab
qlogin -pe threads 12

On the compute node:

vpkg_require matlab
matlab & top
Timing results

matlab
1200% cpu for 16.02 seconds

matlab -singleCompThread
100% cpu for 145.68 seconds
More information

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  http://www.it.udel.edu/research-computing

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Contact the IT Support Center

- **Email**: consult@udel.edu
  If you make the first line of the e-mail message
  Type=Cluster-Mills
  your question will be routed more quickly.

- **Phone**: (302) 831-6000

- **Text**: (302) 722-6820