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: Matlab Parallel Computing Toolbox
Objectives

- Introduce the new Matlab 2012a
  - vpkg_require matlab/r2012a

- Demonstrate Parallel Computing Toolbox
  - matlabpool
  - parfor
Matlab Parallel Computing Toolbox (PCTB)

The `matlabpool open/close` commands control MATLAB workers from a "lab pool" to work on your data-intensive problems.

Other PCTB commands:

- **parfor** - Loops for pleasingly parallel loops, such as parameter sweeps.
- **spmd** - Single program multi-data, not useful on Mills.
- **batch** - Submit a script from MATLAB, not useful on Mills.
Live demo

1. **m files**: Matlab (*.m) code:
   a. `maxEig.m`
   b. `example1_serial.m`
   c. `example1_parallel.m`

2. **commands from the head node**:
   a. `cd`
   b. `qlogin`

3. **commands from the compute node**:
   a. `vpkg_require`
   b. `matlab`
qlogin and pe threads

For this demo we always use:

```
qlogin -pe threads 12
```

Reasons:

1. `matlabpool` defaults to 12 on Mills.
2. Native threads are observed to peak at 1200% CPU usage.
3. Worker CPU usage peaks at 100%.
Command line MATLAB

```matlab
cd matlabdir
qulogin -pe threads 12

vpkg_require matlab/r2012a
matlab -nodesktop -nosplash
tic; maxEig(100); toc
tic; example1_serial(25); toc
tic; example1_parallel(25); toc
```

Change to the directory with `maxEig`. Must use `qlogin` to get on a compute node to use Matlab. PCTB uses Java (don't use `-nojvm`)
Change to the directory with \texttt{maxEig}. Must use \texttt{qlogin} to get on a compute node to use Matlab. Type \texttt{maxEig(100)} in the command window.
function maxe = maxEig(lam)
if (isdeployed)
    lam=str2num(lam);
end

dim=2000;
M=rand(dim);            %Full matrix
D=diag(rand(dim,1));    %Diag matrix

maxe = max(eig( M + lam*D ))
end

Return maximum eigenvalue of 2000x2000 random matrix.
function a = example1_serial(N)
a = zeros(N,1);

for I = 1:N
    a(I) = maxEig(I-1);
end

plot(a)
end

Call maxEig N times with a parameter sweep.
Matlab file: `example1_parallel.m`

```matlab
function a = example1_parallel(N)
a = zeros(N,1);
matlabpool open
parfor I = 1:N
    a(I) = maxEig(I-1);
end
matlabpool close
plot(a)
end
```

Call `maxEig` N times with a parameter sweep.
Comparison Table

<table>
<thead>
<tr>
<th>200 tasks array job MRC</th>
<th>25 tasks single MATLAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comp threads 800 secs</td>
<td>Serial 200 secs</td>
</tr>
<tr>
<td>Single thread 180 secs</td>
<td>PCTB 50 secs</td>
</tr>
</tbody>
</table>
Summary

- MATLAB parfor loops can speed up parameter sweep projects by 12 times.
  
  qlogin -pe threads 12
  vpkg_require matlab/r2012a

- Other usages of MATLAB such as distributing to multiple nodes and batch submissions, are not useful on Mills.
More information

- IT 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
  
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