OPEN MP and MPI on Kingspeak chpc cluster

Command to compile the code with openmp and mpi

/uufs/kingspeak.peaks/sys/pkg/openmpi/std_intel/bin/mpicc -o hem hemhotlz.c -I /uufs/kingspeak.peaks/sys/pkg/openmpi/std_intel/include -L/uufs/kingspeak.peaks/sys/pkg/openmpi/std_intel/lib -fopenmp -L/uufs/kingspeak.peaks/sys/pkg/openmpi/1.6.5/include

Where hem is the executable file of hemhotlz.c program

Command and script to run the code

PBS script

```
#PBS -S /bin/bash

#kingspeak has 16 core nodes (2 sockets, 8 cores each), so, you have to ask

#PBS -l nodes=2:ppn=16,walltime=00:05:00

#PBS -M u0877805@utah.edu

#PBS -N myjob

#PBS -A CS6230

# # Create scratch directory

# mkdir -p /scratch/kingspeak/serial/$USER/$PBS_JOBID

#  # Go to the scratch directory

#  cd /scratch/kingspeak/serial/$USER/$PBS_JOBID

#   # Copy data files to the scratch directory

#   cp $HOME/hem .

#Then, you have to massage the host file to only include number of lines that's equal to number of MPI processes you want to run. Also, on node with 2 sockets 8 cores each I'd run 2 MPI processes

cat $PBS_NODEFILE | uniq > nodefile1

cat nodefile1 nodefile1 | sort > nodefile

#    # Execute the parallel job using OpenMPIsource /uufs/kingspeak.peaks/sys/pkg/openmpi/std_intel/etc/openmpi.sh

mpirun -np 1 -machinefile nodefile -bysocket -bind-to-socket -x OMP_NUM_THREADS=8 ./hem >> output_kingspeak
```

Code to be modified in the Hemholtz c program to see the number of threads

Modify the hemholtz.c to see the number of open mp threads,in the current program omp_get_num_threads() will return 1 as it is not in parallel code

```
#ifdef _OPENMP
  #pragma omp parallel
  {
    int nthreads = omp_get_num_threads();

   fprintf(stdout,"Called % d  thread(s)\n",myproc,nproc,ii,nthreads);
  }
#else
  nthreads = 1;
#endif
```

```
//output of the program for m=5 and n=5 ,proc=2 ,threads=8

//15 iterations

HELMHOLTZ
  C version

  A program which solves the 2D Helmholtz equation.

  This program includes Open MP directives, so that
  it can be run sequentially, or in parallel.

  This program is being run in parallel.

  The number of processors available:
  OMP_GET_NUM_PROCS () = 16

  The number of threads available:
  OMP_GET_NUM_THREADS () = 1
Called 8 thread(s)
Called 8 thread(s)
Called 8 thread(s)
Called 8 thread(s)
Called 8 thread(s)
Called 8 thread(s)
Called 8 thread(s)
Called 8 thread(s)

  The region is [-1,1] x [-1,1].
  The number of nodes in the X direction is M = 5
```

```
 The number of nodes in the Y direction is N = 5
 Number of variables in linear system M * N  = 25
 The scalar coefficient in the Helmholtz equation is ALPHA = 0.250000
 The relaxation value is OMEGA = 1.100000
 The error tolerance is TOL = 0.000100
 The maximum number of Jacobi iterations is IT_MAX = 20

 Right hand side l2 norm = 10.578621
   1  Residual RMS 0.026040
   2  Residual RMS 0.017182
   3  Residual RMS 0.011438
   4  Residual RMS 0.007616
   5  Residual RMS 0.005072
   6  Residual RMS 0.003377
   7  Residual RMS 0.002249
   8  Residual RMS 0.001498
   9  Residual RMS 0.000998
  10  Residual RMS 0.000665
  11  Residual RMS 0.000443
  12  Residual RMS 0.000295
  13  Residual RMS 0.000197
  14  Residual RMS 0.000132
  15  Residual RMS 0.000088

 Total number of iterations 15

 Computed U l2 norm :       2.120244
 Computed U_EXACT l2 norm : 2.125000
 Error l2 norm:             0.004765

HELMHOLTZ
 Normal end of execution.

16 April 2014 01:25:17 PM


//output for m=15 n=15 proc=2 threads=8

//21 iterations

16 April 2014 01:46:06 PM

HELMHOLTZ
 C version

 A program which solves the 2D Helmholtz equation.

 This program includes Open MP directives, so that
 it can be run sequentially, or in parallel.
```

```
 This program is being run in parallel.

 The number of processors available:
 OMP_GET_NUM_PROCS () = 16

 The number of threads available:
 OMP_GET_NUM_THREADS () = 1
Called 8 thread(s)
Called 8 thread(s)
Called 8 thread(s)
Called 8 thread(s)
Called 8 thread(s)
Called 8 thread(s)
Called 8 thread(s)
Called 8 thread(s)

 The region is [-1,1] x [-1,1].
 The number of nodes in the X direction is M = 15
 The number of nodes in the Y direction is N = 15
 Number of variables in linear system M * N  = 225
 The scalar coefficient in the Helmholtz equation is ALPHA = 0.250000
 The relaxation value is OMEGA = 1.100000
 The error tolerance is TOL = 0.000100
 The maximum number of Jacobi iterations is IT_MAX = 20

 Right hand side l2 norm = 40.105565
   1  Residual RMS 0.000908
   2  Residual RMS 0.000870
   3  Residual RMS 0.000839
   4  Residual RMS 0.000811
   5  Residual RMS 0.000785
   6  Residual RMS 0.000760
   7  Residual RMS 0.000737
   8  Residual RMS 0.000714
   9  Residual RMS 0.000693
  10  Residual RMS 0.000672
  11  Residual RMS 0.000652
  12  Residual RMS 0.000633
  13  Residual RMS 0.000614
  14  Residual RMS 0.000596
  15  Residual RMS 0.000579
  16  Residual RMS 0.000562
  17  Residual RMS 0.000545
  18  Residual RMS 0.000530
  19  Residual RMS 0.000514
  20  Residual RMS 0.000499
```

Total number of iterations 21

Computed U l2 norm : 3.333961
Computed U_EXACT l2 norm : 7.466472
Error l2 norm: 4.143507

HELMHOLTZ
Normal end of execution.

16 April 2014 01:46:06 PM