Benchmarks

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Abstract

In this exercise we want to investigate the sustained performance of one node of the Ulysses cluster using HPL, an implementation of the LINPACK benchmark. In addition, comparison is made with the Intel benchmark provided by the MKL library.

1 Introduction

The peak performance of a computing machine is its maximum theoretical performance achievable. It is a measure of the maximum number of floating points operations per second (FLOPS), based on the hardware specification of the machine. FLOPS are calculated in the following way:

$$FLOPS = cpuFrequency \times numberCores \times numberNodes \times numberFPcycle$$

Therefore, since the analysis is performed on one single node of 20 cores, each of them able to perform 8 floating points operations per cycle at an average frequency of 2.8 GHz, then the number of GFLOPS is 448. This value will be taken as the peak performance reference.

2 HPL benchmark

The HPL benchmark is a portable implementation of Linpack created by the Innovative Computing Laboratory of the Tennesee University. Using the steps provided in the assignment we compiled the source code and obtained the ex- ecutable xhpl and its configuration file HPL.dat. The important variables to change while tweaking this file are:

- problem size N;
- block size NB;
- process grids variables P and Q. The product p*q must be equal to the number of processors used for the computation, In this case 20.

  Following table shows the values used in HPL.dat

```
HPLinpack benchmark input file
Innovative Computing Laboratory, University of Tennessee
HPL.out        output file name (if any)
6              device out (6=stdout,7=stderr,file)
1              # of problems sizes (N)
64512          Ns
1              # of NBs
256            NBs
0              PMAP process mapping (0=Row-,1=Column-major)
1              # of process grids (P x Q)
4              Ps
5              Qs
16.0           threshold
1              # of panel fact
2              PFACTs (0=left, 1=Crout, 2=Right)
1              # of recursive stopping criterium
4              NBMINs (>= 1)
1              # of panels in recursion
2              NDIV
1              # of recursive panel fact.
1              RFACTs (0=left, 1=Crout, 2=Right)
1              # of broadcast
1              BCASTs (0=1rg,1=1rM,2=2rg,3=2rM,4=Lng,5=LnM)
1              # of lookahead depth
1              DEPTHs (>=0)
2              SWAP (0=bin-exch,1=long,2=mix)
64             swapping threshold
0              L1 in (0=transposed,1=no-transposed) form
0              U  in (0=transposed,1=no-transposed) form
1              Equilibration (0=no,1=yes)
8              memory alignment in double (> 0)
```

The following is the output of HPL benchmark. The result is 418.1 Gflops that is about the 92.8% of the theoretical peak performance.

T/V	N	NB	P	Q	Time	Gflops
WR11C2R4	64512	256	4	5	428.08	4.181e+02

3 Intel Linpack

We ran another similar benchmark, but this time it's provided directly by Intel and it's very well optimized for intel architectures. As espected the performance of the node are much better in computing this benchmark. Also in this case we had to tune the dimension of the matrix and we kept one that was already in the input file. The output is the following:

```
Performance Summary (GFlops)

Size        LDA      Align.    Average       Maximal
45000     45000     4          422.466        423.7005

Residual checks PASSED

End of tests
```

4 Processors and Threads

In this last part we want to test the the performance of the nodes processor changing the number of threads. Theoretically we had to change the environment variable OMP NUM THREADS and the -np flag. We didn't succeed to do so, in fact the performance obtained where exactly the same of the one obtained changing only the number of processes

Threads	processes	Gflops
1	20	2.404e+01
2	10	5.201e+01
5	4	1.535e+02
10	2	2.391e+02
20	1	4.226e+02