实验四 HPL安装和测试

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实验4-1 HPL的安装和使用

1. 实验目的

使学生掌握HPL的安装及运行。

2. 主要软件包

1) hpl-2.1.tar.gz
2) GotoBLAS2-1.13.tar.gz
3) openmpi-1.6.5.tar.gz

3. 实验内容

3.1 HPL的安装

HPL安装步骤：

(1)安装gotoblas

a. 在 `usr/local/mathlib/goto` 下解压：

```
$ tar -zxvf GotoBLAS2-1.13.tar.gz
```

```
$ cd GotoBLAS2
```

```
$ make   (TARGET=NEHALEM)
```

(2)安装openmpi（实验三内容）

(3)安装HPL

a. 下载hpl-2.1.tar.gz (网址：http://www.netlib.org/benchmark/hpl/hpl-2.1.tar.gz)

b. 在用户目录下解压：

`$ tar –zxvf  hpl-2.1.tar.gz`

`$ cd hpl-2.1`

c. 根据机器的情况复制Makefile模板：

`$ cp setup/Make.Linux_PII_CBLAS Make.Linux`

`$ vi Make.Linux`

d. 如下根据具体情况修改 `Make.Linux`

```
ARCH = Linux

TOPdir = /home/用户目录 / hpl-2.1

MPdir = /home/用户目录/openmpi安装目录/ openmpi-1.6.5

MPinc = $(MPdir)/include

MPlib = -L$(MPdir)/lib

LAdir = usr/local/mathlib/goto/GotoBLAS2的安装目录

LAlib = $(LAdir)/ libgoto2_nehalemp-r1.13.a

HPL_INCLUDES = -I$(INCdir) -I$(INCdir)/$(ARCH) -I$(LAinc) -I$(MPinc)

CC = /home/用户目录/openmpi的安装目录/bin/mpicc

CCNOOPT = $(HPL_DEFS)

CCFLAGS = $(HPL_DEFS) -fomit-frame-pointer -O3 -funroll-loops

LINKER = 同CC

LINKFLAGS =同CCFLAGS
```

编译

a. 在HPL安装目录下运行

```
$ make arch=Linux
```

3.2 HPL的运行

HPL运行的实验步骤：

(1)进入 ～/安装hpl的目录/bin/Linux目录

```
$ cd /home/用户目录/hpl安装目录/bin/Linux
```

(2)准备节点文件

```
$ vi nodes
```

(3)修改 HPL.dat，设置运算规模和进程数等

```
$ vi HPL.dat
```

(4)运行

```
$ mpirun –np 4 –machinefile nodes xhpl
```

运行结果如下：

```
[root@master hpl-2.1]# cd bin/Linux
[root@master Linux]# mpirun -np 4 -machinefile nodes ./xhpl
```

```
HPLinpack 2.1  --  High-Performance Linpack benchmark  --   October 26, 2012
Written by A. Petitet and R. Clint Whaley,  Innovative Computing Laboratory, UTK
Modified by Piotr Luszczek, Innovative Computing Laboratory, UTK
Modified by Julien Langou, University of Colorado Denver
```

```
An explanation of the input/output parameters follows:
T/V    : Wall time / encoded variant.
N      : The order of the coefficient matrix A.
NB     : The partitioning blocking factor.
P      : The number of process rows.
Q      : The number of process columns.
Time   : Time in seconds to solve the linear system.
Gflops : Rate of execution for solving the linear system.

The following parameter values will be used:

N      :    1960     2048
NB     :      60       80
PMAP   : Row-major process mapping
P      :       2        4
Q      :       2        1
PFACT  :   Crout
NBMIN  :       4
NDIV   :       2
RFACT  :   Right
BCAST  :  2ringM
DEPTH  :       1
SWAP   : Mix (threshold = 64)
L1     : transposed form
U      : transposed form
EQUIL  : yes
```

```
- The following scaled residual check will be computed:
      ||Ax-b||_oo / ( eps * ( || x ||_oo * || A ||_oo + || b ||_oo ) * N )
- The relative machine precision (eps) is taken to be            1.110223e-16
- Computational tests pass if scaled residuals are less than                16.0

================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR13R2C4        1960    60     2     2               2.88              1.742e+00
HPL_pdgesv() start time Fri May 24 21:58:55 2019

HPL_pdgesv() end time   Fri May 24 21:58:58 2019

--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N)=        0.0052654 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR13R2C4        1960    80     2     2               2.46              2.044e+00
HPL_pdgesv() start time Fri May 24 21:58:59 2019

HPL_pdgesv() end time   Fri May 24 21:59:01 2019

--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N)=        0.0057346 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR13R2C4        2048    80     2     2               1.59              3.604e+00
HPL_pdgesv() start time Fri May 24 21:59:01 2019

HPL_pdgesv() end time   Fri May 24 21:59:03 2019

--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N)=        0.0054049 ...... PASSED
================================================================================
```

```
--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N)=        0.0054049 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR13R2C4        2048    80     2     2               1.97              2.911e+00
HPL_pdgesv() start time Fri May 24 21:59:03 2019

HPL_pdgesv() end time   Fri May 24 21:59:05 2019

--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N)=        0.0063789 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR13R2C4        1960    60     4     1               4.27              1.170e+00
HPL_pdgesv() start time Fri May 24 21:59:05 2019

HPL_pdgesv() end time   Fri May 24 21:59:10 2019

--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N)=        0.0065418 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR13R2C4        1960    80     4     1               6.07              8.284e-01
HPL_pdgesv() start time Fri May 24 21:59:10 2019

HPL_pdgesv() end time   Fri May 24 21:59:16 2019

--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N)=        0.0061374 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR13R2C4        2048    60     4     1               7.05              8.128e-01
HPL_pdgesv() end time   Fri May 24 21:59:16 2019

--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N)=        0.0061374 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR13R2C4        2048    60     4     1               7.05              8.128e-01
HPL_pdgesv() start time Fri May 24 21:59:16 2019

HPL_pdgesv() end time   Fri May 24 21:59:23 2019

--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N)=        0.0070322 ...... PASSED
================================================================================
T/V                N    NB     P     Q               Time                 Gflops
--------------------------------------------------------------------------------
WR13R2C4        2048    80     4     1               3.93              1.457e+00
HPL_pdgesv() start time Fri May 24 21:59:24 2019

HPL_pdgesv() end time   Fri May 24 21:59:28 2019

--------------------------------------------------------------------------------
||Ax-b||_oo/(eps*(||A||_oo*||x||_oo+||b||_oo)*N)=        0.0067972 ...... PASSED
================================================================================

Finished      8 tests with the following results:
              8 tests completed and passed residual checks,
              0 tests completed and failed residual checks,
              0 tests skipped because of illegal input values.
--------------------------------------------------------------------------------

End of Tests.
================================================================================
```

实验4-2 集群系统性能测试

1. 实验步骤

1.1 计算计算机峰值速度

CPU主频：查看 `/proc/cpuinfo` 文件，将看见cpu的详细信息，其中 cpu MHz是主频值

网上查找资料计算峰值速度

理论浮点峰值＝CPU主频×CPU每个时钟周期执行浮点运算的次数×系统中CPU数
=2400MHz×4×1=9.6GMlops

1.2 性能测试

使用gcc编译器的情况下测试，并将最佳测试结果填写下面表格

进程个数	4	5	6	7
峰值速度	38.4	48	57.6	67.2
HPL测试	12.67	5.38	4.556	3.22
效率	32.99%	11.21%	7.91%	4.79%

CPU个数	N	NB	P	Q	Time	Gflops	参与运算主机名
1	2048	60	2	2	0.42	13.45	Master
2	2048	80	2	2	0.65	9.3	Master/slave1
3	2048	80	2	2	1.65	3.5	Master/slave1/slave2