

高性能计算实验报告

实验7：MPI并行编程

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一、运行结果截图

2*2矩阵

```
supersonic@supersonic-VirtualBox:~/hpc_practice/lab7-mpi$ mpicc -o mpi-dgemm mpi-dgemm.c
supersonic@supersonic-VirtualBox:~/hpc_practice/lab7-mpi$ mpirun -np 1 ./mpi-dgemm
Matrix A:
Matrix A:
-1.000000e+00 -9.167380e-01
-9.980292e-01 -6.467147e-01

Matrix B:
Matrix B:
-2.707955e-01 -8.154047e-01
-8.173388e-01 -2.556555e-02

Matrix C (Result of A * B):
Matrix C:
1.020081e+00 8.388416e-01
7.988468e-01 8.303313e-01
```

4*4矩阵

```
supersonic@supersonic-VirtualBox:~/hpc_practice/lab7-mpi$ mpicc -o mpi-dgemm mpi-dgemm.c
supersonic@supersonic-VirtualBox:~/hpc_practice/lab7-mpi$ mpirun -np 1 ./mpi-dgemm
Matrix A:
Matrix A:
-1.000000e+00 -2.707955e-01 5.350056e-02 8.634630e-01
-9.980292e-01 -8.173388e-01 -9.113315e-02 1.361192e-01
-9.167380e-01 -8.154047e-01 -5.336431e-01 1.121887e-01
-6.467147e-01 -2.556555e-02 6.625836e-01 -8.983362e-01

Matrix B:
Matrix B:
5.341023e-01 7.519617e-01 6.208589e-01 -8.464509e-01
-9.621704e-01 6.311373e-02 -6.231595e-01 6.305478e-01
-4.952805e-01 8.405219e-01 7.726289e-01 9.697820e-01
-4.036057e-01 3.086230e-02 1.412280e-01 -7.632966e-01

Matrix C (Result of A * B):
Matrix C:
-6.485473e-01 -6.974358e-01 -2.888289e-01 6.850690e-02
2.435675e-01 -8.744635e-01 -1.614911e-01 1.371329e-01
5.139494e-01 -1.185891e+00 -4.575017e-01 -3.413287e-01
-2.864045e-01 4.127308e-02 -5.261487e-04 1.859551e+00
```

8*8矩阵

```
supersonic@supersonic-VirtualBox:~/hpc_practice/lab7-mpi$ mpicc -o mpi-dgemm mpi-dgemm.c
supersonic@supersonic-VirtualBox:~/hpc_practice/lab7-mpi$ mpirun -np 1 ./mpi-dgemm
Matrix A:
Matrix A:
1.900078e-02 8.548636e-02 -3.314322e-01 2.440604e-02 -6.461445e-01 -7.460251e-01 5.706861e-01 -6.391164e-02
-3.681220e-01 3.359572e-01 -8.358069e-01 1.730207e-01 -7.762620e-01 -9.918196e-01 -1.155304e-01 -6.060053e-01
4.034051e-01 -6.577163e-01 -4.593707e-01 4.775171e-01 7.053617e-01 -9.989944e-01 -4.241922e-01 -1.056461e-01
-2.655067e-01 6.615583e-01 -8.514753e-01 7.433776e-01 6.223437e-01 -6.140962e-01 7.067059e-01 4.568796e-01
7.526247e-01 7.238108e-01 3.524515e-01 1.559346e-01 9.097746e-01 1.735603e-01 5.194394e-02 9.321860e-01
-2.580107e-01 5.384423e-01 6.203171e-01 9.294072e-01 8.085664e-01 -2.500817e-01 4.568334e-01 5.136816e-01
5.050480e-02 -8.948411e-01 -7.157754e-02 -3.329414e-01 -7.221695e-01 -9.464281e-01 -4.673714e-01 -6.788623e-02
-1.443309e-01 9.334593e-01 1.383701e-01 -2.143441e-01 3.723747e-01 -7.046941e-02 5.669680e-01 7.379329e-01

Matrix B:
Matrix B:
-7.319215e-01 8.165651e-01 -4.029224e-02 8.852518e-01 5.361704e-01 -2.435351e-01 -5.578819e-01 -3.161686e-01
6.921052e-01 5.488294e-01 -9.377434e-01 -2.239507e-01 5.038825e-01 -1.625671e-01 5.086909e-02 -8.637625e-02
-9.638247e-01 -2.678706e-01 2.168604e-01 8.610245e-01 -8.182718e-01 -7.231037e-01 -1.094956e-02 1.762435e-01
8.817096e-01 8.885760e-01 5.845223e-01 8.227684e-01 7.079334e-01 -2.383066e-01 7.650440e-01 1.702999e-01
3.401642e-01 7.696433e-01 -6.350064e-01 -3.245633e-01 -6.507111e-01 -4.004399e-01 5.476602e-01 -8.601459e-01
5.999431e-01 -1.096578e-01 5.024259e-02 6.562465e-02 -9.604593e-01 -9.579758e-01 -8.819950e-01 6.378629e-01
-7.135664e-01 -6.739431e-01 7.975177e-01 4.041545e-01 -1.618930e-01 -5.223948e-01 -7.603972e-01 -1.936786e-01
2.209206e-01 -1.503654e-01 -3.824202e-01 9.420213e-01 -4.072602e-01 -9.257813e-01 9.560251e-02 1.709661e-01

Matrix C (Result of A * B):
Matrix C:
-7.024896e-01 -6.175928e-01 7.138585e-01 6.358140e-02 1.412361e+00 9.497799e-01 -1.198863e-01 -1.091875e-01
5.495472e-01 -5.828320e-02 2.023827e-01 -1.409116e+00 2.501541e+00 2.480544e+00 8.435441e-01 -7.664718e-02
3.326340e-02 1.469986e+00 -1.598574e-02 -6.368557e-02 1.211029e+00 1.221015e+00 1.691703e+00 -1.250213e+00
1.568243e+00 1.036256e+00 -3.969601e-01 -3.099131e-02 1.298360e+00 -5.740629e-02 1.148578e+00 -9.824464e-01
3.303513e-01 1.561958e+00 -1.425547e+00 1.551175e+00 -5.565088e-01 -2.013690e+00 1.271709e-01 -7.343229e-01
6.956050e-01 1.009126e+00 -1.748625e-01 1.339494e+00 -2.857657e-01 -1.493150e+00 1.240700e+00 -5.529886e-01
-1.375815e+00 -8.533851e-01 6.912177e-01 -1.710137e-01 8.812949e-01 1.767113e+00 4.605126e-01 8.840338e-02
2.721833e-01 -3.181251e-02 -1.034846e+00 4.047739e-01 -4.389421e-01 -1.226528e+00 -1.319781e-01 -3.960062e-01
```

二、碰到的问题及解决方法

1. 按步骤安装mpi后无法运行

使用 `sudo apt install mpich mpich-doc -y` 安装了MPICH。在运行课件所给代码示例时发现无法并行。

例如，在运行hellow.c时，输出结果为：

```
hello world from process 0 of 1
hello world from process 0 of 1
hello world from process 0 of 1
hello world from process 0 of 1
```

更新安装包后**没有**解决。

因为一些原因重装了虚拟机和相关的库，此时已无法在code中使用库 `<mpi.h>`，查找原因是C/C++开发环境的包含路径出现问题。

解决方法：

1. 首先运用命令确认MPICH正确安装，并查看头文件位置：

```
dpkg -L mpich
```

2. 配置更新includePath：在 `c_cpp_properties.json` 文件中添加mpich库所在的路径（注意是路径而不是目录）。

配置完后就可以链接到mpich库了。

不过最后只能运行一个进程，即 `-n 1`。