

云计算技术实验一性能测试报告

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【概述】

我们是根据当前机器的可用 CPU 核数来确定解题线程数的,解题线程数与可用 CPU 核数相等。我们设置了五个等级的环境(分别有不同数量的可用 CPU 核以及单线程版本)及七种不同的数据规模(从小到大题目数量为 32、1000、16000、32000、64000、128000、1024000),这样就涵盖了两个问题中不同输入、大小、不同环境、以及包含最简单版本的单线程。

【测试结果】

一、单线程(原代码)

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/Sudoku$ ./sudoku test1 d
0.001011 sec 0.031594 ms each 32
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/Sudoku$ ./sudoku test1000 d
0.098073 sec 0.098073 ms each 1000
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/Sudoku$ ./sudoku test16000 d
0.845618 sec 0.052851 ms each 16000
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/Sudoku$ ./sudoku test32000 d
1.625165 sec 0.050786 ms each 32000
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/Sudoku$ ./sudoku test64000 d
3.293109 sec 0.051455 ms each 64000
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/Sudoku$ ./sudoku test128000 d
6.574268 sec 0.051361 ms each 128000
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/Sudoku$ ./sudoku test1024000 d
52.895476 sec 0.051656 ms each 1024000
```

二、多线程

(1) 32

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test1
calculating finished. Spend 0.00105 s to finish.total solved:32
writing finished. Spend 0.00052 s to finish.total solved:32
total Spend:0.00157 s to finish.
POOL SIZE: 1000 JOB UNIT SIZE: 10 SEM MAXIMUM: 100 NUM OF WORK THREAD: 1
```

(2) 1000

```
jts@ubuntu:~/Desktop/Untitled Folder$ ./try_6 1000 10 1
./test1000
calculating finished. Spend 0.05321 s to finish.total solved:1000
writing finished. Spend 0.00755 s to finish.total solved:1000
total finished. Spend 0.06075 s to finish.POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 1
```

(3) 16000

```
total finished. Spend 0.06075 s to finish.POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 1
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test16000
calculating finished. Spend 0.77965 s to finish.total solved:16000
writing finished. Spend 0.11366 s to finish.total solved:16000
total Spend:0.89331 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 1
```

(4) 32000

```
jts@ubuntu:~/Desktop/Untitled Folder$ ./try_6 1000 10 1
./test32000
calculating finished. Spend 1.47374 s to finish.total solved:32000
writing finished. Spend 0.22230 s to finish.total solved:32000
total finished. Spend 1.69605 s to finish.POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 1
```

(5) 64000

```
jts@ubuntu:~/Desktop/Untitled Folder$ ./try_6 1000 10 1
./test64000
calculating finished. Spend 2.93880 s to finish.total solved:64000
writing finished. Spend 0.46896 s to finish.total solved:64000
total finished. Spend 3.40776 s to finish.POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 1
```

(6) 128000

```
total finished. Spend 3.40776 s to finish.POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 1
jts@ubuntu:~/Desktop/Untitled Folder$ ./try_6 1000 10 1
./test128000
calculating finished. Spend 6.17305 s to finish.total solved:128000
writing finished. Spend 0.87644 s to finish.total solved:128000
total finished. Spend 7.04948 s to finish.POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 1
```

(7) 1024000

```
jts@ubuntu:~/Desktop/Untitled Folder$ ./try_6 1000 10 1
./test1024000
calculating finished. Spend 48.37857 s to finish.total solved:1024000
writing finished. Spend 7.15910 s to finish.total solved:1024000
total finished. Spend 55.53766 s to finish.POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 1
```

三、双线程

(1) 32

```
jts@ubuntu:~/Desktop/Untitled Folder$ ./try_6 1000 10 1
./test1
calculating finished. Spend 0.00186 s to finish.total solved:32
writing finished. Spend 0.00032 s to finish.total solved:32
total finished. Spend 0.00218 s to finish.POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 3
```

(2) 1000

```
total finished. Spend 0.04209 s to finish.POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 2
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)$ ./try_6 1000 10 1
./test1000.2
calculating finished. Spend 0.03148 s to finish.total solved:1000
writing finished. Spend 0.01061 s to finish.total solved:1000
total finished. Spend 0.04209 s to finish.POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 2
```

(3) 16000

```
jts@ubuntu:~/Desktop/Untitled Folder$ ./try_6 1000 10 1
./test16000
calculating finished. Spend 0.28006 s to finish.total solved:16000
writing finished. Spend 0.11233 s to finish.total solved:16000
total finished. Spend 0.39239 s to finish.POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 3
```

(4) 32000

```
jts@ubuntu:~/Desktop/Untitled Folder$ ./try_6 1000 10 1
./test32000
calculating finished. Spend 0.97552 s to finish.total solved:32000
writing finished. Spend 0.22294 s to finish.total solved:32000
total finished. Spend 1.19846 s to finish.POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 2
jts@ubuntu:~/Desktop/Untitled Folder$
```

(5) 64000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test64000
calculating finished. Spend 2.02759 s to finish.total solved:64000
writing finished. Spend 0.46252 s to finish.total solved:64000
total Spend:2.49010 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 2
```

(6) 128000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test128000
calculating finished. Spend 4.64194 s to finish.total solved:128000
writing finished. Spend 0.97167 s to finish.total solved:128000
total Spend:5.61361 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 2
```

(7) 1024000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test1024000
calculating finished. Spend 34.99794 s to finish.total solved:1024000
writing finished. Spend 10.44421 s to finish.total solved:1024000
total Spend:45.44215 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 2
```

四、三线程

(1) 32

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test1
calculating finished. Spend 0.00334 s to finish.total solved:32
writing finished. Spend 0.00032 s to finish.total solved:32
total Spend:0.00365 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 3
```

(2) 1000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test1000
calculating finished. Spend 0.06633 s to finish.total solved:1000
writing finished. Spend 0.00729 s to finish.total solved:1000
total Spend:0.07362 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 3
```

(3) 16000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test16000
calculating finished. Spend 0.89724 s to finish.total solved:16000
writing finished. Spend 0.12404 s to finish.total solved:16000
total Spend:1.02128 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 3
```

(4) 32000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test32000
calculating finished. Spend 1.29080 s to finish.total solved:32000
writing finished. Spend 0.30984 s to finish.total solved:32000
total Spend:1.60064 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 3
```

(5) 64000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test64000
calculating finished. Spend 1.63006 s to finish.total solved:64000
writing finished. Spend 0.45394 s to finish.total solved:64000
total Spend:2.08401 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 3
```

(6) 128000


```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test128000
calculating finished. Spend 3.69475 s to finish.total solved:128000
writing finished. Spend 1.32813 s to finish.total solved:128000
total Spend:5.02287 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 3
```

(7) 1024000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test1024000
calculating finished. Spend 29.48569 s to finish.total solved:1024000
writing finished. Spend 10.49225 s to finish.total solved:1024000
total Spend:39.97794 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 3
```

五、四线程

(1) 32

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test1
calculating finished. Spend 0.00143 s to finish.total solved:32
writing finished. Spend 0.00032 s to finish.total solved:32
total Spend:0.00175 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 4
```

(2) 1000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test1000
calculating finished. Spend 0.02542 s to finish.total solved:1000
writing finished. Spend 0.00764 s to finish.total solved:1000
total Spend:0.03306 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 4
```

(3) 16000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test16000
calculating finished. Spend 0.23556 s to finish.total solved:16000
writing finished. Spend 0.11249 s to finish.total solved:16000
total Spend:0.34805 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 4
```

(4) 32000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test32000
calculating finished. Spend 0.45322 s to finish.total solved:32000
writing finished. Spend 0.23115 s to finish.total solved:32000
total Spend:0.68437 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 4
```

(5) 64000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test64000
calculating finished. Spend 0.99185 s to finish.total solved:64000
writing finished. Spend 0.45217 s to finish.total solved:64000
total Spend:1.44403 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 4
```

(6) 128000

```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test128000
calculating finished. Spend 1.97650 s to finish.total solved:128000
writing finished. Spend 1.02588 s to finish.total solved:128000
total Spend:3.00238 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 4
```

(7) 1024000

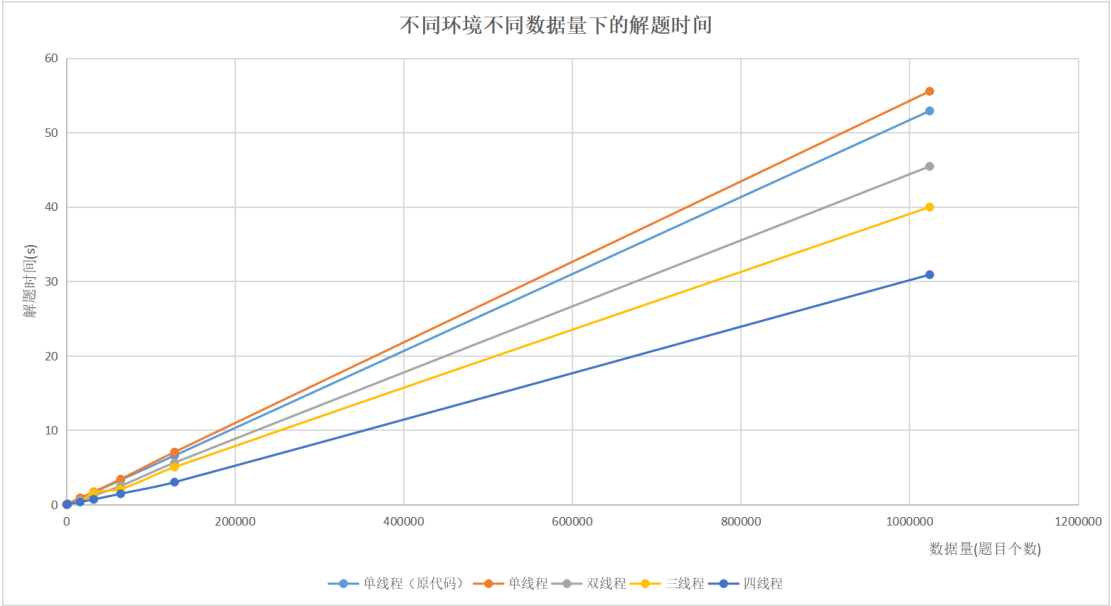
```
jts@ubuntu:~/Desktop/CloudComputingLabs/Lab1/src/working_space/try_6(移除了所有控制台打印)/Performance Testing$ ./try_6 1000 10 0
test1024000
calculating finished. Spend 23.27235 s to finish.total solved:1024000
writing finished. Spend 7.61571 s to finish.total solved:1024000
total Spend:30.88806 s to finish.
POOL_SIZE: 1000 JOB_UNIT_SIZE: 10 SEM_MAXIMUM: 100 NUM_OF_WORK_THREAD: 4
```

【分析表/图】

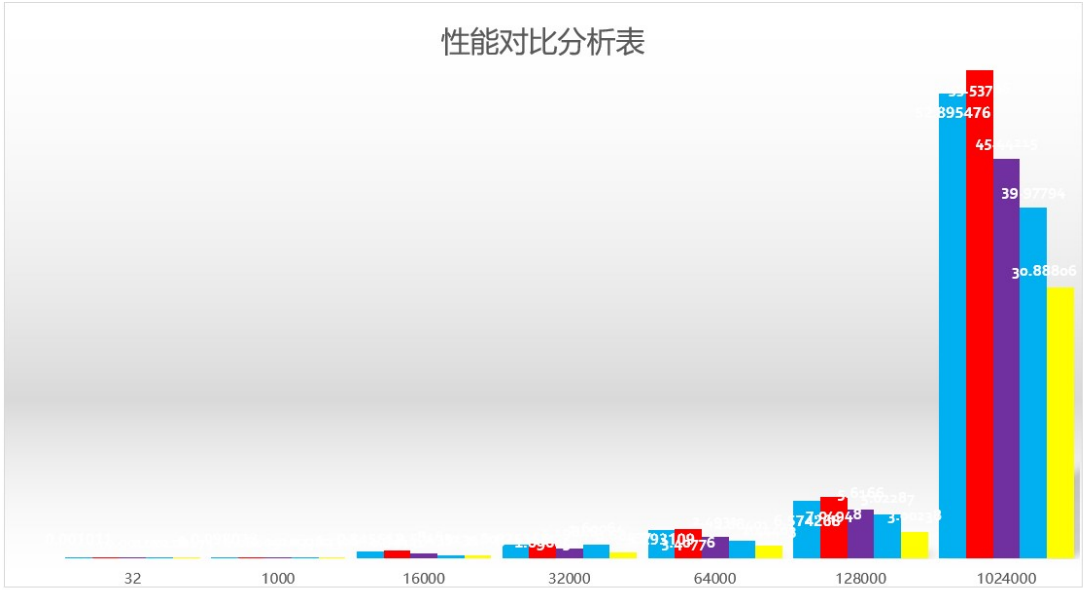
下面来用表格总结整体性能时间：

下列数据默认单位为秒

环境 数据量 \ 解题时间 (s)	单线程（源代码）	单线程	双线程	三线程	四线程
32	0.001011	0.00157	0.00117	0.00218	0.00175
1000	0.098073	0.06075	0.04209	0.07362	0.03306
16000	0.845618	0.89331	0.58465	0.39239	0.34805
32000	1.625165	1.69605	1.19846	1.60064	0.68437
64000	3.293109	3.40776	2.4931	2.08401	1.44403
128000	6.574268	7.04948	5.6166	5.02287	3.00238
1024000	52.895476	55.53766	45.44125	39.97794	30.88806

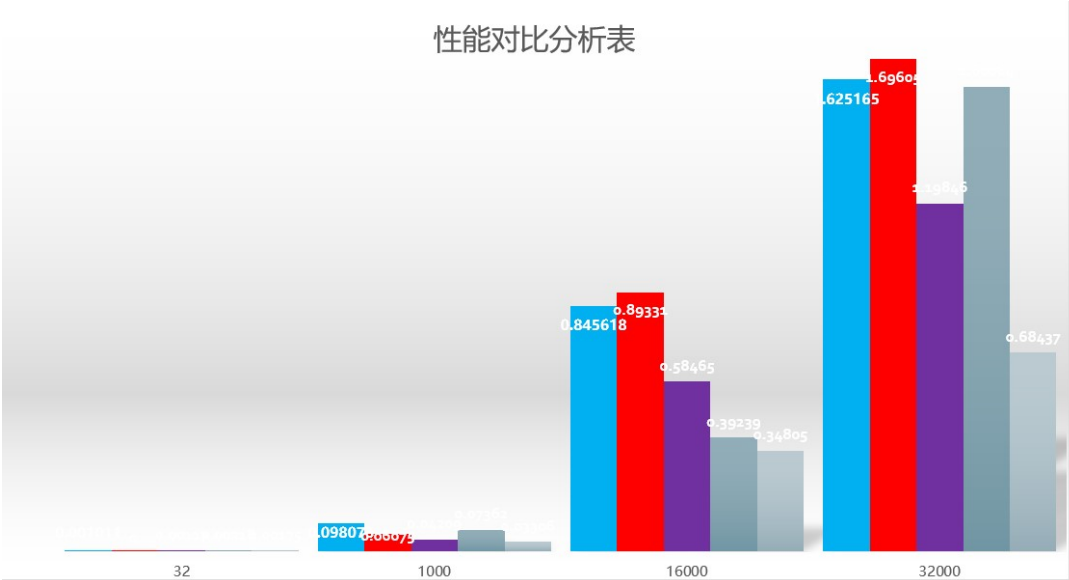


用柱形图更为直观感受



注：蓝、红、绿、紫、黄色柱分别代表单线程（源代码）、单线程、双线程、三线程、四线程

由于前四个图基本显示不出来，因为后面的时间太长，所以这里我再次在下方加入前四个部分的对比图以显示。



加速比以如下公式定义：

$$S_p = \frac{T_1}{T_p}$$

其中：

p 指CPU数量

T_1 指顺序执行算法的执行时间

T_p 指当有 p 个处理器时，并行算法的执行时间

当 $S_p = p$ 时， S_p 便可称为“线性加速比”（英语：linear speedup，又名“理想加速比”）。当某一并行算法的加速比为理想加速比时，若将处理器数量加倍，执行速度也会加倍，即如“理想”之意，有“优秀的可扩展性”。

加速比公式如上，也就是理论上来说多核有几核加速比理论上就应该是几，下面计算了所有数据规模的加速比。

加速比：

环境 数据量 \ 解题时间 (s)	单线程（源代码）	单线程	双线程	三线程	四线程	单线程加速比	双线程加速比	三线程加速比	四线程加速比
32	0.001011	0.00157	0.00117	0.00218	0.00175	64.39%	86.41%	46.38%	57.77%
1000	0.098073	0.06075	0.04209	0.07362	0.03306	161.44%	233.01%	133.22%	296.65%
16000	0.845618	0.89331	0.58465	0.39239	0.34805	94.66%	144.64%	215.50%	242.96%
32000	1.625165	1.69605	1.19846	1.60064	0.68437	95.82%	135.60%	101.53%	237.47%
64000	3.293109	3.40776	2.4931	2.08401	1.44403	96.64%	132.09%	158.02%	228.05%
128000	6.574268	7.04948	5.6166	5.02287	3.00238	93.26%	117.05%	130.89%	218.97%
1024000	52.895476	55.53766	45.44125	39.97794	30.88806	95.24%	116.40%	132.31%	171.25%

【总结】

可以明显看到与理想加速比也就是理论加速比来比较的话，无论都是大小数据规模，差距都是极大的，但是从横向来比较，多核优势在数据量大的情况下是更为明显的，起码是一个递增的趋势，但是纵向来比较的话结果就不一定，可能是由于 **cache** 的一些问题，导致数据加速比率有波动，当然也有可能是其他问题，但尽管有些与理想的差距，总体上来说多核的优势还是体现的很明显的，数据规模庞大的情况下，多核是占据绝对优势的，但在题目数量有限时，多线程优势就不是很明显，至此报告结束，**performance test report** 的要求已经全部完成，感谢助教和老师的辛勤奉献。