Distributed Computing

K-means Hybrid OpenMP/MPI Implementation  
Peformance Report

**2014 – 2015**

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# PC Specifications

All tests in this report made using a PC with the following specs:

|  |  |
| --- | --- |
| Processor: | Intel® Core™ 2 Duo CPU (2.40 GHz) |
| Memory: | 4.00 GB |

# Performance Test With 3 MPI Processes

With 5 clusters, and using the following command (in cmd):  
mpiexec -n 3 DistributedComputing.exe X 5

Where ‘X’ is the number of randomly-generated items to classify.

**OMP:** SENDING & RECEIVING / FINAL DIVISION IN MASTER / MAIN LOOP IN SALVES:

|  |  |  |
| --- | --- | --- |
| X | Minimum time | Total trials |
| 1000000 | 3.762449 | 15 |
| 5000000 | 18.70205 | 5 |

**OMP:** FINAL DIVISION IN MASTER / MAIN LOOP IN SALVES:

|  |  |  |
| --- | --- | --- |
| X | Minimum time | Total trials |
| 1000000 | 3.719407 | 15 |
| 5000000 | 18.55128 | 5 |

**OMP:** MAIN LOOP IN SLAVES:

|  |  |  |
| --- | --- | --- |
| X | Minimum time | Total trials |
| 1000000 | 3.667096 | 15 |
| 5000000 | 18.33614 | 5 |

**OMP:** (NONE):

|  |  |  |
| --- | --- | --- |
| X | Minimum time | Total trials |
| 1000000 | 3.730814 | 15 |
| 5000000 | 18.20739 | 5 |

# Performance Test With 6 MPI Processes

With 5 clusters, and using the following command (in cmd):  
mpiexec -n 5 DistributedComputing.exe X 5

**OMP:** SENDING & RECEIVING / FINAL DIVISION IN MASTER / MAIN LOOP IN SALVES:

|  |  |  |
| --- | --- | --- |
| X | Minimum time | Total trials |
| 1000000 | 4.521675 | 15 |
| 5000000 | 19.41343 | 5 |

**OMP:** FINAL DIVISION IN MASTER / MAIN LOOP IN SALVES:

|  |  |  |
| --- | --- | --- |
| X | Minimum time | Total trials |
| 1000000 | 4.387216 | 15 |
| 5000000 | 19.36680 | 5 |

**OMP:** MAIN LOOP IN SLAVES:

|  |  |  |
| --- | --- | --- |
| X | Minimum time | Total trials |
| 1000000 | 4.396033 | 15 |
| 5000000 | 19.69923 | 5 |

**OMP:** (NONE):

|  |  |  |
| --- | --- | --- |
| X | Minimum time | Total trials |
| 1000000 | 4.303120 | 15 |
| 5000000 | 19.44868 | 5 |

# Conclusion

As shown, using OpenMP didn’t have a big impact to the performance, rather, in some cases, had a bad impact.

Using only 3 MPI processes had a better performance than using 6. Taking into consideration the processor specs of the PC, this result seems logical.

When using 3 MPI processes, the best performance was recorded without using OpenMP at all, while it was recorded with using OpenMP in final division in master, and in the main loop in salves, with 6 MPI processes.

As a result, this test proves that:

1. Using hybrid implementation doesn’t (necessarily) yield to better performance.
2. A bigger number of parallel processes doesn’t (necessarily) equal better performance.
3. Using parallel processing everywhere possible also doesn’t (necessarily) yield to better performance.