Report

What is Linpack?

Linkpack is a software library for performing numerical linear algebra on digital computers, it was intended for use on supercomputers in 1970s and early 1980s.
Always, Linpack, introduced by Jack Dongarra who measure how fast a computer solves a dense n by n system of linear equations Ax=b, is taken as a benchmark to measure a system's floating point computing power, and that is a common task in engineering.

Endo 2010 Linpack [1]

1 what "Linpack" has to do with this paper:
Use Linpack to measure the performance of TSUBAME supercomputer, and also discuss the difference between two types of Linpack implementation, one is TSUBAME supercomputer, while the other Kistler's Linpack implementation is RoadRunner.

2 What the paper was about:
This paper illustrates how to achieve Linpack benchmark test, which ranks the third in the record of a heterogenous system in the world, on TSUBAME supercomputer; and analyze the results after comparing with other system (Kistler's Linpack implementation is RoadRunner). At the same time, the gap between Linpack performance and the theoretical peak performance is also discussed.

3 Main conclusions:
The overhead of DGEMM kernel, PCI communications, inter-node heterogeneity and load imbalance impact the performance of Linpack on TSUBAME. And when compared with that of Roadrunner, the system architecture of TSUBAME has many different features, which also explain the difference of the algorithm design. And some factors are not essential in heterogenous systems, for example, when nodes are homogenously accelerated, inter-node heterogeneity could be avoided.

Heinecke 2013 Design [2]

1 what "Linpack" has to do with this paper:
Conduct different types of Linpack implementations (native and single-node hybrid) with each other, and also compare those with native DGEMM implementation.

2 What the paper was about:
This paper describes, based on the Intel Xeon Phi coprocessor "Knights Corner", the implementations and adjustment of several flavors of Linpack benchmark; it also

introduced the hardware architectures; the optimized implementation, results and analysis of DGEMM were elaborated. Finally, the details of different kinds of implementations and performances were presented.

3 Main conclusions:
Because of the advantage of Knight Corner's salient architectural features, the native DGEMM implementation, the native Linpack implementation, and the single-node hybrid implementation of Linpack all could achieve very good efficiency (near 90%, close to 80% and approximately 80% respectively). Simultaneously, the single-node hybrid implementation of Linpack could scale to a 100-node cluster with over 76% efficiency by utilizing dynamic scheduling and an enhanced look-ahead scheme.

Leng 2002 Performance [3]

1 what "Linpack" has to do with this paper:
use HPL (High Performance Linpack) benchmark to display how the re-mapping of processes-to-processors, namely, changing the order of processors used, could impact the overall performance.

2 What the paper was about:
This paper illustrates the cluster interconnects by which the experiments conducted firstly, and then HPL (High Performance Linpack) benchmark and TOP500 were introduced, subsequently describes how to analyze the communication pattern of SMP (Symmetric Multi-Processor), and design two processes-to-processors the ideal mapping for it, namely, size-major and frequency-major; while for the last one, the results of mapping principles with Round Robin processes arrangement were compared.

3 Main conclusions:
Because of the majority of critical traffic, which refers to the communication pattern of the program, went through shared memory, the slower interconnect configurations and performance could be improved, to be specific, the performance of HPL could be improved at least 10% and at most 50% according to the process mapping and the problem size when using Fast Ethernet. Specially, size-major arrangement could give a more significant improvement when compared with frequency-major arrangement.

Discussion

Explain what/how the three papers are related:
Toshio et al of the first paper [1], and Alexander et al of the second paper [2] both brought some optimization techniques in order to improve the scalability, and they also compared different implementations; while the third paper [3], Tau Leng et al tried to design the mapping of processes to professors, aimed to figure out the communication pattern of SMP

(Symmetric Multi-Processor).

Toshio et al gave a very detailed description about how to achieve the excellent performance of Linpack benchmark results on TSUBAME supercomputer, and also compared that results with experiments and analyzed the differences.

Alexander Heinecke et al designed several different implementations of Linpack Benchmark, and they all achieved a very high efficiency.

Tau Leng et al [3], however, emphasized on and elaborated how to implement the mapping of processes-to-processors so as to improve the performance of interconnect.

References

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