OOKAMI PROJECT APPLICATION

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Project Title: gearshifft

Usage: Testbed

Principal Investigator:

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Names & Email of initial project users:

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- Anthony Curtis, anthony.curtis@stonybrook.edu

Usage Description:

The Fast Fourier Transform is an essential tool in signal analysis and is used across domains, e.g. in natural sciences, engineering, and artificial intelligence. Due to an increasing amount of experimental and simulation data, performant FFT calculations are a crucial aspect of modern science. Recent changes in the TOP500 list indicate a shift from x86-dominated HPC centers toward an increased availability of ARM and POWER processors. This motivates an analysis of the performance of well-established FFT algorithms and different implementations on these systems.

gearshifft is an FFT benchmark suite that was developed to allow for comparison between different CPU, GPU, as well as heterogeneous systems. As part of a master's thesis, support for ARM Performance Libraries was added to gearshifft and the performance of an x86, a POWER and a last generation ARM processor was assessed. In the process, special attention was payed to specific use cases of the scientific staff at HZDR. Furthermore, Roofline analysis was performed to get a better understanding of the effect of the memory hierarchy on FFT performance.

Since SIMD usage of the vendor libraries has been shown to have a great influence on FFT performance, ARM's Scalable Vector Extensions are an addition to the ARM platform that makes evaluation of FFT performance on Ookami worthwhile.

Together with researchers from Anthony Curtis' group, we plan to build a roofline model for the A64FX processor using performance counter data and then run a number of FFT use case scenarios to augment the already published performance data.

Computational Resources:

- Total node hours per year: 500
- Size (nodes) and duration (hours) for a typical batch job: single node, up to 1h for FFT benchmarks, around 24 hours for empirical roofline analysis
- Disk space (home, project, scratch): 1GB, 5GB, 5GB

Personnel Resources:

An exchange of experiences on the usage of floating point performance counters would be appreciated.

Required software:

- CMake
- GCC C++ Compiler
- ARM Performance Libraries
- FFTW3 with OpenMP support
- Boost.System, Boost.Test, Boost.ProgramOptions
- Score-P
- Python 3