Abstract:

Python is a powerful dynamic language enabling faster prototyping-to-production cycles. With its rich ecosystem based on NumPy and SciPy, many useful libraries for scientific computing, data science, and machine learning have been built and widely used. However, usually a penalty associated with such development efficiency is performance. It is known that Python CPU-based libraries often require some kinds of optimization strategies, such as parallelization, device offloading, just-in-time (JIT) compilation, etc, to match the performance to their pure C/C++ counterparts (if exist), and code porting and/or rewriting could be a tedious work, especially for domain scientists who might be less fluent or comfortable in low-level programming. In this talk, as a core contributor to CuPy — a NumPy-compliant GPU array library accelerated by CUDA — I will introduce how it can be used to significantly ease code porting and optimization. Followed by a brief introduction, I will explain how several useful, high-level features, including reduction operations and fast Fourier-Transforms, are optimized under the hood. In addition to its NumPy compliance that considerably lowers the bar to port NumPy code to GPU, CuPy also offers high extensibility with various forms of custom GPU kernels which I will also discuss. Finally, I will present the community effort to make CuPy interoperable with other Python libraries, such as Numba and mpi4py. If time permits, I will discuss CuPy’s internal (including the on-the-fly kernel generation and compilation and the recent ROCm/ROP support for AMD GPUs) and the upcoming Python Array API standard which CuPy will comply with.

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