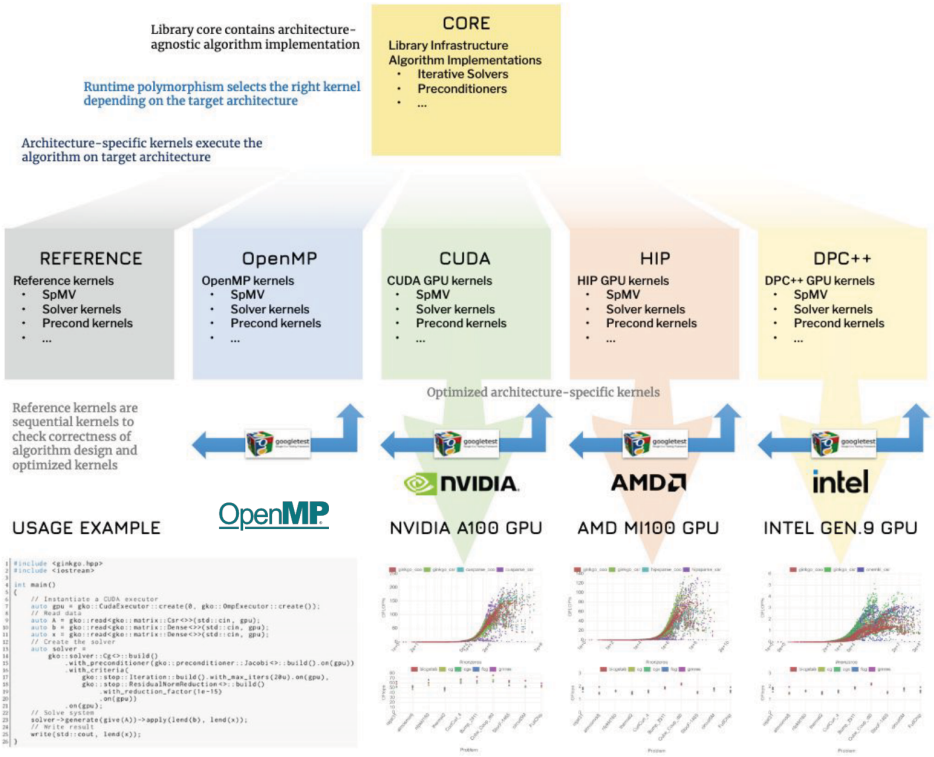
Ginkgo

DESIGN

Ginkgo is a C++ framework for sparse numerical linear algebra. Using a universal linear operator abstraction, Ginkgo provides basic building blocks such as the sparse matrix vector product for a variety of matrix formats, iterative solvers, and preconditioners. Ginkgo targets multi- and many-core systems, and currently features back-ends for AMD GPUs, Intel CPU/GPUs, NVIDIA GPUs, and OpenMP-supporting architectures. Core functionality is separated from hardware-specific kernels for easy extension to other architectures, with runtime polymorphism selecting the correct kernels.



SUSTAINABILITY

Ginkgo is part of the Extreme-scale Scientific Software Stack (E4S) and the extreme-scale Software Development Kit (xSDK), and adopts the xSDK community policies for sustainable software development and high software quality. The source code of the Ginkgo library can be accessed in a public git repository on GitHub. Code development in Ginkgo is realized in a Continuous Integration / Continuous Benchmarking framework. GitLab runners are used on private servers and HPC clusters where Docker/Enroot is used to provide different compilation and execution environments. To test the correct execution, each functionality is complemented by unit tests. The unit testing is realized using the Google Test framework.

This research was supported by the Exascale Computing Project (17-SC-20-SC), a collaborative effort of the U.S. Department of Energy Office of Science and the National Nuclear Security Administration, the Horizon2020 EuroHPC Project MICROCARD, and the Helmholtz Impuls und Vernetzungsfond VH-NG-1241.

SPONSORED BY

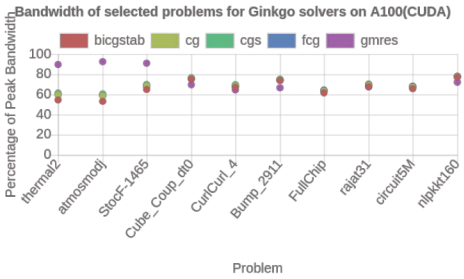
HARDWARE PARTNERS

INTEGRATION

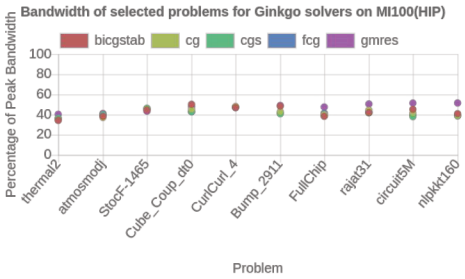
Ginkgo

PERFORMANCE

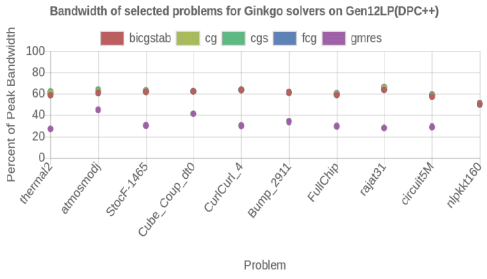
NVIDIA



AMD



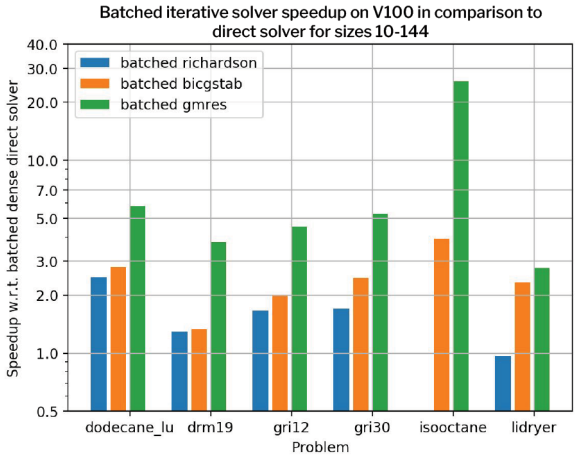
INTEL

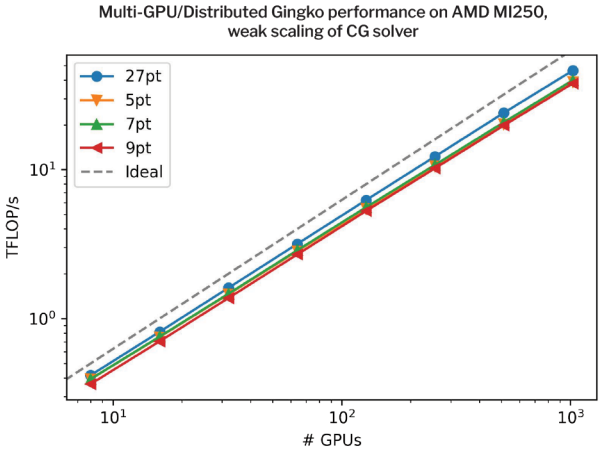


FUNCTIONALITY

		OMP	CUDA	HIP	DPC++
Basic	SpMV	✓	✓	✓	✓
	SpMM	✓	✓	✓	✓
	SpGeMM	✓	✓	✓	✓
Krylov solvers	BiCG	✓	✓	✓	✓
	BiCGSTAB	✓	✓	✓	✓
	CG	✓	✓	✓	✓
	CGS	✓	✓	✓	✓
	GCR	✓	✓	✓	✓
	GMRES	✓	✓	✓	✓
	FCG	✓	✓	✓	✓
	FGMRES	✓	✓	✓	✓
	IR	✓	✓	✓	✓
	IDR	✓	✓	✓	✓
Preconditioners	Block-Jacobi	✓	✓	✓	✓
	ILU/IC	✓	✓	✓	✓
	Parallel ILU/IC	✓	✓	✓	✓
	Parallel ILUT/ICT	✓	✓	✓	✓
	ISAI	✓	✓	✓	✓
Batched	Batched BiCGSTAB	✓	✓	✓	✓
	Batched CG	✓	✓	✓	✓
	Batched GMRES	✓	✓	✓	✓
	Batched ILU	✓	✓	✓	✓
	Batched ISAI	✓	✓	✓	✓
	Batched Block-Jacobi	✓	✓	✓	✓
AMG	AMG preconditioner	✓	✓	✓	✓
	AMG solver	✓	✓	✓	✓
	Parallel Graph Match	✓	✓	✓	✓
Sparse direct	Symbolic Cholesky	✓	✓	✓	✓
	Numeric Cholesky	✓	✓	✓	
	Symbolic LU	✓	✓	✓	✓
	Numeric LU	✓	✓	✓	
	Sparse TRSV	✓	✓	✓	
Utilities	On-Device Matrix Assembly	✓	✓	✓	✓
	MC64/RCM reordering	✓			
	Wrapping user data	✓	✓	✓	✓
	Logging	✓	✓	✓	✓
	PAPI counters	✓	✓	✓	✓

✓ *MPI Support* ✓ *Single-GPU Support*





https://github.com/ginkgo-project/ginkgo