CUBLAS

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CUBLAS : HIGH PERFORMANCE BLAS FOR NVIDIA GPUs

Introduction

Full implementation of the BLAS standard

Plus a few extensions for batched and reduced precision routines, and one or two other things (e.g. SYRKX, GEAM)

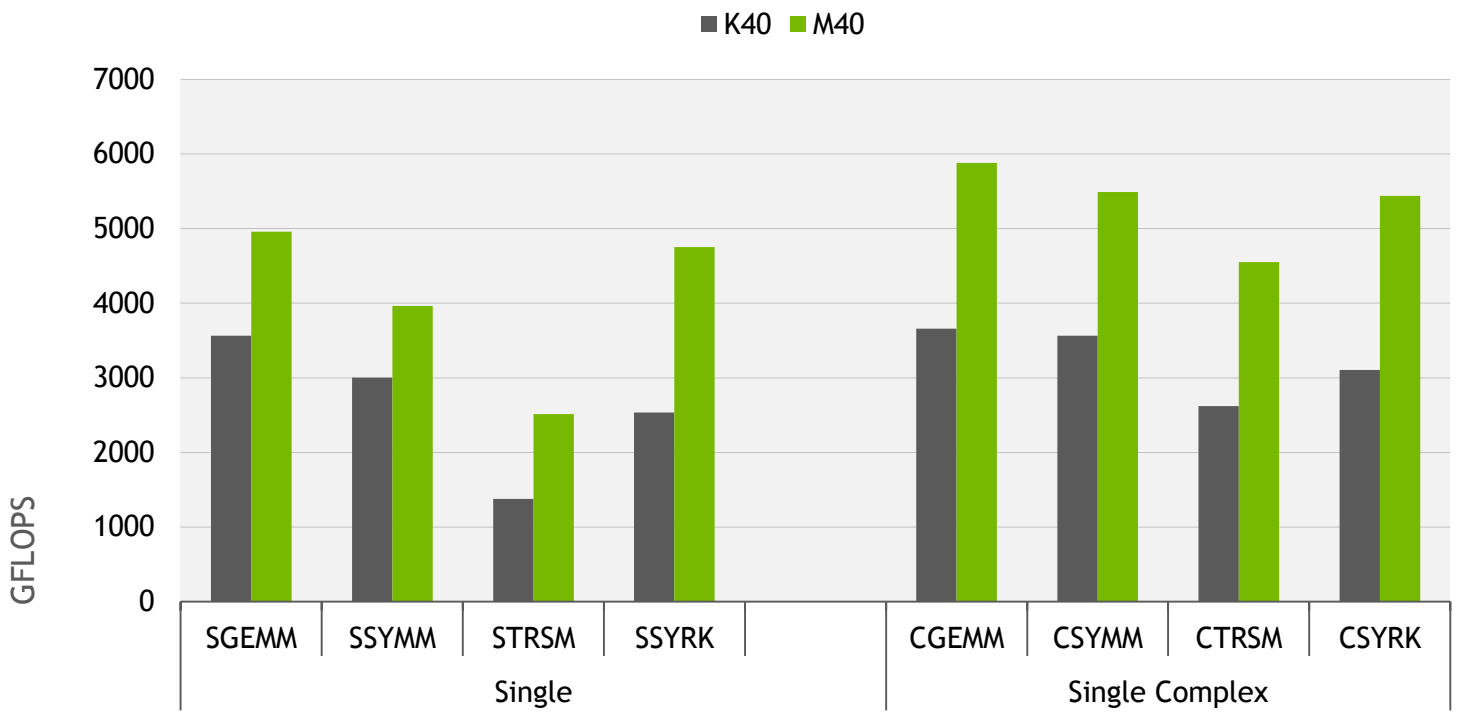
Vanilla cuBLAS : All data and compute on the GPU

cuBLAS-XT : Data on either host or GPU, scales across GPUs in a node

Free with CUDA toolkit, built and maintained by NVIDIA

Several external collaborators

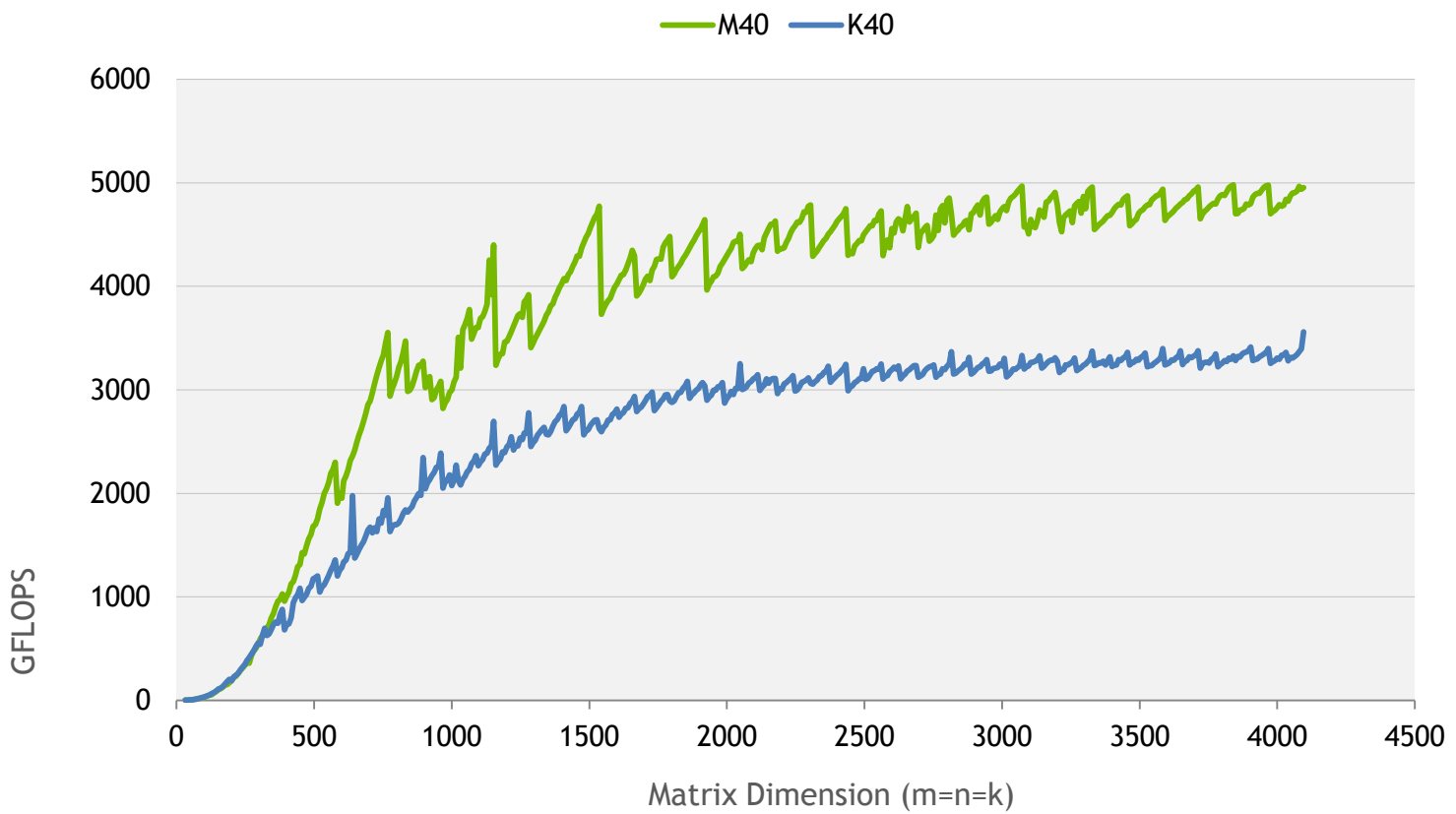
CUBLAS: > 5 TFLOPS SINGLE PRECISION



- cuBLAS 8.0 RC on M40, Base clocks
- cuBLAS 7.5 on K40, Base clocks
- Input and output data on device
- m=n=k=4096, transpose=no, side=right, fill=lower

Performance may vary based on OS and software versions, and motherboard configuration

CUBLAS: SGEMM PERFORMANCE

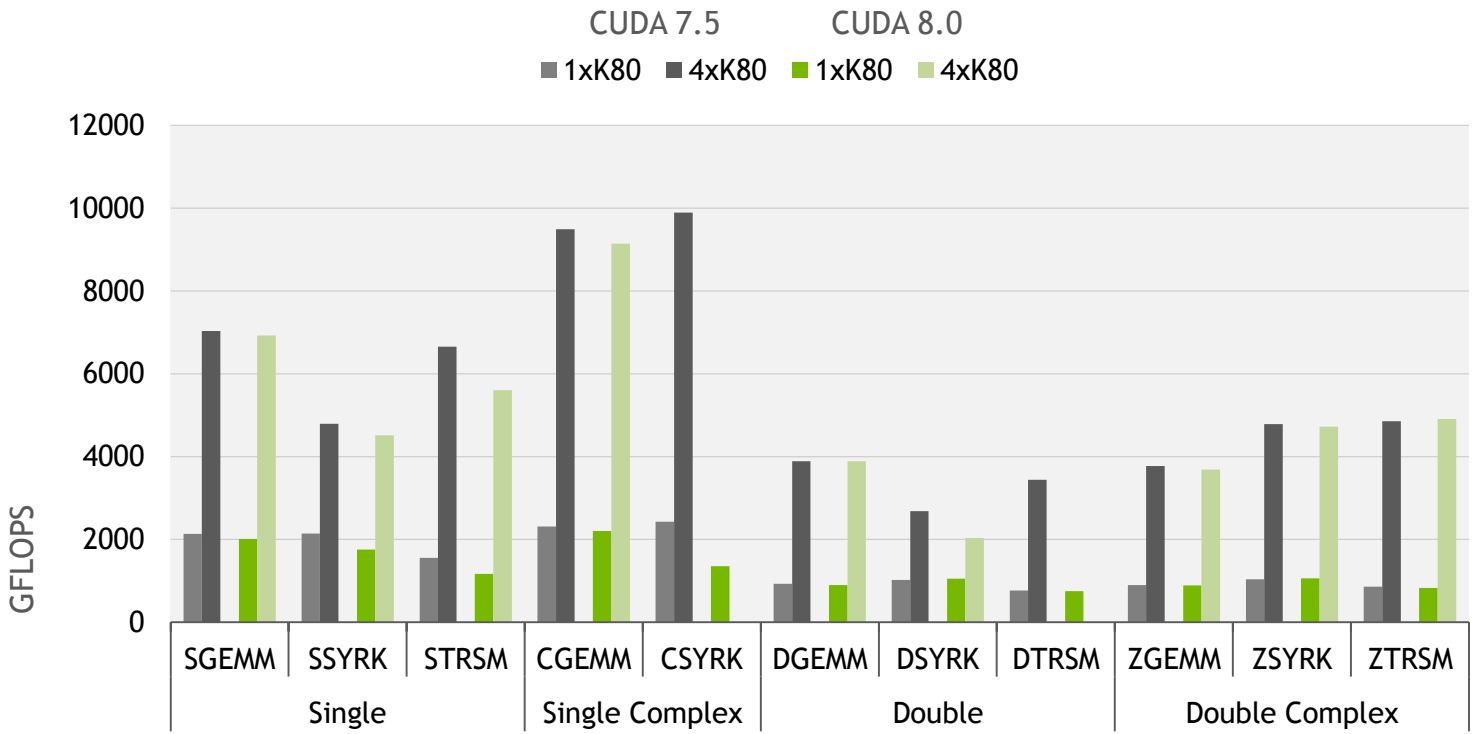


- cuBLAS 8.0 RC on M40, Base clocks, Input and output data on device
- cuBLAS 7.5 on K40, Base clocks, Input and output data on device
- m=n=k=4096

Performance may vary based on OS and software versions, and motherboard configuration

CUBLAS-XT: > 9 TFLOPS ON A SINGLE NODE

Multi-GPU Performance Scaling



- cuBLAS 8.0 RC on K80, base clocks, input and output data on device
- cuBLAS 7.5 on K80, base clocks, input and output data on device

Performance may vary based on OS and software versions, and motherboard configuration

REPRODUCIBLITY

Run-to-run consistency

Bitwise identical results across runs

- Given toolkit/driver versions, hardware and problem

User opt-in for non-reproducible execution

- SYMV has a faster atomic path

Integral to our internal QA process

Necessary for debugging large, concurrent codes

REDUCED PRECISION

cuBLAS 8.0

New cublasHgemm() routine performs computation in FP16 format

FP16 vector arithmetic also available via intrinsics

- Compiler does not automatically vectorize
- Not all math.h functions

Evaluating other library improvements

- cuSPARSE support for fp16 iterative solver refinement iterations
- cuFFT direct fp16 transforms

MIXED PRECISION

“Ex” routines

SGEMMEx/SSYRKEx – FP16/int8 I/O, FP32 math

CGEMMEx/CHERKEx – int8 I/O, FP32 math

```
cublasStatus_t cublasSgemmEx  (handle, transa, transb, m, n, k,
                               const float *alpha,  /* host or device pointer */
                               const void *A,
                               cudaDataType Atype, lda,
                               const void *B,
                               cudaDataType Btype, ldb,
                               const float *beta,  /* host or device pointer */
                               void *C,
                               cudaDataType Ctype, ldc);
```

Generic GEMM – custom I/O and Math types

BATCHED ROUTINES

BATCH_FIXED equivalent

```
cublasStatus_t cublasSgemmBatched (handle, transa, transb, m, n, k,
                                   const float *alpha,  /* host or device pointer */
                                   const float *Aarray[], lda,
                                   const float *Barray[], ldb,
                                   const float *beta,   /* host or device pointer */
                                   float *Carray[],
                                   int ldc,
                                   int batchCount);
```

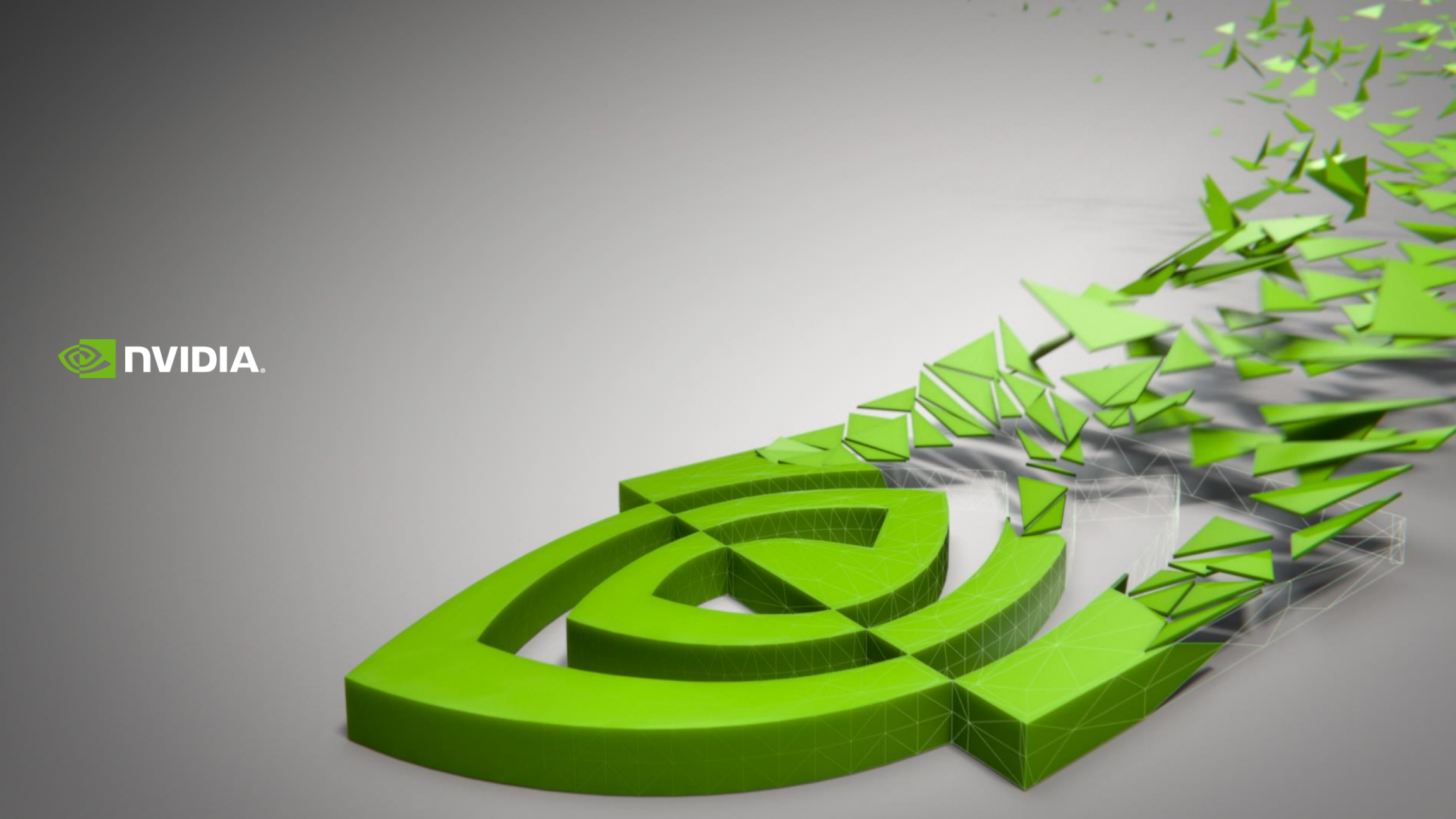
Exists for S, D, C, Z GEMM variants

BATCHED ROUTINES

Strided batched GEMM

```
cublasStatus_t cublasSgemmStridedBatched (handle, transa, transb, m, n, k,
                                          const float *alpha,
                                          const float *A, lda, long long int strideA,
                                          const float *B, ldb, long long int strideB,
                                          const float *beta,
                                          float *C, ldc, long long int strideC,
                                          int batchCount);
```

Exists for S, D, C, Z, H GEMM variants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