



Release Notes

Release 13.4

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Chapter 1. Overview

CUDA Toolkit 13.4 Update 1 - Release Notes

Welcome to the release notes for NVIDIA® CUDA® Toolkit 13.4 Update 1. This release includes enhancements and fixes across the CUDA Toolkit and its libraries.

This documentation is organized into two main sections:

- ▶ **CUDA Platform**

Focuses on the core CUDA infrastructure including component versions, driver compatibility, compiler/runtime features, issues, and deprecations.

- ▶ **CUDA Libraries**

Covers the specialized computational libraries with their feature updates, performance improvements, API changes, and version history across CUDA 13.x releases.

Chapter 2. CUDA Platform

2.1. CUDA Toolkit Major Components

For CUDA 13.4 Update 1, the table below indicates the versions:

Table 1: CUDA 13.4 Update 1 Component Versions

Component Name		Version Information	Supported Architectures
CUDA C++ Core Compute Libraries	Thrust	3.4.3	x86_64, arm64-sbsa, arm64 (Windows)
	CUB	3.4.3	
	libcud++	3.4.3	
	Cooperative Groups	13.3.4.3.1	
CUDA Compatibility Package (Orin)		13.4.47145772	arm64-sbsa
CUDA Application Compiler (crt)		13.4.92	x86_64, arm64-sbsa
CUDA Compilation Optimizer (ctadvisor)		13.4.92	x86_64, arm64-sbsa
CUDA Runtime (cudart)		13.4.92	x86_64, arm64-sbsa
CUDA cublas		13.4.92	x86_64, arm64-sbsa
CUDA cuobjdump		13.4.92	x86_64, arm64-sbsa
CUPTI		13.4.92	x86_64, arm64-sbsa
CUDA cuxxfilt (demangler)		13.4.92	x86_64, arm64-sbsa
CUDA Documentation		13.4.92	x86_64, arm64-sbsa
CUDA GDB		13.4.92	x86_64, arm64-sbsa
CUDA NVCC		13.4.92	x86_64, arm64-sbsa
CUDA nvdisasm		13.4.92	x86_64, arm64-sbsa
CUDA NVML Headers		13.4.92	x86_64, arm64-sbsa
CUDA nvprune		13.4.92	x86_64, arm64-sbsa
CUDA NVRTC		13.4.92	x86_64, arm64-sbsa
CUDA NVTX		13.4.92	x86_64, arm64-sbsa

Table 1 – continued from previous page

Component Name	Version Information	Supported Architectures
CUDA OpenCL	13.4.92	x86_64, arm64 (Windows)
CUDA Profiler API	13.4.92	x86_64, arm64-sbsa
CUDA Sandbox dev	13.4.92	x86_64, arm64-sbsa
CUDA Compute Sanitizer API	13.4.92	x86_64, arm64-sbsa
CUDA TILE-IR AS	13.4.92	x86_64, arm64-sbsa
CUDA cuBLAS	13.8.0.4	x86_64, arm64-sbsa
CUDA cuDLA	13.4.92	arm64-sbsa, arm64
CUDA cuFFT	12.4.0.43	x86_64, arm64-sbsa
CUDA cuFile	1.19.1.55	x86_64, arm64-sbsa
CUDA cuobjclient	1.3.1.55	x86_64, arm64-sbsa
CUDA cuRAND	10.4.4.72	x86_64, arm64-sbsa
CUDA cuSOLVER	12.3.4.7	x86_64, arm64-sbsa
CUDA cuSPARSE	12.8.6.72	x86_64, arm64-sbsa
CUDA NPP	13.2.0.58	x86_64, arm64-sbsa
CUDA nvFatbin	13.4.92	x86_64, arm64-sbsa
CUDA nvJitLink	13.4.92	x86_64, arm64-sbsa
CUDA nvJPEG	13.2.3.58	x86_64, arm64-sbsa
CUDA nvptxcompiler	13.4.92	x86_64, arm64-sbsa
CUDA nvvm	13.4.92	x86_64, arm64-sbsa
Nsight Compute	2026.3.1.2	x86_64, arm64-sbsa
Nsight Systems	2026.3.2.476	x86_64, arm64-sbsa
Nsight Visual Studio Edition (VSE)	2026.3.0.26187	x86_64, arm64 (Windows)
Visual Studio Integration	13.4.92	x86_64, arm64 (Windows)

2.2. CUDA Driver

Note: The NVIDIA driver is **no longer bundled** with the CUDA Toolkit – on Windows starting with CUDA 13.1, and on Linux starting with CUDA 13.4. Download and install the appropriate driver from the official [NVIDIA Driver Downloads](#) page.

Running a CUDA application requires a system with at least one CUDA-capable GPU and a driver that is compatible with the CUDA Toolkit. For more information about various GPU products that are CUDA-capable, visit <https://developer.nvidia.com/cuda/gpus>.

The NVIDIA driver branch corresponding to each CUDA Toolkit release is shown below. Update releases

within a CUDA minor version use the same driver branch.

Table 2: CUDA Toolkit and Corresponding Driver Branch

CUDA Toolkit	Corresponding Driver Branch
CUDA 13.4	R615
CUDA 13.3	R610
CUDA 13.2	R595
CUDA 13.1	R590
CUDA 13.0	R580

Note: Existing CUDA 13.x applications run on drivers ≥ 580 under CUDA minor version compatibility. CUDA 13.4 new features and newly enabled platforms require an R615 or later driver that supports them. The Windows driver for the RTX Spark device is 616.41 or later.

The CUDA driver is backward compatible: applications compiled against a particular CUDA Toolkit version continue to work on subsequent (later) driver releases. In addition, CUDA minor version compatibility allows applications to run on a driver older than the corresponding driver branch, within the ranges shown below. The installed driver must meet or exceed the minimum required version for the CUDA Toolkit. For details, see the [CUDA Compatibility Guide](#) and [CUDA Compatibility and Upgrades](#).

Table 3: CUDA Toolkit and Minimum Required Driver Version for CUDA Minor Version Compatibility

CTK Version	Driver Range for Minor Version Compatibility	
	Min	Max
13.x	≥ 580	N/A
12.x	≥ 525	< 580
11.x	≥ 450	< 525

CUDA 11.0 shipped with earlier driver versions. Minor-version compatibility across the CUDA 11.x family requires driver version 450.80.02 or later on Linux, or 452.39 or later on Windows.

Older CUDA versions (12.9 and earlier)

Table 4: Corresponding Driver Versions (CUDA 12.9 and earlier)

CUDA Toolkit	Corresponding Driver Version	
	Linux x86_64 Driver Version	Windows x86_64 Driver Version
CUDA 12.9 Update 1	$\geq 575.57.08$	≥ 576.57
CUDA 12.9 GA	$\geq 575.51.03$	≥ 576.02

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Table 4 – continued from previous page

CUDA Toolkit	Corresponding Driver Version	
CUDA 12.8 Update 1	>=570.124.06	>=572.61
CUDA 12.8 GA	>=570.26	>=570.65
CUDA 12.6 Update 3	>=560.35.05	>=561.17
CUDA 12.6 Update 2	>=560.35.03	>=560.94
CUDA 12.6 Update 1	>=560.35.03	>=560.94
CUDA 12.6 GA	>=560.28.03	>=560.76
CUDA 12.5 Update 1	>=555.42.06	>=555.85
CUDA 12.5 GA	>=555.42.02	>=555.85
CUDA 12.4 Update 1	>=550.54.15	>=551.78
CUDA 12.4 GA	>=550.54.14	>=551.61
CUDA 12.3 Update 1	>=545.23.08	>=546.12
CUDA 12.3 GA	>=545.23.06	>=545.84
CUDA 12.2 Update 2	>=535.104.05	>=537.13
CUDA 12.2 Update 1	>=535.86.09	>=536.67
CUDA 12.2 GA	>=535.54.03	>=536.25
CUDA 12.1 Update 1	>=530.30.02	>=531.14
CUDA 12.1 GA	>=530.30.02	>=531.14
CUDA 12.0 Update 1	>=525.85.12	>=528.33
CUDA 12.0 GA	>=525.60.13	>=527.41
CUDA 11.8 GA	>=520.61.05	>=520.06
CUDA 11.7 Update 1	>=515.48.07	>=516.31
CUDA 11.7 GA	>=515.43.04	>=516.01
CUDA 11.6 Update 2	>=510.47.03	>=511.65
CUDA 11.6 Update 1	>=510.47.03	>=511.65
CUDA 11.6 GA	>=510.39.01	>=511.23
CUDA 11.5 Update 2	>=495.29.05	>=496.13
CUDA 11.5 Update 1	>=495.29.05	>=496.13
CUDA 11.5 GA	>=495.29.05	>=496.04
CUDA 11.4 Update 4	>=470.82.01	>=472.50
CUDA 11.4 Update 3	>=470.82.01	>=472.50
CUDA 11.4 Update 2	>=470.57.02	>=471.41
CUDA 11.4 Update 1	>=470.57.02	>=471.41

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Table 4 – continued from previous page

CUDA Toolkit	Corresponding Driver Version	
CUDA 11.4.0 GA	>=470.42.01	>=471.11
CUDA 11.3.1 Update 1	>=465.19.01	>=465.89
CUDA 11.3.0 GA	>=465.19.01	>=465.89
CUDA 11.2.2 Update 2	>=460.32.03	>=461.33
CUDA 11.2.1 Update 1	>=460.32.03	>=461.09
CUDA 11.2.0 GA	>=460.27.03	>=460.82
CUDA 11.1.1 Update 1	>=455.32	>=456.81
CUDA 11.1 GA	>=455.23	>=456.38
CUDA 11.0.3 Update 1	>= 450.51.06	>= 451.82
CUDA 11.0.2 GA	>= 450.51.05	>= 451.48
CUDA 11.0.1 RC	>= 450.36.06	>= 451.22
CUDA 10.2.89	>= 440.33	>= 441.22
CUDA 10.1 (10.1.105 general release, and updates)	>= 418.39	>= 418.96
CUDA 10.0.130	>= 410.48	>= 411.31
CUDA 9.2 (9.2.148 Update 1)	>= 396.37	>= 398.26
CUDA 9.2 (9.2.88)	>= 396.26	>= 397.44
CUDA 9.1 (9.1.85)	>= 390.46	>= 391.29
CUDA 9.0 (9.0.76)	>= 384.81	>= 385.54
CUDA 8.0 (8.0.61 GA2)	>= 375.26	>= 376.51
CUDA 8.0 (8.0.44)	>= 367.48	>= 369.30
CUDA 7.5 (7.5.16)	>= 352.31	>= 353.66
CUDA 7.0 (7.0.28)	>= 346.46	>= 347.62

2.3. New Features

2.3.1. CUDA Platform

- None

2.3.2. CUDA Developer Tools

For details on new features, improvements, and bug fixes, see the changelogs for:

- ▶ [Nsight Systems](#).
- ▶ [Nsight Visual Studio Edition](#).
- ▶ [CUPTI](#).
- ▶ [Nsight Compute](#).
- ▶ [Compute Sanitizer](#).
- ▶ [NVML](#).
- ▶ [cuda-gdb](#).

2.3.3. CUDA Compiler

- ▶ PTX ISA 9.4 is supported. For new PTX features, see the [PTX ISA 9.4 documentation](#).

2.3.4. CUDA C++ Core Libraries (CCCL)

- ▶ None

2.3.5. CUDA Python

- ▶ None

2.3.6. CUDA Tile

- ▶ None

2.3.7. CUDA Tile IR

- ▶ None

2.4. Resolved Issues

2.4.1. General CUDA

- Fixed an issue where applications statically built with, or dynamically linking to, an older CUDA Runtime (down to CUDA 11.2) with the R615 driver could report benign public error messages indicating that IMEX channels were incorrectly set up.

2.4.2. CUDA Compiler

- Fixed an issue where kernels using the `fabric.try_put.tensor`, `fabric.try_red.tensor`, or `fabric.try_atom` PTX instructions did not set the `fabric-write` grid attribute, which could leave fabric writes unfenced at grid completion when the kernel was launched in a CUDA graph.

2.4.3. CUDA Tools

- None

2.5. Known Issues

2.5.1. CUDA Platform

- None

2.5.2. CUDA Compiler

- None

2.6. Deprecated or Dropped Features

2.6.1. CUDA Platform

- Legacy Nsight Eclipse Edition plugins are no longer delivered in CUDA Toolkit packages beginning with CUDA 13.3.
- Python 3.10 support is deprecated across the CUDA Python 13.4 packages.

2.6.2. Architectures

- ▶ CUDA 14.0 will move to Armv8.2-A as the minimum supported architecture for ARM64-SBSA.

2.6.3. Operating Systems

- ▶ None

2.6.4. CUDA Toolchains

- ▶ None

Chapter 3. CUDA Libraries

This section covers CUDA Libraries release notes for 13.x releases.

Note: Documentation will be updated to accurately reflect supported C++ standard libraries for CUDA Math Libraries.

3.1. cuBLAS Library

3.1.1. cuBLAS: Release 13.4 Update 1

► New Features

- Emulated FP64 matrix multiplications:
 - Improved ZGEMM peak performance by up to 25% on Rubin GPUs.
 - When the per-handle workspace is insufficient, fixed-point FP64 emulation now allocates its temporary workspace from a cuBLAS-managed, per-device CUDA memory pool that retains memory across stream synchronizations. This avoids repeated allocation overhead without requiring users to tune the default memory pool.

► Known Issues

- When running NVIDIA Compute Sanitizer (versions up to CUDA Toolkit 13.4) with cuBLAS-linked workloads, the tool may report false-positive errors regarding invalid global reads or out-of-bounds (OOB) memory accesses inside cuBLAS accelerated kernels. This is a known issue caused by a limitation in Compute Sanitizer's ability to accurately identify the PTX semantics of the asynchronous global-to-shared memory copy instruction `cp.async.cg.shared.global [dst], [src], cp-size, src-size` when `src-size < cp-size`. In this specific scenario, where the number of bytes to copy exceeds the source buffer size, the hardware guarantees that the remaining bytes (`cp-size - src-size`) in the destination shared memory are automatically padded with zeros, ensuring that the memory access is neither invalid nor OOB. Hence, Compute Sanitizer reports for these specific cases can be safely ignored. [6196059]
- cuBLASLt Grouped GEMM with per-batch tensor-wide scales causes an invalid memory access for groups where $m > 0$, $n > 0$, and $k = 0$. As a workaround, always pass valid scale pointers for each group. This issue was introduced in CUDA Toolkit 13.1 (cuBLAS 13.2.0). [CUB-10481]

► Resolved Issues

- Fixed an issue where cuBLASLt Grouped GEMM operations with CUBLAS_POINTER_MODE_HOST could lead to incorrect results on Hopper GPUs when the number of waves was larger than 2. This issue was introduced in CUDA Toolkit 13.2 Update 1 (cuBLAS 13.4.0). [6681084]
- Fixed an issue where cuBLASLt Grouped GEMM operations could lead to incorrect results on B300 and Rubin GPUs when the input matrices used the NVFP4 data type, the number of waves was larger than 3, and the algorithm attribute CUBLASLT_ALGO_CONFIG_STAGES_ID was CUBLASLT_MATMUL_STAGES_768xAUTO. This issue was introduced in CUDA Toolkit 13.4 (cuBLAS 13.7.0). [6681084]
- Fixed an issue where cublasLtMatmul() could return incorrect output when using split-K if the number of K splits (SPLITK_NUM) did not evenly divide the K dimension and the floor division of K / SPLITK_NUM was an exact multiple of the stage size. This affected only algorithms with CUBLASLT_ALGO_CONFIG_ID equal to 66 on GPUs with compute capability 9.0, 10.x, and 11.x. This issue was introduced in CUDA Toolkit 12.6 Update 2 (cuBLAS 12.6.3). [6580689]
- Fixed an issue where cublasLtMatmul() could produce incorrect results on B300 and Rubin GPUs when the input matrices used the NVFP4 data type. This affected only algorithms with CUBLASLT_ALGO_CONFIG_ID equal to 66 and the algorithm attribute CUBLASLT_ALGO_CONFIG_STAGES_ID set to CUBLASLT_MATMUL_STAGES_768xAUTO. This issue was introduced in CUDA Toolkit 13.3 (cuBLAS 13.5.1). [CUB-10573]

3.1.2. cuBLAS: Release 13.4

► New Features

- Emulated FP64 matrix multiplications:
 - Emulated FP64 matrix multiplications now leverage the Ozaki-II scheme when it provides a performance benefit over the Ozaki-I scheme; the Ozaki-II scheme is supported on NVIDIA Ampere and newer GPUs.
 - On B200 and RTX PRO 6000 Blackwell Server Edition GPUs, this enables up to 175 and 45 TFLOPS of emulated DGEMM performance, respectively, and up to 295 and 70 TFLOPS of emulated ZGEMM performance, respectively, by leveraging the 2M algorithm.
 - Emulated FP64 matrix multiplications now support Rubin GPUs (compute capability 10.7), leveraging the Ozaki-I and Ozaki-II schemes and the new T116 type via the tcgen05.mma instruction to achieve up to 212 TFLOPS of emulated DGEMM performance. Emulated ZGEMM can reach up to 301 TFLOPS, with further improvements to come.
- cuBLASLt adds experimental support for an alternative scaling-factor layout for MXFP8 matmuls through the CUBLASLT_MATMUL_MATRIX_SCALE_VEC32_MN_K4_UE8M0 and CUBLASLT_MATMUL_MATRIX_SCALE_VEC128_MN_K4_UE8M0 scaling modes. For more information, see the [cuBLAS documentation](#).
- Added support for the NVIDIA Rubin (compute capability 10.7) GPU architecture.
- cuBLASLt Grouped GEMM performance is improved on Blackwell data center GPUs through dynamic scheduling of matrix computations. Improvements of up to 20% can be seen for Grouped GEMM calls with a large number of groups (for example, 32). [5913842] [5992105] [CUB-9925]

► Known Issues

- When running NVIDIA Compute Sanitizer (versions up to CUDA Toolkit 13.4) with cuBLAS-linked workloads, the tool may report false-positive errors regarding invalid global reads or out-of-bounds (OOB) memory accesses inside cuBLAS accelerated kernels. This is a known issue caused by a limitation in Compute Sanitizer's ability to accurately identify the PTX semantics of the asynchronous global-to-shared memory copy instruction `cp.async.cg.shared.global [dst], [src], cp-size, src-size` when `src-size < cp-size`. In this specific scenario, where the number of bytes to copy exceeds the source buffer size, the hardware guarantees that the remaining bytes (`cp-size - src-size`) in the destination shared memory are automatically padded with zeros, ensuring that the memory access is neither invalid nor OOB. Hence, Compute Sanitizer reports for these specific cases can be safely ignored. [6196059]
- cuBLASLt Grouped GEMM with per-batch tensor-wide scales causes an invalid memory access for groups where $m > 0$, $n > 0$, and $k = 0$. As a workaround, always pass valid scale pointers for each group. This issue was introduced in CUDA Toolkit 13.1 (cuBLAS 13.2.0). [CUB-10481]
- `cublasLtMatmul()` can return incorrect output when using split-K if the number of K splits (`SPLITK_NUM`) does not evenly divide the K dimension and the floor division of $K / \text{SPLITK_NUM}$ is an exact multiple of the stage size. This affects only algorithms with `CUBLASLT_ALGO_CONFIG_ID` equal to 66 on GPUs with compute capability 9.0, 10.x, and 11.x. As a workaround, use `cublasLtMatmulAlgoConfigGetAttribute()` to query the number of K splits (`CUBLASLT_ALGO_CONFIG_SPLITK_NUM`) and the stage size (derived from `CUBLASLT_ALGO_CONFIG_STAGES_ID`), then use `cublasLtMatmulAlgoConfigSetAttribute()` to set a value that evenly divides the K dimension, or for which $K / \text{SPLITK_NUM}$ is not an exact multiple of the stage size. This issue was first introduced in CUDA Toolkit 12.6 Update 2 (cuBLAS 12.6.3). [6580689]
- cuBLASLt Grouped GEMM operations with `CUBLAS_POINTER_MODE_HOST` can lead to incorrect results on Hopper GPUs when the number of waves is larger than 2. As a workaround, pass device alpha and beta using `CUBLAS_POINTER_MODE_DEVICE`. This issue was introduced in CUDA Toolkit 13.2 Update 1 (cuBLAS 13.4.0). [6681084]
- cuBLASLt Grouped GEMM operations can lead to incorrect results on B300 and Rubin GPUs when the input matrices use the NVFP4 data type, the number of waves is larger than 3, and the algorithm attribute `CUBLASLT_ALGO_CONFIG_STAGES_ID` is `CUBLASLT_MATMUL_STAGES_768xAUTO`. As a workaround, skip such candidates when using `cublasLtMatmulAlgoGetHeuristic()`. [6681084]
- `cublasLtMatmul()` can produce incorrect results on B300 and Rubin GPUs when the input matrices use the NVFP4 data type. This affects only algorithms with `CUBLASLT_ALGO_CONFIG_ID` equal to 66 and the algorithm attribute `CUBLASLT_ALGO_CONFIG_STAGES_ID` is `CUBLASLT_MATMUL_STAGES_768xAUTO`. [CUB-10573]

► Resolved Issues

- Between CUDA Toolkit 13.3 Update 1 and 13.4, cuBLAS released an independent patch release (cuBLAS 13.6.1) that resolves several issues. Refer to the associated [cuBLAS patch release notes](#) for details.
- Fixed an issue where `cublasLtMatmulAlgoGetHeuristic()` could return no algorithms, and `cublasLtMatmul()` could return `CUBLAS_STATUS_NOT_SUPPORTED`, for some NVFP4 matmuls with NVFP4 output and the `CUBLASLT_EPILOGUE_BIAS` epilogue on GPUs with compute capability 12.x. [CUB-10222]

- Fixed an issue where `cublasLtMatmulAlgoGetHeuristic()` returned `CUBLAS_STATUS_INTERNAL_ERROR` and invalidated an in-flight CUDA graph capture when called while a non-default blocking stream was being captured. This issue was introduced in CUDA Toolkit 13.3 (cuBLAS 13.5.1). [6288786]
- Fixed an issue where `cublas<t>gemv()` with `trans` equal to `CUBLAS_OP_T` or `CUBLAS_OP_C` could perform an illegal memory access when the number of elements addressed by the output vector ($n * incy$) exceeded the 32-bit index range. `cublasZgemv()` could additionally return `CUBLAS_STATUS_NOT_SUPPORTED` when $n * lda$ exceeded that range. [6207926]
- Fixed an issue where `cublasZgemv()` with `trans` equal to `CUBLAS_OP_C` and `incy` greater than 1 produced incorrect results when FP64 fixed-point emulation was enabled (`CUBLAS_FP64_EMULATED_FIXEDPOINT_MATH` with `CUBLAS_EMULATION_STRATEGY_EAGER`). [6207926]

3.1.3. cuBLAS: Release 13.3 Update 1

► New Features

- The TMA-based kernel (Hopper and newer) now accelerates DSYMV in addition to the already-enabled SSYMV. The 16-byte alignment requirement for the A pointer was dropped for this kernel, and support for atomics was added through `cublasSetAtomicsMode()`. The geometric speedup across architectures and datatypes is 1.3x, and up to 5.9x.

► Known Issues

- Non-default epilogues are unintentionally allowed for `cublasLtMatmul()` with `int8` inputs using regular data ordering and scale type `CUDA_R_32F`. This is an undocumented and lightly tested feature that users are discouraged from using, and it is planned for removal in the next major release. [CUB-10067]
- In cuBLASLt, the heuristics for the Grouped GEMM API return sub-optimal algorithms when the C and D matrices use `CUBLASLT_ORDER_ROW` ordering. As a workaround, swap `CUBLASLT_MATMUL_PREF_GROUPED_DESC_D_AVERAGE_ROWS` and `CUBLASLT_MATMUL_PREF_GROUPED_DESC_D_AVERAGE_COLS` in the preferences before calling `cublasLtMatmulAlgoGetHeuristic()`. [6335555]
- Multiple cuBLASLt Grouped GEMM operations reusing the same workspace on Hopper GPUs may lead to hangs or unspecified launch failures. This issue was introduced in CUDA Toolkit 13.2 Update 1 (cuBLAS 13.4.0). [6456362]
- Calling `cublasLtMatmulAlgoGetHeuristic()` while a non-default blocking stream is being captured returns `CUBLAS_STATUS_INTERNAL_ERROR`. This issue was introduced in CUDA Toolkit 13.3 (cuBLAS 13.5.1). [6288786]
- GEMV-like operations (e.g., `cublas<t>gemv()`, or `cublasLtMatmul()` with M or N equal to 1) may return `CUBLAS_STATUS_NOT_SUPPORTED` for certain shapes and workspace configurations. This issue was introduced in CUDA Toolkit 13.3 (cuBLAS 13.5.1).
- Strided batched GEMM operations using broadcast operands may perform out-of-bounds memory reads on GPUs with compute capability 12.0 or 12.1 when an input matrix shared across batches (via zero or overlapping strides) is smaller than a few hundred KB. Numerical accuracy is unaffected, but these invalid accesses can trigger compute-sanitizer warnings or, in rare instances, illegal memory access errors. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [6040940] [5996751]

- ▶ GEMM kernels on GPUs with compute capability 10.x or 12.x may access device alpha and beta pointers before calling `cudaGridDependencySynchronize()`. This can result in a WAR hazard if the preceding PDL kernel produces alpha and beta values on device after calling `cudaTriggerProgrammaticLaunchCompletion()`. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [CUB-10409]
- ▶ GEMV-like operations (e.g., `cublas<t>gemv()`, or `cublasLtMatmul()` with M or N equal to 1) may produce incorrect results on GPUs with compute capability 12.0 or 12.1 when the matrix is transposed, its non-accumulation dimension is greater than 3145680, and beta is not equal to 0. This issue was introduced in CUDA Toolkit 13.3 Update 1 (cuBLAS 13.6.0). [CUB-10445]
- ▶ cuBLASLt Grouped GEMM operations with `CUBLAS_POINTER_MODE_HOST` can lead to incorrect results on Hopper GPUs when the number of waves is larger than 2. As a workaround, pass device alpha and beta using `CUBLAS_POINTER_MODE_DEVICE`. This issue was introduced in CUDA Toolkit 13.2 Update 1 (cuBLAS 13.4.0). [6681084]
- ▶ **Resolved Issues**
 - ▶ Fixed an issue where `cublasXt<t>sppmm()` could produce incorrect results with m greater than 46340. [6155165]
 - ▶ Fixed an issue where `cublasLtMatmul()` could run an unsupported combination of data types: an FP32-like compute type with FP32 C and D and non-FP32 A and B, in which case A and B are incorrectly interpreted as FP32 matrices. [CUB-9942]
 - ▶ Fixed an issue where `cublasLtMatmul()` returned `CUBLAS_STATUS_NOT_SUPPORTED` for FP8 Grouped GEMM problems with scale modes `CUBLASLT_MATMUL_MATRIX_SCALE_VEC128_32F` and `CUBLASLT_MATMUL_MATRIX_SCALE_BLK128x128_32F` on Hopper GPUs. [CUB-10031]
 - ▶ Fixed an issue where `cublasLtMatmul()` with int8 inputs and scale type `CUDA_R_32I` would allow non-default epilogues on Blackwell GPUs with compute capability 10.x and return incorrect results. The correct behavior is to disallow all but the default epilogue, as documented. [CUB-10066]

3.1.4. cuBLAS: Release 13.3

- ▶ **New Features**
 - ▶ Enabled memory-parsimonious tiling for FP64 emulated matrix multiplications. This improvement ensures that the workspace memory budget no longer exceeds 8 GB.
 - ▶ Added support for CUDA Green contexts.
 - ▶ Improved FP4 matrix multiplication performance on Blackwell Ultra GPUs by a geometric mean of 5% across a wide range of problems, with up to 7% speedup for some small problems.
 - ▶ Improved TF32 matrix multiplication performance on Blackwell and Blackwell Ultra GPUs by a geometric mean of 27% across a wide range of problems and layouts, with up to 3.5x speedup for some small problems.
 - ▶ Improved TF32 TN matrix multiplication performance on Hopper GPUs by a geometric mean of 11% across a wide range of problems, with up to 40% speedup for some small problems.
 - ▶ Improved SYMV performance with TMA-based acceleration for Hopper, Blackwell, and Blackwell Ultra kernels with up to 27% geomean speedup.
- ▶ **Known Issues**

- ▶ Multiple cuBLASLt Grouped GEMM operations reusing the same workspace on Hopper GPUs may lead to hangs or unspecified launch failures. This issue was introduced in CUDA Toolkit 13.2 Update 1 (cuBLAS 13.4.0). [6456362]
- ▶ cuBLASLt Grouped GEMM operations with CUBLAS_POINTER_MODE_HOST can lead to incorrect results on Hopper GPUs when the number of waves is larger than 2. As a workaround, pass device alpha and beta using CUBLAS_POINTER_MODE_DEVICE. This issue was introduced in CUDA Toolkit 13.2 Update 1 (cuBLAS 13.4.0). [6681084]
- ▶ Calling `cublasLtMatmulAlgoGetHeuristic()` while a non-default blocking stream is being captured returns `CUBLAS_STATUS_INTERNAL_ERROR`. This issue was introduced in CUDA Toolkit 13.3 (cuBLAS 13.5.1). [6288786]
- ▶ GEMV-like operations (e.g., `cublasLtGemm()`, or `cublasLtMatmul()` with M or N equal to 1) may return `CUBLAS_STATUS_NOT_SUPPORTED` for certain shapes and workspace configurations. This issue was introduced in CUDA Toolkit 13.3 (cuBLAS 13.5.1).
- ▶ Strided batched GEMM operations using broadcast operands may perform out-of-bounds memory reads on GPUs with compute capability 12.0 or 12.1 when an input matrix shared across batches (via zero or overlapping strides) is smaller than a few hundred KB. Numerical accuracy is unaffected, but these invalid accesses can trigger compute-sanitizer warnings or, in rare instances, illegal memory access errors. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [6040940] [5996751]
- ▶ GEMM kernels on GPUs with compute capability 10.x or 12.x may access device alpha and beta pointers before calling `cudaGridDependencySynchronize()`. This can result in a WAR hazard if the preceding PDL kernel produces alpha and beta values on device after calling `cudaTriggerProgrammaticLaunchCompletion()`. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [CUB-10409]

3.1.5. cuBLAS: Release 13.2 Update 2

▶ Known Issues

- ▶ Multiple cuBLASLt Grouped GEMM operations reusing the same workspace on Hopper GPUs may lead to hangs or unspecified launch failures. This issue was introduced in CUDA Toolkit 13.2 Update 1 (cuBLAS 13.4.0). [6456362]
- ▶ Strided batched GEMM operations using broadcast operands may perform out-of-bounds memory reads on GPUs with compute capability 12.0 or 12.1 when an input matrix shared across batches (via zero or overlapping strides) is smaller than a few hundred KB. Numerical accuracy is unaffected, but these invalid accesses can trigger compute-sanitizer warnings or, in rare instances, illegal memory access errors. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [6040940] [5996751]
- ▶ GEMM kernels on GPUs with compute capability 10.x or 12.x may access device alpha and beta pointers before calling `cudaGridDependencySynchronize()`. This can result in a WAR hazard if the preceding PDL kernel produces alpha and beta values on device after calling `cudaTriggerProgrammaticLaunchCompletion()`. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [CUB-10409]

▶ Resolved Issues

- ▶ Fixed an issue where `cublasLtMatmul()` ignored the tensor-wide scaling value specified by `CUBLASLT_MATMUL_DESC_D_SCALE_POINTER` for NVFP4 matrix multiplications with NVFP4 output, resulting in incorrect results. This affected algorithms with

CUBLASLT_ALGO_CONFIG_ID equal to 66 on GPUs with compute capability 10.x and 11.x. This issue was introduced in CUDA Toolkit 13.2 Update 1 (cuBLAS 13.4.0). [6059292]

3.1.6. cuBLAS: Release 13.2 Update 1

Note: CUDA Toolkit 13.2 Update 1 contains a critical cuBLAS bug for an issue where `cublasLtMatmul()` could ignore tensor-wide scaling for NVFP4 matrix multiplications, resulting in incorrect results. Please see the [cuBLAS patch release notes](#) for an available cuBLAS patch (13.4.1) to resolve this issue.

► New Features

- Extended the experimental Grouped GEMM API in cuBLASLt to support NVFP4 inputs and bias epilogues on Blackwell GPUs with Compute Capability 10.x and 11.0. Grouped GEMM NVFP4 support currently uses only MMA tile sizes with K equal to 64.
- Extended the experimental Grouped GEMM API in cuBLASLt to support BF16, FP16, and FP8 input data types with BF16, FP16, and FP32 output data types on Hopper GPUs. For FP8 inputs, tensorwide scaling and block scaling (VEC128 and BLK128x128) are supported.
- Improved Grouped GEMM performance on Blackwell GPUs, providing up to 20% higher performance for large problem sizes where the matrices exceed the L2 cache size.

► Known Issues

- `cublasLtMatmul()` ignores the tensor-wide scaling value provided by CUBLASLT_MATMUL_DESC_D_SCALE_POINTER for NVFP4 matrix multiplications with NVFP4 output, leading to incorrect results. This affects algorithms with CUBLASLT_ALGO_CONFIG_ID equal to 66 on GPUs with compute capability 10.x and 11.x. This issue was introduced in CUDA Toolkit 13.2 Update 1. [6059292]
- Multiple cuBLASLt Grouped GEMM operations reusing the same workspace on Hopper GPUs may lead to hangs or unspecified launch failures. This issue was introduced in CUDA Toolkit 13.2 Update 1 (cuBLAS 13.4.0). [6456362]
- cuBLASLt Grouped GEMM operations with CUBLAS_POINTER_MODE_HOST can lead to incorrect results on Hopper GPUs when the number of waves is larger than 2. As a workaround, pass device alpha and beta using CUBLAS_POINTER_MODE_DEVICE. This issue was introduced in CUDA Toolkit 13.2 Update 1 (cuBLAS 13.4.0). [6681084]
- Strided batched GEMM operations using broadcast operands may perform out-of-bounds memory reads on GPUs with compute capability 12.0 or 12.1 when an input matrix shared across batches (via zero or overlapping strides) is smaller than a few hundred KB. Numerical accuracy is unaffected, but these invalid accesses can trigger compute-sanitizer warnings or, in rare instances, illegal memory access errors. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [6040940] [5996751]
- GEMM kernels on GPUs with compute capability 10.x or 12.x may access device alpha and beta pointers before calling `cudaGridDependencySynchronize()`. This can result in a WAR hazard if the preceding PDL kernel produces alpha and beta values on device after calling `cudaTriggerProgrammaticLaunchCompletion()`. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [CUB-10409]

► Resolved Issues

- Fixed an issue in `cublasLtMatmulAlgoGetHeuristic()` that could result in no algorithm candidates being returned for Grouped GEMM on Blackwell GPUs. [CUB-9657]

3.1.7. cuBLAS: Release 13.2

► New Features

- Extended the experimental Grouped GEMM API in cuBLASLt to support MXFP8 inputs on GPUs with Compute Capability 10.x and 11.0.
- Added control over special-case handling in FP32 emulation via the environment variable `CUBLAS_EMULATION_SPECIAL_VALUES_SUPPORT_MASK`. Setting `CUBLAS_EMULATION_SPECIAL_VALUES_SUPPORT_MASK=0` can improve performance for applications that do not require preservation of infinity and NaN values, without requiring code changes. For more information, see the `cudaEmulationSpecialValuesSupport_t` documentation.
- Added FP64 fixed-point emulation support to the `cublas[D|Z]syrrk`, `cublas[D|Z]syrr2k`, `cublasZherk`, and `cublasZher2k` routines. When the math mode is set to `CUBLAS_FP64_EMULATED_FIXEDPOINT_MATH`, cuBLAS will automatically use FP64 emulation for sufficiently large SYRK and HERK problems. Current support is limited to GPUs with Compute Capability 10.0.
- Improved performance on RTX PRO 6000 GPUs, delivering up to 20% speedup for FP8, FP16/BF16, TF32, and INT8 precisions.
- Improved GEMM performance on DGX Spark systems for MXFP8 and NVFP4 data types in large M and N problem sizes, with up to 3× performance improvement for selected matrix shapes.

► Known Issues

- On Blackwell GPUs, FP64 fixed-point emulation kernels may produce incorrect results or experience data corruption when executed concurrently with third-party kernels that allocate tensor memory. *[CUB-9633]*
- Strided batched GEMM operations using broadcast operands may perform out-of-bounds memory reads on GPUs with compute capability 12.0 or 12.1 when an input matrix shared across batches (via zero or overlapping strides) is smaller than a few hundred KB. Numerical accuracy is unaffected, but these invalid accesses can trigger compute-sanitizer warnings or, in rare instances, illegal memory access errors. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). *[6040940] [5996751]*
- GEMM kernels on GPUs with compute capability 10.x or 12.x may access device alpha and beta pointers before calling `cudaGridDependencySynchronize()`. This can result in a WAR hazard if the preceding PDL kernel produces alpha and beta values on device after calling `cudaTriggerProgrammaticLaunchCompletion()`. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). *[CUB-10409]*

► Resolved Issues

- Fixed an issue in `cublasLtMatmul` that could lead to incorrect results when it ran concurrently with another kernel that uses Tensor Memory. This issue only affected algorithms with `CUBLASLT_ALGO_CONFIG_ID` equal to 66 on GPUs with Compute Capability 10.x and 11.x, and existed since cuBLAS 12.8. *[5807900]*
- Fixed an issue in `cublasLtMatmul` that could lead to incorrect results or invalid memory access errors for large leading dimensions, specifically when the product of the data type size and the leading dimension of a matrix exceeded the bounds of a signed 32 bit integer. This issue affected GPUs with Compute Capability 9.0, 10.x, or 11.0, existed since cuBLAS 12.6 Update 2, and only affected algorithms with `CUBLASLT_ALGO_CONFIG_ID` equal to 66. *[CUB-9572]*

- ▶ Fixed an issue in the cuBLASLt Matmul API that could cause FP8 kernels to hang on GPUs with Compute Capability 9.0 when $\text{beta} \neq 0$ and $\text{scale_C} = 0$. This issue only affected algorithms with CUBLASLT_ALGO_CONFIG_ID equal to 66. [CUB-9627]
- ▶ Fixed an issue in the cuBLASLt Grouped GEMM API that ignored groups with $k = 0$, leading to incorrect results. This issue existed since CUDA 13.1. [CUB-9529]
- ▶ Fixed an issue in the cuBLASLt Matmul API that could cause incorrect results when C broadcasting was used ($\text{LDC} = 0$). [5845724]
- ▶ Added missing checks for matrix pointer alignment in the cublasLtMatmul API. [CUB-9577] [CUB-9599] [CUB-9585]
- ▶ Fixed an issue in cublasLtMatmul that could lead to incorrect results for NVFP4 precision on B300 and GB300 GPUs when the m dimension was not a multiple of 64. [CUB-9577]
- ▶ Fixed an issue in cublasLtMatmul that could lead to incorrect results for NVFP4 precision on future GPUs, impacting future hardware compatibility. [CUB-9570]
- ▶ Fixed an issue in GEMM and Matmul APIs with BF16 and FP16 inputs on DGX Spark and FP8 inputs on GeForce that could potentially cause illegal memory accesses. [5846563]
- ▶ Fixed an issue in cuBLASLt to enable CUBLASLT_EPILOGUE_BGRADA and CUBLASLT_EPILOGUE_BGRADB epilogues when the C matrix CUBLASLT_MATRIX_LAYOUT_ORDER was set to CUBLASLT_ORDER_ROW. [4617436]
- ▶ Fixed an integer overflow bug in complex, emulated FP64 matrix multiplication. The affected routines include cublasZgemm, cublasZtrsm, cublasGemmEx, and cublasLtMatmul. The overflow occurred when $2 * m * n + m$ exceeded `UINT_MAX`, where m is the number of rows of $\text{op}(A)$ and C , and n is the number of columns of $\text{op}(B)$ and C . [5720478]
- ▶ Improved GB200 and B200 performance for MXFP8 and NVFP4 precisions when M and N were less than or equal to 32. [CUB-9646]

3.1.8. cuBLAS: Release 13.1 Update 1

▶ Known Issues

- ▶ The cuBLASLt Grouped GEMM API ignores groups with $k = 0$, which can lead to incorrect results. As a workaround, initialize output matrices D with $\text{beta} * C$ for all groups, and then compute Grouped GEMM as $D += A * B$ so the result for groups with $k = 0$ is computed properly. This issue applies to the experimental cuBLASLt Grouped GEMM API introduced in CUDA 13.1. [CUB-9529]
- ▶ Complex FP64 GEMM routines using fixed-point emulation can produce incorrect results when matrix dimensions are large enough that $m * n > 2^{31}$ due to integer overflow in an address calculation. [5720478]
- ▶ `cublasLtMatmul()` may produce incorrect results when run concurrently with another kernel that uses Tensor Memory. This issue affects only algorithms with CUBLASLT_ALGO_CONFIG_ID equal to 66 on GPUs with compute capability 10.x and 11.x, and has existed since cuBLAS 12.8. [5807900]
- ▶ Strided batched GEMM operations using broadcast operands may perform out-of-bounds memory reads on GPUs with compute capability 12.0 or 12.1 when an input matrix shared across batches (via zero or overlapping strides) is smaller than a few hundred KB. Numerical accuracy is unaffected, but these invalid accesses can trigger compute-sanitizer warnings

or, in rare instances, illegal memory access errors. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [6040940] [5996751]

- cuBLAS GEMM kernels on GPUs with compute capability 10.x or 12.x may access device alpha and beta pointers before calling `cudaGridDependencySynchronize()`. This can result in a WAR hazard if the preceding PDL kernel produces alpha and beta values on device after calling `cudaTriggerProgrammaticLaunchCompletion()`. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [CUB-10409]

► Resolved Issues

- Fixed an issue where fixed point emulation with 7 mantissa bits or less could trigger unspecified launch failures. [5692684]
- Fixed an issue where `cublasLtMatmul` with FP8 arguments and `CUBLASLT_MATMUL_MATRIX_SCALE_SCALAR_32F` scaling mode (default) incorrectly required scaling factor addresses to be 16-byte aligned. This issue existed since cuBLAS 12.9. [5728938]

3.1.9. cuBLAS: Release 13.1

► New Features

- Introduced experimental support for grouped GEMM in cuBLASLt. Users can create a matrix with grouped layout using `cublasLtGroupedMatrixLayoutCreate` or `cublasLtGroupedMatrixLayoutInit`, where matrix shapes are passed as device arrays. `cublasLtMatmul` now accepts matrices with grouped layout, in which case matrices are passed as a device array of pointers, where each pointer is a separate matrix that represents a group with its own shapes. Initial support covers A/B types FP8 (E4M3/E5M2), FP16, and BF16, with C/D types FP16, BF16, and FP32; column-major only, default epilogue, 16-byte alignment; requires GPUs with compute capability 10.x or 11.0.

In addition, the following experimental features were added as part of grouped GEMM:

- Per-batch tensor-wide scaling for FP8 inputs, enabled by the new `cublasLtMatmulDescAttributes_t` entry `CUBLASLT_MATMUL_MATRIX_SCALE_PER_BATCH_SCALAR_32F`.
- Per-batch device-side alpha and beta, enabled by the new `cublasLtMatmulDescAttributes_t` entries `CUBLASLT_MATMUL_DESC_ALPHA_BATCH_STRIDE` and `CUBLASLT_MATMUL_DESC_BETA_BATCH_STRIDE`.
- Improved performance on NVIDIA DGX Spark for CFP32 GEMMs. [5514146]
- Added `sm_121` DriveOS support.
- Improved performance on Blackwell (`sm_100` and `sm_103`) via heuristics tuning for FP32 GEMMs whose shapes satisfy $M, N \gg K$. [CUB-8572]
- Improved performance of FP16, FP32, and CFP32 GEMMs on Blackwell Thor.

► Resolved Issues

- Fixed missing memory initialization in `cublasCreate()` that could result in emulation environment variables being ignored. [CUB-9302]
- Removed unnecessary overhead related to loading kernels on GPUs with compute capability 10.3. [5547886]

- ▶ Fixed FP8 matmuls potentially failing to launch on multi-device Blackwell GeForce systems. [CUB-9487]
- ▶ Added stricter checks for in-place matmul to prevent invalid use cases ($C == D$ is allowed if and only if $Cdesc == Ddesc$). As a side effect, users are no longer able to use D as a dummy pointer for C when using `CUBLASLT_POINTER_MODE_DEVICE` with $\beta = 0$. However, a distinct dummy pointer may still be passed. The stricter checking was added in CUDA Toolkit 13.0 Update 2. [5471880]
- ▶ Fixed `cublasLtMatmul` with INT8 inputs, INT32 accumulation, and INT32 outputs potentially returning `CUBLAS_STATUS_NOT_SUPPORTED` when dimension N is larger than 65,536 or when batch count is larger than 1. [5541380]
- ▶ Added validation for batched matmul to reject invalid configurations where the batch counts differ ($Adesc$ batch count $\neq Bdesc$ batch count). [5645772]
- ▶ **Known Issues**
 - ▶ The Grouped GEMM cuBLASLt API ignores groups with $k = 0$, which can lead to incorrect results. As a workaround, initialize each output matrix D with $\beta * C$ for all groups before the call, then compute Grouped GEMM as $D += A * B$ so that the result for groups with $k = 0$ is preserved. This issue applies to the experimental Grouped GEMM cuBLASLt API released in CUDA 13.1. [CUB-9529]
 - ▶ `cublasLtMatmul()` may produce incorrect results when run concurrently with another kernel that uses Tensor Memory. This issue affects only algorithms with `CUBLASLT_ALGO_CONFIG_ID` equal to 66 on GPUs with compute capability 10.x and 11.x, and has existed since cuBLAS 12.8. [5807900]
 - ▶ Strided batched GEMM operations using broadcast operands may perform out-of-bounds memory reads on GPUs with compute capability 12.0 or 12.1 when an input matrix shared across batches (via zero or overlapping strides) is smaller than a few hundred KB. Numerical accuracy is unaffected, but these invalid accesses can trigger compute-sanitizer warnings or, in rare instances, illegal memory access errors. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [6040940] [5996751]
 - ▶ cuBLAS GEMM kernels on GPUs with compute capability 10.x or 12.x may access device alpha and beta pointers before calling `cudaGridDependencySynchronize()`. This can result in a WAR hazard if the preceding PDL kernel produces alpha and beta values on device after calling `cudaTriggerProgrammaticLaunchCompletion()`. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [CUB-10409]

3.1.10. cuBLAS: Release 13.0 Update 2

- ▶ **New Features**
 - ▶ Enabled opt-in fixed-point emulation for FP64 matmuls (D/ZGEMM) which improves performance and power-efficiency. The implementation follows the [Ozaki-1 Scheme](#) and leverages an automatic dynamic precision framework to ensure FP64-level accuracy. See [here](#) for more details on fixed-point emulation along with the [table](#) of supported compute-capabilities and the [CUDA library samples](#) for example usages.
 - ▶ Improved performance on NVIDIA [DGX Spark](#) for FP16/BF16 and FP8 GEMMs.
 - ▶ Added support for [BF16x9 FP32 emulation](#) to `cublas[SC]syr[2]k` and `cublasCher[2]k` routines. With the math mode set to `CUBLAS_FP32_EMULATED_BF16X9_MATH`, for

large enough problems, cuBLAS will automatically dispatch SYRK and HERK to BF16x9-accelerated algorithms.

► **Resolved Issues**

- Fixed undefined behavior caused by dereferencing a `nullptr` when passing an uninitialized matrix layout descriptor for `Cdesc` in `cublasLtMatmul`. [CUB-8911]
- Improved performance of `cublas[SCDZ]syr[2]k` and `cublas[CZ]her[2]k` on Hopper GPUs when dimension `N` is large. [CUB-8293] [5384826]

► **Known Issues**

- `cublasLtMatmul` with INT8 inputs, INT32 accumulation, and INT32 outputs might return `CUBLAS_STATUS_NOT_SUPPORTED` when dimension `N` is larger than 65,536 or when the batch count is larger than 1. The issue has existed since CUDA Toolkit 13.0 Update 1 and will be fixed in a later release. [5541380]
- FP8 matmuls may fail to launch on multi-device Blackwell GeForce systems. As a workaround, run a separate process per device. [CUB-9487]
- `cublasLtMatmul()` may produce incorrect results when run concurrently with another kernel that uses Tensor Memory. This issue affects only algorithms with `CUBLASLT_ALGO_CONFIG_ID` equal to 66 on GPUs with compute capability 10.x and 11.x, and has existed since cuBLAS 12.8. [5807900]
- Strided batched GEMM operations using broadcast operands may perform out-of-bounds memory reads on GPUs with compute capability 12.0 or 12.1 when an input matrix shared across batches (via zero or overlapping strides) is smaller than a few hundred KB. Numerical accuracy is unaffected, but these invalid accesses can trigger compute-sanitizer warnings or, in rare instances, illegal memory access errors. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [6040940] [5996751]
- cuBLAS GEMM kernels on GPUs with compute capability 10.x or 12.x may access device alpha and beta pointers before calling `cudaGridDependencySynchronize()`. This can result in a WAR hazard if the preceding PDL kernel produces alpha and beta values on device after calling `cudaTriggerProgrammaticLaunchCompletion()`. This issue was introduced in CUDA Toolkit 13.0 Update 2 (cuBLAS 13.1.0). [CUB-10409]

3.1.11. cuBLAS: Release 13.0 Update 1

► **New Features**

- Improved performance:
 - Block-scaled FP4 GEMMs on NVIDIA Blackwell and Blackwell Ultra GPUs
 - SYMV on NVIDIA Blackwell GPUs [5171345]
 - `cublasLtMatmul` for small cases when run concurrently with other CUDA kernels [5238629]
 - TF32 GEMMs on Thor GPUs [5313616]
 - **Programmatic Dependent Launch (PDL)** is now supported in some cuBLAS kernels for architectures `sm_90` and above, decreasing kernel launch latencies when executed alongside other PDL kernels.

► **Resolved Issues**

- ▶ Fixed an issue where some `cublasSsyrrkx` kernels produced incorrect results when `beta = 0` on NVIDIA Blackwell GPUs. [CUB-8846]
- ▶ Resolved issues in `cublasLtMatmul` with INT8 inputs, INT32 accumulation, and INT32 outputs where:
 - ▶ `cublasLtMatmul` could have produced incorrect results when A and B matrices used regular ordering (`CUBLASLT_ORDER_COL` or `CUBLASLT_ORDER_ROW`). [CUB-8874]
 - ▶ `cublasLtMatmul` could have been run with unsupported configurations of `alpha/beta`, which must be 0 or 1. [CUB-8873]
- ▶ **Known Issues**
 - ▶ `cublasLtMatmul()` may produce incorrect results when run concurrently with another kernel that uses Tensor Memory. This issue affects only algorithms with `CUBLASLT_ALGO_CONFIG_ID` equal to 66 on GPUs with compute capability 10.x and 11.x, and has existed since cuBLAS 12.8. [5807900]

3.1.12. cuBLAS: Release 13.0

- ▶ **New Features**
 - ▶ The `cublasGemmEx`, `cublasGemmBatchedEx`, and `cublasGemmStridedBatchedEx` functions now accept `CUBLAS_GEMM_AUTOTUNE` as a valid value for the `algo` parameter. When this option is used, the library benchmarks a selection of available algorithms internally and chooses the optimal one based on the given problem configuration. The selected algorithm is cached within the current `cublasHandle_t`, so subsequent calls with the same problem descriptor will reuse the cached configuration for improved performance.

This is an experimental feature. Users are encouraged to transition to the `cuBLASLt` API, which provides fine-grained control over algorithm selection through the heuristics API and includes support for additional data types such as FP8 and block-scaled formats, as well as kernel fusion. (See autotuning example in [cuBLASLt](#)).

 - ▶ Improved performance of BLAS Level 3 non-GEMM kernels (SYRK, HERK, TRMM, SYMM, HEMM) for FP32 and CF32 precisions on NVIDIA Blackwell GPUs.
 - ▶ This release adds support for `sm_110` GPUs for `arm64-sbsa` on Linux.
- ▶ **Resolved Issues**
 - ▶ Fixed an issue where some `cublasZtrmm()` kernels produced incorrect results when `M` is equal to 1 and `side` is `CUBLAS_SIDE_RIGHT` on NVIDIA Ada and Blackwell GeForce-class GPUs. [5452663]
- ▶ **Known Issues**
 - ▶ `cublasLtMatmul` previously ignored user-specified auxiliary (Aux) data types for ReLU epilogues and defaulted to using a bitmask. The correct behavior is now enforced: an error is returned if an invalid Aux data type is specified for ReLU epilogues. [CUB-7984]
 - ▶ Some `cublasSsyrrkx()` kernels produce incorrect results when `beta` is equal to 0 on Blackwell GPUs. [CUB-8846]
 - ▶ `cublasLtMatmul()` may produce incorrect results when run concurrently with another kernel that uses Tensor Memory. This issue affects only algorithms with `CUBLASLT_ALGO_CONFIG_ID` equal to 66 on GPUs with compute capability 10.x and 11.x, and has existed since cuBLAS 12.8. [5807900]

► **Deprecations**

- The experimental feature for atomic synchronization along the rows (CUBLASLT_MATMUL_DESC_ATOMIC_SYNC_NUM_CHUNKS_D_ROWS) and columns (CUBLASLT_MATMUL_DESC_ATOMIC_SYNC_NUM_CHUNKS_D_COLS) of the output matrix which was deprecated in 12.8 has now been **removed**.
- Starting with this release, cuBLAS will return CUBLAS_STATUS_NOT_SUPPORTED if any of the following descriptor attributes are set but the corresponding scale is not supported:
 - CUBLASLT_MATMUL_DESC_A_SCALE_POINTER
 - CUBLASLT_MATMUL_DESC_B_SCALE_POINTER
 - CUBLASLT_MATMUL_DESC_D_SCALE_POINTER
 - CUBLASLT_MATMUL_DESC_D_OUT_SCALE_POINTER
 - CUBLASLT_MATMUL_DESC_EPILOGUE_AUX_SCALE_POINTER
- Previously, this restriction applied only to **non-narrow precision** matmuls. It now also applies to narrow precision matmuls when a scale is set for a non-narrow precision tensor.

3.2. cuFFT Library

3.2.1. cuFFT: Release 13.4

► **New Features**

- Added new plan property NVFFT_PLAN_PROPERTY_INT64_BLUESTEIN_ONLY to enforce Bluestein-only kernels.
- Added new plan property NVFFT_PLAN_PROPERTY_INT64_DISABLE_FMA to disable fused multiply-add contraction when using LTO kernels.

► **Resolved Issues**

- Added alignment checks that prevent unaligned memory access when using user-provided work areas.
- Fixed a correctness issue in real-side LTO callback kernels for R2C and C2R transforms. This issue was first identified in CUDA Toolkit 13.3 Update 1.

3.2.2. cuFFT: Release 13.3 Update 1

► **Known Issues**

- An issue identified in CUDA 13.3 affects the correctness of real-side LTO callback kernels for R2C and C2R transforms. It affects only even sizes above certain large thresholds (8192 or greater in single precision, or 4096 or greater in double precision) whose length has a largest prime factor of at least 127.

3.2.3. cuFFT: Release 13.3

► New Features

- Expanded LTO support to include transform sizes divisible by primes larger than 127, along with increased callback support.

► Resolved Issues

- Fixed an issue where `cufftXtQueryPlan` could result in floating-point exceptions when querying multi-GPU plans that are not single-batch one-dimensional FFTs. [5923044]

3.2.4. cuFFT: Release 13.2

► New Features

- Using cuFFT link-time optimized (LTO) kernels now requires NVRTC.

► Deprecations

- `cufftDebug` is deprecated and will be removed in a future release.

3.2.5. cuFFT: Release 13.1

► New Features

- Improved performance for transforms whose sizes are powers of 2, 3, 5, and 7 on Blackwell GPUs, in both single and double precision.
- Improved performance for selected power-of-two sizes in 2D and 3D transforms, in both single and double precision.
- Introduced an experimental cuFFT device API that provides host functions to query or generate device function code and exposes database metadata through a C++ header for use with the cuFFTDx library.

► Resolved Issues

- Fixed a correctness issue, identified in CUDA 13.0, that affected a very specific subset of kernels: half- and bfloat16-precision strided R2C and C2R FFTs of size 1.

3.2.6. cuFFT: Release 13.0 Update 1

► Known Issues

- In CUDA 13.0, a correctness issue affects a specific subset of kernels, namely half and bfloat precision size 1 strided R2C and C2R kernels. A fix will be included in a future CUDA release.

3.2.7. cuFFT: Release 13.0

► New Features

- Added new error codes:
 - CUFFT_MISSING_DEPENDENCY
 - CUFFT_NVRTC_FAILURE
 - CUFFT_NVJITLINK_FAILURE
 - CUFFT_NVSHMEM_FAILURE
- Introduced CUFFT_PLAN_NULL, a value that can be assigned to a `cufftHandle` to indicate a null handle. It is safe to call `cufftDestroy` on a null handle.
- Improved performance for single-precision C2C multi-dimensional FFTs and large power-of-2 FFTs.

► Known Issues

- An issue identified in CUDA 13.0 affects the correctness of a specific subset of cuFFT kernels, specifically half-precision and bfloat16 size-1 strided R2C and C2R transforms. A fix will be included in a future CUDA release.

► Deprecations

- Removed support for Maxwell, Pascal, and Volta GPUs, corresponding to compute capabilities earlier than Turing.
- Removed legacy cuFFT error codes:
 - CUFFT_INCOMPLETE_PARAMETER_LIST
 - CUFFT_PARSE_ERROR
 - CUFFT_LICENSE_ERROR
- Removed the `libcufft_static_nocallback.a` static library. Users should link against `libcufft_static.a` instead, as both are functionally equivalent.

3.3. cuSOLVER Library

3.3.1. cuSOLVER: Release 13.4

► New Features

- Further reduced device workspace for `cusolverDnXgesvd` when singular vectors are requested and the input matrix is tall-and-skinny ($m > n$).
- Reduced device workspace for `cusolverDnXgeev` by optimizing the Householder reflector accumulation (ORGHR) stage, enabling computation of larger eigenvalue problems within available GPU memory.

► Resolved Issues

- Fixed an issue where `cusolverDnXgetrf` silently discarded a NaN value in the input matrix instead of propagating it to the factored output. [5849138]

3.3.2. cuSOLVER: Release 13.3 Update 1

► New Features

- Improved `cusolverDnXgetrf` performance with pivoting for `sm_90`, `sm_100`, `sm_103`, and `sm_120`.

► Resolved Issues

- Fixed an issue where `cusolverDn{C/Z}sytrf()` and `cusolverDn{C/Z}sytrs()` with `devI piv == nullptr` could treat the complex symmetric input as Hermitian instead of symmetric, which could lead to incorrect results for complex symmetric problems. The documented symmetric factorization and solve behaviors have been restored.
- Fixed accuracy issues on ill-conditioned and rank-deficient matrices for `cusolverDnXgesvdp` and `cusolverDnXpolar`.

3.3.3. cuSOLVER: Release 13.3

► New Features

- Improved `cusolverDnXgeev` performance when computing eigenvectors by moving eigenvector post-processing from the host to the device.

► Known Issues

- The `cusolverDn{C,Z}sytrf` and `cusolverDnXsytrs` APIs assume that the complex input matrix A is Hermitian instead of symmetric when `devI piv` is set to `NULL`. This issue exists starting with CUDA Toolkit 13.1. [5797471]

3.3.4. cuSOLVER: Release 13.2 Update 1

► New Features

- Improved performance of `cusolverDnXgeqrf()` and `cusolverDn{S,D,C,Z}geqrf()` on `sm_90`, `sm_100`, `sm_103`, and `sm_120` for matrices with `m <= 65536`.
- Added the new public 64-bit interface `cusolverDnXpolar()`, which exposes the QDWH algorithm implementation for polar decomposition in cuSOLVERDn.
- Added the new public 64-bit interface `cusolverDnXstedc()`, which computes the eigenvalues and, optionally, eigenvectors of a symmetric tridiagonal matrix using the divide-and-conquer method.

3.3.5. cuSOLVER: Release 13.2

► New Features

- Added FP64 fixed-point emulation support to cuSOLVERDn. The following new APIs are available:
 - `cusolverDnSetFixedPointEmulationMantissaControl()`
 - `cusolverDnGetFixedPointEmulationMantissaControl()`
 - `cusolverDnSetFixedPointEmulationMaxMantissaBitCount()`
 - `cusolverDnGetFixedPointEmulationMaxMantissaBitCount()`
 - `cusolverDnSetFixedPointEmulationMantissaBitOffset()`
 - `cusolverDnGetFixedPointEmulationMantissaBitOffset()`
 - `cusolverDnSetEmulationSpecialValuesSupport()`
 - `cusolverDnGetEmulationSpecialValuesSupport()`
- Added the `cusolverDnXsygvd` API to support larger problem sizes.

► Known Issues

- Starting with CUDA Toolkit 13.1, `cusolverDn{C,Z}sytrf` and `cusolverDnXsytrs` assume the complex input matrix A is Hermitian (instead of symmetric) when `devI piv == NULL`. [5797471]

3.3.6. cuSOLVER: Release 13.1

► Resolved Issues

- Fixed a bug that prevented users from changing the algorithm for `cusolverDnXsyev-Batched` by using `cusolverDnSetAdvOptions`. [5539844]

3.3.7. cuSOLVER: Release 13.0 Update 1

► Resolved Issues

- Fixed a race condition in `cusolverDnXgeev` that could occur when using multiple host threads with either separate handles per thread or a shared handle, which caused execution to abort and returned `CUSOLVER_STATUS_INTERNAL_ERROR`.

3.3.8. cuSOLVER: Release 13.0

► New Features

- cuSOLVER offers a new math mode to leverage improved performance of [emulated FP32 arithmetic](#) on NVIDIA Blackwell GPUs.

To enable and control this feature, the following new APIs have been added:

- `cusolverDnSetMathMode()`
- `cusolverDnGetMathMode()`
- `cusolverDnSetEmulationStrategy()`
- `cusolverDnGetEmulationStrategy()`
- Performance improvements for `cusolverDnXsyevBatched()` have been made by introducing an internal algorithm switch on Blackwell GPUs for matrices of size $n \leq 32$.
To revert to the previous algorithm for all problem sizes, use [cusolverDnSetAdvOptions\(\)](#).
For more details, refer to the [cusolverDnXsyevBatched\(\)](#) documentation.

► Deprecations

- `cuSOLVERMg` is deprecated and may be removed in an upcoming major release. Users are encouraged to use [cuSOLVERMp](#) for multi-GPU functionality across both single and multi-node environments. To disable the deprecation warning, add the compiler flag `-DDISABLE_CUSOLVERMG_DEPRECATED`.
- `cuSOLVERSp` and `cuSOLVERRf` are fully deprecated and may be removed in an upcoming major release. Users are encouraged to use the [cuDSS](#) library for better performance and ongoing support.

For help with the transition, refer to the [cuDSS samples](#) or [CUDA samples](#) for migrating from `cuSOLVERSp` to `cuDSS`.

To disable the deprecation warning, add the compiler flag:
`-DDISABLE_CUSOLVER_DEPRECATED`.

► Resolved Issues

- The supported input matrix size for `cusolverDnXsyevd`, `cusolverDnXsyevdx`, `cusolverDnXsyevBatched`, `cusolverDn<t>syevd`, and `cusolverDn<t>syevdx` is no longer limited to $n \leq 32768$.

This update also applies to routines that share the same internal implementation: `cusolverDnXgesvdr`, `cusolverDnXgesvdp`, `cusolverDn<t>sygvd`, `cusolverDn<t>sygvdxd`, and `cusolverDn<t>gesvdaStridedBatched`.

3.4. cuSPARSE Library

3.4.1. cuSPARSE: Release 13.4

► **Known Issues**

- Mixed-precision CSR/COO SpMM is not supported in some cases. Refer to the cuSPARSE documentation for details.

► **Resolved Issues**

- Fixed a bug with cached parameters in SpMV0p.

3.4.2. cuSPARSE: Release 13.3 Update 1

► **New Features**

- Improved SpGEAM performance by an average of 40%. *[CUSPARSE-3361]*
- Reduced preprocessing time for SpMM ALG3.

► **Known Issues**

- Incorrect result when running BSR SDDMM on a very large matrix.

► **Resolved Issues**

- Fixed a rarely occurring issue in CSC and transposed CSR SpMV. *[5975307]*
- Fixed an accuracy issue in mixed-precision SELL SpMV.
- Fixed an issue with the algorithm configuration cache in SpMV0p.

3.4.3. cuSPARSE: Release 13.3

► **New Features**

- Added support for the CSC format in SpSV and SpSM.
- Improved CSR SpMV ALG2 performance by an average of 11%.
- Added the Generic API SpGEAM for sparse matrix-matrix addition.
- Added SpMV0p ALG1 with reduced preprocessing overhead.
- Added support for mixed index types in SpMV0p computation for CSR matrices with 64-bit offsets and 32-bit indices.
- Added support for the FP32 data type in SpMV0p.
- Avoided recompilation for the same epilogue in SpMV0p.
- Added mixed-precision support in SpMV for 32-bit input matrices and 64-bit input vectors.
- Added support for updating matrix values after preprocessing in SpMV0p ALG1.

► **Resolved Issues**

- Fixed a memory leak in `SpMVOp` when `destroy_lrb()` was called. [5974043]

3.4.4. cuSPARSE: Release 13.2 Update 1

► New Features

- Improved `cusparseSpMVOp_createDescr()` performance by up to 2.5x.
- Reduced `cusparseSpMVOp_createPlan()` planning latency for default epilogues through ahead-of-time compilation, avoiding JIT compilation in this case.

► Resolved Issues

- Fixed an issue that caused performance regressions in BSR SpMM for certain block sizes. [5860241]

► Deprecation

- Deprecated the `SpMMOp` and `SpGEMMreuse` APIs.

3.4.5. cuSPARSE: Release 13.2

► New Features

- Improved the runtime of the `SpMVOp::buffer_size_estimate` API.

3.4.6. cuSPARSE: Release 13.1 Update 1

► New Features

- Added a new `cusparseSpMVOp_bufferSize` API that returns the size of the workspace buffer required for `SpMVOp` computations. Users provide this buffer when creating `cusparseSpMVOpDescr_t`, removing internal memory allocations.
- Improved `SpMVOp` performance on B200. [CUSPARSE-2931] [CUSPARSE-2932] [CUSPARSE-2933]

► Resolved Issues

- Fixed an accuracy issue in mixed-precision CSR/COO SpMM computations. [CUSPARSE-2349]
- Fixed an issue in CSR SpMM computations when the input dense matrix has a high number of columns. [CUSPARSE-2301]

3.4.7. cuSPARSE: Release 13.1

► New Features

- Introduced an experimental Sparse Matrix-Vector Multiplication (SpMVOp) API that provides improved performance compared with the existing generic CsrMV API. This API supports CSR format with 32-bit indices, double precision, and user-defined epilogues.
- The nvJitLink shared library is now loaded dynamically at runtime.
- Improved `cusparsExcsrsort` with reduced memory usage and higher performance. [CUSPARSE-2630]

► Known Issues

- When using 32-bit indexing, `cusparsSpSV` and `cusparsSpSM` may crash if the number of nonzero elements (nnz) approaches $2^{31} - 1$. [CUSPARSE-2211]

► Resolved Issues

- Fixed potential issues when input and output pointers are not 16-byte aligned in `cusparsCsr2cscEx2`, `cusparsSparseToDense`, and CSR/COO `cusparsSpMM`. [CUSPARSE-2380]
- Fixed a determinism issue in CSR `cusparsSpMM` ALG3. [CUSPARSE-2612]
- All routines now support matrices with up to $2^{31} - 1$ nonzero elements (nnz) when using 32-bit indexing, with the exception of `cusparsSpSV` and `cusparsSpSM`. [CUSPARSE-2153]
- Fixed a potential race condition that could occur when dynamically loading driver APIs. [CUSPARSE-2764]

3.4.8. cuSPARSE: Release 13.0 Update 1

► New Features

- Added support for the BSR format in the generic SpMV API (CUSPARSE-2518).

► Deprecation

- Deprecated the legacy BSR SpMV API (replaced by the generic SpMV API).

► Resolved Issues

- Enabled all generic APIs to support zero-dimension matrices/vectors ($m, n, k = 0$) (CUSPARSE-2378).
- Enabled all generic APIs to support small-dimension matrices/vectors (small m , n , or k) (CUSPARSE-2379).
- Fixed incorrect results in mixed-precision CSR/COO SpMV computations (CUSPARSE-2349).

3.4.9. cuSPARSE: Release 13.0

► New Features

- Added support for 64-bit index matrices in SpGEMM computation. (*CUSPARSE-2365*)

► Known Issues

- cuSPARSE logging APIs can crash on Windows.
- CUSPARSE_SPM_CSR_ALG3 does not return deterministic results as stated in the documentation.

► Deprecation

- Dropped support for pre-Turing architectures (Maxwell, Volta, and Pascal).

► Resolved Issues

- Fixed a bug in `cusparseSparseToDense_bufferSize` that caused it to request up to 16× more memory than required. [*CUSPARSE-2352*]
- Fixed unwanted 16-byte alignment requirements on the external buffer. Most routines will now work with any alignment. In the generic API, only `cusparseSpGEMM` routines are still affected. [*CUSPARSE-2352*]
- Fixed incorrect results from `cusparseCsr2cscEx2` when any of the input matrix dimensions are zero, such as when $m = 0$ or $n = 0$. [*CUSPARSE-2319*]
- Fixed incorrect results from CSR SpMV when any of the input matrix dimensions are zero, such as when $m = 0$ or $n = 0$. [*CUSPARSE-1800*]

3.5. Math Library

3.5.1. CUDA Math: Release 13.4

► New Features

- Added new FP8 scaling factor type `__nv_fp8_ue5m3` and corresponding conversion operations in `cuda_fp8.h`. [*5482730*]

► Resolved Issues

- Fixed fp128 nearest integral functions returning off-by-one results in pathological cases. This fix also delivers performance improvements of 2x–8x for fp128 operations on GB200 and up to approximately 200x on RTX 5080, covering conversion, nearest integral, `frexp`, `ilogb`, `modf`, and multiplication. Fixed an underflow in fp128 hypot.
- Fixed `__hmin_nan` and `__hmax_nan` bfloat16 functions ignoring the sign of zero in emulation code paths for devices with compute capability below 8.0 and host CPUs; `-0.0` now correctly compares as less than `+0.0`. [*6182113*]
- Fixed `__nv_fp8_ue5m3` conversions from long integer types that could produce a result off by one. [*6182039*]

3.5.2. CUDA Math: Release 13.3

► Resolved Issues

- Fixed an issue where silent data corruption could occur when the CUDA Math API `__mul24()` intrinsic was called with compile-time constant inputs due to undefined behavior from compiler optimizations applied to overflowing signed integer multiplication. This issue was introduced in CUDA Toolkit 11.1 and resolved in CUDA Toolkit 13.3. [\[5807344\]](#)

3.5.3. CUDA Math: Release 13.2 Update 1

► Known Issues

- Silent data corruption can occur when the CUDA Math API `__mul24()` intrinsic is called with compile-time constant inputs. Compiler optimizations applied to overflowing signed integer multiplication can expose the program to undefined behavior. This issue was introduced in CUDA Toolkit 11.1 and will be fixed in a future release. [\[5807344\]](#)

3.5.4. CUDA Math: Release 13.2

► New Features

- Accuracy and performance improvements were made to the following libdevice single-precision math functions:
 - `expm1f()`: up to 20% faster, with minor accuracy improvements.
 - `erff()`: 5% to 10% faster, with minor accuracy improvements.

These gains come from algorithmic simplifications, reduced branching, and tighter approximations. [\[5480287\]](#)

► Resolved Issues

- ACLE extension support for GCC: ARM64 users, notice the behavior change for `__clz` and `__clzll` CUDA Math integer intrinsics: the signatures were updated to match the host compiler's declarations, relevant for GCC 11.4 onwards. The (un-)signedness of the return type of the intrinsic affects the caller code relying on integer types promotions. [\[6258270\]](#)

3.5.5. CUDA Math: Release 13.0

► New Features

- Single and double precision math functions received targeted performance and accuracy improvements through algorithmic simplifications, reduced branching, and tighter approximations.
 - `atan2f`, `atan2`: Up to 10% faster with minor improvements in accuracy.
 - `sinhf`, `coshf`, `acoshf`, `asinhf`, `asinh`: Up to 50% speedups with minor improvements in accuracy.
 - `cbrtf`, `rcbrtf`: 15% faster with minor improvements in accuracy.

- ▶ `erfinvf`, `erfcinvf`, `normcdfinvf`: Minor accuracy improvements, performance neutral.
- ▶ `ldexpf`, `ldexp`: Up to 3x faster in single precision and 30% faster in double precision, with no accuracy loss.
- ▶ `modff`, `modf`: Up to 50% faster in single precision and 10% faster in double precision, with no accuracy loss.

3.6. nvJPEG Library

3.6.1. nvJPEG: Release 13.4 Update 1

▶ Resolved Issues

- ▶ Fixed parsing issues that could cause crashes or hangs when decoding malformed JPEG bitstreams.

3.6.2. nvJPEG: Release 13.3 Update 1

▶ Resolved Issues

- ▶ Fixed an issue that would cause `nvjpegCreate*` calls to error out on Orin. [6176492]

3.6.3. nvJPEG: Release 13.3

▶ New Features

- ▶ Added support for region-of-interest decoding with `nvjpegDecodeBatchedEx` when using the `NVJPEG_BACKEND_LOSSLESS_JPEG` backend.

▶ Resolved Issues

- ▶ Fixed an issue with boundary handling when decoding a region of interest with `NVJPEG_FLAGS_UPSAMPLING_WITH_INTERPOLATION` enabled.

3.6.4. nvJPEG: Release 13.2 Update 2

▶ Known Issues

- ▶ `nvjpegCreate*` calls may error out on Orin due to compatibility issues with the `libnvcuvid.so` driver library. This issue is fixed in CUDA Toolkit 13.3 Update 1. [6176492]

3.6.5. nvJPEG: Release 13.2 Update 1

► New Features

- Added the NVJPEG_OUTPUT_UNCHANGEDI enum value to nvjpegOutputFormat_t for unchanged interleaved output. For chroma subsampling formats other than 4:4:4, chroma values are duplicated so that the chroma and luma dimensions match.

3.6.6. nvJPEG: Release 13.1 Update 1

► Resolved Issues

- Reduced nvJPEG encoder initialization time on Thor. [5533951]

3.6.7. nvJPEG: Release 13.1

► Resolved Issues

- nvJPEG's lossless JPEG 92 (lj92) implementation can now correctly handle lj92 files that contain a comment marker in the header. [5484797]

3.6.8. nvJPEG: Release 13.0 Update 1

► Resolved Issues

- Fixed a race condition in certain cases during progressive encoding [5307748].
- Fixed an uninitialized read when encoding images as 4:1:0 JPEG bitstreams [5308008].

3.6.9. nvJPEG: Release 13.0

► Deprecations

- Removed the nvjpegEncoderParamsCopyHuffmanTables API.

► Resolved Issues

- nvJPEG is now more robust and no longer crashes or exhibits undefined behavior when decoding malformed or truncated bitstreams. [5168024, 5133845, 5143450]
- nvjpegEncodeYUV now avoids reading outside of allocated device memory in certain cases. [5133826]
- Optimized memory usage when encoding RGB inputs using the hardware encoder.
- Fixed issues related to rounding in various transform, sampling, and conversion steps, improving image quality for both encoder and decoder. [5064901, 3976092]
- Various bug fixes for improved security.

3.7. NPP Library

3.7.1. NPP: Release 13.4

► Resolved Issues

- Fixed a regression in `nppiNV12ToRGB_8u_ColorTwist32f_P2C3R_Ctx` introduced in CUDA 12.9 that could render black NV12 frames as blue. [\[6229084\]](#)

3.7.2. NPP: Release 13.1

► Resolved Issues

- Fixed an issue in `nppiCFAToRGB_8u_C1C3R()` affecting SSIM validation for NPPI_BAYER_GBRG patterns. [\[5192648\]](#)

3.7.3. NPP: Release 13.0

► Deprecations

► Removal of Legacy Non-Context APIs

All legacy NPP APIs without the `_Ctx` suffix have been deprecated and are now removed starting with this release. Developers should transition to the context-aware (`_Ctx`) versions to ensure continued support and compatibility with the latest CUDA releases.

► Deprecation of `nppGetStreamContext()`

The `nppGetStreamContext()` API has been deprecated and removed. Developers are strongly encouraged to adopt application-managed stream contexts by explicitly managing the `NppStreamContext` structure. For guidance, refer to the [NPP Documentation – General Conventions](#).

► Resolved Issues

- Fixed an issue in `nppiFloodFillRange_8u_C1IR_Ctx` where the flood fill operation did not correctly fill the full target area. [\[5141474\]](#)
- Resolved a bug in the `nppiDebayer()` API that affected proper reconstruction of color data during Bayer pattern conversion. [\[5138782\]](#)

Chapter 4. Notices

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