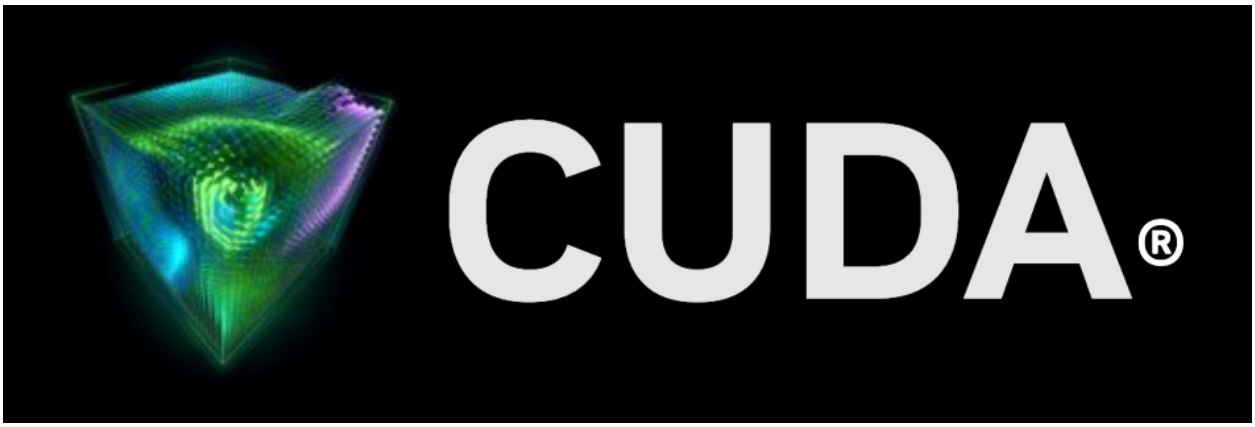

Release Notes

Release 13.2

NVIDIA Corporation

Apr 12, 2026

Contents

Chapter 1. Overview

CUDA Toolkit 13.2 Update 1 - Release Notes

Welcome to the release notes for NVIDIA® CUDA® Toolkit 13.2 Update 1. This release includes enhancements and fixes across the CUDA Toolkit and its libraries.

This documentation is organized into two main sections:

- **General CUDA**

  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.

Note: Starting March 9, 2026, cuBLAS patch releases are available independently of CUDA Toolkit releases for critical bug fixes. For the latest patch available for this release line, see the cuBLAS patch downloads page. For patch applicability to specific CUDA Toolkit releases, see the cuBLAS patch versions and release notes.

Chapter 2. General CUDA

2.1. CUDA Toolkit Major Components

Note: Starting with CUDA 11, individual components within the CUDA Toolkit (for example: compiler, libraries, tools) are versioned independently.

For CUDA 13.2 Update 1, the table below indicates the versions:

Table 1: CUDA 13.2 Update 1 Component Versions

Component Name		Version Information	Supported Architectures	Supported Platforms
CUDA C++ Core Compute Libraries	Thrust	3.2.0	x86_64, arm64-sbsa	Linux, Windows
	CUB	3.2.0		
	libcu++	3.2.0		
	Cooperative Groups	13.2.75		
CUDA Application Compiler (crt)		13.2.78	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA Compilation Optimizer (ctadvisor)		13.2.78	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA Runtime (cudart)		13.2.75	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA culibos		13.2.75	x86_64, arm64-sbsa	Linux
CUDA cuobjdump		13.2.78	x86_64, arm64-sbsa	Linux, Windows
CUPTI		13.2.75	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA cuxxfilt (demangler)		13.2.78	x86_64, arm64-sbsa	Linux, Windows

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Table 1 – continued from previous page

Component Name	Version Information	Supported Architectures	Supported Platforms
CUDA Documentation	13.2.75	x86_64	Linux, Windows
CUDA GDB	13.2.75	x86_64, arm64-sbsa	Linux, WSL
CUDA Nsight Eclipse Plugin	13.2.75	x86_64	Linux
CUDA NVCC	13.2.78	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA nvdisasm	13.2.78	x86_64, arm64-sbsa	Linux, Windows
CUDA NVML Headers	13.2.82	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA nvprune	13.2.78	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA NVRTC	13.2.78	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA NVTX	13.2.75	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA OpenCL	13.2.75	x86_64	Linux, Windows
CUDA Profiler API	13.2.75	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA Sandbox dev	13.2.82	x86_64, arm64-sbsa	Linux, WSL
CUDA Compute Sanitizer API	13.2.76	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA TILE-IR AS	13.2.78	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA cuBLAS	13.4.0.1	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA cuDLA	13.2.75	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA cuFFT	12.2.0.46	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA cuobjclient	1.1.1.22	x86_64, arm64-sbsa	Linux
CUDA cuFile	1.17.1.22	x86_64, arm64-sbsa	Linux
CUDA cuRAND	10.4.2.55	x86_64, arm64-sbsa	Linux, Windows, WSL

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Table 1 – continued from previous page

Component Name	Version Information	Supported Architectures	Supported Platforms
CUDA cuSOLVER	12.2.0.1	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA cuSPARSE	12.7.10.1	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA NPP	13.1.0.48	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA nvFatbin	13.2.78	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA nvJitLink	13.2.78	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA nvJPEG	13.1.0.48	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA nvptxcompiler	13.2.78	x86_64, arm64-sbsa	Linux, Windows, WSL
CUDA nvvm	13.2.78	x86_64, arm64-sbsa	Linux, Windows, WSL
Nsight Compute	2026.1.1.2	x86_64, arm64-sbsa	Linux, Windows, WSL (Windows 11)
Nsight Systems	2025.6.3.541	x86_64, arm64-sbsa	Linux, Windows, WSL
Nsight Visual Studio Edition (VSE)	2026.1.0.25345	x86_64 (Windows)	Windows
nvidia_fs[1]	2.28.4	x86_64, arm64-sbsa	Linux
nvlsm	2025.10.11	x86_64, arm64-sbsa	Linux
Visual Studio Integration	13.2.75	x86_64 (Windows)	Windows
NVIDIA Linux Driver	595.58.03	x86_64, arm64-sbsa	Linux

[1] Only available on select Linux distros

2.2. CUDA Driver

Running a CUDA application requires the system with at least one CUDA capable GPU and a driver that is compatible with the CUDA Toolkit. See Table 3. For more information various GPU products that are CUDA capable, visit https://developer.nvidia.com/cuda-gpus.

Each release of the CUDA Toolkit requires a minimum version of the CUDA driver. The CUDA driver is backward compatible, meaning that applications compiled against a particular version of the CUDA will continue to work on subsequent (later) driver releases.

More information on compatibility can be found at https://docs.nvidia.com/cuda/cuda-c-best-practices-guide/index.html#cuda-compatibility-and-upgrades.

Note: Starting with CUDA 11.0, the toolkit components are individually versioned, and the toolkit itself is versioned as shown in the table below.

The minimum required driver version for CUDA minor version compatibility is shown below. CUDA minor version compatibility is described in detail in https://docs.nvidia.com/deploy/cuda-compatibility/index.html

Table 2: 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

* Using a Minimum Required Version that is **different** from Toolkit Driver Version could be allowed in compatibility mode – please read the CUDA Compatibility Guide for details.

** Starting with CUDA 13.1, the Windows display driver is **no longer** bundled with the CUDA Toolkit package. Users must download and install the appropriate NVIDIA driver separately from the official driver download page.

For more information on supported driver versions, see the CUDA Compatibility Guide for drivers.

*** CUDA 11.0 was released with an earlier driver version, but by upgrading to Tesla Recommended Drivers 450.80.02 (Linux) / 452.39 (Windows), minor version compatibility is possible across the CUDA 11.x family of toolkits.

The version of the development NVIDIA GPU Driver packaged in each CUDA Toolkit release is shown below.

Table 3: CUDA Toolkit and Corresponding Driver Versions

CUDA Toolkit	Toolkit Driver Version	
	Linux x86_64 Driver Version	Windows x86_64 Driver Version
CUDA 13.2 Update 1	>=595.58.03	N/A

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Table 3 – continued from previous page

CUDA Toolkit	Toolkit Driver Version	
CUDA 13.2 GA	>=595.45.04	N/A
CUDA 13.1 Update 1	>=590.48.01	N/A
CUDA 13.1 GA	>=590.44.01	N/A
CUDA 13.0 Update 2	>=580.95.05	N/A
CUDA 13.0 Update 1	>=580.82.07	N/A
CUDA 13.0 GA	>=580.65.06	N/A
CUDA 12.9 Update 1	>=575.57.08	>=576.57
CUDA 12.9 GA	>=575.51.03	>=576.02
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

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CUDA Toolkit	Toolkit Driver Version	
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
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

- CUDA Toolkit driver bundling (pre-CUDA 13.1):
  - The CUDA Toolkit previously included an NVIDIA display driver for convenience.

- This bundled driver was intended only for development purposes.
- It is not recommended for production use, especially with Tesla GPUs.

- Recommended driver for Tesla GPUs:
  - For production environments using Tesla GPUs, download the latest certified driver from the official NVIDIA Driver Downloads site:

    https://www.nvidia.com/drivers

- Optional driver installation during Toolkit setup:
  - During CUDA Toolkit installation, users may choose to skip driver installation:
    - On Windows: via interactive or silent install options.
    - On Linux: by skipping driver meta packages.
- Change in CUDA 13.1 (Windows-specific):
  - Starting with CUDA 13.1, the Windows display driver is **no longer bundled** with the CUDA Toolkit.
  - Windows users must **manually download and install** the appropriate driver from the official NVIDIA site.
- Driver compatibility notes:
  - Some compatibility tables may list “N/A” for Windows driver versions.
  - Users must still ensure the installed driver meets or exceeds the minimum required version for the CUDA Toolkit.
  - For details, refer to the official CUDA Compatibility Guide for Drivers:

    https://docs.nvidia.com/deploy/cuda-compatibility/index.html

2.3. New Features

General CUDA

- No new features in this release.

CUDA Compiler

- For new features from PTX, refer to PTX ISA version 9.2.

2.3.1. 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.

- CUDA-C++-Programming-Guide.

2.4. Resolved Issues

2.4.1. CUDA Compiler

- No resolved issues in this release.

2.5. Known Issues

2.5.1. General CUDA

- On SLES 16 systems used for NVLink 5 testing, NVIDIA Fabric Manager may fail to start when DOCA OFED is installed.

  Symptom:

  NVIDIA Fabric Manager fails to start on SLES 16 systems used for NVLink 5 testing when DOCA OFED is installed.

  Problem Description:

  This issue can occur because the `ib_core` module is provided by both the SLES 16 kernel and DOCA OFED, which can lead to a module conflict.

  Workaround:

  Unload the SLES 16 kernel-provided `ib_core` module and load the DOCA OFED-provided `ib_core` module instead. After loading the DOCA OFED-provided module, NVIDIA Fabric Manager starts and the system operates correctly.

- CUDA initialization can fail on certain Linux kernels with KASLR enabled.

  Symptom:

  CUDA initialization fails. This issue is indicated by the following debug message:

  ```
  [64689.125237] nvidia-uvm: uvm_pmm_gpu.c:3176 devmem_alloc_pagemap[pid:92821]
  ↪request_free_mem_region() err -34
  ```

  Problem Description:

  Certain Linux kernels have a known issue in HMM initialization when KASLR is enabled.

  Workaround:

  Fixes for this issue are being handled in upstream kernels. In the meantime, you can use one of the following workarounds:

  - Option 1: Disable KASLR (preferred option)

    If using GRUB, edit `/etc/default/grub` and add `nokaslr` to `GRUB_CMDLINE_LINUX_DEFAULT`:

```
GRUB_CMDLINE_LINUX_DEFAULT="quiet splash nokaslr"
```

Then update GRUB and reboot:

```
sudo update-grub
sudo reboot
```

- Option 2: Disable HMM for UVM
  1. Create or edit `/etc/modprobe.d/uvm.conf`.
  2. Add or update the following line:

     ```
     options nvidia_uvm uvm_disable_hmm=1
     ```

  3. Unload and reload the `nvidia_uvm` kernel module, or reboot the system:

     ```
     sudo modprobe -r nvidia_uvm
     sudo modprobe nvidia_uvm
     ```

2.5.2. CUDA Compiler

- Data Race in WGMMA A/B Register Copy Propagation

  Symptom:

  Kernels that use `wgmma.mma_async` with `wgmma.wait_group.sync.aligned N` where `N >= 1` can produce incorrect numerical results when `mov` instructions are intentionally placed after the wait to prevent WGMMA input registers from being overwritten by in-flight HGMMAs.

  Problem Description:

  In pipelined warp-group MMA loops, `mov.b32` instructions are sometimes intentionally placed after `wgmma.wait_group.sync.aligned N` where `N > 0` to ensure that WGMMA input registers are not overwritten while HGMMAs from the previous iteration are still in flight. In this case, the compiler can incorrectly copy-propagate across `wgmma.wait_group.sync.aligned N` and eliminate those `mov` instructions.

  For example, in the following pattern, `ldmatrix.x4` feeds two consecutive WGMMA calls. The compiler eliminates the second `mov`, exposing the race:

```
$loop:
    ldmatrix.sync.aligned.m8n8.x4.shared.b16 {%r71, %r91, %r81, %r101}, [%r8];

    mov.b32 %r70, %r71;
    wgmma.fence.sync.aligned;
    wgmma.mma_async { }, {%r70, ..}, ...;
    wgmma.commit_group.sync.aligned;
    wgmma.wait_group.sync.aligned 1;

    mov.b32 %r80, %r81;                    // compiler eliminates this mov
    wgmma.fence.sync.aligned;
    wgmma.mma_async { }, {%r80, ..}, ...; // uses %r81 directly after copy
↪propagation
    wgmma.commit_group.sync.aligned;
    wgmma.wait_group.sync.aligned 1;
```

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```
    bra $loop;
    wgmma.wait_group.sync.aligned 0;
```

Possible workarounds:

1. Use `wgmma.wait_group.sync.aligned 0` to wait for all in-flight groups before the next `ldmatrix`.
2. Use individual `ldmatrix.x1` loads directly into WGMMA input registers, which avoids the `mov` pattern that triggers the incorrect copy propagation.

2.6. Deprecated or Dropped Features

2.6.1. General CUDA

- CUDA 13.0 deprecates the following legacy vector types:
  - `double4`
  - `long4`
  - `ulong4`
  - `longlong4`
  - `ulonglong4`

  These types are being replaced by new aligned variants:
  - `*_16a` and `*_32a` (e.g., `double4_16a`, `double4_32a`)

  Deprecation warnings can be managed as follows:
  - Globally silenced by defining `__NV_NO_VECTOR_DEPRECATION_DIAG`
  - Locally suppressed using the macro pair `__NV_SILENCE_HOST_DEPRECATION_BEGIN` / `__NV_SILENCE_HOST_DEPRECATION_END`

  These legacy types are planned for removal in CUDA 14.0.
- The **CUDA installer** for Windows **no longer** bundles the display driver. Users must install the display driver separately, either before or after installing the CUDA Toolkit.
- **Multi-device launch APIs** and related references for Cooperative Groups **have been removed**. These APIs were previously marked as deprecated in CUDA 12.x:
  - `cudaLaunchCooperativeKernelMultiDevice` has been removed from `cuda_runtime_api.h`.
  - The accompanying parameter struct `cudaLaunchParam` has been removed from `driver_types.h`.
  - `this_multi_grid` and `multi_grid_group` have been removed from `cooperative_groups.h`.

- **Changes to cudaDeviceProperties structure**:

  In CUDA 13.0, several deprecated fields have been removed from the `cudaDeviceProperties` structure. To ensure forward compatibility, use the recommended replacement APIs listed below:

  Removed Fields and Their Replacements

Removed Field	Replacement API
clockRate	`cudaDeviceGetAttribute(cudaDevAttrClockRate)`
deviceOverlap	Use the `asyncEngineCount` field
kernelExecTimeoutEnabled	`cudaDeviceGetAttribute(cudaDevAttrKernelExecTimeout)`
computeMode	`cudaDeviceGetAttribute(cudaDevAttrComputeMode)`
maxTexture1DLinear	`cudaDeviceGetTexture1DLinearMaxWidth()`
memoryClockRate	`cudaDeviceGetAttribute(cudaDevAttrMemoryClockRate)`
singleToDoublePrecisionPerfRatio	`cudaDeviceGetAttribute(cudaDevAttrSingleToDoublePrecisionPerfRat`
cooperativeMultiDeviceLaunch	*No replacement available*

  Removed cudaDeviceAttr Types (No Replacement Available)

  - `cudaDevAttrCooperativeMultiDeviceLaunch`
  - `cudaDevAttrMaxTimelineSemaphoreInteropSupported`

- The following legacy header files related to deprecated texture and surface references have been removed from the CUDA 13.0 runtime:
  - cuda_surface_types.h
  - cuda_texture_types.h
  - surface_functions.h
  - texture_fetch_functions.h

2.6.2. Deprecated Architectures

- Architecture support for Maxwell, Pascal, and Volta is considered feature-complete. Offline compilation and library support for these architectures have been removed in CUDA Toolkit 13.0 major version release. The use of CUDA Toolkits through the 12.x series to build applications for these architectures will continue to be supported, but newer toolkits will be unable to target these architectures.

2.6.3. Deprecated or Dropped Operating Systems

- Support for Ubuntu 20.04 has been dropped starting with this release. Users are advised to migrate to Ubuntu 22.04 LTS or later.

2.6.4. Deprecated or Dropped CUDA Toolchains

CUDA Tools

- As of CUDA 13.1, support for Nsight Eclipse Edition plugins is deprecated, and will be dropped in a future CUDA release.

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 13.2 Update 1

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

3.1.2. 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]syrk`, `cublas[D|Z]syr2k`, `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 on 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*]
- **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 `beta != 0` and `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 (`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 `op(A)` and C, and `n` is the number of columns of `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*]

3.1.3. 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 `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*]
- **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*]

3.1.4. 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 SM121 DriveOS support.
- Improved performance on Blackwell (`sm_100` and `sm_103`) via heuristics tuning for FP32 GEMMs whose shapes satisfy `M, N >> 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 != `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*]

3.1.5. 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*]

3.1.6. 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 `cublasSsyrkx` 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*]

3.1.7. 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 of SM110 GPUs for arm64-sbsa on Linux.

- **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]*
- **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 13.2

- **New Features**
  - Using cuFFT link-time optimized (LTO) kernels now requires NVRTC.
- **Deprecations**
  - `cufftDebug` is deprecated and will be removed in a future release.

3.2.2. 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.

3.2.3. 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.

3.2.4. 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 13.2 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.

3.3.2. 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 `devIpiv == NULL`.[*5797471*]

3.3.3. cuSOLVER: Release 13.1

- **Resolved Issues**
  - Fixed a bug that prevented users from changing the algorithm for `cusolverDnXsyevBatched` by using `cusolverDnSetAdvOptions`.[*5539844*]

3.3.4. 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.

3.3.5. 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 <= 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 <= 32768`.

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

3.4. cuSPARSE Library

3.4.1. 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.

3.4.2. cuSPARSE: Release 13.2

- **New Features**
  - Improved the runtime of the `SpMVOp::buffer_size_estimate` API.

3.4.3. 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*]

3.4.4. 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, `cusparseSpSV` and `cusparseSpSM` 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 `cusparseCsr2cscEx2`, `cusparseSparseToDense`, and CSR/COO `cusparseSpMM`. *[CUSPARSE-2380]*
  - Fixed a determinism issue in CSR `cusparseSpMM` 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 `cusparseSpSV` and `cusparseSpSM`. [*CUSPARSE-2153*]
  - Fixed a potential race condition that could occur when dynamically loading driver APIs. [*CUSPARSE-2764*]

3.4.5. 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)*.

3.4.6. 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_SPMM_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 13.2 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*]

3.5.2. 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*]

3.5.3. 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 13.2 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.

3.6.2. 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]*

3.6.3. 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*).

3.6.4. 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 13.1 Update 1

- **Resolved Issues**
  - Reduced nvJPEG Encoder initialization time on Thor. [*5533951*]

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 and the usage demonstrated in the StreamContexts example.
- **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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