



JAX

Release Notes

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Chapter 1. JAX Overview

[JAX](#) is a framework for high-performance numerical computing and machine learning research. It combines numpy-like APIs, automatic differentiation, XLA acceleration and simple primitives for scaling across GPUs.

The JAX NGC Container comes with all dependencies included, providing an easy place to start developing applications in areas such as NLP, computer vision, multimodality, physics-based simulations, reinforcement learning, drug discovery, and neural rendering.

The JAX NGC Container is optimized for GPU acceleration, and contains a validated set of libraries that enable and optimize GPU performance. This container may also include modifications to the JAX source code in order to maximize performance and compatibility. This container also includes software for accelerated Training ([cuDNN](#), [NCCL](#), [TransformerEngine](#)).

For working with neural networks, the JAX NGC Container includes [Flax](#), a neural network library with support for common deep learning models, layers and optimizers. We also include additional containers for training LLMs with [Paxml](#) and MaxText. You can use the JAX, Paxml, or MaxText containers for your deep learning workloads or install your own favorite libraries on top of them.

Chapter 2. Pulling A Container

About this task

Before you can pull a container from the NGC container registry:

- ▶ Install Docker.
 - ▶ For NVIDIA DGX™ users, see [Preparing to use NVIDIA Containers Getting Started Guide](#).
 - ▶ For non-DGX users, see NVIDIA® GPU Cloud™ (NGC) container registry [installation documentation](#) based on your platform.
- ▶ (Optional) Ensure that you have access and can log in to the NGC container registry.
Refer to [NGC Getting Started Guide](#) for more information.

The deep learning frameworks, the NGC Docker containers, and the deep learning framework containers are stored in the `nvcr.io/nvidia` repository.

Chapter 3. Running JAX

Before you begin

Before you can run an NGC deep learning framework container, your Docker[®] environment must support NVIDIA GPUs. To run a container, issue the appropriate command as explained in [Running A Container](#) and specify the registry, repository, and tags.

About this task

On a system with GPU support for NGC containers, when you run a container, the following occurs:

- ▶ The container runtime loads the image into a container which runs the software.
- ▶ You define the runtime resources of the container by including additional flags and settings that are used with the command.

These flags and settings are described in [Running A Container](#).

- ▶ The GPUs are explicitly defined for the Docker container (defaults to all GPUs, but can be specified by using the `NVIDIA_VISIBLE_DEVICES` environment variable).



Note: Starting in Docker 19.03, complete the steps below.

The method implemented in your system depends on the DGX OS version that you installed (for DGX systems), the NGC Cloud Image that was provided by a Cloud Service Provider, or the software that you installed to prepare to run NGC containers on TITAN PCs, Quadro PCs, or NVIDIA Virtual GPUs (vGPUs).

Procedure

1. Issue the command for the applicable release of the container that you want.

The following command assumes you want to pull the latest JAX core container, where 24.04 is the container version for the April 2024 release:

```
docker pull nvcr.io/nvidia/jax:24.04-py3
```

To pull the latest Paxml container:

```
docker pull nvcr.io/nvidia/jax:24.04-paxml-py3
```

To pull the latest MaxText container:

```
docker pull nvcr.io/nvidia/jax:24.04-maxtext-py3
```

2. In the terminal, paste the above command.

Ensure that the pull successfully completes before you proceed to step 3.

3. Run the container image:

- ▶ Use the following commands to run the container, where 24.04 is the container version:

```
docker run --gpus all -it --rm -v local_dir:container_dir nvcr.io/nvidia/jax:24.04-py3
```

If you use multiprocessing for multi-threaded data loaders, the default shared memory segment size with which the container runs might not be enough. Therefore, you should increase the shared memory size by issuing one of the following commands:

- ▶ **--ipc=host**

- ▶ **--shm-size=<requested memory size>**

in the command line to

```
docker run --gpus all
```

To pull data and model descriptions from locations outside the container for use by JAX or save results to locations outside the container, mount one or more host directories as [Docker® data volumes](#). This is done via the `-v` parameter in the example above.

Chapter 4. JAX Release 24.04

The NVIDIA container image for JAX, release 24.04 is available on [NGC](#).

Contents of the JAX container

This container image contains the complete source for the following software:

- ▶ JAX: /opt/jax
- ▶ XLA: /opt/xla
- ▶ Flax: /opt/flax
- ▶ TransformerEngine: /opt/transformer-engine

The JAX runtime package jaxlib is prebuilt and installed in the default Python environment (/usr/local/lib/python3.10/dist-packages/jaxlib) in the container image.

The container also includes the following:

- ▶ [JAX v0.4.26](#)
- ▶ [Ubuntu 22.04.2 LTS](#) with [Python 3.10](#)
- ▶ [NVIDIA CUDA® 12.4.1](#)
- ▶ [NVIDIA cuBLAS 12.4.5.8](#)
- ▶ [NVIDIA cuDNN 9.1.0.70](#)
- ▶ [NVIDIA NCCL 2.21.5](#)
- ▶ [rdma-core 39.0](#)
- ▶ NVIDIA HPC-X 2.18
- ▶ [Nsight Compute 2024.1.1.0](#)
- ▶ [Nsight Systems 2024.2.1.106](#)
- ▶ TransformerEngine 1.5

Driver Requirements

Release 23.10 is based on [CUDA 12.4.1](#), which requires [NVIDIA Driver](#) release 545 or later. However, if you are running on a data center GPU (for example, T4 or any other data center GPU), you can use NVIDIA driver release 470.57 (or later R470), 525.85 (or later R525), 535.86 (or later R535), or 545.23 (or later R545).

The CUDA driver's compatibility package only supports particular drivers. Thus, users should upgrade from all R418, R440, R450, R460, R510, and R520 drivers, which are not forward-compatible with CUDA 12.3. For a complete list of supported drivers, see the [CUDA Application Compatibility](#) topic. For more information, see [CUDA Compatibility and Upgrades](#).

Key Features and Enhancements

This JAX release includes the following key features and enhancements.

- ▶ JAX container images in version 24.04 are based on [jaxlib==0.4.26](#).
- ▶ PAXML and Maxtext containers are available in version 24.04.

JAX Toolbox

The JAX Toolbox [projects](#) focus on achieving the best performance and convergence on NVIDIA Hopper and Ampere tensor cores and provide the latest deep learning models and scripts for training and fine-tuning. These examples are tested against a nightly CI as well as each NGC container release to ensure consistent accuracy and performance over time.

Projects

- ▶ [GPT](#): Decoder-only LLM used in many modern text applications. You can also find the latest performance and convergence on the [model card](#).
- ▶ [LLaMA-2](#): Decoder-only LLM ranging in scale from 7B to 70B parameters. You can find the latest performance and convergence on our [model card](#).
 - ▶ This release also introduces LoRA support for fine-tuning of LLaMA models. We include an example script that finetunes LLaMA 2 7B on BoolQ and achieves significant metric improvements. You can find the convergence and performance results on the above model card.
 - ▶ LLaMA-2 recipes are also available in maxtext. You can find instructions and performance results on our [model card](#).
- ▶ MoE: GLaM style MoE with configs up to 1.14T parameter scale. You can find the latest information on our [model card](#).
- ▶ [T5](#): This model was introduced in the [Exploring the Limits of Transfer Learning with a Unified Text-to-Text Transformer](#) paper. This is a popular model for sequence-to-sequence modeling tasks. You can find the latest performance and convergence on our [model card](#).
- ▶ [ViT](#): The Vision Transformer was introduced in the [An Image is Worth 16x16 Words: Transformers for Image Recognition at Scale](#) paper. This is a popular computer vision model used for image classification, but is also a foundational model for GenAI applications such as Multimodal Language Models. The ViT model also showcases [NVIDIA DALI](#) data pipelines. This is particularly helpful for smaller models where data pipelines tend to be the bottleneck.

- [Imagen](#): Text-to-image generative diffusion model based on [Photorealistic Text-to-Image Diffusion Models with Deep Language Understanding](#) paper. You can find the latest performance and convergence on our [model card](#).

Nightly Containers

In addition to projects, JAX Toolbox includes nightly containers for libraries across the JAX ecosystem.

Container	Type	Image URI
jax	-	ghcr.io/nvidia/jax:jax
paxml	LLM framework	ghcr.io/nvidia/jax:pax
t5x	LLM framework	ghcr.io/nvidia/jax:t5x
levanter	LLM framework	ghcr.io/nvidia/jax:levanter
maxtext	LLM framework	ghcr.io/nvidia/jax:maxtext
triton	JAX extension	ghcr.io/nvidia/jax:triton
equinox	layer library	ghcr.io/nvidia/jax:equinox
grok	model	ghcr.io/nvidia/jax:grok

NVIDIA Tx5 and Paxml Container Versions

The following table shows what versions of CUDA and JAX are supported in each of the NVIDIA containers for JAX.

The JAX version in the Paxml and T5x containers are development versions. See `/opt/jax-source` and `/opt/xla-source` for the version used in each container.

Known Issues

- A JAX eigensolver unit test is failing due to a flaw in the test itself using a hard-coded workspace size. This should not impact real applications, where the workspace size is computed by the cuSolver API.
- There is a known convergence issue with GPT 126M when Flash Attention is enabled.
- There is a known divergence issue with Flash Attention in PAXML when enabled natively via XLA without Transformer Engine. If training models with TransformerEngine disabled/absent, it is recommended to run without Flash Attention by passing `--xla_gpu_enable_cudnn_fmha=false`.
- LLaMA fine-tuning via PAXML does not currently support FP8.
- MoE does not currently support TransformerEngine.
- There is a known CVE that affects the amd64 Paxml container related to TensorFlow 2.9.x due to pinning TensorFlow to 2.9.x in [Paxml](#). We will fix these in an upcoming release.

- ▶ [CVE-2023-25668](#)
- ▶ There is a known issue in the Maxtext container where failures may be observed if `--xla_gpu_enable_custom_fusions` and `--xla_gpu_enable_address_computation_fusion` flags are enabled. It is advised to disable these two flags by adding `--xla_gpu_enable_custom_fusions=false` and `--xla_gpu_enable_address_computation_fusion=false` to the `XLA_FLAGS` environment variable.

Chapter 5. JAX Release 24.03

There is no JAX container in DLFW release 24.03.

Chapter 6. JAX Release 24.02

There is no JAX container in DLFW release 24.02.

Chapter 7. JAX Release 23.12

There is no JAX container in DLFW release 23.12.

Chapter 8. JAX Release 23.10

The NVIDIA container image for JAX, release 23.10 is available on [NGC](#).

Contents of the JAX container

This container image contains the complete source of the version of JAX in `/opt/jax-source`. It is prebuilt and installed within the container image.

The container also includes the following:

- ▶ [Ubuntu 22.04.2 LTS](#) with [Python 3.10.12](#)
- ▶ [NVIDIA CUDA® 12.2.0](#)
- ▶ [NVIDIA cuBLAS 12.2.5.6](#)
- ▶ [NVIDIA cuDNN 8.9.5](#)
- ▶ [NVIDIA NCCL 2.19.3](#)
- ▶ [rdma-core 39.0](#)
- ▶ Mellanox OFED 5.9-0.5.6.0
- ▶ [Nsight Compute 2023.2.2.3](#)
- ▶ [Nsight Systems 2023.3.1.92](#)
- ▶ [NVIDIA DALI® 1.30.0](#) in T5x containers
- ▶ TransformerEngine
 - ▶ 1.0.0.dev0+1f4c397 in Paxml container
 - ▶ 0.13.0+511241c in T5x container

Driver Requirements

Release 23.10 is based on [CUDA 12.2.0](#), which requires [NVIDIA Driver](#) release 535 or later. However, if you are running on a data center GPU (for example, T4 or any other data center GPU), you can use NVIDIA driver release 450.51 (or later R450), 470.57 (or later R470), 510.47 (or later R510), or 525.85 (or later R525), or 535.86 (or later R535).

The CUDA driver's compatibility package only supports particular drivers. Thus, users should upgrade from all R418, R440, R460, and R520 drivers, which are not forward-compatible with CUDA 12.2. For a complete list of supported drivers, see the [CUDA](#)

[Application Compatibility](#) topic. For more information, see [CUDA Compatibility and Upgrades](#).

GPU Requirements

Release 23.10 supports CUDA compute capability 6.0 and later. This corresponds to GPUs in the NVIDIA Pascal, NVIDIA Volta™, NVIDIA Turing™, NVIDIA Ampere architecture, and NVIDIA Hopper™ architecture families. For a list of GPUs to which this compute capability corresponds, see [CUDA GPUs](#). For additional support details, see [Deep Learning Frameworks Support Matrix](#).

Key Features and Enhancements

This JAX release includes the following key features and enhancements.

- ▶ JAX container images in version 23.10 are based on [jaxlib==0.4.17](#).
- ▶ T5X and PAXML containers are available in version 23.10.
- ▶ PAXML arm64 containers are available: [nvcr.io/nvidia/jax:23.10-paxml-py3-arm64](#).
- ▶ PAXML ships with Hopper support for FP8 training.

Announcements

- ▶ [Transformer Engine](#) is a library for accelerating Transformer models on NVIDIA GPUs. It includes support for 8-bit floating point (FP8) precision on Hopper GPUs which provides better training and inference performance with lower memory utilization. Transformer Engine also includes a collection of highly optimized modules for popular Transformer architectures and an automatic mixed precision-like API that can be used seamlessly with your JAX code.

NVIDIA JAX Container Versions

The following table shows what versions of CUDA and JAX are supported in each of the NVIDIA containers for JAX.

Container Version	CUDA Toolkit	JAX
23.10	NVIDIA CUDA 12.2.0	0.4.17
23.08	NVIDIA CUDA 12.1.1	0.4.14

NVIDIA Tx5 and Paxml Container Versions

The following table shows what versions of CUDA and JAX are supported in each of the NVIDIA containers for JAX.

	Container Version	CUDA Toolkit	JAX
Paxml	23.10	NVIDIA CUDA 12.2.2	0.4.17.dev20231010

	Container Version	CUDA Toolkit	JAX
	23.08	NVIDIA CUDA 12.1.1	0.4.14 (579808d98)
T5x	23.10	NVIDIA CUDA 12.2.2	0.4.17.dev20231010
	23.08	NVIDIA CUDA 12.1.1	0.4.14 (603eeb190)

The JAX version in the Paxml and T5x containers are development versions. See `/opt/jax-source` and `/opt/xla-source` for the version used in each container.

Inspecting Source code in NVIDIA T5x and Paxml Containers

If you would like to inspect the pax's source code (paxml and praxis) to learn more about what is being run, you can do so by inspecting the source within the `nvcr.io/nvidia/jax:23.10-paxml-py3` container. Their locations within the container are:

- ▶ Paxml: `/opt/paxml`
- ▶ Praxis: `/opt/praxis`

Similarly, for t5x's source code in `nvcr.io/nvidia/jax:23.10-t5x-py3`:

- ▶ t5x: `/opt/t5x`

JAX Toolbox Examples

The JAX Toolbox [examples](#) focus on achieving the best performance and convergence from NVIDIA Hopper and NVIDIA Ampere architecture tensor cores by using the latest deep learning example networks and model scripts for training.

These examples are tested against a nightly CI as well as each NGC container release to ensure consistent accuracy and performance over time.

- ▶ [GPT model](#): This is a decoder-only LLM architecture used in many modern text applications. This model script is available on [Github](#). You can also find the latest performance and secured convergence on the [model card](#) on Github.
- ▶ [T5 model](#): This model was introduced in the [Exploring the Limits of Transfer Learning with a Unified Text-to-Text Transformer](#) paper. This is a popular model for sequence-to-sequence modeling tasks involving text. This model script is available on [Github](#). You can also find the latest performance and secured convergence on the [model card](#) on Github.
- ▶ [ViT model](#): The Vision Transformer was introduced in the [An Image is Worth 16x16 Words: Transformers for Image Recognition at Scale](#) paper. This is a popular computer vision model used for image classification, but is also a foundational model for GenAI applications such as Multimodal Language Models. The ViT model also showcases NVIDIA DALI data pipelines. This is particularly helpful for smaller models where data pipelines tend to be the bottleneck. The model script is available on [Github](#). You can also find the latest performance and secured convergence on the [model card](#) on Github.

Known Issues

- ▶ Pipeline parallelism is not supported with NVIDIA Transformer Engine enabled in the Paxml container.
- ▶ There could be random failures when running JAX in single-process with multi-GPU. This is a known issue due to the XLA version in the 23.10 containers. The issue will be resolved in the next release and the recommendation is to run with multi-processing enabled (1 GPU per process).
- ▶ There is a known degradation in accuracy in the Paxml container when training with enabling dropout in transformer layers from TransformerEngine. This issue will be resolved in a future container release.
- ▶ Performance degradation:
 - ▶ There is a 10% performance regression on Paxml's 126M parameter model, trained with BF16 on A100s, when NVIDIA Transformer Engine is disabled. This will be fixed in a future release.
 - ▶ There is a 1-2% performance regression in the 23.10 Paxml container compared to the 23.08 Paxml container on A100s.
 - ▶ ViT has an 11% pretraining performance regression in the T5X container compared to the [initial JAX-Toolbox release container](#).
 - ▶ The T5 model in T5x has a 6-9% performance regression.
- ▶ The JAX, T5x, and Paxml containers are an early release and have some differences from the [NGC TensorFlow](#) container that will be addressed in future releases. Some differences include CUDA minor version, support for 3rd party network devices via HPC-X, and versions of CTK/cuDNN/NCCL and so on. Some packages that do not currently ship include:
 - ▶ JupyterLab including Jupyter-TensorBoard
 - ▶ NVIDIA TensorRT
 - ▶ TensorBoard
 - ▶ NVIDIA HPC-X with UCX and OpenMPI
 - ▶ OpenMPI
 - ▶ NVIDIA RAPIDS
 - ▶ cuTENSOR
 - ▶ GDRCopy
- ▶ The `jax.experimental.sparse` sparse matrix package currently produces incorrect matrix multiplication results on NVIDIA Ampere architecture/Hopper GPUs. Volta GPUs appear to not be affected. See detailed issue [here](#).
- ▶ There are known CVEs that affect the amd64 Paxml container related to TensorFlow 2.9.x due to pinning TensorFlow to 2.9.x in [Paxml](#) and [Lingvo](#). We will fix these in an upcoming release. The known CVEs are:

- ▶ [CVE-2023-25668](#)
- ▶ [CVE-2023-25658](#)
- ▶ [CVE-2023-25663](#)
- ▶ [CVE-2023-25664](#)
- ▶ [CVE-2023-25664](#)
- ▶ [CVE-2023-25672](#)
- ▶ [CVE-2023-25674](#)
- ▶ [CVE-2023-25660](#)
- ▶ [CVE-2023-27579](#)
- ▶ [CVE-2023-25671](#)
- ▶ [CVE-2023-25659](#)
- ▶ [CVE-2023-25662](#)
- ▶ [CVE-2023-25675](#)
- ▶ [CVE-2023-25801](#)
- ▶ [CVE-2023-25670](#)
- ▶ [CVE-2023-25669](#)
- ▶ [CVE-2023-25665](#)
- ▶ [CVE-2023-25673](#)
- ▶ [CVE-2023-25666](#)

Chapter 9. JAX Release 23.08

The NVIDIA container image for JAX, release 23.08 is available on [NGC](#).

Contents of the JAX container

This container image contains the complete source of the version of JAX in `/opt/jax-source`. It is prebuilt and installed within the container image.

The container also includes the following:

- ▶ [Ubuntu 22.04.2 LTS](#) with [Python 3.10.12](#)
- ▶ [NVIDIA CUDA® 12.1.1](#)
- ▶ [NVIDIA cuBLAS 12.2.5](#)
- ▶ [NVIDIA cuDNN 8.9.4](#)
- ▶ [NVIDIA NCCL 2.18.3](#)
- ▶ [rdma-core 39.0](#)
- ▶ Mellanox OFED 5.9-0.5.6.0
- ▶ [Nsight Compute 2023.2.0](#)
- ▶ [Nsight Systems 2023.2.0](#)
- ▶ [NVIDIA DALI® 1.28.0](#) in Paxml and T5x containers
- ▶ TransformerEngine 0.13.0.dev0+03202c3 in Paxml and T5x containers

Driver Requirements

Release 23.08 is based on [CUDA 12.1.1](#), which requires [NVIDIA Driver](#) release 525.60.13 or later. However, if you are running on a data center GPU (for example, T4 or any other data center GPU), you can use NVIDIA driver release 450.51 (or later R450), 470.57 (or later R470), 510.47 (or later R510), or 525.85 (or later R525).

The CUDA driver's compatibility package only supports particular drivers. Thus, users should upgrade from all R418, R440, R460, and R520 drivers, which are not forward-compatible with CUDA 12.1. For a complete list of supported drivers, see the [CUDA Application Compatibility](#) topic. For more information, see [CUDA Compatibility and Upgrades](#).

GPU Requirements

Release 23.08 supports CUDA compute capability 6.0 and later. This corresponds to GPUs in the NVIDIA Pascal, NVIDIA Volta™, NVIDIA Turing™, NVIDIA Ampere architecture, and NVIDIA Hopper™ architecture families. For a list of GPUs to which this compute capability corresponds, see [CUDA GPUs](#). For additional support details, see [Deep Learning Frameworks Support Matrix](#).

Key Features and Enhancements

This JAX release includes the following key features and enhancements.

- ▶ JAX container images in version 23.08 are based on jaxlib==0.4.14.
- ▶ T5X and PAXML containers are available in version 23.08.

Announcements

- ▶ [Transformer Engine](#) is a library for accelerating Transformer models on NVIDIA GPUs. It includes support for 8-bit floating point (FP8) precision on Hopper GPUs which provides better training and inference performance with lower memory utilization. Transformer Engine also includes a collection of highly optimized modules for popular Transformer architectures and an automatic mixed precision-like API that can be used seamlessly with your JAX code.

NVIDIA JAX Container Versions

The following table shows what versions of CUDA and JAX are supported in each of the NVIDIA containers for JAX.

Container Version	CUDA Toolkit	JAX
23.08	NVIDIA CUDA 12.1.1	0.4.14

NVIDIA Tx5 and Paxml Container Versions

The following table shows what versions of CUDA and JAX are supported in each of the NVIDIA containers for JAX.

	Container Version	CUDA Toolkit	JAX
Paxml	23.08	NVIDIA CUDA 12.1.1	0.4.14 (579808d98)
T5x	23.08	NVIDIA CUDA 12.1.1	0.4.14 (603eeb190)

The JAX version in the Paxml and T5x containers are development versions. See `/opt/jax-source` and `/opt/xla-source` for the version used in each container.

Inspecting Source code in NVIDIA T5x and Paxml Containers

If you would like to inspect the pax's source code (paxml and praxis) to learn more about what is being run, you can do so by inspecting the source within the `nvcr.io/nvidia/jax:23.08-paxml-py3` container. Their locations within the container are:

- ▶ Paxml: `/opt/paxml`
- ▶ Praxis: `/opt/praxis`

Similarly, for t5x's source code in `nvcr.io/nvidia/jax:23.08-t5x-py3`:

- ▶ t5x: `/opt/t5x`

JAX Toolbox Examples

The JAX Toolbox [examples](#) focus on achieving the best performance and convergence from NVIDIA Hopper and NVIDIA Ampere architecture tensor cores by using the latest deep learning example networks and model scripts for training.

These examples are tested against a nightly CI as well as each NGC container release to ensure consistent accuracy and performance over time.

- ▶ [GPT model](#): This is a decoder-only LLM architecture used in many modern text applications. This model script is available on [Github](#). You can also find the latest performance and secured convergence on the [model card](#) on Github.
- ▶ [T5 model](#): This model was introduced in the [Exploring the Limits of Transfer Learning with a Unified Text-to-Text Transformer](#) paper. This is a popular model for sequence-to-sequence modeling tasks involving text. This model script is available on [Github](#). You can also find the latest performance and secured convergence on the [model card](#) on Github.

Known Issues

- ▶ Pipeline parallelism is not supported with NVIDIA Transformer Engine enabled in the Paxml container.
- ▶ There is a 15% performance regression on Paxml's 126M parameter model, trained with BF16 on A100s, when NVIDIA Transformer Engine is disabled. This will be fixed in a future release.
- ▶ The Paxml container (`nvcr.io/nvidia/jax:23.08-paxml-py3`) does not fully support Hopper yet. Future releases will add Hopper support.
- ▶ There is a known sporadic NCCL crash that happens when using the T5x container at node counts greater than or equal to 32 nodes. We will fix this in a future release. The issue is tracked [here](#).
- ▶ The JAX, T5x, and Paxml containers are an early release and have some differences from the [NGC TensorFlow](#) container that will be addressed in future releases. Some differences include CUDA minor version, support for 3rd party network devices via

HPC-X, and versions of CTK/cuDNN/NCCL and so on. Some packages that do not currently ship include:

- ▶ JupyterLab including Jupyter-TensorBoard
- ▶ NVIDIA TensorRT
- ▶ TensorBoard
- ▶ NVIDIA HPC-X with UCX and OpenMPI
- ▶ OpenMPI
- ▶ NVIDIA RAPIDS
- ▶ cuTENSOR
- ▶ GDRCopy
- ▶ The `jax.experimental.sparse` sparse matrix package currently produces incorrect matrix multiplication results on NVIDIA Ampere architecture/Hopper GPUs. Volta GPUs appear to not be affected. See detailed issue [here](#).
- ▶ There are known CVEs that affect the Paxml container related to TensorFlow 2.9.x due to pinning TensorFlow to 2.9.x in [Paxml](#) and [Lingvo](#). We will fix these in an upcoming release. The known CVEs are:
 - ▶ [CVE-2023-25668](#)
 - ▶ [CVE-2023-25658](#)
 - ▶ [CVE-2023-25663](#)
 - ▶ [CVE-2023-25664](#)
 - ▶ [CVE-2023-25664](#)
 - ▶ [CVE-2023-25672](#)
 - ▶ [CVE-2023-25674](#)
 - ▶ [CVE-2023-25660](#)
 - ▶ [CVE-2023-27579](#)
 - ▶ [CVE-2023-25671](#)
 - ▶ [CVE-2023-25659](#)
 - ▶ [CVE-2023-25662](#)
 - ▶ [CVE-2023-25675](#)
 - ▶ [CVE-2023-25801](#)
 - ▶ [CVE-2023-25670](#)
 - ▶ [CVE-2023-25669](#)
 - ▶ [CVE-2023-25665](#)
 - ▶ [CVE-2023-25673](#)
 - ▶ [CVE-2023-25666](#)

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