NVIDIA TensorRT

Installation Guide | NVIDIA Docs

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Chapter 1. Overview

The core of NVIDIA® TensorRT™ is a C++ library that facilitates high-performance inference on NVIDIA graphics processing units (GPUs). TensorRT takes a trained network, which consists of a network definition and a set of trained parameters, and produces a highly optimized runtime engine that performs inference for that network.

TensorRT provides API's via C++ and Python that help to express deep learning models via the Network Definition API or load a pre-defined model via the parsers that allow TensorRT to optimize and run them on an NVIDIA GPU. TensorRT applies graph optimizations, layer fusion, among other optimizations, while also finding the fastest implementation of that model leveraging a diverse collection of highly optimized kernels. TensorRT also supplies a runtime that you can use to execute this network on all of NVIDIA's GPU's from the NVIDIA Kepler™ generation onwards.

TensorRT also includes optional high speed mixed precision capabilities with the NVIDIA Pascal™, NVIDIA Volta™, NVIDIA Turing™, NVIDIA Ampere, and NVIDIA Hopper™ Architectures.

Chapter 2. Getting Started

Ensure you are familiar with the following installation requirements and notes.

- If you are using the TensorRT Python API and PyCUDA isn't already installed on your system, see Installing PyCUDA. If you encounter any issues with PyCUDA usage, you may need to recompile it yourself. For more information, refer to Installing PyCUDA on Linux.
- Ensure you are familiar with the *NVIDIA TensorRT Release Notes*.
- Verify that you have the NVIDIA CUDA® toolkit installed. If CUDA is not already installed, review the CUDA Installation Guide for instructions on how to install the CUDA Toolkit. The following versions are supported:
  - 11.8
  - 11.7 update 1
  - 11.6 update 2
  - 11.5 update 2
  - 11.4 update 4
  - 11.3 update 1
  - 11.2 update 2
  - 11.1 update 1
  - 11.0 update 1
  - 10.2
- Verify that you have cuDNN installed. Review the cuDNN Installation Guide if you do not already have cuDNN installed since it's a runtime requirement for TensorRT. TensorRT 8.5.3 supports cuDNN 8.6.0.
- The TensorFlow to TensorRT model export requires TensorFlow 1.15.5. Some Python samples require TensorFlow 2.5.1, such as `efficientdet` and `efficientnet`.
- The PyTorch examples have been tested with PyTorch 1.11.0, but may work with older versions.
- The ONNX-TensorRT parser has been tested with ONNX 1.12.0 and supports opset 16.
- If the target system has both TensorRT and one or more training frameworks installed on it, the simplest strategy is to use the same version of cuDNN for the training frameworks as expected by TensorRT. If this is not possible, or for

some reason strongly undesirable, be careful to properly manage the side-by-side installation of cuDNN on the single system. In some cases, depending on the training framework being used, this may not be possible without patching the training framework sources.

- The installation instructions below assume you want the full TensorRT; both the C++ and Python APIs. In some environments and use cases, you may not want to install the Python functionality. If that is the case, simply don't install the Debian or RPM packages labeled Python or the `whl` files. None of the C++ API functionality depends on Python. You would need to install the UFF `whl` file if you want to export UFF files from TensorFlow models.

Chapter 3. Installing TensorRT

You can choose between the following installation options when installing TensorRT; Debian or RPM packages, a Python wheel file, a tar file, or a zip file.

The Debian and RPM installations automatically install any dependencies, however, it:

- requires `sudo` or root privileges to install
- provides no flexibility as to which location TensorRT is installed into
- requires that the CUDA toolkit and cuDNN have also been installed using Debian or RPM packages.
- does not allow more than one minor version of TensorRT to be installed at the same time

The tar file provides more flexibility, such as installing multiple versions of TensorRT at the same time. However, you need to ensure that you have the necessary dependencies already installed and you must manage `LD_LIBRARY_PATH` yourself. For more information, see Tar File Installation.

The zip file is the only option currently for Windows. It does not support any other platforms besides Windows. Ensure that you have the necessary dependencies already installed. For more information, see Zip File Installation.

TensorRT versions: TensorRT is a product made up of separately versioned components. The version of the product conveys important information about the significance of new features while the library version conveys information about the compatibility or incompatibility of the API. The following table shows the versioning of the TensorRT components.

Table 1. Versioning of TensorRT components

Product or Component	Previously Released Version	Current Version	Version Description
TensorRT product	8.5.2	8.5.3	+1.0.0 when significant new

Product or Component		Previously Released Version	Current Version	Version Description
				capabilities are added. +0.1.0 when capabilities have been improved.
`nvinfer` libraries, headers, samples, and documentation.		8.5.2	8.5.3	+1.0.0 when the API or ABI changes in a non-compatible way. +0.1.0 when the API or ABI changes are backward compatible
UFF	`uff-converter-tf` Debian and RPM packages	8.5.2	8.5.3	+0.1.0 while we are developing the core functionality. Set to 1.0.0 when we have all base functionality in place.
	`uff-*.whl` file	0.6.9	0.6.9	
`graphsurgeon`	`graphsurgeon-tf` Debian and RPM packages	8.5.2	8.5.3	+0.1.0 while we are developing the core functionality. Set to 1.0.0 when we have all base functionality in place.
	`graphsurgeon-*.whl` file	0.4.6	0.4.6	
`onnx-graphsurgeon`	`onnx-graphsurgeon` Debian and RPM packages	8.5.2	8.5.3	+0.1.0 while we are developing the core functionality. Set to 1.0.0 when we have all base
	`onnx_graphsurgeon-*.whl` file	0.3.12	0.3.12	

Product or Component		Previously Released Version	Current Version	Version Description
				functionality in place.
`libnvinfer` Python packages	▶ `python3-libnvinfer` ▶ `python3-libnvinfer-dev` Debian and RPM packages	8.5.2	8.5.3	+1.0.0 when the API or ABI changes in a non-compatible way. +0.1.0 when the API or ABI changes are backward compatible.
	`tensorrt.whl` file	8.5.2	8.5.3	

3.1. Python Package Index Installation

This section contains instructions for installing TensorRT from the Python Package Index.

When installing TensorRT from the Python Package Index, you're not required to install TensorRT from a `.tar`, `.deb`, or `.rpm` package. All required libraries are included in the Python package. However, the header files, which may be needed if you want to access TensorRT C++ APIs or to compile plugins written in C++, are not included. Additionally, if you already have the TensorRT C++ library installed, using the Python package index version will install a redundant copy of this library, which may not be desirable. Refer to Tar File Installation for information on how to manually install TensorRT wheels that do not bundle the C++ libraries. You can stop after this section if you only need Python support.

The `tensorrt` Python wheel files only support Python versions 3.8 to 3.12 at this time and will not work with other Python versions. Only the Linux operating system and x86_64 CPU architecture is currently supported. These Python wheel files are expected to work on RHEL 8 or newer and Ubuntu 20.04 or newer.

Note: If you do not have root access, you are running outside a Python virtual environment, or for any other reason you would prefer a user installation, then append `--user` to any of the `pip` commands provided.

1. Ensure the `pip` Python module is up-to-date and the `wheel` Python module is installed before proceeding or you may encounter issues during the TensorRT Python installation.

```
python3 -m pip install --upgrade pip
```

```
python3 -m pip install wheel
```

2. Install the TensorRT Python wheel.

```
python3 -m pip install --upgrade tensorrt
```

The above `pip` command will pull in all the required CUDA libraries in Python wheel format from PyPI because they are dependencies of the TensorRT Python wheel. Also, it will upgrade `tensorrt` to the latest version if you had a previous version installed.

A TensorRT Python Package Index installation is split into multiple modules:

- TensorRT libraries (`tensorrt_libs`)
- Python bindings matching the Python version in use (`tensorrt_bindings`)
- Frontend source package, which pulls in the correct version of dependent TensorRT modules from pypi.nvidia.com (`tensorrt`)
- You can append `-cu11` or `-cu12` to any of the Python modules if you require a different CUDA major version. When unspecified, the TensorRT Python meta-packages default to the CUDA 12.x variants, which is the latest CUDA version supported by TensorRT.

Optionally, install the TensorRT lean or dispatch runtime wheels, which are similarly split into multiple Python modules. If you are only using TensorRT to run pre-built version compatible engines, you can install these wheels without installing the regular TensorRT wheel.

```
python3 -m pip install --upgrade tensorrt_lean
python3 -m pip install --upgrade tensorrt_dispatch
```

3. To verify that your installation is working, use the following Python commands to:

- Import the `tensorrt` Python module.
- Confirm that the correct version of TensorRT has been installed.
- Create a `Builder` object to verify that your CUDA installation is working.

```
python3
>>> import tensorrt
>>> print(tensorrt.__version__)
>>> assert tensorrt.Builder(tensorrt.Logger())
```

Use a similar procedure to verify that the lean and dispatch modules work as expected:

```
python3
>>> import tensorrt_lean as trt
>>> print(trt.__version__)
>>> assert trt.Runtime(trt.Logger())

python3
>>> import tensorrt_dispatch as trt
>>> print(trt.__version__)
>>> assert trt.Runtime(trt.Logger())
```

If the final Python command fails with an error message similar to the error message below, then you may not have the NVIDIA driver installed or the NVIDIA driver may not be working properly. If you are running inside a container, then try starting from one of the `nvidia/cuda:x.y-base-<os>` containers.

```
[TensorRT] ERROR: CUDA initialization failure with error 100. Please check your CUDA
 installation: ...
```

If the preceding Python commands worked, then you should now be able to run any of the TensorRT Python samples to further confirm that your TensorRT installation is working. For more information about TensorRT samples, refer to the NVIDIA TensorRT Sample Support Guide.

3.2. Downloading TensorRT

Ensure you are a member of the NVIDIA Developer Program. If not, follow the prompts to gain access.

1. Go to: https://developer.nvidia.com/tensorrt.
2. Click GET STARTED, then click Download Now.
3. Select the version of TensorRT that you are interested in.
4. Select the check-box to agree to the license terms.
5. Click the package you want to install. Your download begins.

3.2.1. Debian Installation

This section contains instructions for a developer installation. This installation method is for new users or users who want the complete developer installation, including samples and documentation for both the C++ and Python APIs.

For advanced users who are already familiar with TensorRT and want to get their application running quickly, are using an NVIDIA CUDA container, or want to set up automation, follow the network repo installation instructions (refer to Using The NVIDIA CUDA Network Repo For Debian Installation).

Note:

- The following commands are examples for `amd64`, however, the commands are identical for `arm64`.
- When installing Python packages using this method, you must install dependencies manually with `pip`.

Ensure that you have the following dependencies installed.

- CUDA 11.0 update 3, 11.1 update 1, 11.2 update 2, 11.3 update 1, 11.4 update 4, 11.5 update 2, 11.6 update 2, 11.7 update 1, 11.8, 12.0 update 1, 12.1 update 1, 12.2 update 2, 12.3 update 2, or 12.4 update 1
- cuDNN 8.9.7 (Optional and not required for lean or dispatch runtime installations.)

1. Install CUDA according to the CUDA installation instructions.
2. Download the TensorRT local repo file that matches the Ubuntu version and CPU architecture that you are using.
3. Install TensorRT from the Debian local repo package. Replace `ubuntuxx04`, `10.x.x`, and `cuda-x.x` with your specific OS version, TensorRT version, and CUDA version.

```
os="ubuntuxx04"
tag="10.x.x-cuda-x.x"
sudo dpkg -i nv-tensorrt-local-repo-${os}-${tag}_1.0-1_amd64.deb
sudo cp /var/nv-tensorrt-local-repo-${os}-${tag}/*-keyring.gpg /usr/share/keyrings/
sudo apt-get update
```

For the full C++ and Python runtimes

```
sudo apt-get install tensorrt
```

For the lean runtime only, instead of `tensorrt`

```
sudo apt-get install libnvinfer-lean10
sudo apt-get install libnvinfer-vc-plugin10
```

For lean runtime Python package

```
sudo apt-get install python3-libnvinfer-lean
```

For the dispatch runtime only, instead of `tensorrt`

```
sudo apt-get install libnvinfer-dispatch10
sudo apt-get install libnvinfer-vc-plugin10
```

For dispatch runtime Python package

```
sudo apt-get install python3-libnvinfer-dispatch
```

For all TensorRT Python packages without samples

```
python3 -m pip install numpy
sudo apt-get install python3-libnvinfer-dev
```

The following additional packages will be installed:

```
python3-libnvinfer
python3-libnvinfer-lean
python3-libnvinfer-dispatch
```

If you want to install Python packages for the lean or dispatch runtime *only*, specify these individually rather than installing the `dev` package.

If you want to run samples that require `onnx-graphsurgeon` or use the Python module for your own project

```
python3 -m pip install numpy onnx
sudo apt-get install onnx-graphsurgeon
```

4. Verify the installation.

```
dpkg-query -W tensorrt
```

You should see something similar to the following:

```
tensorrt 10.0.1.x-1+cuda12.4
```

3.2.1.1. Using The NVIDIA CUDA Network Repo For Debian Installation

This installation method is for advanced users who are already familiar with TensorRT and want to get their application running quickly or to set up automation, such as when using containers. New users or users who want the complete installation, including samples and documentation, should follow the local repo installation instructions (refer to Debian Installation).

Note: If you are using a CUDA container with cuDNN included, then the NVIDIA CUDA network repository will already be set up and you can skip step 1.

1. To install the CUDA network repository, follow the instructions at the CUDA Toolkit Download page.

a). Select the Linux operating system.
b). Select the desired architecture.
c). Select the Ubuntu distribution.
d). Select the desired Ubuntu version.
e). Select the “deb (network)” installer type.
f). Enter the commands provided into your terminal.

You can omit the final `apt-get install` command if you do not require the entire CUDA toolkit. While installing TensorRT, `apt` downloads the required CUDA and cuDNN dependencies for you automatically.

2. Install the TensorRT package that fits your particular needs.
   a). For only running TensorRT C++ applications:
   ```
   sudo apt-get install tensorrt-libs
   ```
   b). For also building TensorRT C++ applications:
   ```
   sudo apt-get install tensorrt-dev
   ```
   c). For running TensorRT Python applications:
   ```
   python3 -m pip install numpy
   sudo apt-get install python3-libnvinfer
   ```
   d). If your application requires other Python modules, such as `onnx-graphsurgeon`, then it’s recommended to use `pip` to install the Python modules rather than using Debian packages to improve Python compatibility. Refer to onnx-graphsurgeon · PyPI for additional information.
3. When using the CUDA network repository, Ubuntu will by default install TensorRT for the latest CUDA version. The following commands will install `libnvinfer8` and related TensorRT packages for an older CUDA version and hold the `libnvinfer8` package at this version. Replace `8.x.x.x` with your version of TensorRT and `cudax.x` with your CUDA version for your install.
   ```
   version="8.x.x.x-1+cudax.x"
   sudo apt-get install tensorrt-dev=${version}

   sudo apt-mark hold tensorrt-dev
   ```
   If you want to upgrade to the latest version of TensorRT or the latest version of CUDA, then you can unhold the `libnvinfer8` package using the following command.
   ```
   sudo apt-mark unhold tensorrt-dev
   ```
   You may need to repeat these steps for `libcudnn8` to prevent cuDNN from being updated to the latest CUDA version. Refer to the *NVIDIA TensorRT Release Notes* for the specific version of cuDNN that was tested with your version of TensorRT. Example commands for downgrading and holding the cuDNN version can be found in Upgrading TensorRT. Refer to the *NVIDIA cuDNN Installation Guide* for additional information.

   If the CUDA network repository and a TensorRT local repository are enabled at the same time you may observe package conflicts with either TensorRT or cuDNN. You will need to configure APT so that it prefers local packages over network packages. You can do this by creating a new file at `/etc/apt/preferences.d/local-repo` with the following lines:
   ```
   Package: *
   Pin: origin ""
   ```

```
Pin-Priority: 1001
```

Note: This preference change will affect more than just TensorRT in the unlikely event that you have other repositories which are also not downloaded over HTTP(S). To revert APT to its original behavior simply remove the newly created file.

3.2.2. RPM Installation

This section contains instructions for installing TensorRT from an RPM package. This installation method is for new users or users who want the complete installation, including samples and documentation for both the C++ and Python APIs.

For advanced users who are already familiar with TensorRT and want to get their application running quickly or to set up automation, follow the network repo installation instructions (see Using The NVIDIA CUDA Network Repo For RPM Installation).

Note:

- Before issuing the following commands, you'll need to replace `rhelx`, `8.x.x`, and `cuda-x.x` with your specific OS version, TensorRT version, and CUDA version.
- The following example commands are for `x86_64`, but the commands should be identical for `ppc64le`.
- When installing Python packages using this method, you will need to install dependencies manually with `pip`.
- Prior releases of TensorRT included cuDNN within the local repo package. TensorRT 8.5 no longer bundles cuDNN and requires a separate cuDNN installation.

Ensure that you have the following dependencies installed.

- CUDA 10.2, 11.0 update 1, 11.1 update 1, 11.2 update 2, 11.3 update 1, 11.4 update 4, 11.5 update 2, 11.6 update 2, 11.7 update 1 or 11.8
- cuDNN 8.6.0

1. Install CUDA according to the CUDA installation instructions.
2. Install cuDNN according to the cuDNN installation instructions.
3. Download the TensorRT local repo file that matches the RHEL/CentOS version and CPU architecture you are using.
4. Install TensorRT from the RPM local repo package.

```
os="rhelx"
tag="8.x.x-cuda-x.x"
sudo rpm -Uvh nv-tensorrt-local-repo-${os}-${tag}-1.0-1.x86_64.rpm
sudo yum clean expire-cache
```

The packages which can be installed are:

```
graphsurgeon-tf.x86_64
libnvinfer-bin.x86_64
libnvinfer-devel.x86_64
libnvinfer-plugin-devel.x86_64
libnvinfer-plugin8.x86_64
libnvinfer-samples.x86_64
```

```
libnvinfer8.x86_64
libnvonnxparsers-devel.x86_64
libnvonnxparsers8.x86_64
libnvparsers-devel.x86_64
libnvparsers8.x86_64
python3-libnvinfer.x86_64
python3-libnvinfer-devel.x86_64
tensorrt.x86_64
tensorrt-devel.x86_64
tensorrt-libs.x86_64
uff-converter-tf.x86_64
onnx-graphsurgeon.x86_64
```

Install TensorRT.

```
sudo yum install tensorrt
```

If using Python 3.x:

```
python3 -m pip install numpy
sudo yum install python3-libnvinfer-devel
```

The following additional packages will be installed:

```
python3-libnvinfer
```

Note: For Rocky Linux or RHEL 8.x users, be aware that the TensorRT Python bindings will only be installed for Python 3.8 due to package dependencies and for better Python support. If your default `python3` is version 3.6 then you may need to use `update-alternatives` to switch to Python version 3.8 by default, invoke Python using `python3.8`, or remove `python36` packages if no longer required.

For the UFF converter (only required if you plan to use TensorRT with TensorFlow):

```
python3 -m pip install protobuf
sudo yum install uff-converter-tf
```

The `graphsurgeon-tf` package will also be installed with the above command.

If you would like to run the samples that require ONNX `graphsurgeon` or use the Python module for your own project, run:

```
python3 -m pip install numpy onnx
sudo yum install onnx-graphsurgeon
```

5. Verify the installation.

   a). Run:

   ```
   rpm -qa | grep tensorrt
   ```

   You should see something similar to the following:

   ```
   tensorrt-8.5.3.x-1.cuda11.8.x86_64
   ```

   b). Run:

   ```
   rpm -qa | grep -e libnvinfer -e libnv.*parsers
   ```

   You should see something similar to the following:

   ```
   libnvinfer-plugin8-8.5.3-1.cuda11.8.x86_64
   libnvinfer-devel-8.5.3-1.cuda11.8.x86_64
   libnvinfer-bin-8.5.3-1.cuda11.8.x86_64
   libnvinfer8-8.5.3-1.cuda11.8.x86_64
   libnvinfer-samples-8.5.3-1.cuda11.8.x86_64
   libnvinfer-plugin-devel-8.5.3-1.cuda11.8.x86_64
   libnvonnxparsers8-8.5.3-1.cuda11.8.x86_64
   libnvonnxparsers-devel-8.5.3-1.cuda11.8.x86_64
   libnvparsers8-8.5.3-1.cuda11.8.x86_64
   libnvparsers-devel-8.5.3-1.cuda11.8.x86_64
   python3-libnvinfer-8.5.3-1.cuda11.8.x86_64
   ```

```
python3-libnvinfer-devel-8.5.3-1.cuda11.8.x86_64
```

c). Run:

```
rpm -qa | grep graphsurgeon-tf
```

You should see something similar to the following:

```
graphsurgeon-tf-8.5.3-1.cuda11.8.x86_64
```

d). Run:

```
rpm -qa | grep uff-converter-tf
```

You should see something similar to the following:

```
uff-converter-tf-8.5.3-1.cuda11.8.x86_64
```

e). Run:

```
rpm -qa | grep onnx-graphsurgeon
```

You should see something similar to the following:

```
onnx-graphsurgeon-8.5.3-1.cuda11.8.x86_64
```

3.2.2.1. Using The NVIDIA CUDA Network Repo For RPM Installation

This installation method is for advanced users who are already familiar with TensorRT and want to get their application running quickly or to set up automation. New users or users who want the complete installation, including samples and documentation, should follow the local repo installation instructions (see RPM Installation).

Note: If you are using an CUDA container with cuDNN included, then the CUDA network repository will already be set up and you can skip step 1.

1. To install the CUDA network repository, follow the instructions at the CUDA Toolkit Download page for the latest CUDA version.
   a). Select the Linux operating system.
   b). Select the desired architecture.
   c). Select the CentOS, RHEL, or Rocky distribution.
   d). Select the desired CentOS, RHEL, or Rocky version.
   e). Select the “rpm (network)” installer type.
   f). Enter the commands provided into your terminal.

   You can omit the final `yum/dnf install` command if you do not require the entire CUDA toolkit. While installing TensorRT, `yum/dnf` downloads the required CUDA and cuDNN dependencies for you automatically.
2. Install the TensorRT package that fits your particular needs. When using the NVIDIA CUDA network repository, RHEL will by default install TensorRT for the latest CUDA version. If you need the libraries for other CUDA versions, refer to step 3.
   a). For only running TensorRT C++ applications:

   ```
   sudo yum install tensorrt-libs
   ```

   b). For also building TensorRT C++ applications:

   ```
   sudo yum install tensorrt-devel
   ```

   c). For running TensorRT Python applications:

```
python3 -m pip install numpy
sudo yum install python3-libnvinfer
```

d). If your application requires other Python modules, such as `onnx-graphsurgeon`, then it's recommended to use `pip` to install the Python modules rather than using RPM packages to improve Python compatibility. Refer to onnx-graphsurgeon · PyPI for additional information.

3. The following commands install `libnvinfer8` and related TensorRT packages for an older CUDA version and hold the `libnvinfer8` package at this version. Replace `8.x.x.x` with your version of TensorRT and `cudax.x` with your CUDA version for your install.

```
version="8.x.x.x-1.cudax.x"
sudo yum downgrade tensorrt-devel-${version}

sudo yum install yum-plugin-versionlock
sudo yum versionlock tensorrt-devel
```

If you want to upgrade to the latest version of TensorRT or the latest version of CUDA, then you can unhold the `libnvinfer8` package using the following command.

```
sudo yum versionlock delete tensorrt-devel
```

You may need to repeat these steps for `libcudnn8` to prevent cuDNN from being updated to the latest CUDA version. Refer to the *NVIDIA TensorRT Release Notes* for the specific version of cuDNN that was tested with your version of TensorRT. Example commands for downgrading and holding the cuDNN version can be found in Upgrading TensorRT. Refer to the *NVIDIA cuDNN Installation Guide* for additional information.

3.2.3. Tar File Installation

1. Install the following dependencies, if not already present:
   - CUDA 10.2, 11.0 update 1, 11.1 update 1, 11.2 update 2, 11.3 update 1, 11.4 update 4, 11.5 update 2, 11.6 update 2, 11.7 update 1, or 11.8
   - cuDNN 8.6.0
   - Python 3 (Optional)
2. Download the TensorRT tar file that matches the CPU architecture and CUDA version you are using.
3. Choose where you want to install TensorRT. This tar file will install everything into a subdirectory called `TensorRT-8.x.x.x`.
4. Unpack the tar file.

```
version="8.x.x.x"
arch=$(uname -m)
cuda="cuda-x.x"
cudnn="cudnn8.x"
tar -xzvf TensorRT-${version}.Linux.${arch}-gnu.${cuda}.${cudnn}.tar.gz
```

Where:

- `8.x.x.x` is your TensorRT version
- `cuda-x.x` is CUDA version `10.2` or `11.8`
- `cudnn8.x` is cuDNN version `8.6`

This directory will have sub-directories like `lib`, `include`, `data`, etc...

```
ls TensorRT-${version}
bin  data  doc  graphsurgeon  include  lib  onnx_graphsurgeon  python  samples  targets
 uff
```

5. Add the absolute path to the TensorRT `lib` directory to the environment variable `LD_LIBRARY_PATH`:

```
export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:<TensorRT-${version}/lib>
```

6. Install the Python TensorRT wheel file.

```
cd TensorRT-${version}/python

python3 -m pip install tensorrt-*-cp3x-none-linux_x86_64.whl
```

7. Install the Python UFF wheel file. This is only required if you plan to use TensorRT with TensorFlow.

```
cd TensorRT-${version}/uff

python3 -m pip install uff-0.6.9-py2.py3-none-any.whl
```

Check the installation with:

```
which convert-to-uff
```

8. Install the Python `graphsurgeon` wheel file.

```
cd TensorRT-${version}/graphsurgeon

python3 -m pip install graphsurgeon-0.4.6-py2.py3-none-any.whl
```

9. Install the Python `onnx-graphsurgeon` wheel file.

```
cd TensorRT-${version}/onnx_graphsurgeon

python3 -m pip install onnx_graphsurgeon-0.3.12-py2.py3-none-any.whl
```

10. Verify the installation:

a). Ensure that the installed files are located in the correct directories. For example, run the `tree -d` command to check whether all supported installed files are in place in the `lib`, `include`, `data`, etc... directories.

b). Build and run one of the shipped samples, for example, `sampleMNIST` in the installed directory. You should be able to compile and execute the sample without additional settings. For more information, refer to sampleMNIST.

c). The Python samples are in the `samples/python` directory.

3.2.4. Zip File Installation

This section contains instructions for installing TensorRT from a zip package on Windows 10.

Ensure that you have the following dependencies installed.

- CUDA 10.2, 11.0 update 1, 11.1 update 1, 11.2 update 2, 11.3 update 1, 11.4 update 4, 11.5 update 2, 11.6 update 2, 11.7 update 1 or 11.8
- cuDNN 8.6.0

1. Download the TensorRT zip file that matches the Windows version you are using.

2. Choose where you want to install TensorRT. The zip file will install everything into a subdirectory called `TensorRT-8.x.x.x`. This new subdirectory will be referred to as `<installpath>` in the steps below.
3. Unzip the `TensorRT-8.x.x.x.Windows10.x86_64.cuda-x.x.cudnn8.x.zip` file to the location that you chose.

   Where:

   - `8.x.x.x` is your TensorRT version
   - `cuda-x.x` is CUDA version `10.2` or `11.8`
   - `cudnn8.x` is cuDNN version `8.6`
4. Add the TensorRT library files to your system `PATH`. There are two ways to accomplish this task:
   a). Leave the DLL files where they were unzipped and add `<installpath>/lib` to your system `PATH`. You can add a new path to your system `PATH` using the steps below.
      i. Press the Windows key and search for "environment variables" which should present you with the option Edit the system environment variables and click it.
      ii. Click Environment Variables... at the bottom of the window.
      iii. Under System variables, select Path and click Edit....
      iv. Click either New or Browse to add a new item that contains `<installpath>/lib`.
      v. Continue to click OK until all the newly opened windows are closed.
      vi. If your cuDNN libraries were not copied to the CUDA installation directory and instead left where they were unzipped, then repeat the above steps for the cuDNN `bin` directory.

   b). Copy the DLL files from `<installpath>/lib` to your CUDA installation directory, for example, `C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\vX.Y\bin`, where `vX.Y` is your CUDA version. The CUDA installer should have already added the CUDA path to your system `PATH`.
5. Install one of the TensorRT Python wheel files from `<installpath>/python`:

```
python.exe -m pip install tensorrt-*-cp3x-none-win_amd64.whl
```

6. To verify that your installation is working you should open a Visual Studio Solution file from one of the samples, such as sampleMNIST, and confirm that you are able to build and run the sample.

   If you want to use TensorRT in your own project, ensure that the following is present in your Visual Studio Solution project properties:

   a). `<installpath>/lib` has been added to your `PATH` variable and is present under VC ++ Directories > Executable Directories.

   b). `<installpath>/include` is present under C/C++ > General > AdditionalDirectories.

c). `nvinfer.lib` and any other `LIB` files that your project requires are present under Linker > Input > Additional Dependencies.

Note: In order to build the included samples, you should have Visual Studio 2017 or later installed. The community edition is sufficient to build the TensorRT samples.

7. If you are using TensorFlow or PyTorch, install the `uff`, `graphsurgeon`, and `onnx_graphsurgeon` wheel packages. You must prepare the Python environment before installing `uff`, `graphsurgeon` or `onnx_graphsurgeon`.

   If using Python 3.x:

```
python3 -m pip install <installpath>\graphsurgeon\graphsurgeon-0.4.6-py2.py3-none-any.whl
python3 -m pip install <installpath>\uff\uff-0.6.9-py2.py3-none-any.whl
python3 -m pip install <installpath>\onnx_graphsurgeon\onnx_graphsurgeon-0.3.12-py2.py3-none-any.whl
```

3.3. Additional Installation Methods

Aside from installing TensorRT from the product package, you can also install TensorRT from the following locations.

TensorRT container
The TensorRT container provides an easy method for deploying TensorRT with all necessary dependencies already packaged in the container. For information about installing TensorRT via a container, refer to the *NVIDIA TensorRT Container Release Notes*.

NVIDIA JetPack™
JetPack bundles all Jetson platform software, including TensorRT. Use it to flash your Jetson Developer Kit with the latest OS image, install NVIDIA SDKs, and jump-start your development environment. For information about installing TensorRT through JetPack, refer to the JetPack documentation.

For JetPack downloads, refer to the Develop: Jetpack.

NVIDIA DRIVE®
With every release, TensorRT delivers features to make the NVIDIA DRIVE Development Platform an excellent computing platform for Autonomous Driving. For more information about installing TensorRT through NVIDIA DRIVE, refer to the NVIDIA DRIVE documentation. For Drive downloads, refer to Download DRIVE.

DRIVE OS 6.0 Linux Standard
For step-by-step instructions on how to install TensorRT, refer to the installation section of the *NVIDIA DRIVE Platform Installation with NVIDIA SDK Manager*. The safety proxy runtime is not installed by default in the NVIDIA DRIVE OS Linux SDK. To install the safety proxy runtime on this platform, refer to the *DRIVE OS Linux Installation Guide* and *DRIVE OS QNX Installation Guide* documents.

3.3.1. App Server Installation

This type of installation is for cloud users or container users who will be going to production.

If you are going to be deploying the application to a server and running an already existing application in a minimal or standalone environment, then this type of installation allows you to set up a runtime environment instead of a full development environment. It provides a simple list of packages you can install if you want to run an application you've already developed.

When setting up servers which will host TensorRT powered applications, you can simply install any of the following Debian packages using `apt-get`:

- the `libnvinfer8` package (C++) plus any additional library packages you require, or
- the `python3-libnvinfer` package (Python 3.x).

3.3.2. Cross Compile Installation

If you intend to cross compile TensorRT for AArch64, then start with the Using The NVIDIA CUDA Network Repo For Debian Installation section to set up the network repository and TensorRT for the host. Steps to prepare your machine for cross compilation and how to cross compile the TensorRT samples can be found in Cross Compiling Samples For AArch64 Users.

Chapter 4. Upgrading TensorRT

Upgrading TensorRT to the latest version is only supported when the currently installed TensorRT version is equal to or newer than the last two public GA releases. For example, TensorRT 8.4.x supports upgrading from TensorRT 8.2.x and TensorRT 8.4.x.

If you want to upgrade from an unsupported version, then you should upgrade incrementally until you reach the latest version of TensorRT or uninstall and then reinstall the latest version of TensorRT. If you have an EA version of TensorRT installed, you should first upgrade to the corresponding GA version.

4.1. Linux And Windows Users

The following section provides step-by-step instructions for upgrading TensorRT for Linux and Windows users.

4.1.1. Upgrading From TensorRT 8.2.x To TensorRT 8.5.x

When upgrading from TensorRT 8.2.x to TensorRT 8.5.x, ensure you are familiar with the following.

Using a Debian file

- The Debian packages are designed to upgrade your development environment without removing any runtime components that other packages and programs might rely on. If you installed TensorRT 8.2.x via a Debian package and you upgrade to TensorRT 8.5.x, your libraries, samples, and headers will all be updated to the TensorRT 8.5.x content. After you have downloaded the new local repo, use `apt-get` to upgrade your system to the new version of TensorRT.

```
os="ubuntuxx04"
tag="8.x.x-cuda-x.x"
sudo dpkg -i nv-tensorrt-local-repo-${os}-${tag}_1.0-1_amd64.deb
sudo cp /var/nv-tensorrt-local-repo-${os}-${tag}/*-keyring.gpg /usr/share/keyrings

sudo apt-get update
sudo apt-get install tensorrt
```

If using Python:

```
sudo apt-get install python3-libnvinfer-dev
```

- If you are using the `uff-converter` and/or `graphsurgeon`, then you should also upgrade those Debian packages to the latest versions.

```
sudo apt-get install uff-converter-tf graphsurgeon-tf onnx-graphsurgeon
```

- After you upgrade, ensure you have a directory `/usr/src/tensorrt` and the corresponding version shown by the `dpkg -l tensorrt` command is `8.x.x.x`.
- If installing a Debian package on a system where the previously installed version was from a tar file, note that the Debian package will not remove the previously installed files. Unless a side-by-side installation is desired, it would be best to remove the older version before installing the new version to avoid compiling against outdated libraries.
- The cuDNN version should also be upgraded along with TensorRT. Refer to the cuDNN Installation Guide for more information. If you are currently or were previously using the CUDA network repository, then it may conflict with the version of `libcudnn8` that is expected to be installed for the new version of TensorRT. The following commands will change `libcudnn8` to version 8.6.x.x, which is supported and tested with TensorRT 8.5.x, and hold the `libcudnn8` package at this version. Replace `cudax.x` with the appropriate CUDA version for your install.

```
version="8.6.x.x-1+cudax.x"
sudo apt-get install libcudnn8=${version} libcudnn8-dev=${version}
sudo apt-mark hold libcudnn8 libcudnn8-dev
```

Using an RPM file

- The RPM packages are designed to upgrade your development environment without removing any runtime components that other packages and programs might rely on. If you installed TensorRT 8.2.x via an RPM package and you want to upgrade to TensorRT 8.5.x, your libraries, samples, and headers will all be updated to the TensorRT 8.5.x content. After you have downloaded the new local repo, issue:

```
os="rhelx"
tag="8.x.x-cuda-x.x"
sudo rpm -Uvh nv-tensorrt-local-repo-${os}-${tag}-1.0-1.x86_64.rpm
sudo yum clean expire-cache
sudo yum install tensorrt
```

  If using Python:

```
sudo yum install python3-libnvinfer-devel
```

- If using `uff-converter` and/or `graphsurgeon`:

```
sudo yum install uff-converter-tf graphsurgeon-tf onnx-graphsurgeon
```

- After you upgrade, ensure you see the `/usr/src/tensorrt` directory and the corresponding version shown by the `rpm -qa tensorrt` command is `8.x.x.x`.
- The cuDNN version should also be upgraded along with TensorRT. Refer to the cuDNN Installation Guide for more information. If you are currently or were previously using the CUDA network repository, then it may conflict with the version of `libcudnn8` that is expected to be installed for the new version of TensorRT. The following commands will change `libcudnn8` to version 8.6.x.x, which

is supported and tested with TensorRT 8.5.x, and hold the `libcudnn8` package at this version. Replace `cudax.x` with the appropriate CUDA version for your install.

```
version="8.6.x.x-1.cudax.x"
sudo yum downgrade libcudnn8-${version} libcudnn8-devel-${version}
sudo yum install yum-plugin-versionlock
sudo yum versionlock libcudnn8 libcudnn8-devel
```

Using a tar file

- If you are upgrading using the tar file installation method, then install TensorRT into a new location. Tar file installations can support multiple use cases including having a full installation of TensorRT 8.2.x with headers and libraries side-by-side with a full installation of TensorRT 8.5.x. If the intention is to have the new version of TensorRT replace the old version, then the old version should be removed once the new version is verified.
- Update the environment variable `LD_LIBRARY_PATH` to the absolute path containing the TensorRT `lib` directory for the new TensorRT tar file installation.
- If installing a tar file on a system where the previously installed version was from a Debian package, note that the tar file installation will not remove the previously installed packages. Unless a side-by-side installation is desired, it would be best to remove the previously installed `libnvinfer8`,`libnvinfer-dev`,`libnvinfer-samples` and other related packages to avoid confusion.

Using a zip file

- If you are upgrading using the zip file installation method, then install TensorRT into a new location. Zip file installations can support multiple use cases including having a full installation of TensorRT 8.2.x with headers and libraries side-by-side with a full installation of TensorRT 8.5.x. If the intention is to have the new version of TensorRT replace the old version, then the old version should be removed once the new version is verified.
- After unzipping the new version of TensorRT you will need to either update the `PATH` environment variable to point to the new install location or copy the DLL files to the location where you previously installed the TensorRT libraries. Refer to Zip File Installation for more information about setting the `PATH` environment variable.

Chapter 5. Uninstalling TensorRT

This section provides step-by-step instructions for ways in which you can uninstall TensorRT.

To uninstall TensorRT using the untarred file, simply delete the tar files and reset `LD_LIBRARY_PATH` to its original value.

To uninstall TensorRT using the zip file, simply delete the unzipped files and remove the newly added path from the `PATH` environment variable.

To uninstall TensorRT using the Debian or RPM packages, follow these steps:

1. Uninstall `libnvinfer8` which was installed using the Debian or RPM packages.
   ```
   sudo apt-get purge "libnvinfer*"
   sudo apt-get purge "nv-tensorrt-local-repo*"
   ```
   Or
   ```
   sudo yum erase "libnvinfer*"
   sudo yum erase "nv-tensorrt-local-repo*"
   ```
2. Uninstall `uff-converter-tf`, `graphsurgeon-tf`, and `onnx-graphsurgeon` which were also installed using the Debian or RPM packages.
   ```
   sudo apt-get purge graphsurgeon-tf onnx-graphsurgeon
   ```
   Or
   ```
   sudo yum erase graphsurgeon-tf onnx-graphsurgeon
   ```
   The `uff-converter-tf` package will also be removed with the above command.

   You can use the following command to uninstall `uff-converter-tf` and not remove `graphsurgeon-tf`, however, it is no longer required.
   ```
   sudo apt-get purge uff-converter-tf
   ```
   Or
   ```
   sudo yum erase uff-converter-tf
   ```
   You can later use `autoremove` to uninstall `graphsurgeon-tf` as well.
   ```
   sudo apt-get autoremove
   ```
   Or
   ```
   sudo yum autoremove
   ```
3. Uninstall the Python TensorRT wheel file.
   ```
   sudo pip3 uninstall tensorrt
   ```
4. Uninstall the Python UFF wheel file.
   ```
   sudo pip3 uninstall uff
   ```
5. Uninstall the Python GraphSurgeon wheel file.
   ```
   sudo pip3 uninstall graphsurgeon
   ```

6. Uninstall the Python ONNX GraphSurgeon wheel file.

```
sudo pip3 uninstall onnx-graphsurgeon
```

Chapter 6. Installing PyCUDA

This section provides useful information regarding PyCUDA including how to install.

ATTENTION: If you have to update your CUDA version on your system, do not install PyCUDA at this time. Perform the steps in Updating CUDA first, then install PyCUDA.

Note: When installing PyCUDA, ensure that you have NumPy installed beforehand. If not, run the following command before proceeding:

```
python3 -m pip install numpy
```

PyCUDA is used within Python wrappers to access NVIDIA's CUDA APIs. It is not strictly necessary in order to use TensorRT, but many of the samples use it.

Some of the key features of PyCUDA include:

- Maps all of CUDA into Python.
- Enables run-time code generation (RTCG) for flexible, fast, automatically tuned codes.
- Added robustness: automatic management of object lifetimes, automatic error checking
- Added convenience: comes with ready-made on-GPU linear algebra, reduction, scan.
- Add-on packages for FFT and LAPACK available.
- Fast. Near-zero wrapping overhead.

To install PyCUDA first make sure `nvcc` is in your `PATH`, then issue the following command:

```
python3 -m pip install 'pycuda<2021.1'
```

If you encounter any issues with PyCUDA usage after installing PyCUDA with the above command, you may need to recompile it yourself. For more information, see Installing PyCUDA on Linux.

6.1. Updating CUDA

Existing installations of PyCUDA will not automatically work with a newly installed CUDA Toolkit. That is because PyCUDA will only work with a CUDA Toolkit that is already on the

target system when PyCUDA was installed. This requires that PyCUDA be updated after the newer version of the CUDA Toolkit is installed.

The steps below are the most reliable method to ensure that everything works in a compatible fashion after the CUDA Toolkit on your system has been upgraded.

1. Uninstall the existing PyCUDA installation.
2. Update CUDA. For more information, see the *NVIDIA CUDA Installation Guide*.
3. Install PyCUDA. To install PyCUDA, issue the following command:

```
pip install 'pycuda<2021.1'
```

Chapter 7. Troubleshooting

For troubleshooting support refer to your support engineer or post your questions onto the NVIDIA Developer Forum.

NVIDIA Developer Forum

Appendix A. Appendix

The following section provides our list of acknowledgements.

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RESNET-50 Caffe models

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