# TENSORRT

DU-08731-001_v5.0 RC | September 2018

## Installation Guide

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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 which performs inference for that network.

You can describe a TensorRT network using a C++ or Python API, or you can import an existing Caffe, ONNX, or TensorFlow model using one of the provided parsers.

The TensorRT API includes import methods to help you express your trained deep learning models for TensorRT to optimize and run. TensorRT applies graph optimizations, layer fusion, and finds the fastest implementation of that model leveraging a diverse collection of highly optimized kernels, and a runtime that you can use to execute this network in an inference context.

TensorRT includes an infrastructure that allows you to leverage the high speed mixed precision capabilities of Pascal, Volta, and Turing GPUs as an optional optimization.

# 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 will almost certainly need to recompile it yourself. For more information, see Installing PyCUDA on Linux.
- Ensure you are familiar with the Release Notes. The current version of the release notes can be found online at TensorRT Release Notes.
- Verify that you have the CUDA Toolkit installed, versions 9.0 and 10.0 are supported.
- The TensorFlow to TensorRT model export requires TensorFlow 1.9.0.
- The PyTorch examples have been tested with PyTorch 0.4.0 and 0.4.1, but should work with older versions.
- 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 the one that TensorRT ships with. 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 **`libnvcaffe_parser.so`** library file from previous versions is now called **`libnvparsers.so`** in TensorRT 5.0. The installed symbolic link for **`libnvcaffe_parser.so`** is updated to point to the new **`libnvparsers.so`** library. The static library **`libnvcaffe_parser.a`** is also symbolically linked to the new **`libnvparsers_static.a`**.
- The sample tool **`giexec`** that was included with TensorRT 3.0 has been renamed to **`trtexec`**.
- The installation instructions below assume you want the full TensorRT; both the C++ and TensorRT Python APIs. In some environments and use cases, you may not want

to install the Python functionality. In which 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. 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 **Download**.
3. Complete the TensorRT Download Survey.
4. Select the checkbox to agree to the license terms.
5. Click the package you want to install. Your download begins.

# Chapter 4. INSTALLING TENSORRT

You can choose between the following installation options when installing TensorRT; Debian or RPM packages or a tar 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 has also been installed using Debian or RPM packages.

The tar file provides more flexibility, however, you need to ensure that you have the necessary dependencies already installed.

**TensorRT versions:** TensorRT is a product made up of separately versioned components. The version on 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 | 4.0.1 | 5.0.0 | +1.0 when significant new capabilities are added.<br>+0.1 when capabilities have been improved. |

| Product or Component | | Previously Released Version | Current Version | Version Description |
|---|---|---|---|---|
| **nvinfer** library, headers, samples, and documentation. | | 4.1.2 | 5.0.0 | +1.0 when the API changes in a non-compatible way.<br>+0.1 when the API changes are backward compatible |
| UFF | **uff-converter-tf** Debian and RPM packages | 4.1.2 | 5.0.0 | +0.1 while we are developing the core functionality. |
| | **uff-*.whl** file | 0.4.0 | 0.5.1 | Set to 1.0 when we have all base functionality in place. |
| **graphsurgeon** | **graphsurgeon-tf** Debian and RPM packages | 4.1.2 | 5.0.0 | +0.1 while we are developing the core functionality. |
| | **graphsurgeon-*.whl** file | 0.2.0 | 0.2.2 | Set to 1.0 when we have all base functionality in place. |
| **libnvinfer** python packages | ▸ **python-libnvinfer**<br>▸ **python-libnvinfer-dev**<br>▸ **python3-libnvinfer**<br>▸ **python3-libnvinfer-dev**<br>Debian and RPM packages<br>The **python3** RPM | 4.1.2 | 5.0.0 | +1.0 when the API changes in a non-compatible way.<br>+0.1 when the API changes are backward compatible. |

| Product or Component | | Previously Released Version | Current Version | Version Description |
|---|---|---|---|---|
| | packages are not supported in TensorRT 5.0 RC, however, they will be supported for 5.0 GA. | | | |
| | `tensorrt.whl` file | 4.0.1 | 5.0.0 | |

# 4.1. Debian Installation

This section contains instructions for a developer installation and an app server installation. Choose which installation best fits your needs.

**Developer Installation:** The following instructions sets up a full TensorRT development environment with samples, documentation and both the C++ and Python API.

**Attention** If only the C++ development environment is desired, you can modify the following instructions and simply not install the Python, UFF, and graphsurgeon packages.

Before issuing the following commands, you'll need to replace **`ubuntu1x04`**, **`cudax.x`**, **`trt4.x.x.x`** and **`yyyymmdd`** with your specific OS version, CUDA version, TensorRT version and package date. The following commands are examples.

1. Install TensorRT from the Debian package.

```
$ sudo dpkg -i
nv-tensorrt-repo-ubuntu1x04-cudax.x-trt5.x.x.x-rc-yyyymmdd_1-1_amd64.deb
$ sudo apt-key add /var/nv-tensorrt-repo-cudax.x-trt5.x.x.x-rc-
yyyymmdd/7fa2af80.pub

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

If using Python 2.7:

```
$ sudo apt-get install python-libnvinfer-dev
```

The following additional packages will be installed:

```
  python-libnvinfer
```

If using Python 3.x:

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

The following additional packages will be installed:

```
  python3-libnvinfer
```

In either case:

```
$ sudo apt-get install uff-converter-tf
```

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

2. Verify the installation.

```
$ dpkg -l | grep TensorRT
```

You should see something similar to the following:

```
ii  graphsurgeon-tf 5.0.0-1+cuda10.0 amd64 GraphSurgeon for TensorRT package
ii  libnvinfer-dev 5.0.0-1+cuda10.0 amd64 TensorRT development libraries and
 headers
ii  libnvinfer-samples 5.0.0-1+cuda10.0 amd64 TensorRT samples and
 documentation
ii  libnvinfer5 5.0.0-1+cuda10.0 amd64 TensorRT runtime libraries
ii  python-libnvinfer 5.0.0-1+cuda10.0 amd64 Python bindings for TensorRT
ii  python-libnvinfer-dev 5.0.0-1+cuda10.0 amd64 Python development package
 for TensorRT
ii  python3-libnvinfer 5.0.0-1+cuda10.0 amd64 Python 3 bindings for TensorRT
ii  python3-libnvinfer-dev 5.0.0-1+cuda10.0 amd64 Python 3 development
 package for TensorRT
ii  tensorrt 5.0.0.10-1+cuda10.0 amd64 Meta package of TensorRT
ii  uff-converter-tf 5.0.0-1+cuda10.0 amd64 UFF converter for TensorRT
 package
```

**App Server Installation:** When setting up servers which will host TensorRT powered applications, you can simply install any of the following:

- the **libnvinfer5** package (C++), or
- the **python-libnvinfer** package (Python 2.7), or
- the **python3-libnvinfer** package (Python 3.x).

Issue the following commands if you want to run an application that was built with TensorRT using the Debian package, for example:

```
$ sudo dpkg -i
nv-tensorrt-repo-ubuntu1x04-cudax.x-trt5.x.x.x-rc-yyyymmdd_1-1_amd64.deb
$ sudo apt-key add /var/nv-tensorrt-repo-cudax.x-trt5.x.x.x-rc-
yyyymmdd/7fa2af80.pub

$ sudo apt-get update
```

```
$ sudo apt-get install libnvinfer5
```

## 4.2. RPM Installation

This section contains instructions for installing TensorRT from an RPM package.

Before issuing the following commands, you'll need to replace **cudax.x**, **trt5.x.x.x**, and **yyyymmdd** with your specific CUDA version, TensorRT version, and package date. The following commands are examples.

1. Install TensorRT from the RPM package.

```
$ sudo rpm -ivh nv-tensorrt-repo-rhel7-cudax.x-trt5.x.x.x-rc-
yyyymmdd-1-1.x86_64.rpm
           $ sudo yum clean expire-cache
           $ sudo yum install tensorrt
```

   If using Python 2.7:

```
$ sudo yum install python-libnvinfer-devel
```

   The following additional packages will be installed:

```
python-libnvinfer
```

   and for the UFF converter:

```
$ sudo yum install uff-converter-tf
```

2. Verify the installation.
   a) Run:

```
$ yum list | grep tensorrt
```

      You should see something similar to the following:

```
tensorrt.x86_64                              5.0.0.10-1.cuda9.0
 installed
```

   b) Run:

```
$ yum list | grep libnvinfer
```

      You should see something similar to the following:

```
libnvinfer-devel.x86_64                      5.0.0-1.cuda9.0
 installed
libnvinfer-samples.x86_64                    5.0.0-1.cuda9.0
 installed
libnvinfer5.x86_64                           5.0.0-1.cuda9.0
 installed
python-libnvinfer.x86_64                     5.0.0-1.cuda9.0
 installed
python-libnvinfer-devel.x86_64               5.0.0-1.cuda9.0
 installed
```

   c) Run:

```
$ yum list | grep graphsurgeon-tf
```

You should see something similar to the following:

```
graphsurgeon-tf.x86_64                      5.0.0-1.cuda9.0
 installed
```

d) Run:

```
$ yum list | grep uff-converter-tf
```

You should see something similar to the following:

```
uff-converter-tf.x86_64                    5.0.0-1.cuda9.0
 installed
```

**App Server Installation:** When setting up servers which will host TensorRT powered applications, you can simply install any of the following:

- the **libnvinfer** package (C++), or
- the **python-libnvinfer** package (Python), or
- the **python3-libnvinfer** package (Python).

Issue the following commands if you want to run an application that was built with TensorRT. Install TensorRT from the debian package, for example:

```
$ sudo dpkg -i
nv-tensorrt-repo-ubuntu1x04-cudax.x-rc-trt5.x.x.x-yyyymmdd_1-1_amd64.deb

$ sudo apt-get update
$ sudo apt-get install libnvinfer
```

## 4.3. Tar File Installation

Before issuing the following commands, you'll need to replace **5.x.x.x** with your specific TensorRT version. The following commands are examples.

1. Install the following dependencies, if not already present:
   - Install the CUDA Toolkit v9.0 or 10.0
   - cuDNN 7.1.3
   - Python 2 or Python 3 (Optional)
2. Choose where you want to install TensorRT. This tar file will install everything into a directory called **TensorRT-5.x.x.x**.
3. Unpack the tar file.

   ```
   $ tar xzvf TensorRT-5.x.x.x.Ubuntu-1x.04.x.x86_64-gnu.cuda-
   x.x.cudnn7.3.tar.gz
   ```

   Where:

   - **5.x.x.x** is your TensorRT version

- **Ubuntu-1x.04.x** is **14.04.5**, **16.04.4** or **18.04.1**
- **cuda-x.x** is the CUDA version **9.0** or **10.0**.

This directory will have sub-directories like **lib**, **include**, **data**, etc…

```
$ ls TensorRT-5.x.x.x
bin  data  doc  graphsurgeon  include  lib  python  samples  targets
 TensorRT-Release-Notes.pdf  uff
```

4. Add the absolute path to the TensorRT **lib** directory to the environment variable **LD_LIBRARY_PATH**:

```
$ export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:<eg:TensorRT-5.x.x.x/lib>
```

5. Install the Python TensorRT wheel file.

```
$ cd TensorRT-5.x.x.x/python
```

If using Python 2.7:

```
$ sudo pip2 install tensorrt-5.x.x.x-py2.py3-none-any.whl
```

If using Python 3.x:

```
$ sudo pip3 install tensorrt-5.x.x.x-py2.py3-none-any.whl
```

6. Install the Python UFF wheel file.

```
$ cd TensorRT-5.x.x.x/uff
```

If using Python 2.7:

```
$ sudo pip2 install uff-0.5.1-py2.py3-none-any.whl
```

If using Python 3.x:

```
$ sudo pip3 install uff-0.5.1-py2.py3-none-any.whl
```

In either case:

```
$ which convert-to-uff
/usr/local/bin/convert-to-uff
```

7. Install the Python **graphsurgeon** wheel file.

```
$ cd TensorRT-5.x.x.x/graphsurgeon
```

If using Python 2.7:

```
$ sudo pip2 install graphsurgeon-0.2.2-py2.py3-none-any.whl
```

If using Python 3.x:

```
$ sudo pip3 install graphsurgeon-0.2.2-py2.py3-none-any.whl
```

8. 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 about sampleMNSIT, see the TensorRT Developer Guide.
c) The new Python examples are in the **`samples/python`** directory and the related data is in the **`python/data`** directory.

## 4.4. 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, see the TensorRT Container Release Notes.

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

For JetPack downloads, see Develop: Jetpack.

**NVIDIA DriveWorks**
With every release, TensorRT delivers features to make the DRIVE Development Platform an excellent computing platform for Autonomous Driving. For more information about installing TensorRT through DriveWorks, see the DriveWorks documentation.

For DriveWorks downloads, see NVIDIA Developer: Drive Downloads.

# Chapter 5. UPGRADING TENSORRT

## 5.1. Upgrading from TensorRT 4.0.x to TensorRT 5.0.x

When upgrading from TensorRT 4.0.x to TensorRT 5.0.x, ensure you are familiar with the following notes:

**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 4.0.x via a Debian package and you upgrade to TensorRT 5.0.x, your documentation, samples, and headers will all be updated to the TensorRT 5.0.x content. After you have downloaded the new local-repo, use **`apt-get`** to upgrade your system to the new version of TensorRT.

```
sudo dpkg -i nv-tensorrt-repo-ubuntu1x04-cudax.x-trt5.x.x.x-rc-
yyyymmdd_1-1_amd64.deb
sudo apt-get update
sudo apt-get install tensorrt libcudnn7
```

- 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
```

- After you upgrade, ensure you have a directory called **`/usr/src/`** and the corresponding version shown by the **`dpkg -l`** command is **`5.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.

- If you are currently or were previously using the machine learning Debian repository, then it may conflict with the version of **libcudnn7** that is expected to be installed from the local repository for TensorRT. The following commands will downgrade **libcudnn7** to version 7.3.x.x which is supported and tested with TensorRT 5.0, and hold the **libcudnn7** package at this version. Replace **cuda9.0** with the appropriate CUDA version for your install.

```
sudo apt-get install libcudnn7=7.3.0.29-1+cuda9.0 \
  libcudnn7-dev=7.3.0.29-1+cuda9.0
sudo apt-mark hold libcudnn7 libcudnn7-dev
```

**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 4.0.x with headers and documentation side-by-side with a full installation of TensorRT 5.0.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.
- 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 **libnvinfer4**, **libnvinfer-dev**, and **libnvinfer-samples** packages to avoid confusion.

## 5.2. Upgrading from TensorRT 3.0.x to TensorRT 5.0.x

When upgrading from TensorRT 3.0.x to TensorRT 5.0.x, ensure you are familiar with the following notes:

**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 3.0.x via a Debian package and you upgrade to TensorRT 5.0.x, your documentation, samples, and headers will all be updated to the TensorRT 5.0.x content. After you have downloaded the new local repo use **apt-get** to upgrade your system to the new version of TensorRT.

```
sudo dpkg -i nv-tensorrt-repo-ubuntu1x04-cudax.x-trt5.x.x.x-rc-
yyyymmdd_1-1_amd64.deb
sudo apt-get update
sudo apt-get install tensorrt libcudnn7
```

- After you upgrade, ensure you have a directory called **/usr/src/** and the corresponding version shown by the **dpkg -l** command is **5.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.
- If **libcudnn6** has been installed in parallel with **libcudnn7**, then you may need to switch the default **libcudnn** to **libcudnn7** in order to properly build applications with TensorRT. TensorRT 5.0 does not support **libcudnn6** and the behavior is unpredictable if **libcudnn6** is used. You can switch to the latest **libcudnn** using **update-alternatives** in auto mode rather than manual mode, which will choose the last installed version of **libcudnn**. This can be done using the following command:

```
$ sudo update-alternatives --auto libcudnn
```

- If you are currently or were previously using the machine learning Debian repository, then it may conflict with the version of **libcudnn7** that is expected to be installed from the local repository for TensorRT. The following commands will downgrade **libcudnn7** to version 7.3.x.x which is supported and tested with TensorRT 5.0, and hold the **libcudnn7** package at this version. Replace **cuda9.0** with the appropriate CUDA version for your install.

```
sudo apt-get install libcudnn7=7.3.0.29-1+cuda9.0 \
  libcudnn7-dev=7.3.0.29-1+cuda9.0
sudo apt-mark hold libcudnn7 libcudnn7-dev
```

### 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 3.0.x with headers and documentation side-by-side with a full installation of TensorRT 5.0.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.
- 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 **`libnvinfer4`**, **`libnvinfer-dev`**, and **`libnvinfer-samples`** packages to avoid confusion.

# Chapter 6. UNINSTALLING TENSORRT

To uninstall TensorRT using the tar file, simply either delete the tar files or reset the **LD_LIBRARY_PATH** to the new package location. To uninstall TensorRT using the Debian or RPM package, follow these steps:

1. Uninstall **libnvinfer5** which was installed using the Debian or RPM packages.

   ```
   $ sudo apt-get purge "libnvinfer*"
   ```

   Or

   ```
   $ sudo yum erase "libnvinfer*"
   ```

2. Uninstall **uff-converter-tf** and **graphsurgeon-tf**, which were also installed using the Debian or RPM packages.

   ```
   $ sudo apt-get purge "graphsurgeon-tf"
   ```

   Or

   ```
   $ sudo yum erase "graphsurgeon-tf"
   ```

   The **uff-converter-tf** 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 --purge autoremove
   ```

   Or

   ```
   $ sudo yum autoremove
   ```

3. Uninstall the Python TensorRT wheel file.

If using Python 2.7:

```
$ sudo pip2 uninstall tensorrt
```

If using Python 3.x:

```
$ sudo pip3 uninstall tensorrt
```

4. Uninstall the Python UFF wheel file.

   If using Python 2.7:

   ```
   $ sudo pip2 uninstall uff
   ```

   If using Python 3.x:

   ```
   $ sudo pip3 uninstall uff
   ```

5. Uninstall the Python GraphSurgeon wheel file.

   If using Python 2.7:

   ```
   $ sudo pip2 uninstall graphsurgeon
   ```

   If using Python 3.x:

   ```
   $ sudo pip3 uninstall graphsurgeon
   ```

# Chapter 7. INSTALLING PYCUDA

**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.

PyCUDA is used within Python wrappers to access NVIDIA's CUDA APIs. 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, issue the following command:

```
pip install 'pycuda>=2017.1.1'
```

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

## 7.1. 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 CUDA Installation Guide.
3. Install PyCUDA. To install PyCUDA, issue the following command:

```
pip install 'pycuda>=2017.1.1'
```

# Chapter 8. TROUBLESHOOTING

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

# Appendix A. APPENDIX

## A.1. ACKNOWLEDGEMENTS

TensorRT uses elements from the following software, whose licenses are reproduced below:

### Google Protobuf

This license applies to all parts of Protocol Buffers except the following:

- Atomicops support for generic gcc, located in **`src/google/protobuf/stubs/atomicops_internals_generic_gcc.h`**. This file is copyrighted by Red Hat Inc.
- Atomicops support for AIX/POWER, located in **`src/google/protobuf/stubs/atomicops_internals_power.h`**. This file is copyrighted by Bloomberg Finance LP.

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EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED
TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA,
OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY
THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT
(INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF
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### Google Flatbuffers

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