



# NVIDIA cuDNN

Installation Guide | NVIDIA Docs

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# Chapter 1. Overview

The NVIDIA® CUDA® Deep Neural Network library (cuDNN) is a GPU-accelerated library of primitives for deep neural networks. cuDNN provides highly tuned implementations for standard routines such as forward and backward convolution, pooling, normalization, and activation layers. cuDNN is part of the NVIDIA Deep Learning SDK.

Deep learning researchers and framework developers worldwide rely on cuDNN for high-performance GPU acceleration. It allows them to focus on training neural networks and developing software applications rather than spending time on low-level GPU performance tuning. cuDNN accelerates widely used deep learning frameworks and is freely available to members of the NVIDIA Developer Program™.

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# Chapter 2. Installing cuDNN On Linux

## 2.1. Prerequisites

For the latest compatibility software versions of the OS, NVIDIA CUDA, the CUDA driver, and the NVIDIA hardware, see the [NVIDIA cuDNN Support Matrix](#).

### 2.1.1. Installing NVIDIA Graphics Drivers

Install up-to-date NVIDIA graphics drivers on your Linux system.

#### Procedure

1. Go to: [NVIDIA download drivers](#)
2. Select the GPU and OS version from the drop-down menus.
3. Download and install the NVIDIA graphics driver as indicated on that web page. For more information, select the **ADDITIONAL INFORMATION** tab for step-by-step instructions for installing a driver.
4. Restart your system to ensure the graphics driver takes effect.

### 2.1.2. Installing The CUDA Toolkit For Linux

Refer to the following instructions for installing CUDA on Linux, including the CUDA driver and toolkit: [NVIDIA CUDA Installation Guide for Linux](#).

### 2.1.3. Installing zlib

#### About this task

For Ubuntu users, to install the zlib package, run:

```
sudo apt install zlib1g
```

For RHEL users, to install the zlib package, run:

```
sudo yum install zlib
```

## 2.2. Downloading cuDNN For Linux

### Before you begin

In order to download cuDNN, ensure you are registered for the [NVIDIA Developer Program](#).

### Procedure

1. Go to: [NVIDIA cuDNN home page](#).
2. Click **Download**.
3. Complete the short survey and click **Submit**.
4. Accept the Terms and Conditions. A list of available download versions of cuDNN displays.
5. Select the cuDNN version you want to install. A list of available resources displays.

## 2.3. Installing On Linux

The following steps describe how to build a cuDNN dependent program. Choose the installation method that meets your environment needs. For example, the tar file installation applies to all Linux platforms. The Debian installation package applies to Ubuntu 16.04, 18.04 and 20.04.

### About this task

In the following sections:

- ▶ your CUDA directory path is referred to as `/usr/local/cuda/`
- ▶ your cuDNN download path is referred to as `<cuda_path>`

### 2.3.1. Tar File Installation

Before issuing the following commands, you'll need to replace `x.x` and `v8.x.x.x` with your specific CUDA and cuDNN versions and package date.

### Procedure

1. Navigate to your `<cuda_path>` directory containing the cuDNN tar file.
2. Unzip the cuDNN package.
3. Copy the following files into the CUDA toolkit directory.

```
$ tar -xzvf cudnn-11.5-linux-*.tgz
```

```
$ sudo cp cuda/include/cudnn*.h /usr/local/cuda/include
```

```
$ sudo cp -P cuda/lib64/libcudnn* /usr/local/cuda/lib64
```

```
$ sudo chmod a+r /usr/local/cuda/include/cudnn*.h /usr/local/cuda/lib64/libcudnn*
```

## 2.3.2. Debian Installation

Before issuing the following commands, you'll need to replace `x.x` and `8.x.x.x` with your specific CUDA and cuDNN versions and package date.

### About this task

#### Procedure

1. Navigate to your `<cuda_path>` directory containing the cuDNN Debian file.
2. Install the runtime library.

```
sudo dpkg -i libcudnn8_x.x.x-1+cudax.x_amd64.deb
```

or

```
sudo dpkg -i libcudnn8_x.x.x-1+cudax.x_arm64.deb
```

3. Install the developer library.

```
sudo dpkg -i libcudnn8-dev_8.x.x.x-1+cudax.x_amd64.deb
```

or

```
sudo dpkg -i libcudnn8-dev_8.x.x.x-1+cudax.x_arm64.deb
```

4. Install the code samples and the cuDNN library documentation.

```
sudo dpkg -i libcudnn8-samples_8.x.x.x-1+cudax.x_amd64.deb
```

or

```
sudo dpkg -i libcudnn8-samples_8.x.x.x-1+cudax.x_arm64.deb
```

## 2.3.3. RPM Installation

### About this task

#### Procedure

1. Download the RPM package `libcudnn*.rpm` to the local path.
2. Install the RPM package from the local path. This will install the cuDNN libraries.

```
rpm -ivh libcudnn8-*.x86_64.rpm
rpm -ivh libcudnn8-devel-*.x86_64.rpm
rpm -ivh libcudnn8-samples-*.x86_64.rpm
```

or

```
rpm -ivh libcudnn8-*.aarch64.rpm
rpm -ivh libcudnn8-devel-*.aarch64.rpm
rpm -ivh libcudnn8-samples-*.aarch64.rpm
```

## 2.3.4. Package Manager Installation

The Package Manager installation interfaces with your system's package manager.



If the actual installation packages are available online, then the package manager will automatically download them and install them. Otherwise, the package manager installs a local repository containing the installation packages on the system.

Whether the repository is available online or installed locally, the installation procedure is identical.

### 2.3.4.1. Ubuntu Network Installation

These are the installation instructions for Ubuntu 18.04 and 20.04 users.

#### Procedure

1. Enable the repository. The following commands enable the repository containing information about the appropriate cuDNN libraries online for Ubuntu 18.04 and 20.04.

```
wget https://developer.download.nvidia.com/compute/cuda/repos/${OS}/x86_64/cuda-
${OS}.pin

sudo mv cuda-${OS}.pin /etc/apt/preferences.d/cuda-repository-pin-600
sudo apt-key adv --fetch-keys https://developer.download.nvidia.com/compute/cuda/repos/
${OS}/x86_64/7fa2af80.pub
sudo add-apt-repository "deb https://developer.download.nvidia.com/compute/cuda/repos/
${OS}/x86_64/ /"
sudo apt-get update
```

2. Install the cuDNN library:

```
sudo apt-get install libcudnn8=${cudnn_version}-1+${cuda_version}
sudo apt-get install libcudnn8-dev=${cudnn_version}-1+${cuda_version}
```

Where:

- ▶ `${cudnn_version}` is 8.3.0.\*
- ▶ `${cuda_version}` is cuda10.2 or cuda11.5

### 2.3.4.2. RHEL Network Installation

These are the installation instructions for RHEL7 and RHEL8 users.

#### Procedure

1. Enable the repository:

```
sudo yum-config-manager --add-repo https://developer.download.nvidia.com/compute/cuda/
repos/${OS}/x86_64/cuda-${OS}.repo

sudo yum clean all
```

Where `${OS}` is `rhel7` or `rhel8`.

2. Install the cuDNN library:

```
sudo yum install libcudnn8=${cudnn_version}-1.${cuda_version}
sudo yum install libcudnn8-devel=${cudnn_version}-1.${cuda_version}
```

Where:

- ▶ `${cudnn_version}` is 8.3.0.\*
- ▶ `${cuda_version}` is cuda10.2 or cuda11.5

## 2.4. Verifying The Install On Linux

To verify that cuDNN is installed and is running properly, compile the `mnistCUDNN` sample located in the `/usr/src/cudnn_samples_v8` directory in the Debian file.

### Procedure

1. Copy the cuDNN samples to a writable path.

```
$cp -r /usr/src/cudnn_samples_v8/ $HOME
```

2. Go to the writable path.

```
$ cd $HOME/cudnn_samples_v8/mnistCUDNN
```

3. Compile the `mnistCUDNN` sample.

```
$make clean && make
```

4. Run the `mnistCUDNN` sample.

```
$ ./mnistCUDNN
```

If cuDNN is properly installed and running on your Linux system, you will see a message similar to the following:

```
Test passed!
```

## 2.5. Upgrading From cuDNN 7.x.x To cuDNN 8.x.x

Since version 8 can coexist with previous versions of cuDNN, if the user has an older version of cuDNN such as v6 or v7, installing version 8 will not automatically delete an older revision. Therefore, if the user wants the latest version, install cuDNN version 8 by following the installation steps.

### About this task

To upgrade from cuDNN v7 to v8, refer to the [Package Manager Installation](#) section and follow the steps for your OS.

To switch between v7 and v8 installations, issue `sudo update-alternatives --config libcudnn` and choose the appropriate cuDNN version.

## 2.6. Troubleshooting

Join the [NVIDIA Developer Forum](#) to post questions and follow discussions.

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# Chapter 3. Installing cuDNN On Windows

## 3.1. Prerequisites

For the latest compatibility software versions of the OS, CUDA, the CUDA driver, and the NVIDIA hardware, see the [cuDNN Support Matrix](#).

### 3.1.1. Installing NVIDIA Graphic Drivers

Install up-to-date NVIDIA graphics drivers on your Windows system.

#### Procedure

1. Go to: [NVIDIA download drivers](#)
2. Select the GPU and OS version from the drop-down menus.
3. Download and install the NVIDIA driver as indicated on that web page. For more information, select the **ADDITIONAL INFORMATION** tab for step-by-step instructions for installing a driver.
4. Restart your system to ensure the graphics driver takes effect.

### 3.1.2. Installing The CUDA Toolkit For Windows

Refer to the following instructions for installing CUDA on Windows, including the CUDA driver and toolkit: [NVIDIA CUDA Installation Guide for Windows](#).

### 3.1.3. Installing zlib

#### Procedure

1. Download and extract the zlib package from [ZLIB DLL](#).
2. Add the directory path of `zlibwapi.dll` to the environment variable `PATH`.

## 3.2. Downloading cuDNN For Windows

### Before you begin

In order to download cuDNN, ensure you are registered for the [NVIDIA Developer Program](#).

### Procedure

1. Go to: [NVIDIA cuDNN home page](#).
2. Click **Download**.
3. Complete the short survey and click **Submit**.
4. Accept the Terms and Conditions. A list of available download versions of cuDNN displays.
5. Select the cuDNN version that you want to install. A list of available resources displays.
6. Extract the cuDNN archive to a directory of your choice.

## 3.3. Installing On Windows

The following steps describe how to build a cuDNN dependent program.

### About this task

Before issuing the following commands, you'll need to replace `x.x` and `8.x.x.x` with your specific CUDA and cuDNN versions and package date.

Where:

- ▶ The CUDA directory path is referred to as `C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\vx.x`
- ▶ The cuDNN directory path is referred to as `<installpath>`

### Procedure

1. Navigate to your `<installpath>` directory containing cuDNN.
2. Unzip the cuDNN package.  
`cuda-nv-windows-x86_64-*-*archive.zip`
3. Copy the following files into the CUDA toolkit directory.
  - a). Copy `<installpath>\cuda\bin\cudnn*.dll` to `C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\vx.x\bin`.
  - b). Copy `<installpath>\cuda\include\cudnn*.h` to `C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\vx.x\include`.
  - c). Copy `<installpath>\cuda\lib\x64\cudnn*.lib` to `C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\vx.x\lib\x64`.

4. Set the following environment variables to point to where cuDNN is located. To access the value of the `$ (CUDA_PATH)` environment variable, perform the following steps:
  - a). Open a command prompt from the **Start** menu.
  - b). Type `Run` and hit **Enter**.
  - c). Issue the `control sysdm.cpl` command.
  - d). Select the **Advanced** tab at the top of the window.
  - e). Click **Environment Variables** at the bottom of the window.
  - f). Ensure the following values are set:
 

```
Variable Name: CUDA_PATH
Variable Value: C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\vx.x
```
5. Include `cuda.lib` in your Visual Studio project.
  - a). Open the Visual Studio project and right-click on the project name.
  - b). Click **Linker > Input > Additional Dependencies**.
  - c). Add `cuda.lib` and click **OK**.

## 3.4. Upgrading From cuDNN 7.x.x To cuDNN 8.x.x

Navigate to your `<installpath>` directory containing cuDNN and delete the old cuDNN `lib` and `header` files. Reinstall the latest cuDNN version by following the steps in [Installing On Windows](#).

## 3.5. Troubleshooting

Join the [NVIDIA Developer Forum](#) to post questions and follow discussions.

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# Chapter 4. Cross-compiling cuDNN Samples

This section describes how to cross-compile cuDNN samples.

## 4.1. NVIDIA DRIVE OS Linux

Follow the below steps to cross-compile cuDNN samples on NVIDIA DRIVE® OS Linux.

### 4.1.1. Installing The CUDA Toolkit For DRIVE OS

#### Before you begin

Before issuing the following commands, you'll need to replace `x-x` with your specific CUDA version.

#### Procedure

1. Download the Ubuntu package: `cuda*ubuntu*_amd64.deb`
2. Download the cross compile package: `cuda*-cross-aarch64*_all.deb`
3. Execute the following commands:

```
sudo dpkg -i cuda*ubuntu*_amd64.deb
```

```
sudo apt-get update
```

```
sudo apt-get install cuda-toolkit-x-x -y
```

```
sudo apt-get install cuda-cross-aarch64* -y
```

### 4.1.2. Installing cuDNN For DRIVE OS

#### Procedure

1. Download cuDNN Ubuntu package for your preferred CUDA toolkit version: `*libcudnn7-cross-aarch64_*.deb`
2. Download the cross compile package: `libcudnn7-dev-cross-aarch64_*.deb`
3. Execute the following commands:

```
sudo dpkg -i *libcudnn7-cross-aarch64_*.deb
sudo dpkg -i libcudnn7-dev-cross-aarch64_*.deb
```

### 4.1.3. Cross-compiling cuDNN Samples For DRIVE OS

#### Procedure

1. Copy the `cuda_samples_v7` directory to your home directory:

```
$ cp -r /usr/src/cudnn_samples_v7 $HOME
```

2. For each sample, execute the following commands:

```
$ cd $HOME/cudnn_samples_v7/(each sample)
$ make TARGET_ARCH=aarch64
```

## 4.2. NVIDIA DRIVE OS QNX

Follow the below steps to cross-compile cuDNN samples on NVIDIA DRIVE OS for QNX.

### 4.2.1. Installing The CUDA Toolkit For QNX

#### Before you begin

Before issuing the following commands, you'll need to replace `x-x` with your specific CUDA version.

#### Procedure

1. Download the Ubuntu package: `cuda*ubuntu*_amd64.deb`
2. Download the cross compile package: `cuda*-cross-aarch64*_all.deb`
3. Execute the following commands:

```
sudo dpkg -i cuda*ubuntu*_amd64.deb
sudo dpkg -i cuda*-cross-aarch64*_all.deb
sudo apt-get update
sudo apt-get install cuda-toolkit-x-x -y
sudo apt-get install cuda-cross-qnx -y
```

### 4.2.2. Installing cuDNN For QNX

#### Procedure

1. Download the cuDNN Ubuntu package for your preferred CUDA toolkit version:  
`*libcudnn7-cross-aarch64_*.deb`
2. Download the cross compile package: `libcudnn7-dev-cross-aarch64_*.deb`

- Execute the following commands:

```
sudo dpkg -i *libcudnn7-cross-aarch64_*.deb
sudo dpkg -i libcudnn7-dev-cross-aarch64_*.deb
```

### 4.2.3. Set The Environment Variables

#### Procedure

To set the environment variables, issue the following commands:

```
export CUDA_PATH={PATH}/install/cuda/
export QNX_HOST={PATH}/host/linux/x86_64
export QNX_TARGET={PATH}/target/qnx7
```

### 4.2.4. Cross-compiling cuDNN Samples For QNX

#### Procedure

- Copy the `cuda_samples_v7` directory to your home directory:
- ```
$ cp -r /usr/src/cudnn_samples_v7 $HOME
```
- For each sample, execute the following commands:



**Note:** Before issuing the following commands, you'll need to replace `7.x.x` with your specific cuDNN version.

```
$ cd $HOME/cudnn_samples_v7/ (each sample)
$ make TARGET_OS=QNX TARGET_ARCH=aarch64 HOST_COMPILER={SET FULL PATH to YOUR CROSS COMPILER}
(for example: make TARGET_OS=QNX TARGET_ARCH=aarch64 HOST_COMPILER=$QNX_HOST/usr/bin/aarch64-unknown-nto-qnx7.x.x-g++)
```

## 4.3. Linux AArch64 SBSA

Follow the below steps to cross-compile cuDNN samples on Linux AArch64 which incorporates ARM<sup>®</sup> based CPU cores for Server Base System Architecture (SBSA).

### 4.3.1. Installing The CUDA Toolkit For Linux AArch64 SBSA

#### Before you begin

Before issuing the following commands, you'll need to replace `x-x` with your specific CUDA version.



## Procedure

1. Download the Ubuntu package: `cuda*ubuntu*_amd64.deb`
2. Download the Cross compile package: `cuda*-cross-aarch64*_all.deb`
3. Execute the following commands:

```
sudo dpkg -i cuda*ubuntu*_amd64.deb
sudo apt-get update
sudo apt-get install cuda-toolkit-x-x -y
sudo apt-get install cuda-cross-aarch64* -y
```

## 4.3.2. Installing cuDNN For Linux AArch64 SBSA

### Procedure

1. Download the cuDNN Ubuntu package for your preferred CUDA toolkit version:  
`libcudnn8-cross-aarch64_*.deb`
2. Download the cross compile package: `libcudnn8-dev-cross-aarch64_*.deb`
3. Execute the following commands:

```
sudo dpkg -i libcudnn8_*/cuda11.4_amd64.deb
sudo dpkg -i libcudnn8-dev_*/cuda11.4_amd64.deb
sudo dpkg -i libcudnn8-samples_*/cuda11.4_amd64.deb
sudo dpkg -i libcudnn8-cross-aarch64_*.deb
sudo dpkg -i libcudnn8-dev-cross-aarch64_*.deb
```

4. Install AArch64 host compiler.

```
sudo apt install g++-aarch64-linux-gnu
```

## 4.3.3. Cross-compiling cuDNN Samples For Linux AArch64 SBSA

### Procedure

1. Copy the `cuda_samples_v8` directory to your home directory:

```
$ cp -r /usr/src/cudnn_samples_v8 $HOME
```

2. For each sample, execute the following commands:

```
$ cd $HOME/cudnn_samples_v8/(each sample)
$ sudo make TARGET_ARCH=aarch64 SBSA=1
```

---

# Chapter 5. Appendix

## 5.1. ACKNOWLEDGEMENTS

NVIDIA would like to thank the following individuals and institutions for their contributions:

- ▶ This product includes zlib - a general purpose compression library <https://zlib.net/> Copyright © 1995-2017 Jean-loup Gailly and Mark Adler
- ▶ This product includes zstr - a C++ zlib wrapper <https://github.com/mateidavid/zstr> Copyright © 2015 Matei David, Ontario Institute for Cancer Research
- ▶ This product includes RapidJSON - A fast JSON parser/generator for C++ with both SAX/ DOM style API <https://github.com/Tencent/rapidjson> Copyright © 2015 THL A29 Limited, a Tencent company, and Milo Yip.

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