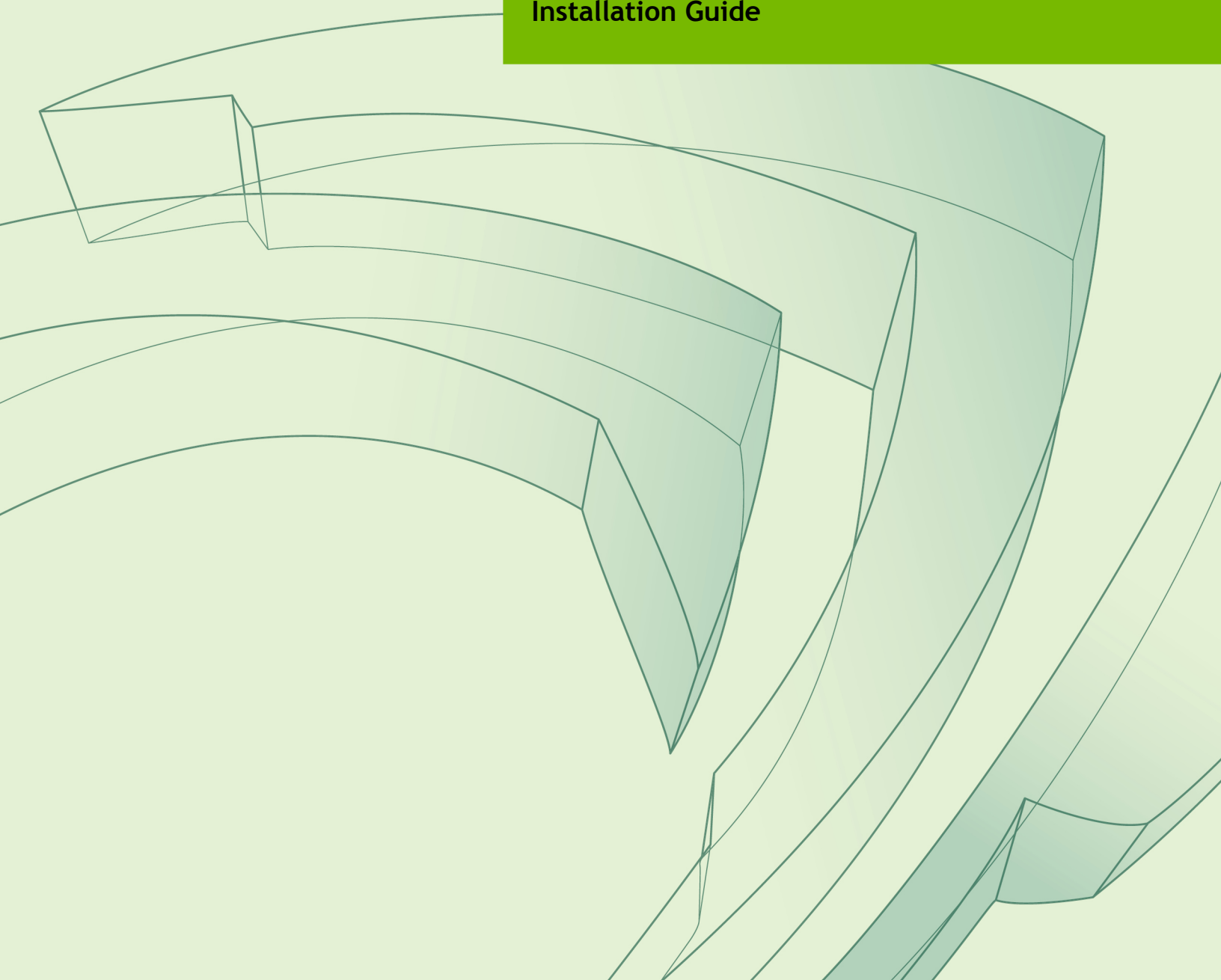




# CUDNN

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## Installation Guide



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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, including Caffe, Caffe2, TensorFlow, Theano, Torch, PyTorch, MXNet, and Microsoft Cognitive Toolkit. cuDNN is freely available to members of the NVIDIA Developer Program.

# Chapter 2.

## INSTALLING CUDNN ON LINUX

### 2.1. Prerequisites

Ensure you meet the following requirements before you install cuDNN.

- ▶ A GPU of compute capability 3.0 or higher. To understand the compute capability of the GPU on your system, see: [CUDA GPUs](#).
- ▶ If you are using cuDNN with a Volta GPU, version 7 or later is required.
- ▶ One of the following supported Architecture - OS combinations:
  - ▶ On x86\_64 (for installing cuDNN with debian files) - Ubuntu 14.04 or Ubuntu 16.04
  - ▶ On x86\_64 (for installing tgz files) - Any Linux distribution
  - ▶ On POWER8/POWER9 - RHEL7.4
- ▶ One of the following supported CUDA versions and NVIDIA graphics driver:
  - ▶ NVIDIA graphics driver R375 or newer for CUDA 8
  - ▶ NVIDIA graphics driver R384 or newer for CUDA 9
  - ▶ NVIDIA graphics driver R390 or newer for CUDA 9.2

For more information, see

- ▶ [Installing NVIDIA Graphics Drivers](#)
- ▶ [Installing CUDA](#)

#### 2.1.1. Installing NVIDIA Graphics Drivers

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

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

- Restart your system to ensure the graphics driver takes effect.

## 2.1.2. Installing CUDA

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

## 2.2. Downloading cuDNN

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

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

## 2.3. Installing cuDNN 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 14.04 and 16.04.

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. Installing from a Tar File

- Navigate to your `<cuda_path>` directory containing the cuDNN Tar file.
- Unzip the cuDNN package.

```
$ tar -xzvf cudnn-9.0-linux-x64-v7.tgz
```

- Copy the following files into the CUDA Toolkit directory, and change the file permissions.

```
$ sudo cp cuda/include/cudnn.h /usr/local/cuda/include
$ sudo cp 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. Installing from a Debian File

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

```
sudo dpkg -i libcudnn7_7.0.3.11-1+cuda9.0_amd64.deb
```

3. Install the developer library, for example:

```
sudo dpkg -i libcudnn7-dev_7.0.3.11-1+cuda9.0_amd64.deb
```

4. Install the code samples and the cuDNN Library User Guide, for example:

```
sudo dpkg -i libcudnn7-doc_7.0.3.11-1+cuda9.0_amd64.deb
```

## 2.4. Verifying

To verify that cuDNN is installed and is running properly, compile the mnistCUDNN sample located in the `/usr/src/cudnn_samples_v7` directory in the debian file.

1. Copy the cuDNN sample to a writable path.

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

2. Go to the writable path.

```
$ cd $HOME/cudnn_samples_v7/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 v6 to v7

cuDNN v7 can coexist with previous versions of cuDNN, such as v5 or v6.

## 2.6. Troubleshooting

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

# Chapter 3.

## INSTALLING CUDNN ON MAC OS X

### 3.1. Prerequisites

Ensure you meet the following requirements before you install cuDNN.

- ▶ A GPU of compute capability 3.0 or higher. To understand the compute capability of the GPU on your system, see: [CUDA GPUs](#).
- ▶ Mac OS X 10.11 or later
- ▶ NVIDIA graphics driver 378.05.05.25f01 or newer. For more information, see [Installing NVIDIA Graphics Drivers](#).
- ▶ CUDA 9.0 RC. For more information, see [Installing CUDA](#).

#### 3.1.1. Installing NVIDIA Graphics Drivers

Install up-to-date NVIDIA graphics drivers on your Mac OS X system.

1. Go to: [NVIDIA download drivers](#)
2. Select the GPU and OS version from the drop down menus.
3. Download and install NVIDIA graphics driver 378.05 or newer. 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 CUDA

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

### 3.2. Downloading cuDNN

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

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 to want to install. A list of available resources displays.
6. Extract the cuDNN archive to a directory of your choice.

### 3.3. Installing cuDNN on Mac OS X

The following steps describe how to build a cuDNN dependent program. In the following sections:

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

1. Navigate to your `<installpath>` directory containing cuDNN.
2. Unzip the cuDNN package.

```
$ tar -xzvf cudnn-9.0-osx-x64-v7.tgz
```

3. Copy the following files into the CUDA Toolkit directory, and change the file permissions.

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

4. Set the following environment variables to point to where cuDNN is located.

```
$ export DYLD_LIBRARY_PATH=/usr/local/cuda/lib:$DYLD_LIBRARY_PATH
```

### 3.4. Verifying

To verify that cuDNN is working properly on your Mac OS X system, perform the following step.

Run the following command.

```
$ echo -e '#include"cuda.h"\n void main(){}' | nvcc -x c - -o /dev/null -I/usr/local/cuda/include -L/usr/local/cuda/lib -lcudnn
```

If no error occurs, both the header and library are installed and can be located by the `nvcc` compiler.



## 3.5. Upgrading from v6 to v7

cuDNN v7 can coexist with previous versions of cuDNN, such as v5 or v6.

## 3.6. Troubleshooting

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

# Chapter 4.

## INSTALLING CUDNN ON WINDOWS

### 4.1. Prerequisites

Ensure you meet the following requirements before you install cuDNN.

- ▶ A GPU of compute capability 3.0 or higher. To understand the compute capability of the GPU on your system, see: [CUDA GPUs](#).
- ▶ One of the following supported platforms:
  - ▶ Windows 7
  - ▶ Windows 10
  - ▶ Windows Server 2012
- ▶ One of the following supported CUDA versions and NVIDIA graphics driver:
  - ▶ NVIDIA graphics driver R377 or newer for CUDA 8
  - ▶ NVIDIA graphics driver R384 or newer for CUDA 9
  - ▶ NVIDIA graphics driver R390 or newer for CUDA 9.2

For more information, see

- ▶ [Installing NVIDIA Graphics Drivers](#)
- ▶ [Installing CUDA](#)

#### 4.1.1. Installing NVIDIA Graphics Drivers

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

1. Go to: [NVIDIA download drivers](#)
2. Select the GPU and OS version from the drop down menus.
3. Download and install NVIDIA driver as indicated in that webpage. 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.

## 4.1.2. Installing CUDA

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

## 4.2. Downloading cuDNN

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

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 to want to install. A list of available resources displays.
6. Extract the cuDNN archive to a directory of your choice.

## 4.3. Installing cuDNN on Windows

The following steps describe how to build a cuDNN dependent program. In the following sections:

- ▶ your CUDA directory path is referred to as `C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v9.0`
  - ▶ your cuDNN directory path is referred to as `<installpath>`
1. Navigate to your `<installpath>` directory containing cuDNN.
  2. Unzip the cuDNN package.

```
cuda-9.0-windows7-x64-v7.zip
```

or

```
cuda-9.0-windows10-x64-v7.zip
```

3. Copy the following files into the CUDA Toolkit directory.
  - a) Copy `<installpath>\cuda\bin\cuda64_7.dll` to `C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v9.0\bin`.
  - b) Copy `<installpath>\cuda\include\cuda.h` to `C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v9.0\include`.
  - c) Copy `<installpath>\cuda\lib\x64\cuda.lib` to `C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v9.0\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\v9.0
```

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**.

## 4.4. Upgrading from v6 to v7

cuDNN v7 can coexist with previous versions of cuDNN, such as v5 or v6.

## 4.5. Troubleshooting

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

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