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™.

Chapter 2. Installing cuDNN On Linux

2.1. Prerequisites

For the latest compatibility software versions of the OS, CUDA, the CUDA driver, and the NVIDIA hardware, see the 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.

2.2. 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 `<cudnnpath>`

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 `<cudnnpath>` directory containing the cuDNN tar file.
2. Unzip the cuDNN package.

```
$ tar -xzvf cudnn-x.x-linux-x64-v8.x.x.x.tgz
```

or

```
$ tar -xzvf cudnn-x.x-linux-aarch64sbsa-v8.x.x.x.tgz
```

3. Copy the following files into the CUDA Toolkit directory.

```
$ 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 CUDAand cuDNN versions and package date.

About this task

Procedure

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

```
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, for example:

```
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, for example:

```
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 16.04, 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.

Options	Description

For Ubuntu 16.04	`wget https://developer.download.nvidia.com/compute/cuda/repos/ubuntu1604/x86_64/cuda-ubuntu1604.pin`
	
	`sudo mv cuda-ubuntu1604.pin /etc/apt/preferences.d/cuda-repository-pin-600`
	`sudo apt-key adv --fetch-keys http://developer.download.nvidia.com/compute/cuda/repos/ubuntu1604/x86_64/7fa2af80.pub`
	`sudo add-apt-repository "deb https://developer.download.nvidia.com/compute/cuda/repos/ubuntu1604/x86_64/ /"`
	`sudo apt-get update`

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`
	
	Where `${OS}` is `ubuntu1804` or `ubuntu2004`.

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:

- `${cudnn_version}` is `8.1.1.*`
- `${cuda_version}` is `cuda10.2` or `cuda11.2`

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 8.1.1.*
- ${cuda_version} is cuda10.2 or cuda11.2

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.

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.

3.2. 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 to 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.
   `cudnn-x.x-windows-x64-v8.x.x.x.zip`
   or
   `cudnn-x.x-windows10-x64-v8.x.x.x.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 `cudnn.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 `cudnn.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.

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 `cudnn_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`

3. 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

1. Copy the `cudnn_samples_v7` directory to your home directory:

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

2. 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++)
```

Chapter 5. Appendix

5.1. ACKNOWLEDGEMENTS

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