

Pytorch(GPU)与CUDA的环境配置

I. 简介

A. CUDA

CUDA(Compute Unified Device Architecture)是由NVIDIA推出的并行计算架构，是一种硬件技术。CUDA旨在利用GPU来执行通用计算任务。与传统的CPU相比，GPU在处理大规模并行计算任务时具有更高的效率和更低的能耗。CUDA的出现，使得GPU不再仅仅局限于图形处理领域，而是可以广泛应用于科学计算、数据分析、人工智能等多个领域。CUDA为开发者提供了一套丰富的API，这些API涵盖了从底层硬件访问到高层抽象的各种功能。开发者可以使用这些API来编写高效的并行计算程序，并充分利用GPU的并行计算能力。

CUDA Toolkit是一套完整的软件开发工具集，包括编译器、库和API，用于开发CUDA应用程序。

cuDNN (CUDA Deep Neural Network library) 是由NVIDIA提供的一个深度学习库，专门用于加速深度神经网络的训练和推理。它包含了高度优化的深度学习操作实现，可以显著提高深度学习模型在NVIDIA GPU上的性能

B. PyTorch

PyTorch是一个开源的机器学习库，它为用户提供了构建和训练机器学习模型所需的丰富工具。其中，PyTorch能够利用NVIDIA CUDA技术，实现神经网络在GPU上的高效并行计算，这一特性使得深度学习模型的训练更加迅速且高效。

II. 环境

- 系统环境: Windows 11(X86_64, RTX4060)
- 工具: Miniconda

```
conda -V # 查询Conda版本
# conda 24.7.1
```

- Python版本: 3.8.16

III. 步骤

- 确定Python版本，以找到对于支持的Pytorch版本
- 查看当前系统支持的CUDA版本

```
nvidia-smi
```

```
nvidia-smi
```

Sat Oct 5 16:22:45 2024

NVIDIA-SMI 537.45				Driver Version: 537.45				CUDA Version: 12.2			
GPU	Name			TCC/WDDM	Bus-Id	Disp. A		Volatile	Uncorr.	ECC	
Fan	Temp	Perf		Pwr:Usage/Cap		Memory-Usage		GPU-Util	Compute	M.	
									MIG	M.	
0	NVIDIA GeForce RTX 4060			WDDM	00000000:01:00.0	Off				N/A	
N/A	40C	P8		4W / 40W	121MiB / 8188MiB			25%	Default	N/A	

Processes:											
GPU	GI	CI	PID	Type	Process name				GPU Memory		
	ID	ID							Usage		
0	N/A	N/A	8348	C+G	...on\wallpaper_engine\wallpaper32.exe				N/A		

- 可以看到当前系统所支持的最高CUDA版本为12.2
- 安装Pytorch(GPU)版本之前需要先安装CUDA和cuDNN，否则Pytorch无法正常工作

3. 安装CUDA

- 可以在官网下载安装(不方便版本管理): <https://developer.nvidia.com/cuda-toolkit-archive>
- 利用conda在虚拟环境中安装(比较新的版本没有): 此处安装11.8.0

```
conda search cudatoolkit # 查看可以安装的版本
```

```
Loading channels: done
# Name Version Build Channel
cudatoolkit 8.0 4 anaconda/pkgs/main
cudatoolkit 9.0 1 anaconda/pkgs/main
cudatoolkit 9.2 0 anaconda/pkgs/main
cudatoolkit 10.0.130 0 anaconda/pkgs/main
cudatoolkit 10.1.168 0 anaconda/pkgs/main
cudatoolkit 10.1.243 h74a9793_0 anaconda/pkgs/main
cudatoolkit 10.2.89 h74a9793_0 anaconda/pkgs/main
cudatoolkit 10.2.89 h74a9793_1 anaconda/pkgs/main
cudatoolkit 11.0.221 h74a9793_0 anaconda/pkgs/main
cudatoolkit 11.3.1 h59b6b97_2 anaconda/pkgs/main
cudatoolkit 11.8.0 hd77b12b_0 anaconda/pkgs/main
```

```
conda install cudatoolkit==11.8.0
```

```
The following packages will be downloaded:

package | build
-----|-----
ca-certificates-2024.9.24 | haa95532_0 131 KB defaults
cudatoolkit-11.8.0 | hd77b12b_0 639.8 MB defaults
-----|-----
Total: 640.0 MB

The following NEW packages will be INSTALLED:

cudatoolkit      anaconda/pkgs/main/win-64::cudatoolkit-11.8.0-hd77b12b_0

The following packages will be UPDATED:

ca-certificates      2024.7.2-haa95532_0 --> 2024.9.24-haa95532_0

Proceed ([y]/n)? y

Downloading and Extracting Packages:

Preparing transaction: done
Verifying transaction: done
Executing transaction: done
```

4. 安装cuDNN

- cuDNN与CUDA toolkit也有版本对应关系。
NVIDIA cuDNN is a GPU-accelerated library of primitives for deep neural networks.

Download cuDNN v8.9.7 (December 5th, 2023), for CUDA 12.x
Download cuDNN v8.9.7 (December 5th, 2023), for CUDA 11.x
Download cuDNN v8.9.6 (November 1st, 2023), for CUDA 12.x
Download cuDNN v8.9.6 (November 1st, 2023), for CUDA 11.x
Download cuDNN v8.9.5 (October 27th, 2023), for CUDA 12.x
Download cuDNN v8.9.5 (October 27th, 2023), for CUDA 11.x
Download cuDNN v8.9.4 (August 8th, 2023), for CUDA 12.x
Download cuDNN v8.9.4 (August 8th, 2023), for CUDA 11.x

- 可以在官网下载：<https://developer.nvidia.com/rdp/cudnn-archive>
- 也可在conda中下载：

```
conda search cudnn
```

```
Loading channels: done
# Name                                Version                                Build                                Channel
cudnn                                  7.1.4                                cuda8.0_0                           anaconda/pkgs/main
cudnn                                  7.1.4                                cuda9.0_0                           anaconda/pkgs/main
cudnn                                  7.3.1                                cuda10.0_0                          anaconda/pkgs/main
cudnn                                  7.3.1                                cuda9.0_0                           anaconda/pkgs/main
cudnn                                  7.6.0                                cuda10.0_0                          anaconda/pkgs/main
cudnn                                  7.6.0                                cuda10.1_0                          anaconda/pkgs/main
cudnn                                  7.6.0                                cuda9.0_0                           anaconda/pkgs/main
cudnn                                  7.6.4                                cuda10.0_0                          anaconda/pkgs/main
cudnn                                  7.6.4                                cuda10.1_0                          anaconda/pkgs/main
cudnn                                  7.6.4                                cuda9.0_0                           anaconda/pkgs/main
cudnn                                  7.6.5                                cuda10.0_0                          anaconda/pkgs/main
cudnn                                  7.6.5                                cuda10.1_0                          anaconda/pkgs/main
cudnn                                  7.6.5                                cuda10.2_0                          anaconda/pkgs/main
cudnn                                  7.6.5                                cuda9.0_0                           anaconda/pkgs/main
cudnn                                  7.6.5                                cuda9.2_0                           anaconda/pkgs/main
cudnn                                  8.2.1                                cuda11.3_0                          anaconda/pkgs/main
cudnn                                  8.9.2.26                             cuda11_0                            anaconda/pkgs/main
cudnn                                  8.9.2.26                             cuda12_0                            anaconda/pkgs/main
cudnn                                  9.1.1.17                             cuda12_0                            anaconda/pkgs/main
```

```
conda install cudnn==8.9.2.26=cuda11_0
```

The following packages will be downloaded:

package	build		
cudnn-8.9.2.26	cuda11_0	457.3 MB	defaults
Total:		457.3 MB	

The following NEW packages will be INSTALLED:

```
cudnn                                anaconda/pkgs/main/win-64::cudnn-8.9.2.26-cuda11_0
```

Proceed ([y]/n)? y

Downloading and Extracting Packages:

```
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
```

5. 安装Pytorch

- 在官网上找对应的版本: <https://pytorch.org/>

NOTE: Latest PyTorch requires Python 3.8 or later.

PyTorch Build	Stable (2.4.1)			Preview (Nightly)	
Your OS	Linux		Mac		Windows
Package	Conda	Pip		LibTorch	Source
Language	Python			C++ / Java	
Compute Platform	CUDA 11.8	CUDA 12.1	CUDA 12.4	ROCm 6.1	CPU
Run this Command:	conda install pytorch torchvision torchaudio pytorch-cuda=11.8 -c pytorch -c nvidia				

- 在虚拟环境中安装:

```
conda install pytorch torchvision torchaudio pytorch-cuda=11.8 -c pytorch -c nvidia
```

```
Downloading and Extracting Packages:
pytorch-2.4.1 | 1.38 GB | #####8 | 8%
libcublas-dev-11.11. | 375.9 MB | 1 | 0%
libcuspars-dev-11.7 | 175.7 MB | | 0%
libcufft-dev-10.9.0. | 144.6 MB | 1 | 0%
libnpp-dev-11.8.0.86 | 143.2 MB | | 0%
libcusolver-dev-11.4 | 94.1 MB | | 0%
cuda-nvrtc-11.8.89 | 72.1 MB | | 0%
libcurand-dev-10.3.5 | 49.7 MB | | 0%
cuda-nvrtc-dev-11.8. | 16.1 MB | | 0%
cuda-cupti-11.8.87 | 11.5 MB | | 0%
sympy-1.13.2 | 11.3 MB | | 0%
torchvision-0.19.1 | 7.7 MB | | 0%
torchaudio-2.4.1 | 7.0 MB | | 0%
networkx-3.1 | 2.7 MB | | 0%
libnvjpeg-dev-11.9.0 | 1.9 MB | | 0%
mpfr-4.0.2 | 1.5 MB | | 0%
cuda-cudart-11.8.89 | 1.4 MB | | 0%
cuda-cccl-12.4.127 | 1.4 MB | | 0%
mpir-3.0.0 | 1.3 MB | | 0%
mpmath-1.3.0 | 832 KB | | 0%
cuda-cudart-dev-11.8 | 723 KB | | 0%
libjpeg-turbo-2.0.0 | 618 KB | | 0%
brotli-python-1.0.9 | 347 KB | | 0%
libuv-1.48.0 | 322 KB | | 0%
libnpp-11.8.0.86 | 294 KB | | 0%
jinja2-3.1.4 | 271 KB | | 0%
mpc-1.1.0 | 260 KB | | 0%
urllib3-2.2.3 | 182 KB | | 0%
... (more hidden) ...
```

6. 测试安装结果

- 在conda环境中进入python命令行:

```
python
```

```
Python 3.8.19 (default, Mar 20 2024, 19:55:45) [MSC v.1916 64 bit (AMD64)] :: Anaconda, Inc. on win32
Type "help", "copyright", "credits" or "license" for more information.
>>>
```

- 导入torch包并查看版本、查看cuda版本、查看cudnn版本

```
import torch

print(torch.__version__)
print(torch.version.cuda)
print(torch.backends.cudnn.version())
```

```
>>> print(torch.__version__)
2.4.1
>>> print(torch.version.cuda)
11.8
>>> print(torch.backends.cudnn.version())
90100
```