Manual for Image Classification using TensorFlow

This instruction manual provides the procedure to setup the infrastructure and environment to perform machine learning-based image classfication. Along with this manual, a compressed file named `requirements_image.zip` is provided for requried software package and library installations.

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Section 1. Specifications for Machine

This section describe the requirments for environment setup, including hardware aspect and software aspect. This instruction is intended for `MicroSoft Windows` users.

1-1. Hardware for Host Machine:

The following are the hardware specification needed for your machine.

Category	Value
CPU	**4 cores** or higher x86-64 (**64-bit**)
Memory	**8 GB** or higher
Disk	**1 TB** (1024 GB) or higher
GPU	An NVIDIA GPU device gen. **GTX 7-series** or newer

[IMPORTANT] An **AMD** GPU deivce will not be compatible!

1-2. Software:

The following are the required softwares:

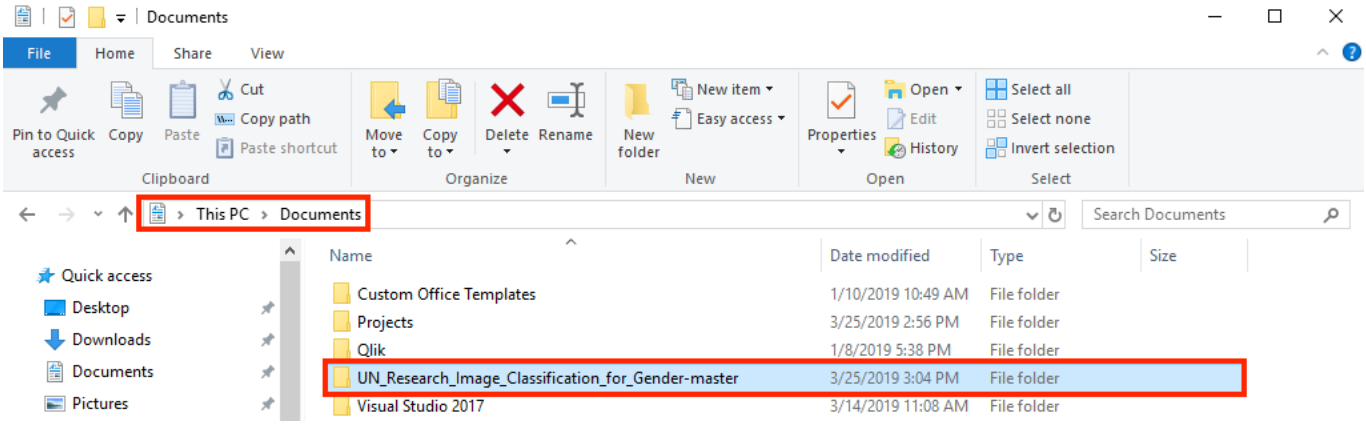
Category	Name
Operating System	Microsoft Windows **10**
Programming	Python **3.6**
Machine Learning	CUDA **9.0** by NVIDIA

Section 2. Deploy this Repository on your Computer

Along with this manual, a file named `programs_image.zip` which stores the program files was given. Please extract it into the location:

```
C:\Users\<user_name>\Documents\
# Change <user_name> to your computer username.
```

After the extraction, a folder named `UN_Research_Image_Classification_for_Gender-master` should be available under `Documents` folder as follow:



Section 3. Software Installation

In this section, the environment setup for the prepared machine is described. A compressed file name `requirements_image.zip` is provided along with this manual. It contains all the software installation executables needed to get the machine ready. Please uncompress it with a compression software like `IZArc`, `WinRAR`, or `7-zip`.

If the computer does not have a compression software available, `7-zip` is a recommendation. Please use the link: https://www.7-zip.org/a/7z1900-x64.exe to download and install it. Visit https://www.7-zip.org/ if the provided link is not working.

Please extract the content of `requirements_image.zip`. The structure is as follow:

```
+-- Dataset/
|   +-- training_imgs/
|   |   +-- female/
|   |   |   +-- (many image files)
|   |   +-- male/
|   |   |   +-- (many image files)
|   |   +-- unknown/
|   |   |   +-- (many image files)
|   +-- freelancer_supply_20190204.csv
|
+-- Installation/
|   +-- Git-2.21.0-64-bit.exe
|   +-- python-3.6.8-amd64.exe
|   +-- cuda_9.0.176_win10_network.exe
|   +-- cudnn_lib/
|   |   +-- bin/
|   |   |   +-- cudnn64_7.dll
|   |   +-- include/
|   |   |   +-- cudnn.h
|   |   +-- lib/
|   |   |   +-- x64/
|   |   |   |   +-- cudnn.lib
|   +-- vc_redist.x64.exe
|   +-- vs_community__881455873.1549905826.exe
```

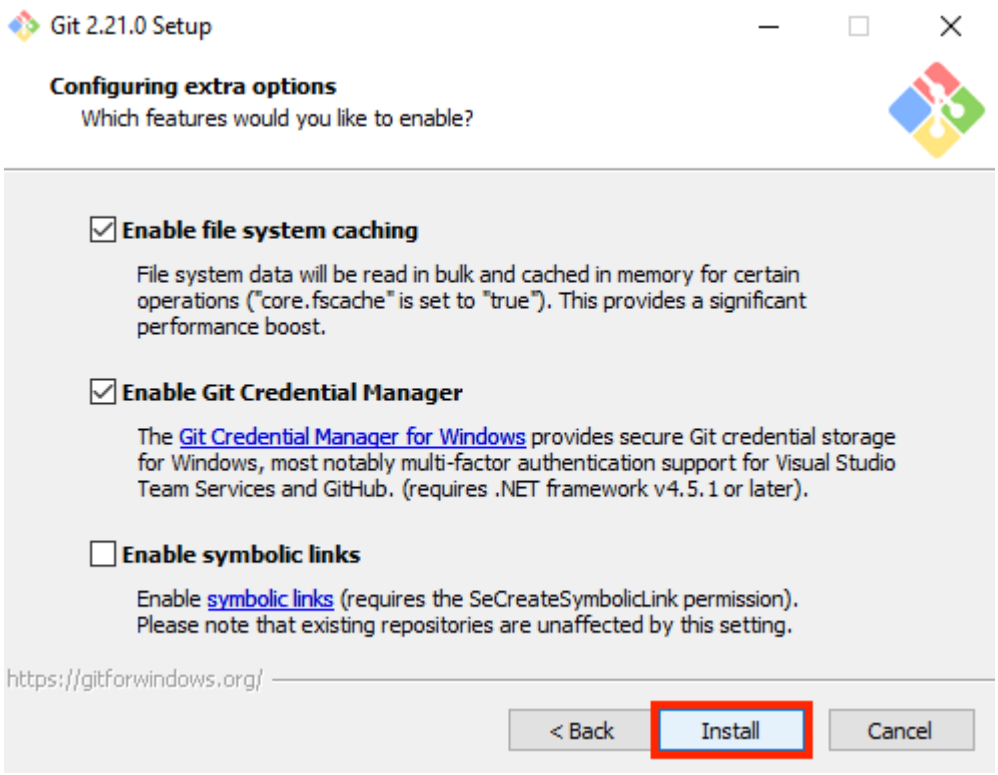
3-1. Install Git for Windows

Git is the repository syncing service for repository management. In the `requirements_image.zip`, a folder named `Installation` contains `Git-2.21.0-64-bit.exe`, which is for the installation. If the file is not found, please visit https://git-scm.com/downloads and click `Download X.X.X for Windows` to download the executable.

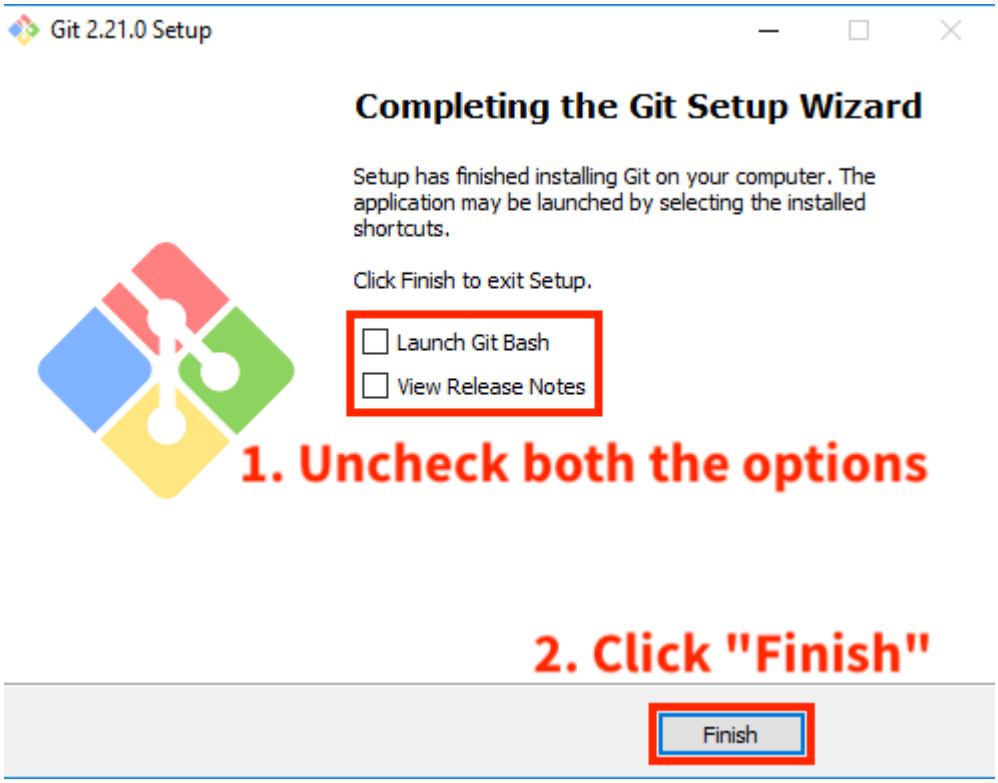
Procedure

1. Double-click on `Git-2.21.0-64-bit.exe`, click `Next`:

2. Keep click on `Next` until the following page, click `Install`:



3. Wait until the process complete, **uncheck** all the given options then click `Finish`:



3-2. Install Python 3.6 Environment

Python is the programming language used for this project. The file `python-3.6.8-amd64.exe` is available under folder `Installation`. If the file is not found, please visit https://www.python.org/downloads/release/python-368/, scroll down to the bottom of the page, and find the download link `Windows x86-64 executable installer`.

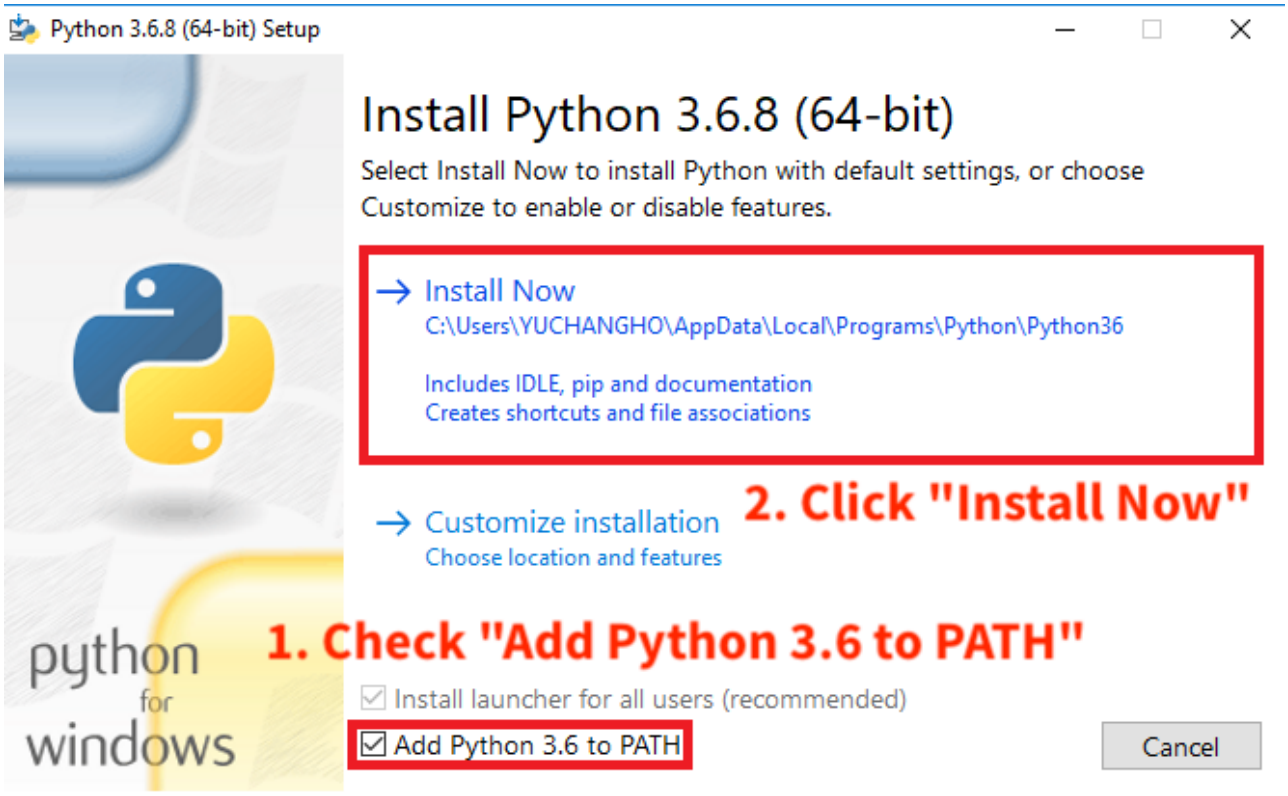
Files **1. Scroll down to the bottom to find section "Files"**

Version	Operating System	Description	MD5 Sum	File Size	GPG
Gzipped source tarball	Source release		48f393a04c2e66c77bfc114e589ec630	23010188	SIG
XZ compressed source tarball	Source release		51aac91bdf8be95ec0a62d174890821a	17212420	SIG
macOS 64-bit/32-bit installer	Mac OS X	for Mac OS X 10.6 and later	eb1a23d762946329c2aa3448d256d421	33258809	SIG
macOS 64-bit installer	Mac OS X	for OS X 10.9 and later	786c4d9183c754f58751d52f509bc971	27073838	SIG
Windows help file	Windows		0b04278f5bdb8ee85ae5ae66af0430b2	7868305	SIG
Windows x86-64 embeddable zip file	Windows	for AMD64/EM64T/x64	73df7cb2f1500ff36d7dbeeac3968711	7276004	SIG
Windows x86-64 executable installer	Windows	for AMD64/EM64T/x64	72f37686b7ab240ef70fdb931bdf3cb5	31830944	SIG
Windows x86-64 web-based installer	Windows	for AMD64/EM64T/x64	39dde5f535c16d642e84fc7a69f43e05	1331744	SIG
Windows x86 embeddable zip file	Windows		60470b4cceba52094121d43cd3f6ce3a	6560373	SIG
Windows x86 executable installer	Windows		9c7b1ebdd3a8df0eebfda2f107f1742c	30807656	SIG
Windows x86 web-based installer	Windows		80de96338691698e10a935ecd0bdaacb	1296064	SIG

2. Use this link to download

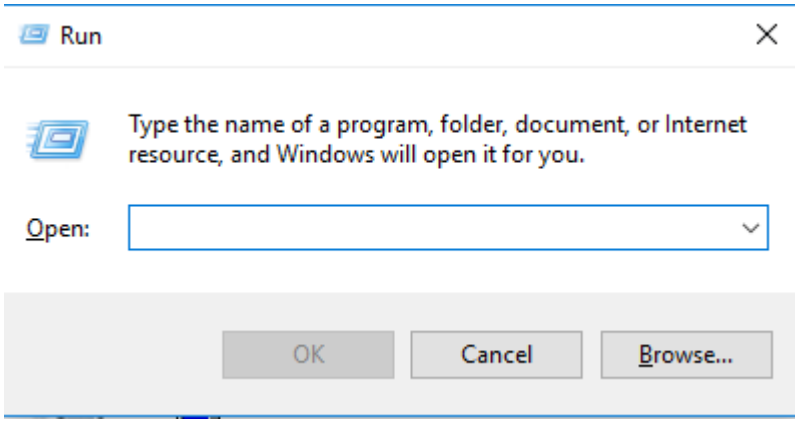
Procedure

1. Make sure to **check** `Add Python 3.6 to PATH` then click `Install Now`:

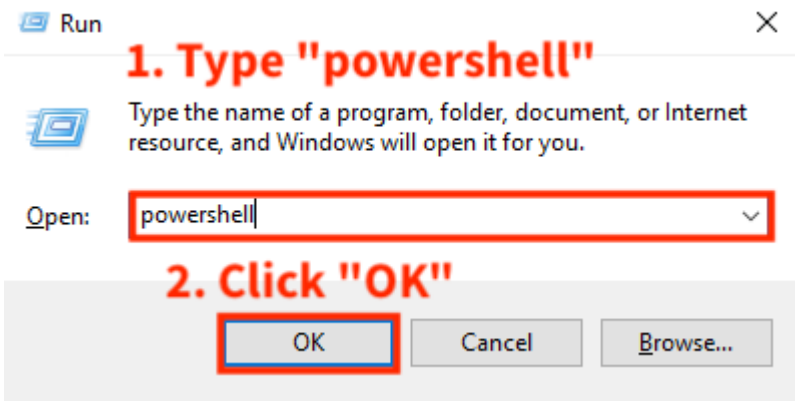


2. Open up an `Windows Powershell` by follow the steps:

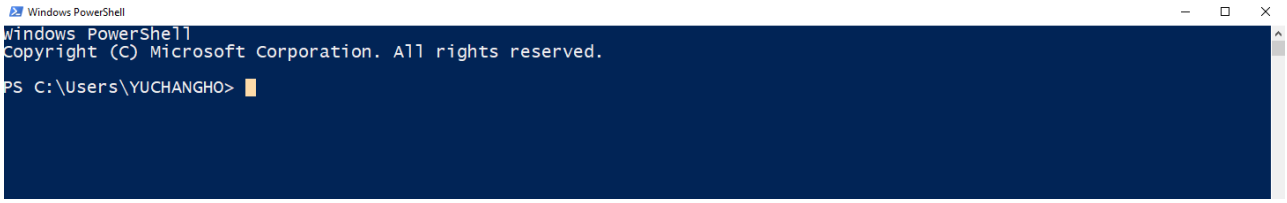
   a. Press "`win` key  + `R`" on the keyboard, the following window will be prompted:



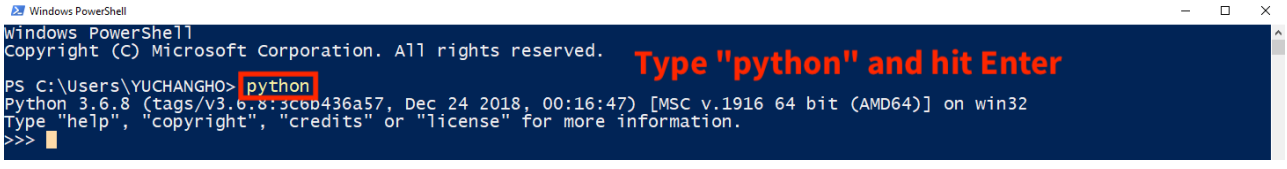
b. Type `powershell` then hit `Enter`



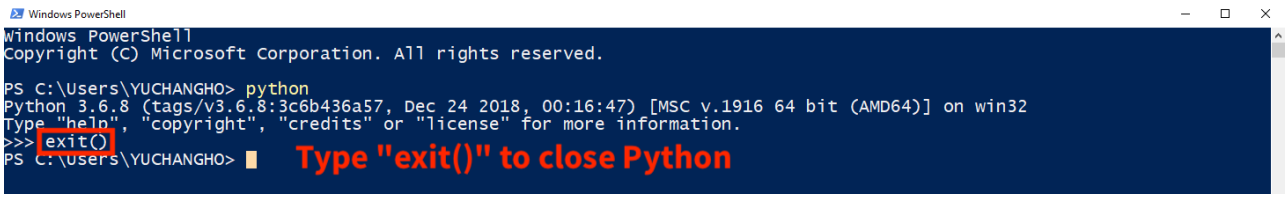
c. This is the **Windows PowerShell**:



d. Within the window, type `python` then hit `Enter`:



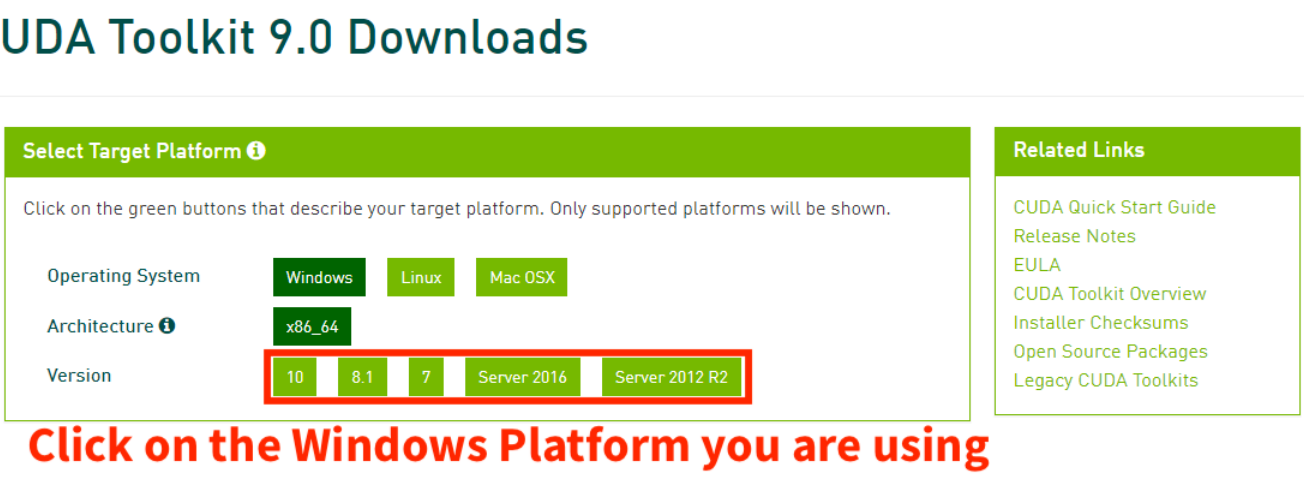
e. If no error message shows up, type `exit()` to quit the program or simply close the window.



3-3. Install NVIDIA CUDA 9.0 Library (for Computer with NIVIDA GPU Device Only)

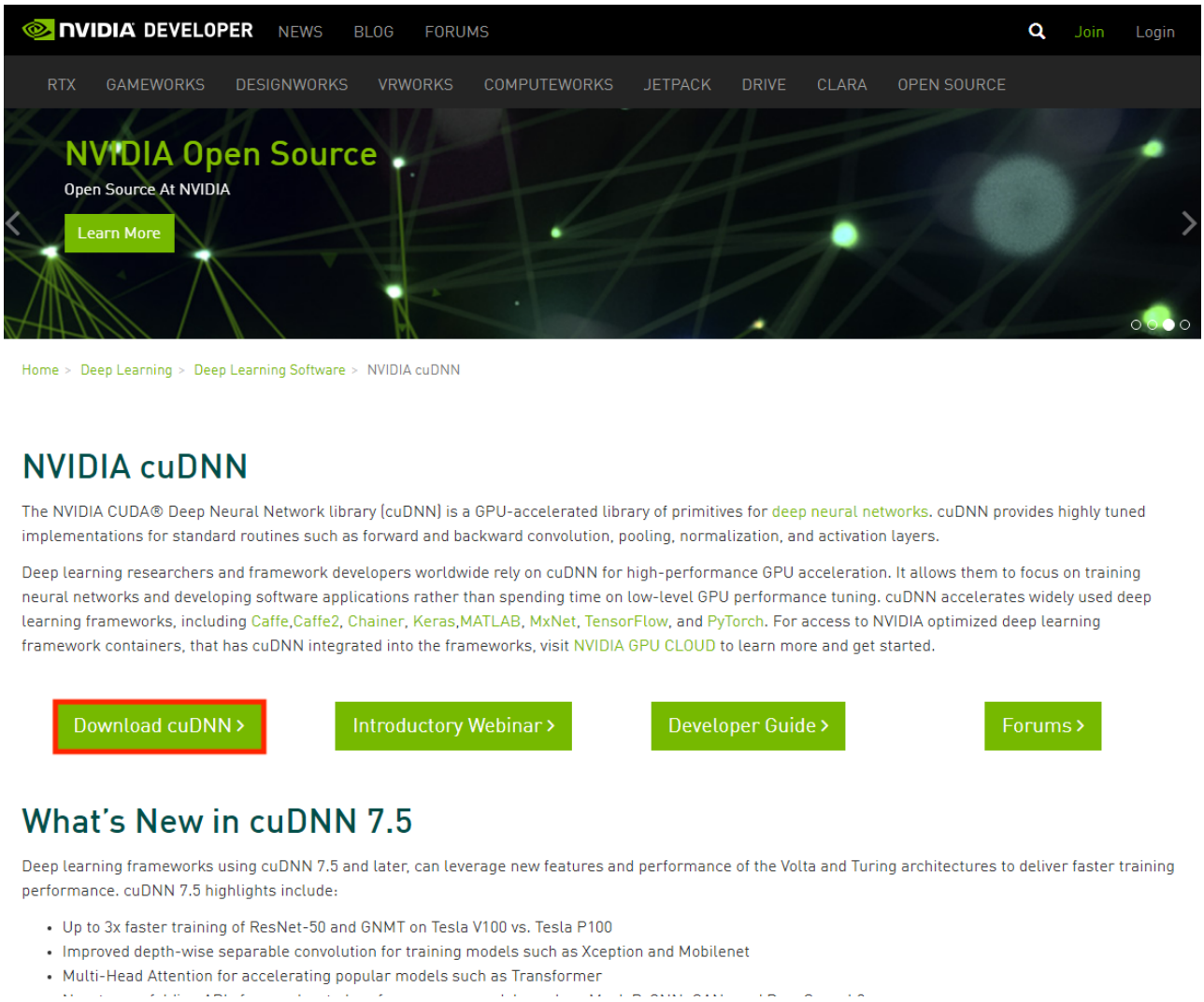
In this sub-section, the NVIDIA CUDA 9.0 library will be installed. It is the library for accerlating the TensorFlow computation while conducting **image classification for gender identification**. Please make sure the working machine has a `compatible NIVIDIA GPU device` equipped. Please refer to https://www.geforce.com/hardware/technology/cuda/supported-gpus for the list of compatible NIVIDA GPU. Also, for the latest updated tutorial for the installation, please refer to the TensorFlow developer site for enabling GPU support for TensorFlow: https://www.tensorflow.org/install/gpu

In the given `requirements_image.zip`, an executable named `cuda_9.0.176_win10_network.exe` could be found under folder `Installation`. If the file is not found, please visit https://developer.nvidia.com/cuda-90-download-archive?target_os=Windows&target_arch=x86_64 and use the link `Windows` to download.

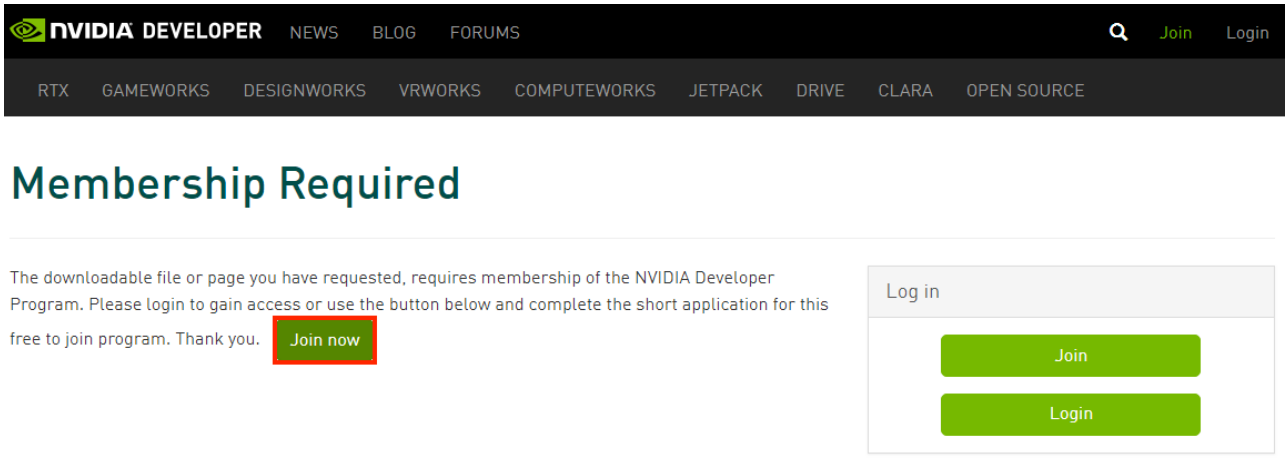


An folder named `cudnn_lib` is also available under the same folder. Those are the requirements for the installation. If `cudnn_lib` is not found, please visit https://developer.nvidia.com/cudnn and click on the link `Download cuDNN`. It will ask for an valid NVIDIA developer account to proceed to download. Follow the steps below:

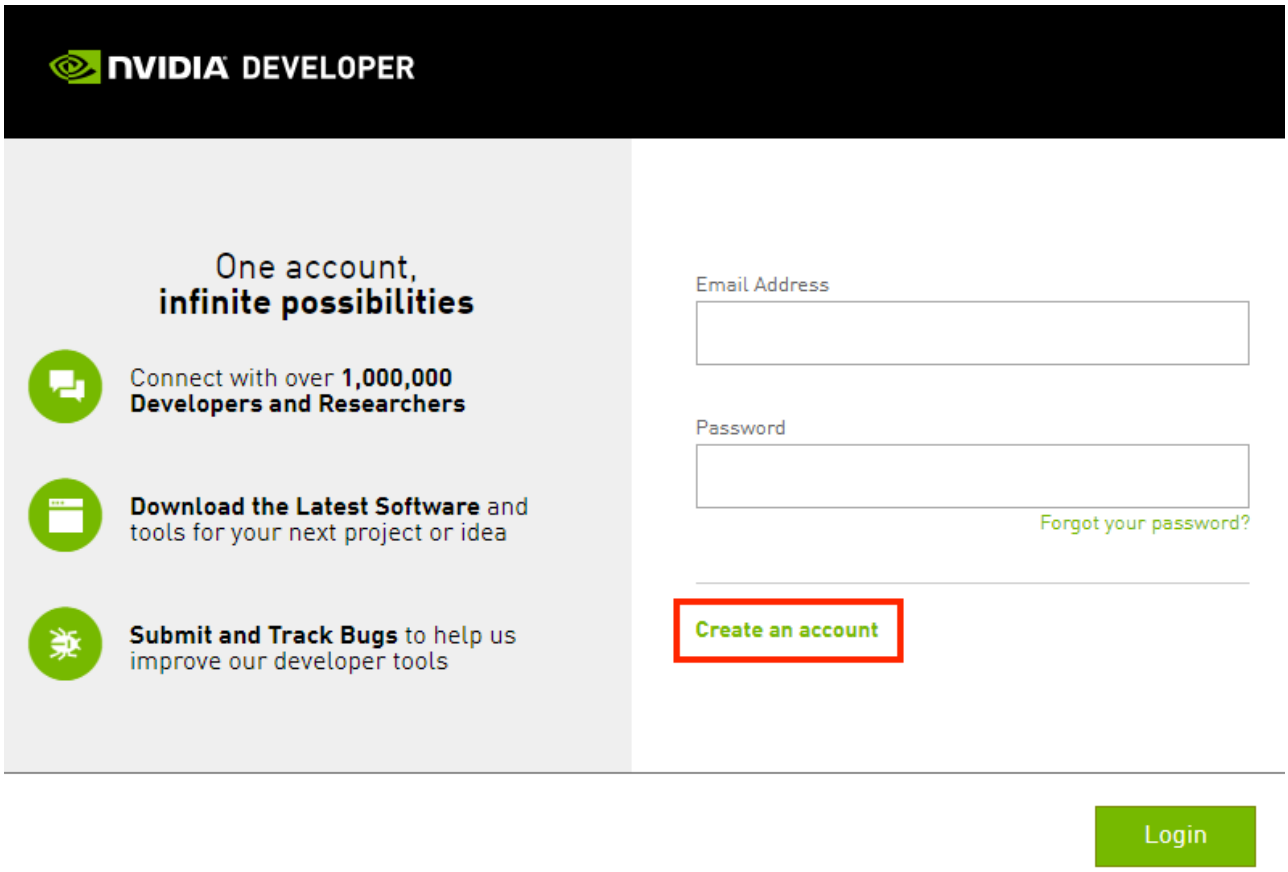
1. Click `Download cuDNN`:



2. Click `Join Now`:

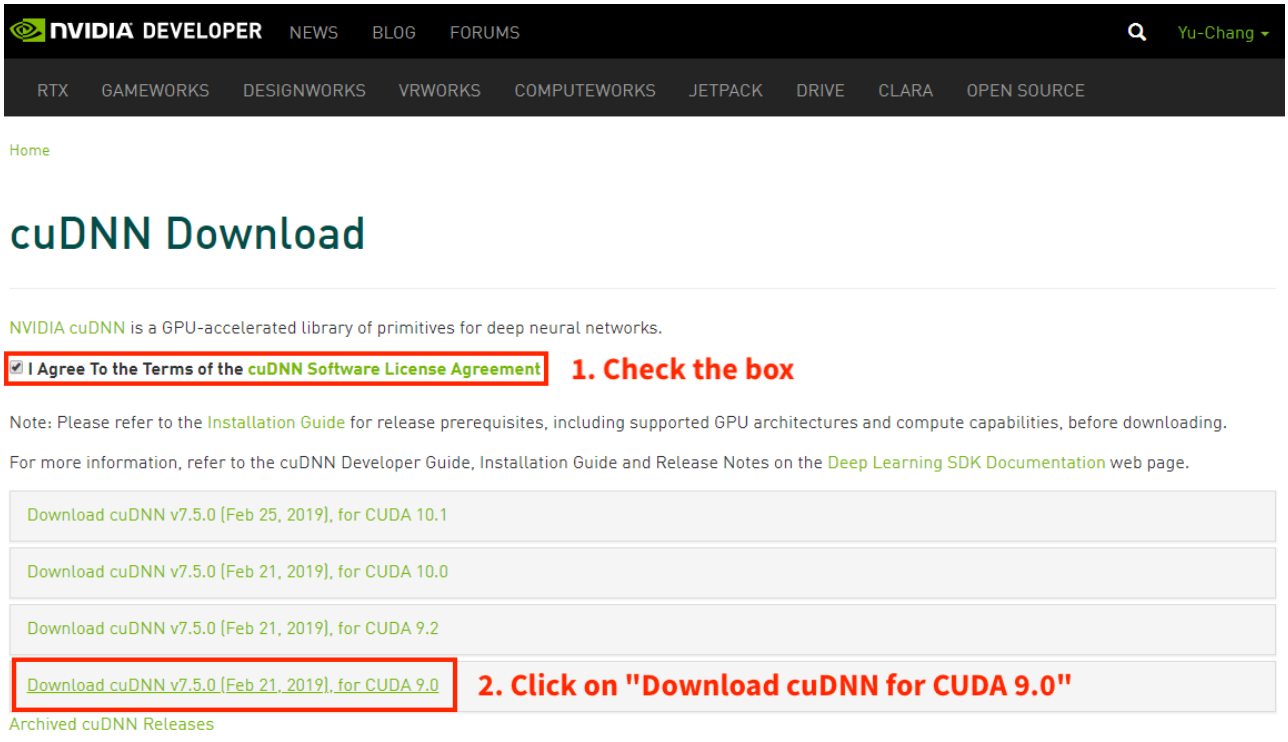


3. Click `Create an account` and then follow the webpage's instructions for account creation:

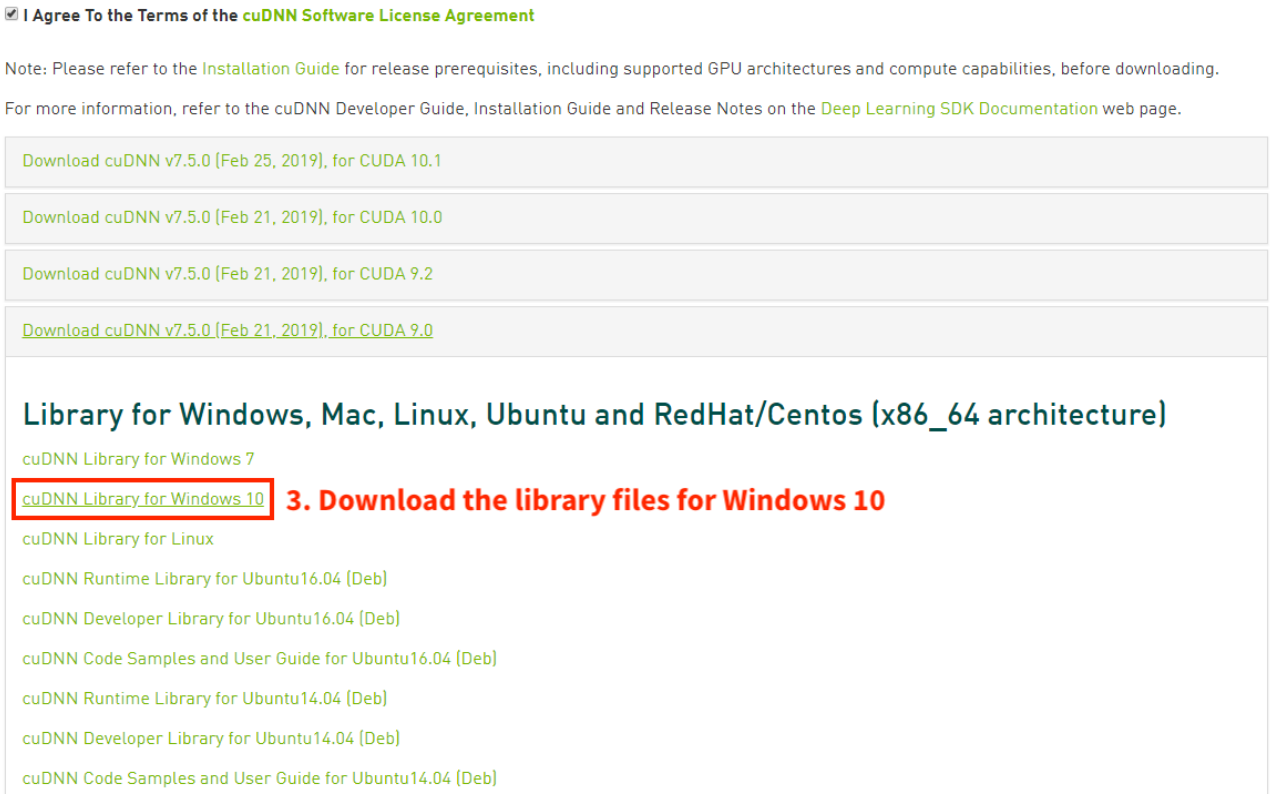


4. After the account is created, head back to https://developer.nvidia.com/cudnn, click on `Download cuDNN` again

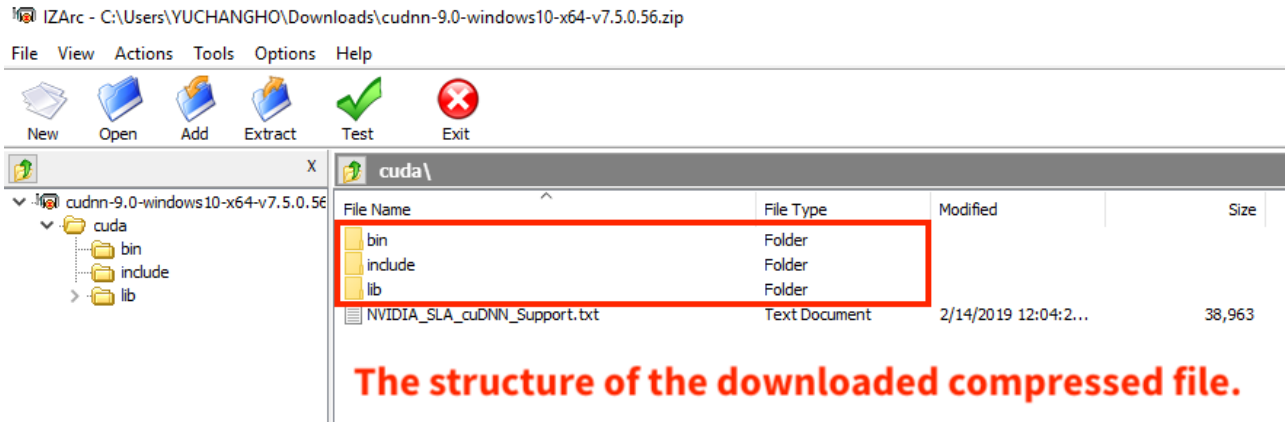
5. Check the box to accept the agreement, then find the link for **CUDA 9.0**:



6. Find the link for **Windows 10**:

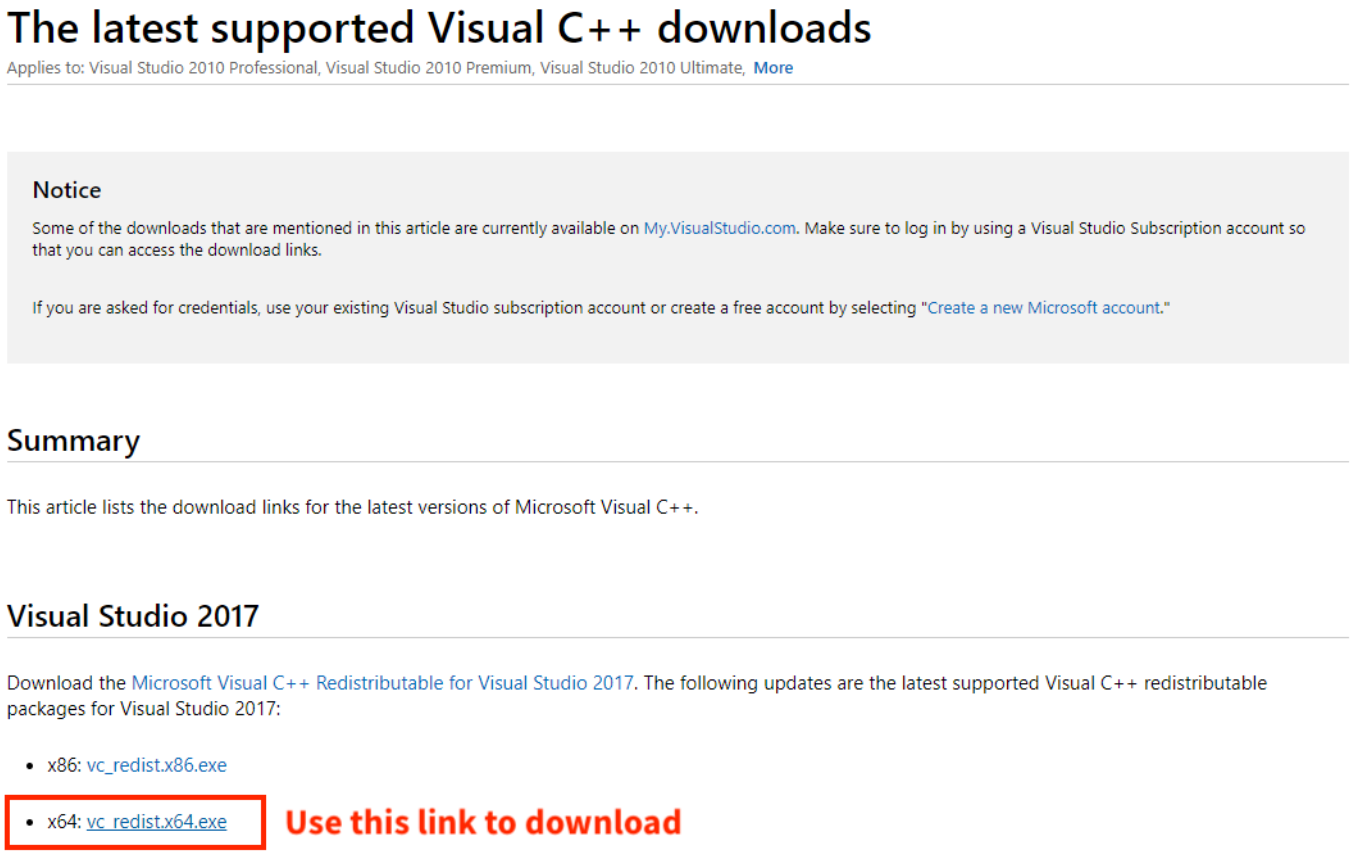


7. The downloaded compressed file could look like this:



3-3-1. Install MS Visual Studio Tools

In the folder `Installation`, two executables, `vc_redist.x64.exe` and `vs_community__881455873.1549905826.exe`, are available. Refer to https://support.microsoft.com/en-us/help/2977003/the-latest-supported-visual-c-downloads to download `vc_redist.x64.exe` under section `Visual Studio 2017`.



The latest supported Visual C++ downloads

Applies to: Visual Studio 2010 Professional, Visual Studio 2010 Premium, Visual Studio 2010 Ultimate, More

Notice

Some of the downloads that are mentioned in this article are currently available on My.VisualStudio.com. Make sure to log in by using a Visual Studio Subscription account so that you can access the download links.

If you are asked for credentials, use your existing Visual Studio subscription account or create a free account by selecting "Create a new Microsoft account."

Summary

This article lists the download links for the latest versions of Microsoft Visual C++.

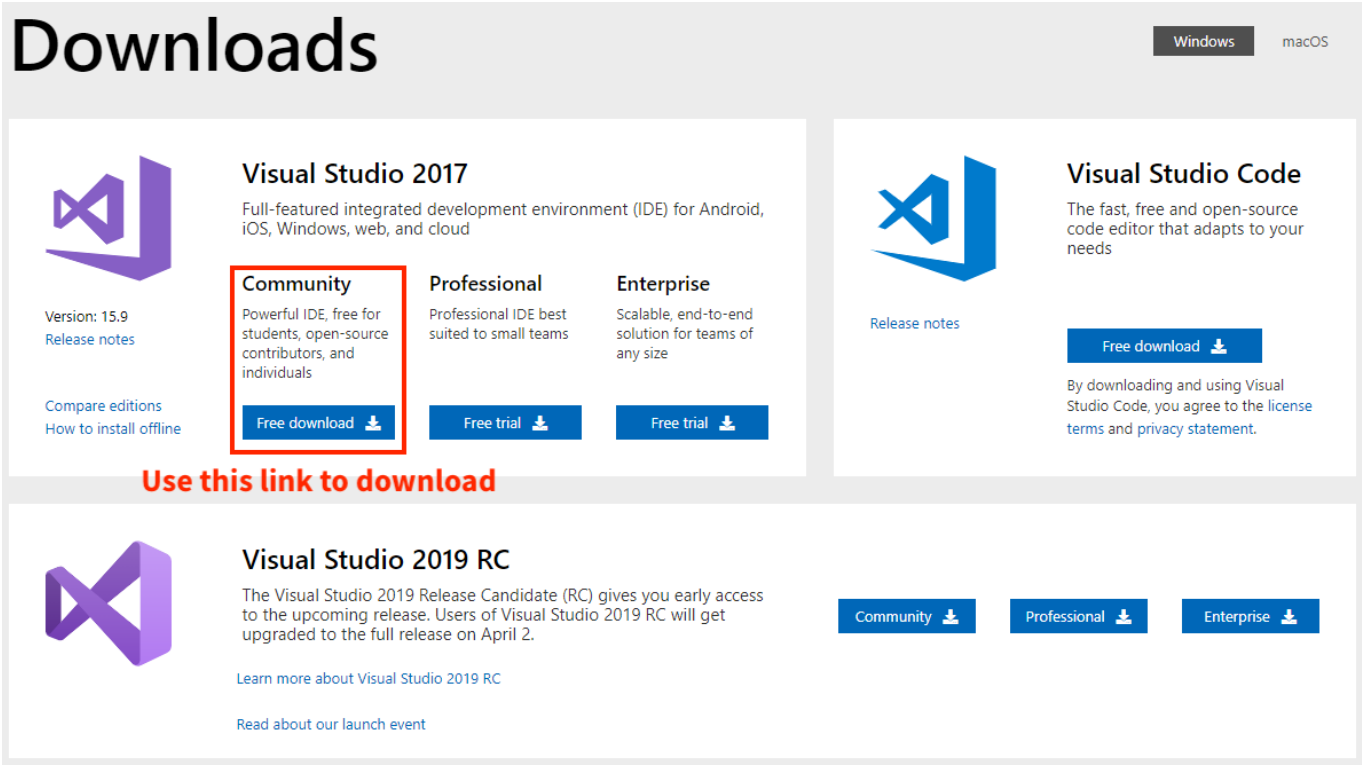
Visual Studio 2017

Download the Microsoft Visual C++ Redistributable for Visual Studio 2017. The following updates are the latest supported Visual C++ redistributable packages for Visual Studio 2017:

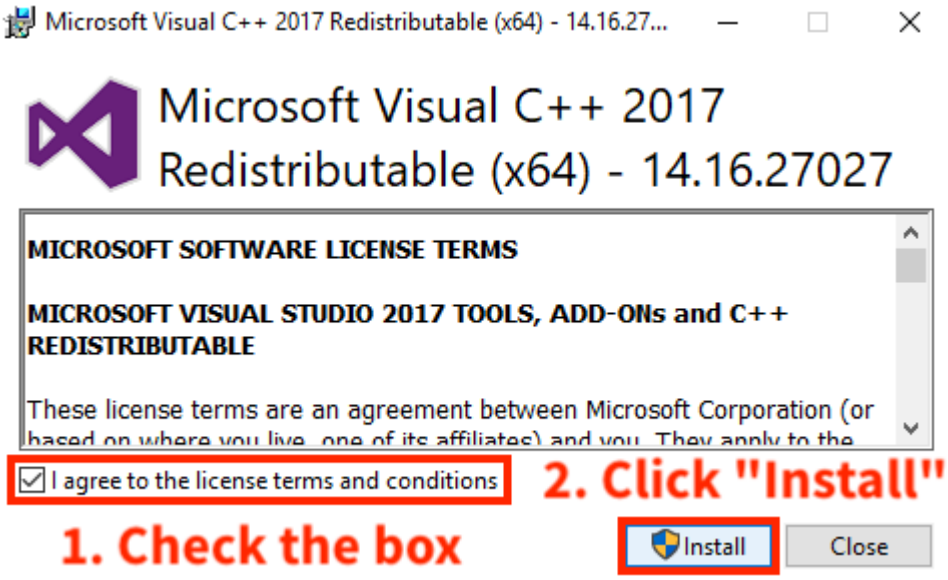
- x86: vc_redist.x86.exe
- x64: vc_redist.x64.exe

Use this link to download

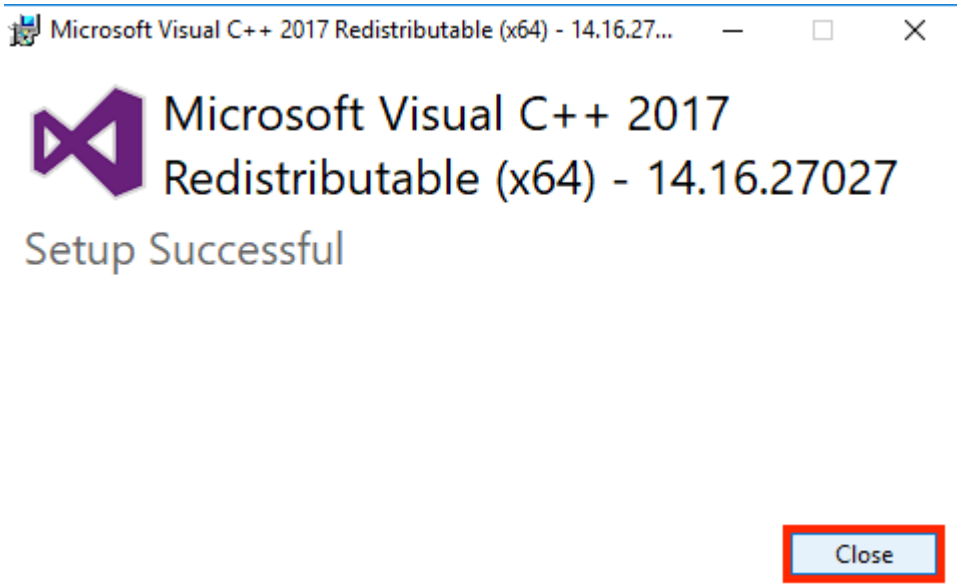
Refer to https://visualstudio.microsoft.com/downloads/#build-tools-for-visual-studio-2017 to download `vs_community__881455873.1549905826.exe` as follow:



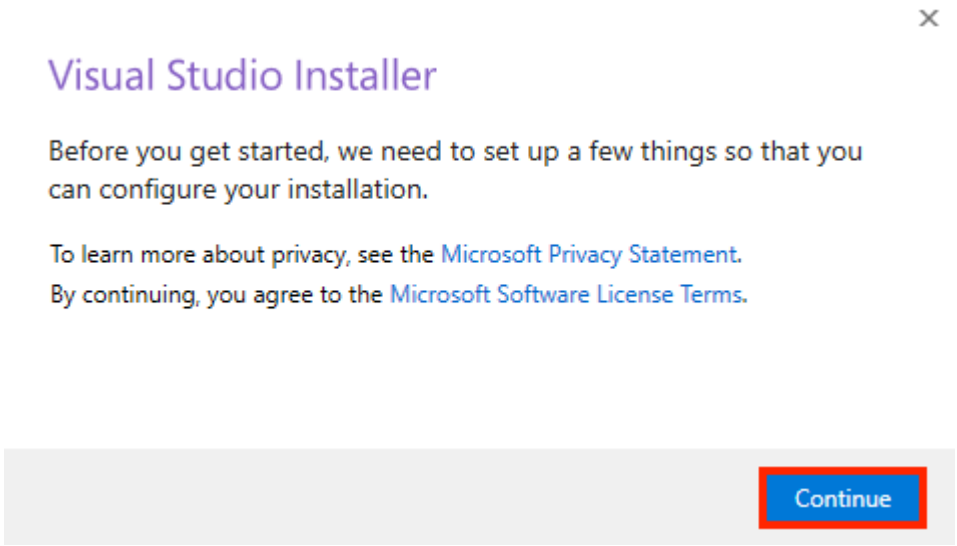
1. Double-click on `vc_redist.x64.exe`, check the box to accept agreement then click `Install`:



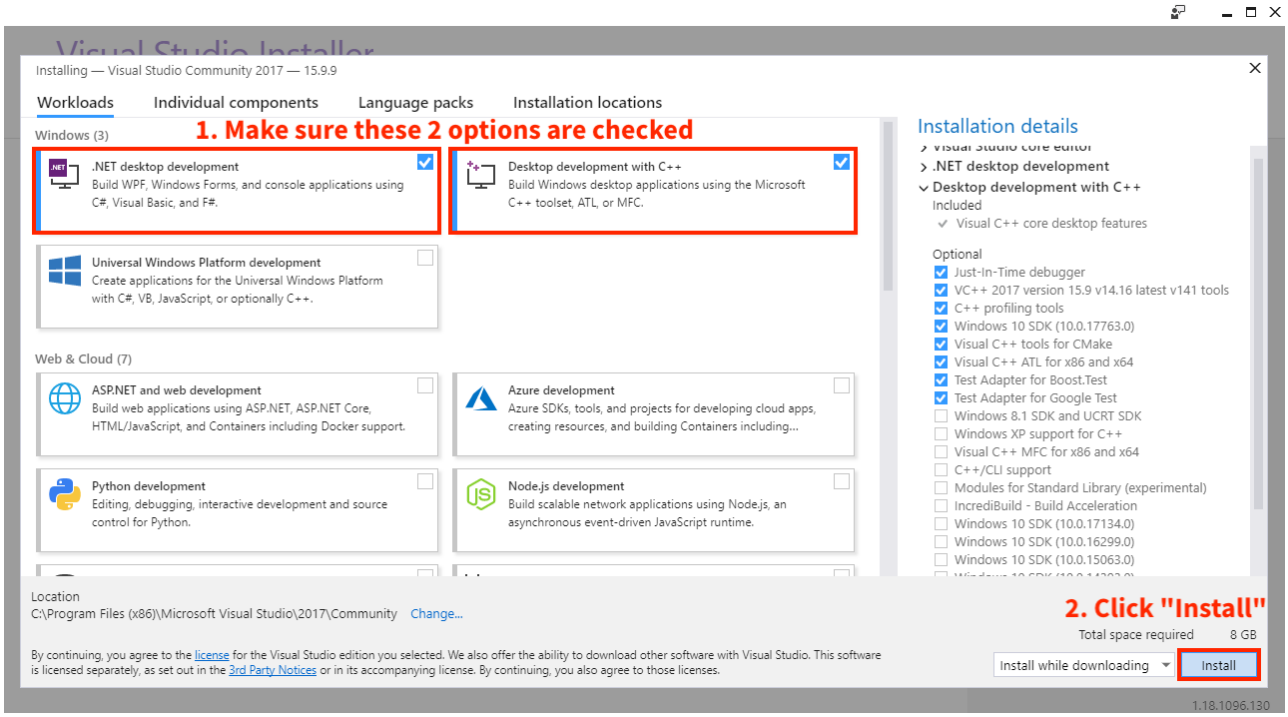
2. Click `Close` to finish the installation:



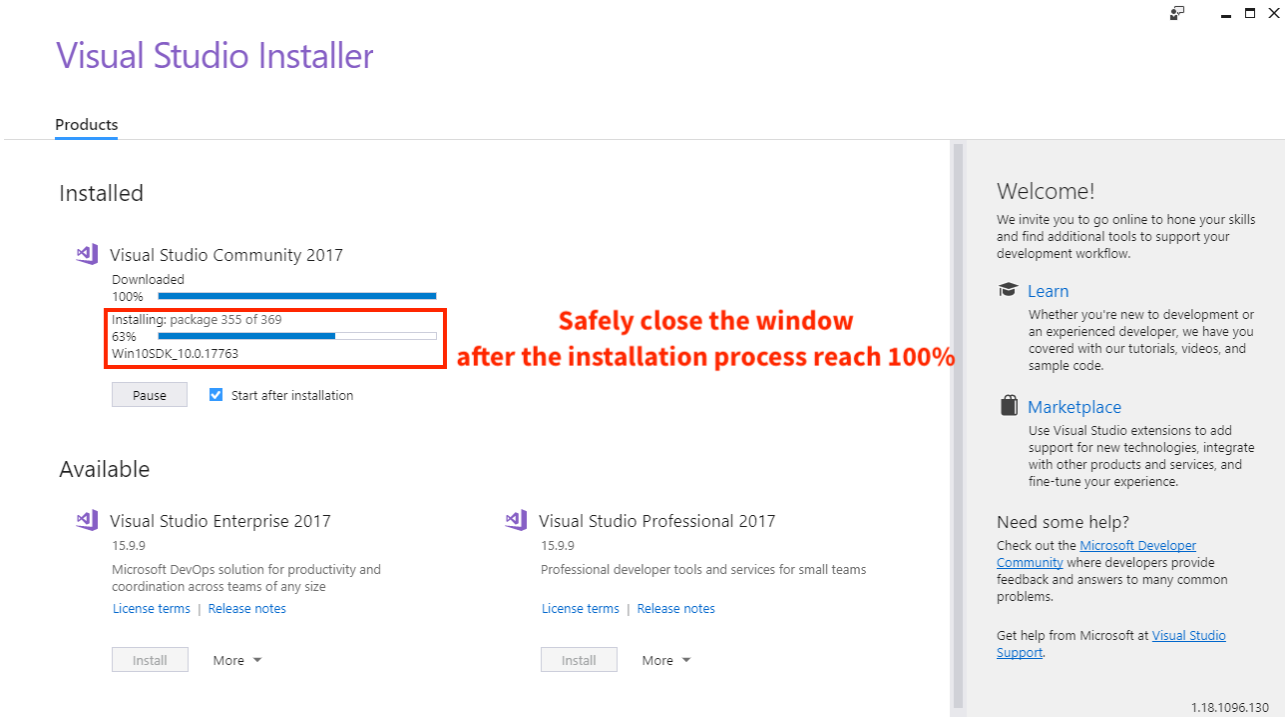
3. Double-click on `vs_community__881455873.1549905826.exe`, click `Continue`:



4. Make sure the following **2** options are **checked**, then click `Install`:
    - .NET Desktop Development
    - Desktop development with C++

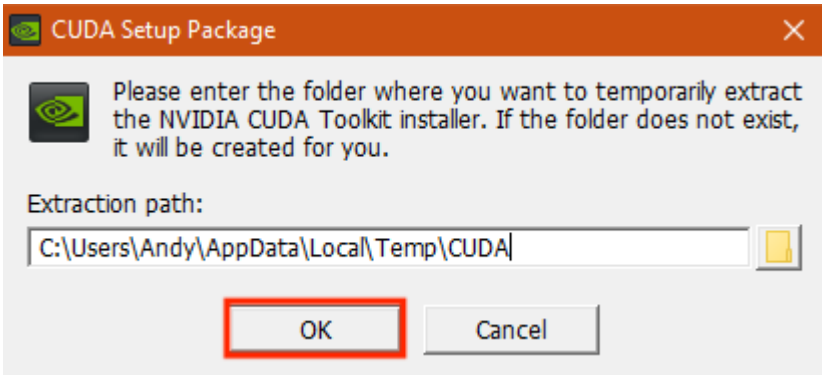


5. Safely close the window after the installation process reach **100%**:

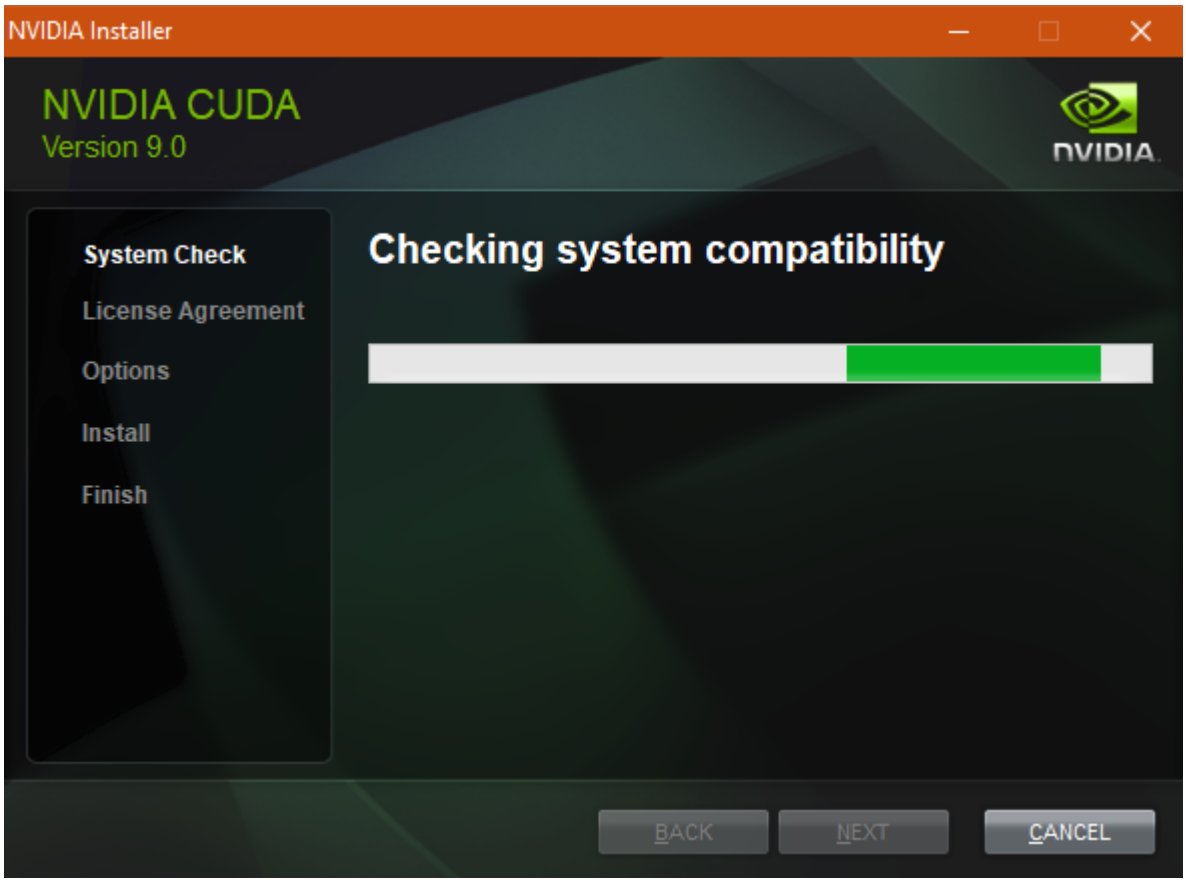


3-3-2. Install CUDA 9.0 and cuDNN

1. Double-click on `cuda_9.0.176_win10_network.exe`, then click `OK`:

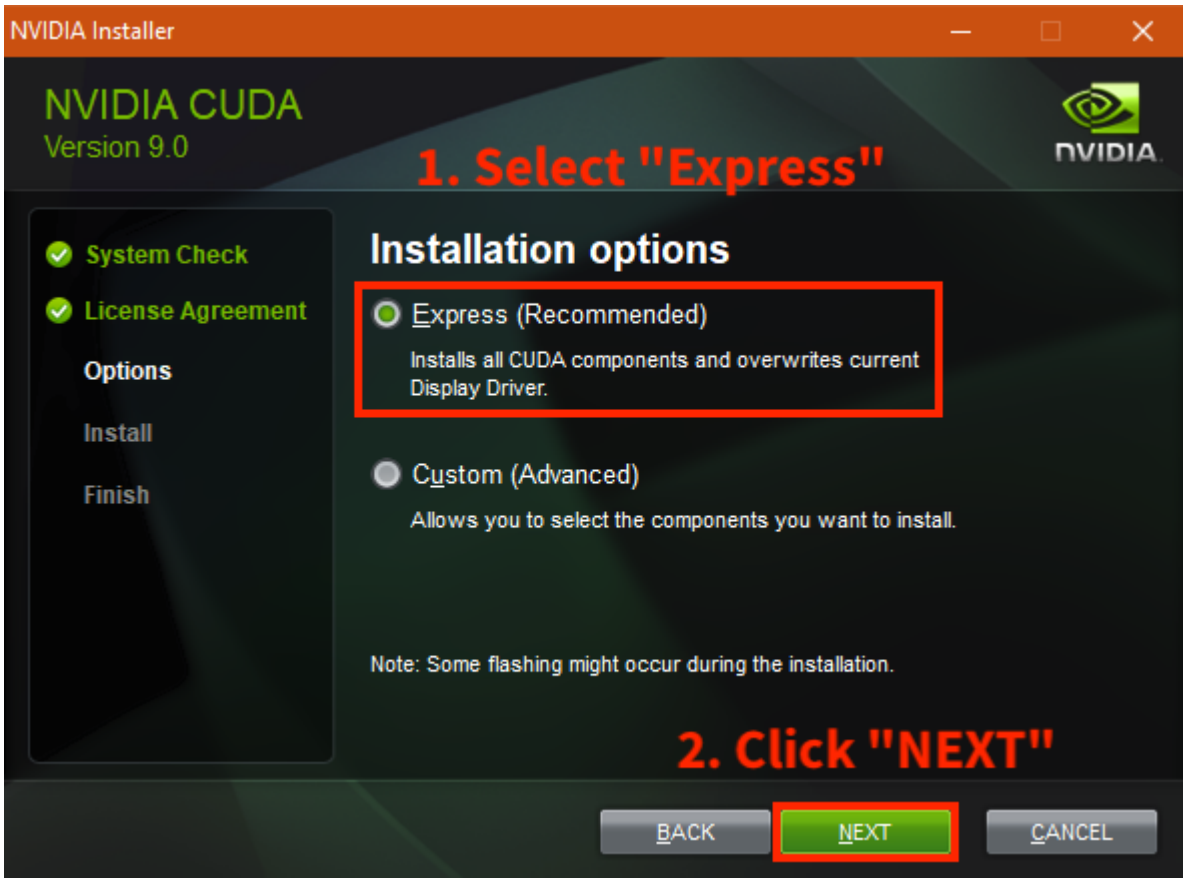


2. Wait for the program to check the system compatibility:

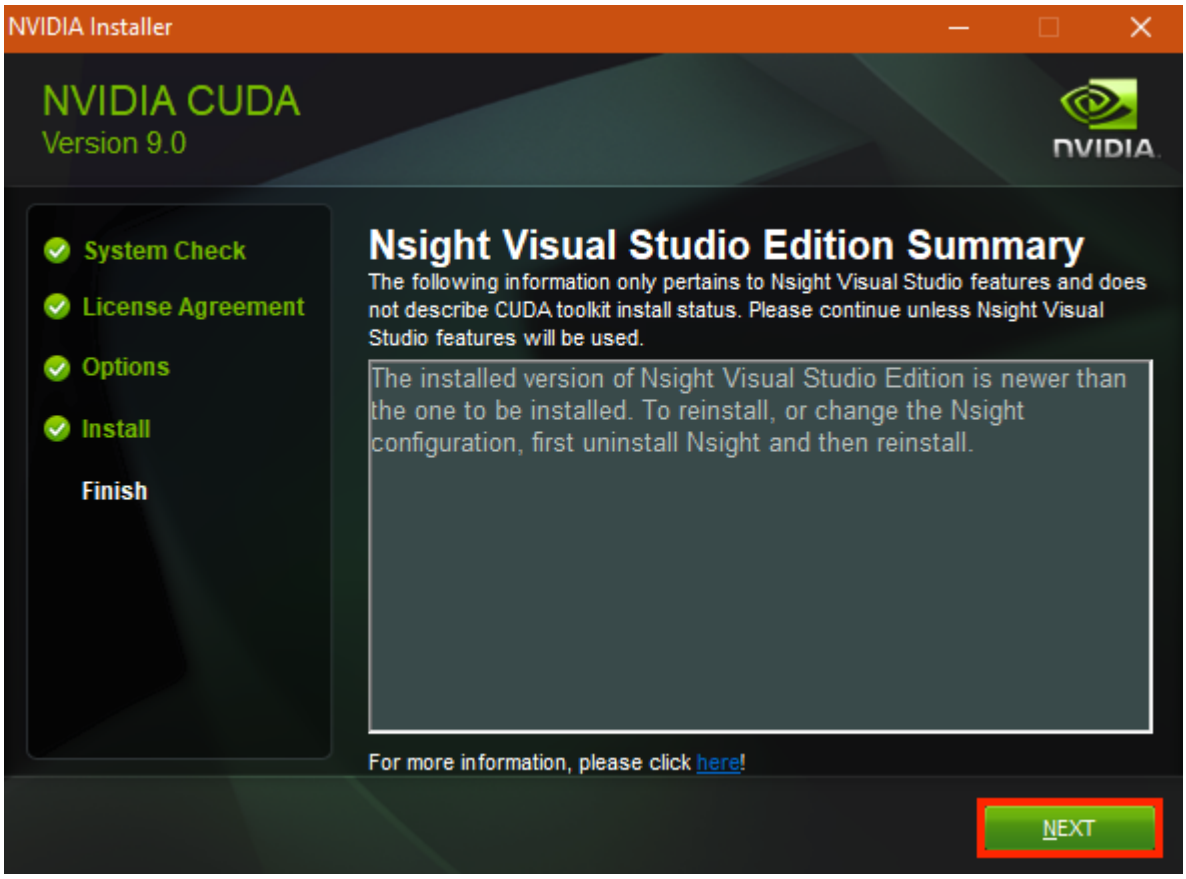


3. Click `AGREE AND CONTINUE`:

4. Make sure the option `Express` is selected then click `NEXT`:



5. Wait for the installation to complete. The screen might go dark for several times during installation. Click `NEXT` if this page shows up:



6. **Uncheck** all the given options then click `CLOSE` to finish the installation:

7. Within the folder `cudnn_lib`, **3** folders are given as follow:

```
cudnn_lib/
|   +-- bin/
|   |   +-- cudnn64_7.dll
|   +-- include/
|   |   +-- cudnn.h
|   +-- lib/
|   |   +-- x64/
|   |   |   +-- cudnn.lib
```

a. Open a `File Explorer`

b. Copy the file `bin/cudnn64_7.dll` into the folder:

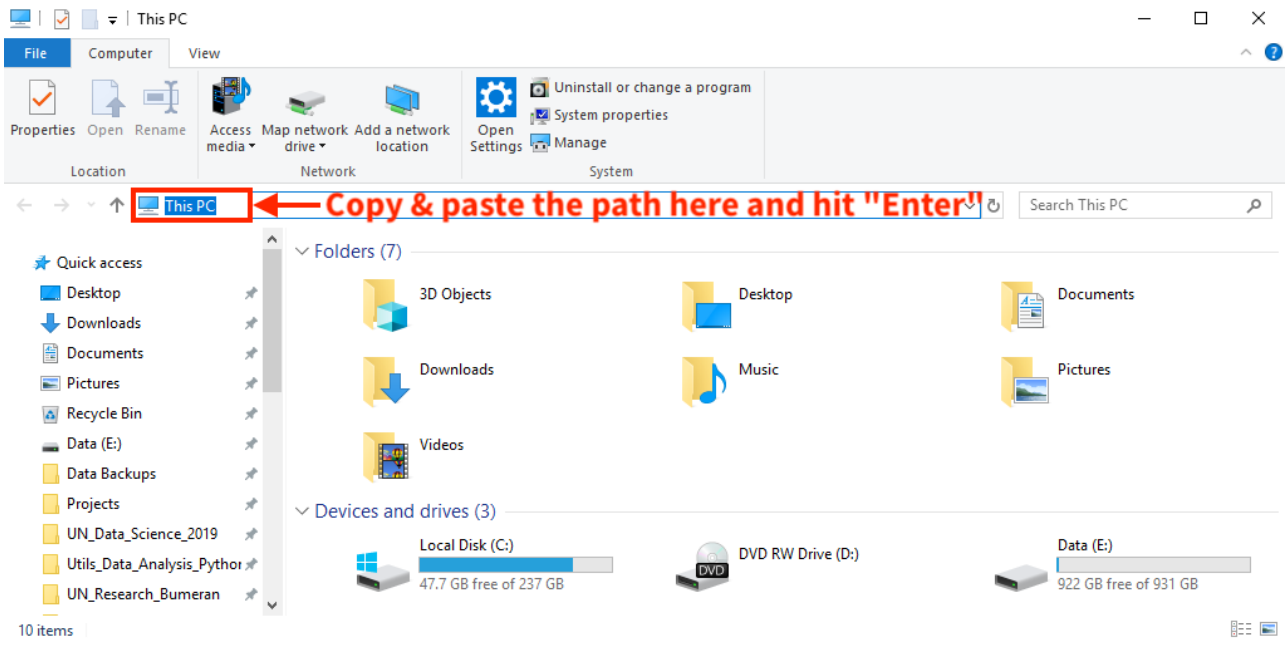
```
C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v9.0\bin
```

c. Copy the file `include/cudnn.h` into the folder:

```
C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v9.0\include
```

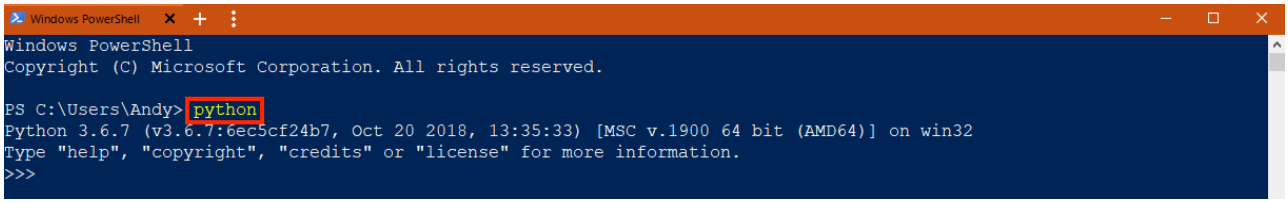
d. Copy the file `lib/x64/cudnn.lib` into the folder:

```
C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v9.0\lib\x64
```



3-3-3. Test the GPU Support

1. Open up a `Windows Powershell`, type `python` then hit `Enter`:

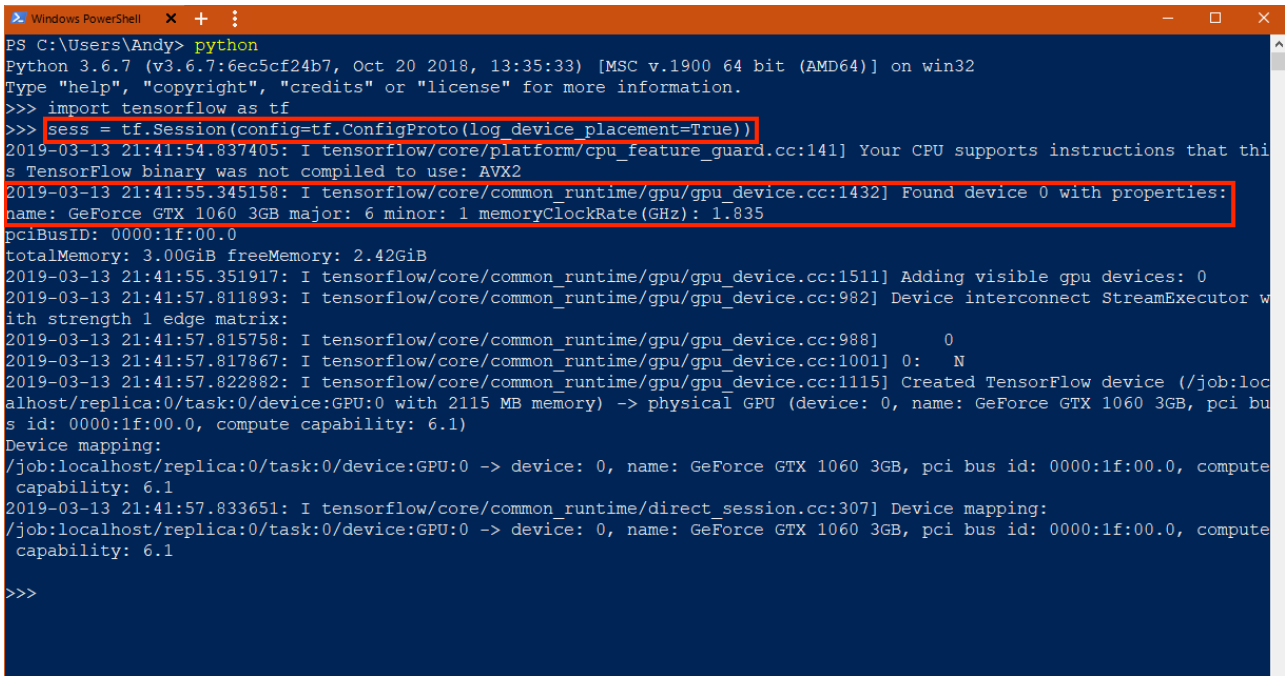


2. Input the following code and hit `Enter`:

```
import tensorflow as tf
```

3. Type the following code and hit `Enter`, the name of equipped GPU device should shows up. Here the name of the GPU is `GeForce GTX 1060`:

```
sess = tf.Session(config=tf.ConfigProto(log_device_placement=True))
```



4. If everything works correctly, type `exit()` to close Python or simply close the window.

Section 4. Perform Image Classification for Project **Labor Market Analysis**

> Requirement: ***A machine with a compatible NVIDIA GPU device available & tensorflow-gpu lib. for Python available***

For labor market analysis, one of the objectives is to provide **gender-related analysis**. For **Freelancer** dataset, however, the gender information for each job seeker is not revealed. Therefore, a **TensorFlow-based Machine Learning model** for **image classification** is proposed. The profile pictures of job seekers on Freelancer were already collected within the dataset.

Procedure

1. Scraping Profile Pictures:

   To prepare for downloading the profile images, in the extracted folder of the given `requirements_image.zip`, a folder named `Dataset` contains the pre-scraped Freelancer dataset that holds the links to all the profile pictures. Follows:

   a. Copy the file `freelancer_supply_20190204.csv` into the path:

   ```
   C:\Users\<user_name>\Documents\UN_Research_Image_Classification_for_Gender-master\labor_market\gender_classification\downloading
   # Change <user_name> to the computer username.
   ```

   b. Open a **Windows Powershell**, then:

   ```
   $ cd 'C:\Users\
   <user_name>\Documents\UN_Research_Image_Classification_for_Gender-master\labor_market\gender_classification\downloading'
   # Change <user_name> to the computer username. Then, run the program:
   $ python run.py -u 1
   ```

   c. The program will prompt to ask for inputing the exact filename of the Freelancer dataset file. Type the following then hit `Enter`:

   ```
   ./freelancer_supply_20190204.csv
   ```

2. Performing Image Classification:

   a. Create **1** folder named `imgs` under path:

   ```
   C:\Users\<user_name>\Documents\UN_Research_Image_Classification_for_Gender-master\labor_market\gender_classification\
   ```

```
# Change <user_name> to the computer username.
```

b. Place the images which to be classified into that newly created folder.

c. Under extracted folder of `requirements_image.zip`, the folder `Dataset` contains a folder `training_imgs`. Copy that folder into the same path given above. The folder `training_imgs` has 3 sub-folders, **female**, **male**, and **unknown**. Each of the sub-folders contains nearly ***1000*** pre-classified images. Those images are the training dataset for machine learning model training.

d. Open a **Windows Powershell**, navigate to the program folder by:

```
$ cd C:\Users\
<user_name>\Documents\UN_Research_Image_Classification_for_Gender-
master\labor_market\gender_classification\classifying
# Change <user_name> to the computer username.
```

e. Perform model retraining:

```
$ python retrain.py --img_dir=../training_imgs
# Wait until the process complete.
```

f. Finally, perform classification on the target images:

```
$ python label_image.py --graph=/tmp/output_graph.pb --
labels=/tmp/output_labels.txt \
    --input_layer=Placeholder --output_layer=final_result \
    --start 0 --concurrent 1000 --partition 1000 \
    --img_dir=../imgs/ \
    --data_file=*.jpg \
# Wait until the process complete.
```