



## TensorFlow 2 with GPU on Windows: Step-by-step instructions

How to properly install CUDA and cuDNN on Windows to use TensorFlow with GPU support

### Software requirements

- Python 3.9–3.11
- pip version 19.0 or higher for Linux (requires manylinux2014 support) and Windows. pip version 20.3 or higher for macOS.
- Windows Native Requires Microsoft Visual C++ Redistributable for Visual Studio 2015, 2017 and 2019

The following NVIDIA® software required for GPU support

- NVIDIA® GPU drivers version 450.80.02 or higher.
- CUDA® Toolkit 11.8.
- cuDNN SDK 8.6.0.

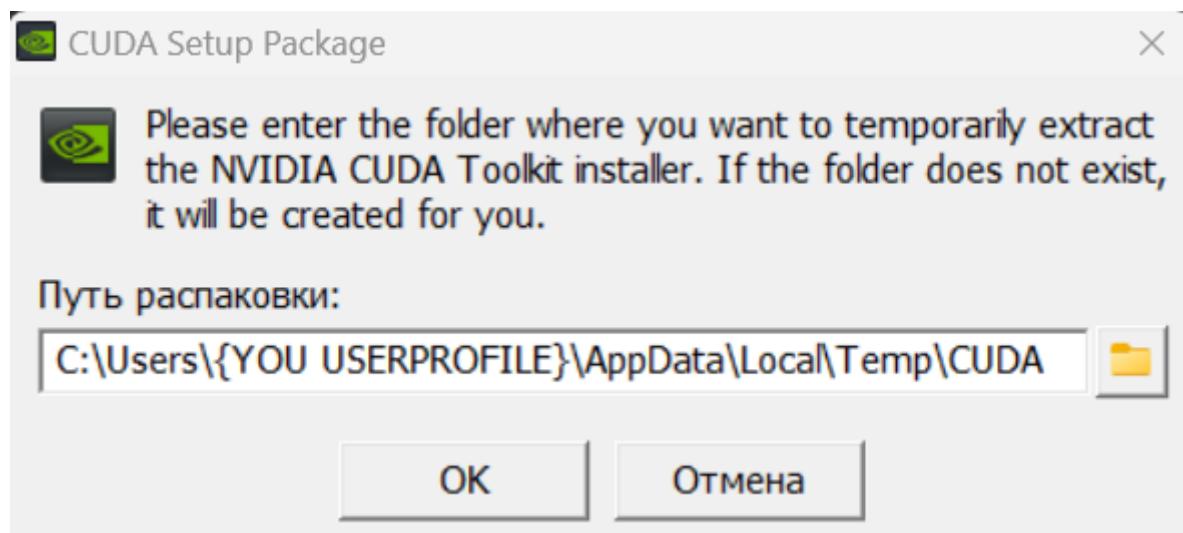
### Prerequisites

- Download [GeForce Experience](#) to update drivers
- Download [Microsoft Visual C++](#) drivers
- Download [Visual Studio](#) and [Visual Studio Code](#)
- Download [CUDA Toolkit version - 11.8](#) or [Latest version \(not recommended\)](#)
- Download [cuDNN v8.9.7](#) for [CUDA v11.8.0](#):
- Download [NVIDIA Nsight Developer Tools](#):
  - [Nsight Integration for Visual Studio](#)
  - [Nsight Compute](#)
  - [Nsight Graphics](#)
  - [Nsight Systems](#)

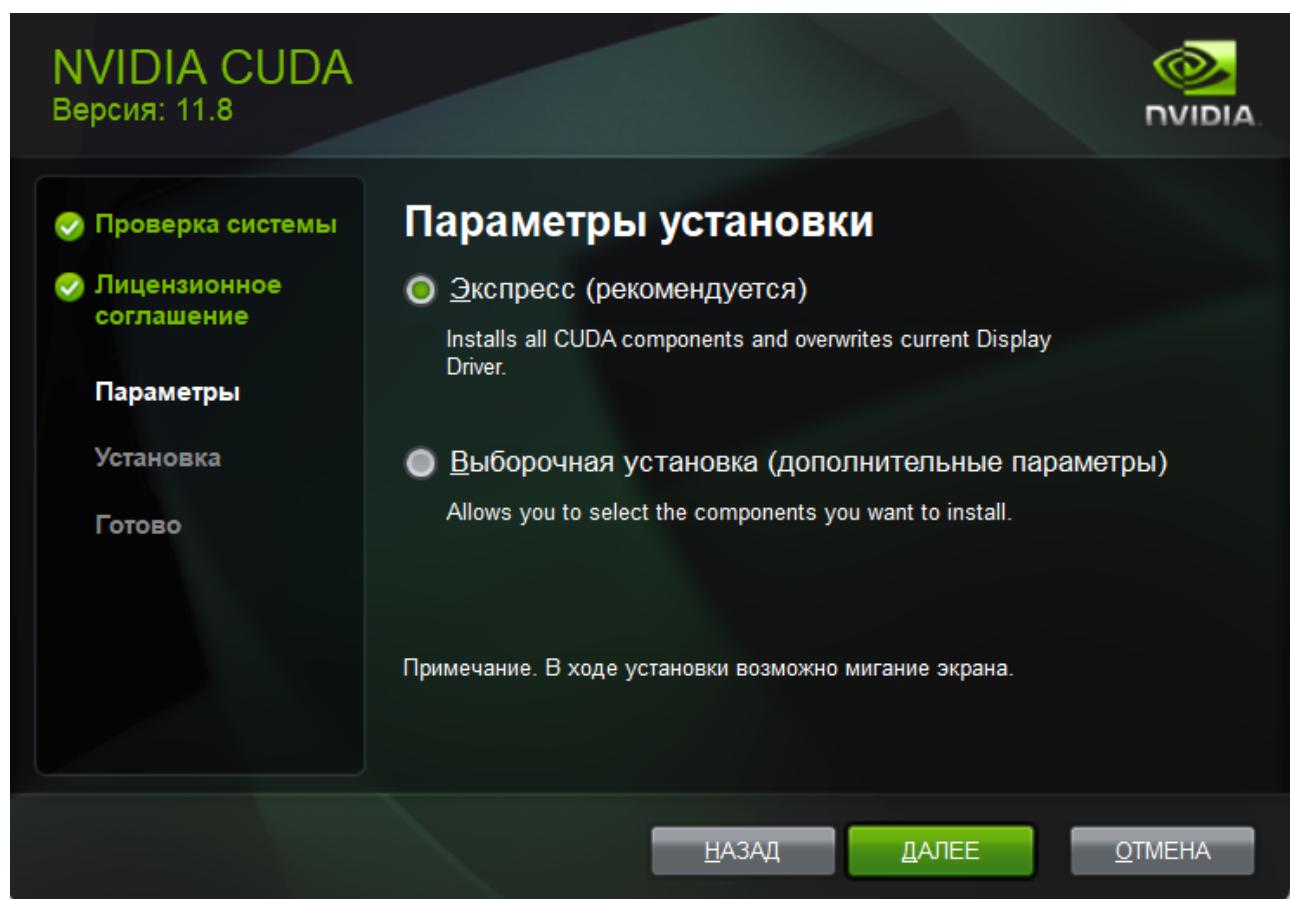
### Installation

- [Cuda Toolkit](#)

Open the downloaded file `cuda_11.8.0_522.06_windows.exe` and follow the installation instructions.



In the options select `express` installation



- **CUDNN**

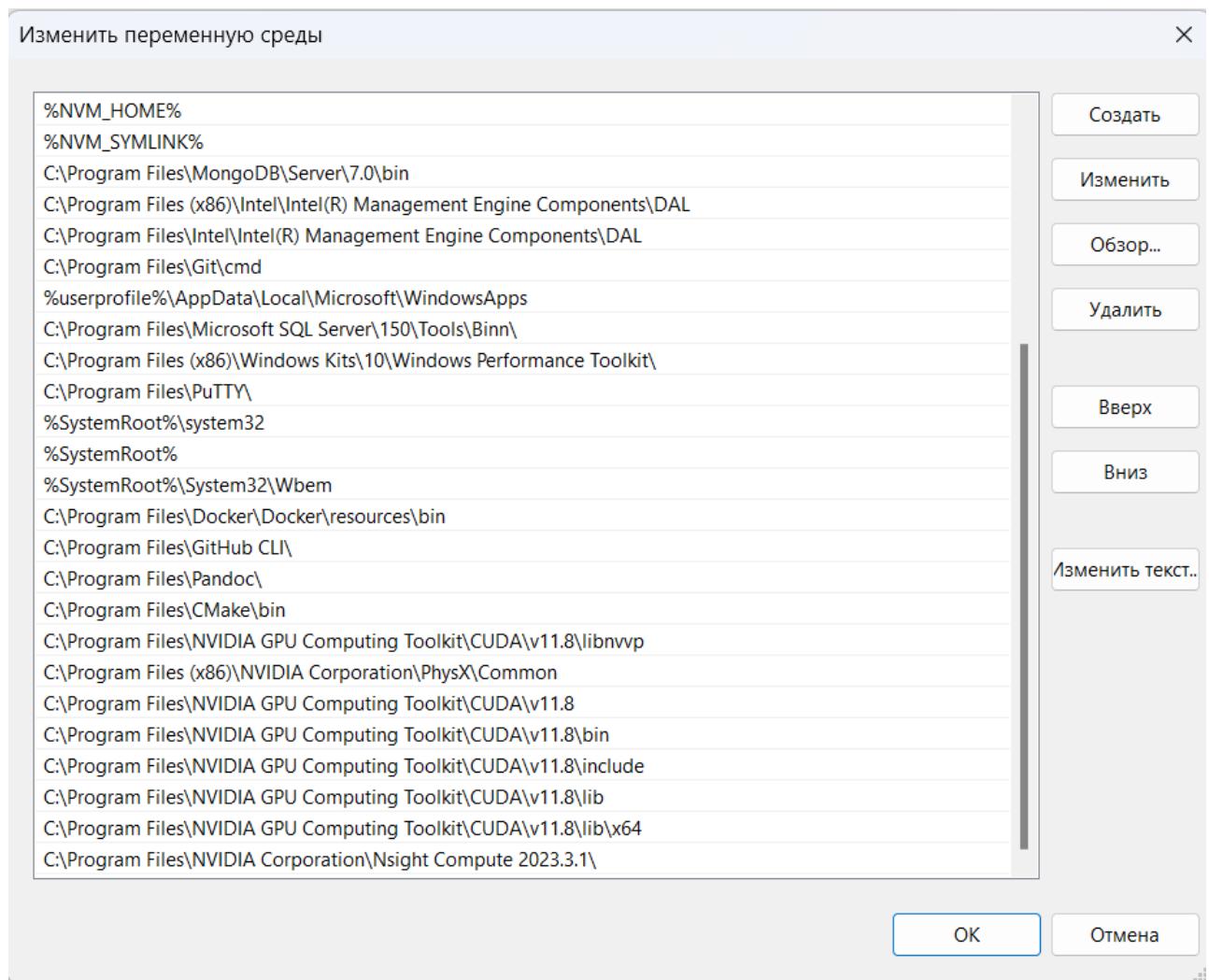
Unzip the archive `cudnn-windows-x86_64-8.9.7.29_cuda11-archive.zip` and move with replace all files in the `lib`, `include` and `bin` folders on `C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v11.8` with files from the corresponding archive folders:

The screenshot shows a Windows File Explorer window with the following path: ... > Локальный диск (C:) > Program Files > NVIDIA GPU Computing Toolkit > CUDA > v11.8. The table below lists the contents of this directory.

Имя	Дата изменения	Тип	Размер
bin	18.12.2023 21:24	Папка с файлами...	
compute-sanitizer	18.12.2023 21:24	Папка с файлами...	
extras	18.12.2023 21:24	Папка с файлами...	
include	18.12.2023 21:24	Папка с файлами...	
lib	18.12.2023 21:24	Папка с файлами...	
libnvvp	18.12.2023 21:24	Папка с файлами...	
nvml	18.12.2023 21:24	Папка с файлами...	
nvvm	18.12.2023 21:24	Папка с файлами...	
src	18.12.2023 21:24	Папка с файлами...	
tools	18.12.2023 21:24	Папка с файлами...	
CUDA_Toolkit_Release_Notes.txt	26.08.2022 1:33	Текстовый документ...	79 КБ
DOCS	26.08.2022 1:33	Файл	1 КБ
EULA.txt	26.08.2022 1:33	Текстовый документ...	61 КБ
LICENSE	08.08.2022 22:38	Файл	29 КБ
README	26.08.2022 1:33	Файл	1 КБ
version.json	29.09.2022 21:17	Исходный файл...	3 КБ

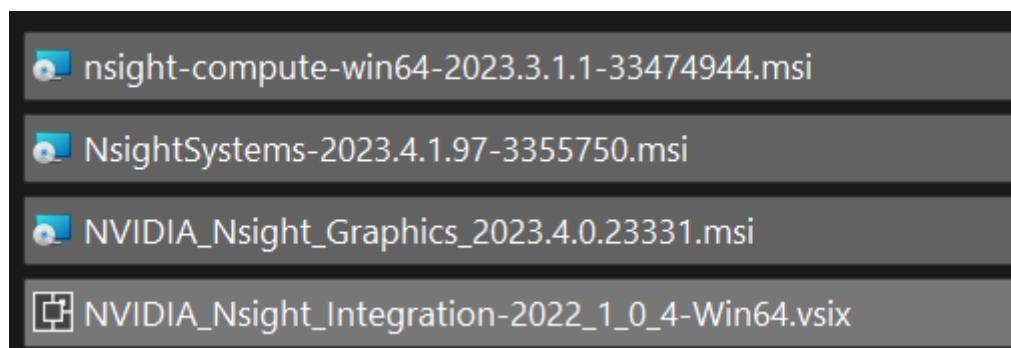
Add the following lines to your system and user \$Path variable:

```
C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v11.8
C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v11.8\bin
C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v11.8\include
C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v11.8\lib
C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA\v11.8\lib\x64
```



- NVIDIA Nsight Developer Tools

Install all the NVIDIA Nsight developer tools that we downloaded earlier



## Verifying installation success

- Run the following commands in a terminal

```
nvcc --version # Shows CUDA version
```

```
(musa1) ~ nvcc --version
nvcc: NVIDIA (R) Cuda compiler driver
Copyright (c) 2005–2022 NVIDIA Corporation
Built on Wed_Sep_21_10:41:10_Pacific_Daylight_Time_2022
Cuda compilation tools, release 11.8, V11.8.89
Build cuda_11.8.r11.8/compiler.31833905_0

(musa1) ~ ## Verifying installation success
(musa1) ~ bash
(musa1) ~ nvcc --version (Nvidia CUDA Compiler – показывает версию CUDA)
(musa1) ~ nvidia-smi (NVTDIA System Management Interface)
```

nvidia-smi # Shows the NVIDIA system management interface

```
(musa1) ~ nvidia-smi
Tue Dec 19 01:28:10 2023
+-----+
| NVIDIA-SMI 546.33       Driver Version: 546.33       CUDA Version: 12.3 |
| GPU  Name  Изображений TCC/WDDM  Bus-Id   Control Disp.A  Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap | Memory-Usage | GPU-Util  Compute M. | MIG M. |
|+-----+
| 0  NVIDIA GeForce GTX 1660 ... WDDM  00000000:01:00.0 On      N/A |
| 0% 49C  P8    13W / 125W  910MiB / 6144MiB  3% Default N/A |
+-----+
```

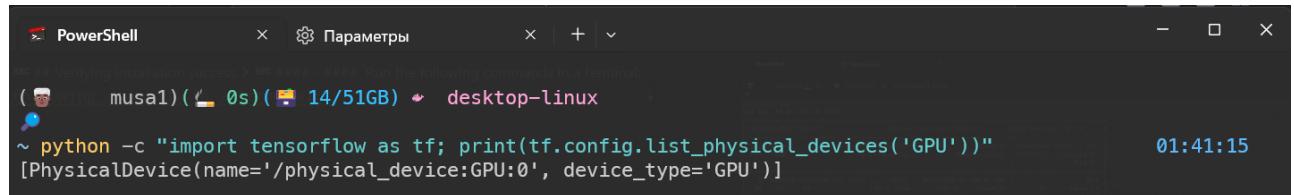
Показывает интерфейс управления системой

Processes:	GPU	GT	CI	PID	Type	Process name	GPU Memory Usage
	ID	ID					
0	N/A	N/A	1972	C+G	...5nh2txyewy\ShellExperienceHost.exe	N/A	Показывает интерфейс управления
0	N/A	N/A	2992	C+G	...crosoft\Edge\Application\msedge.exe	N/A	системой NVIDIA
0	N/A	N/A	3840	C+G	...iveControlPanel\SystemSettings.exe	N/A	для сторонних расширений
0	N/A	N/A	5248	C+G	...ilcloud\WebView2\msedgewebview2.exe	N/A	
0	N/A	N/A	8656	C+G	...on\120.0.2210.77\msedgewebview2.exe	N/A	
0	N/A	N/A	8984	C+G	...B\sytem_tray\lghub_system_tray.exe	N/A	
0	N/A	N/A	10612	C+G	C:\Windows\explorer.exe	N/A	
0	N/A	N/A	12092	C+G	...2txyewy\StartMenuExperienceHost.exe	N/A	
0	N/A	N/A	12152	C+G	...nt.CBS_cw5n1h2txyewy\SearchHost.exe	N/A	
0	N/A	N/A	14064	C+G	...s\WinUI3Apps\PowerToys.Settings.exe	N/A	
0	N/A	N/A	15084	C+G	...oole\Chrome\Application\chrome.exe	N/A	
0	N/A	N/A	16564	C+G	...s\WinUI3Apps\PowerToys.Peek.UI.exe	N/A	
0	N/A	N/A	16816	C+G	...werToys\PowerToys.PowerLauncher.exe	N/A	

**Caution:** TensorFlow **2.10** was the **last** TensorFlow release that supported **GPU** on **native-Windows**. Starting with TensorFlow 2.11, you will need to install **TensorFlow in WSL2**, or install tensorflow or tensorflow-cpu and, optionally, try the **TensorFlow-DirectML-Plugin**'

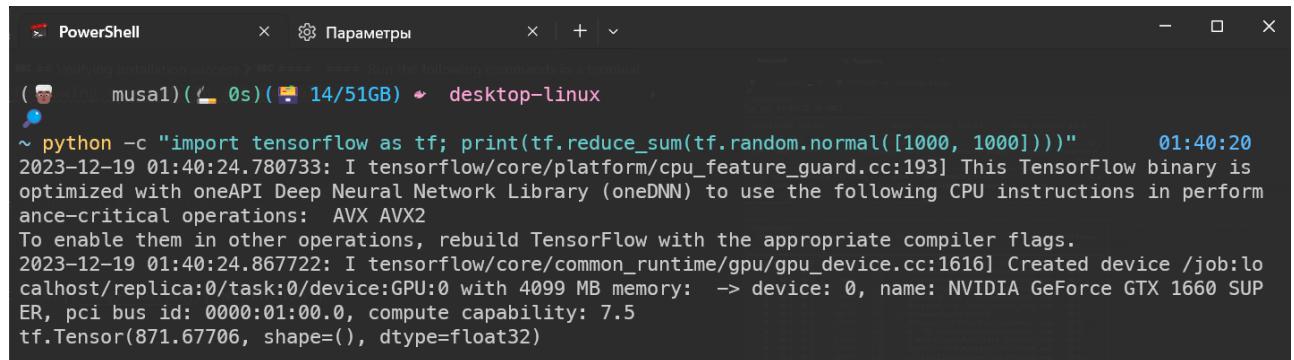
```
# Upgrade pip to latest version
python -m pip install --upgrade pip
# Anything above 2.10 is not supported on the GPU on Windows Native
python -m pip install "tensorflow<2.11"
```

```
# Verify the installation:  
python -c "import tensorflow as tf;  
print(tf.config.list_physical_devices('GPU'))"  
# If a list of GPU devices is returned, you've installed TensorFlow  
successfully.
```



A screenshot of a terminal window titled "PowerShell". The command `~ python -c "import tensorflow as tf; print(tf.config.list\_physical\_devices('GPU'))"` is run, and the output shows a single GPU device: [PhysicalDevice(name='/physical\_device:GPU:0', device\_type='GPU')]. The timestamp is 01:41:15.

```
# If a tensor is returned, you've installed TensorFlow successfully.  
python -c "import tensorflow as tf;  
print(tf.reduce_sum(tf.random.normal([1000, 1000])))"
```



A screenshot of a terminal window titled "PowerShell". The command `~ python -c "import tensorflow as tf; print(tf.reduce\_sum(tf.random.normal([1000, 1000])))"` is run. The output includes TensorFlow version information (2023-12-19 01:40:24.780733), a note about oneAPI DNN, and details about the created GPU device (job:0, name: NVIDIA GeForce GTX 1660 SUPER, pci bus id: 0000:01:00.0, compute capability: 7.5). The timestamp is 01:40:20.

✿ Thank you for your attention! ✿

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