

# CUDA + TensorFlow 설치

2023. 5. 24


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한병엽

# 1. 소개

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## 2. 그래픽 드라이버




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### 3. 그래픽 드라이버 설치 확인

nvidia-smi

```
C:\Windows\system32\cmd.exe
Microsoft Windows [Version 10.0.19045.2846]
(c) Microsoft Corporation. All rights reserved.

C:\Users\User>nvidia-smi
Wed May 24 19:10:26 2023

+-----+
| NVIDIA-SMI 531.61                  Driver Version: 531.61      CUDA Version: 12.1     |
+-----+-----+
| GPU   Name                               TCC/WDDM  Bus-Id      Disp.A   Volatile Uncorr. ECC |
| Fan  Temp  Perf              Pwr:Usage/Cap     Memory-Usage | GPU-Util  Compute M. |
|=====+=====+
|  0  NVIDIA GeForce GTX 1650 T...  WDDM      00000000:02:00:0  Off      N/A       |
| N/A   37C   P0               12W /  N/A         0MiB / 4096MiB |    0%      Default  |
|                               |                      MIG M. |
+-----+-----+

Processes:
+-----+
| GPU   GI   CI           PID   Type   Process name                      GPU Memory |
|  ID   ID   ID                                   |      Usage |
+-----+-----+
| No running processes found |
+-----+

C:\Users\User>
```

# 4. CUDA Toolkit 1

[https://www.tensorflow.org/install/source\\_windows?hl=ko](https://www.tensorflow.org/install/source_windows?hl=ko)


## GPU

★ 참고: 기본 Windows에서 GPU 지원은 2.10 이하 버전에서만 사용할 수 있으며, TF 2.11부터는 CUDA 빌드가 Windows에서 지원되지 않습니다. Windows에서 TensorFlow GPU를 사용하려면 WSL2에서 TensorFlow를 빌드/설치하거나 TensorFlow-DirectML-Plugin과 함께 tensorflow-cpu를 사용해야 합니다.

버전	파이썬 버전	컴파일러	빌드 도구	cuDNN	쿠다
tensorflow_gpu-2.10.0	3.7-3.10	MSVC 2019	바젤 5.1.1	8.1	11.2
tensorflow_gpu-2.9.0	3.7-3.10	MSVC 2019	바젤 5.0.0	8.1	11.2
tensorflow_gpu-2.8.0	3.7-3.10	MSVC 2019	바젤 4.2.1	8.1	11.2
tensorflow_gpu-2.7.0	3.7-3.9	MSVC 2019	바젤 3.7.2	8.1	11.2
tensorflow_gpu-2.6.0	3.6-3.9	MSVC 2019	바젤 3.7.2	8.1	11.2
tensorflow_gpu-2.5.0	3.6-3.9	MSVC 2019	바젤 3.7.2	8.1	11.2
tensorflow_gpu-2.4.0	3.6-3.8	MSVC 2019	바젤 3.1.0	8.0	11.0
tensorflow_gpu-2.3.0	3.5-3.8	MSVC 2019	바젤 3.1.0	7.6	10.1
tensorflow_gpu-2.2.0	3.5-3.8	MSVC 2019	바젤 2.0.0	7.6	10.1
tensorflow_gpu-2.1.0	3.5-3.7	MSVC 2019	바젤 0.27.1-0.29.1	7.6	10.1
tensorflow_gpu-2.0.0	3.5-3.7	MSVC 2017	바젤 0.26.1	7.4	10
tensorflow_gpu-1.15.0	3.5-3.7	MSVC 2017	바젤 0.26.1	7.4	10
tensorflow_gpu-1.14.0	3.5-3.7	MSVC 2017	바젤 0.24.1-0.25.2	7.4	10
tensorflow_gpu-1.13.0	3.5-3.7	MSVC 2015 업데이트 3	바젤 0.19.0-0.21.0	7.4	10
tensorflow_gpu-1.12.0	3.5-3.6	MSVC 2015 업데이트 3	바젤 0.15.0	7.2	9.0
tensorflow_gpu-1.11.0	3.5-3.6	MSVC 2015 업데이트 3	바젤 0.15.0	7	9
tensorflow_gpu-1.10.0	3.5-3.6	MSVC 2015 업데이트 3	씨메이크 v3.6.3	7	9
tensorflow_gpu-1.9.0	3.5-3.6	MSVC 2015 업데이트 3	씨메이크 v3.6.3	7	9
tensorflow_gpu-1.8.0	3.5-3.6	MSVC 2015 업데이트 3	씨메이크 v3.6.3	7	9
tensorflow_gpu-1.7.0	3.5-3.6	MSVC 2015 업데이트 3	씨메이크 v3.6.3	7	9
tensorflow_gpu-1.6.0	3.5-3.6	MSVC 2015 업데이트 3	씨메이크 v3.6.3	7	9
tensorflow_gpu-1.5.0	3.5-3.6	MSVC 2015 업데이트 3	씨메이크 v3.6.3	7	9
tensorflow_gpu-1.4.0	3.5-3.6	MSVC 2015 업데이트 3	씨메이크 v3.6.3	6	8
tensorflow_gpu-1.3.0	3.5-3.6	MSVC 2015 업데이트 3	씨메이크 v3.6.3	6	8
tensorflow_gpu-1.2.0	3.5-3.6	MSVC 2015 업데이트 3	씨메이크 v3.6.3	5.1	8

# 5. CUDA Toolkit 2

<https://developer.nvidia.com/cuda-toolkit-archive>

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## CUDA Toolkit Archive

Previous releases of the CUDA Toolkit, GPU Computing SDK, documentation and developer drivers can be found using the links below. Please select the release you want from the list below, and be sure to check [www.nvidia.com/drivers](http://www.nvidia.com/drivers) for more recent production drivers appropriate for your hardware configuration.


[Download Latest CUDA Toolkit](#) [Learn More about CUDA Toolkit 11](#)

**Latest Release**  
CUDA Toolkit 11.2.0 [Dec 2020], [Versioned Online Documentation](#)

**Archived Releases**  
[CUDA Toolkit 11.1.1 \[Oct 2020\], Versioned Online Documentation](#)  
[CUDA Toolkit 11.1.0 \[Sept 2020\], Versioned Online Documentation](#)  
[CUDA Toolkit 11.0 Update1 \[Aug 2020\], Versioned Online Documentation](#)  
[CUDA Toolkit 11.0 \[May 2020\], Versioned Online Documentation](#)  
[CUDA Toolkit 10.2 \[Nov 2019\], Versioned Online Documentation](#)  
[CUDA Toolkit 10.1 update2 \[Aug 2019\], Versioned Online Documentation](#)  
[CUDA Toolkit 10.1 update1 \[May 2019\], Versioned Online Documentation](#)  
[CUDA Toolkit 10.1 \[Feb 2019\], Online Documentation](#)  
[CUDA Toolkit 10.0 \[Sept 2018\], Online Documentation](#)  
[CUDA Toolkit 9.2 \[May 2018\], Online Documentation](#)  
[CUDA Toolkit 9.1 \[Dec 2017\], Online Documentation](#)  
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[CUDA Toolkit 8.0 GA1 \[Sept 2016\], Online Documentation](#)  
[CUDA Toolkit 7.5 \[Sept 2015\]](#)  
[CUDA Toolkit 7.0 \[March 2015\]](#)  
[CUDA Toolkit 6.5 \[August 2014\]](#)  
[CUDA Toolkit 6.0 \[April 2014\]](#)  
[CUDA Toolkit 5.5 \[July 2013\]](#)

보기

폴더 ▾


  
cuda\_11.7.1\_516  
.94\_windows

2022년

# 6. cuDNN 1

<https://developer.nvidia.com/rdp/cudnn-archive>

지포스 로그인 필요

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## cuDNN Archive

NVIDIA cuDNN is a GPU-accelerated library of primitives for deep neural networks.

[Download cuDNN v8.0.4 \[September 28th, 2020\], for CUDA 11.1](#)

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[Download cuDNN v8.0.4 \[September 28th, 2020\], for CUDA 10.2](#)

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[Download cuDNN v8.0.3 \[August 26th, 2020\], for CUDA 10.2](#)

[Download cuDNN v8.0.3 \[August 26th, 2020\], for CUDA 10.1](#)


[Download cuDNN v8.0.2 \[July 24th, 2020\], for CUDA 11.0](#)


[Download cuDNN v8.0.2 \[July 24th, 2020\], for CUDA 10.2](#)


[Download cuDNN v8.0.2 \[July 24th, 2020\], for CUDA 10.1](#)


[Download cuDNN v8.0.1 RC2 \[June 26th, 2020\], for CUDA 11.0](#)

[Download cuDNN v8.0.1 RC2 \[June 26th, 2020\], for CUDA 10.2](#)

  
bin

  
include

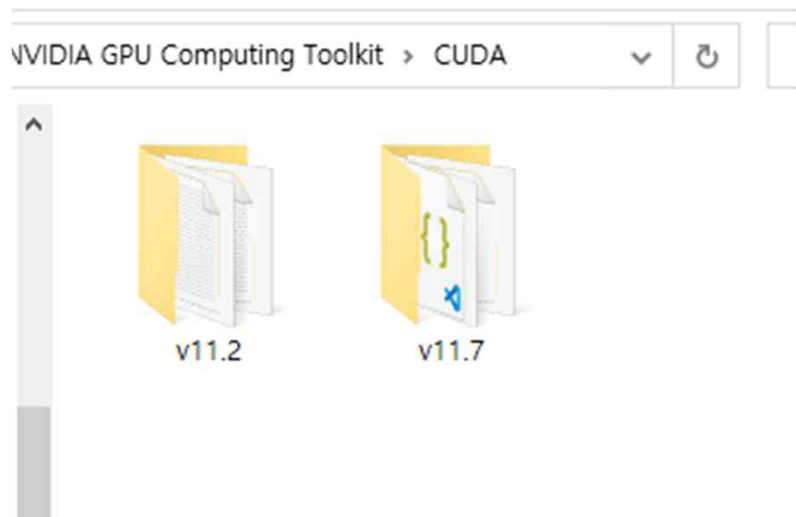
  
lib

  
LICENSE

# 7. cuDNN 2

C:\Program Files\NVIDIA GPU Computing Toolkit\CUDA

NVIDIA GPU Computing Toolkit > CUDA

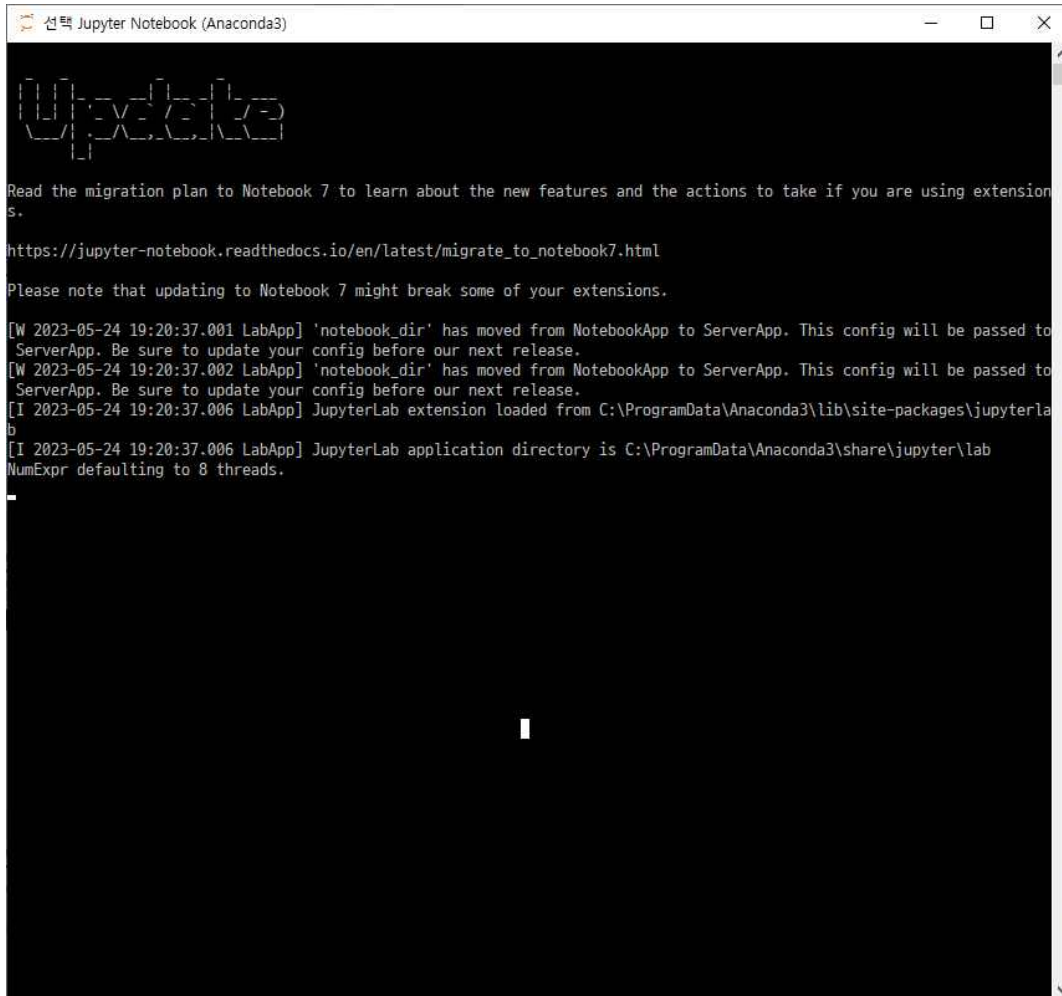


v11.2 v11.7

이름	수정한 날짜	유형	크기
bin	2023-05-17 오후 8:34	파일 폴더	
compute-sanitizer	2023-05-17 오후 8:33	파일 폴더	
extras	2023-05-17 오후 8:33	파일 폴더	
include	2023-05-17 오후 8:34	파일 폴더	
lib	2023-05-17 오후 8:33	파일 폴더	
libnvvp	2023-05-17 오후 8:33	파일 폴더	
nvml	2023-05-17 오후 8:33	파일 폴더	
nvvm	2023-05-17 오후 8:33	파일 폴더	
src	2023-05-17 오후 8:33	파일 폴더	
tools	2023-05-17 오후 8:33	파일 폴더	
CUDA_Toolkit_Release_Notes	2022-05-20 오전 11:09	텍스트 문서	74KB
DOCS	2022-05-20 오전 11:09	파일	1KB
EULA	2022-05-20 오전 11:09	텍스트 문서	61KB
LICENSE	2023-05-17 오후 8:34	파일	29KB
README	2022-05-20 오전 11:09	파일	1KB
version	2022-07-29 오후 5:58	JSON 원본 파일	3KB



## 8. 가상환경 생성



```
선택 Jupyter Notebook (Anaconda3)

[Notebook]

Read the migration plan to Notebook 7 to learn about the new features and the actions to take if you are using extensions.
https://jupyter-notebook.readthedocs.io/en/latest/migrate_to_notebook7.html
Please note that updating to Notebook 7 might break some of your extensions.

[W 2023-05-24 19:20:37.001 LabApp] 'notebook_dir' has moved from NotebookApp to ServerApp. This config will be passed to
ServerApp. Be sure to update your config before our next release.
[W 2023-05-24 19:20:37.002 LabApp] 'notebook_dir' has moved from NotebookApp to ServerApp. This config will be passed to
ServerApp. Be sure to update your config before our next release.
[I 2023-05-24 19:20:37.006 LabApp] JupyterLab extension loaded from C:\ProgramData\Anaconda3\lib\site-packages\jupyterlab
[I 2023-05-24 19:20:37.006 LabApp] JupyterLab application directory is C:\ProgramData\Anaconda3\share\jupyter\lab
NumExpr defaulting to 8 threads.
```

`conda create -n [가상환경이름] python=3.7`

`conda activate [가상환경이름]`

`pip install tensorflow-gpu==2.4.0`

`pip install keras`

`pip install jupyter notebook`

`pip install ipykernel`

`python -m ipykernel install --user --name  
[가상환경이름]`

# 9. GPU 연동 확인 1

```
from tensorflow.python.client import device_lib  
print(device_lib.list_local_devices())
```

```
In [1]: from tensorflow.python.client import device_lib  
print(device_lib.list_local_devices())
```

```
[name: "/device:CPU:0"  
device_type: "CPU"  
memory_limit: 268435456  
locality {  
}  
incarnation: 16569114874829537099  
xla_global_id: -1  
, name: "/device:GPU:0"  
device_type: "GPU"  
memory_limit: 2236245607  
locality {  
  bus_id: 1  
  links {  
  }  
}  
incarnation: 6774070776413944580  
physical_device_desc: "device: 0, name: NVIDIA GeForce GTX 1650 Ti with Max-Q Design, pci bus id: 0000:02:00.0, compute capability: 7.5"  
xla_global_id: 416903419  
]
```

# 10. GPU 연동 확인 2

```
import tensorflow as tf
from tensorflow import keras

import numpy as np
import matplotlib.pyplot as plt

print(tf.__version__)

fashion_mnist = keras.datasets.fashion_mnist
(train_images, train_labels), (test_images, test_labels) = fashion_mnist.load_data()

class_names = ['T-shirt/top', 'Trouser', 'Pullover', 'Dress', 'Coat',
               'Sandal', 'Shirt', 'Sneaker', 'Bag', 'Ankle boot']

plt.figure()
plt.imshow(train_images[0])
plt.colorbar()
plt.grid(False)
plt.show()

train_images = train_images / 255.0
test_images = test_images / 255.0

plt.figure(figsize=(10,10))
for i in range(25):
    plt.subplot(5,5,i+1)
    plt.xticks([])
    plt.yticks([])
    plt.grid(False)
    plt.imshow(train_images[i], cmap=plt.cm.binary)
    plt.xlabel(class_names[train_labels[i]])
plt.show()

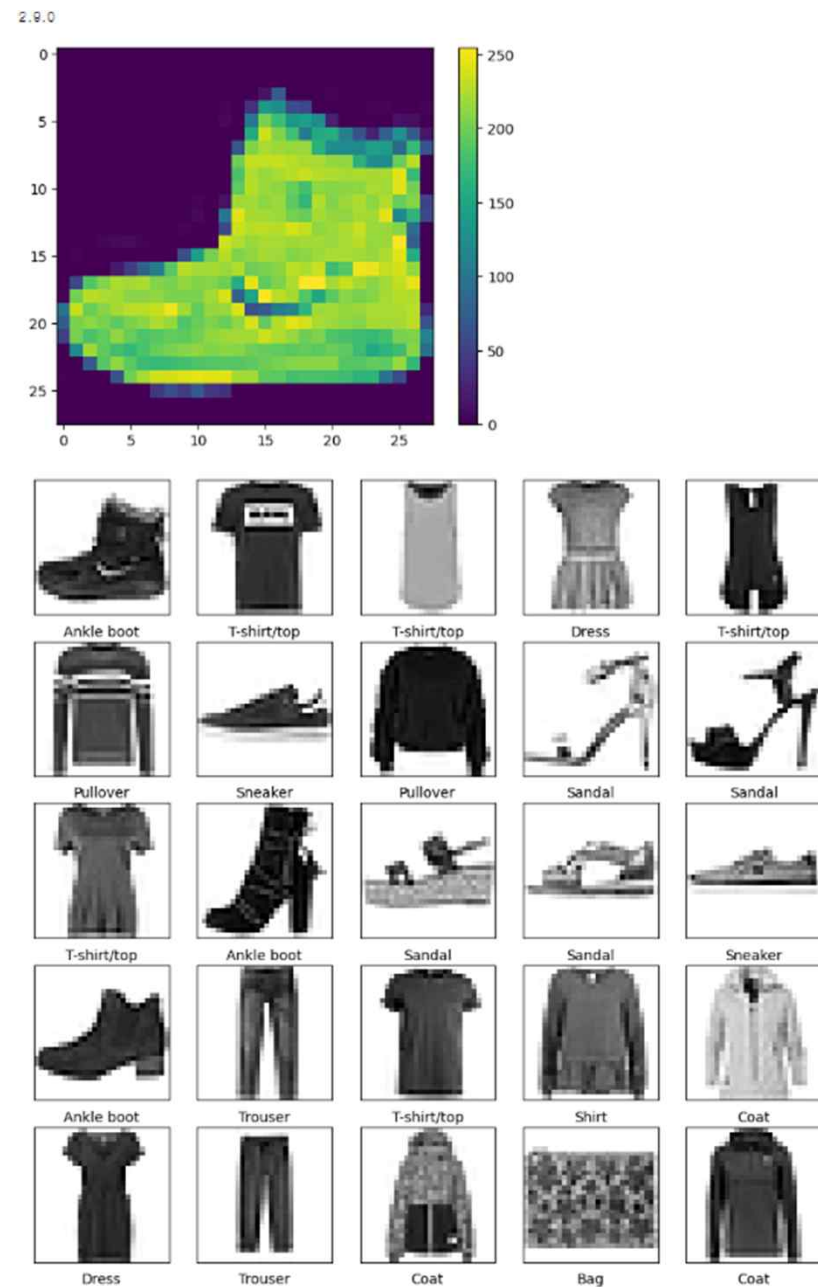
model = keras.Sequential([
    keras.layers.Flatten(input_shape=(28, 28)),
    keras.layers.Dense(128, activation='relu'),
    keras.layers.Dense(10, activation='softmax')
])

model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])

model.fit(train_images, train_labels, epochs=5)

test_loss, test_acc = model.evaluate(test_images, test_labels, verbose=2)

print('테스트 정확도:', test_acc)
```



# 11. GPU 연동 확인 3

## GPU

```
Epoch 1/5
1875/1875 [=====] - 5s 2ms/step - loss: 0.5002 - accuracy: 0.8245
Epoch 2/5
1875/1875 [=====] - 4s 2ms/step - loss: 0.3769 - accuracy: 0.8637
Epoch 3/5
1875/1875 [=====] - 5s 3ms/step - loss: 0.3360 - accuracy: 0.8776
Epoch 4/5
1875/1875 [=====] - 5s 3ms/step - loss: 0.3130 - accuracy: 0.8845
Epoch 5/5
1875/1875 [=====] - 5s 3ms/step - loss: 0.2946 - accuracy: 0.8910
313/313 - 1s - loss: 0.3648 - accuracy: 0.8676 - 702ms/epoch - 2ms/step
```

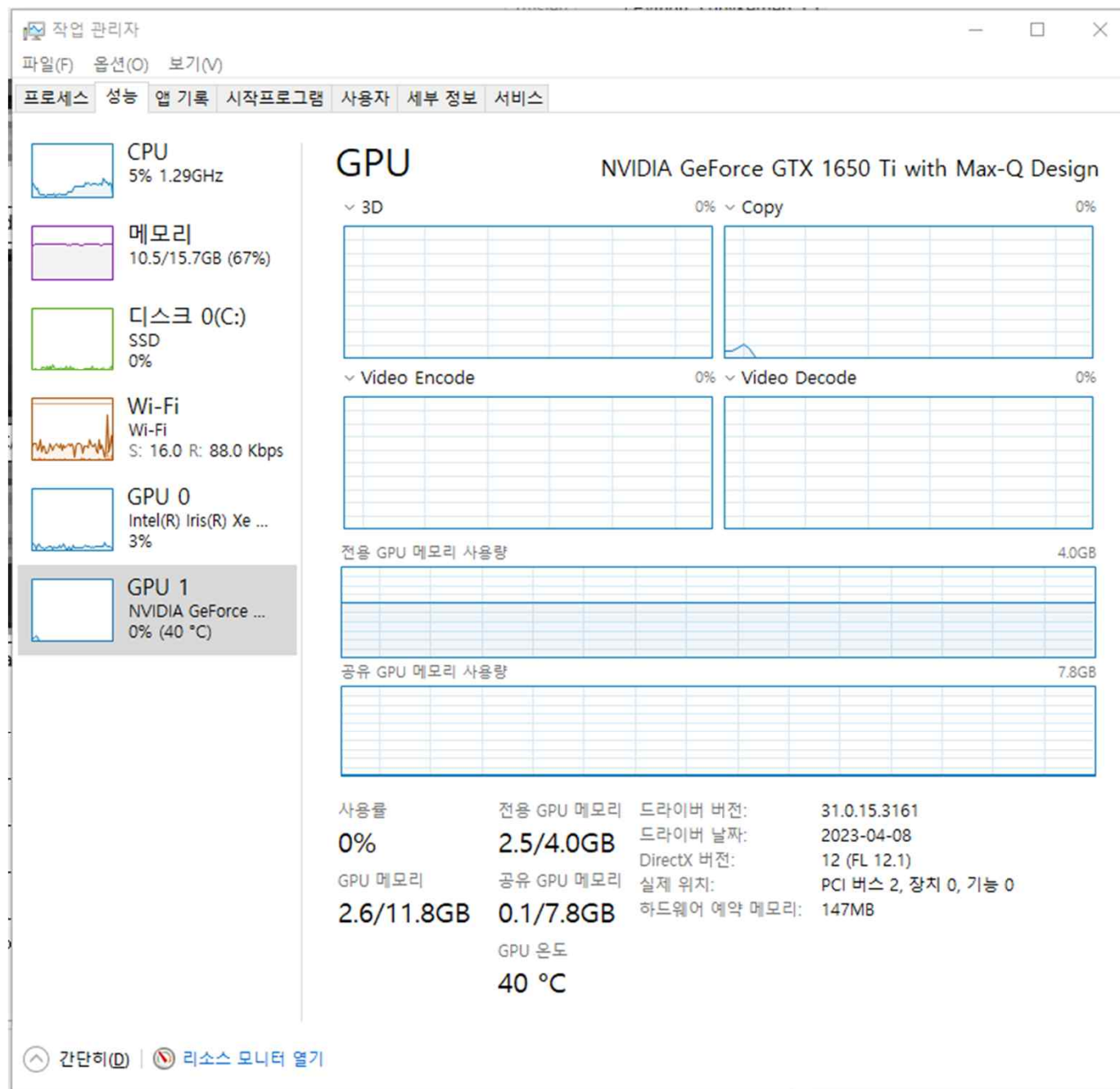
테스트 정확도: 0.8676000237464905

## CPU

```
Epoch 1/5
1875/1875 [=====] - 7s 3ms/step - loss: 0.4998 - accuracy: 0.8253
Epoch 2/5
1875/1875 [=====] - 5s 3ms/step - loss: 0.3740 - accuracy: 0.8643
Epoch 3/5
1875/1875 [=====] - 5s 3ms/step - loss: 0.3371 - accuracy: 0.8766
Epoch 4/5
1875/1875 [=====] - 5s 3ms/step - loss: 0.3128 - accuracy: 0.8846
Epoch 5/5
1875/1875 [=====] - 5s 3ms/step - loss: 0.2949 - accuracy: 0.8913
313/313 - 1s - loss: 0.3513 - accuracy: 0.8762 - 1s/epoch - 4ms/step
```

테스트 정확도: 0.8762000203132629

# 12. GPU 연동 확인 4



**감사합니다**