

DeepRob Discussion 3

1/27/2026



Session Agenda

- Running Locally
- NVidia NeRF Demo



Discussion Learning Objectives

- Environment Setup
 - Coding Environment
 - Required Libraries
 - Verify Operation
- Preliminary review of results
 - Demonstration Output
 - Submit for Points



Coding Environment

- Microsoft VS Code
 - Available at [Visual Studio Code - Code Editing. Redefined](#)



Coding Environment

- Add PATH Variables!
- Add Context Menus



Project File Requisition

[Project 2 | DeepRob: Deep Learning for Robot Perception](#)

- Drag notebook files to VS Code

A screenshot of the Visual Studio Code editor interface. The top bar shows two open files: 'two_layer_net (1).ipynb' and 'two_layer_net (1).py 2'. The breadcrumb navigation indicates the current file is 'two_layer_net (1).ipynb' located in 'C:\Users> allus > Downloads > two_layer_net (1).ipynb', which is part of a workspace for 'Implementing a Neural Network'. The editor content displays the following text:

ROB 498-004/599-004 Project 2-1: Two Layer Neural Network

Before we start, please put your name and UMID in following format

: Firstname LASTNAME, #00000000 // e.g.) Anthony OPIPARI, #12345678

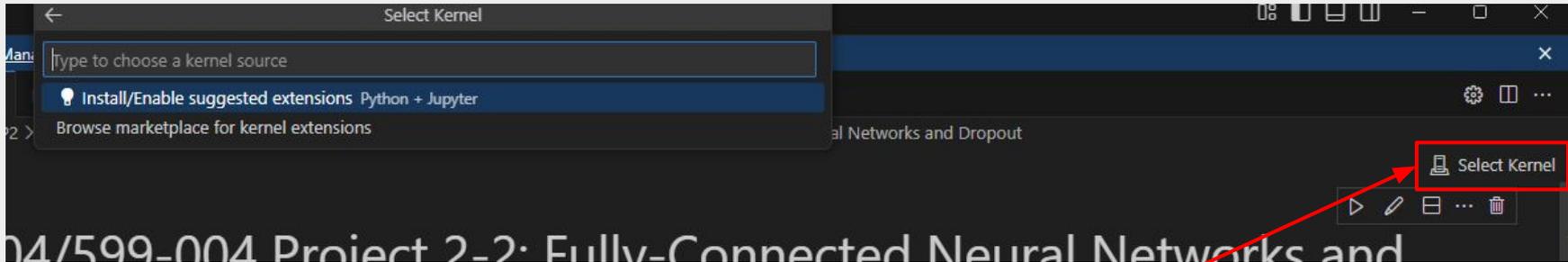
Your Answer:
Raphael ALLUSSON, #40680860

Setup Code



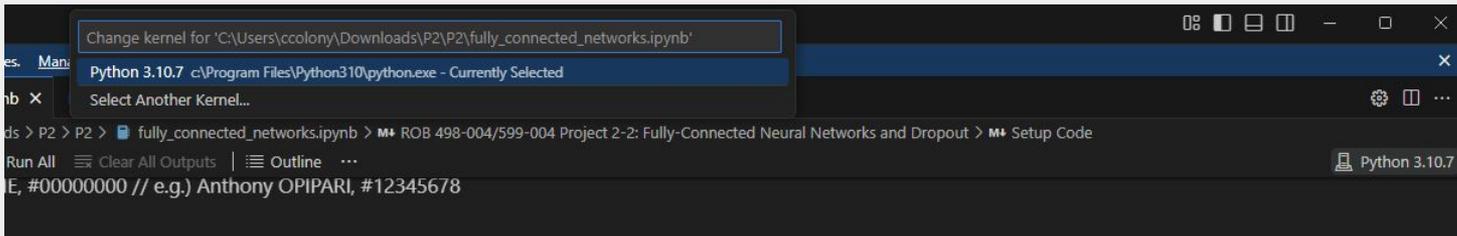
Install Python/Jupyter Extension

Should pop-up when opening notebook

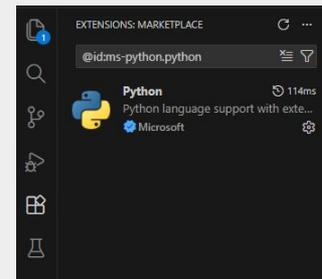


May need to select kernel manually

Select Python Environment



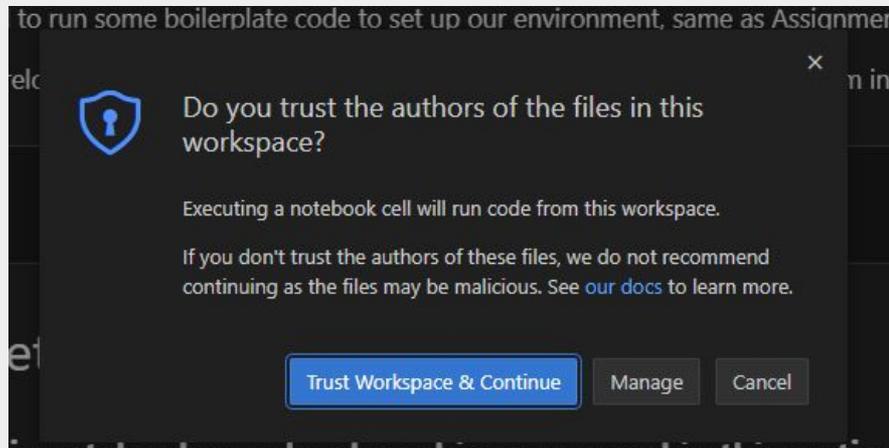
May need to install python extension for
VS Code





Trust the Workspace

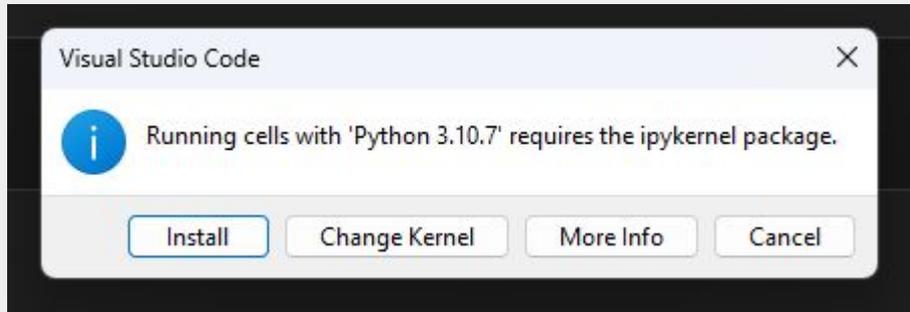
Select Trust Workspace & Continue





Install Kernel Package

Select Install





Skip Colab Specific Cells

This is not a problem

```
>
from google.colab import drive
drive.mount('/content/drive')

[3] 0.1s

...
-----
ModuleNotFoundError                                Traceback (most recent call last)
Cell In[3], line 1
----> 1 from google.colab import drive
      2 drive.mount('/content/drive')

ModuleNotFoundError: No module named 'google.colab'
```



Setup Project Path

Replace google drive path with local file path

```
import os

# TODO: Fill in the Google Drive path where you uploaded the assignment
# Example: If you create a 2026WN folder and put all the files under P1 folder, then '2026WN/P1'
# GOOGLE_DRIVE_PATH_AFTER_MYDRIVE = '2026WN/P1'
GOOGLE_DRIVE_PATH_AFTER_MYDRIVE = r'C:\Users\allusson\Downloads\P2'
GOOGLE_DRIVE_PATH = os.path.join('drive', 'My Drive', GOOGLE_DRIVE_PATH_AFTER_MYDRIVE)
print(os.listdir(GOOGLE_DRIVE_PATH))
```

Copy path

Delete ('drive', 'My Drive') from os.path.join()



Bypass Timezones

```
os.environ["TZ"] = ""  
#time.tzset()
```

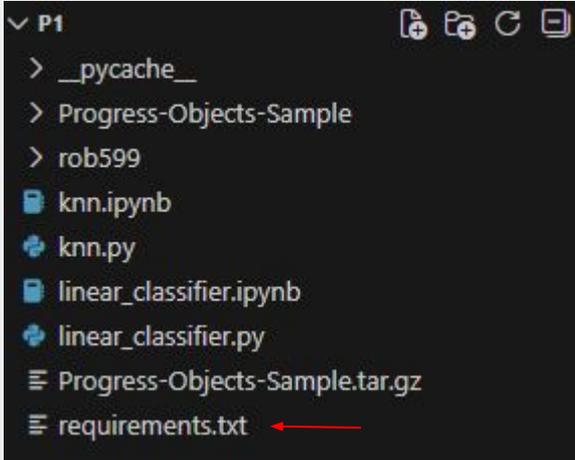


Start Installing Packages

```
ModuleNotFoundError: No module named 'torch'
```



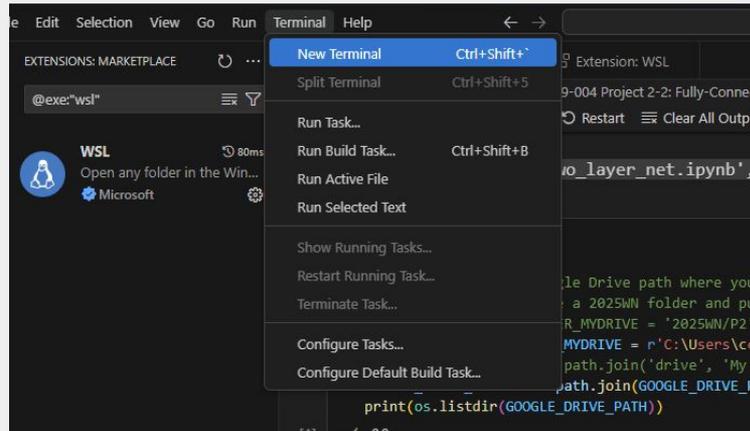
Start Installing Packages



```
requirements.txt
1  --extra-index-url https://download.pytorch.org/whl/cu126
2  torch
3  torchvision
4  gdown
5  matplotlib
```

Start Installing Packages

Install Packages from Terminal





Start Installing Packages

Torch is from pytorch.org

PyTorch Build	Stable (2.6.0)		Preview (Nightly)		
Your OS	Linux	Mac	Windows		
Package	Conda	Pip	LibTorch	Source	
Language	Python		C++ / Java		
Compute Platform	CUDA 11.8	CUDA 12.4	CUDA 12.6	ROCm 6.2.4	CPU
Run this Command:	<pre>pip3 install torch torchvision torchaudio --index-url https://download.pytorch.org/whl/cu126</pre>				



Start Installing Packages

Install Packages from Terminal

```
PROBLEMS 4 OUTPUT DEBUG CONSOLE TERMINAL PORTS JUPYTER
PS C:\Users\ccolony> pip3 install torch torchvision torchaudio --index-url https://download.pytorch.org/whl/cu126
Defaulting to user installation because normal site-packages is not writeable
Looking in indexes: https://download.pytorch.org/whl/cu126
Collecting torch
  Downloading https://download.pytorch.org/whl/cu126/torch-2.6.0%2Bcu126-cp310-cp310-win_amd64.whl (2496.1 MB)
    1.1/2.5 GB 131.2 MB/s eta 0:00:11
```



Start Installing Packages

Torch Complete

```
PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS JUPYTER
Collecting MarkupSafe>=2.0
  Downloading https://download.pytorch.org/whl/MarkupSafe-2.1.5-cp310-cp310-win_amd64.whl (17 kB)
Installing collected packages: mpmath, sympy, pillow, numpy, networkx, MarkupSafe, fsspec, filelock, jinja2, torch, torchvision, torchaudio
WARNING: The script isympy.exe is installed in 'C:\Users\ccolony\AppData\Roaming\Python\Python310\Scripts' which is not on PATH.
Consider adding this directory to PATH or, if you prefer to suppress this warning, use --no-warn-script-location.
WARNING: The scripts f2py.exe and numpy-config.exe are installed in 'C:\Users\ccolony\AppData\Roaming\Python\Python310\Scripts' which is not on PATH.
Consider adding this directory to PATH or, if you prefer to suppress this warning, use --no-warn-script-location.
WARNING: The scripts torchfrtrace.exe and torchrun.exe are installed in 'C:\Users\ccolony\AppData\Roaming\Python\Python310\Scripts' which is not on PATH.
Consider adding this directory to PATH or, if you prefer to suppress this warning, use --no-warn-script-location.
Successfully installed MarkupSafe-2.1.5 filelock-3.13.1 fsspec-2024.6.1 jinja2-3.1.4 mpmath-1.3.0 networkx-3.3 numpy-2.1.2 pillow-11.0.0 sympy-1.13.1 torch-2.6.0+cu126 torchaudio-2.6.0+cu126 torch
ision-0.21.0+cu126
WARNING: There was an error checking the latest version of pip.
PS C:\Users\ccolony> |
```



Start Installing Packages

Matplotlib: [matplotlib · PyPI](#)

```
File c:\Users\ccolony\Downloads\P2\P2\rob599\__init__.py:1
----> 1 from . import data, grad, submit
      2 from .solver import Solver
...
----> 4 import matplotlib.pyplot as plt
      5 import torch
      6 import torchvision
```

ModuleNotFoundError: No module named 'matplotlib'

Output is truncated. View as a [scrollable element](#) or open in a [text editor](#). Adjust cell output [settings...](#)

Start Installing Packages

Run in terminal

```
Successfully installed MarkupSafe-2.1.5 filelock-3.13.1  
ision-0.21.0+cu126  
WARNING: There was an error checking the latest versi  
PS C:\Users\ccolony> pip install matplotlib
```



Start Installing Packages

Run in terminal

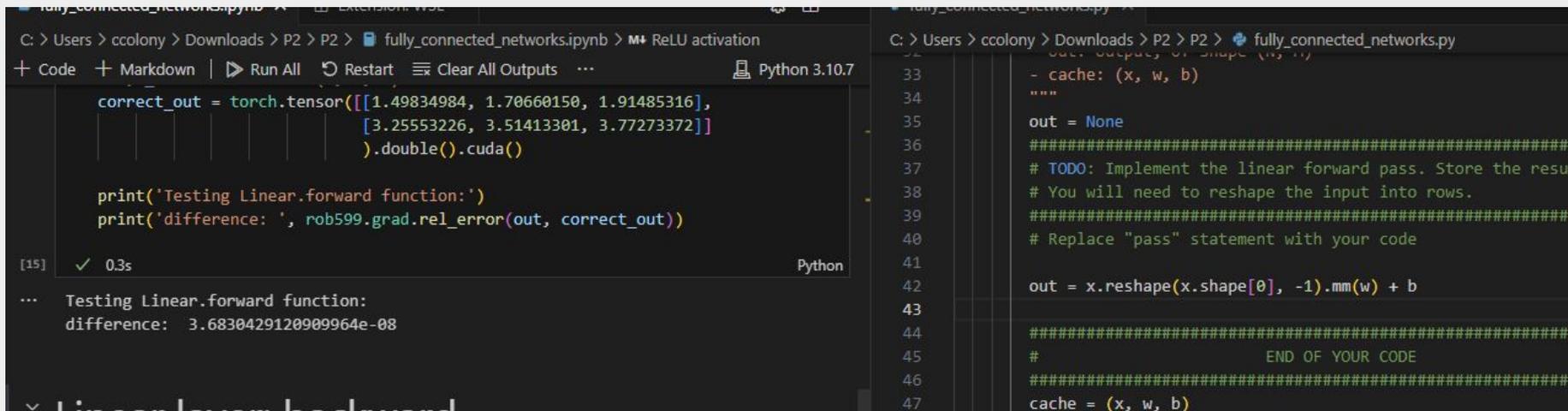
```
gdown 5.2.0
```

```
pip install gdown
```

```
Successfully installed contourpy-1.3.1 cycLER-0.12.1 fonttools-4.55.8 kiwisolver-1.4.5  
[notice] A new release of pip available: 22.2.2 -> 25.0  
[notice] To update, run: python.exe -m pip install --upgrade pip  
PS C:\Users\ccolony> pip install gdown
```

Start Coding!

Can Split Like Colab



```
C: > Users > ccolony > Downloads > P2 > P2 > fully_connected_networks.ipynb > M+ ReLU activation
+ Code + Markdown | ▶ Run All ⏪ Restart ☰ Clear All Outputs ... Python 3.10.7
correct_out = torch.tensor([[1.49834984, 1.70660150, 1.91485316],
                             [3.25553226, 3.51413301, 3.77273372]])
                             ).double().cuda()

print('Testing Linear.forward function:')
print('difference: ', rob599.grad.rel_error(out, correct_out))

[15] ✓ 0.3s Python
... Testing Linear.forward function:
difference: 3.6830429120909964e-08

Linear layer backward
```

```
C: > Users > ccolony > Downloads > P2 > P2 > fully_connected_networks.py
- cache: (x, w, b)
"""
out = None
#####
# TODO: Implement the linear forward pass. Store the result
# You will need to reshape the input into rows.
#####
# Replace "pass" statement with your code

out = x.reshape(x.shape[0], -1).mm(w) + b
43
44 #####
45 #                               END OF YOUR CODE
46 #####
47 cache = (x, w, b)
```



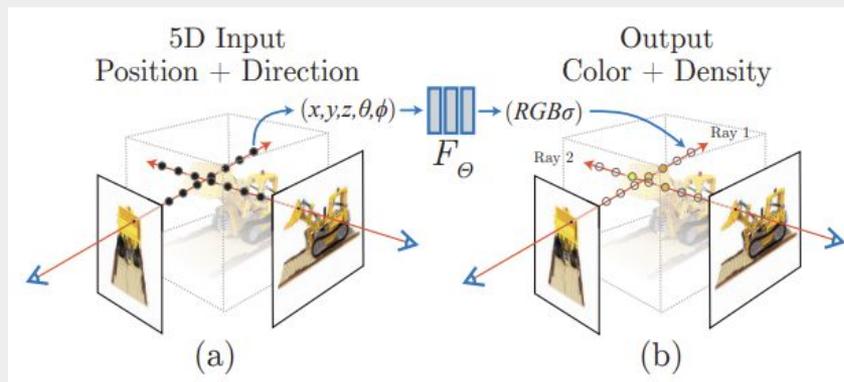
Discussion Learning Objectives

- Environment Setup
 - Coding Environment
 - Required Libraries
 - Verify Operation

- NVIDIA NeRF Demo
 - Understand Neural Radiance Fields
 - Examine Instant-NGP contribution

Neural Radiance Fields - (NeRF)

- Static scene \rightarrow Continuous 5D Function
 - Inputs: 3D location (x, y, z) + 2D viewing angle (θ, ϕ)
 - Outputs: Color (r, g, b) + Volume Density (σ)





Neural Radiance Fields - (NeRF)

- Ray tracing for volume rendering

$$C(\mathbf{r}) = \int_{t_n}^{t_f} T(t) \sigma(\mathbf{r}(t)) \mathbf{c}(\mathbf{r}(t), \mathbf{d}) dt, \text{ where } T(t) = \exp\left(-\int_{t_n}^t \sigma(\mathbf{r}(s)) ds\right).$$

$$\mathbf{r}(t) = \mathbf{o} + t\mathbf{d}$$

- Numerical Estimation
 - Sampled from N points along ray

$$\hat{C}(\mathbf{r}) = \sum_{i=1}^N T_i (1 - \exp(-\sigma_i \delta_i)) \mathbf{c}_i, \text{ where } T_i = \exp\left(-\sum_{j=1}^{i-1} \sigma_j \delta_j\right),$$

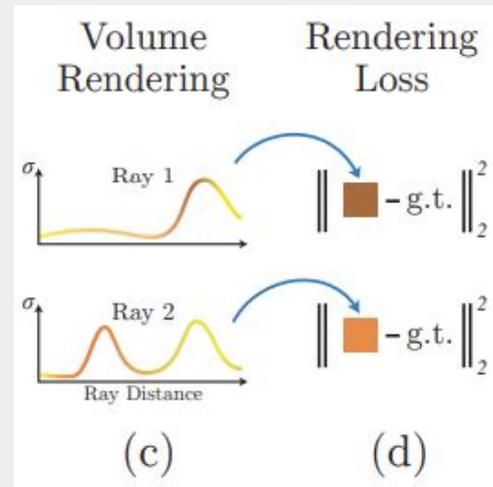
Neural Radiance Fields - Optimization

- Total Squared Error Loss

$$\mathcal{L} = \sum_{\mathbf{r} \in \mathcal{R}} \left[\left\| \hat{C}_c(\mathbf{r}) - C(\mathbf{r}) \right\|_2^2 + \left\| \hat{C}_f(\mathbf{r}) - C(\mathbf{r}) \right\|_2^2 \right]$$

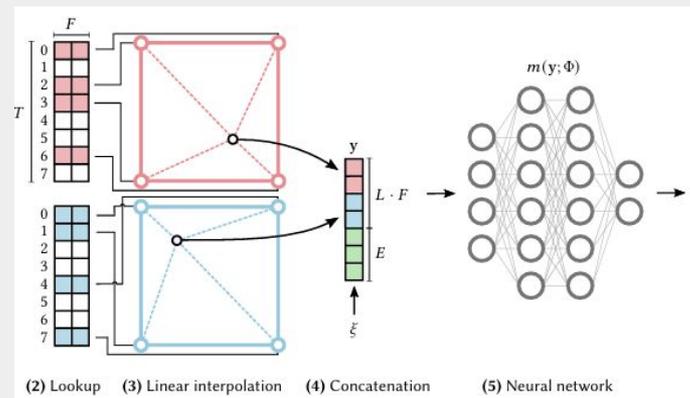
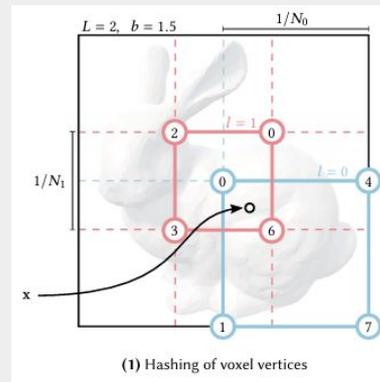
- Positional Encoding
 - Fixes blurry rendering due to low-frequency bias

$$\gamma(p) = \left(\sin(2^0 \pi p), \cos(2^0 \pi p), \dots, \sin(2^{L-1} \pi p), \cos(2^{L-1} \pi p) \right)$$



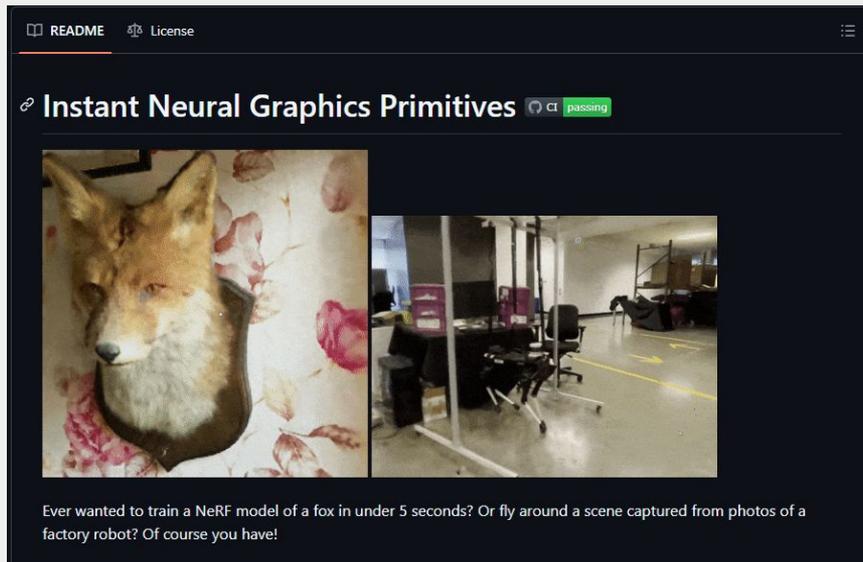
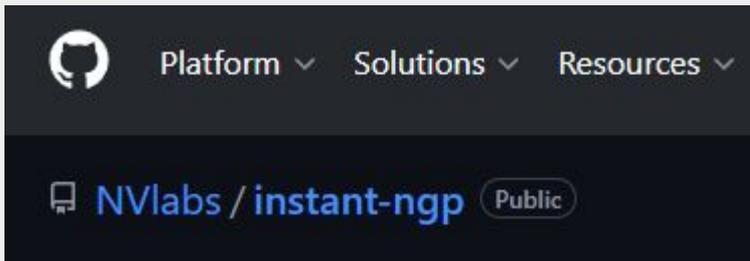
Instant NGP

- **Multiresolution Hash Encoding:** Stores scene details in learnable lookup table rather than a deep network
- **Tiny MLP:** Uses a small, lightweight neural network to simply interpret features instead of memorizing geometry.
- **Drastically reduced training:** 1-2 days → 5-15 seconds
 - Runs on consumer GPU



VR NVIDIA NeRF Demo

GitHub Repo: instant-ngp





VR NVIDIA NeRF Demo

[Download for Instant NGP Demo \(4000 Series\)](#)

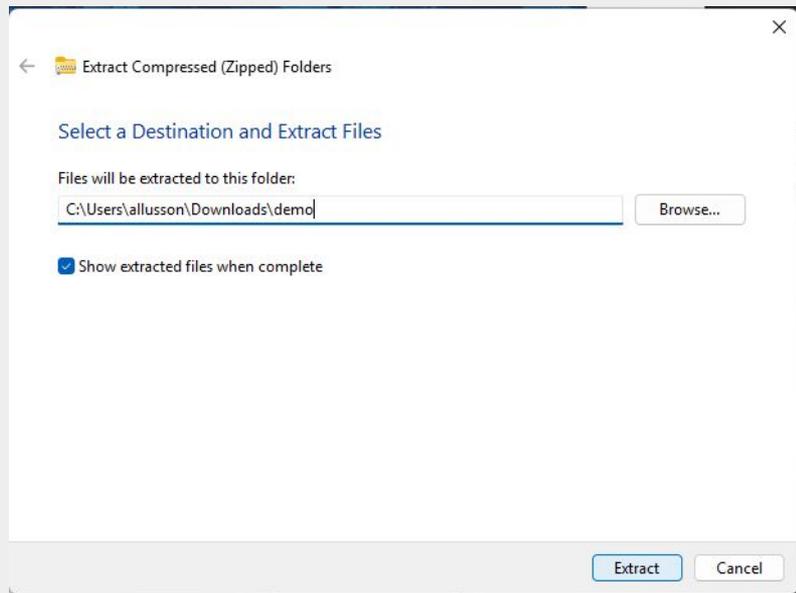
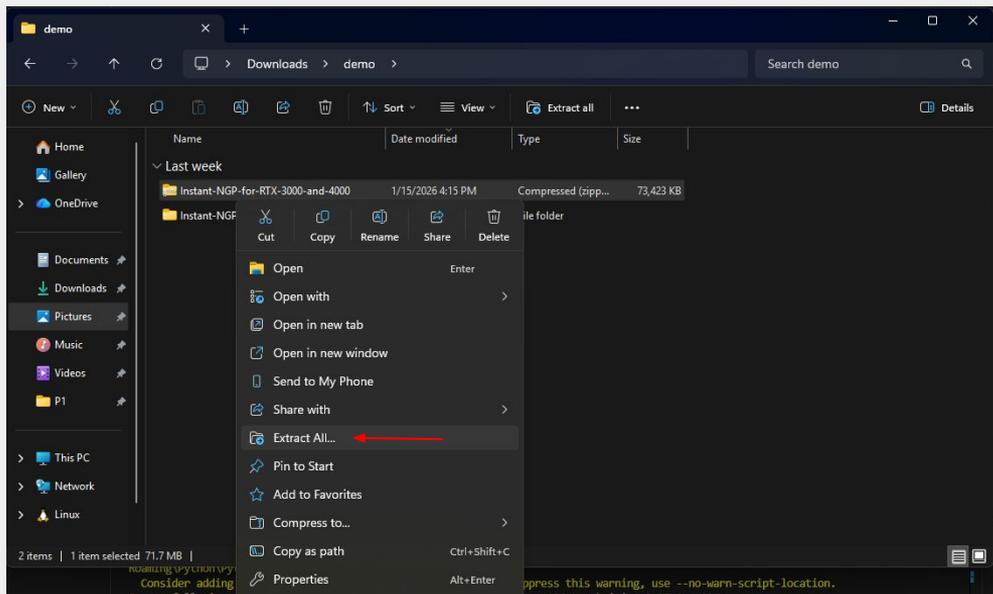
Installation

If you have Windows, download one of the following releases corresponding to your graphics card and extract it. Then, start `instant-ngp.exe`.

- [RTX 5000 series and other Blackwell cards](#)
- [RTX 3000 & 4000 series, RTX A4000–A6000, and other Ampere & Ada cards](#) ←
- [RTX 2000 series, Titan RTX, Quadro RTX 4000–8000, and other Turing cards](#)
- [GTX 1000 series, Titan Xp, Quadro P1000–P6000, and other Pascal cards](#)

VR NVIDIA NeRF Demo

Extract .zip files

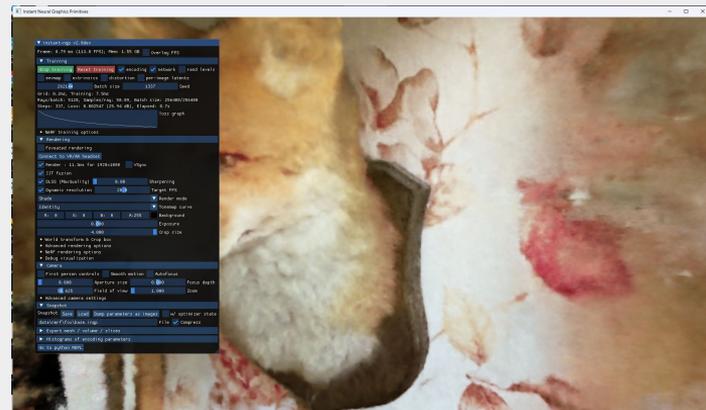


VR NVIDIA NeRF Demo

- Open a windows terminal
- Navigate to \Instant-NGP-for-RTX-3000-and-4000\
- Run instant-ngp model

```
PS C:\Users\allusson\Downloads> cd .\demo\Instant-NGP-for-RTX-3000-and-4000\  
PS C:\Users\allusson\Downloads\demo\Instant-NGP-for-RTX-3000-and-4000> |
```

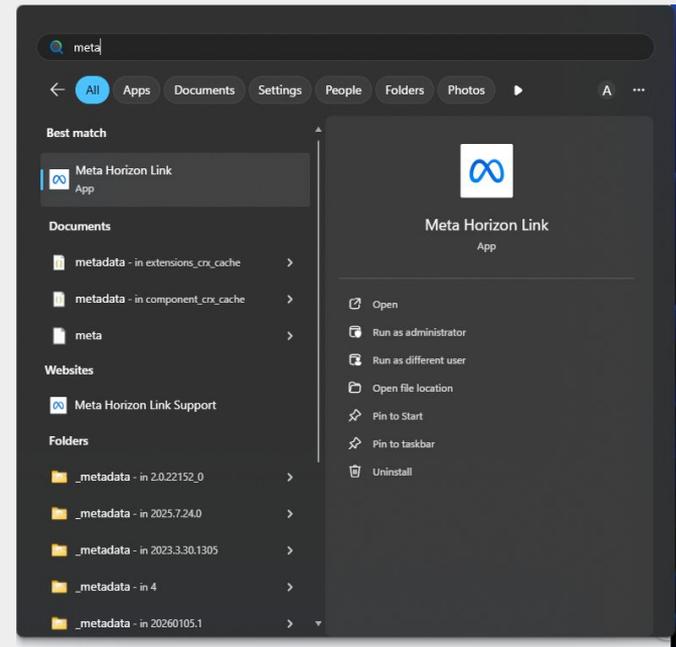
```
instant-ngp$ ./instant-ngp data/nerf/fox
```





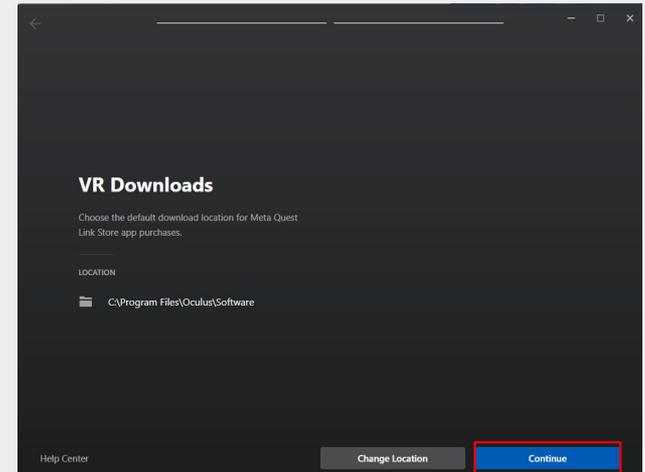
VR NVIDIA NeRF Demo

- Open Meta Horizon Link Application



VR NVIDIA NeRF Demo

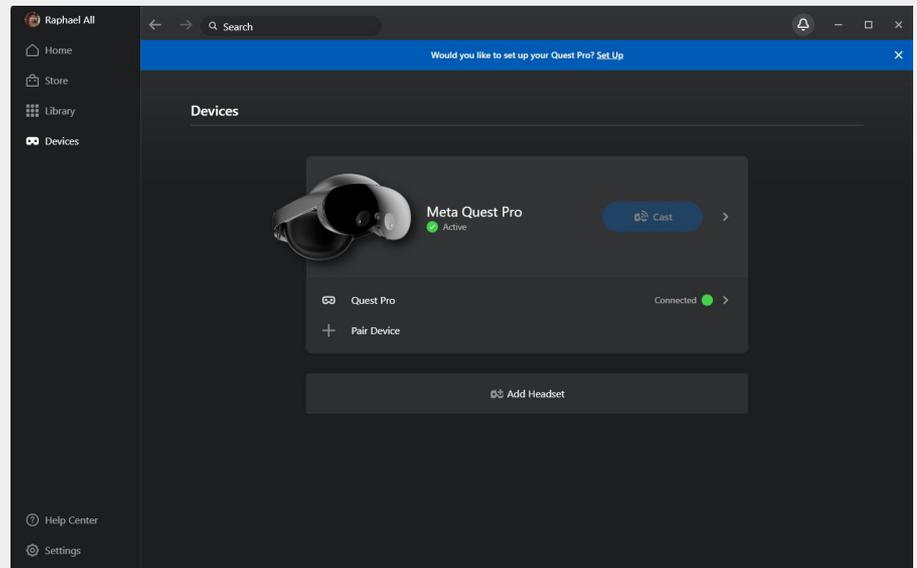
- Log into or create a Meta Account
- Continue with setup
- Connection through USB-C cable





VR NVIDIA NeRF Demo

Navigate to devices





VR NVIDIA NeRF Demo

- Put on Quest Pro Headset
- Enable link if prompted using handheld remotes



Adjust size as needed

VR NVIDIA NeRF Demo

Locate Desktop Icon and select it to see desktop screen



VR NVIDIA NeRF Demo

Connect to VR headset

May need to enable permissions in settings (General)

