

- Practical Demonstration:
 - How to Run RayBNN
 - On Local Host

Jintao (Joseph) Li

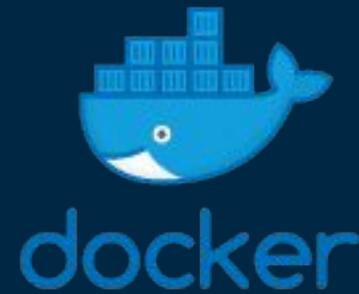
Download the Source Code - v1

<https://www.sensor-net.net/a-3d-ray-traced-biological-neural-network-learning-model/>

Source Code For RayBNN v1.0.0

<https://zenodo.org/records/10846144>

Run on local host with Docker



Download the Source Code - v2

Source Code For RayBNN v2.0.1

https://github.com/BrosnanYuen/RayBNN_Neural

https://github.com/BrosnanYuen/RayBNN_DataLoader

https://github.com/BrosnanYuen/RayBNN_Sparse

https://github.com/BrosnanYuen/RayBNN_Raytrace

https://github.com/BrosnanYuen/RayBNN_Python

https://github.com/BrosnanYuen/RayBNN_Cell

https://github.com/BrosnanYuen/RayBNN_Optimizer

https://github.com/BrosnanYuen/RayBNN_Graph

https://github.com/BrosnanYuen/RayBNN_DiffEq



Digital Research
Alliance of Canada

Run on Digital Canada

By script

Brosnan's RayBNN - V1 - System Requirements

- **RTX 3090 or more powerful with at least 24GB VRAM**
- **32GB RAM**
- **20 GB of disk space**



Brosnan's RayBNN - V1 - Software Requirements

Docker (<https://www.docker.com/>)

Rust (<https://www.rust-lang.org/>)

Arrayfire (<https://github.com/arrayfire/arrayfire>)

Arrayfire Rust (<https://github.com/arrayfire/arrayfire-rust>)

Pytorch (<https://pytorch.org/>)

Pytorch geometric (https://github.com/pyg-team/pytorch_geometric)

Matlab

Containers

Images

Volumes

Builds

Docker Scout

Extensions

Containers [Give feedback](#)



Your running containers show up here

A container is an isolated environment for your code



What is a container?

5 mins

```
1 FROM node  
2 RUN mkdir -p  
3 WORKDIR /app  
4 COPY packa|
```

How do I run a container?

6 mins

[View more in the Learning center](#)

Installation - Windows

<https://www.rust-lang.org/>

Installing Rust

You can try Rust online in the Rust Playground without installing anything on your computer.

[TRY RUST WITHOUT INSTALLING](#)

Rustup: the Rust installer and version management tool

The primary way that folks install Rust is through a tool called Rustup, which is a Rust installer and version management tool.

It looks like you're running Windows. To start using Rust, download the installer, then run the program and follow the onscreen instructions. You may need to install the [Visual Studio C++ Build tools](#) when prompted to do so. If you are not on Windows see "[Other Installation Methods](#)".

[DOWNLOAD RUSTUP-INIT.EXE \(32-BIT\)](#)

[DOWNLOAD RUSTUP-INIT.EXE \(64-BIT\)](#)

Installation - Windows

```
info: downloading component 'clippy'  
info: downloading component 'rust-docs'  
  15.1 MiB / 15.1 MiB (100 %) 11.3 MiB/s in 1s ETA: 0s  
info: downloading component 'rust-std'  
  18.0 MiB / 18.0 MiB (100 %) 15.4 MiB/s in 1s ETA: 0s  
info: downloading component 'rustc'  
  57.4 MiB / 57.4 MiB (100 %) 21.9 MiB/s in 2s ETA: 0s  
Rust info: downloading component 'rustfmt'  
info: installing component 'cargo'  
info: installing component 'clippy'  
Rust info: installing component 'rust-docs'  
ava: 15.1 MiB / 15.1 MiB (100 %) 4.1 MiB/s in 3s ETA: 0s  
info: installing component 'rust-std'  
The: 18.0 MiB / 18.0 MiB (100 %) 17.4 MiB/s in 1s ETA: 0s  
info: installing component 'rustc'  
  57.4 MiB / 57.4 MiB (100 %) 17.4 MiB/s in 3s ETA: 0s  
1) ( info: installing component 'rustfmt'  
  | info: default toolchain set to 'stable-x86_64-pc-windows-msvc'  
  
2) | stable-x86_64-pc-windows-msvc installed - rustc 1.78.0 (9b00956e5 2024-04-29)  
|  
3) |  
| Rust is installed now. Great!  
| To get started you may need to restart your current shell.  
| This would reload its PATH environment variable to include  
| Cargo's bin directory (%USERPROFILE%\.cargo\bin).  
>
```

Installation

stable-x86_64

Rust is installed

To get started
This would require
Cargo's bin directory

Press the Enter key

Add this path

```
C:\Users\18010\AppData\Local\Microsoft\WindowsApps
C:\dev\common\vscode\bin
C:\dev\go\go1.20.6\bin
C:\Users\18010\.dotnet\tools
C:\Users\18010\AppData\Local\JetBrains\Toolbox\scripts
C:\dev\anaconda3
C:\dev\anaconda3\Scripts
C:\dev\CMake\bin
C:\dev\flutter\bin
C:\Users\18010\AppData\Roaming\nvm
C:\Program Files\nodejs
%NVM_HOME%
%NVM_SYMLINK%
D:\web\nvm\global
D:\Qt\6.8.0\mingw_64\bin
D:\Qt\Tools\MinGW\bin
C:\dev\java\jdk17\bin
%USERPROFILE%\dotnet\tools
C:\dev\mingw64\bin
C:\Users\18010\AppData\Local\GitHubDesktop\bin
%USERPROFILE%.cargo\bin
```

78.0 (9b00956e5)

nt shell.
o include

Check Installation - Windows

Rustc -V // **rustc --version**

Cargo -V // **cargo --version**

```
C:\Users\30288>rustc --version
rustc 1.78.0 (9b00956e5 2024-04-29)
```

```
C:\Users\30288>cargo --version
cargo 1.78.0 (54d8815d0 2024-03-26)
```

If compile error happens

“**sudo apt install gcc -y**”

Install Arrayfire

By Command “ git clone h

```
PS J:\ece590> cd RayBNN
PS J:\ece590\RayBNN> git c
Cloning into 'arrayfire'...
remote: Enumerating objects...
remote: Counting objects: 1
remote: Compressing objects...
remote: Total 67593 (delta 1)
Receiving objects: 100% (67593/67593), 10.4 MiB/s, done.
```

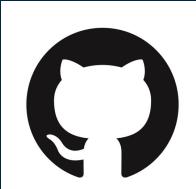
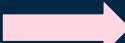
```
arrayfire
├── .github
└── CMakeModules
    ├── docs
    ├── examples
    ├── extern
    ├── include
    ├── LICENSES
    ├── src
    └── test
        ├── .coveralls.yml
        ├── .gitignore
        └── .gitmodules
        └── ACKNOWLEDGEMENTS.md
        └── CMakeLists.txt
        └── CMakePresets.json
        └── conanfile.py
        └── CONTRIBUTING.md
        └── COPYRIGHT.md
        └── CTestConfig.cmake
        └── LICENSE
        └── README.md
        └── vcpkg.json
```

arrayfire.git ”

re/arrayfire.git

, pack-reused 65019
lib/s, done.

Need
Help?



Install ArrayFire

```
PS J:\ece590\RayBNN> cd arrayfire
PS J:\ece590\RayBNN\arrayfire> mkdir build
```

目录: J:\ece590\RayBNN\arrayfire

Mode	LastWriteTime	Length	Name
d----	-----	-----	build

```
PS J:\ece590\RayBNN\arrayfire> cd build
PS J:\ece590\RayBNN\arrayfire\build>
```

Install ArrayFire



```
PS J:\ece590\RayBNN\arrayfire\build> ls
PS J:\ece590\RayBNN\arrayfire\build> cmake ..
-- Building for: Visual Studio 17 2022
-- Selecting Windows SDK version 10.0.22000.0 to target Windows 10.0.22631.
-- The C compiler identification is MSVC 19.40.33811.0
-- The CXX compiler identification is MSVC 19.40.33811.0
-- Detecting C compiler ABI info
-- Detecting C compiler ABI info - done
-- Check for working C compiler: C:/Program Files/Microsoft Visual Studio/2022/Community/VC/Tools/MSVC/14.40.33807/bin/Hostx64/x64/cl.exe - skipped
-- Detecting C compile features
-- Detecting C compile features - done
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler ABI info - done
-- Check for working CXX compiler: C:/Program Files/Microsoft Visual Studio/2022/Community/VC/Tools/MSVC/14.40.33807/bin/Hostx64/x64/cl.exe - skipped
-- Detecting CXX compile features
-- Detecting CXX compile features - done
-- Performing Test cplusplus_define
-- Performing Test cplusplus_define - Success
-- Performing Test cxx_compliance
```

Download & Support

ArrayFire is a free and open source software library for high performance computing. We encourage you to use the software for non-commercial purposes.

If you are using ArrayFire commercially or for open source development, we ask that you contribute back to the project through our [Support Programs](#).

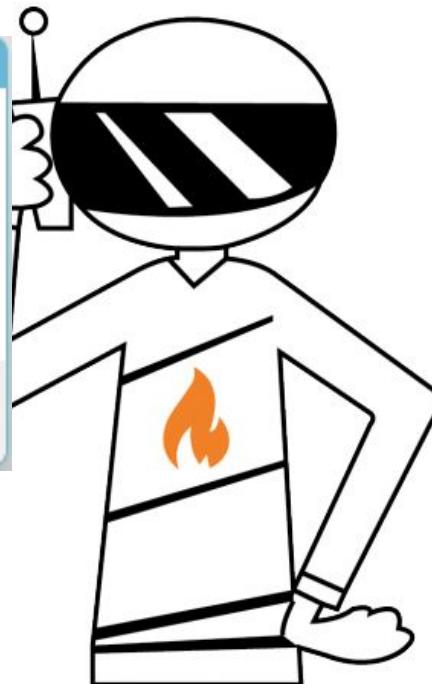
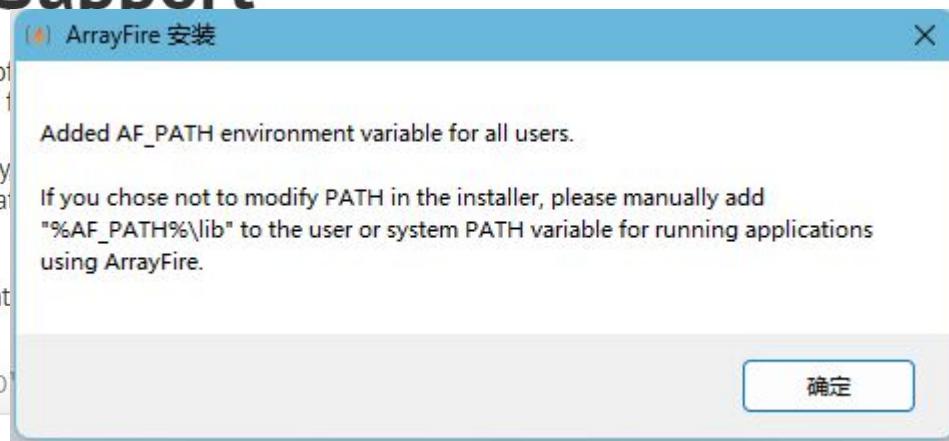
These contributions enable us to maintain

[WINDOWS](#)[LINUX](#)[MACOS](#)**ArrayFire v3.9.0**

Built on CUDA 12.2, oneAPI 2023.2.

Check out our GitHub repository to [build from the source](#).

Looking for an older installer? [Try here](#).



Install Pytorch

START LOCALLY

Select your preferences and run the install command. Stable represents the most currently tested and supported version of PyTorch. This should be suitable for many users. Preview is available if you want the latest, not fully tested and supported, builds that are generated nightly. Please ensure that you have **met the prerequisites below (e.g., numpy)**, depending on your package manager. Anaconda is our recommended package manager since it installs all dependencies. You can also [install previous versions of PyTorch](#). Note that LibTorch is only available for C++.

NOTE: Latest PyTorch requires Python 3.8 or later.

PyTorch Build	Stable (2.3.1)		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 6.0

Run this Command:
`pip3 install torch torchvision torchaudio --index-url https://download.pytorch.org/wheel/cu118`

Install Pytorch

```
PS C:\Users\30288> pip3 install torch torchvision torchaudio --index-url https://download.pytorch.org/whl/cu118
Defaulting to user installation because normal site-packages is not writeable
Looking in indexes: https://download.pytorch.org/whl/cu118
Collecting torch
  Downloading https://download.pytorch.org/whl/cu118/torch-2.3.1%2Bcu118-cp310-cp310-win_amd64.whl (2673.0 MB)
    2.7/2.7 GB 621.9 kB/s eta 0:00:00
Collecting torchvision
  Downloading https://download.pytorch.org/whl/cu118/torchvision-0.18.1%2Bcu118-cp310-cp310-win_amd64.whl (4.9 MB)
    4.9/4.9 MB 6.7 MB/s eta 0:00:00
Default: 18
Collecting torchaudio
  Downloading https://download.pytorch.org/whl/cu118/torchaudio-2.3.1%2Bcu118-cp310-cp310-win_amd64.whl (4.0 MB)
    4.0/4.0 MB 6.6 MB/s eta 0:00:00
Collecting fsspec
  Downloading https://download.pytorch.org/whl/fsspec-2024.2.0-py3-none-any.whl (170 kB)
    170.9/170.9 KB 686.8 kB/s eta 0:00:00
Collecting sympy
  Downloading https://download.pytorch.org/whl/sympy-1.12-py3-none-any.whl (5.7 MB)
    5.7/5.7 MB 6.9 MB/s eta 0:00:00
Collecting jinja2
  Downloading https://download.pytorch.org/whl/Jinja2-3.1.3-py3-none-any.whl (133 kB)
    133.2/133.2 KB 715.1 kB/s eta 0:00:00
Collecting typing-extensions>=4.8.0
  Downloading https://download.pytorch.org/whl/typing_extensions-4.9.0-py3-none-any.whl (32 kB)
Collecting networkx
  Downloading https://download.pytorch.org/whl/networkx-3.2.1-py3-none-any.whl (1.6 MB)
    1.6/1.6 MB 34.8 MB/s eta 0:00:00
Collecting filelock
```

Error During Installing Pytorch

```
Collecting mpmath>=0.19
  Downloading https://download.pytorch.org/wheel/mpmath-1.3.0-py3-none-any.whl (536 kB)
    536.2/536.2 KB 2.6 MB/s eta 0:00:00
Installing collected packages: tbb, mpmath, intel-openmp, typing-extensions, sympy, pillow, numpy, networkx, mkl, MarkupSafe, fsspec, filelock, jinja2, torch, torchvision, torchaudio
  WARNING: The script isympy.exe is installed in 'C:\Users\30288\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 script f2py.exe is installed in 'C:\Users\30288\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 convert-caffe2-to-onnx.exe, convert-onnx-to-caffe2.exe and torchrun.exe are installed in 'C:\Users\30288\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.
ERROR: Could not install packages due to an OSError: [Errno 28] No space left on device
```

Add it to the environment variable

Check Pytorch

```
python -c "import torch; print(torch.__version__)"
```

```
Successfully installed torchaudio-2.3.1+cu118 torchvision-0.18.1+cu118
PS C:\Users\30288> python -c "import torch; print(torch.__version__)"
2.3.1+cu118
PS C:\Users\30288> |
```

Pytorch geometric

Installation

```
PS C:\Users\30288> pip install torch_geometric
Defaulting to user installation because normal site-packages is not writeable
Collecting torch_geometric
  Downloading torch_geometric-2.5.3-py3-none-any.whl (1.1 MB)
    1.1/1.1 MB 3.0 MB/s eta 0:00:00
Collecting requests
  Downloading requests-2.32.3-py3-none-any.whl (64 kB)
    64.9/64.9 KB 3.4 MB/s eta 0:00:00
Collecting scipy
  Downloading scipy-1.14.0-cp310-cp310-win_amd64.whl (44.8 MB)
    19.6/44.8 MB 10.9 MB/s eta 0:00:03
```

pip install torch_geometric

pip install torch_geometric

[Open MATLAB Online](#)[Install MATLAB](#)Recent: [Files](#) | [Folders](#)

Name

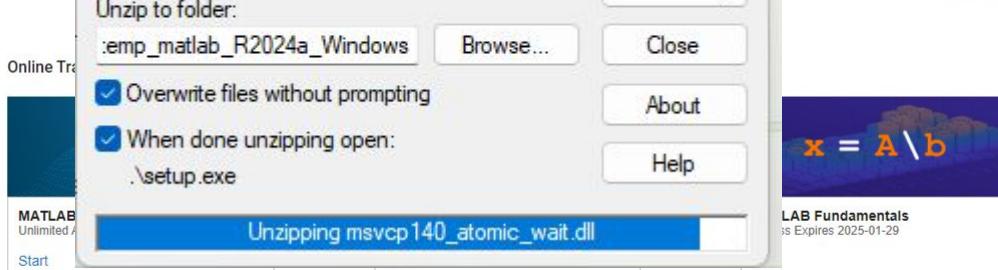
[a2q2.m](#)
MATLAB[Euler.m](#)
MATLAB[firstTE.m](#)
MATLAB

Last Modified

4 months ago

10 months ago

10 months ago

[View all files](#)[View more ▾](#)[View all courses](#)

Follow Brosnan's Installation Guide

Installation Guide

1. On the Host Machine. Place RayBNN.zip into \$RAYBNN_DIR and unzip it.

Set the \$RAYBNN_DIR environmental variable to a folder that will store all the RayBNN files

For example, setting \$RAYBNN_DIR to /opt/

```
export RAYBNN_DIR=/opt/
```

Place RayBNN.zip into \$RAYBNN_DIR and unzip it to produce:

- \$RAYBNN_DIR/RayBNN/src/
- \$RAYBNN_DIR/RayBNN/examples/
- \$RAYBNN_DIR/RayBNN/matlab_plot/
- \$RAYBNN_DIR/RayBNN/python_verify/

Get the directory for RayBNN

```
Mode          LastWriteTime    Length Name
----          -----          ---- -
d-----      2024/7/10 22:15          arrayfire
d-----      2024/7/10 17:48          raybnn
-a---      2024/7/10 17:23      86194 RayBNN.pdf
-a---      2024/7/10 17:23   16619750 raybnn.zip
```

```
PS J:\ece590\RayBNN> pwd
```

Path

```
J:\ece590\RayBNN
```

Command to set up RayBNN

```
setx RAYBNN_DIR "J:\ece590\RayBNN"
```

```
PS J:\ece590\RayBNN> export RAYBNN_DIR=/J:\ece590\RayBNN
export : 无法将“export”项识别为 cmdlet、函数、脚本文件或可运行程序的名称。
所在位置 行:1 字符: 1
+ export RAYBNN_DIR=/J:\ece590\RayBNN
+ ~~~~~
+ CategoryInfo          : ObjectNotFound: (export:String) [], Command
+ FullyQualifiedErrorId : CommandNotFoundException

PS J:\ece590\RayBNN> setx RAYBNN_DIR "J:\ece590\RayBNN"

成功：指定的值已得到保存。
PS J:\ece590\RayBNN>
```

export RAYBNN_DIR= pwd

for Unix / Linux

- \$RAYBNN_DIR/RayBNN/src/
- \$RAYBNN_DIR/RayBNN/examples/
- \$RAYBNN_DIR/RayBNN/matlab_plot/
- \$RAYBNN_DIR/RayBNN/python_verify/

Check whether those directory Work

```
PS J:\ece590\RayBNN\RayBNN\examples> cd J:\ece590\RayBNN\RayBNN\matlab_plot\>
PS J:\ece590\RayBNN\RayBNN\matlab_plot> cd J:\ece590\RayBNN\RayBNN\python_verify\>
PS J:\ece590\RayBNN\RayBNN\python_verify> ls
```

目录： J:\ece590\RayBNN\RayBNN\python_verify

Mode	LastWriteTime	Length	Name
-----	-----	-----	-----
d-----	2024/7/10 17:48		EEG
d-----	2024/7/10 17:48		RSSI2
-a----	2024/7/10 17:48	819	changeprecision.py
-a----	2024/7/10 17:48	7062	convertf16.py

```
PS J:\ece590\RayBNN\RayBNN\python_verify> ls
-a---- 2024/7/10 17:48 1739 figure4a_plot.m
-a---- 2024/7/10 17:48 1689 figure4b_plot.m
          .rs
```

Matlab - Done

2. Make Sure Matlab is Installed On the Host Machine.

Make sure Matlab is installed on the host system. Tested on Matlab 2023a

CUDA

```
docker run --name raybnn --gpus all -v %RAYBNN_DIR%:/workspace -w /workspace -it nvcr.io/nvidia/cuda:12.1.1-cudnn8-devel-ubuntu22.04 bash
```

3. On the Host Machine. Download CUDA Docker Container from Nvidia

This will download a CUDA Docker Container and link \$RAYBNN_DIR directory in the Host Machine to the /workspace/ directory in the Docker Container.

```
docker run --name raybnn \
--gpus all \
-v $RAYBNN_DIR:/workspace \
-w /workspace \
-it nvcr.io/nvidia/cuda:12.1.1-cudnn8-devel-ubuntu22.04 bash
```

Settings [Give feedback](#)

Must be signed in with an active subscription

General

Resources

Docker Engine

Builders

Kubernetes

Software updates

Extensions

Features in development

Notifications

 Expose daemon on tcp://localhost:2375 without TLS

Exposing daemon on TCP without TLS helps legacy clients connect to the daemon. It also makes yourself vulnerable to remote code execution attacks. Use with caution.

 Use the WSL 2 based engine (Windows Home can only run the WSL 2 backend)

WSL 2 provides better performance than the Hyper-V backend. [Learn more](#)

 Add the *.docker.internal names to the host's /etc/hosts file (Requires password)

Lets you resolve *.docker.internal DNS names from both the host and your containers. [Learn more](#)

 Use containerd for pulling and storing images [Give feedback](#)

Use this if you need support for multi-platform images, image lazy-loading, or Wasm.

Only images and containers in the active image store are visible. All your other containers and images still exist. To see them again, turn off this feature.

 Send usage statistics

Send error reports, system version and language as well as Docker Desktop lifecycle information (e.g., starts, stops, resets).

 Use Enhanced Container Isolation

Enhance security by preventing containers from breaching the Linux VM. [Learn more](#)

Cancel

Apply & restart

```
Runtimes: io.containerd.runc.v2 runc
Default Runtime: runc
Init Binary: docker-init
containerd version: d2d58213f83a351ca8f528a95fb145f5654e957
runc version: v1.1.12-0-g51d5e94
init version: de40ad0
Security Options:
  seccomp
    Profile: unconfined
Kernel Version: 5.15.153.1-microsoft-standard-WSL2
Operating System: Docker Desktop
OSType: linux
Architecture: x86_64
CPUs: 16
Total Memory: 15.52GiB
Name: docker-desktop
ID: 18e92413-1505-44af-b66f-6ddab307009f
Docker Root Dir: /var/lib/docker
Debug Mode: false
HTTP Proxy: http.docker.internal:3128
HTTPS Proxy: http.docker.internal:3128
No Proxy: hubproxy.docker.internal
Labels:
  com.docker.desktop.address=npipe://\\.\pipe\docker_cli
Experimental: false
Insecure Registries:
  hubproxy.docker.internal:5555
  127.0.0.0/8
Live Restore Enabled: false
```

```
PS C:\Users\30288> docker run --name raybnn --gpus all -v %RAYBNN_DIR%:/workspace -w /workspace -it nvcr.io/nvidia/cuda:  
12.1.1-cudnn8-devel-ubuntu22.04 bash  
Unable to find image 'nvcr.io/nvidia/cuda:12.1.1-cudnn8-devel-ubuntu22.04' locally  
12.1.1-cudnn8-devel-ubuntu22.04: Pulling from nvidia/cuda  
aece8493d397: Pull complete  
dd4939a04761: Pull complete  
b0d7cc89b769: Pull complete  
1532d9024b9c: Pull complete  
04fc8a31fa53: Pull complete  
a14a8a8a6ebc: Download complete  
7d61afc7a3ac: Download complete  
8bd2762ffdd9: Download complete  
2a5ee6fadd42: Download complete  
22ba0fb08ae2: Downloading [=====>] 2.338GB/2.548GB  
4d37a6bba88f: Download complete  
4bc954eb910a: Downloading [=====>] 1.391GB/1.472GB
```

Make sure the Disk Storage more than 20GB

```
Windows PowerShell - PS C:\Users\30288> docker run --name raybnn --gpus all -v %RAYBNN_DIR%:/workspace -w /workspace -it nvcr.io/nvidia/cuda:12.1.1-cudnn8-devel-ubuntu22.04 bash
Unable to find image 'nvcr.io/nvidia/cuda:12.1.1-cudnn8-devel-ubuntu22.04' locally
12.1.1-cudnn8-devel-ubuntu22.04: Pulling from nvidia/cuda
aece8493d397: Pull complete
dd4939a04761: Pull complete
b0d7cc89b769: Pull complete
1532d9024b9c: Pull complete
04fc8a31fa53: Pull complete
a14a8a8a6ebc: Download complete
7d61afc7a3ac: Download complete
8bd2762ffdd9: Download complete
2a5ee6fadd42: Download complete
22ba0fb08ae2: Downloading [=====>] 2.338GB/2.548GB
4d37a6bba88f: Download complete
4bc954eb910a: Downloading [=====>] 1.391GB/1.472GB
PS C:\Users\30288> docker system prune -a
WARNING! This will remove:
- all stopped containers
- all networks not used by at least one container
- all images without at least one container associated to them
- all build cache

Are you sure you want to continue? [y/N] y
```

```
PS C:\Users\30288> docker run --name raybnn --gpus all -v "J:\ece590\RayBNN\raybnn:/workspace" -w /workspace -it nvcr.io/nvidia/cuda:12.1.1-cudnn8-devel-ubuntu22.04 bash
Unable to find image 'nvcr.io/nvidia/cuda:12.1.1-cudnn8-devel-ubuntu22.04' locally
12.1.1-cudnn8-devel-ubuntu22.04: Pulling from nvidia/cuda
aece8493d397: Pull complete
dd4939a04761: Pull complete
b0d7cc89b769: Pull complete
1532d9024b9c: Pull complete
04fc8a31fa53: Pull complete
a14a8a8a6ebc: Downloading [=====] 189.6MB/1.329GB
7d61afc7a3ac: Download complete
8bd2762ffdd9: Download complete
2a5ee6fadd42: Download complete
22ba0fb08ae2: Downloading [==>] 164.6MB/2.548GB
4d37a6bba88f: Download complete
4bc954eb910a: Downloading [=====] 195.5MB/1.472GB
```

Successful! Finally!

```
PS C:\Users\30288> docker run --name raybnn --gpus all -v "J:\ece590\RayBNN\raybnn:/workspace" -w /workspace -it nvcr.io/nvidia/cuda:12.1.1-cudnn8-devel-ubuntu22.04 bash  
Unable to find image 'nvcr.io/nvidia/cuda:12.1.1-cudnn8-devel-ubuntu22.04' locally  
12.1.1-cudnn8-devel-ubuntu22.04: Pulling from nvidia/cuda  
aece8493d397: Pull complete  
dd4939a04761: Pull complete  
b0d7cc89b769: Pull complete  
1532d9024b9c: Pull complete  
04fc8a31fa53: Pull complete  
a14a8a8a6ebc: Pull complete  
7d61afc7a3ac: Pull complete  
8bd2762fffd9: Pull complete  
2a5ee6fadd42: Pull complete  
22ba0fb08ae2: Pull complete  
4d37a6bba88f: Pull complete  
4bc954eb910a: Pull complete  
Digest: sha256:21196d81f56b48dbe70494d5f10322e1a77cc47ffe202a3bf68eab81533c20f  
Status: Downloaded newer image for nvcr.io/nvidia/cuda:12.1.1-cudnn8-devel-ubuntu22.04  
  
=====  
== CUDA ==  
=====  
CUDA Version 12.1.1  
  
Container image Copyright (c) 2016–2023, NVIDIA CORPORATION & AFFILIATES. All rights reserved.  
  
This container image and its contents are governed by the NVIDIA Deep Learning Container License.  
By pulling and using the container, you accept the terms and conditions of this license:  
https://developer.nvidia.com/ngc/nvidia-deep-learning-container-license  
  
A copy of this license is made available in this container at /NGC-DL-CONTAINER-LICENSE for your convenience.  
root@3bf60712aeel:/workspace# |
```

Containers

Images

Volumes

Builds

Docker Scout

Extensions

Containers [Give feedback](#)

Container CPU usage

0.00% / 1600% (16 CPUs available)

Container memory usage

193.5MB / 15.16GB

[Show charts](#)

Search



Only show running containers

<input type="checkbox"/>	Name	Image	Status	Port(s)	CPU (%)	Last started	Actions
<input type="checkbox"/>	raybnn 3bf60712e	nvcr.io/nvidia/cl	Running		0%	1 hour ago	

Showing 1 item

Walkthroughs



Multi-container applications

8 mins



Containerize your application

3 mins

root@3bf60712aeel:/workspace X

+ ▾

Container image Copyright (c) 2016–2023, NVIDIA CORPORATION & AFFILIATES. All rights reserved.

This container image and its contents are governed by the NVIDIA Deep Learning Container License.
By pulling and using the container, you accept the terms and conditions of this license:
<https://developer.nvidia.com/ngc/nvidia-deep-learning-container-license>

A copy of this license is made available in this container at /NGC-DL-CONTAINER-LICENSE for your convenience.

root@3bf60712aeel:/workspace# nvidia-smi

Fri Jul 12 01:28:27 2024

NVIDIA-SMI 535.54.04			Driver Version: 536.23		CUDA Version: 12.2		
GPU	Name	Persistence-M	Bus-Id	Disp.A	Volatile	Uncorr.	ECC
Fan	Temp	Perf	Pwr:Usage/Cap	Memory-Usage	GPU-Util	Compute M.	MIG M.
<hr/>							
0	NVIDIA GeForce RTX 4060 Ti	On	00000000:01:00.0	On			N/A
30%	40C	P0	26W / 160W	737MiB / 8188MiB	0%	Default	N/A

Processes:					
GPU	GI	CI	PID	Type	Process name
ID			ID		GPU Memory Usage
<hr/>					
					No running processes found

root@3bf60712aeel:/workspace# |

5. Inside the Docker Container, Install Dependencies and Install RayBNN

`./install.sh` installs all of the dependencies inside the docker container.

```
cd /workspace/RayBNN
```

```
chmod 700 ./install.sh
```

```
bash ./install.sh
```

```
exit
```

```
root@3bf60712aeel:/workspace X + ▾
Container image Copyright (c) 2016-2023, NVIDIA CORPORATION & AFFILIATES. All rights reserved.

This container image and its contents are governed by the NVIDIA Deep Learning Container License.
By pulling and using the container, you accept the terms and conditions of this license:
https://developer.nvidia.com/ngc/nvidia-deep-learning-container-license

A copy of this license is made available in this container at /NGC-DL-CONTAINER-LICENSE for your convenience.

root@3bf60712aeel:/workspace# nvidia-smi
Fri Jul 12 01:28:27 2024
+-----+
| NVIDIA-SMI 535.54.04      Driver Version: 536.23      CUDA Version: 12.2 |
+-----+
| GPU  Name        Persistence-M | 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 Ti     On  | 00000000:01:00.0  On   |           N/A | | |
| 30% 40C  P0    26W / 160W | 737MiB / 8188MiB | 0%       Default |
|          |          |             |              | N/A |
+-----+
+-----+
| Processes:                               GPU Memory |
| GPU  GI CI PID  Type  Process name        Usage  |
| ID   ID   |
+-----+
| No running processes found               |
+-----+
root@3bf60712aeel:/workspace# ls
Cargo.lock Cargo.toml README.md RayBNN.pdf examples install.sh matlab_plot plot_results_matlab.sh python_verify run_results_fig4_other_models.sh run_results_rust.sh src test_data
root@3bf60712aeel:/workspace#
```

Chmod the Script

```
root@3bf60712aee1:/workspace# ls  
Cargo.lock Cargo.toml README.md RayBNN.pdf examples install.sh matlab_plot  
root@3bf60712aee1:/workspace# chmod 700 ./install.sh  
root@3bf60712aee1:/workspace# |
```

Start Running!

```
root@3bf60712aee1:/workspace# ls
Cargo.lock  Cargo.toml  README.md  RayBNN.pdf  examples  install.sh  matlab_plot  plot_results_matlab.sh
root@3bf60712aee1:/workspace# chmod 700 ./install.sh
root@3bf60712aee1:/workspace# bash ./install.sh
Get:1 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu2204/x86_64 InRelease [1581 B]
Get:2 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu2204/x86_64 Packages [858 kB]
Get:3 http://security.ubuntu.com/ubuntu jammy-security InRelease [129 kB]
Get:4 http://archive.ubuntu.com/ubuntu jammy InRelease [270 kB]
Get:5 http://security.ubuntu.com/ubuntu jammy-security/main amd64 Packages [1998 kB]
Get:6 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 Packages [1127 kB]
Get:7 http://security.ubuntu.com/ubuntu jammy-security/multiverse amd64 Packages [44.7 kB]
Get:8 http://archive.ubuntu.com/ubuntu jammy-updates InRelease [128 kB]
Get:9 http://security.ubuntu.com/ubuntu jammy-security/restricted amd64 Packages [2601 kB]
Get:10 http://archive.ubuntu.com/ubuntu jammy-backports InRelease [127 kB]
32% [Waiting for headers]
```

```
root@3bf60712aeef:~/workspace| + - X
-- Checking for [openblas]
-- Includes found
-- Looking for cblas_dgemm
-- Looking for cblas_dgemm - found
-- CBLAS Symbols FOUND
-- CBLAS library found
-- Found LAPACKE: /usr/lib/x86_64-linux-gnu/liblapacke.so
-- Could NOT find Doxygen (missing: DOXYGEN_EXECUTABLE)
-- Check size of int
-- Check size of int - done
-- MKL: Thread Layer(Intel OpenMP) Interface(4-byte Integer)
-- Could NOT find MKL: Source the compilervars.sh or mklvars.sh scripts included with your installation of MKL. This script searches for the libraries in MKLROOT, LIBRARY_PATHS(Linux), and LIB(Windows) environment variables (missing: MKL_INCLUDE_DIR MKL_Core_LINK_LIBRARY MKL_Interface_LINK_LIBRARY MKL_ThreadLayer_LINK_LIBRARY)
-- Could NOT find MKL: Source the compilervars.sh or mklvars.sh scripts included with your installation of MKL. This script searches for the libraries in MKLROOT, LIBRARY_PATHS(Linux), and LIB(Windows) environment variables (missing: MKL_INCLUDE_DIR MKL_Core_STATIC_LINK_LIBRARY MKL_Interface_STATIC_LINK_LIBRARY MKL_ThreadLayer_STATIC_LINK_LIBRARY)
-- Could NOT find GTest (missing: GTEST_LIBRARY GTEST_INCLUDE_DIR GTEST_MAIN_LIBRARY)
-- Found Boost: /usr/lib/x86_64-linux-gnu/cmake/Boost-1.74.0/BoostConfig.cmake (found suitable version "1.74.0", minimum required is "1.70")
CMake Warning at CMakeLists.txt:137 (find_package):
  By not providing "findMKL.cmake" in CMAKE_MODULE_PATH this project has
  asked CMake to find a package configuration file provided by "MKL", but
  CMake did not find one.

Could not find a package configuration file provided by "MKL" (requested
version 2023.1) with any of the following names:

  MKLConfig.cmake
  mkl-config.cmake

Add the installation prefix of "MKL" to CMAKE_PREFIX_PATH or set "MKL_DIR"
to a directory containing one of the above files. If "MKL" provides a
separate development package or SDK, be sure it has been installed.

-- Looking for a CUDA compiler
-- Looking for a CUDA compiler - /usr/local/cuda/bin/nvcc
-- The CUDA compiler identification is NVIDIA 12.1.105
-- Detecting CUDA compiler ABI info
-- Detecting CUDA compiler ABI info - done
-- Check for working CUDA compiler: /usr/local/cuda/bin/nvcc - skipped
-- Detecting CUDA compile features
-- Detecting CUDA compile features - done
-- Looking for sgemm_
-- Looking for sgemm_ - not found
-- Looking for sgemm_
-- Looking for sgemm_ - found
-- Found BLAS: /usr/lib/x86_64-linux-gnu/libopenblas.so
-- Looking for cheev_
-- Looking for cheev_ - found
-- Found LAPACK: /usr/lib/x86_64-linux-gnu/libopenblas.so;-lm;-ldl
-- Project 'span_lite', package 'span-lite' version: '0.10.2'
```

```
root@3bf60712aeel:/workspace| x + v
+-----+
| Processes:          GPU Memory Usage |
| GPU   GI   CI      PID  Type  Process name |
| ID    ID   ID      ID   ID   |
+-----+
| No running processes found |
+-----+
root@3bf60712aeel:/workspace| ls
Cargo.toml README.md RayBNN.pdf install.sh nvidia_gpus plot_results.m
root@3bf60712aeel:~/nvidia_gpus$ ./install.sh
root@3bf60712aeel:~/nvidia_gpus$ bash ./install.sh
Get:1 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu2204/x86_64 InRelease [158 kB]
Get:2 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu2204/x86_64 Packages [858 kB]
Get:3 https://security.ubuntu.com/ubuntu jammy-security InRelease [129 kB]
Get:4 http://archive.ubuntu.com/ubuntu jammy InRelease [270 kB]
Get:5 http://security.ubuntu.com/ubuntu jammy-security/main amd64 Packages [1998 kB]
Get:6 http://security.ubuntu.com/ubuntu jammy-security/universe amd64 Packages [1127 kB]
Get:7 http://security.ubuntu.com/ubuntu jammy-security/multiverse amd64 Packages [44.7 kB]
Get:8 http://archive.ubuntu.com/ubuntu jammy-updates InRelease [128 kB]
Get:9 http://security.ubuntu.com/ubuntu jammy-updates/restricted amd64 Packages [2601 kB]
Get:10 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 Packages [1266 kB]
Get:11 http://archive.ubuntu.com/ubuntu jammy-updates/multiverse amd64 Packages [266 kB]
Get:12 http://archive.ubuntu.com/ubuntu jammy/universe amd64 Packages [17.5 kB]
Get:13 http://archive.ubuntu.com/ubuntu jammy/main amd64 Packages [1792 kB]
Get:14 http://archive.ubuntu.com/ubuntu jammy/restricted amd64 Packages [164 kB]
Get:15 http://archive.ubuntu.com/ubuntu jammy-updates/universe amd64 Packages [1419 kB]
Get:16 http://archive.ubuntu.com/ubuntu jammy-updates/restricted amd64 Packages [2674 kB]
Get:17 http://archive.ubuntu.com/ubuntu jammy-updates/main amd64 Packages [2263 kB]
Get:18 http://archive.ubuntu.com/ubuntu jammy-updates/multiverse amd64 Packages [51.8 kB]
Get:19 http://archive.ubuntu.com/ubuntu jammy-backports/main amd64 Packages [81.0 kB]
Get:20 http://archive.ubuntu.com/ubuntu jammy-backports/universe amd64 Packages [32.2 kB]
Fetched 33.5 MB in 4s (8973 kB/s)
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
57 packages can be upgraded. Run 'apt list --upgradable' to see them.
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
Calculating upgrade... Done
The following packages have been kept back:
  libcuda1 libcuda1n8-dev libnccl-dev libnccl2
The following packages will be upgraded:
  apt base-files bash binutils binutils-common binutils-x86-64-linux-gnu bsdtar coreutils cuda
  liblklki libc6 libc6-dev libc6.1 libc6-dev liblctf-nobfd liblctf libdpkg-perl libgnutls3
  libpam-modules libpam-runtime libpam8g libperl5.34 libprocps8 libsmartcols1 libsqlite3-0
  procps tar util-linux
53 upgraded, 0 newly installed, 0 to remove and 4 not upgraded.
Need to get 37.1 MB of archives.
```



Process at 18:40

```
[ 15%] Building CXX object src/api/unified/CMakeFiles/af.dir/__/cpp/transform.cpp.o
[ 15%] Building CXX object src/api/unified/CMakeFiles/af.dir/__/cpp/transform_coordinates.cpp.o
[ 15%] Building CXX object src/api/unified/CMakeFiles/af.dir/__/cpp/translate.cpp.o
[ 15%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/Event.cpp.o
[ 15%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/exampleFunction.cpp.o
[ 15%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/bilateral.cpp.o
[ 15%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/resize.cpp.o
[ 15%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/canny.cpp.o
[ 15%] Building CUDA object src/backend/cuda/CMakeFiles/afcuda.dir/count.cu.o
[ 15%] Building CXX object src/api/unified/CMakeFiles/af.dir/__/cpp/transpose.cpp.o
[ 15%] Building CXX object src/api/unified/CMakeFiles/af.dir/__/cpp/unary.cpp.o
[ 15%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/fast.cpp.o
[ 15%] Building CXX object src/api/unified/CMakeFiles/af.dir/__/cpp/unwrap.cpp.o
[ 15%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/reshape.cpp.o
[ 15%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/rotate.cpp.o
[ 15%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/Event.cpp.o
[ 15%] Building CXX object src/api/unified/CMakeFiles/af.dir/__/cpp/util.cpp.o
[ 15%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/exampleFunction.cpp.o
[ 15%] Building CXX object src/api/unified/CMakeFiles/af.dir/__/cpp/var.cpp.o
[ 15%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/scan.cpp.o
[ 15%] Building CUDA object src/backend/cuda/CMakeFiles/afcuda.dir/fast.cu.o
[ 15%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/scan_by_key.cpp.o
[ 15%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/select.cpp.o
[ 15%] Building CXX object src/api/unified/CMakeFiles/af.dir/__/cpp/where.cpp.o
[ 15%] Building CXX object src/api/unified/CMakeFiles/af.dir/__/cpp/wrap.cpp.o
[ 15%] Building CXX object src/api/unified/CMakeFiles/af.dir/__/cpp/yccbr_rgb.cpp.o
[ 15%] Building CUDA object src/backend/cuda/CMakeFiles/afcuda.dir/harris.cu.o
[ 16%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/set.cpp.o
[ 16%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/shift.cpp.o
[ 16%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/histogram.cpp.o
[ 16%] Linking CXX shared library libaf.so
[ 16%] Building CUDA object src/backend/cuda/CMakeFiles/afcuda.dir/homography.cu.o
[ 16%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/hsv_rgb.cpp.o
[ 16%] Built target af
[ 16%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/sift.cpp.o
[ 16%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/sobel.cpp.o
[ 16%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/solve.cpp.o
[ 16%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/fft.cpp.o
[ 16%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/match_template.cpp.o
[ 16%] Building CUDA object src/backend/cuda/CMakeFiles/afcuda.dir/max.cu.o
[ 16%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/sort.cpp.o
[ 16%] Building CUDA object src/backend/cuda/CMakeFiles/afcuda.dir/mean.cu.o
[ 16%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/sort_by_key.cpp.o
[ 16%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/meanshift.cpp.o
[ 16%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/fftconvolve.cpp.o
[ 16%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/flood_fill.cpp.o
[ 16%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/GraphicsResourceManager.cpp.o
[ 16%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/medfilt.cpp.o
[ 16%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/medfilt.cpp.o
[ 16%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/sort_index.cpp.o
[ 16%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/sparse.cpp.o
```

```
[ 25%] Built target test_join_unified
[ 25%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/_/__/api/c/iir.cpp.o
[ 25%] Linking CXX executable match_template_unified
[ 25%] Built target test_lu_dense_unified
[ 25%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/iota.cpp.o
[ 25%] Built target test_match_template_unified
[ 25%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/ireduce.cpp.o
[ 25%] Linking CXX executable index_unified
[ 25%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/_/__/api/c/image.cpp.o
[ 25%] Building CXX object test/CMakeFiles/test_matrix_manipulation.dir/matrix_manipulation.cpp.o
[ 25%] Building CXX object test/CMakeFiles/test_mean_unified.dir/mean.cpp.o
[ 25%] Building CXX object test/CMakeFiles/test_meanshift_unified.dir/meanshift.cpp.o
[ 26%] Linking CXX executable math_unified
[ 26%] Building CXX object test/CMakeFiles/test_meanvar_unified.dir/meanvar.cpp.o
[ 26%] Building CXX object test/CMakeFiles/test_medfilt_unified.dir/medfilt.cpp.o
[ 26%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/_/__/api/c/imageio.cpp.o
[ 26%] Built target test_math_unified
[ 26%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/sort_by_key.cpp.o
[ 26%] Building CXX object test/CMakeFiles/test_median_unified.dir/median.cpp.o
[ 26%] Linking CXX executable matrix_manipulation_unified
[ 26%] Built target test_matrix_manipulation_unified
[ 26%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/sort_index.cpp.o
[ 26%] Built target test_index_unified
[ 26%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/sparse.cpp.o
[ 26%] Linking CXX executable meanshift_unified
[ 26%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/sparse_arith.cpp.o
[ 26%] Built target test_meanshift_unified
[ 26%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/jit.cpp.o
[ 26%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/join.cpp.o
[ 26%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/_/__/api/c/imageio2.cpp.o
[ 26%] Linking CXX executable mean_unified
[ 26%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/_/__/api/c/implicit.cpp.o
[ 26%] Linking CXX executable median_unified
[ 26%] Linking CXX executable medfilt_unified
[ 26%] Built target test_mean_unified
[ 26%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/sparse blas.cpp.o
[ 26%] Built target test_median_unified
[ 26%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/sum.cpp.o
[ 26%] Built target test_medfilt_unified
[ 26%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/surface.cpp.o
[ 26%] Building CXX object test/CMakeFiles/test_memory_unified.dir/memory.cpp.o
[ 26%] Linking CXX executable meanvar_unified
[ 26%] Building CXX object src/backend/cuda/CMakeFiles/afcuda.dir/lookup.cpp.o
[ 26%] Building CXX object src/backend/opencl/CMakeFiles/afopencl.dir/susan.cpp.o
[ 26%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/_/__/api/c/index.cpp.o
[ 26%] Built target test_meanvar_unified
[ 26%] Building CXX object src/backend/cpu/CMakeFiles/afcpu.dir/_/__/api/c/internal.cpp.o
[ 26%] Building CXX object test/CMakeFiles/test_memory_lock_unified.dir/memory_lock.cpp.o
[ 26%] Building CXX object test/CMakeFiles/test_missing_unified.dir/missing.cpp.o
[ 26%] Building CXX object test/CMakeFiles/test_moddims_unified.dir/moddims.cpp.o
```

Process at 18:55



```
[ 71%] Linking CXX executable integer_opencl
[ 71%] Built target integer_cuda
[ 71%] Built target rainfall_cpu
[ 71%] Built target rainfall_cuda
[ 71%] Built target convolve_cuda
[ 71%] Linking CXX executable vectorize_cuda
[ 71%] Linking CXX executable rainfall_OpenCL
[ 71%] Building CXX object examples/getting_started/CMakeFiles/vectorize_OpenCL.dir/vectorize.cpp.o
[ 71%] Building CXX object examples/graphics/CMakeFiles/conway_cpu.dir/conway.cpp.o
[ 71%] Building CXX object examples/graphics/CMakeFiles/conway_pretty_cpu.dir/conway_pretty.cpp.o
[ 71%] Building CXX object examples/graphics/CMakeFiles/fractal_cpu.dir/fractal.cpp.o
[ 71%] Building CXX object examples/graphics/CMakeFiles/field_cpu.dir/field.cpp.o
[ 71%] Built target convolve_OpenCL
[ 71%] Built target vectorize_cpu
[ 71%] Building CXX object examples/graphics/CMakeFiles/gravity_sim_cpu.dir/gravity_sim.cpp.o
[ 71%] Built target integer_OpenCL
[ 71%] Building CXX object examples/graphics/CMakeFiles/histogram_cpu.dir/histogram.cpp.o
[ 71%] Built target rainfall_OpenCL
[ 71%] Built target vectorize_cuda
[ 71%] Building CXX object examples/graphics/CMakeFiles/plot2d_cpu.dir/plot2d.cpp.o
[ 71%] Building CXX object examples/graphics/CMakeFiles/plot3_cpu.dir/plot3.cpp.o
[ 71%] Building CXX object examples/graphics/CMakeFiles/surface_cpu.dir/surface.cpp.o
[ 71%] Linking CXX executable conway_cpu
[ 71%] Linking CXX executable field_cpu
[ 71%] Linking CXX executable conway_pretty_cpu
[ 71%] Linking CXX executable fractal_cpu
[ 72%] Linking CXX executable vectorize_OpenCL
[ 72%] Linking CXX executable histogram_cpu
[ 72%] Linking CXX executable plot2d_cpu
[ 72%] Linking CXX executable plot3_cpu
[ 72%] Linking CXX executable surface_cpu
[ 72%] Built target field_cpu
[ 72%] Built target conway_cpu
[ 72%] Built target conway_pretty_cpu
[ 72%] Built target fractal_cpu
[ 72%] Built target histogram_cpu
[ 72%] Building CXX object examples/graphics/CMakeFiles/conway_cuda.dir/conway.cpp.o
[ 72%] Built target vectorize_OpenCL
[ 72%] Building CXX object examples/graphics/CMakeFiles/conway_pretty_cuda.dir/conway_pretty.cpp.o
[ 72%] Building CXX object examples/graphics/CMakeFiles/field_cuda.dir/field.cpp.o
[ 73%] Building CXX object examples/graphics/CMakeFiles/fractal_cuda.dir/fractal.cpp.o
[ 73%] Building CXX object examples/graphics/CMakeFiles/gravity_sim_cuda.dir/gravity_sim.cpp.o
[ 73%] Building CXX object examples/graphics/CMakeFiles/histogram_cuda.dir/histogram.cpp.o
[ 73%] Built target plot3_cpu
[ 73%] Built target plot2d_cpu
[ 73%] Linking CXX executable gravity_sim_cpu
[ 73%] Built target surface_cpu
[ 73%] Building CXX object examples/graphics/CMakeFiles/plot2d_cuda.dir/plot2d.cpp.o
[ 73%] Building CXX object examples/graphics/CMakeFiles/plot3_cuda.dir/plot3.cpp.o
[ 73%] Building CXX object examples/graphics/CMakeFiles/surface_cuda.dir/surface.cpp.o
```

Process at 19:10

```
[ 82%] Built target test_stdev_unified
Consolidate compiler generated dependencies of target test_susan_cpu
[ 83%] Built target test_susan_cpu
Consolidate compiler generated dependencies of target test_susan_cuda
[ 83%] Built target test_susan_cuda
Consolidate compiler generated dependencies of target test_susan_opencl
[ 83%] Built target test_susan_opencl
Consolidate compiler generated dependencies of target test_susan_unified
[ 83%] Built target test_susan_unified
Consolidate compiler generated dependencies of target test_svd_dense_cpu
[ 83%] Built target test_svd_dense_cpu
Consolidate compiler generated dependencies of target test_svd_dense_cuda
[ 83%] Built target test_svd_dense_cuda
Consolidate compiler generated dependencies of target test_svd_dense_opencl
[ 83%] Built target test_svd_dense_opencl
Consolidate compiler generated dependencies of target test_svd_dense_unified
[ 83%] Built target test_svd_dense_unified
Consolidate compiler generated dependencies of target test_threading_cpu
[ 83%] Built target test_threading_cpu
Consolidate compiler generated dependencies of target test_threading_cuda
[ 83%] Built target test_threading_cuda
Consolidate compiler generated dependencies of target test_threading_opencl
[ 83%] Built target test_threading_opencl
Consolidate compiler generated dependencies of target test_threading_unified
[ 83%] Built target test_threading_unified
Consolidate compiler generated dependencies of target test_tile_cpu
[ 83%] Built target test_tile_cpu
Consolidate compiler generated dependencies of target test_tile_cuda
[ 83%] Built target test_tile_cuda
Consolidate compiler generated dependencies of target test_tile_opencl
[ 84%] Built target test_tile_opencl
Consolidate compiler generated dependencies of target test_tile_unified
[ 84%] Built target test_tile_unified
Consolidate compiler generated dependencies of target test_topk_cpu
[ 84%] Built target test_topk_cpu
Consolidate compiler generated dependencies of target test_topk_cuda
[ 84%] Built target test_topk_cuda
Consolidate compiler generated dependencies of target test_topk_opencl
[ 84%] Built target test_topk_opencl
Consolidate compiler generated dependencies of target test_topk_unified
[ 84%] Built target test_topk_unified
Consolidate compiler generated dependencies of target test_transform_cpu
[ 84%] Built target test_transform_cpu
Consolidate compiler generated dependencies of target test_transform_cuda
[ 84%] Built target test_transform_cuda
Consolidate compiler generated dependencies of target test_transform_opencl
[ 84%] Built target test_transform_opencl
Consolidate compiler generated dependencies of target test_transform_unified
[ 84%] Built target test_transform_unified
Consolidate compiler generated dependencies of target test_transform_coordinates_cpu
```

Process at 19:18

Containers

Images

Volumes

Builds

Docker Scout

Extensions

Containers [Give feedback](#)

Container CPU usage

0.00% / 1600% (16 CPUs available)

Container memory usage

193.5MB / 15.16GB

[Show charts](#)

Search



Only show running containers

<input type="checkbox"/>	Name	Image	Status	Port(s)	CPU (%)	Last started	Actions
<input type="checkbox"/>	raybnn 3bf60712e	nvcr.io/nvidia/cl	Running		0%	1 hour ago	

Showing 1 item

Walkthroughs



Multi-container applications

8 mins



Containerize your application

3 mins

```
stable-x86_64-unknown-linux-gnu installed - rustc 1.79.0 (129f3b996 2024-06-10)
```

Rust is installed now. Great!

To get started you may need to restart your current shell.
This would reload your PATH environment variable to include
Cargo's bin directory (\$HOME/.cargo/bin)

To configure your current shell, you need to edit
the corresponding env file under \$HOME

This is usually done by running one of
. "\$HOME/.cargo/env" # For
source "\$HOME/.cargo/env.fish" # For
Git LFS initialized.

Cloning into 'AlcalaData'...

remote: Enumerating objects: 25, done.
remote: Total 25 (delta 0), reused 0 (delta 0)
Unpacking objects: 100% (25/25), 201.6
Filtering content: 100% (7/7), 154.13

mkdir: cannot create directory '/works
cp: target '/workspace/RayBNN/test_data/' is not a directory
cp: target '/workspace/RayBNN/python_verify/RSSI2/' is not a directory
cp: cannot create regular file '/workspace/RayBNN/matlab_plot/meanY.csv': No such file or directory
cp: cannot create regular file '/workspace/RayBNN/matlab_plot/stdY.csv': No such file or directory

root@3bf60712aeel:/workspace# ls

Cargo.lock Cargo.toml README.md RayBNN.pdf arrayfire examples install.sh matlab_plot plot_results_matlab.sh python_verify run_results_fig4_other_models.sh run_results_rust.sh src test_data

root@3bf60712aeel:/workspace# pwd

/workspace

root@3bf60712aeel:/workspace#

Containers

Images

Volumes

Builds

Docker Scout

Extensions

Images

[Give feedback](#)

Local

Hub

9.48 GB / 0 Bytes in use 1 images

Last refresh: 21 hours ago



Search



<input type="checkbox"/>	Name	Tag	Status	Created	Size	Actions
<input type="checkbox"/>	nvcr.io/nvidia/cuda d3262c91d05f	12.1.1-cudnn8-devel-ubuntu2: In use	In use	8 months ago	9.48 GB	

Showing 1 item

Walkthroughs



```
1 FROM node
2 RUN mkdir -p /app
3 WORKDIR /app
4 COPY package.json .
```

How do I run a container?

6 mins



Run Docker Hub images

5 mins

New version available



3

6. Install the Docker Container to run other models

Download pytorch docker container Tested on RTX 3090 with i5-8400

```
docker run --name othermodel \
--gpus all \
-v $RAYBNN_DIR:/workspace \
-w /workspace \
-it pytorch/pytorch:1.13.1-cuda11.6-cudnn8-devel bash

apt update

apt install wget git curl git-lfs build-essential

pip install scikit-learn matplotlib pandas pytorch-lightning==1.9.0

pip install torch_geometric

pip install pyg_lib torch_scatter \
torch_sparse torch_cluster \
torch_spline_conv \
-f https://data.pyg.org/whl/torch-1.13.0+cu116.html

exit
```

Run Other Model

```
Windows PowerShell X + ▾  
PS C:\Users\30288> docker run --name othermodel --gpus all -v "J:\ece590\RayBNN\raybnn:/workspace" -w /workspace -it pytorch/pytorch:1.13.1-cuda11.6-cudnn8-devel bash  
Unable to find image 'pytorch/pytorch:1.13.1-cuda11.6-cudnn8-devel' locally  
1.13.1-cuda11.6-cudnn8-devel: Pulling from pytorch/pytorch  
fb668870d8a7: Pull complete  
3dc32ed140fb: Pull complete  
54a1df240516: Pull complete  
cf378b3cb3c7: Pull complete  
9b4412378859: Pull complete  
502253a1be21: Pull complete  
5c7dd67e5809: Pull complete  
bdfd23ed3f48: Pull complete  
aeeldd761bdd: Pull complete  
5fedaa9af2542: Pull complete  
f8371ecb849a: Pull complete  
643ca681a7f9: Pull complete  
4935d5ab98cd: Pull complete  
d9d8ce8de3c3: Downloading [=====>] 2.995GB/5.25GB  
67657873c2d7: Download complete
```

Run out C disk storage

Containers

Images

Volumes

Builds

Docker Scout

Extensions

Containers [Give feedback](#)

Container CPU usage

97.24% / 1600% (16 CPUs available)

Container memory usage

337.8MB / 15.15GB

[Show charts](#)

Search



Only show running containers

<input type="checkbox"/>	Name	Image	Status	Port(s)	CPU (%)	Last started	Actions
<input type="checkbox"/>	raybnn 3346ae4cc	nvcr.io/nvidia/cl	Exited (127)		0%	1 hour ago	
<input type="checkbox"/>	othermoi b60cc86c	pytorch/pytorch	Running		21.84%	2 minutes ago	

Showing 2 items

Walkthroughs



Multi-container applications

8 mins



Containerize your application

3 mins

```
root@3346ae4cd4fe: /workspace X + - PS C:\Users\52322> docker restart raybnn  
raybnn  
PS C:\Users\52322> docker exec -it raybnn bash  
root@3346ae4cd4fe:/workspace#
```

New Model

```
root@b60cc8e6c43b:~/workspace# + | - | X
Setting up liberror-perl (0.17025-1) ...
Setting up libpsl5:amd64 (0.19.1-5build1) ...
Setting up librtmp1:amd64 (2.4+20151223.gitfa8646d.1-1) ...
Setting up libbsd0:amd64 (0.8.7-1ubuntu0.1) ...
Setting up libkrb5support0:amd64 (1.16-2ubuntu0.4) ...
Setting up krb5-locales (1.16-2ubuntu0.4) ...
Setting up publicsuffix (20180223.1310-1) ...
Setting up wget (1.19.4-1ubuntu2.2) ...
Setting up libxdmcp6:amd64 (1:1.1.2-3) ...
Setting up libkeyutils1:amd64 (1.5.9-9.2ubuntu2.1) ...
Setting up libx11-data (2:1.6.4-3ubuntu0.4) ...
Setting up libxau6:amd64 (1:1.0.8-1ubuntu1) ...
Setting up libk5crypto3:amd64 (1.16-2ubuntu0.4) ...
Setting up libkrb5-3:amd64 (1.16-2ubuntu0.4) ...
Setting up libxcb1:amd64 (1.13-2ubuntu18.04) ...
Setting up libx11-6:amd64 (2:1.6.4-3ubuntu0.4) ...
Setting up libxml2:amd64 (2:1.1.2-2) ...
Setting up libgssapi-krb5-2:amd64 (1.16-2ubuntu0.4) ...
Setting up openssh-client (1:7.6p1-4ubuntu0.7) ...
Setting up libxext6:amd64 (2:1.3.3-1) ...
Setting up libcurl3-gnutls:amd64 (7.58.0-2ubuntu3.24) ...
Setting up libcurl4:amd64 (7.58.0-2ubuntu3.24) ...
Setting up xauth (1:1.0.10-1) ...
Setting up git (1:2.17.1-1ubuntu0.18) ...
Setting up git-lfs (2.3.4-1) ...
Setting up curl (7.58.0-2ubuntu3.24) ...
Processing triggers for libc-bin (2.27-3ubuntu1.6) ...
/sbin/ldconfig.real: /usr/lib/x86_64-linux-gnu/libcuda.so.1 is not a symbolic link

root@b60cc8e6c43b:~/workspace# pip install scikit-learn matplotlib pandas pytorch-lightning==1.9.0
Collecting scikit-learn
  Downloading scikit_learn-1.5.1-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (13.4 MB)
    13.4/13.4 MB 7.2 MB/s eta 0:00:00
Collecting matplotlib
  Downloading matplotlib-3.9.1-cp310-cp310-manylinux_2_17_x86_64.manylinux2014_x86_64.whl (8.3 MB)
    8.3/8.3 MB 11.7 MB/s eta 0:00:00
Collecting pandas
  Downloading pandas-2.2.2-cp310-cp310-manylinux_2_17_x86_64.manyLinux2014_x86_64.whl (13.0 MB)
    3.6/13.0 MB 13.1 MB/s eta 0:00:01
```

```
PS C:\Users\52322> docker restart raybnn
raybnn
PS C:\Users\52322> docker exec -it raybnn bash
root@3346ae4cd4fe:/workspace# ls
Cargo.lock  RayBNN.pdf      examples      new_matlab_plot      pytorch_geometric      src
Cargo.toml   arrayfire       install.sh    plot_results_matlab.sh run_results_fig4_other_models.sh test_data
README.md    arrayfire-rust  matlab_plot  python_verify        run_results_rust.sh
root@3346ae4cd4fe:/workspace# |
```

```
root@3346ae4cd4fe:/workspace# ls
Cargo.lock      arrayfire           collision_run_time_serial.csv  final_neuron_num.csv  matlab_plot
Cargo.toml      arrayFire-rust       examples                   glia_pos.csv        neuron_num_list2.csv
README.md       collision_run_time.csv   figure1_neural_network.csv  initial_cell_num.csv  neuron_pos.csv
RayBNN.pdf      collision_run_time_batch.csv  final_glia_num.csv    install.sh         new_matlab_plot
root@3346ae4cd4fe:/workspace# vi run_results_rust.sh
bash: vi: command not found
root@3346ae4cd4fe:/workspace# vim run_results_rust.sh
bash: vim: command not found
root@3346ae4cd4fe:/workspace# cat run_results_rust.sh
#!/bin/bash
#####
#Generate results for Fig. 1b
#related scripts at:
#RayBNN/examples/figure1b.rs
#####
RUSTFLAGS=-Awarnings cargo run --example figure1b --release

#####
#Generate results for Fig. 2a
#related scripts at:
#RayBNN/examples/figure2a.rs
#####
RUSTFLAGS=-Awarnings cargo run --example figure2a --release

#####
#Generate results for Fig. 2b
#related scripts at:
#RayBNN/examples/figure2b.rs
#####
RUSTFLAGS=-Awarnings cargo run --example figure2b --release

#####
#Generate results for Fig. 2c
#related scripts at:
#RayBNN/examples/figure2c.rs
#####
RUSTFLAGS=-Awarnings cargo run --example figure2c --release

#####
#Generate results for Fig. 2d
#related scripts at:
#RayBNN/examples/figure2d.rs
#####
RUSTFLAGS=-Awarnings cargo run --example figure2d --release

#####
#Generate results for Fig. 2e
#related scripts at:
#RayBNN/examples/figure2e.rs
#####
```

```
root@3346ae4cd4fe:/workspace ~ + - X
#####
#Generate results for Fig. 2d
#related scripts at:
#RayBNN/examples/figure2d.rs
#####
RUSTFLAGS=-Awarnings cargo run --example figure2d --release

#####
#Generate results for Fig. 2e
#related scripts at:
#RayBNN/examples/figure2e.rs
#####
RUSTFLAGS=-Awarnings cargo run --example figure2e --release

#####
#Generate results for Fig. 2f
#related scripts at:
#RayBNN/examples/figure2f.rs
#####
RUSTFLAGS=-Awarnings cargo run --example figure2f --release

#####
#Generate results for Fig. 4 using RayBNN model
#related scripts at:
#RayBNN model: RayBNN/examples/figure4.rs
#####
RUSTFLAGS=-Awarnings cargo run --example figure4_raybnn --release

root@3346ae4cd4fe:/workspace# bash run_results_rust.sh
Compiling raybnn v0.1.5 (/workspace)
  Finished 'release' profile [optimized] target(s) in 6.55s
    Running 'target/release/examples/figure1b'
Compiling raybnn v0.1.5 (/workspace)
  Finished 'release' profile [optimized] target(s) in 7.09s
    Running 'target/release/examples/figure2a'
Initial Number of Cells: [20, 20, 40, 80, 160, 320, 640, 1280, 2560, 4000, 8000, 16000, 32000, 64000, 128000, 256000, 512000, 1024000, 2048000, 4000000, 8000000, 16000000, 32000000]
final_neuron_num [10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7987, 15990, 31899, 63661, 126597, 250402, 489994, 938471, 1683938, 2838694, 4029272, 4063698, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7995, 15982, 31908, 63629, 126596, 250328, 489995, 937986, 168403, 2839202, 4030964, 4063485, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3998, 7995, 15986, 31899, 63619, 126565, 250464, 490178, 938248, 1684995, 4030312, 4061619, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3998, 7995, 15979, 31904, 63630, 126602, 250255, 490073, 938076, 1685246, 283961, 4032344, 4062623, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1998, 3999, 7995, 15988, 31901, 63610, 126639, 250397, 489874, 937620, 1686320, 2838484, 4030538, 4061501, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 4000, 7993, 15971, 31901, 63627, 126599, 250329, 489842, 937290, 1685172, 2840271, 4029522, 4064501, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3997, 7995, 15986, 31907, 63662, 126529, 250564, 489888, 937797, 1684907, 2838915, 4031006, 4063841, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7992, 15981, 31900, 63639, 126598, 250337, 489770, 938241, 1, 685266, 2839362, 4031380, 4064759]
final_glia_num [10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7987, 15990, 31899, 63661, 126597, 250402, 489994, 938471, 1683939, 2838694, 4029272, 4063698, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 4000, 7995, 15985, 31898, 63647, 126592, 250521, 490026, 938178, 1684128, 2839446, 4029903, 4063544, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3997, 7995, 15982, 31908, 63630, 126596, 250328, 489995, 937987, 168403, 2839203, 4030964, 4063485, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3998, 7995, 15986, 31899, 63629, 126566, 250464, 490178, 938248, 1684995, 4030312, 4061619, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7993, 15978, 31910, 63655, 126659, 250511, 489965, 937960, 1684814, 2838548, 4030705, 4062173, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3998, 7995, 15979, 31904, 63630,
```

Process get Started

```
Downloaded num-integer v0.1.45
Downloaded crossbeam-epoch v0.9.15
Downloaded quote v1.0.32
Downloaded pest-meta v2.7.2
Downloaded pest derive v2.7.2
Downloaded num_cpus v1.16.0
Downloaded getrandom v0.2.10
Downloaded cpufeatures v0.2.9
Downloaded crossbeam-utils v0.8.16
Downloaded pest_generator v2.7.2
Downloaded num_iter v0.1.43
Downloaded num v0.4.1
Downloaded ppv-lite86 v0.2.17
Downloaded py_literal v0.4.0
Downloaded memoffset v0.9.0
Downloaded crossbeam-deque v0.8.3
Downloaded rustc_version v0.3.3
Downloaded rand_core v0.6.4
Downloaded 71 crates (4.2 MB) in 0.38s
Compiling autocfg v1.1.0
Compiling proc-macro2 v1.0.66
Compiling unicode-ident v1.0.11
Compiling thiserror v1.0.44
Compiling cfg-if v1.0.0
Compiling libm v0.2.7
Compiling ucd-trie v0.1.6
Compiling libc v0.2.147
Compiling serde v1.0.183
Compiling crossbeam-utils v0.8.16
Compiling serde_derive v1.0.183
Compiling crc32fast v1.3.2
Compiling serde_json v1.0.104
Compiling once_cell v1.18.0
Compiling scopeguard v1.2.0
Compiling ryu v1.0.15
Compiling itoa v1.0.9
Compiling adler v1.0.2
Compiling rawpointer v0.2.1
Compiling miniz_oxide v0.7.1
Compiling rayon-core v1.11.0
Compiling byteorder v1.4.3
Compiling ppv-lite86 v0.2.17
Compiling match_cfg v0.1.0
Compiling num_traits v0.2.16
Compiling num-integer v0.1.45
Compiling num-bigint v0.4.3
Compiling memoffset v0.9.0
Compiling crossbeam-epoch v0.9.15
Compiling num-rational v0.4.1
Compiling num-iter v0.1.43
Building [==>]
```

] 18/107: num-iter(build.rs), crc32fast(build.rs), num-bigint(build.rs), serde(build.rs), crossbeam-epoch(build.rs), memoffset(build.rs), num-integer(build.rs), lib...

```
root@3bf60712aeef:~/workspace| + | - | X
Compiling ndarray-npy v0.8.1
Compiling raybnn v0.1.5 (/workspace)
Finished 'release' profile [optimized] target(s) in 36.42s
Running 'target/release/examples/figure1b'
Compiling proc-macro2 v1.0.66
Compiling libm v0.2.7
Compiling thiserror v1.0.44
Compiling num-traits v0.2.16
Compiling libc v0.2.147
Compiling num-integer v0.1.45
Compiling crossbeam-utils v0.8.16
Compiling num-bigint v0.4.3
Compiling memoffset v0.9.0
Compiling serde v1.0.183
Compiling crossbeam-epoch v0.9.15
Compiling serde_json v1.0.104
Compiling num-rational v0.4.1
Compiling crossbeam-channel v0.5.8
Compiling quote v1.0.32
Compiling syn v2.0.28
Compiling getrandom v0.2.10
Compiling crossbeam-deque v0.8.3
Compiling num_cpus v1.16.0
Compiling hostname v0.3.1
Compiling rand_core v0.6.4
Compiling rayon-core v1.11.0
Compiling rand_chacha v0.3.1
Compiling rand v0.8.5
Compiling rayon v1.7.0
Compiling num-complex v0.4.3
Compiling half v2.3.1
Compiling num-iter v0.1.43
Compiling ndarray v0.15.6
Compiling thiserror-impl v1.0.44
Compiling num v0.4.1
Compiling pest v2.7.2
Compiling zip v0.5.13
Compiling semver-parser v0.10.2
Compiling pest_meta v2.7.2
Compiling semver v0.11.0
Compiling rustc_version v0.3.3
Compiling pest_generator v2.7.2
Compiling arrayfire_fork v3.8.1
Compiling pest_derive v2.7.2
Compiling py_literal v0.4.0
Compiling ndarray-npy v0.8.1
Compiling raybnn v0.1.5 (/workspace)
Finished 'release' profile [optimized] target(s) in 29.98s
Running 'target/release/examples/figure2a'
Initial Number of Cells: [20, 20, 40, 80, 160, 320, 640, 1280, 2560, 4000, 8000, 16000, 32000, 64000, 128000, 256000, 512000, 1024000, 2048000, 4000000, 8000000, 16000000, 32000000]
```

```
Compiling raybnn v0.1.5 (/workspace)
Finished 'release' profile [optimized] target(s) in 29.98s
    Running 'target/release/examples/figure2a'
Initial Number of Cells: [20, 20, 40, 80, 160, 320, 640, 1280, 2560, 4000, 8000, 16000, 32000, 64000, 128000, 256000, 512000, 1024000, 2048000, 4000000, 8000000, 16000000, 32000000]
run_results_rust.sh: line 14: 1484 Segmentation fault      RUSTFLAGS=-Awarnings cargo run --example figure2a --release
Compiling arrayfire_fork v3.8.1
Compiling raybnn v0.1.5 (/workspace)
Finished 'release' profile [optimized] target(s) in 13.06s
    Running 'target/release/examples/figure2b'
Initial Number of Cells: [20, 20, 40, 80, 160, 320, 640, 1280, 2560, 4000, 8000, 16000]
initial_neuron_num [10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7987, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3999, 7993, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3998, 7991, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3999, 7994, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 4000, 7996, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7999, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7993]
final_glia_num [10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7987, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3999, 7993, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3998, 7991, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3999, 7994, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 4000, 7996, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7999, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7993]
collision_run_time [0.009865154, 0.000998426, 0.001880249, 0.001835548, 0.002684369, 0.00115113, 0.001796346, 0.001722944, 0.005659046, 0.012823831, 0.050886914, 1.476809626, 0.000726619, 0.000712018, 0.000457112, 0.000494613, 0.000615716, 0.000524214, 0.000523414, 0.000700018, 0.004773624, 0.009927159, 0.186250959, 1.928676217, 0.000890717, 0.000580112, 0.000410908, 0.00051391, 0.000446309, 0.000473609, 0.000524211, 0.000646213, 0.004988299, 0.00758955, 0.171155005, 2.024328265, 0.001078026, 0.000635616, 0.000381009, 0.000453311, 0.000409411, 0.000454111, 0.00040891, 0.000521813, 0.002826671, 0.008658515, 0.383377915, 2.008316498, 0.000932824, 0.000641017, 0.000612416, 0.000525314, 0.000674717, 0.000643816, 0.001626241, 0.014554871, 0.010858277, 0.013278839, 0.050172579, 2.611695484, 0.000838521, 0.000575414, 0.00039601, 0.000420711, 0.000458311, 0.00041561, 0.000443711, 0.000540914, 0.002763368, 0.007484183, 0.170785883, 2.146975878, 0.001064727, 0.000589815, 0.000560114, 0.000628116, 0.000418511, 0.000445112, 0.000427811, 0.000536014, 0.0004671419, 0.012875429, 0.17272381, 3.172038288, 0.000828021, 0.000517413, 0.000565114, 0.000482213, 0.000517713, 0.000415811, 0.000453912, 0.001162229, 0.004545315, 0.093712471, 1.517745114, 1.1991312, 0.000562414, 0.000419711, 0.000481613, 0.000455511, 0.001464437, 0.000535214, 0.001294633, 0.009024629, 0.042181666, 0.111682724, 0.538321112, 2.81689135, 0.000822121, 0.000459811, 0.000462512, 0.0004591]
Initial Number of Cells: [20, 20, 40, 80, 160, 320, 640, 1280, 2560, 4000, 8000, 16000, 32000, 64000, 128000, 256000, 512000, 1024000]
```

```
Compiling pybind11 v2.4.0
Compiling ndarray-npy v0.8.1
Compiling raybnn v0.1.5 (/workspace)
    Finished 'release' profile [optimized] target(s) in 29.98s
    Running 'target/release/examples/figure2a'
Initial Number of Cells: [20, 20, 40, 80, 160, 320, 640, 1280, 2560, 4000, 8000, 16000, 32000, 64000, 128000, 256000, 512000, 1024000, 2048000, 4000000, 8000000, 16000000, 32000000]
run_results_rust.sh: line 14: 1484 Segmentation fault      RUSTFLAGS=-Awarnings cargo run --example figure2a --release
Compiling arrayfire叉 v3.8.1
Compiling raybnn v0.1.5 (/workspace)
    Finished 'release' profile [optimized] target(s) in 13.06s
    Running 'target/release/examples/figure2b'
Initial Number of Cells: [20, 20, 40, 80, 160, 320, 640, 1280, 2560, 4000, 8000, 16000]
final_neuron_num [10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7987, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3999, 7993, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3996, 7997, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3999, 7994, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 4000, 7996, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7999, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7993]
final_glia_num [10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7987, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3999, 7993, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3996, 7997, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3999, 7994, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 4000, 7996, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7999, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7993]
collision_run_time [0.009865154, 0.009998426, 0.001880249, 0.001835548, 0.002684369, 0.00115113, 0.001796346, 0.001722944, 0.005659046, 0.012823831, 0.056886914, 1.476809626, 0.000726619, 0.000712018, 0.000457112, 0.000494613, 0.000615716, 0.000524214, 0.000523414, 0.000700018, 0.004773624, 0.009927159, 0.186250959, 1.928676217, 0.000890717, 0.000580112, 0.000410908, 0.00051391, 0.000446309, 0.000473609, 0.00052421, 0.000646213, 0.0004988299, 0.00750955, 0.171155005, 2.024328265, 0.0010783026, 0.000635616, 0.000381009, 0.000453311, 0.000409411, 0.00040891, 0.000521813, 0.002826671, 0.08658518, 0.383377915, 2.880316498, 0.000932024, 0.000641017, 0.000612416, 0.000525314, 0.000674717, 0.000643816, 0.001626241, 0.014554871, 0.010858277, 0.013278839, 0.050172579, 2.611695484, 0.000838521, 0.000575414, 0.00039601, 0.00420711, 0.000458311, 0.00041561, 0.000443711, 0.000540914, 0.002763368, 0.007484183, 0.170785883, 2.146975878, 0.001064727, 0.000589815, 0.000560114, 0.000428116, 0.000418511, 0.000445112, 0.000427811, 0.000536014, 0.0004671419, 0.012875429, 0.17272381, 3.172038288, 0.000828021, 0.000517413, 0.000565114, 0.000482213, 0.000517713, 0.000415811, 0.000453912, 0.001162229, 0.004545315, 0.093712471, 1.517745114, 1.199130105, 0.000562414, 0.000419711, 0.000481613, 0.000455511, 0.001464437, 0.000535214, 0.001294633, 0.0009024629, 0.042181666, 0.111682724, 0.538321112, 2.81689135, 0.000822121, 0.000459811, 0.000462512, 0.00045912, 0.000481412, 0.000439911, 0.000572515, 0.006671269, 0.031930308, 0.086155378, 0.40115144, 1.878319781]
Initial Number of Cells: [20, 20, 40, 80, 160, 320, 640, 1280, 2560, 4000, 8000, 16000, 32000, 64000, 128000, 256000, 512000, 1024000]
^C
root@3bf60712aeel:/workspace# exit
exit

What's next:
    Try Docker Debug for seamless, persistent debugging tools in any container or image → docker debug raybnn
    Learn more at https://docs.docker.com/go/debug-cli/
```

I have changed the device - for following step!

Reproducing the Results in the Manuscript

Reproducing results in batch

On the Host Machine, Restart the Docker Container

```
docker restart raybnn  
  
docker exec -it raybnn bash  
  
cd /workspace/RayBNN  
  
bash run_results_rust.sh  
  
exit
```

Result of Processing Slide 62 - 77

You can skip this part if you wanna see the graphing

Result - Figure 2a

```
Compiling raybnn v0.1.5 (/workspace)
Finished 'release' profile [optimized] target(s) in 22.17s
Running 'target/release/examples/figure2a'
Initial Number of Cells: [20, 20, 40, 80, 160, 320, 640, 1280, 2560, 4000, 8000, 16000, 32000, 64000, 128000, 256000, 512000, 1024000, 2048000, 4000000, 8000000, 16000000, 32000000]

final_neuron_num [10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7987, 15990, 31899, 63661, 126597, 250402, 489994, 938471, 1683938, 2838694, 4029272, 4063698, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3997, 7995, 15982, 31908, 63629, 126596, 250328, 489995, 937986, 1684403, 2839202, 4030964, 4063485, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3998, 7995, 15986, 31899, 63619, 126565, 250464, 490178, 938240, 1684995, 2839685, 4030312, 4061619, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3998, 7995, 15979, 31904, 63630, 126602, 250255, 490073, 938076, 1685246, 2839961, 4032344, 4062623, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1998, 3999, 7995, 15988, 31901, 63610, 126639, 250397, 489874, 937620, 1686320, 2838484, 4030538, 4061501, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 4000, 7993, 15971, 31901, 63627, 126599, 250329, 489842, 937290, 1685172, 2840271, 4029522, 4064581, 10, 10, 20, 40, 80, 160, 320, 639, 1280, 2000, 3997, 7995, 15986, 31907, 63662, 126529, 250564, 489888, 937797, 1684907, 2838915, 4031006, 4063841, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7992, 15981, 31900, 63639, 126598, 250337, 489770, 938241, 1, 685266, 2839362, 4031380, 4064759]
final_glia_num [10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7987, 15990, 31899, 63661, 126597, 250402, 489994, 938471, 1683939, 2838694, 4029272, 4063698, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3997, 7995, 15982, 31908, 63630, 126596, 250328, 489995, 937987, 1684403, 2839203, 4030964, 4063485, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3998, 7995, 15986, 31899, 63620, 126566, 250464, 490179, 938240, 1684995, 2839685, 4030312, 4061619, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7993, 15978, 31906, 63665, 250511, 489965, 937960, 1684814, 2838548, 4030705, 4062173, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3998, 7995, 15979, 31904, 63630, 126603, 250255, 490073, 938077, 1685246, 2839961, 4032345, 4062623, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1998, 3999, 7995, 15988, 31901, 63611, 126640, 250397, 489874, 937620, 1686320, 2838485, 4030539, 4061502, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 4000, 7993, 15971, 31901, 63627, 126599, 250329, 489842, 937290, 1685172, 2840272, 4029523, 4064582, 10, 10, 20, 40, 80, 160, 320, 639, 1280, 2000, 3997, 7995, 15986, 31908, 63662, 126529, 250564, 489888, 937797, 1684907, 2838915, 4031006, 4063842, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7992, 15981, 31900, 63639, 126598, 250337, 489771, 938241, 1, 685266, 2839362, 4031380, 4064759]
collision_run_time [0.099521133, 0.000370236, 0.001021925, 0.001052326, 0.104771002, 0.001296715, 0.091530182, 0.002539125, 0.005317068, 0.007202114, 0.012226082, 0.027133386, 0.047509295, 0.115536708, 1.851429618, 7.341832353, 8.752283816, 12.261199531, 24.963678357, 51.083028337, 108.493632003, 242.986453017, 573.062338321, 0.06882437, 0.001458741, 0.00101516, 0.000873197, 0.000745838, 0.001601761, 0.003225435, 0.004607889, 0.022759785, 0.032125608, 0.049875538, 0.133220678, 0.059149944, 0.230618027, 1.226109393, 3.437390364, 5.216615201, 10.76736304, 23.841474287, 48.989912626, 108.422326988, 221.041631845, 636.338845724, 0.001373644, 0.000671731, 0.000775507, 0.001032901, 0.000611012, 0.002173582, 0.00343786, 0.020083474, 0.023691977, 0.030502863, 0.048775291, 0.129344643, 0.212026278, 0.459731196, 1.247207388, 2.968109632, 5.367474858, 11.707091957, 23.804741651, 50.415428857, 100.613003115, 220.14554003, 581.227875997, 0.001408289, 0.000542369, 0.000527039, 0.000635968, 0.009777221, 0.002311244, 0.005635484, 0.17871276, 0.077098859, 0.09003583, 0.132969064, 0.096588673, 0.248211412, 1.758415254, 0.225164129, 2.449917804, 4.980031831, 11.549892691, 23.15459251, 47.775281907, 104.813911551, 238.437190252, 508.272348275, 0.00438075, 0.004675756, 0.001601049, 0.000712761, 0.000796445, 0.002419288, 0.001706121, 0.017077403, 0.089679466, 0.08561559, 0.096700835, 0.094692538, 1.409302525, 0.113603366, 0.620941281, 2.683026698, 6.674749922, 10.519491061, 23.567804385, 47.891995909, 107.382517028, 247.289936189, 511.367753294, 0.006103107, 0.002156309, 0.00154986, 0.001179531, 0.001182281, 0.003547903, 0.005781776, 0.017670402, 0.667197769, 0.089088526, 0.0694448564, 0.084736446, 0.221828731, 0.581156994, 1.24484987, 2.639702452, 5.151929992, 11.024069081, 22.954418421, 47.392777314, 99.343186206, 244.659160073, 695.251407203, 0.004293237, 0.000600986, 0.000605387, 0.000655972, 0.0008858038, 0.004476643, 0.005368087, 0.017826117, 0.068058199, 0.090209513, 0.085075418, 0.10516519, 0.238886528, 0.638772359, 2.607071982, 1.6541110555, 5.524289573, 11.540737363, 9, 23.807069475, 48.056843241, 106.678005906, 215.227807842, 693.567499556, 0.004738932, 0.001729286, 0.003288057, 0.00149653, 0.007377846, 0.004561601, 0.007914378, 0.007784907, 0.023026574, 0.03933131, 0.048145454, 0.136634949, 0.087817566, 0.271791287, 1.088625155, 3.3434948355, 5.09198964, 10.835693194, 23.972130517, 47.90977258, 102.280986523, 219.2178477, 555.557812541, 0.003360126, 0.002151376, 0.00101938034, 0.000638574, 0.000832536, 0.002312195, 0.005664503, 0.017684517, 0.059603847, 0.093318566, 0.085960416, 0.102429046, 0.244222773, 0.598752839, 1.569747706999999, 2.436832918, 5.256190773, 12.817022558, 22.86502975, 48.152990847, 108.786111897, 213.732971279, 689.711501331, 0.002245727, 0.000753311, 0.000750264, 0.000950245, 0.000824694, 0.001872432, 0.003057634, 0.006994003, 0.023017524, 0.031708828, 0.050605647, 0.127221608, 0.074934942, 0.45171025, 1.197119816, 3.158035365, 5.493864859, 11.003426786, 23.458194263, 52.911286196, 113.972693741, 228.193393258, 620.359152325]
```

Result - Figure 2b

Result - Figure 2d

```
Compiling raybnn v0.1.5 (/workspace)
Finished 'release' profile [optimized] target(s) in 6.72s
Running 'target/release/examples/figure2c'
Compiling raybnn v0.1.5 (/workspace)
Finished 'release' profile [optimized] target(s) in 4.74s
Running 'target/release/examples/figure2d'
neuron_num 250
Add neurons 0.068518615, 516
hidden_pos_total 392
input_pos 392
start
Ray trace 0.995542447, 140228
neuron_num 500
Add neurons 0.054336501, 766
hidden_pos_total 642
input_pos 642
start
Ray trace 1.051731427, 366026
neuron_num 1000
Add neurons 0.093770089, 1252
hidden_pos_total 1128
input_pos 1128
start
Ray trace 26.141923622, 1091885
neuron_num 2000
Add neurons 0.256924487, 2233
hidden_pos_total 2109
input_pos 2109
start
Ray trace 119.164928599, 3671888
neuron_num 4000
Add neurons 0.204637257, 4177
hidden_pos_total 4053
input_pos 4053
start
Ray trace 884.333786886, 12890846
neuron_num 8000
Add neurons 0.661103709, 8090
hidden_pos_total 7966
input_pos 7966
start
Ray trace 5279.18486645, 46737543
neuron_num 10000
Add neurons 0.914132105, 10084
hidden_pos_total 9960
input_pos 9960
start
```

```
Ray trace 5453.081127751, 46874371
neuron_num 10000
Add neurons 1.187777737, 10086
hidden_pos_total 9962
input_pos 9962
start
Ray trace 16365.599439456, 71191222
con: [140255, 363505, 1102431, 3644405, 12977553, 46874371, 71191222]
neurons: [250, 500, 1000, 2000, 4000, 8000, 10000]
time: [0.112485766, 1.027008024, 32.179863387, 118.457153496, 970.627232926, 5453.081127751, 16365.599439456]
Add neurons 0.066798099, 517
hidden_pos_total 393
input_pos 393
start
Ray trace 2.874625317, 81784
Add neurons 0.048466426, 761
hidden_pos_total 637
input_pos 637
start
Ray trace 1.629566576, 63614
Add neurons 0.163206724, 1244
hidden_pos_total 1120
input_pos 1120
start
Ray trace 2.61776278, 79241
Add neurons 1.577199129, 2233
hidden_pos_total 2109
input_pos 2109
start
Ray trace 0.461236596, 111107
Add neurons 0.24549072, 4207
hidden_pos_total 4083
input_pos 4083
start
Ray trace 7.521772998999995, 211654
Add neurons 0.752339438, 8100
hidden_pos_total 7976
input_pos 7976
start
Ray trace 51.061995817, 403742
Add neurons 1.064182569, 15959
hidden_pos_total 15835
input_pos 15835
start
Ray trace 324.67413367, 802226
Add neurons 3.656083815, 31625
hidden_pos_total 31501
```

```
root@3346ae4cd4fe:/worksp ~ + |  
hidden_pos_total 15835  
input_pos 15835  
start  
Ray trace 324.67413367, 802226  
Add neurons 3.656083815, 31625  
hidden_pos_total 31501  
input_pos 31501  
start  
Ray trace 2432.512865635, 1601253  
Add neurons 10.565592641, 63014  
hidden_pos_total 62890  
input_pos 62890  
start  
Ray trace 17833.292458509, 3200545  
con: [81784, 63614, 79241, 111107, 211654, 403742, 802226, 1601253, 3200545]  
neurons: [250, 500, 1000, 2000, 4000, 8000, 16000, 32000, 64000]  
time: [2.874625317, 1.629566576, 2.61776278, 0.461236596, 7.521772998999995, 51.061995817, 324.67413367, 2432.512865635, 17833.292458509]  
Add neurons 0.094520116, 517  
hidden_pos_total 393  
input_pos 393  
start  
Ray trace 0.390661191, 2529  
Add neurons 0.070180329, 764  
hidden_pos_total 640  
input_pos 640  
start  
Ray trace 0.426150749, 4592  
Add neurons 0.134146319, 1255  
hidden_pos_total 1131  
input_pos 1131  
start  
Ray trace 0.751675962, 9089  
Add neurons 0.144868736, 2234  
hidden_pos_total 2110  
input_pos 2110  
start  
Ray trace 1.580015105999998, 17955  
Add neurons 0.297163708, 4188  
hidden_pos_total 4064  
input_pos 4064  
start  
Ray trace 3.422479245, 35124  
Add neurons 0.549534141, 8124  
hidden_pos_total 8000  
input_pos 8000  
start  
Ray trace 5.742512664, 70608  
Add neurons 0.833380772, 15945  
hidden_pos_total 15821  
input_pos 15821  
start
```

```
root@3346ae4cd4fe:/worksp ~ + ~
hidden_pos_total 15821
input_pos 15821
start
Ray trace 12.563409669, 140899
Add neurons 4.071386407, 31651
hidden_pos_total 31527
input_pos 31527
start
Ray trace 25.996556069, 284546
Add neurons 5.789663655, 63016
hidden_pos_total 62892
input_pos 62892
start
Ray trace 47.31707821, 571469
Add neurons 32.008230995, 125707
hidden_pos_total 125583
input_pos 125583
start
Ray trace 175.713521849, 1142424
Add neurons 106.518093988, 235509
hidden_pos_total 235385
input_pos 235385
start
Ray trace 207.836060858, 2149785
con: [2529, 4592, 9089, 17955, 35172, 70608, 140899, 284546, 571469, 1142424, 2149785]
neurons: [250, 500, 1000, 2000, 4000, 8000, 16000, 32000, 64000, 128000, 240000]
time: [0.390661191, 0.426150749, 0.751675962, 1.5800151059999998, 3.422479245, 5.742512664, 12.563409669, 25.996556069, 47.31707821, 175.713521849, 207.836060858]
Add neurons 0.066800546, 514
hidden_pos_total 390
input_pos 390
start
Ray trace 0.023240288, 16203
Add neurons 0.132165415, 760
hidden_pos_total 636
input_pos 636
start
Ray trace 0.033939851, 32003
Add neurons 0.146535881, 1256
hidden_pos_total 1132
input_pos 1132
start
Ray trace 0.072934025, 51366
Add neurons 0.156971575, 2239
hidden_pos_total 2115
input_pos 2115
start
Ray trace 0.084777269, 100258
Add neurons 0.274478675, 4199
hidden_pos_total 4075
input_pos 4075
start
```

```
root@3346ae4cd4fe: /workspace + ▾
start
Ray trace 0.084777269, 100258
Add neurons 0.274478675, 4199
hidden_pos_total 4075
input_pos 4075
start
Ray trace 0.192337889, 207932
Add neurons 0.525893902, 8110
hidden_pos_total 7986
input_pos 7986
start
Ray trace 0.22376626, 441246
Add neurons 1.016834578, 15924
hidden_pos_total 15800
input_pos 15800
start
Ray trace 1.125231838, 804725
Add neurons 3.12260196, 31694
hidden_pos_total 31570
input_pos 31570
start
Ray trace 3.41553371, 1609543
Add neurons 10.052409454, 62992
hidden_pos_total 62868
input_pos 62868
start
Ray trace 8.541730157, 2953892
Add neurons 9.734430123, 125751
hidden_pos_total 125627
input_pos 125627
start
Ray trace 19.779872716, 5892446
Add neurons 21.276313606, 235607
hidden_pos_total 235483
input_pos 235483
start
Ray trace 39.17441639, 10655924
con: [16203, 32003, 51366, 100258, 207932, 441246, 804725, 1609543, 2953892, 5892446, 10655924]
neurons: [250, 500, 1000, 2000, 4000, 8000, 16000, 32000, 64000, 128000, 240000]
time: [0.023240288, 0.033939851, 0.072934025, 0.084777269, 0.192337889, 0.22376626, 1.125231838, 3.41553371, 8.541730157, 19.779872716, 39.17441639]
Add neurons 0.06372493, 520
hidden_pos_total 396
input_pos 396
start
Ray trace 0.043560299, 12621
Add neurons 0.091751536, 757
hidden_pos_total 633
input_pos 633
start
Ray trace 0.060433117, 22474
Add neurons 0.10413027, 1254
```

root@3346ae4cd4fe:/workspace

```
start
Ray trace 0.060433117, 22474
Add neurons 0.10413827, 1254
hidden_pos_total 1130
input_pos 1130
start
Ray trace 0.076164841, 37880
Add neurons 0.15642399, 2229
hidden_pos_total 2105
input_pos 2105
start
Ray trace 0.145452161, 72414
Add neurons 0.345262478, 4211
hidden_pos_total 4087
input_pos 4087
start
Ray trace 0.238762096, 141934
Add neurons 0.505841907, 8137
hidden_pos_total 8013
input_pos 8013
start
Ray trace 0.336493486, 273570
Add neurons 1.045048466, 15963
hidden_pos_total 15839
input_pos 15839
start
Ray trace 0.587337521, 546096
Add neurons 2.034903219, 31673
hidden_pos_total 31549
input_pos 31549
start
Ray trace 1.201767968, 1112586
Add neurons 5.685859176, 62981
hidden_pos_total 62857
input_pos 62857
start
Ray trace 2.5377946270000002, 2200542
Add neurons 32.04753951, 125729
hidden_pos_total 125605
input_pos 125605
start
Ray trace 5.758414192, 4386305
Add neurons 104.277354264, 235461
hidden_pos_total 235337
input_pos 235337
start
Ray trace 10.617795761, 8323477
con: [12621, 22474, 37880, 72414, 141934, 273570, 546096, 1112586, 2200542, 4386305, 8323477]
neurons: [250, 500, 1000, 2000, 4000, 8000, 16000, 32000, 64000, 128000, 240000]
time: [0.043560299, 0.060433117, 0.076164841, 0.145452161, 0.238762096, 0.336493486, 0.587337521, 1.201767968, 2.5377946270000002, 5.758414192, 10.617795761]
Compiling raybnn v0.1.5 (/workspace)
```

Result - Figure 2e

```
Compiling raybnn v0.1.5 (/workspace)
Finished 'release' profile [optimized] target(s) in 12.32s
Running 'target/release/examples/figure2e'
testnum 42.893208
Add neurons 0.001246419, 41
hidden_pos_total 39
input_pos 39
Ray trace 0.079442133, 1465
testnum 85.786415
Add neurons 0.001654385, 82
hidden_pos_total 80
input_pos 80
Ray trace 0.032469396, 5848
testnum 171.57283
Add neurons 0.000857089, 160
hidden_pos_total 158
input_pos 158
Ray trace 0.03936489, 21730
testnum 343.14566
Add neurons 0.001567452, 315
hidden_pos_total 313
input_pos 313
Ray trace 0.182307364, 73557
testnum 686.2913
Add neurons 0.004771512, 545
hidden_pos_total 543
input_pos 543
Ray trace 0.441528925, 184603
testnum 1372.5826
Add neurons 0.072352605, 908
hidden_pos_total 906
input_pos 906
Ray trace 13.209886647, 374902
testnum 2745.1653
Add neurons 0.134433565, 1219
hidden_pos_total 1217
input_pos 1217
Ray trace 34.172521508, 522461
testnum 5490.3306
Add neurons 0.081463331, 1045
hidden_pos_total 1043
input_pos 1043
Ray trace 1.694334521, 445405
```

Result - Figure 2f

```
root@3346ae4cd4fe:/workspace ~ + ^ 
Compiling raybnn v0.1.5 (/workspace)
Finished 'release' profile [optimized] target(s) in 4.78s
Running 'target/release/examples/figure2f'
testnum 10980.661
Add neurons 0.044730217, 7330
hidden_pos_total 7328
input_pos 7328
Ray trace 0.289528566, 240084
testnum 21961.322
Add neurons 0.559227329, 9736
hidden_pos_total 9734
input_pos 9734
Ray trace 7.950219294, 378383
testnum 43922.645
Add neurons 1.198711908, 8759
hidden_pos_total 8757
input_pos 8757
Ray trace 1.78004687, 319077
testnum 65369.25
Add neurons 2.007754954, 5933
hidden_pos_total 5931
input_pos 5931
Ray trace 3.23586312, 204697
testnum 85807.87
Add neurons 2.507017054, 3688
hidden_pos_total 3686
input_pos 3686
Ray trace 0.993434062, 103265
testnum 107254.47
Add neurons 3.85409683, 2168
hidden_pos_total 2166
input_pos 2166
Ray trace 0.045487413, 107755
testnum 128701.08
Add neurons 3.647014675, 1214
hidden_pos_total 1212
input_pos 1212
Ray trace 1.457479943, 101442
testnum 171594.28
Add neurons 5.440060664, 367
hidden_pos_total 365
input_pos 365
Ray trace 0.228510592, 10032
testnum 257380.72
Add neurons 8.239289427, 42
hidden_pos_total 40
input_pos 40
Ray trace 8.619788025, 145
```

Result - Figure 4

```
root@3346ae4cd4fe:/workspace ~ + | 
Compiling raybnn v0.1.5 (/workspace)
Finished 'release' profile [optimized] target(s) in 12.15s
Running 'target/release/examples/figure4_raybnn'
Creating Network
Load Dataset
loss_val 0.6365288
elapsed 19.580868
loss_val 0.50307536
elapsed 11.6230135
loss_val 0.4378621
elapsed 5.7592525
loss_val 0.3759012
elapsed 5.391919
loss_val 0.29472783
elapsed 6.8327756
loss_val 0.19457273
elapsed 7.881089
loss_val 0.1422544
elapsed 6.101311
loss_val 0.09454756
elapsed 8.767388
loss_val 0.08260634
elapsed 18.30798
loss_val 0.067280434
elapsed 37.595104
loss_val 0.11134003
elapsed 26.323488
Creating Network
Load Dataset
loss_val 0.6228349
elapsed 4.653286
loss_val 0.56964105
elapsed 4.9963684
loss_val 0.44687524
elapsed 5.0641284
loss_val 0.3846051
elapsed 6.07098
loss_val 0.29674536
elapsed 7.4098797
loss_val 0.14955574
elapsed 12.21926
loss_val 0.07021442
elapsed 18.80056
loss_val 0.0719139
elapsed 7.236863
loss_val 0.060785875
elapsed 20.893373
loss_val 0.05936813
elapsed 18.718596
loss_val 0.07704646
elapsed 13.552479
```

```
root@3346ae4cd4fe: /worksp X + ▾
```

```
elapsed 18.718596
loss_val 0.07704646
elapsed 13.552479
Creating Network
Load Dataset
loss_val 0.6399113
elapsed 4.723156
loss_val 0.5481447
elapsed 4.758381
loss_val 0.46498972
elapsed 4.4819784
loss_val 0.36703202
elapsed 9.518922
loss_val 0.3075326
elapsed 7.808286
loss_val 0.16534907
elapsed 9.475785
loss_val 0.09942674
elapsed 12.432862
loss_val 0.07434124
elapsed 16.15752
loss_val 0.067181006
elapsed 15.316345
loss_val 0.075776815
elapsed 11.596601
loss_val 0.07091065
elapsed 18.430313
Creating Network
```

```
Creating Network
Load Dataset
loss_val 0.6170843
elapsed 4.6189556
loss_val 0.50347894
elapsed 11.368198
loss_val 0.39428702
elapsed 10.2792015
loss_val 0.3541723
elapsed 7.2133675
loss_val 0.21386
elapsed 14.249244
loss_val 0.12948842
elapsed 12.876348
loss_val 0.06449648
elapsed 17.27745
loss_val 0.053666957
elapsed 15.4803095
loss_val 0.06320351
elapsed 10.933799
loss_val 0.05263421
elapsed 19.47135
loss_val 0.056449648
elapsed 24.361448
```

root@3346ae4cd4fe: /worksp X + ^

```
elapsed 19.47135
loss_val 0.056449648
elapsed 24.361448
Creating Network
Load Dataset
loss_val 0.5454633
elapsed 12.81914
loss_val 0.48997942
elapsed 8.493389
loss_val 0.39580315
elapsed 10.623175
loss_val 0.44299233
elapsed 15.684645
loss_val 0.22063325
elapsed 15.720345
loss_val 0.1126324
elapsed 17.24043
loss_val 0.08065574
elapsed 14.343958
loss_val 0.073356904
elapsed 9.020126
loss_val 0.06322311
elapsed 12.202015
loss_val 0.07157953
elapsed 17.093885
loss_val 0.07935766
elapsed 25.853064
Creating Network
```

```
elapsed 25.853064
Creating Network
Load Dataset
loss_val 0.6274579
elapsed 5.3593097
loss_val 0.5498973
elapsed 4.6987567
loss_val 0.46457735
elapsed 5.0523825
loss_val 0.38453424
elapsed 7.6152067
loss_val 0.25959542
elapsed 10.093828
loss_val 0.13709912
elapsed 13.181914
loss_val 0.08923114
elapsed 13.417107
loss_val 0.06330822
elapsed 16.718473
loss_val 0.060597353
elapsed 10.511888
loss_val 0.06574945
elapsed 15.2536545
loss_val 0.06364916
elapsed 26.919966
```

root@3346ae4cd4fe: /worksp X + ▾

```
elapsed 26.919966
Creating Network
Load Dataset
loss_val 0.5921908
elapsed 9.425489
loss_val 0.5464213
elapsed 5.458548
loss_val 0.4592653
elapsed 4.447302
loss_val 0.37310728
elapsed 7.533798
loss_val 0.30775112
elapsed 6.1414943
loss_val 0.12758291
elapsed 18.088535
loss_val 0.10693607
elapsed 6.660369
loss_val 0.08842469
elapsed 7.1357703
loss_val 0.06648392
elapsed 18.792215
loss_val 0.07283095
elapsed 12.813743
loss_val 0.9874284
elapsed 18.661825
Creating Network
```

```
Creating Network
Load Dataset
loss_val 0.57383233
elapsed 11.482439
loss_val 0.4972133
elapsed 10.899924
loss_val 0.4379025
elapsed 5.567483
loss_val 0.38464293
elapsed 5.076354
loss_val 0.33274883
elapsed 5.4842916
loss_val 0.14669254
elapsed 10.048949
loss_val 0.099533245
elapsed 11.561925
loss_val 0.058950387
elapsed 14.500506
loss_val 0.049702846
elapsed 18.25934
loss_val 0.057590708
elapsed 12.412883
loss_val 0.08622445
elapsed 26.030209
Creating Network
Load Dataset
```

root@3346ae4cd4fe: /worksp X + ^

```
elapsed 26.030209
Creating Network
Load Dataset
loss_val 0.6348069
elapsed 4.316791
loss_val 0.5417511
elapsed 4.2352915
loss_val 0.45443597
elapsed 4.205975
loss_val 0.3989281
elapsed 5.4074
loss_val 0.31765255
elapsed 7.6051407
loss_val 0.17343019
elapsed 10.794449
loss_val 0.118017785
elapsed 7.9590383
loss_val 0.081157774
elapsed 9.478231
loss_val 0.0734963
elapsed 7.7622643
loss_val 0.08553574
elapsed 12.618695
loss_val 0.06923095
elapsed 21.425789
Creating Network
```

```
Creating Network
Load Dataset
loss_val 0.61918855
elapsed 4.5801444
loss_val 0.5155055
elapsed 9.029591
loss_val 0.4080362
elapsed 11.912691
loss_val 0.3637185
elapsed 7.7353983
loss_val 0.27095246
elapsed 8.5096
loss_val 0.12177085
elapsed 15.408037
loss_val 0.09106144
elapsed 8.681295
loss_val 0.060160663
elapsed 12.6268
loss_val 0.067819074
elapsed 10.777083
loss_val 0.4214722
elapsed 22.342522
loss_val 0.082063794
elapsed 25.730223
Creating Network
Load Dataset
```

```
elapsed 25.730223
Creating Network
Load Dataset
loss_val 0.6619522
elapsed 4.7420626
loss_val 0.5890928
elapsed 4.9965973
loss_val 0.43386543
elapsed 11.143205
loss_val 0.3854705
elapsed 5.2932725
loss_val 0.29146305
elapsed 9.069308
loss_val 0.1769939
elapsed 5.8971505
loss_val 0.09153259
elapsed 9.989783
loss_val 0.06723999
elapsed 16.119617
loss_val 0.07404832
elapsed 7.5875683
loss_val 0.07115077
elapsed 11.318317
loss_val 0.46666247
elapsed 26.242548
root@3346ae4cd4fe:/workspace#
hidden_pos_total 7966
```

Plot Figure 1b, an example of a simple neural network

Related scripts at

- RayBNN/examples/figure1b.rs
- RayBNN/matlab_plot/figure1b_plot.m

Figure 1b is an example of a simple neural network with raytraced connections

Inside Docker Container, generate ./figure1_neural_network.csv that contains the entire neural network

```
cd /workspace/RayBNN  
cargo run --example figure1b --release  
mv *.csv ./matlab_plot/
```

On the Host Machine, Plot ./figure1_neural_network.csv using Matlab

```
cd $RAYBNN_DIR/RayBNN/matlab_plot/  
matlab -r figure1b_plot.m
```

```
root@3346ae4cd4fe:/workspace# + - v
WColIdx_0_00256.csv glia_pos.csv info_4_14.csv info_9_50.csv test_act_1_14.csv test_act_6_50.csv test_pred_10_8.csv test_pred_6_14.csv
WColIdx_0_00512.csv info_0_100.csv info_4_16.csv info_9_6.csv test_act_1_16.csv test_act_6_6.csv test_pred_1_100.csv test_pred_6_16.csv
WColIdx_0_01024.csv info_0_12.csv info_4_162.csv info_9_75.csv test_act_1_162.csv test_act_6_75.csv test_pred_1_12.csv test_pred_6_162.csv
WColIdx_0_02048.csv info_0_125.csv info_4_32.csv info_9_8.csv test_act_1_32.csv test_act_6_8.csv test_pred_1_125.csv test_pred_6_32.csv
WRowIdxC00_0_00016.csv info_0_14.csv info_4_50.csv initial_cell_num.csv test_act_1_50.csv test_act_7_100.csv test_pred_1_14.csv test_pred_6_50.csv
WRowIdxC00_0_00032.csv info_0_16.csv info_4_6.csv install.sh test_act_1_6.csv test_act_7_12.csv test_pred_1_16.csv test_pred_6_6.csv
WRowIdxC00_0_00064.csv info_0_162.csv info_4_75.csv matlab_plot test_act_1_75.csv test_act_7_125.csv test_pred_1_162.csv test_pred_6_75.csv
WRowIdxC00_0_00128.csv info_0_32.csv info_4_8.csv neuron_idx_0_00016.csv test_act_1_8.csv test_act_7_14.csv test_pred_1_32.csv test_pred_6_8.csv
WRowIdxC00_0_00256.csv info_0_50.csv info_5_100.csv neuron_idx_0_00032.csv test_act_2_100.csv test_act_7_16.csv test_pred_1_50.csv test_pred_7_100.csv
WRowIdxC00_0_00512.csv info_0_6.csv info_5_12.csv neuron_idx_0_00064.csv test_act_2_12.csv test_act_7_162.csv test_pred_1_6.csv test_pred_7_12.csv
WRowIdxC00_0_01024.csv info_0_75.csv info_5_125.csv neuron_idx_0_00128.csv test_act_2_125.csv test_act_7_32.csv test_pred_1_75.csv test_pred_7_125.csv
WRowIdxC00_0_02048.csv info_0_8.csv info_5_14.csv neuron_idx_0_00256.csv test_act_2_14.csv test_act_7_50.csv test_pred_1_8.csv test_pred_7_14.csv
arrayfire arrayfire info_10_100.csv info_5_16.csv neuron_idx_0_00512.csv test_act_2_16.csv test_act_7_6.csv test_pred_2_100.csv test_pred_7_16.csv
arrayfire-rust arrayfire-rust info_10_12.csv info_5_162.csv neuron_idx_0_01024.csv test_act_2_162.csv test_act_7_75.csv test_pred_2_12.csv test_pred_7_162.csv
collision_run_time.csv collision_run_time.csv info_10_125.csv info_5_32.csv neuron_idx_0_02048.csv test_act_2_32.csv test_act_7_8.csv test_pred_2_125.csv test_pred_7_32.csv
collision_run_time_batch.csv collision_run_time_batch.csv info_10_14.csv info_5_50.csv neuron_num_list.csv test_act_2_50.csv test_act_8_100.csv test_pred_2_14.csv test_pred_7_50.csv
collision_run_time_serial.csv collision_run_time_serial.csv info_10_16.csv info_5_6.csv neuron_num_list2.csv test_act_2_6.csv test_act_8_12.csv test_pred_2_16.csv test_pred_7_6.csv
density_list.csv density_list.csv info_10_162.csv info_5_75.csv neuron_pos.csv test_act_2_75.csv test_act_8_125.csv test_pred_2_162.csv test_pred_7_75.csv
examples examples info_10_32.csv info_5_8.csv neuron_pos_0_00016.csv test_act_2_8.csv test_act_8_14.csv test_pred_2_32.csv test_pred_7_8.csv
fig2f_WColIdx_0_00512.csv fig2f_WColIdx_0_00512.csv info_10_50.csv info_6_100.csv neuron_pos_0_00032.csv test_act_3_100.csv test_act_8_16.csv test_pred_2_50.csv test_pred_8_100.csv
fig2f_WColIdx_0_01024.csv fig2f_WColIdx_0_01024.csv info_10_6.csv info_6_12.csv neuron_pos_0_00064.csv test_act_3_12.csv test_act_8_162.csv test_pred_2_6.csv test_pred_8_12.csv
fig2f_WColIdx_0_02048.csv fig2f_WColIdx_0_02048.csv info_10_75.csv info_6_125.csv neuron_pos_0_00128.csv test_act_3_125.csv test_act_8_32.csv test_pred_2_75.csv test_pred_8_125.csv
fig2f_WColIdx_0_03048.csv fig2f_WColIdx_0_03048.csv info_10_8.csv info_6_14.csv neuron_pos_0_00256.csv test_act_3_14.csv test_act_8_50.csv test_pred_2_8.csv test_pred_8_14.csv
fig2f_WColIdx_0_04001.csv fig2f_WColIdx_0_04001.csv info_1_100.csv info_6_16.csv neuron_pos_0_00512.csv test_act_3_16.csv test_act_8_6.csv test_pred_3_100.csv test_pred_8_16.csv
fig2f_WColIdx_0_05001.csv fig2f_WColIdx_0_05001.csv info_1_12.csv info_6_162.csv neuron_pos_0_01024.csv test_act_3_162.csv test_act_8_75.csv test_pred_3_12.csv test_pred_8_162.csv
fig2f_WColIdx_0_06001.csv fig2f_WColIdx_0_06001.csv info_1_125.csv info_6_32.csv neuron_pos_0_02048.csv test_act_3_32.csv test_act_8_8.csv test_pred_3_125.csv test_pred_8_32.csv
fig2f_WColIdx_0_08001.csv fig2f_WColIdx_0_08001.csv info_1_14.csv info_6_50.csv new_matlab_plot test_act_3_50.csv test_act_9_100.csv test_pred_3_14.csv test_pred_8_50.csv
fig2f_WColIdx_0_12001.csv fig2f_WColIdx_0_12001.csv info_1_16.csv info_6_6.csv plot_results_matlab.sh test_act_3_6.csv test_act_9_12.csv test_pred_3_16.csv test_pred_8_6.csv
fig2f_WRowIdxC00_0_00512.csv fig2f_WRowIdxC00_0_00512.csv info_1_162.csv info_6_75.csv python_verify test_act_3_75.csv test_act_9_125.csv test_pred_3_162.csv test_pred_8_75.csv
fig2f_WRowIdxC00_0_01024.csv fig2f_WRowIdxC00_0_01024.csv info_1_32.csv info_6_8.csv pytorch_geometric test_act_3_8.csv test_act_9_14.csv test_pred_3_32.csv test_pred_8_8.csv
fig2f_WRowIdxC00_0_02048.csv fig2f_WRowIdxC00_0_02048.csv info_1_50.csv info_7_100.csv run_results_fig4_other_models.sh test_act_4_100.csv test_act_9_16.csv test_pred_3_50.csv test_pred_9_100.csv
fig2f_WRowIdxC00_0_03048.csv fig2f_WRowIdxC00_0_03048.csv info_1_6.csv info_7_12.csv run_results_rust.sh test_act_4_120.csv test_act_9_162.csv test_pred_3_6.csv test_pred_9_12.csv
fig2f_WRowIdxC00_0_04001.csv fig2f_WRowIdxC00_0_04001.csv info_1_75.csv info_7_125.csv sri target test_act_4_125.csv test_act_9_32.csv test_pred_3_75.csv test_pred_9_125.csv
fig2f_WRowIdxC00_0_05001.csv fig2f_WRowIdxC00_0_05001.csv info_1_8.csv info_7_14.csv test_act_0_100.csv test_act_4_14.csv test_act_9_50.csv test_pred_3_8.csv test_pred_9_14.csv
fig2f_WRowIdxC00_0_06001.csv fig2f_WRowIdxC00_0_06001.csv info_2_100.csv info_7_16.csv test_act_0_12.csv test_act_4_16.csv test_act_9_6.csv test_pred_4_100.csv test_pred_9_16.csv
fig2f_WRowIdxC00_0_08001.csv fig2f_WRowIdxC00_0_08001.csv info_2_12.csv info_7_162.csv test_act_0_125.csv test_act_4_162.csv test_act_9_75.csv test_pred_4_12.csv test_pred_9_162.csv
fig2f_WRowIdxC00_0_12001.csv fig2f_WRowIdxC00_0_12001.csv info_2_125.csv info_7_32.csv test_act_0_125.csv test_act_4_32.csv test_act_9_8.csv test_pred_4_125.csv test_pred_9_32.csv
fig2f_density_list.csv fig2f_density_list.csv info_2_14.csv info_7_50.csv test_act_0_14.csv test_act_4_50.csv test_data test_pred_4_14.csv test_pred_9_50.csv
fig2f_neuron_idx_0_00512.csv fig2f_neuron_idx_0_00512.csv info_2_16.csv info_7_6.csv test_act_0_16.csv test_act_4_6.csv test_pred_0_100.csv test_pred_4_16.csv
fig2f_neuron_idx_0_01024.csv fig2f_neuron_idx_0_01024.csv info_2_162.csv info_7_75.csv test_act_0_162.csv test_act_4_75.csv test_pred_0_12.csv test_pred_4_162.csv
fig2f_neuron_idx_0_02048.csv fig2f_neuron_idx_0_02048.csv info_2_32.csv info_7_8.csv test_act_0_32.csv test_act_4_8.csv test_pred_0_125.csv test_pred_4_32.csv
fig2f_neuron_idx_0_03048.csv fig2f_neuron_idx_0_03048.csv info_2_50.csv info_8_100.csv test_act_0_50.csv test_act_5_100.csv test_pred_0_14.csv test_pred_4_50.csv
fig2f_neuron_idx_0_04001.csv fig2f_neuron_idx_0_04001.csv info_2_6.csv info_8_12.csv test_act_0_6.csv test_act_5_12.csv test_pred_0_16.csv test_pred_4_6.csv
fig2f_neuron_idx_0_05001.csv fig2f_neuron_idx_0_05001.csv info_2_75.csv info_8_125.csv test_act_0_75.csv test_act_5_125.csv test_pred_0_162.csv test_pred_4_75.csv
fig2f_neuron_idx_0_06001.csv fig2f_neuron_idx_0_06001.csv info_2_8.csv info_8_14.csv test_act_0_8.csv test_act_5_14.csv test_pred_0_32.csv test_pred_4_8.csv
fig2f_neuron_idx_0_08001.csv fig2f_neuron_idx_0_08001.csv info_3_100.csv info_8_16.csv test_act_10_100.csv test_act_5_16.csv test_pred_0_50.csv test_pred_5_100.csv
root@3346ae4cd4fe:/workspace# cd examples
root@3346ae4cd4fe:/workspace/examples# ls
figure1b.rs figure2b.rs figure2d.rs figure2f.rs figure3b.rs figure4_raybnn.rs figure5_raybnn2.rs table1_deep4net_raybnn.rs table1_transfer_xdawn_deep4net_raybnn.rs
figure2a.rs figure2c.rs figure2e.rs figure3a.rs figure3d.rs figure4_raybnn_optim.rs figure6_raybnn2.rs table1_raybnn_optim.rs
root@3346ae4cd4fe:/workspace/examples#
```

Plot - Figure 1b

```
root@3346ae4cd4fe:/workspace# cd examples
root@3346ae4cd4fe:/workspace/examples# ls
figure1b.rs figure2b.rs figure2d.rs figure2f.rs figure3b.rs figure4_raybnn.rs      figure5_raybnn2.rs  table1_deep4net_raybnn.rs  table1_transfer_xdawn_deep4net_raybnn.rs
figure2a.rs figure2c.rs figure2e.rs figure3a.rs figure3d.rs figure4_raybnn_optim.rs  figure6_raybnn2.rs  table1_raybnn_optim.rs
root@3346ae4cd4fe:/workspace/examples# cargo run --example figure1b --release
Compiling autocfg v1.1.0
Compiling proc-macro2 v1.0.66
Compiling unicode-ident v1.0.11
Compiling thiserror v1.0.44
Compiling cfg-if v1.0.0
Compiling libm v0.2.7
Compiling ucd-trie v0.1.6
Compiling libc v0.2.147
Compiling serde v1.0.183
Compiling crossbeam-utils v0.8.16
Compiling serde_derive v1.0.183
Compiling once_cell v1.18.0
Compiling crc32fast v1.3.2
Compiling serde_json v1.0.104
Compiling itoa v1.0.9
Compiling scopeguard v1.2.0
Compiling adler v1.0.2
Compiling ryu v1.0.15
Compiling rawpointer v0.2.1
Compiling rayon-core v1.11.0
Compiling miniz_oxide v0.7.1
Compiling num-traits v0.2.16
Compiling num-integer v0.1.45
Compiling num-bigint v0.4.3
Compiling memoffset v0.9.0
Compiling crossbeam-epoch v0.9.15
Compiling matrixmultiply v0.3.7
Compiling num-iter v0.1.43
Building [=====] 21/107: crc32fast(build), crossbeam-utils, thiserror(build), serde_derive, crossbeam-epoch(build.rs), num-integer(build.rs), libc(build.rs), n...
```

```
root@3346ae4cd4fe:/worksp X + ▾
```

```
Compiling adler v1.0.2
Compiling ryu v1.0.15
Compiling rawpointer v0.2.1
Compiling rayon-core v1.11.0
Compiling miniz_oxide v0.7.1
Compiling num-traits v0.2.16
Compiling num-integer v0.1.45
Compiling num-bigint v0.4.3
Compiling memoffset v0.9.0
Compiling crossbeam-epoch v0.9.15
Compiling matrixmultiply v0.3.7
Compiling num-iter v0.1.43
Compiling num-rational v0.4.1
Compiling crossbeam-channel v0.5.8
Compiling flate2 v1.0.26
Compiling byteorder v1.4.3
Compiling ppv-lite86 v0.2.17
Compiling quote v1.0.32
Compiling lazy_static v1.4.0
Compiling getrandom v0.2.10
Compiling syn v2.0.28
Compiling num_cpus v1.16.0
Compiling match_cfg v0.1.0
```

```
Compiling match_cfg v0.1.0
Compiling either v1.9.0
Compiling hostname v0.3.1
Compiling rand_core v0.6.4
Compiling nohash-hasher v0.2.0
Compiling rand_chacha v0.3.1
Compiling rand v0.8.5
Compiling crossbeam-deque v0.8.3
Compiling num-complex v0.4.3
Compiling half v2.3.1
Compiling thiserror-impl v1.0.44
Compiling rayon v1.7.0
Compiling ndarray v0.15.6
Compiling num v0.4.1
Compiling pest v2.7.2
Compiling zip v0.5.13
Compiling semver-parser v0.10.2
Compiling pest_meta v2.7.2
Compiling semver v0.11.0
Compiling rustc_version v0.3.3
Compiling pest_generator v2.7.2
Compiling arrayfire_fork v3.8.1
Compiling pest_derive v2.7.2
Compiling py_literal v0.4.0
Compiling ndarray-npy v0.8.1
Compiling raybnn v0.1.5 (/workspace)
    Finished 'release' profile [optimized] target(s) in 36.11s
        Running '/workspace/target/release/examples/figure1b'
root@3346ae4cd4fe:/workspace/examples#
```

Plot Output Csv

```
$ run_results_rust.sh figure1_neural_network.csv X
examples > figure1_neural_network.csv
1 -0.17504264,-0.08350303,-0.033015713,-0.11782305,-0.006046123,-0.013754985,0.041539777,0.086195774,-0.03633223,-0.07844993,-0.062000636,-0.0825422
2 0,0,0,0,0,0,0,0,26,46,75,105,129,143,177,208,233,268,303,338,370,398,437,477,517,555,604,659,679,705,725,760,795,834,866,882,915,930,959,984
3 0,1,2,3,4,5,6,7,8,10,13,22,25,26,27,28,29,32,36,37,40,42,43,50,51,58,3,6,7,9,11,15,17,19,27,29,36,37,39,41,42,44,46,48,50,54,0,1,2,3,4,5,6,7,8,9,1
4 -3.128837e-7,-1.0042684e-8,6.5898416e-7,4.759105e-7,-6.877254e-7,-2.3181335e-6,-1.0190323e-6,-6.4143876e-8,-4.4717854e-8,8.39365e-7,-0.045616087,-
5 1.0,1.0,1.0,1.0,0.9999998,1.0,0.9999999,1.0,0.9999998,1.0,1.0,0.9999994,0.9999994,0.9999999,1.0000001,0.9999994,1.0,1.0,0.9999997,1.0000001,0.9
6 -2.885567e-8,1.1792589e-7,-4.863389e-9,3.09619e-8,1.23693065e-8,2.7736954e-8,-4.4700364e-8,3.9708375e-8,1.1669447e-7,2.071365e-7,5.7670654e-8,-2.1
7 1.3015596e-8,-2.569744e-10,-6.5680766e-10,-8.1372453e-10,4.1894115e-9,1.026872e-8,-1.2964386e-8,5.3851973e-10,1.3946971e-8,5.4476748e-9,1.1009854e
8 -1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-1.0,-
9 -1.23017605e-8,-1.822651e-8,-7.1331083e-9,-7.375791e-9,8.433091e-9,-1.70166e-8,3.9234953e-9,1.1750543e-9,1.9369422e-8,3.5580865e-9,-1.0062521e-8,6
10 3.1640449,2.0151715,-0.07757171,1.0475712,-0.8578888,2.8066957,-1.581829,-0.16264114,0.59159464,-1.0454084,0.27638248,-0.13415714,0.80571526,-0.05
11 -2.4909048,-1.4381245,0.0,1.4381244,-2.876249,-1.7613356,0.0,1.7613355,-3.0507226,-1.9294466,0.7894228,2.3266666,-0.096865624,-1.3641683,-3.262648
12 0,1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,
13 200,10,1,2,61,3,5000,32,1
14 0.1,0.5,0.001,3.9029062,0.1,4.0,0.01,0.0,0.0,0.005,0.01,0.01
```

15

Copy the csv to matlab_plot

```
matlab_plot
├── CSRtoCOO.m
└── figure1_neural_network.csv
```

```
figure1b_plot.m
figure2a_plot.m
figure2b_plot.m
figure2c_plot.m
figure2d_plot.m
figure2e_plot.m
figure2f_plot.m
figure3a_plot.m
figure3b_plot.m
figure3c_plot.m
figure3d_plot.m
figure3e_plot.m
```

Make Sure Matlab Plot on Local Host - Not in Docker

```
root@3346ae4cd4fe:/workspace/matlab_plot# ls
CSRtoCOO.m      figure1_neural_network.csv  figure2b_plot.m  figure2e_plot.m
Prob_length.m    figure1b_plot.m              figure2c_plot.m  figure2f_plot.m
UAF.m            figure2a_plot.m              figure2d_plot.m  figure3a_plot.m
root@3346ae4cd4fe:/workspace/matlab_plot# matlab -r figure1b_plot.m
bash: matlab: command not found
root@3346ae4cd4fe:/workspace/matlab_plot#
```

File Edit Selection View Go Run Terminal Help

raybnn

EXPLORER

RAYBNN

- > arrayfire
- > arrayfire-rust
- > examples
- matlab_plot
 - C CSRtoCOO.m
 - figure1_neural_network.csv
 - C figure1b_plot.m
 - C figure2a_plot.m
 - C figure2b_plot.m
 - C figure2c_plot.m
 - C figure2d_plot.m
 - C figure2e_plot.m
 - C figure2f_plot.m
 - C figure3a_plot.m
 - C figure3b_plot.m
 - C figure3c_plot.m
 - C figure3d_plot.m
 - C figure3e_plot.m
 - C figure3f_plot.m
 - C figure4a_plot.m
 - C figure4b_plot.m
 - C figure4c_plot.m
 - C figure4d_plot.m
 - C figure4e_plot.m
 - C figure4f_plot.m
 - meanY.dat
 - C plotTree.m
 - C Prob_length.m
 - C readNetworkFile.m
 - C redblue.m
 - stdY.dat
 - C UAF.m

OUTLINE

TIMELINE

figure1_neural_network.csv new_matlab_plot

figure1_neural_network.csv matlab_plot

C figure1b_plot.m x

```
6
7 filename = './figure1_neural_network.csv';
8
9 %Read Neural Network file
10 [WValues,WRowIdxCSR,WColIdx,H,A,B,C,D,E,glia_pos,neuron_pos,neuron_idx,net_data] = readNetworkFile(filename);
11
12 %Resize Network to Neural Network Sphere Radius
13 rs = max(neuron_pos,[],"all")*1.2;
14 neuron_pos=neuron_pos/rs;
15 glia_pos=glia_pos/rs;
16
17 %Get Network Parameters
18 neuron_size = net_data(1);
19 input_size = net_data(2);
20 output_size = net_data(3);
21
22 active_size = size(neuron_idx,1);
23
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

powerShell + ×

```
PS C:\Users\52322\OneDrive\Desktop\raybnn> cd matlab_plot
PS C:\Users\52322\OneDrive\Desktop\raybnn\matlab_plot> pwd
Path
-----
C:\Users\52322\OneDrive\Desktop\raybnn\matlab_plot

PS C:\Users\52322\OneDrive\Desktop\raybnn\matlab_plot> matlab -r figure1b_plot.m
```

master ↻ ⊞ 0 △ 0 ⌂ 0

Ln 1, Col 1 Spaces: 4 UTF-8 LF Objective-C

Local Host ! - Run with VScode on Local Host

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL PORTS

```
PS C:\Users\52322\OneDrive\Desktop\raybnn> cd matlab_plot  
PS C:\Users\52322\OneDrive\Desktop\raybnn\matlab_plot> pwd
```

Path

```
C:\Users\52322\OneDrive\Desktop\raybnn\matlab_plot
```

```
PS C:\Users\52322\OneDrive\Desktop\raybnn\matlab_plot> matlab -r figure1b_plot.m
```

Once it Starts - Matlab will Appear



**Remember to register and login with your
Uvic email**

Uvic offer free pass of Matlab for student

当前文件夹 C:\Users\52322\OneDrive\Desktop\raybnn\matlab_plot

名称

- CSRtoCOO.m
- figure1_neural_network.csv
- figure1b_plot.m
- figure2a_plot.m
- figure2b_plot.m
- figure2c_plot.m
- figure2d_plot.m
- figure2e_plot.m
- figure2f_plot.m
- figure3a_plot.m
- figure3b_plot.m
- figure3c_plot.m
- figure3d_plot.m
- figure3e_plot.m
- figure3f_plot.m
- figure4a_plot.m
- figure4b_plot.m
- figure4c_plot.m
- figure4d_plot.m
- figure4e_plot.m
- figure4f_plot.m
- meanY.dat
- plotTree.m

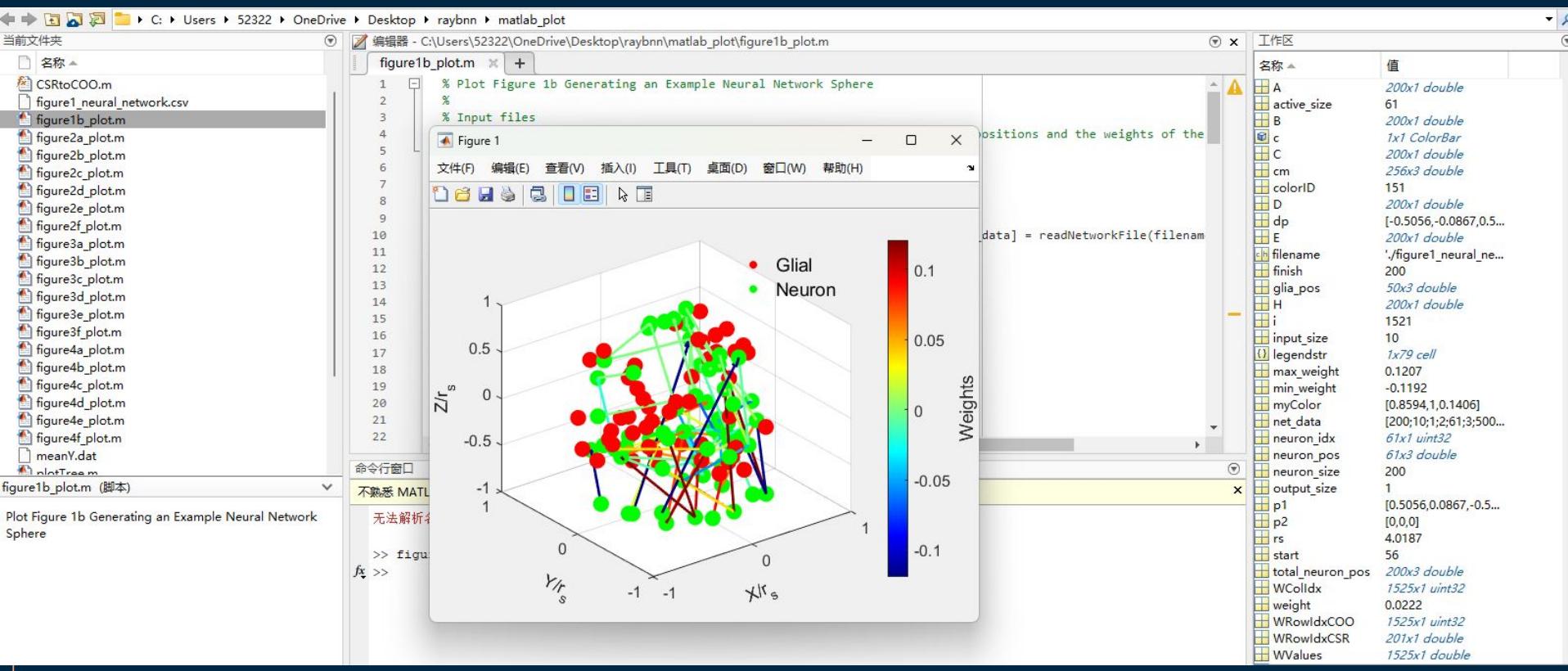
figure1b_plot.m × + 编辑器 - C:\Users\52322\OneDrive\Desktop\raybnn\matlab_plot\figure1b_plot.m

```
1 % Plot Figure 1b Generating an Example Neural Network Sphere
2 %
3 % Input files
4 % ./figure1_neural_network.csv    Neural network file containing the cell positions and the weights of the
5 %
6
7 filename = './figure1_neural_network.csv';
8
9 %Read Neural Network file
10 [WValues,WRowIdxCSR,WColIdx,H,A,B,C,D,E,glia_pos,neuron_pos,neuron_idx,net_data] = readNetworkFile(filename);
11
12 %Resize Network to Neural Network Sphere Radius
13 rs = max(neuron_pos,[],"all")*1.2;
14 neuron_pos=neuron_pos/rs;
15 glia_pos=glia_pos/rs;
16
17 %Get Network Parameters
18 neuron_size = net_data(1);
19 input_size = net_data(2);
20 output_size = net_data(3);
21
22
```

命令行窗口 不熟悉 MATLAB? 请参阅有关[快速入门](#)的资源。

无法解析名称 'figure1b_plot.m'。

f x >>



Finally!

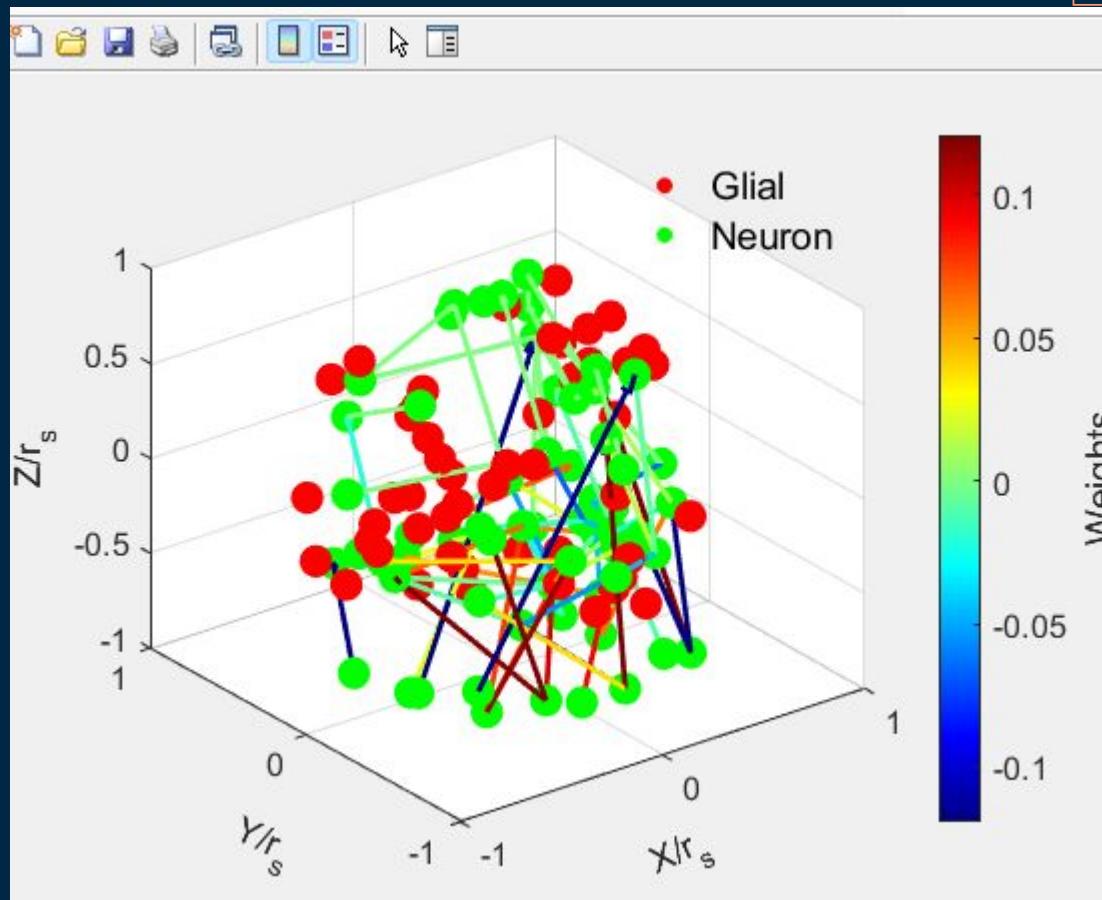


Figure 1b

All the Steps Above

If you still feels confuse about that, I will plot another figure 2a.

Follow all the steps carefully, you will be good ! ^_^

Plot Figure 2a Measuring the Cell Density and Probability of Collisions

Related scripts at

- [RayBNN/examples/figure2a.rs](#)
- [RayBNN/matlab_plot/figure2a_plot.m](#)

Where my Matlab file at

```
root@3346ae4cd4fe:/workspace/matlab_plot# cd /workspace/examples
root@3346ae4cd4fe:/workspace/examples# ls
figure1_neural_network.csv  figure2a.rs  figure2c.rs  figure2e.rs  figure3a.rs  figure3d.rs
figure1b.rs                figure2b.rs  figure2d.rs  figure2f.rs  figure3b.rs  figure4_raybnn.rs
root@3346ae4cd4fe:/workspace/examples#
```



Since I'm going to plot 2a, make sure the **figure2a.rs** here

Run this Command to generate

```
root@3346ae4cd4fe:/workspace/matlab_plot# cd /workspace/examples
root@3346ae4cd4fe:/workspace/examples# ls
figure1_neural_network.csv  figure2a.rs  figure2c.rs  figure2e.rs  figure3a.rs
figure1b.rs                figure2b.rs  figure2d.rs  figure2f.rs  figure3b.rs
root@3346ae4cd4fe:/workspace/examples# cargo run --example figure2a --release
```



```
root@3346ae4cd4fe:/workspace/examples# cargo run --example figure2a --release
Compiling libm v0.2.7
Compiling thiserror v1.0.44
Compiling libc v0.2.147
Compiling crossbeam-utils v0.8.16
Compiling num-bigint v0.4.3
Compiling serde v1.0.183
Compiling crossbeam-epoch v0.9.15
Compiling serde_json v1.0.104
Compiling crc32fast v1.3.2
Compiling num-rational v0.4.1
Compiling matrixmultiply v0.3.7
Compiling num-iter v0.1.43
Compiling flate2 v1.0.26
Compiling num-traits v0.2.16
Compiling pest v2.7.2
Compiling crossbeam-channel v0.5.8
Compiling getrandom v0.2.10
Compiling num_cpus v1.16.0
Compiling hostname v0.3.1
Compiling zip v0.5.13
Compiling crossbeam-deque v0.8.3
Compiling rand_core v0.6.4
Compiling num-integer v0.1.45
Compiling num-complex v0.4.3
Compiling rand_chacha v0.3.1
Compiling rayon-core v1.11.0
Compiling half v2.3.1
Compiling ndarray v0.15.6
Compiling rand v0.8.5
Compiling semver-parser v0.10.2
Compiling pest_meta v2.7.2
Compiling rayon v1.7.0
Compiling semver v0.11.0
Building [=====>] 82/107: semver-parser, semver, pest_meta, serde_json
```

This step will generate the necessary csv file we need to plot

Figure 2a takes a while

```
Compiling rayon-core v1.11.0
Compiling half v2.3.1
Compiling ndarray v0.15.6
Compiling rand v0.8.5
Compiling semver-parser v0.10.2
Compiling pest_meta v2.7.2
Compiling rayon v1.7.0
Compiling semver v0.11.0
Compiling rustc_version v0.3.3
Compiling pest_generator v2.7.2
Compiling arrayfire_fork v3.8.1
Compiling pest_derive v2.7.2
Compiling num v0.4.1
Compiling py_literal v0.4.0
Compiling ndarray-npy v0.8.1
Compiling raybnm v0.1.5 (/workspace)
Finished 'release' profile [optimized] target(s) in 27.78s
Running '/workspace/target/release/examples/figure2a'
```

```
Initial Number of Cells: [20, 20, 40, 80, 160, 320, 640, 1280, 2560, 4000, 8000, 16000, 32000, 64000, 128000, 256000, 512000, 1024000, 2048000, 4000000, 8000000, 16000000, 32000000]
final_neuron_num [10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7987, 15990, 31899, 63661, 126597, 250492, 489994, 938471, 1683938, 2838694, 4029272, 4063698, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7995, 15985, 31897, 63647, 126592, 250520, 490025, 938177, 1684127, 2839445, 4029992, 4063543, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3997, 7995, 15982, 31988, 63629, 126596, 250328, 489995, 937987, 1684403, 2839203, 4030964, 4063485, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3998, 7995, 15986, 31899, 63619, 126565, 250464, 496178, 938240, 1684995, 2839685, 4030312, 4061619, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3998, 7995, 15979, 31904, 63630, 126568, 250255, 490073, 938076, 1685246, 2839961, 4032344, 4062623, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1998, 3999, 7995, 15988, 31981, 63610, 126639, 250397, 489874, 937628, 1686320, 2838484, 4030538, 4061501, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7995, 15986, 31987, 63662, 126529, 250564, 489888, 937797, 1684907, 2838915, 4031006, 4063841, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7992, 15981, 31980, 63639, 126598, 250337, 489770, 938241, 1685266, 2839362, 4031380, 4064759]
final_glia_num [10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7987, 15990, 31899, 63661, 126597, 250492, 489994, 938471, 1683939, 2838694, 4029272, 4063698, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3995, 7995, 15985, 31898, 63647, 126592, 250520, 490026, 938178, 1684128, 2839446, 4029993, 4063544, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3997, 7995, 15982, 31988, 63630, 126596, 250328, 489995, 937987, 1684403, 2839203, 4030964, 4063485, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1999, 3998, 7995, 15986, 31899, 63620, 126566, 250464, 490179, 938240, 1684995, 2839685, 4030312, 4061619, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3998, 7995, 15979, 31904, 63630, 126602, 250255, 490073, 938076, 1685246, 2839961, 4032344, 4062623, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 1998, 3999, 7995, 15988, 31981, 63610, 126639, 250397, 489874, 937628, 1686320, 2838484, 4030538, 4061501, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3997, 7995, 15986, 31987, 63662, 126529, 250564, 489888, 937797, 1684907, 2838915, 4031006, 4063841, 10, 10, 20, 40, 80, 160, 320, 640, 1280, 2000, 3999, 7992, 15981, 31980, 63639, 126598, 250337, 489770, 938241, 1685266, 2839362, 4031380, 4064759]
collision_run_time [0.068725895, 0.000810059, 0.001972005, 0.002157878, 0.003512846, 0.001157799, 0.001897483, 0.001872156, 0.004801993, 0.007818304, 0.015063444, 0.026732088, 0.047766958, 0.121802108, 0.945789521, 10.18457157, 9.840878236, 13.670626982, 27.378864431, 52.368486436, 111.555289773, 244.465369024, 590.561830731, 0.004938962, 0.000558969, 0.000534825, 0.000620156, 0.000598778, 0.001667749, 0.002810948, 0.004559859, 0.032021891, 0.033896395, 0.056741867, 0.143600344, 0.084884047, 0.26784917, 1.307694106, 3.4541440469999998, 5.563203888, 11.346757269, 24.658615249, 50.362826527, 111.496806655, 227.863055224, 657.219698936, 0.008273332, 0.00235319, 0.000880636, 0.000873177, 0.000826131, 0.001607112, 0.002524775, 0.011625836, 0.0266852, 0.036199213, 0.055687019, 0.109293925, 0.226405716, 0.596651975, 1.313626866, 3.025867808, 5.41415068, 12.096788868, 24.49494943704, 51.606944863, 184.190107848, 225.806579244, 573.638093099, 0.006228742, 0.001733965, 0.000962063, 0.001861268, 0.000794138, 0.002686228, 0.005752972, 0.018094893, 0.005117847, 0.104130807, 0.077885927, 0.099006588, 0.250813295, 1.9547730942, 0.245133561, 2.70028564, 5.331099183, 11.994930152, 24.191771831, 52.14397714, 112.275340815, 256.375835151, 524.358758608, 0.005144339, 0.002001939, 0.000555345, 0.000642576, 0.000743999, 0.006224853, 0.002006666, 0.021032206, 0.088288191, 0.114268532, 0.09778173, 1.447504848, 0.10933083, 0.570637434, 2.710021037, 6.78902664, 10.878184168, 24.101483018, 49.444793065, 116.472703479, 253.589205658, 530.41963583, 0.005446245, 0.001964781, 0.000667437, 0.000628573, 0.0009833009, 0.003362987, 0.00638066, 0.017654931, 0.075518406, 0.098163436, 0.03969819, 0.111591377, 0.257944547, 0.591204828, 1.283609152, 2.78798014, 5.392399078, 11.764688558, 24.232675881, 49.984414882, 105.588548498, 258.215044324, 715.47359407, 0.004889239, 0.002478794, 0.001230086, 0.001137539, 0.0022448314, 0.003303785, 0.005845633, 0.021054357, 0.08879749, 0.118877766, 0.068380151, 0.107080022, 0.241181714, 0.622298596, 2.43954768, 1.7933802650000001, 5.64136515, 11.441765211, 24.298872238, 58.585440796, 113.651777777, 223.11087806, 714.74986236, 0.004807689, 0.002768303, 0.000796341, 0.000572395, 0.000542687, 0.00173375, 0.003096723, 0.0072417974, 0.027361394, 0.036494772, 0.056982836, 0.093167702, 0.055099702, 0.313057632, 1.205713463, 3.325035706, 5.242160018, 10.944655557, 24.909053962, 49.846785646, 104.295796059, 225.063902555, 575.896593263, 0.005369299, 0.005445164, 0.00359427, 0.00163807, 0.0021227315, 0.002767762, 0.054442463, 0.021589467, 0.076393463, 0.115524057, 0.128023914, 0.106879008, 0.247531397, 0.56984101, 1.489817827, 2.602829886, 3.514569971, 12.409628816, 23.768127514, 49.438576493, 111.255640154, 223.229040225, 690.765873137, 0.005143779, 0.00138373, 0.001352412, 0.000568708, 0.000667229, 0.001782357, 0.000938217, 0.006845964, 0.02244843, 0.0355556636, 0.052565631, 0.142336428, 0.141432561, 0.608165442, 1.320878121999999, 2.952692309999999, 5.494805929, 11.205832411, 25.170742612, 50.16941498, 113.637687341, 226.767999969, 591.822710176]
```

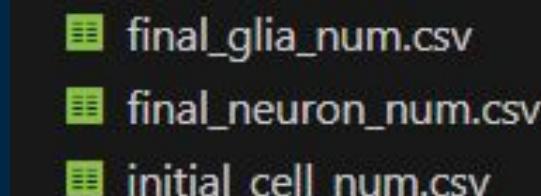
```
root@3346ae4cd4fe:/workspace/examples#
```

Figure 2a

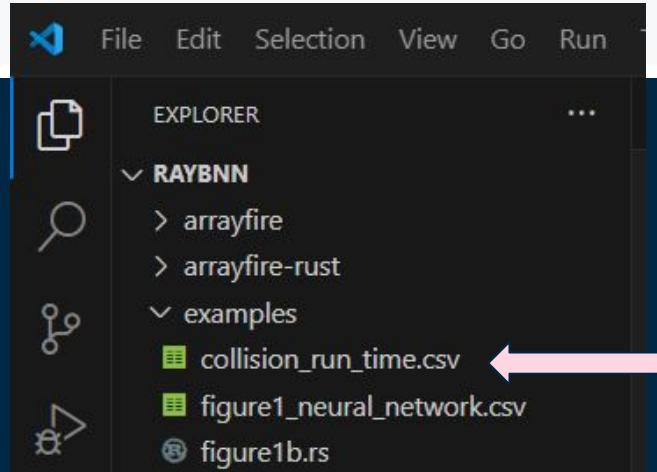
For this figure, there are 4 Csv file needed.

On the Host Machine, Plot ./initial_cell_num.csv ./final_neuron_num.csv ./final_glia_num.csv ./collision_run_time.csv using Matlab

```
cd $RAYBNN_DIR/RayBNN/matlab_plot/  
matlab -r figure2a_plot.m
```



```
final_glia_num.csv  
final_neuron_num.csv  
initial_cell_num.csv
```



Copy CSV File

**Copy the four required CSV file under
Matlab_plot directory.**

▼ matlab_plot
└ collision_run_time.csv
└ CSRtoCOO.m
└ figure1_neural_network.csv
└ figure1b_plot.m
└ figure2a_plot.m
└ figure2b_plot.m
└ figure2c_plot.m
└ figure2d_plot.m
└ figure2e_plot.m
└ figure2f_plot.m
└ figure3a_plot.m
└ figure3b_plot.m
└ figure3c_plot.m
└ figure3d_plot.m
└ figure3e_plot.m
└ figure3f_plot.m
└ figure4a_plot.m
└ figure4b_plot.m
└ figure4c_plot.m
└ figure4d_plot.m
└ figure4e_plot.m
└ figure4f_plot.m
└ final_glia_num.csv
└ final_neuron_num.csv
└ initial_cell_num.csv
└ meanY.dat

Plot by Matlab On Local Host

当前文件夹

名称	值
collision_run_time.csv	200x1 double
CSRtoCOO.m	61
figure1_neural_network.csv	200x1 double
figure1b_plot.m	1x1 ColorBar
figure2a_plot.m	200x1 double
figure2b_plot.m	256x3 double
figure2c_plot.m	151
figure2d_plot.m	200x1 double
figure2e_plot.m	[-0.5056,-0.0867,0.5...
figure2f_plot.m	200x1 double
figure3a_plot.m	'/figure1_neural_ne...
figure3b_plot.m	200
figure3c_plot.m	50x3 double
figure3d_plot.m	200x1 double
figure3e_plot.m	1521
figure3f_plot.m	10
figure4a_plot.m	1x79 cell
figure4b_plot.m	0.1207
figure4c_plot.m	-0.1192
figure4d_plot.m	[0.8594,1.0,1.1406]
figure4e_plot.m	[200;10;1;2;61;3;500;...
figure4f_plot.m	61x1 uint32
final_glia_num.csv	61x3 double
figure2a_plot.m (脚本)	200

编辑器 - C:\Users\52322\OneDrive\Desktop\raybnn\matlab_plot\figure2a_plot.m

```
1 % Plot Figure 2a Measuring the Cell Density and Probability of Collisions
2 % The neural network sphere radius is constant, while the number of cells changes.
3 % It allows us to plot cell density vs the probability of cell collisions
4 %
5 %
6 % Input files
7 % ./initial_cell_num.csv Contains the initial number of cells
8 % ./final_neuron_num.csv Contains the final number of neurons after deleting collided cells
9 % ./final_glia_num.csv Contains the final number of glial cells after deleting collided cells
10 % ./collision_run_time.csv Contains the time it takes to run collision detection
11
12
13
14
15
16 clear all;
17 close all;
18
19 fontsz=16;
20
21
22
```

命令行窗口

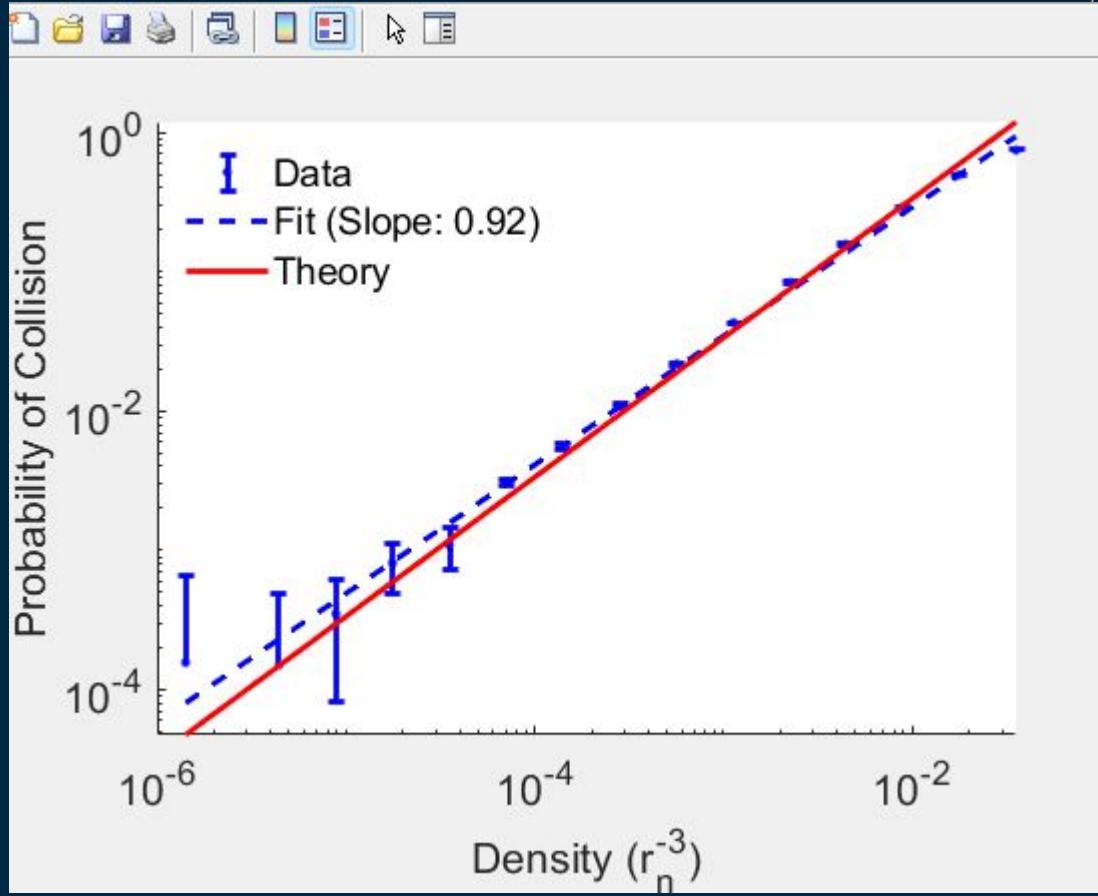
不熟悉 MATLAB? 请参阅有关[快速入门](#)的资源。

无法解析名称 'figure1b_plot.m'。

```
>> figure1b_plot
>>
```

工作区

名称	值
A	200x1 double
active_size	61
B	200x1 double
c	1x1 ColorBar
C	200x1 double
cm	256x3 double
colorID	151
D	200x1 double
dp	[-0.5056,-0.0867,0.5...
E	200x1 double
filename	'/figure1_neural_ne...
finish	200
glia_pos	50x3 double
H	200x1 double
i	1521
input_size	10
legendstr	1x79 cell
max_weight	0.1207
min_weight	-0.1192
myColor	[0.8594,1.0,1.1406]
net_data	[200;10;1;2;61;3;500;...
neuron_idx	61x1 uint32
neuron_pos	61x3 double
neuron_size	200
output_size	1
p1	[0.5056,0.0867,-0.5...
p2	[0,0,0]
rs	4.0187
start	56
total_neuron_pos	200x3 double
WColIdx	1525x1 uint32
WRowIdxCOO	0.0222
WRowIdxCSR	1525x1 uint32
WValues	201x1 double
	1525x1 double







GeForce 900 GeForce 10 GeForce 20 **GeForce 30** GeForce 40

RX 7000 RX 6000 RX 5000 RX 400/500/Vega **Radeon R300**

RTX 4090

RTX 4090D

RTX 4080
SUPER

RTX 4080

RTX 4070 Ti
SUPER

RTX 3090 Ti RTX 4070 Ti

RTX 3090

RTX 3080 Ti RTX 4070
SUPER

RX 7900 XTX

RX 7900 XT

RX 6950 XT

RX 6900 XT
Water Cooling
Edition

RX 6900 XT

RX 7900 GRE

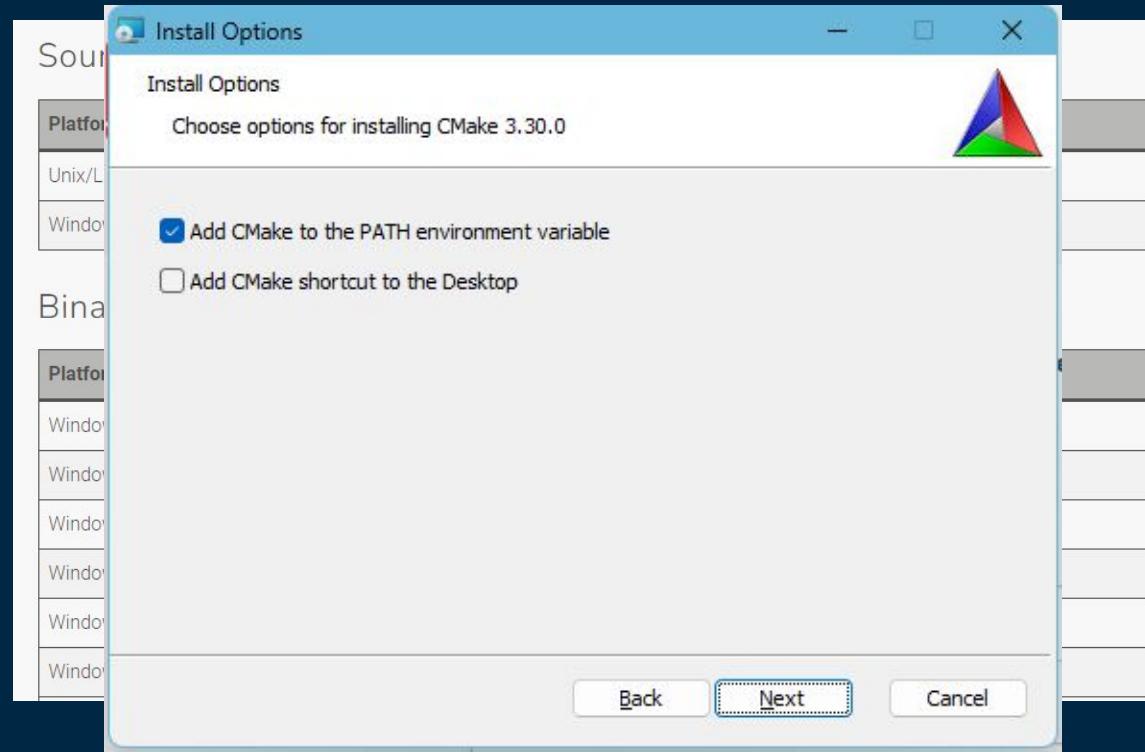
Install Git - Use Git Command on Windows

<https://git-scm.com/>



Install CMake

<https://cmake.org/download/>



Trouble Shoot

```
note: This error originates from a subprocess, and is likely not a problem with pip.
```

```
error: legacy-install-failure
```

```
x Encountered error while trying to install package.
```

```
↳ torch_scatter
```

```
note: This is an issue with the package mentioned above, not pip.
```

```
hint: See above for output from the failure.
```

```
root@b60cc8e6c43b:/workspace# nvcc --version
```

```
nvcc: NVIDIA (R) Cuda compiler driver
```

```
Copyright (c) 2005-2022 NVIDIA Corporation
```

```
Built on Tue_Mar_8_18:18:20_PST_2022
```

```
Cuda compilation tools, release 11.6, V11.6.124
```

```
Build cuda_11.6.r11.6/compiler.31057947_0
```

```
root@b60cc8e6c43b:/workspace# apt-get update
```

```
Hit:1 https://developer.download.nvidia.com/compute/cuda/repos/ubuntu1804/x86_64 InRelease
```

```
Hit:2 http://archive.ubuntu.com/ubuntu bionic InRelease
```

```
Hit:3 http://security.ubuntu.com/ubuntu bionic-security InRelease
```

```
Hit:4 http://archive.ubuntu.com/ubuntu bionic-updates InRelease
```

```
Hit:5 http://archive.ubuntu.com/ubuntu bionic-backports InRelease
```

```
Reading package lists... Done
```

```
root@b60cc8e6c43b:/workspace#
```