

This is the main Colab Document that we ran all of our experiments from using a T4 GPU. We downloaded (and edited) the provided VAE repository, and all file edits can be seen attached to this assignment. Mainly, they focused on syntax changes to PyTorch Lightning due to updates over the years, as well as properly editing directories in order for proper configuration in a Colaboratory environment. To run different models, their configuration (.yaml) files must be edited in order to match your runtime environment and current dataset. A separate notebook is provided specifically for the training of a VAE-GAN model; much of the code is duplicated there.

```
# Setting up data
mkdir Data
cd Data
import gdown

file_id = '1m8-EBPgi5MRubrm6iQjafK2QMhDBMSfJ'
url = f'https://drive.google.com/uc?id={file_id}'

gdown.download(url, output='Data', quiet=False)

Downloading...
From: https://drive.google.com/uc?id=1m8-EBPgi5MRubrm6iQjafK2QMhDBMSfJ
To: /content/Data/Data
100%|██████████| 1.31G/1.31G [00:20<00:00, 64.9MB/s]

{"type": "string"}

#Install dataset from git
!git clone https://github.com/MicheleDamian/prostate-gleason-
dataset.git

fatal: destination path 'prostate-gleason-dataset' already exists and
is not an empty directory.

# Mounting Drive
from google.colab import drive
drive.mount('/content/drive')

Drive already mounted at /content/drive; to attempt to forcibly
remount, call drive.mount("/content/drive", force_remount=True).

cd /content/drive/MyDrive/VAE_final_project/
/content/drive/MyDrive/VAE_final_project

!git clone https://github.com/AntixK/PyTorch-VAE.git

fatal: destination path 'PyTorch-VAE' already exists and is not an
empty directory.

cd PyTorch-VAE

/content/drive/MyDrive/VAE_final_project/PyTorch-VAE
```

```
!pip install cohere openai tiktoken
!pip install -r requirements.txt

Collecting cohere
  Downloading cohere-4.37-py3-none-any.whl (48 kB)
  48.9/48.9 kB 1.5 MB/s eta
0:00:00
  221.4/221.4 kB 9.8 MB/s eta
0:00:00
  anylinux_2_17_x86_64.manylinux2014_x86_64.whl (2.0 MB)
  2.0/2.0 MB 87.8 MB/s eta
0:00:00
Requirement already satisfied: aiohttp<4.0,>=3.0 in
/usr/local/lib/python3.10/dist-packages (from cohere) (3.9.1)
Collecting backoff<3.0,>=2.0 (from cohere)
  Downloading backoff-2.2.1-py3-none-any.whl (15 kB)
Collecting fastavro<2.0,>=1.8 (from cohere)
  Downloading fastavro-1.9.1-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (3.1 MB)
  3.1/3.1 MB 93.7 MB/s eta
0:00:00
Requirement already satisfied: importlib_metadata<7.0,>=6.0 in
/usr/local/lib/python3.10/dist-packages (from cohere) (6.8.0)
Requirement already satisfied: requests<3.0.0,>=2.25.0 in
/usr/local/lib/python3.10/dist-packages (from cohere) (2.31.0)
Requirement already satisfied: urllib3<3,>=1.26 in
/usr/local/lib/python3.10/dist-packages (from cohere) (2.0.7)
Requirement already satisfied: anyio<4,>=3.5.0 in
/usr/local/lib/python3.10/dist-packages (from openai) (3.7.1)
Requirement already satisfied: distro<2,>=1.7.0 in
/usr/lib/python3/dist-packages (from openai) (1.7.0)
Collecting httpx<1,>=0.23.0 (from openai)
  Downloading httpx-0.25.2-py3-none-any.whl (74 kB)
  75.0/75.0 kB 9.8 MB/s eta
0:00:00
Requirement already satisfied: pydantic<3,>=1.9.0 in
/usr/local/lib/python3.10/dist-packages (from openai) (1.10.13)
Requirement already satisfied: sniffio in
/usr/local/lib/python3.10/dist-packages (from openai) (1.3.0)
Requirement already satisfied: tqdm>4 in
/usr/local/lib/python3.10/dist-packages (from openai) (4.66.1)
Requirement already satisfied: typing-extensions<5,>=4.5 in
/usr/local/lib/python3.10/dist-packages (from openai) (4.5.0)
Requirement already satisfied: regex>=2022.1.18 in
/usr/local/lib/python3.10/dist-packages (from tiktoken) (2023.6.3)
Requirement already satisfied: attrs>=17.3.0 in
/usr/local/lib/python3.10/dist-packages (from aiohttp<4.0,>=3.0-
>cohere) (23.1.0)
Requirement already satisfied: multidict<7.0,>=4.5 in
/usr/local/lib/python3.10/dist-packages (from aiohttp<4.0,>=3.0-
```

```
>cohere) (6.0.4)
Requirement already satisfied: yarl<2.0,>=1.0 in
/usr/local/lib/python3.10/dist-packages (from aiohttp<4.0,>=3.0-
>cohere) (1.9.3)
Requirement already satisfied: frozenlist>=1.1.1 in
/usr/local/lib/python3.10/dist-packages (from aiohttp<4.0,>=3.0-
>cohere) (1.4.0)
Requirement already satisfied: aiosignal>=1.1.2 in
/usr/local/lib/python3.10/dist-packages (from aiohttp<4.0,>=3.0-
>cohere) (1.3.1)
Requirement already satisfied: async-timeout<5.0,>=4.0 in
/usr/local/lib/python3.10/dist-packages (from aiohttp<4.0,>=3.0-
>cohere) (4.0.3)
Requirement already satisfied: idna>=2.8 in
/usr/local/lib/python3.10/dist-packages (from anyio<4,>=3.5.0->openai)
(3.6)
Requirement already satisfied: exceptiongroup in
/usr/local/lib/python3.10/dist-packages (from anyio<4,>=3.5.0->openai)
(1.2.0)
Requirement already satisfied: certifi in
/usr/local/lib/python3.10/dist-packages (from httpx<1,>=0.23.0-
>openai) (2023.11.17)
Collecting httpcore==1.* (from httpx<1,>=0.23.0->openai)
  Downloading httpcore-1.0.2-py3-none-any.whl (76 kB)
  76.9/76.9 kB 10.6 MB/s eta
0:00:00
  httpcore==1.*->httpx<1,>=0.23.0->openai)
  Downloading h11-0.14.0-py3-none-any.whl (58 kB)
  58.3/58.3 kB 7.9 MB/s eta
0:00:00
Requirement already satisfied: zipp>=0.5 in /usr/local/lib/python3.10/dist-
packages (from importlib_metadata<7.0,>=6.0->cohere) (3.17.0)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/dist-packages (from requests<3.0.0,>=2.25.0-
>cohere) (3.3.2)
Installing collected packages: h11, fastavro, backoff, tiktoken,
httpcore, httpx, cohere, openai
Successfully installed backoff-2.2.1 cohere-4.37 fastavro-1.9.1 h11-
0.14.0 httpcore-1.0.2 httpx-0.25.2 openai-1.3.7 tiktoken-0.5.2
Collecting pytorch-lightning==1.5.6 (from -r requirements.txt (line
1))
  Downloading pytorch_lightning-1.5.6-py3-none-any.whl (525 kB)
  525.4/525.4 kB 7.6 MB/s eta
0:00:00
  -r requirements.txt (line 2))
  Downloading PyYAML-6.0-cp310-cp310-
manylinux_2_5_x86_64.manylinux1_x86_64.manylinux_2_12_x86_64.manylinux
2010_x86_64.whl (682 kB)
  682.2/682.2 kB 47.2 MB/s eta
```

```
0:00:00
Requirement already satisfied: tensorboard>=2.2.0 in
/usr/local/lib/python3.10/dist-packages (from -r requirements.txt
(line 3)) (2.14.1)
Requirement already satisfied: torch>=1.6.1 in
/usr/local/lib/python3.10/dist-packages (from -r requirements.txt
(line 4)) (2.1.0+cu118)
Requirement already satisfied: torchsummary==1.5.1 in
/usr/local/lib/python3.10/dist-packages (from -r requirements.txt
(line 5)) (1.5.1)
Requirement already satisfied: torchvision>=0.10.1 in
/usr/local/lib/python3.10/dist-packages (from -r requirements.txt
(line 6)) (0.16.0+cu118)
Requirement already satisfied: numpy>=1.17.2 in
/usr/local/lib/python3.10/dist-packages (from pytorch-
lightning==1.5.6->-r requirements.txt (line 1)) (1.23.5)
Requirement already satisfied: future>=0.17.1 in
/usr/local/lib/python3.10/dist-packages (from pytorch-
lightning==1.5.6->-r requirements.txt (line 1)) (0.18.3)
Requirement already satisfied: tqdm>=4.41.0 in
/usr/local/lib/python3.10/dist-packages (from pytorch-
lightning==1.5.6->-r requirements.txt (line 1)) (4.66.1)
Requirement already satisfied: fsspec[http]!=2021.06.0,>=2021.05.0
in /usr/local/lib/python3.10/dist-packages (from pytorch-
lightning==1.5.6->-r requirements.txt (line 1)) (2023.6.0)
Collecting torchmetrics>=0.4.1 (from pytorch-lightning==1.5.6->-r
requirements.txt (line 1))
  Downloading torchmetrics-1.2.1-py3-none-any.whl (806 kB)
----- 806.1/806.1 kB 53.1 MB/s eta
0:00:00
pytorch-lightning==1.5.6->-r requirements.txt (line 1))
  Downloading pyDeprecate-0.3.1-py3-none-any.whl (10 kB)
Requirement already satisfied: packaging>=17.0 in
/usr/local/lib/python3.10/dist-packages (from pytorch-
lightning==1.5.6->-r requirements.txt (line 1)) (23.2)
Requirement already satisfied: typing-extensions in
/usr/local/lib/python3.10/dist-packages (from pytorch-
lightning==1.5.6->-r requirements.txt (line 1)) (4.5.0)
Requirement already satisfied: absl-py>=0.4 in
/usr/local/lib/python3.10/dist-packages (from tensorboard>=2.2.0->-r
requirements.txt (line 3)) (1.4.0)
Requirement already satisfied: grpcio>=1.48.2 in
/usr/local/lib/python3.10/dist-packages (from tensorboard>=2.2.0->-r
requirements.txt (line 3)) (1.59.3)
Requirement already satisfied: google-auth<3,>=1.6.3 in
/usr/local/lib/python3.10/dist-packages (from tensorboard>=2.2.0->-r
requirements.txt (line 3)) (2.17.3)
Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in
/usr/local/lib/python3.10/dist-packages (from tensorboard>=2.2.0->-r
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requirements.txt (line 3)) (1.0.0)  
Requirement already satisfied: markdown>=2.6.8 in  
/usr/local/lib/python3.10/dist-packages (from tensorboard>=2.2.0->-r  
requirements.txt (line 3)) (3.5.1)  
Requirement already satisfied: protobuf>=3.19.6 in  
/usr/local/lib/python3.10/dist-packages (from tensorboard>=2.2.0->-r  
requirements.txt (line 3)) (3.20.3)  
Requirement already satisfied: requests<3,>=2.21.0 in  
/usr/local/lib/python3.10/dist-packages (from tensorboard>=2.2.0->-r  
requirements.txt (line 3)) (2.31.0)  
Requirement already satisfied: setuptools>=41.0.0 in  
/usr/local/lib/python3.10/dist-packages (from tensorboard>=2.2.0->-r  
requirements.txt (line 3)) (67.7.2)  
Requirement already satisfied: six>1.9 in  
/usr/local/lib/python3.10/dist-packages (from tensorboard>=2.2.0->-r  
requirements.txt (line 3)) (1.16.0)  
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0  
in /usr/local/lib/python3.10/dist-packages (from tensorboard>=2.2.0->-r  
requirements.txt (line 3)) (0.7.2)  
Requirement already satisfied: werkzeug>=1.0.1 in  
/usr/local/lib/python3.10/dist-packages (from tensorboard>=2.2.0->-r  
requirements.txt (line 3)) (3.0.1)  
Requirement already satisfied: filelock in  
/usr/local/lib/python3.10/dist-packages (from torch>=1.6.1->-r  
requirements.txt (line 4)) (3.13.1)  
Requirement already satisfied: sympy in  
/usr/local/lib/python3.10/dist-packages (from torch>=1.6.1->-r  
requirements.txt (line 4)) (1.12)  
Requirement already satisfied: networkx in  
/usr/local/lib/python3.10/dist-packages (from torch>=1.6.1->-r  
requirements.txt (line 4)) (3.2.1)  
Requirement already satisfied: jinja2 in  
/usr/local/lib/python3.10/dist-packages (from torch>=1.6.1->-r  
requirements.txt (line 4)) (3.1.2)  
Requirement already satisfied: triton==2.1.0 in  
/usr/local/lib/python3.10/dist-packages (from torch>=1.6.1->-r  
requirements.txt (line 4)) (2.1.0)  
Requirement already satisfied: pillow!=8.3.\*,>=5.3.0 in  
/usr/local/lib/python3.10/dist-packages (from torchvision>=0.10.1->-r  
requirements.txt (line 6)) (9.4.0)  
Requirement already satisfied: aiohttp!=4.0.0a0,!4.0.0a1 in  
/usr/local/lib/python3.10/dist-packages (from fsspec[http]!  
=2021.06.0,>=2021.05.0->pytorch-lightning==1.5.6->-r requirements.txt  
(line 1)) (3.9.1)  
Requirement already satisfied: cachetools<6.0,>=2.0.0 in  
/usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3-  
>tensorboard>=2.2.0->-r requirements.txt (line 3)) (5.3.2)  
Requirement already satisfied: pyasn1-modules>=0.2.1 in  
/usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3-

```

>tensorboard>=2.2.0->-r requirements.txt (line 3)) (0.3.0)
Requirement already satisfied: rsa<5,>=3.1.4 in
/usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3-
>tensorboard>=2.2.0->-r requirements.txt (line 3)) (4.9)
Requirement already satisfied: requests-oauthlib>=0.7.0 in
/usr/local/lib/python3.10/dist-packages (from google-auth-
oauthlib<1.1,>=0.5->tensorboard>=2.2.0->-r requirements.txt (line 3))
(1.3.1)
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0-
>tensorboard>=2.2.0->-r requirements.txt (line 3)) (3.3.2)
Requirement already satisfied: idna<4,>=2.5 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0-
>tensorboard>=2.2.0->-r requirements.txt (line 3)) (3.6)
Requirement already satisfied: urllib3<3,>=1.21.1 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0-
>tensorboard>=2.2.0->-r requirements.txt (line 3)) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0-
>tensorboard>=2.2.0->-r requirements.txt (line 3)) (2023.11.17)
Collecting lightning-utilities>=0.8.0 (from torchmetrics>=0.4.1-
>pytorch-lightning==1.5.6->-r requirements.txt (line 1))
  Downloading lightning_utilities-0.10.0-py3-none-any.whl (24 kB)
Requirement already satisfied: MarkupSafe>=2.1.1 in
/usr/local/lib/python3.10/dist-packages (from werkzeug>=1.0.1-
>tensorboard>=2.2.0->-r requirements.txt (line 3)) (2.1.3)
Requirement already satisfied: mpmath>=0.19 in
/usr/local/lib/python3.10/dist-packages (from sympy->torch>=1.6.1->-r
requirements.txt (line 4)) (1.3.0)
Requirement already satisfied: attrs>=17.3.0 in
/usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!
=4.0.0a1->fsspec[http]!=2021.06.0,>=2021.05.0->pytorch-
lightning==1.5.6->-r requirements.txt (line 1)) (23.1.0)
Requirement already satisfied: multidict<7.0,>=4.5 in
/usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!
=4.0.0a1->fsspec[http]!=2021.06.0,>=2021.05.0->pytorch-
lightning==1.5.6->-r requirements.txt (line 1)) (6.0.4)
Requirement already satisfied: yarl<2.0,>=1.0 in
/usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!
=4.0.0a1->fsspec[http]!=2021.06.0,>=2021.05.0->pytorch-
lightning==1.5.6->-r requirements.txt (line 1)) (1.9.3)
Requirement already satisfied: frozenlist>=1.1.1 in
/usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!
=4.0.0a1->fsspec[http]!=2021.06.0,>=2021.05.0->pytorch-
lightning==1.5.6->-r requirements.txt (line 1)) (1.4.0)
Requirement already satisfied: aiosignal>=1.1.2 in
/usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!
=4.0.0a1->fsspec[http]!=2021.06.0,>=2021.05.0->pytorch-
lightning==1.5.6->-r requirements.txt (line 1)) (1.3.1)

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Requirement already satisfied: async-timeout<5.0,>=4.0 in
/usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!
=4.0.0a1->fsspec[http]!=2021.06.0,>=2021.05.0->pytorch-
lightning==1.5.6->-r requirements.txt (line 1)) (4.0.3)
Requirement already satisfied: pyasn1<0.6.0,>=0.4.6 in
/usr/local/lib/python3.10/dist-packages (from pyasn1-modules>=0.2.1-
>google-auth<3,>=1.6.3->tensorboard>=2.2.0->-r requirements.txt (line
3)) (0.5.1)
Requirement already satisfied: oauthlib>=3.0.0 in
/usr/local/lib/python3.10/dist-packages (from requests-
oauthlib>=0.7.0->google-auth-oauthlib<1.1,>=0.5->tensorboard>=2.2.0->-
r requirements.txt (line 3)) (3.2.2)
Installing collected packages: PyYAML, pyDeprecate, lightning-
utilities, torchmetrics, pytorch-lightning
  Attempting uninstall: PyYAML
    Found existing installation: PyYAML 6.0.1
    Uninstalling PyYAML-6.0.1:
      Successfully uninstalled PyYAML-6.0.1
Successfully installed PyYAML-6.0 lightning-utilities-0.10.0
pyDeprecate-0.3.1 pytorch-lightning-1.5.6 torchmetrics-1.2.1
```

```
# !pip install torch>=1.3 pytorch-lightning>=0.6.0
!pip install --upgrade torchtext
```

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Requirement already satisfied: torchtext in
/usr/local/lib/python3.10/dist-packages (0.16.0)
Collecting torchtext
  Downloading torchtext-0.16.1-cp310-cp310-manylinux1_x86_64.whl (2.0
MB)
----- 2.0/2.0 MB 28.2 MB/s eta
0:00:00
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-packages
(from torchtext) (4.66.1)
Requirement already satisfied: requests in
/usr/local/lib/python3.10/dist-packages (from torchtext) (2.31.0)
Collecting torch==2.1.1 (from torchtext)
  Downloading torch-2.1.1-cp310-cp310-manylinux1_x86_64.whl (670.2 MB)
----- 670.2/670.2 MB 1.4 MB/s eta
0:00:00
Requirement already satisfied: numpy in /usr/local/lib/python3.10/dist-
packages (from torchtext) (1.23.5)
Collecting torchdata==0.7.1 (from torchtext)
  Downloading torchdata-0.7.1-cp310-cp310-
manylinux_2_17_x86_64.manylinux2014_x86_64.whl (4.7 MB)
----- 4.7/4.7 MB 81.8 MB/s eta
0:00:00
Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-
packages (from torch==2.1.1->torchtext) (3.13.1)
Requirement already satisfied: typing-extensions in
/usr/local/lib/python3.10/dist-packages (from torch==2.1.1->torchtext)
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(4.5.0)
Requirement already satisfied: sympy in
/usr/local/lib/python3.10/dist-packages (from torch==2.1.1->torchtext)
(1.12)
Requirement already satisfied: networkx in
/usr/local/lib/python3.10/dist-packages (from torch==2.1.1->torchtext)
(3.2.1)
Requirement already satisfied: jinja2 in
/usr/local/lib/python3.10/dist-packages (from torch==2.1.1->torchtext)
(3.1.2)
Requirement already satisfied: fsspec in
/usr/local/lib/python3.10/dist-packages (from torch==2.1.1->torchtext)
(2023.6.0)
Collecting nvidia-cuda-nvrtc-cu12==12.1.105 (from torch==2.1.1-
>torchtext)
  Downloading nvidia_cuda_nvrtc_cu12-12.1.105-py3-none-
manylinux1_x86_64.whl (23.7 MB)
----- 23.7/23.7 MB 73.5 MB/s eta
0:00:00
e-cu12==12.1.105 (from torch==2.1.1->torchtext)
  Downloading nvidia_cuda_runtime_cu12-12.1.105-py3-none-
manylinux1_x86_64.whl (823 kB)
----- 823.6/823.6 kB 67.5 MB/s eta
0:00:00
torch==2.1.1->torchtext)
  Downloading nvidia_cuda_cupti_cu12-12.1.105-py3-none-
manylinux1_x86_64.whl (14.1 MB)
----- 14.1/14.1 MB 94.6 MB/s eta
0:00:00
torch==2.1.1->torchtext)
  Downloading nvidia_cudnn_cu12-8.9.2.26-py3-none-
manylinux1_x86_64.whl (731.7 MB)
----- 731.7/731.7 MB 2.3 MB/s eta
0:00:00
torch==2.1.1->torchtext)
  Downloading nvidia_cublas_cu12-12.1.3.1-py3-none-
manylinux1_x86_64.whl (410.6 MB)
----- 410.6/410.6 MB 3.8 MB/s eta
0:00:00
torch==2.1.1->torchtext)
  Downloading nvidia_cufft_cu12-11.0.2.54-py3-none-
manylinux1_x86_64.whl (121.6 MB)
----- 121.6/121.6 MB 6.4 MB/s eta
0:00:00
torch==2.1.1->torchtext)
  Downloading nvidia_curand_cu12-10.3.2.106-py3-none-
manylinux1_x86_64.whl (56.5 MB)
----- 56.5/56.5 MB 12.6 MB/s eta
0:00:00
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torch==2.1.1->torchtext)
  Downloading nvidia_cusolver_cu12-11.4.5.107-py3-none-
manylinux1_x86_64.whl (124.2 MB)
_____ 124.2/124.2 MB 8.4 MB/s eta
0:00:00
torch==2.1.1->torchtext)
  Downloading nvidia_cusparses_cu12-12.1.0.106-py3-none-
manylinux1_x86_64.whl (196.0 MB)
_____ 196.0/196.0 MB 6.0 MB/s eta
0:00:00
torch==2.1.1->torchtext)
  Downloading nvidia_nccl_cu12-2.18.1-py3-none-manylinux1_x86_64.whl
(209.8 MB)
_____ 209.8/209.8 MB 6.3 MB/s eta
0:00:00
torch==2.1.1->torchtext)
  Downloading nvidia_nvtx_cu12-12.1.105-py3-none-manylinux1_x86_64.whl
(99 kB)
_____ 99.1/99.1 kB 12.6 MB/s eta
0:00:00
Requirement already satisfied: triton==2.1.0 in
/usr/local/lib/python3.10/dist-packages (from torch==2.1.1->torchtext)
(2.1.0)
Requirement already satisfied: urllib3>=1.25 in
/usr/local/lib/python3.10/dist-packages (from torchdata==0.7.1-
>torchtext) (2.0.7)
Collecting nvidia-nvjitlink-cu12 (from nvidia-cusolver-
cu12==11.4.5.107->torch==2.1.1->torchtext)
  Downloading nvidia_nvjitlink_cu12-12.3.101-py3-none-
manylinux1_x86_64.whl (20.5 MB)
_____ 20.5/20.5 MB 65.4 MB/s eta
0:00:00
Requirement already satisfied: charset-normalizer<4,>=2 in
/usr/local/lib/python3.10/dist-packages (from requests->torchtext)
(3.3.2)
Requirement already satisfied: idna<4,>=2.5 in
/usr/local/lib/python3.10/dist-packages (from requests->torchtext)
(3.6)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.10/dist-packages (from requests->torchtext)
(2023.11.17)
Requirement already satisfied: MarkupSafe>=2.0 in
/usr/local/lib/python3.10/dist-packages (from jinja2->torch==2.1.1-
>torchtext) (2.1.3)
Requirement already satisfied: mpmath>=0.19 in
/usr/local/lib/python3.10/dist-packages (from sympy->torch==2.1.1-
>torchtext) (1.3.0)
Installing collected packages: nvidia-nvtx-cu12, nvidia-nvjitlink-
cu12, nvidia-nccl-cu12, nvidia-curand-cu12, nvidia-cufft-cu12, nvidia-

```

```
cuda-runtime-cu12, nvidia-cuda-nvrtc-cu12, nvidia-cuda-cupti-cu12,
nvidia-cublas-cu12, nvidia-cusparse-cu12, nvidia-cudnn-cu12, nvidia-
cusolver-cu12, torch, torchdata, torchtext
```

```
Attempting uninstall: torch
```

```
Found existing installation: torch 2.1.0+cu118
```

```
Uninstalling torch-2.1.0+cu118:
```

```
Successfully uninstalled torch-2.1.0+cu118
```

```
Attempting uninstall: torchdata
```

```
Found existing installation: torchdata 0.7.0
```

```
Uninstalling torchdata-0.7.0:
```

```
Successfully uninstalled torchdata-0.7.0
```

```
Attempting uninstall: torchtext
```

```
Found existing installation: torchtext 0.16.0
```

```
Uninstalling torchtext-0.16.0:
```

```
Successfully uninstalled torchtext-0.16.0
```

```
ERROR: pip's dependency resolver does not currently take into account
all the packages that are installed. This behaviour is the source of
the following dependency conflicts.
```

```
torchaudio 2.1.0+cu118 requires torch==2.1.0, but you have torch 2.1.1
which is incompatible.
```

```
torchvision 0.16.0+cu118 requires torch==2.1.0, but you have torch
2.1.1 which is incompatible.
```

```
Successfully installed nvidia-cublas-cu12-12.1.3.1 nvidia-cuda-cupti-
cu12-12.1.105 nvidia-cuda-nvrtc-cu12-12.1.105 nvidia-cuda-runtime-
cu12-12.1.105 nvidia-cudnn-cu12-8.9.2.26 nvidia-cufft-cu12-11.0.2.54
nvidia-curand-cu12-10.3.2.106 nvidia-cusolver-cu12-11.4.5.107 nvidia-
cusparse-cu12-12.1.0.106 nvidia-nccl-cu12-2.18.1 nvidia-nvjitlink-
cu12-12.3.101 nvidia-nvtx-cu12-12.1.105 torch-2.1.1 torchdata-0.7.1
torchtext-0.16.1
```

```
!pip install --upgrade torch pytorch-lightning torchvision torchaudio
```

```
Requirement already satisfied: torch in
```

```
/usr/local/lib/python3.10/dist-packages (2.1.1)
```

```
Requirement already satisfied: pytorch-lightning in
```

```
/usr/local/lib/python3.10/dist-packages (1.5.6)
```

```
Collecting pytorch-lightning
```

```
Downloading pytorch_lightning-2.1.2-py3-none-any.whl (776 kB)
```

```
0:00:00 776.9/776.9 kB 15.4 MB/s eta
```

```
ent already satisfied: torchvision in /usr/local/lib/python3.10/dist-
packages (0.16.0+cu118)
```

```
Collecting torchvision
```

```
Downloading torchvision-0.16.1-cp310-cp310-manylinux1_x86_64.whl
(6.8 MB)
```

```
6.8/6.8 MB 112.0 MB/s eta
```

```
0:00:00
```

```
ent already satisfied: torchaudio in /usr/local/lib/python3.10/dist-
packages (2.1.0+cu118)
```

```
Collecting torchaudio
```

Downloading torchaudio-2.1.1-cp310-cp310-manylinux1\_x86\_64.whl (3.3 MB)

3.3/3.3 MB 81.4 MB/s eta

0:00:00

Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-packages (from torch) (3.13.1)

Requirement already satisfied: typing-extensions in /usr/local/lib/python3.10/dist-packages (from torch) (4.5.0)

Requirement already satisfied: sympy in /usr/local/lib/python3.10/dist-packages (from torch) (1.12)

Requirement already satisfied: networkx in /usr/local/lib/python3.10/dist-packages (from torch) (3.2.1)

Requirement already satisfied: jinja2 in /usr/local/lib/python3.10/dist-packages (from torch) (3.1.2)

Requirement already satisfied: fsspec in /usr/local/lib/python3.10/dist-packages (from torch) (2023.6.0)

Requirement already satisfied: nvidia-cuda-nvrtc-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch) (12.1.105)

Requirement already satisfied: nvidia-cuda-runtime-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch) (12.1.105)

Requirement already satisfied: nvidia-cuda-cupti-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch) (12.1.105)

Requirement already satisfied: nvidia-cudnn-cu12==8.9.2.26 in /usr/local/lib/python3.10/dist-packages (from torch) (8.9.2.26)

Requirement already satisfied: nvidia-cublas-cu12==12.1.3.1 in /usr/local/lib/python3.10/dist-packages (from torch) (12.1.3.1)

Requirement already satisfied: nvidia-cufft-cu12==11.0.2.54 in /usr/local/lib/python3.10/dist-packages (from torch) (11.0.2.54)

Requirement already satisfied: nvidia-curand-cu12==10.3.2.106 in /usr/local/lib/python3.10/dist-packages (from torch) (10.3.2.106)

Requirement already satisfied: nvidia-cusolver-cu12==11.4.5.107 in /usr/local/lib/python3.10/dist-packages (from torch) (11.4.5.107)

Requirement already satisfied: nvidia-cuspars-cu12==12.1.0.106 in /usr/local/lib/python3.10/dist-packages (from torch) (12.1.0.106)

Requirement already satisfied: nvidia-nccl-cu12==2.18.1 in /usr/local/lib/python3.10/dist-packages (from torch) (2.18.1)

Requirement already satisfied: nvidia-nvtx-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch) (12.1.105)

Requirement already satisfied: triton==2.1.0 in /usr/local/lib/python3.10/dist-packages (from torch) (2.1.0)

Requirement already satisfied: nvidia-nvjitlink-cu12 in /usr/local/lib/python3.10/dist-packages (from nvidia-cusolver-cu12==11.4.5.107->torch) (12.3.101)

Requirement already satisfied: numpy>=1.17.2 in /usr/local/lib/python3.10/dist-packages (from pytorch-lightning) (1.23.5)

Requirement already satisfied: tqdm>=4.57.0 in /usr/local/lib/python3.10/dist-packages (from pytorch-lightning) (4.66.1)

Requirement already satisfied: PyYAML<=5.4 in  
/usr/local/lib/python3.10/dist-packages (from pytorch-lightning) (6.0)  
Requirement already satisfied: torchmetrics<=0.7.0 in  
/usr/local/lib/python3.10/dist-packages (from pytorch-lightning)  
(1.2.1)  
Requirement already satisfied: packaging<=20.0 in  
/usr/local/lib/python3.10/dist-packages (from pytorch-lightning)  
(23.2)  
Requirement already satisfied: lightning-utilities<=0.8.0 in  
/usr/local/lib/python3.10/dist-packages (from pytorch-lightning)  
(0.10.0)  
Requirement already satisfied: requests in  
/usr/local/lib/python3.10/dist-packages (from torchvision) (2.31.0)  
Requirement already satisfied: pillow!=8.3.\*,>=5.3.0 in  
/usr/local/lib/python3.10/dist-packages (from torchvision) (9.4.0)  
Requirement already satisfied: aiohttp!=4.0.0a0,!4.0.0a1 in  
/usr/local/lib/python3.10/dist-packages (from fsspec->torch) (3.9.1)  
Requirement already satisfied: setuptools in  
/usr/local/lib/python3.10/dist-packages (from lightning-  
utilities<=0.8.0->pytorch-lightning) (67.7.2)  
Requirement already satisfied: MarkupSafe<=2.0 in  
/usr/local/lib/python3.10/dist-packages (from jinja2->torch) (2.1.3)  
Requirement already satisfied: charset-normalizer<4,>=2 in  
/usr/local/lib/python3.10/dist-packages (from requests->torchvision)  
(3.3.2)  
Requirement already satisfied: idna<4,>=2.5 in  
/usr/local/lib/python3.10/dist-packages (from requests->torchvision)  
(3.6)  
Requirement already satisfied: urllib3<3,>=1.21.1 in  
/usr/local/lib/python3.10/dist-packages (from requests->torchvision)  
(2.0.7)  
Requirement already satisfied: certifi<=2017.4.17 in  
/usr/local/lib/python3.10/dist-packages (from requests->torchvision)  
(2023.11.17)  
Requirement already satisfied: mpmath<=0.19 in  
/usr/local/lib/python3.10/dist-packages (from sympy->torch) (1.3.0)  
Requirement already satisfied: attrs<=17.3.0 in  
/usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!  
=4.0.0a1->fsspec->torch) (23.1.0)  
Requirement already satisfied: multidict<7.0,>=4.5 in  
/usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!  
=4.0.0a1->fsspec->torch) (6.0.4)  
Requirement already satisfied: yarl<2.0,>=1.0 in  
/usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!  
=4.0.0a1->fsspec->torch) (1.9.3)  
Requirement already satisfied: frozenlist<=1.1.1 in  
/usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!  
=4.0.0a1->fsspec->torch) (1.4.0)  
Requirement already satisfied: aiosignal<=1.1.2 in

```

/usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!
=4.0.0a1->fsspec->torch) (1.3.1)
Requirement already satisfied: async-timeout<5.0,>=4.0 in
/usr/local/lib/python3.10/dist-packages (from aiohttp!=4.0.0a0,!
=4.0.0a1->fsspec->torch) (4.0.3)
Installing collected packages: torchvision, torchaudio, pytorch-
lightning
  Attempting uninstall: torchvision
    Found existing installation: torchvision 0.16.0+cu118
    Uninstalling torchvision-0.16.0+cu118:
      Successfully uninstalled torchvision-0.16.0+cu118
  Attempting uninstall: torchaudio
    Found existing installation: torchaudio 2.1.0+cu118
    Uninstalling torchaudio-2.1.0+cu118:
      Successfully uninstalled torchaudio-2.1.0+cu118
  Attempting uninstall: pytorch-lightning
    Found existing installation: pytorch-lightning 1.5.6
    Uninstalling pytorch-lightning-1.5.6:
      Successfully uninstalled pytorch-lightning-1.5.6
Successfully installed pytorch-lightning-2.1.2 torchaudio-2.1.1
torchvision-0.16.1

```

#### *# Importing Necessary Packages*

```

import os
import yaml
import argparse
import numpy as np
from pathlib import Path
from models import *
from models import vanilla_vae
from models import mssim_vae
from experiment import VAEXperiment
import torch.backends.cudnn as cudnn
from pytorch_lightning import Trainer
from pytorch_lightning.loggers import TensorBoardLogger
from pytorch_lightning import seed_everything
from pytorch_lightning.callbacks import LearningRateMonitor,
ModelCheckpoint
from dataset import VAEDataset
from pytorch_lightning.strategies import DDPStrategy

!pwd

/content/drive/MyDrive/VAE_final_project

```

```

# Loading in configuration file for current model
config_filename = 'configs/joint_vae.yaml'

```

```

with open(config_filename, 'r') as file:
    try:
        config = yaml.safe_load(file)
    except yaml.YAMLError as exc:
        print(exc)

# Initializing logger
tb_logger = TensorBoardLogger(save_dir=config['logging_params']
                              ['save_dir'],
                              name=config['model_params']['name'],)

# For reproducibility
seed_everything(config['exp_params']['manual_seed'], True)

model = vae_models[config['model_params']['name']]
(**config['model_params'])
experiment = VAEXperiment(model,
                          config['exp_params'])

# Setting up PyTorch Lightning Datamodule object
data = VAEDataset(**config["data_params"], pin_memory=True)

data.setup()

INFO:lightning_fabric.utilities.seed:Seed set to 1265

# Installing MedMNIST for other datasets
!pip install medmnist

Collecting medmnist
  Downloading medmnist-2.2.3-py3-none-any.whl (22 kB)
Requirement already satisfied: numpy in
/usr/local/lib/python3.10/dist-packages (from medmnist) (1.23.5)
Requirement already satisfied: pandas in
/usr/local/lib/python3.10/dist-packages (from medmnist) (1.5.3)
Requirement already satisfied: scikit-learn in
/usr/local/lib/python3.10/dist-packages (from medmnist) (1.2.2)
Requirement already satisfied: scikit-image in
/usr/local/lib/python3.10/dist-packages (from medmnist) (0.19.3)
Requirement already satisfied: tqdm in /usr/local/lib/python3.10/dist-
packages (from medmnist) (4.66.1)
Requirement already satisfied: Pillow in
/usr/local/lib/python3.10/dist-packages (from medmnist) (9.4.0)
Collecting fire (from medmnist)
  Downloading fire-0.5.0.tar.gz (88 kB)
  88.3/88.3 kB 2.6 MB/s eta
0:00:00
etadate (setup.py) ... ent already satisfied: torch in
/usr/local/lib/python3.10/dist-packages (from medmnist) (2.1.1)
Requirement already satisfied: torchvision in

```

/usr/local/lib/python3.10/dist-packages (from medmnist) (0.16.1)  
Requirement already satisfied: six in /usr/local/lib/python3.10/dist-packages (from fire->medmnist) (1.16.0)  
Requirement already satisfied: termcolor in /usr/local/lib/python3.10/dist-packages (from fire->medmnist) (2.3.0)  
Requirement already satisfied: python-dateutil<=2.8.1 in /usr/local/lib/python3.10/dist-packages (from pandas->medmnist) (2.8.2)  
Requirement already satisfied: pytz<=2020.1 in /usr/local/lib/python3.10/dist-packages (from pandas->medmnist) (2023.3.post1)  
Requirement already satisfied: scipy<=1.4.1 in /usr/local/lib/python3.10/dist-packages (from scikit-image->medmnist) (1.11.4)  
Requirement already satisfied: networkx<=2.2 in /usr/local/lib/python3.10/dist-packages (from scikit-image->medmnist) (3.2.1)  
Requirement already satisfied: imageio<=2.4.1 in /usr/local/lib/python3.10/dist-packages (from scikit-image->medmnist) (2.31.6)  
Requirement already satisfied: tifffile<=2019.7.26 in /usr/local/lib/python3.10/dist-packages (from scikit-image->medmnist) (2023.9.26)  
Requirement already satisfied: PyWavelets<=1.1.1 in /usr/local/lib/python3.10/dist-packages (from scikit-image->medmnist) (1.5.0)  
Requirement already satisfied: packaging<=20.0 in /usr/local/lib/python3.10/dist-packages (from scikit-image->medmnist) (23.2)  
Requirement already satisfied: joblib<=1.1.1 in /usr/local/lib/python3.10/dist-packages (from scikit-learn->medmnist) (1.3.2)  
Requirement already satisfied: threadpoolctl<=2.0.0 in /usr/local/lib/python3.10/dist-packages (from scikit-learn->medmnist) (3.2.0)  
Requirement already satisfied: filelock in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (3.13.1)  
Requirement already satisfied: typing-extensions in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (4.5.0)  
Requirement already satisfied: sympy in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (1.12)  
Requirement already satisfied: jinja2 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (3.1.2)  
Requirement already satisfied: fsspec in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (2023.6.0)  
Requirement already satisfied: nvidia-cuda-nvrtc-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist)

(12.1.105)  
Requirement already satisfied: nvidia-cuda-runtime-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (12.1.105)  
Requirement already satisfied: nvidia-cuda-cupti-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (12.1.105)  
Requirement already satisfied: nvidia-cudnn-cu12==8.9.2.26 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (8.9.2.26)  
Requirement already satisfied: nvidia-cublas-cu12==12.1.3.1 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (12.1.3.1)  
Requirement already satisfied: nvidia-cufft-cu12==11.0.2.54 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (11.0.2.54)  
Requirement already satisfied: nvidia-curand-cu12==10.3.2.106 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (10.3.2.106)  
Requirement already satisfied: nvidia-cusolver-cu12==11.4.5.107 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (11.4.5.107)  
Requirement already satisfied: nvidia-cuspars-cu12==12.1.0.106 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (12.1.0.106)  
Requirement already satisfied: nvidia-nccl-cu12==2.18.1 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (2.18.1)  
Requirement already satisfied: nvidia-nvtx-cu12==12.1.105 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (12.1.105)  
Requirement already satisfied: triton==2.1.0 in /usr/local/lib/python3.10/dist-packages (from torch->medmnist) (2.1.0)  
Requirement already satisfied: nvidia-nvjitlink-cu12 in /usr/local/lib/python3.10/dist-packages (from nvidia-cusolver-cu12==11.4.5.107->torch->medmnist) (12.3.101)  
Requirement already satisfied: requests in /usr/local/lib/python3.10/dist-packages (from torchvision->medmnist) (2.31.0)  
Requirement already satisfied: MarkupSafe>=2.0 in /usr/local/lib/python3.10/dist-packages (from jinja2->torch->medmnist) (2.1.3)  
Requirement already satisfied: charset-normalizer<4,>=2 in /usr/local/lib/python3.10/dist-packages (from requests->torchvision->medmnist) (3.3.2)  
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests->torchvision->medmnist) (3.6)  
Requirement already satisfied: urllib3<3,>=1.21.1 in



```
/usr/local/lib/python3.10/dist-packages (from requests->torchvision-
>medmnist) (2.0.7)
Requirement already satisfied: certifi>=2017.4.17 in
/usr/local/lib/python3.10/dist-packages (from requests->torchvision-
>medmnist) (2023.11.17)
Requirement already satisfied: mpmath>=0.19 in
/usr/local/lib/python3.10/dist-packages (from sympy->torch->medmnist)
(1.3.0)
Building wheels for collected packages: fire
  Building wheel for fire (setup.py) ... e=fire-0.5.0-py2.py3-none-
any.whl size=116934
sha256=6aa4ea7530f5ba4aa3261f29c12b77c4b56cef4c5a3061051b3a81103a06547
4
  Stored in directory:
/root/.cache/pip/wheels/90/d4/f7/9404e5db0116bd4d43e5666eaa3e70ab53723
ele3ea40c9a95
Successfully built fire
Installing collected packages: fire, medmnist
Successfully installed fire-0.5.0 medmnist-2.2.3
```

```
# Important MedMNIST Dataset
```

```
import numpy as np
import medmnist
from medmnist import INFO, Evaluator
import torch
import torch.nn as nn
import torch.optim as optim
import torch.utils.data as data
import torchvision.transforms as transforms
```

```
# Swap with name of desired MedMNIST dataset
```

```
data_flag = 'chestmnist'
download = True
```

```
info = INFO[data_flag]
task = info['task']
n_channels = info['n_channels']
n_classes = len(info['label'])
```

```
DataClass = getattr(medmnist, info['python_class'])
```

```
# Create MedMNIST Dataloaders https://github.com/MedMNIST/MedMNIST
```

```
# preprocessing
```

```
data_transform = transforms.Compose([
    transforms.ToTensor(),
    transforms.Resize((64, 64)),
    transforms.Normalize(mean=[.5], std=[.5])
])
```

```
# load the data
```

```

train_dataset = DataClass(split='train', transform=data_transform,
download=download)
train_dataset, val_dataset =
torch.utils.data.random_split(train_dataset, (62400, 16068))
test_dataset = DataClass(split='test', transform=data_transform,
download=download)

pil_dataset = DataClass(split='train', download=download)

# encapsulate data into dataloader form
train_loader = data.DataLoader(dataset=train_dataset, batch_size=128,
shuffle=True)
val_loader = data.DataLoader(dataset=val_dataset, batch_size = 128,
shuffle=False)
test_loader = data.DataLoader(dataset=test_dataset, batch_size=128,
shuffle=False)

Using downloaded and verified file: /root/.medmnist/chestmnist.npz
Using downloaded and verified file: /root/.medmnist/chestmnist.npz
Using downloaded and verified file: /root/.medmnist/chestmnist.npz

# Converting MedMNIST Dataloaders to LightningDataModules
from pytorch_lightning import LightningDataModule
class MNISTDataModule(LightningDataModule):
    def __init__(self, train_loader, val_loader, test_loader):
        super().__init__()
        self.train_loader = train_loader
        self.val_loader = val_loader
        self.test_loader = test_loader

    def setup(self, stage: str):
        pass

    def train_dataloader(self):
        return self.train_loader

    def val_dataloader(self):
        return self.val_loader

    def test_dataloader(self):
        return self.test_loader

# Use MNISTDataModule if using a MedMNIST dataset
data = MNISTDataModule(train_loader, val_loader, test_loader)

import matplotlib.pyplot as plt
test_trainloader = data.train_dataloader()

for images, labels in test_trainloader:

```

```
#view as images
# plt.imshow()
break
```

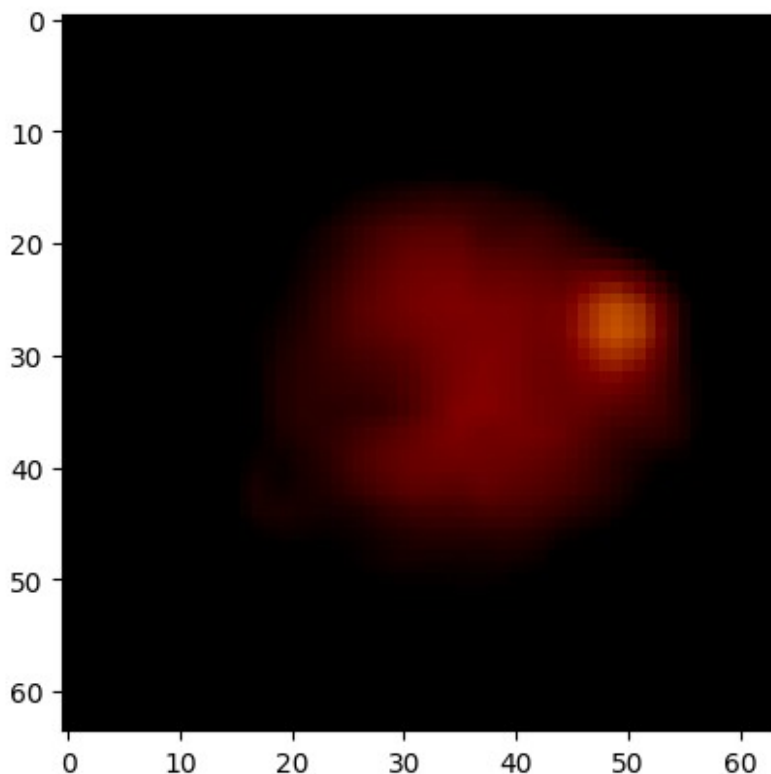
```
/usr/local/lib/python3.10/dist-packages/torchvision/transforms/
functional.py:1603: UserWarning: The default value of the antialias
parameter of all the resizing transforms (Resize(),
RandomResizedCrop(), etc.) will change from None to True in v0.17, in
order to be consistent across the PIL and Tensor backends. To suppress
this warning, directly pass antialias=True (recommended, future
default), antialias=None (current default, which means False for
Tensors and True for PIL), or antialias=False (only works on Tensors -
PIL will still use antialiasing). This also applies if you are using
the inference transforms from the models weights: update the call to
weights.transforms(antialias=True).
warnings.warn(
```

```
# Example training image from MedMNIST after normalization and
upscaling
```

```
plt.imshow(images[0].permute(1,2,0).numpy())
```

```
WARNING:matplotlib.image:Clipping input data to the valid range for
imshow with RGB data ([0..1] for floats or [0..255] for integers).
```

```
<matplotlib.image.AxesImage at 0x7e1d0e4423b0>
```



```

# Initializing trainer object
runner = Trainer(logger=tb_logger,
                  callbacks=[
                      LearningRateMonitor(),
                      ModelCheckpoint(save_top_k=2,
                                      dirpath
=os.path.join(tb_logger.log_dir , "checkpoints"),
                                      monitor= "val_loss",
                                      save_last= True),
                      ],
                  strategy='ddp_notebook',
                  **config['trainer_params'])

# Samples and reconstructions logged to Google Drive
Path(f"{tb_logger.log_dir}/Samples").mkdir(exist_ok=True,
parents=True)
Path(f"{tb_logger.log_dir}/Reconstructions").mkdir(exist_ok=True,
parents=True)

INFO:pytorch_lightning.utilities.rank_zero:GPU available: True (cuda),
used: True
INFO:pytorch_lightning.utilities.rank_zero:TPU available: False,
using: 0 TPU cores
INFO:pytorch_lightning.utilities.rank_zero:IPU available: False,
using: 0 IPU's
INFO:pytorch_lightning.utilities.rank_zero:HPU available: False,
using: 0 HPU's

# TensorBoard object in order to monitor performance of trained models
%load_ext tensorboard
%tensorboard --logdir {config['logging_params']['save_dir']}

The tensorboard extension is already loaded. To reload it, use:
%reload_ext tensorboard

<IPython.core.display.Javascript object>

# Fitting trainer object

print(f"==== Training {config['model_params']['name']} =====")
runner.fit(experiment, data)

==== Training JointVAE =====

INFO:lightning_fabric.utilities.seed:[rank: 0] Seed set to 1265
INFO:lightning_fabric.utilities.distributed:Initializing distributed:
GLOBAL_RANK: 0, MEMBER: 1/1
INFO:pytorch_lightning.utilities.rank_zero:-----
-----
---
distributed_backend=nccl

```

All distributed processes registered. Starting with 1 processes

INFO:pytorch\_lightning.accelerators.cuda:LOCAL\_RANK: 0 -

CUDA\_VISIBLE\_DEVICES: [0]

INFO:pytorch\_lightning.callbacks.model\_summary:

	Name	Type	Params
--	------	------	--------

0	model	JointVAE	4.1 M
---	-------	----------	-------

4.1 M	Trainable params		
-------	------------------	--	--

0	Non-trainable params		
---	----------------------	--	--

4.1 M	Total params		
-------	--------------	--	--

16.404	Total estimated model params size (MB)		
--------	--	--	--

```
{"model_id": "0c90e2709cd949119c3bfa9889aecb89", "version_major": 2, "version_minor": 0}
```

/usr/local/lib/python3.10/dist-packages/pytorch\_lightning/trainer/connectors/data\_connector.py:441: The 'val\_data\_loader' does not have many workers which may be a bottleneck. Consider increasing the value of the 'num\_workers' argument to 'num\_workers=1' in the 'DataLoader' to improve performance.

/usr/local/lib/python3.10/dist-packages/torchvision/transforms/functional.py:1603: UserWarning: The default value of the antialias parameter of all the resizing transforms (Resize(), RandomResizedCrop(), etc.) will change from None to True in v0.17, in order to be consistent across the PIL and Tensor backends. To suppress this warning, directly pass antialias=True (recommended, future default), antialias=None (current default, which means False for Tensors and True for PIL), or antialias=False (only works on Tensors - PIL will still use antialiasing). This also applies if you are using the inference transforms from the models weights: update the call to weights.transforms(antialias=True).

warnings.warn(  
/content/drive/MyDrive/VAE\_final\_project/PyTorch-VAE/models/joint\_vae.py:202: UserWarning: Using a target size (torch.Size([128, 1, 64, 64])) that is different to the input size (torch.Size([128, 3, 64, 64])). This will likely lead to incorrect results due to broadcasting. Please ensure they have the same size.

recons\_loss =F.mse\_loss(recons, input, reduction='mean')

/usr/local/lib/python3.10/dist-packages/pytorch\_lightning/trainer/connectors/data\_connector.py:441: The 'train\_data\_loader' does not have many workers which may be a bottleneck. Consider increasing the value of the 'num\_workers' argument to 'num\_workers=1' in the 'DataLoader' to improve performance.

```
{"model_id": "725741685d134f549c0e3092bc55d25f", "version_major": 2, "version_minor": 0}
```

```
/content/drive/MyDrive/VAE_final_project/PyTorch-VAE/models/  
joint_vae.py:202: UserWarning: Using a target size (torch.Size([64, 1,  
64, 64])) that is different to the input size (torch.Size([64, 3, 64,  
64])). This will likely lead to incorrect results due to broadcasting.  
Please ensure they have the same size.
```

```
    recons_loss =F.mse_loss(recons, input, reduction='mean')
```

```
{"model_id":"c50f44bc5be4422f90ceaf8d642ebda2","version_major":2,"vers  
ion_minor":0}
```

```
/content/drive/MyDrive/VAE_final_project/PyTorch-VAE/models/  
joint_vae.py:202: UserWarning: Using a target size (torch.Size([68, 1,  
64, 64])) that is different to the input size (torch.Size([68, 3, 64,  
64])). This will likely lead to incorrect results due to broadcasting.  
Please ensure they have the same size.
```

```
    recons_loss =F.mse_loss(recons, input, reduction='mean')
```

```
{"model_id":"552f1d449b324e80a730c4f2f6fb1259","version_major":2,"vers  
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```

```
{"model_id":"7be0b51482734b08b2504f59e5ba6311","version_major":2,"vers  
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```

```
{"model_id":"c9ddd97c36a8412994d7674209c5606b","version_major":2,"vers  
ion_minor":0}
```

```
{"model_id":"6d730613e53a48b38b6f37b1bb788d63","version_major":2,"vers  
ion_minor":0}
```

```
{"model_id":"d9fb1d35287241af94f69cde1b7412d4","version_major":2,"vers  
ion_minor":0}
```

```
{"model_id":"eca590da2cf34450a975d022208d2e05","version_major":2,"vers  
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```

```
{"model_id":"84d5648695fc461ca530883be228476d","version_major":2,"vers  
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```

```
{"model_id":"8fd3f63268a1451b90dab44b884f7bab","version_major":2,"vers  
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```

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```

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```

```
{"model_id":"ea3a6c853d984b43b29402f8de095978","version_major":2,"vers  
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```

```
{"model_id":"8c675de5763d4fafa62f14020d625edf","version_major":2,"vers  
ion_minor":0}
```

```
{"model_id": "1344b71d6a5d4c3797dfe220f644689b", "version_major": 2, "version_minor": 0}

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{"model_id": "48e052566f6b4ee992931972540228e5", "version_major": 2, "version_minor": 0}

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{"model_id": "628e4423d6f5472eab34c834b2674faa", "version_major": 2, "version_minor": 0}
```

```
{"model_id": "32c63ea529124b0aac66c2cec5087d88", "version_major": 2, "version_minor": 0}

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{"model_id": "03d666b8b607416f9bcd5478f54417a5", "version_major": 2, "version_minor": 0}

{"model_id": "f7cd9dd01d8e4f9d93c023060e78da2c", "version_major": 2, "version_minor": 0}

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{"model_id": "2e215cfb7c33496c8615c1503a6e4ef2", "version_major": 2, "version_minor": 0}

{"model_id": "6480c66ec8d04351af1a5c86529e6c8a", "version_major": 2, "version_minor": 0}
```



```
{"model_id": "c37ff87bbec544c98ab5eb24b5f44c47", "version_major": 2, "version_minor": 0}
```

```
INFO:pytorch_lightning.utilities.rank_zero:`Trainer.fit` stopped:  
`max_epochs=50` reached.
```