Convolutional Neural Network Lunar Crater Identification - 6 Latent Variables

Yarden Kinreich

Project Overview

This report summarizes the run of the CNN 6 Latent Variable pipeline, including training results, reconstructions, and clustering.

Dataset

Crater database (Link to Download): https://astrogeology.usgs.gov/search/map/moon_crater_database_v1_r
Moon LRO LROC WAC Global Morphology Mosaic 100m (File): https://planetarymaps.usgs.gov/mosaic/Lunar
WAC_Mosaic_global_100m_June2013.tif

Preprocessing

1. Filter Robbin's craters data-set by diameter and latitudes

- 3km <diameter <10km
- -60< latitude < 60

2. Crop the craters images from the LRO mosaic by crater's central coordinate and diameter

- Coordinates projection translation between Robins database and LRO mosaic
- image projection correction for round craters instead of elliptical

3. Unfirming

- All craters' shades flipped to be on the right side of the image
- All craters' images resized to 100X100 pixels

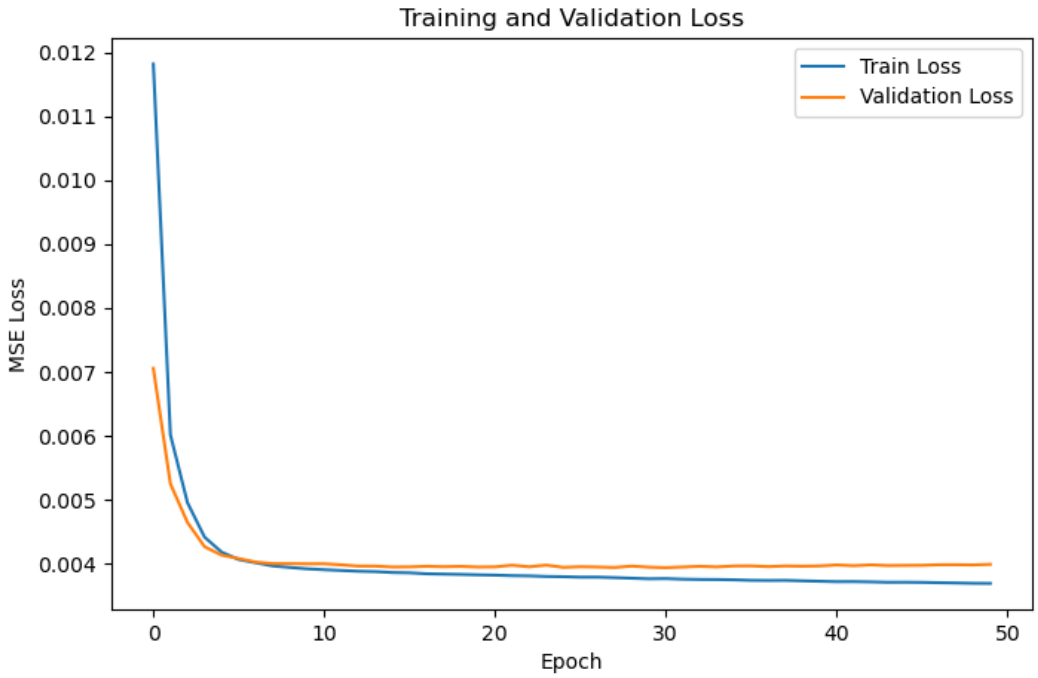
Pipeline Info

```
%cd /Users/yardenkinreich/Documents/Projects/Masters/autoencoder_project

import sys
import os
import numpy as np
sys.path.append(os.path.abspath('src'))

from torchsummary import summary
from src.train.train import ConvAutoencoder

# Example hyperparameters and dataset info
num_examples =  len(np.load("data/processed/craters.npy"))
latent_dim = 6
epochs = 50
batch_size = 32

print(f"Number of examples used: {num_examples}")
print(f"Autoencoder latent dimension: {latent_dim}")
print(f"Training epochs: {epochs}")
print(f"Batch size: {batch_size}")

model = ConvAutoencoder(latent_dim=latent_dim)
summary(model, (1, 100, 100))
```

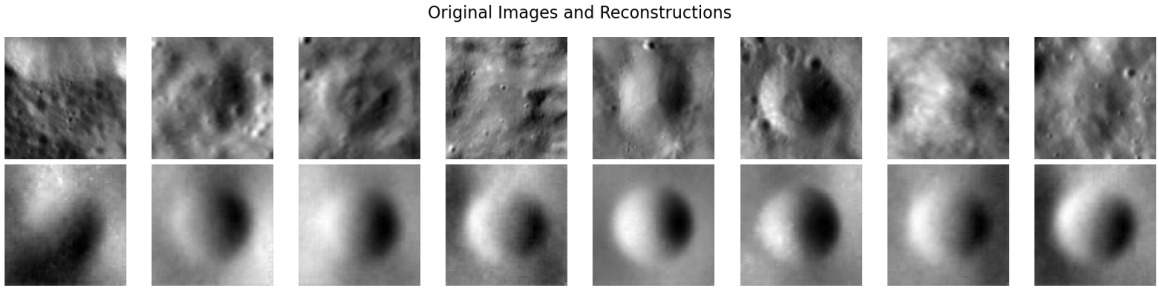
```
/Users/yardenkinreich/Documents/Projects/Masters/autoencoder_project
Number of examples used: 10000
Autoencoder latent dimension: 6
Training epochs: 50
Batch size: 32
----------------------------------------------------------------
        Layer (type)               Output Shape         Param #
================================================================
            Conv2d-1          [-1, 16, 50, 50]             160
              ReLU-2          [-1, 16, 50, 50]               0
            Conv2d-3          [-1, 32, 25, 25]           4,640
              ReLU-4          [-1, 32, 25, 25]               0
           Flatten-5               [-1, 20000]               0
            Linear-6                   [-1, 6]         120,006
            Linear-7               [-1, 20000]         140,000
```

```
              ReLU-8                 [-1, 20000]               0
           Unflatten-9           [-1, 32, 25, 25]               0
  ConvTranspose2d-10           [-1, 16, 50, 50]           4,624
             ReLU-11           [-1, 16, 50, 50]               0
  ConvTranspose2d-12          [-1, 1, 100, 100]             145
          Sigmoid-13          [-1, 1, 100, 100]               0
================================================================
Total params: 269,575
Trainable params: 269,575
Non-trainable params: 0
----------------------------------------------------------------
Input size (MB): 0.04
Forward/backward pass size (MB): 2.29
Params size (MB): 1.03
Estimated Total Size (MB): 3.36
----------------------------------------------------------------
```

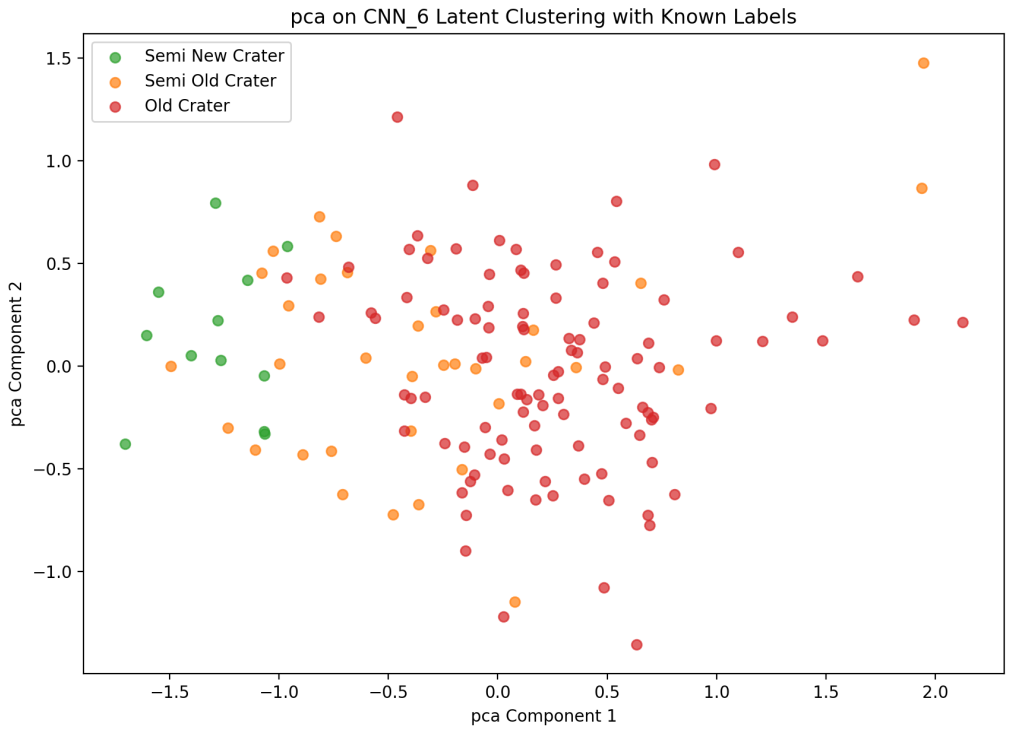
Train and Validation Loss Plot



Model Reconstruction Figure



Plot Clustering of PCA on Latent Variables: Julie D. Stopar Craters with Labels



Plot Clustering of PCA on Latent Variables: Julie D. Stopar Craters Images