Convolutional Neural Network Lunar Crater Identification - 20 Latent Variables & L2 Regulation

Yarden Kinreich

Project Overview

This report summarizes the run of the CNN 20 Latent Variable with L2 Regulation pipeline, including training results, reconstructions, and clustering.

Dataset

Crater database (Link to Download): https://astrogeology.usgs.gov/search/map/moon_crater_database_v1_re
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

```
/home/yardenk/autoencoder_project
Number of examples used: 50000
Autoencoder latent dimension: 20
Used 0.2 portion for validation
Training epochs: 50
Batch size: 32
Used L2 regulation, in ADAM optimizer
----------------------------------------------------------------
        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, 20]          400,020
           Linear-7              [-1, 20000]          420,000
             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: 829,589
Trainable params: 829,589
Non-trainable params: 0
----------------------------------------------------------------
Input size (MB): 0.04
Forward/backward pass size (MB): 2.29
Params size (MB): 3.16
Estimated Total Size (MB): 5.49
----------------------------------------------------------------
```
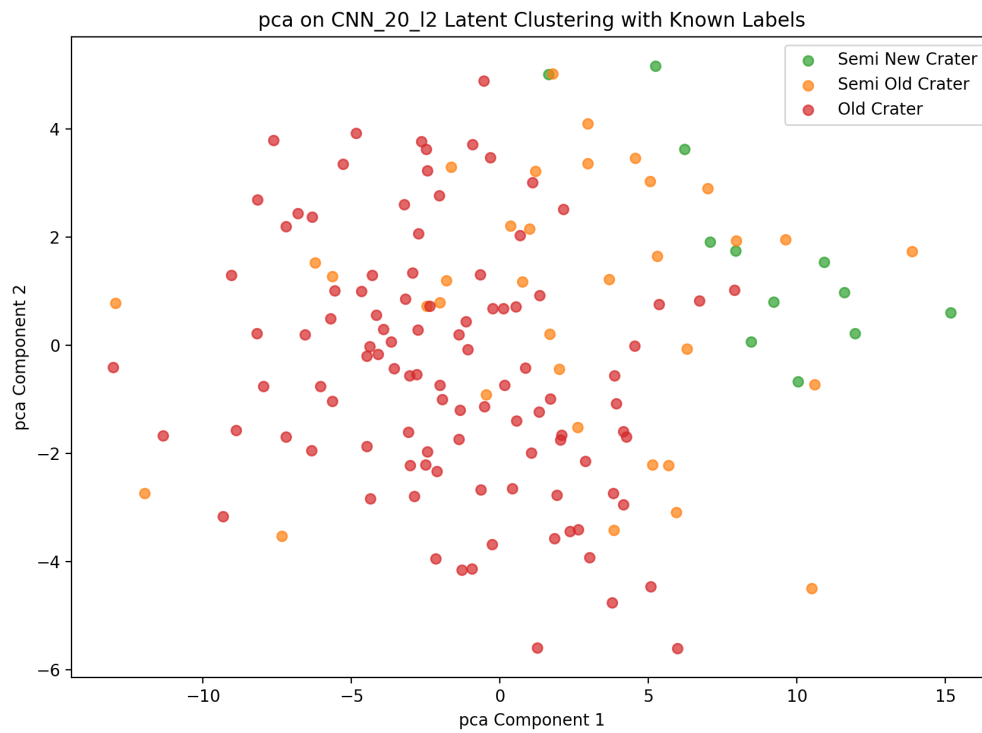
Train and Validation Loss Plot

Training and Validation Loss
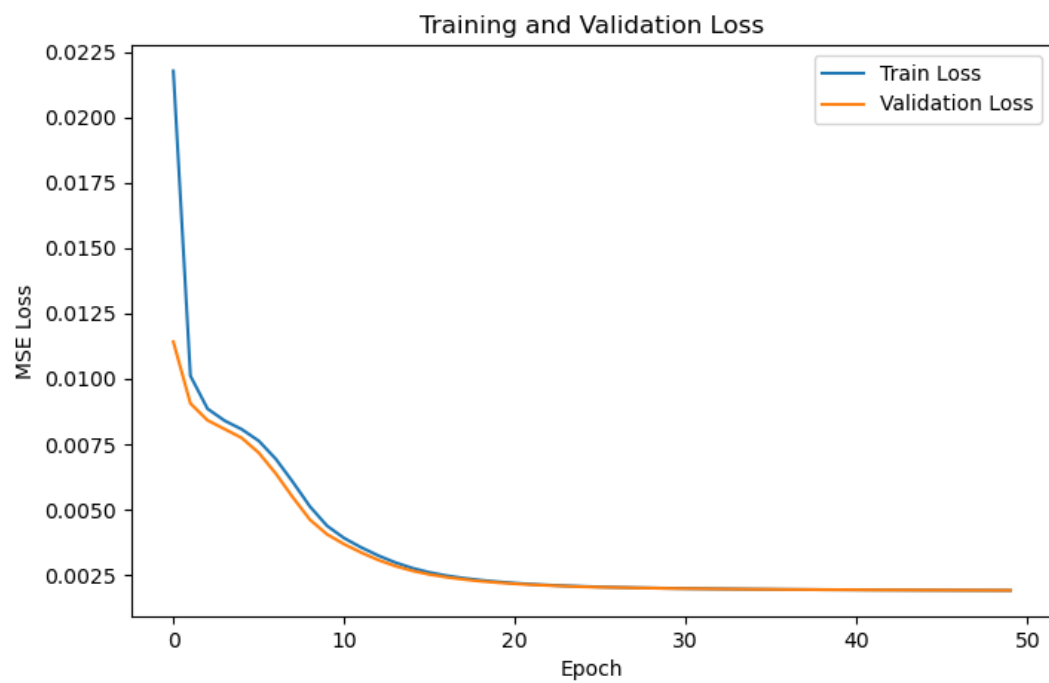
Model Reconstruction Figure

Original Images and Reconstructions
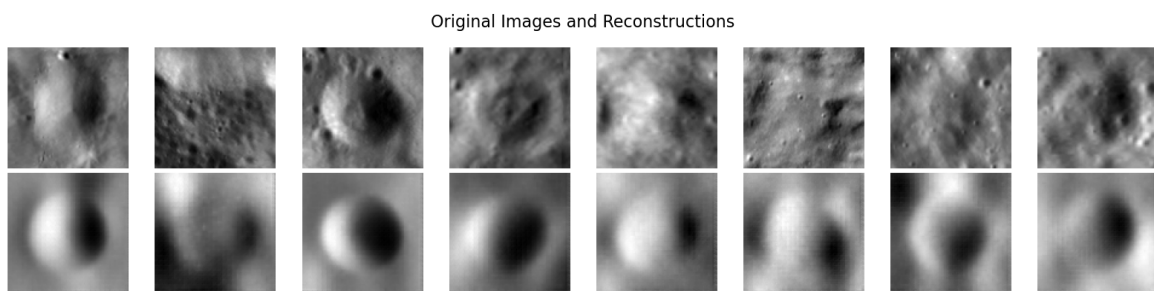
Plot Clustering of PCA on Latent Variables: Julie D. Stopar Craters with Labels

pca on CNN_20_l2 Latent Clustering with Known Labels

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

pca on CNN_20_l2 Latent Image Clustering