Curiosity Clustering

A Semi-supervised labeling of the images of Mars shot by the Curiosity Rover!

Introduction

- Curiosity is NASA's rover on Mars performing experiments and sends images back on regular basis.
- There are approx 25 classes and each class had 250 images which makes classification by a normal CNN very difficult.
- Hence this approach of using an autoencoder.

People

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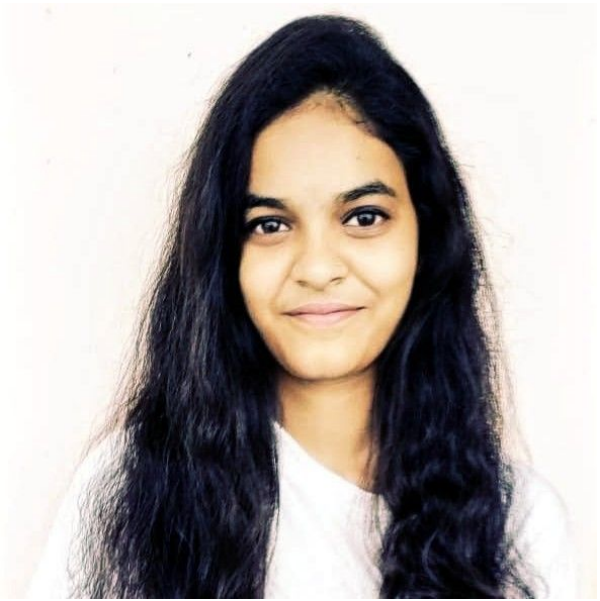
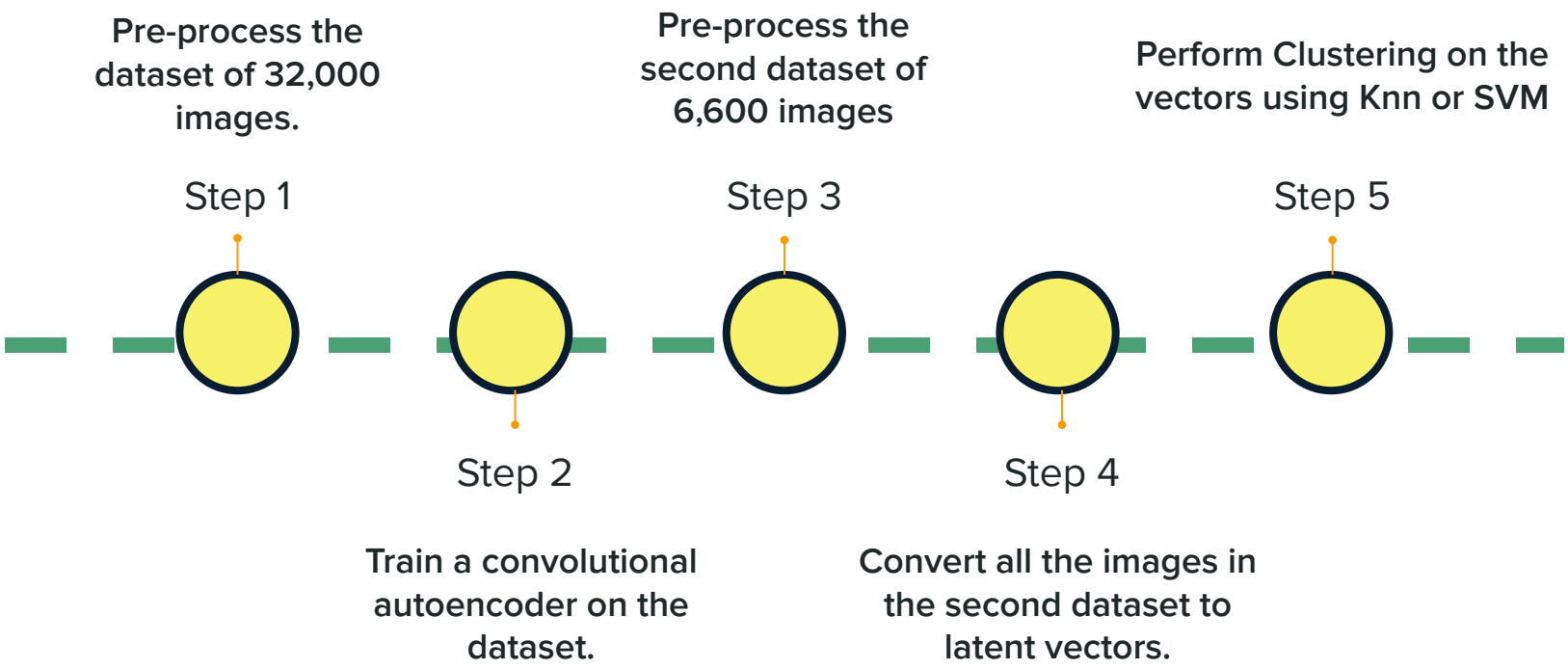


Inspiration

- Initial inspiration from a paper: “Deep Clustering on Mars Rover image datasets”
- Only a small part of the dataset was labelled which made classification using CNN difficult.

  This projects attempts to get a decent accuracy by converting the images to a lower dimensional representation (aka latent vectors)

Abstract

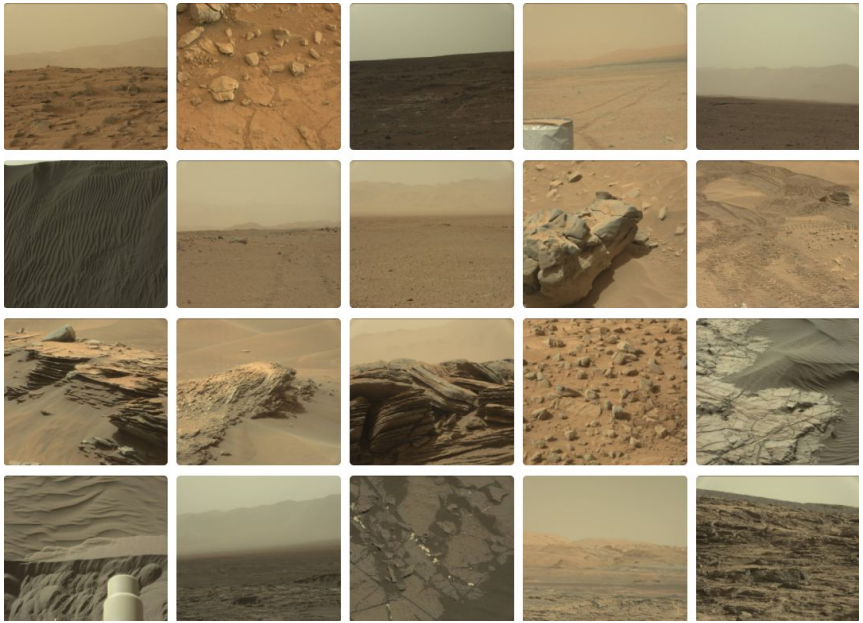

Pre-process the dataset of 32,000 images.
Step 1
Step 2
Train a convolutional autoencoder on the dataset.
Pre-process the second dataset of 6,600 images
Step 3
Step 4
Convert all the images in the second dataset to latent vectors.
Perform Clustering on the vectors using Knn or SVM
Step 5

Dataset

We have used a dataset having 32,000 colour images shot by the Curiosity rover between August 2012 and November 2018.

Out of these only 6,600 images were labelled. These spanned over 24 classes.

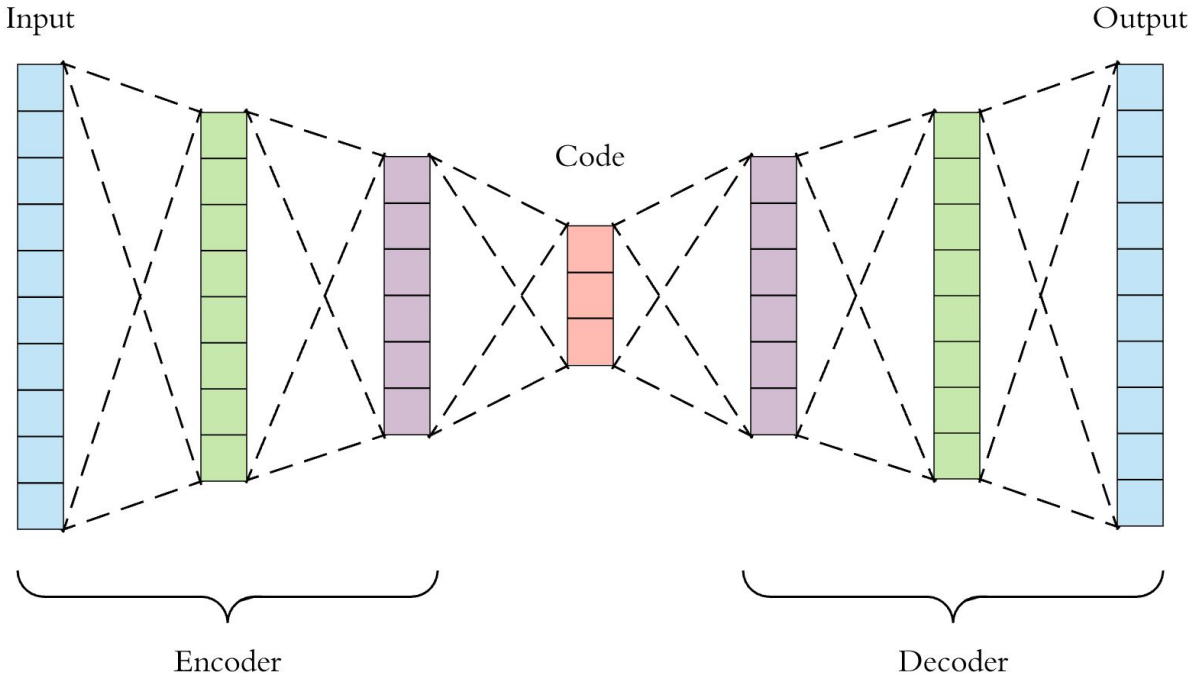
The images show different Martian features.



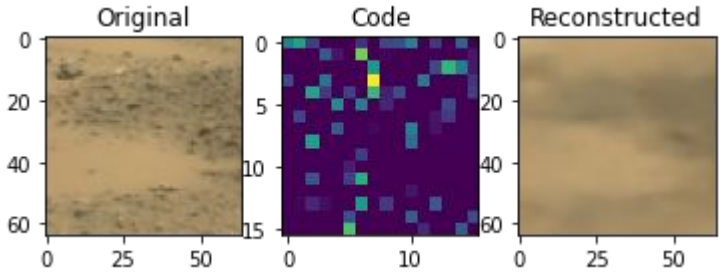
Methodology : Autoencoder

Autoencoder Architecture

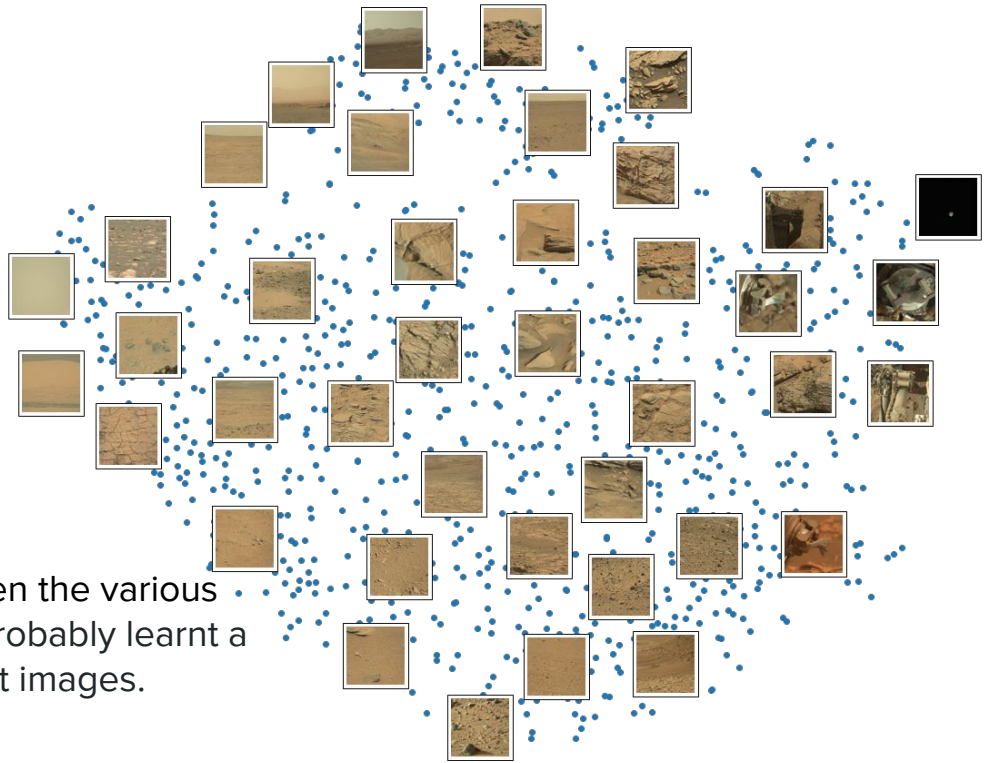
- Basic structure of the autoencoder
- For encoder we have used 3 Conv-2D layers , 3 Max Pooling 2D layers , One flatten and 4 Dense layers. We used Relu as the activation function.
- For decoder we used 4 Dense layers , 4 Conv 2D layers, 3 UpSampling 2D. Relu was used as the activation function for all the layers except the last layer where we used Sigmoid.
- Optimiser - Adam
- Loss function - mse



Training and Visualisation



The model was trained for 150 epochs.
The decoder(reconstruction) also performed nominally.



The visualisation shows good separation between the various classes. This implies that the autoencoder has probably learnt a good latent-representation mapping for the input images.

Methodology : Classification

Latent vector classification

We implemented three classification algorithms on the latent vectors:

1. Naivè bayes
2. KNN
3. SVM

Algorithm used	Accuracy
Naivè Bayes	37.852%
KNN	92.085%
SVM	94.539%

Future Works

- We can use a Variational Autoencoder instead of an Autoencoder to improve latent space representation.
- We can try using a simple feed forward network instead of a Support Vector Machine to improve classification of the latent vectors.
- We can increase the input resolution from 64x64 to 228x288 and above, to get better results.
- We can try using k-means clustering as well, to make the entire pipeline unsupervised, and see how it affects performance.

References/Links

- Dataset: Mars surface image (Curiosity rover) labeled data set | Zenodo
- Kiri L. Wagstaff, You Lu, Alice Stanboli, Kevin Grimes, Thamme Gowda, and Jordan Padams. "Deep Mars: CNN Classification of Mars Imagery for the PDS Imaging Atlas." *Proceedings of the Thirtieth Annual Conference on Innovative Applications of Artificial Intelligence*, 2018. (For further information about the dataset)
- Dataset for the unlabelled data: https://dominikschmidt.xyz/mars32k/
- Github link: https://github.com/Naimish240/CuriosityClassifier
- Inspiration from : Paper on “Deep Clustering for Mars Rover image datasets”