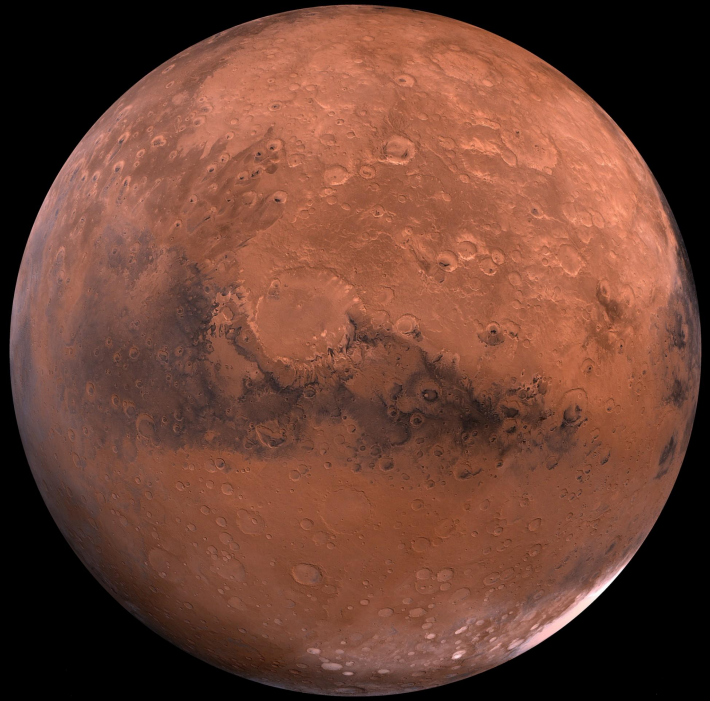
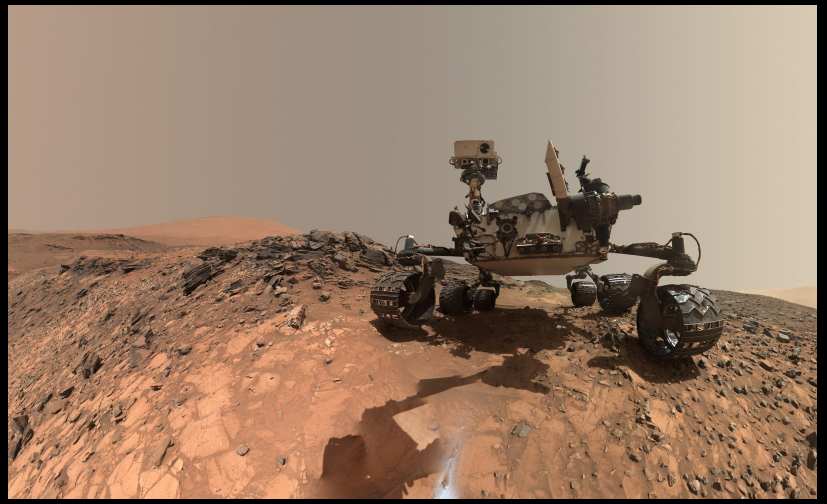
Mars Surface and Curiosity Image Classification Using a Convolutional Neural Network

Project Presentation

By Zachary Pruessner





Mars, our nearest planetary neighbor.
Potential cradle of extraterrestrial life.
Its explorer, Curiosity. A technological feat that provides scientists with valuable data.

Curiosity generates raw images that are.

- Uncategorized
- Differing size
- Not easily accessed

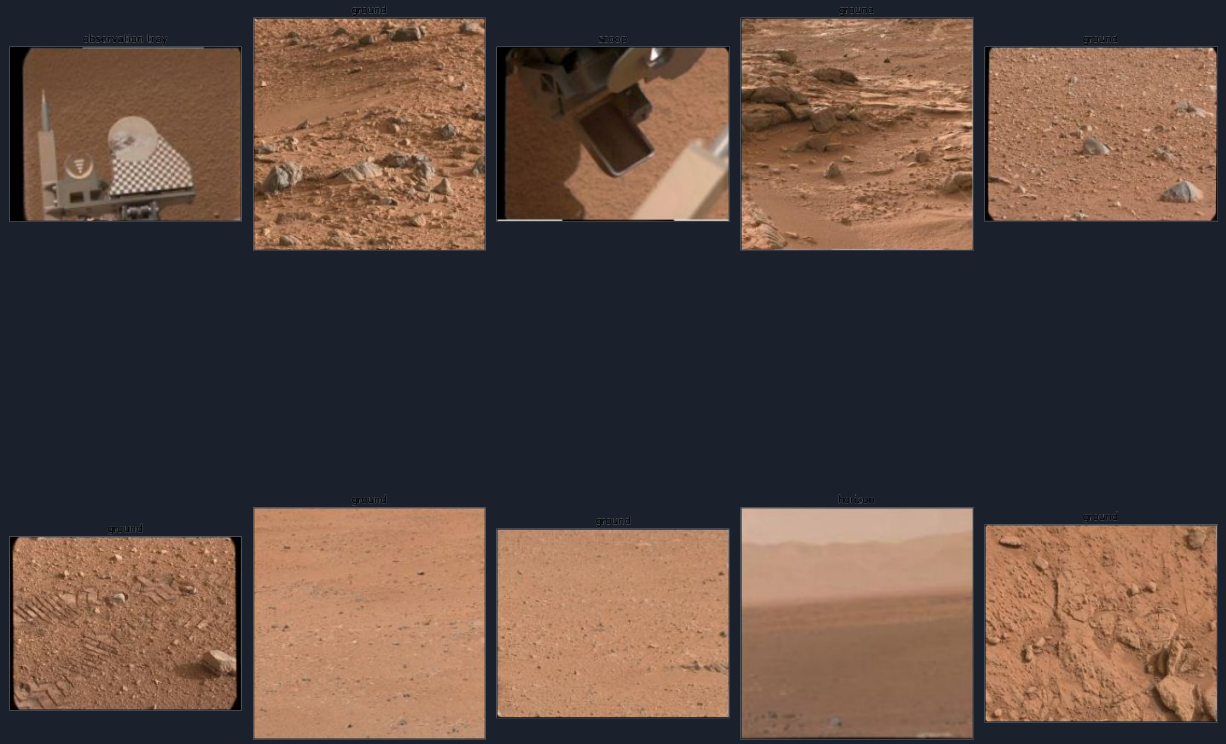
These images provide information about Mars, but they need to be labeled and sorted to be used optimally.

Problem Statement
Solution
And Success Metrics

Problem - Large amount of uncategorized images capable of providing insight.

Solution - Build a Convolutional Neural Network to label all images so that they can be searched for in a dataset based on their label.

Success Metrics - This project will be considered successful if the model achieves 98% accuracy or better.



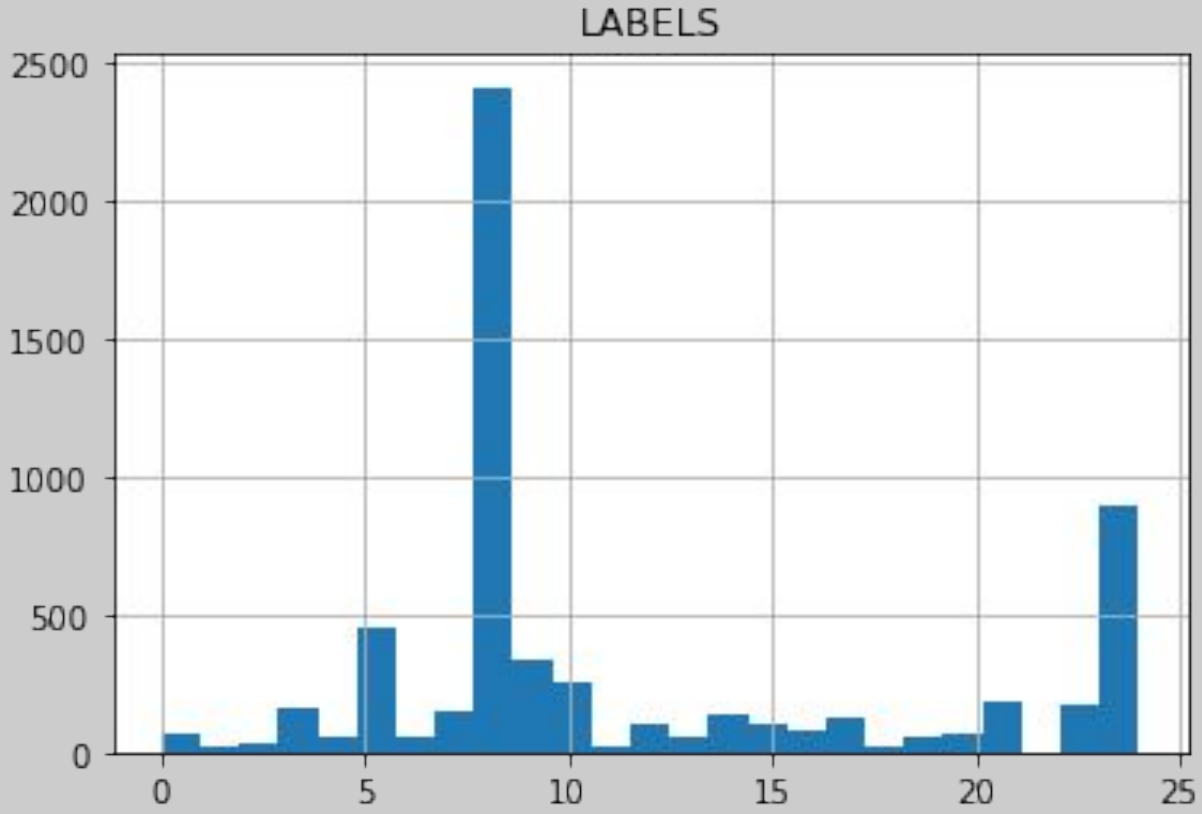
Sample of images from dataset

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.

Data Wrangling

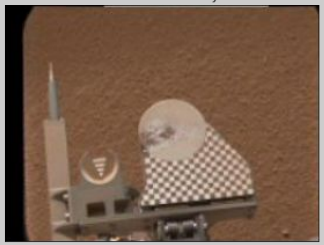
1. Visual inspection
2. Pathing correction
3. Merging of csv files
4. Map label names to numbers

Exploring the Data



Distribution of labels in dataset. Note the imbalance due to label 8.

observation tray



ground

scoop

ground

ground

ground

ground

ground

horizon

ground

Preprocessing

Transformations performed during preprocessing

- ➔ Image resize to 128x128
- ➔ Image normalization
- ➔ One hot encoding of labels

Convolutional Neural Networks

Ideal model for images

Models

Model 1

Conv2d

MaxPooling2D

Dropout

Flatten

Dense

Dense

Model 2

Conv2d

MaxPooling2D

Conv2d

MaxPooling2D

Dropout

Flatten

Dense

Dense

Model 3

Conv2d

MaxPooling2D

Conv2d

MaxPooling2D

Conv2d

MaxPooling2D

Dropout

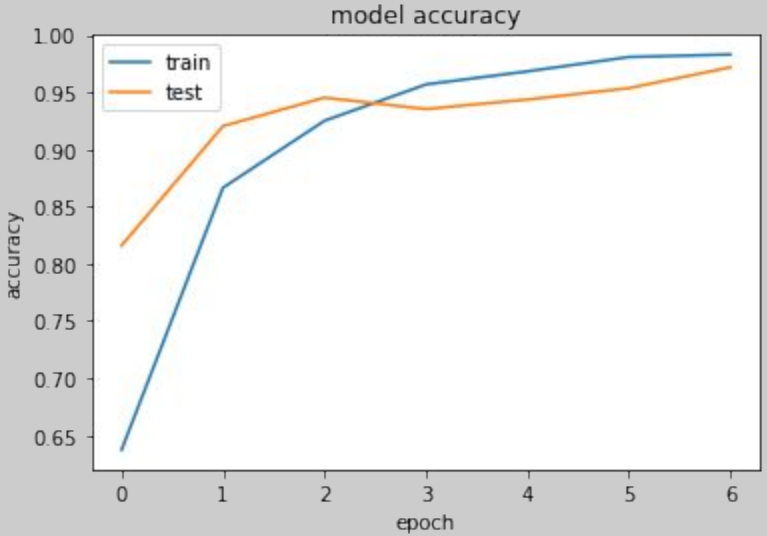
Flatten

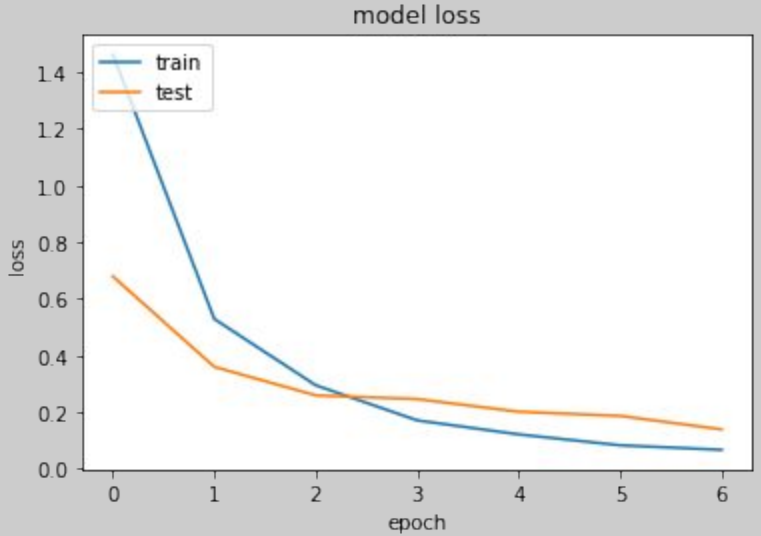
Dense

Dense

Analysis

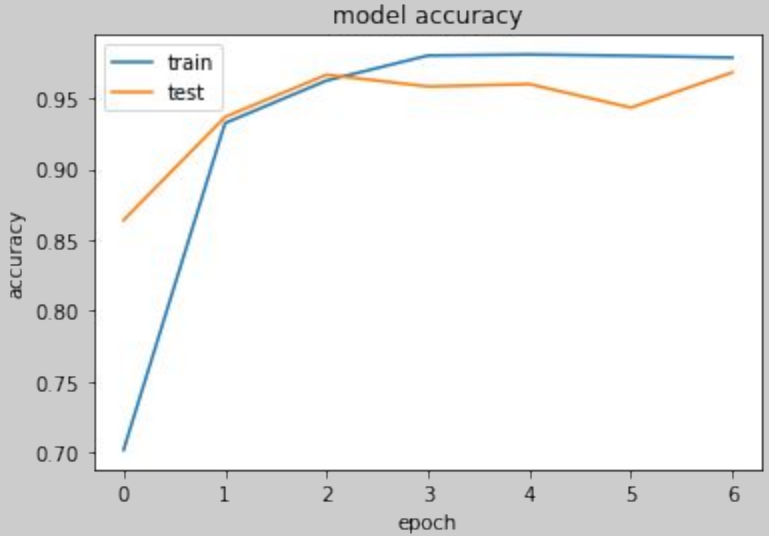
Model 1 history in accuracy and loss

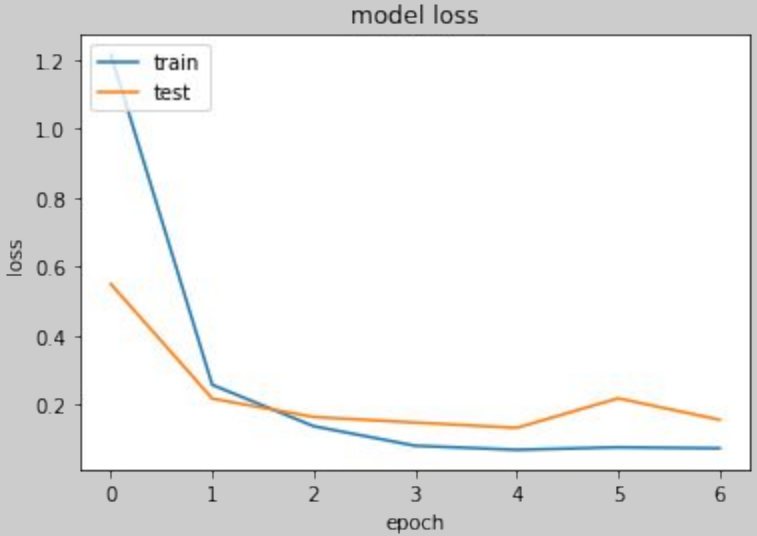




loss: 0.0661 - accuracy: 0.9830 - mae: 0.0034 - val_loss: 0.1383 - val_accuracy: 0.9718 - val_mae: 0.0046

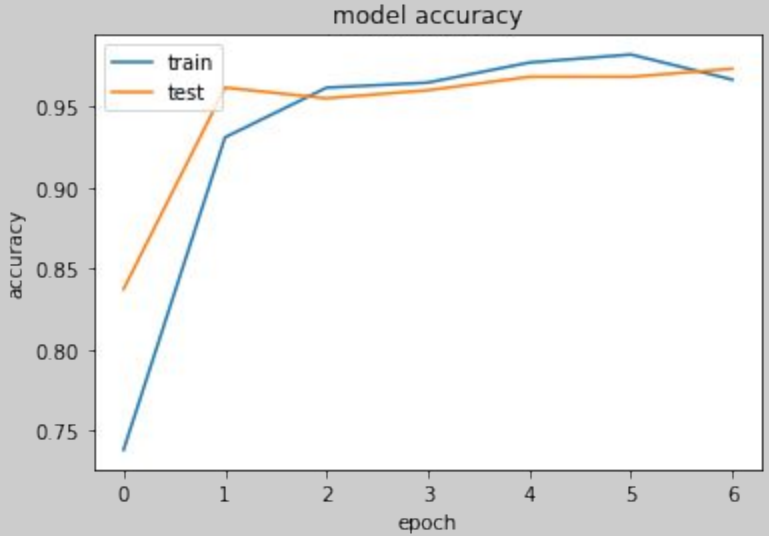
Model 2 history in accuracy and loss

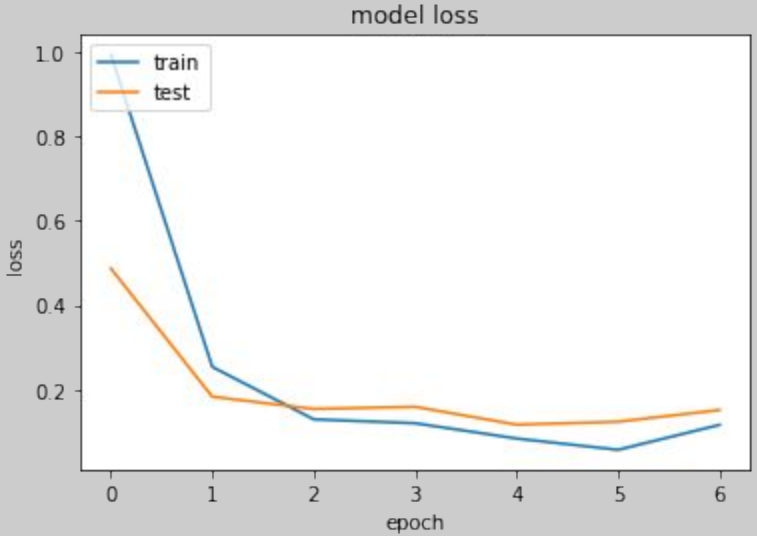




loss: 0.0729 - accuracy: 0.9790 - mae: 0.0029 - val_loss: 0.1557 - val_accuracy: 0.9685 - val_mae: 0.0034

Model 3 history in accuracy and loss





loss: 0.1166 - accuracy: 0.9668 - mae: 0.0042 - val_loss: 0.1517 - val_accuracy: 0.9735 - val_mae: 0.0030

Recommendation

Based on the results, model 3 is likely to perform best when applied to the labeling of images.

This conclusion is based on its performance on the validation set.