River Delta Satellite Image Classification

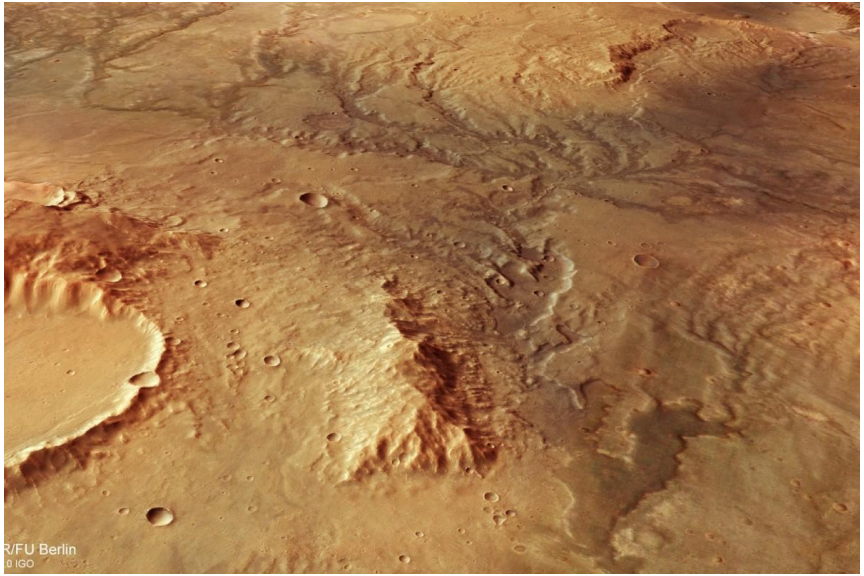
Using a neural network to classify land and river delta images.

Alex Beat

Business Overview

Problem: A model is needed to help process the large amounts of raw images returned from Mars data.

Business Value: This model will speed up the processing of Mars image data to help classify river delta patterns and aid scientists in honing in on locations that contain traces of existing or pre-existing water on the planet.



Method

Images were scraped from Google Image Search to obtain a unique image dataset of 1,600+ Earth satellite images.

A convolutional neural network model (CNN) was trained on an expanded set of 2,232 images through use of data augmentation.

Phase 1: The model processes Earth image tiles classify land and river deltas.

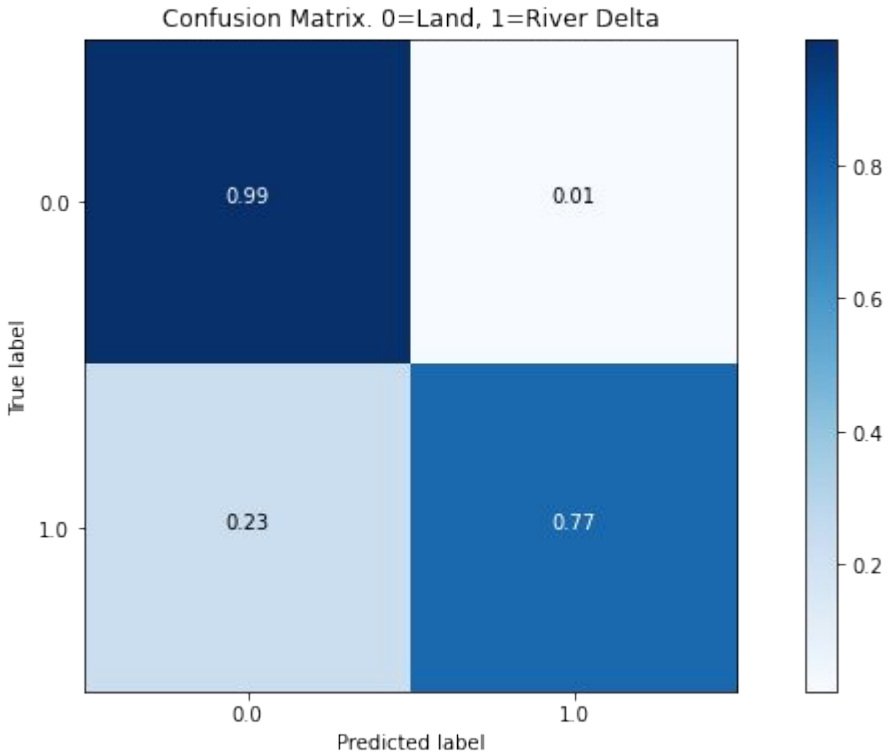
Phase 2: Second model to process Mars image tiles.

CNN Model.

Recall for river deltas: 77%

Precision: 98%

Overall accuracy 91%



*Additional model reports in the appendix.

Phase 1 Use Cases

Addition of time series into model processing will give an overview of changes to specific river deltas over time.

- **Climate change**
- **Agriculture**
- **Commercial and residential real estate**

Phase 2 Use Case: Water on Mars

Large amounts of raw data from Mars exists that needs to be processed as more and more of it continues to be collected.

Machine learning model will aid scientists in process.

Classify river delta patterns and return coordinates for scientists to follow up.

River delta patterns could provide potential traces for pre-existence of water.

Summary & Recommendations

Implement this model to aid in faster processing of large quantity raw Mars data.

Additional use cases on Earth:

- Climate change
- Agriculture
- Commercial and residential real estate

Future Work

Obtain cleaner images.

Note the displayed images and the text/image artifacts they contain.

Result of basic Google Image Search algorithm webscrape.

Land

Delta

Future Work cont.

Implement supervised training model.

Grid search for better hyperparameter tuning.

Obtain a bigger set of images.

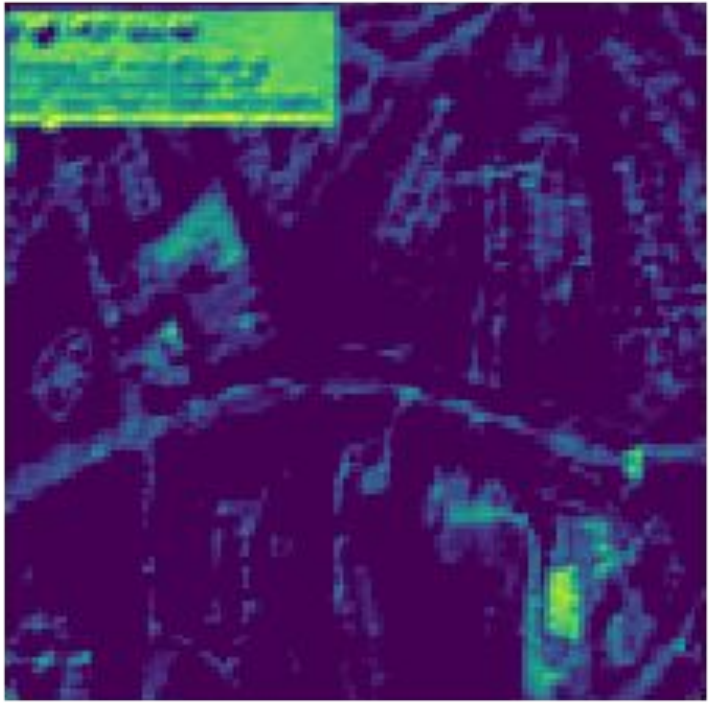
Obtain Mars API images that have paired location coordinates.

Time series adaptation of Phase 1 for Earth river delta change observation.

Thank you.

Appendix.

Feature map of CNN pattern recognition within hidden layers.



Appendix.

CNN model layers.

Each layer develops more patterns and more channel dimensions of the images, going from 32 up to 128 feature mapped dimensions.

Dense layers at the end connect all of the parameters as final learning step for output.

```
Model: "sequential_6"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_18 (Conv2D)           (None, 126, 126, 32)      896
_________________________________________________________________
max_pooling2d_18 (MaxPooling (None, 63, 63, 32)        0
_________________________________________________________________
conv2d_19 (Conv2D)           (None, 61, 61, 64)        18496
_________________________________________________________________
max_pooling2d_19 (MaxPooling (None, 30, 30, 64)        0
_________________________________________________________________
conv2d_20 (Conv2D)           (None, 28, 28, 128)       73856
_________________________________________________________________
max_pooling2d_20 (MaxPooling (None, 14, 14, 128)       0
_________________________________________________________________
flatten_6 (Flatten)          (None, 25088)             0
_________________________________________________________________
dense_13 (Dense)             (None, 512)               12845568
_________________________________________________________________
dense_14 (Dense)             (None, 1)                 513
=================================================================
Total params: 12,939,329
Trainable params: 12,939,329
Non-trainable params: 0
```

Appendix.

Training and testing accuracy shown through model training process.

X-axis steps are known as epochs.

Loss shows how well the model is predicting during training.