Hyper Parameter Tuning in Neural Optical Image Categorizer for the E-log (NOICE)

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Abstract

The Fermilab Accelerator Division Electronic logbook (E-log) is a record of all the activities and events in the Division for the past 10 years and more. The E-log search function is a valuable resource and the institutional memory of the accelerator complex. About 300,000 files are stored in the E-log, of which the vast majority are images attached to entries and comments. The visual information contained in the images is not presently searchable. The goal of Team NOICE (Neural Optical Image Categorizer for the E-log) was to design a neural network able to produce label categories for these images for use by searches.

The group developed a dataset and trained a convolutional neural network (CNN) with optimized hyperparameter. Final performance metrics are presented.

Dataset Generation

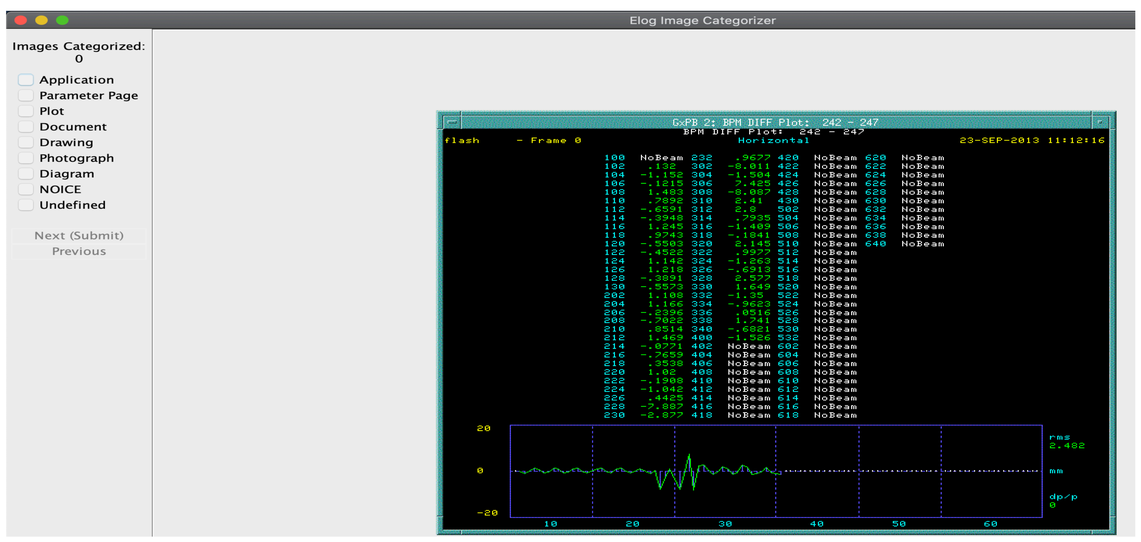
Below we present the dataset generated by humans and used for training.

A human-generated a dataset of 8,000 images were used as validation and training.

An example image which is both plot and application is shown below.

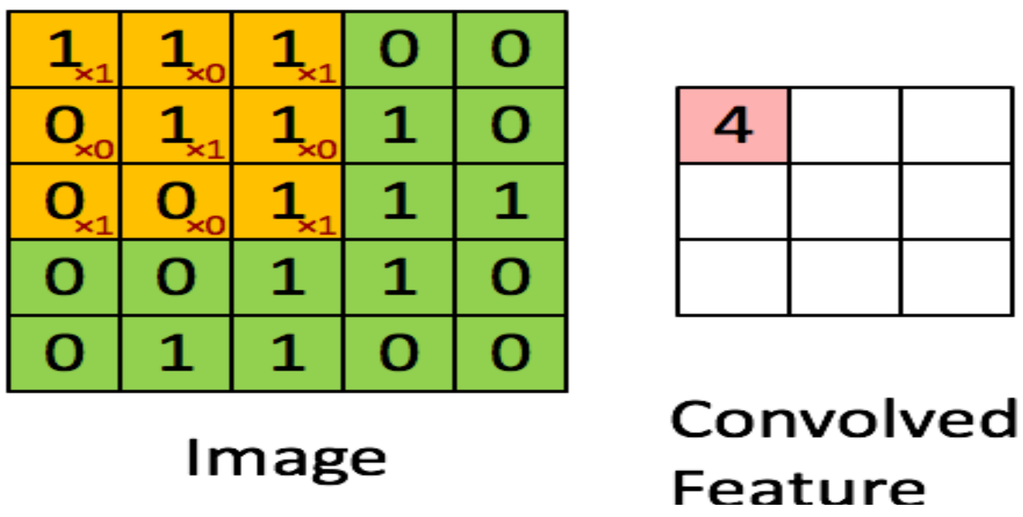
Label Frequency without Combinations

index	Labels	Count	Percentage
0	Plot	4499	52.66
1	ParameterPage	2088	24.44
2	Application	1155	13.52
3	Photograph	361	4.23
4	Undefined	171	2.0
5	Diagram	103	1.21
6	Document	78	0.91
7	NOICE	76	0.89
8	Drawing	12	0.14



- Plot
- Parameter Page
- Photograph
- Document
- Drawing
- Diagram
- NOICE
- Application
- Undefined

Convolutional Neural Network (CNN)



A convolutional Neural Network (CNN) is Set of algorithms using machine learning Interpret sensory data (classify, categorize, and cluster)

We use it to find the best model

- http://ufldl.stanford.edu/tutorial/supervised/FeatureExtractionUsingConvolution/

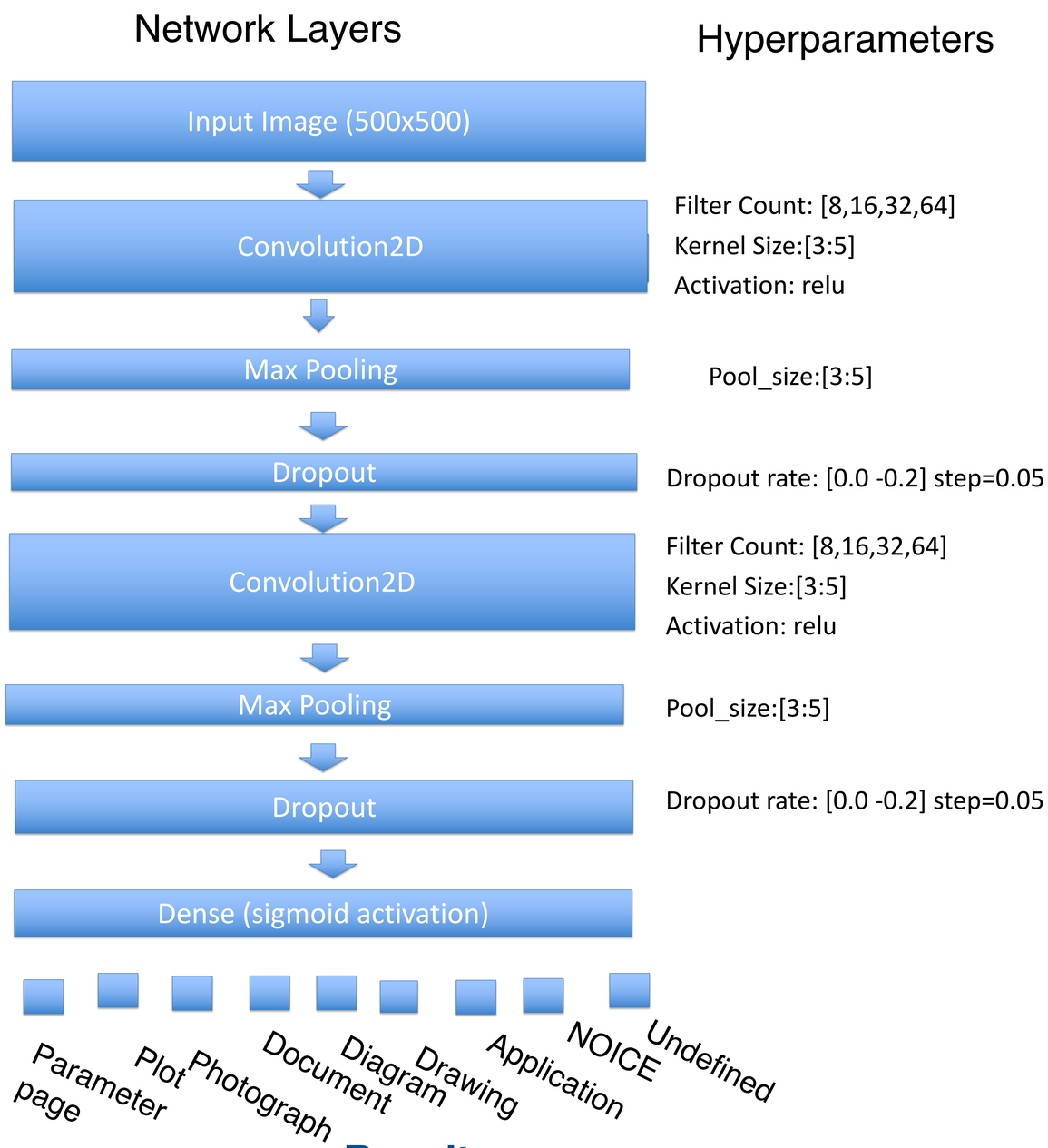
Tools

Code base was established and developed in Git.

Networks and Hyperparameter tuning script written in python and TensorFlow were executed in a Docker container running on a Google Cloud platform virtual machine (NVIDIA V100 GPUs)

Hyper Parameter Tuning

The process of Hyperparameter tuning is used to enhance the model performance, defined as validation accuracy.



Results

We achieved the final validation loss 0.0987 with the hyperparameter values shown below

Layer 1: Filters: 8, Kernel: 5, Activation: relu, Pool: 3, Dropout: 0.0

Layer 2: Filters: 64, Kernel: 5, Activation: relu, Pool: 3, Dropout: 0.0

The next best validation loss was 0.1013

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