Is it Raining Cats or Dogs?

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Introduction

The ability to properly classify images of different species and breeds of animals is an interesting problem well suited to machine learning

There is wide application in industries such as agriculture, health services and animal services.

Examples:

- Classifying species of mosquitoes known to carry the Zika virus to identify high-risk areas with minimal cost
- Identifying individuals of a species such as whales

Data Set:

- Cats and Dogs Breeds Classification Oxford Dataset
- Located at https://www.kaggle.com/zippyz/cats-and-dogs-breeds-classification-oxford-dataset
- 7,393 labeled images

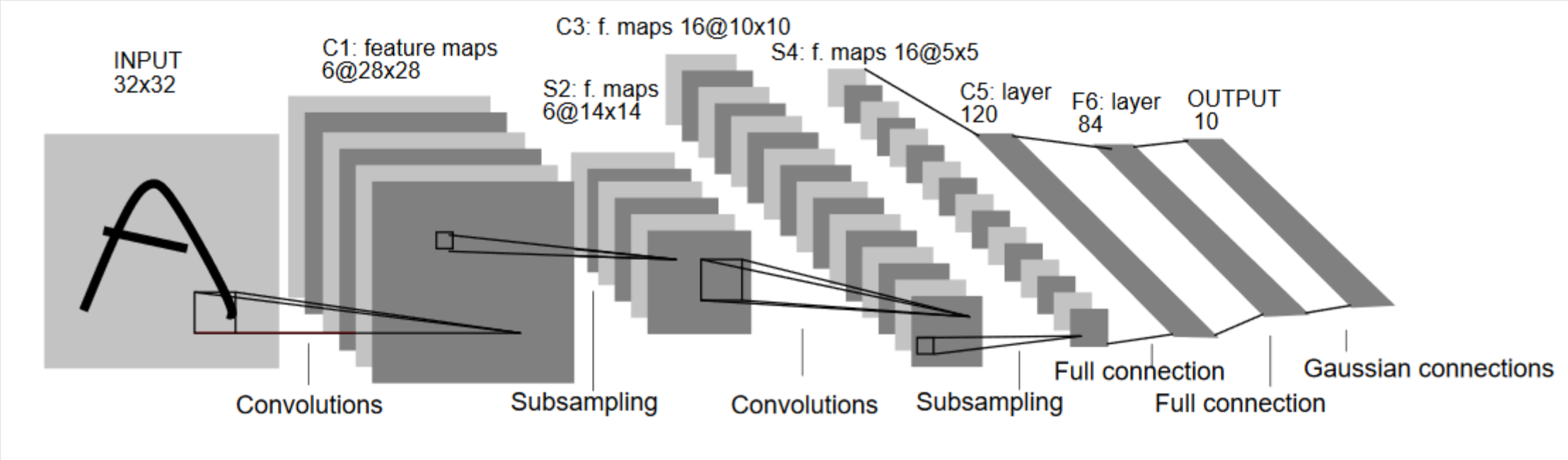
Methodology

Simple Beginnings: Binary classification of dogs vs. cats

Network: CNN

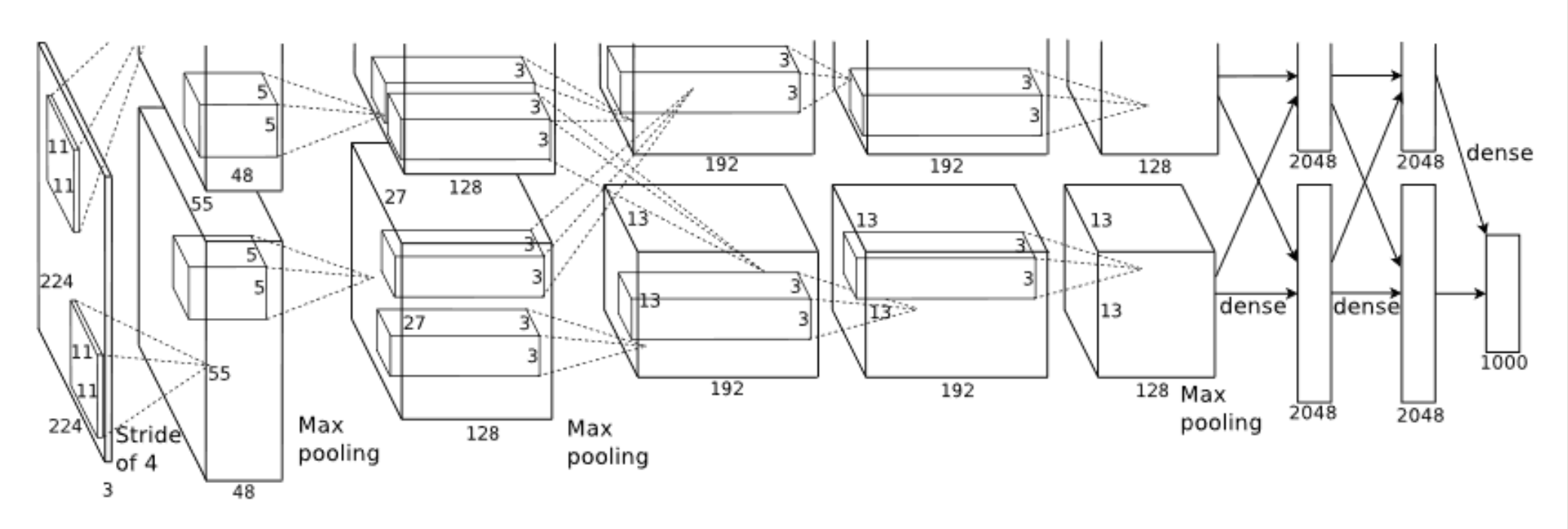
- Attempt two different architectures based on previous work
  - LeNet (Lecun et al., 1998)
  - AlexNet (Krizhevsky et al., 2012)

LeNet



Lecun et al., 1998

AlexNet



Krizhevsky et al., 2012

Caffe

Framework suited for deep learning and designed for speed

Accepts different kinds of data types: Lightening Memory-Mapped Database

Data Processing

Set Up the Data Structure: separate the image files into folders named by label

Resize the images: for ease of use, the images were resized to squares

Histogram Equalization: method of enhancing contrast

Create the lmdb: combine the data and the labels

Data Processing within Caffe

Transformation Parameters: within the data layer there are transformation options

mean subtraction: for this you need the image mean

mirror augmentation

Results

Attempted several versions of LeNet parameters

First attempts yielded disappointing results

Layers & Functions

Model	Batch Size	Convl Layer #	Fully Connect Layer #	Dropout	Loss Function
LeNet	64	2	2	0	Cross Entropy
LeNet(upd)	50	2	2	0	Cross Entropy
AlexNet	64	5	3	2	Cross Entropy

Parameters

Test Iteration	Test Interval	Learning Rate	Momentum	Weight Decay	Gamma
100	500	0.01	0.9	0.0005	0.001
50	200	0.001	0.5	0.0001	0.001

Results - LeNet

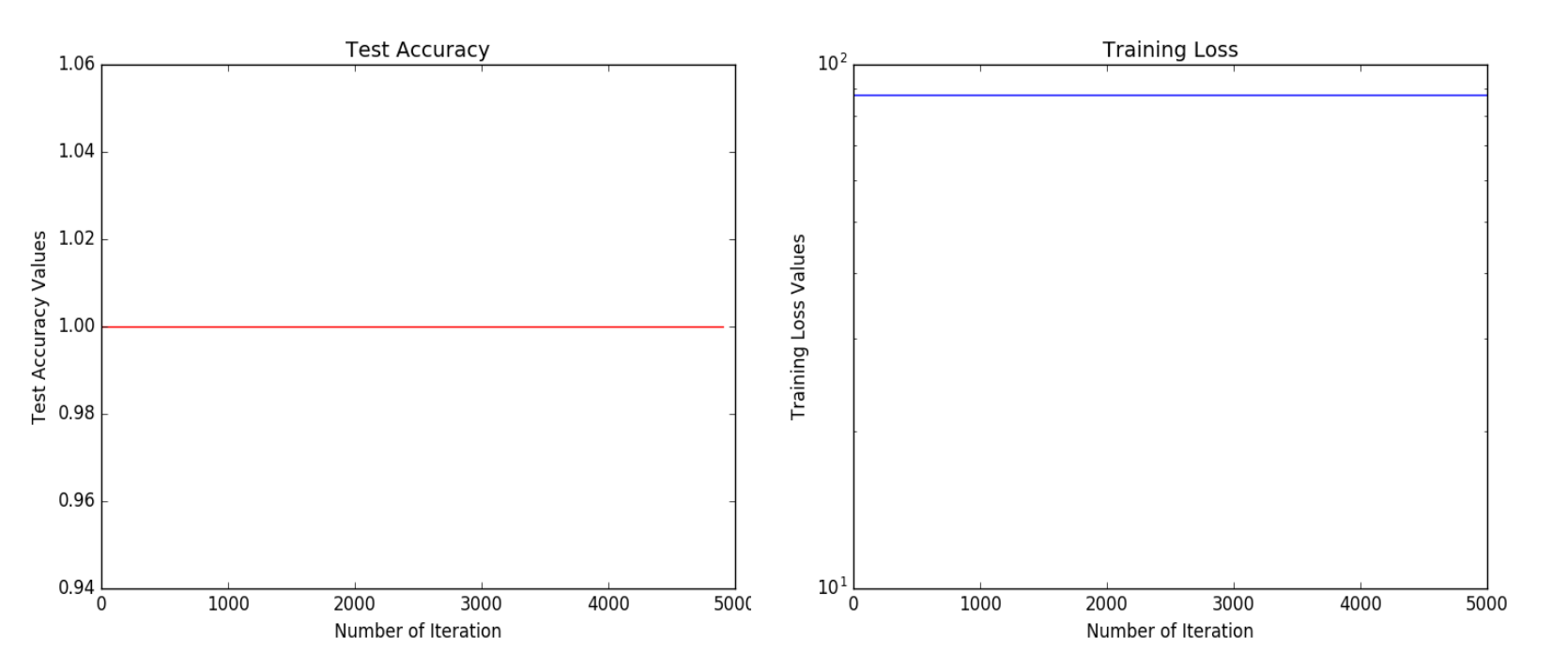


Figure 1: Test Accuracy and Training Loss results of LeNet base model

Results - LeNet

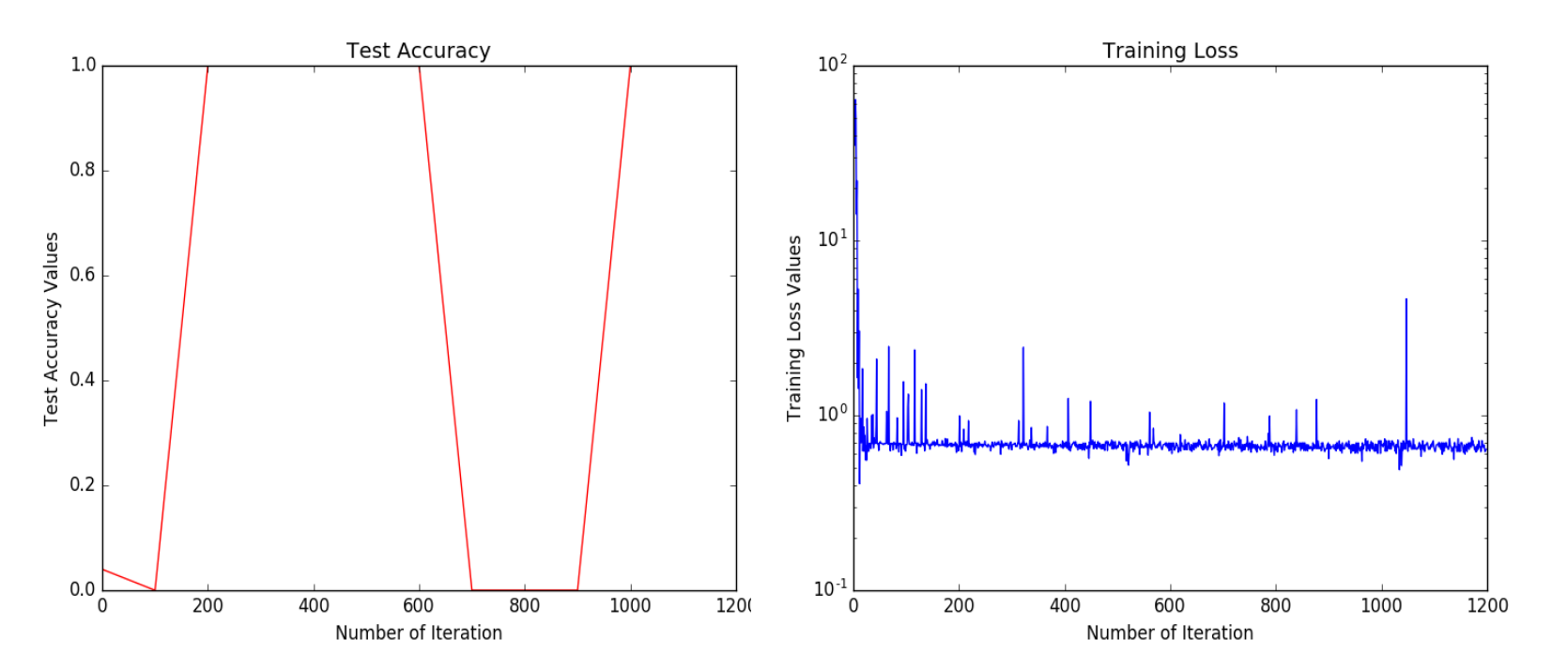


Figure 2: Test Accuracy and Training Loss results of LeNet 1 model

Results - LeNet

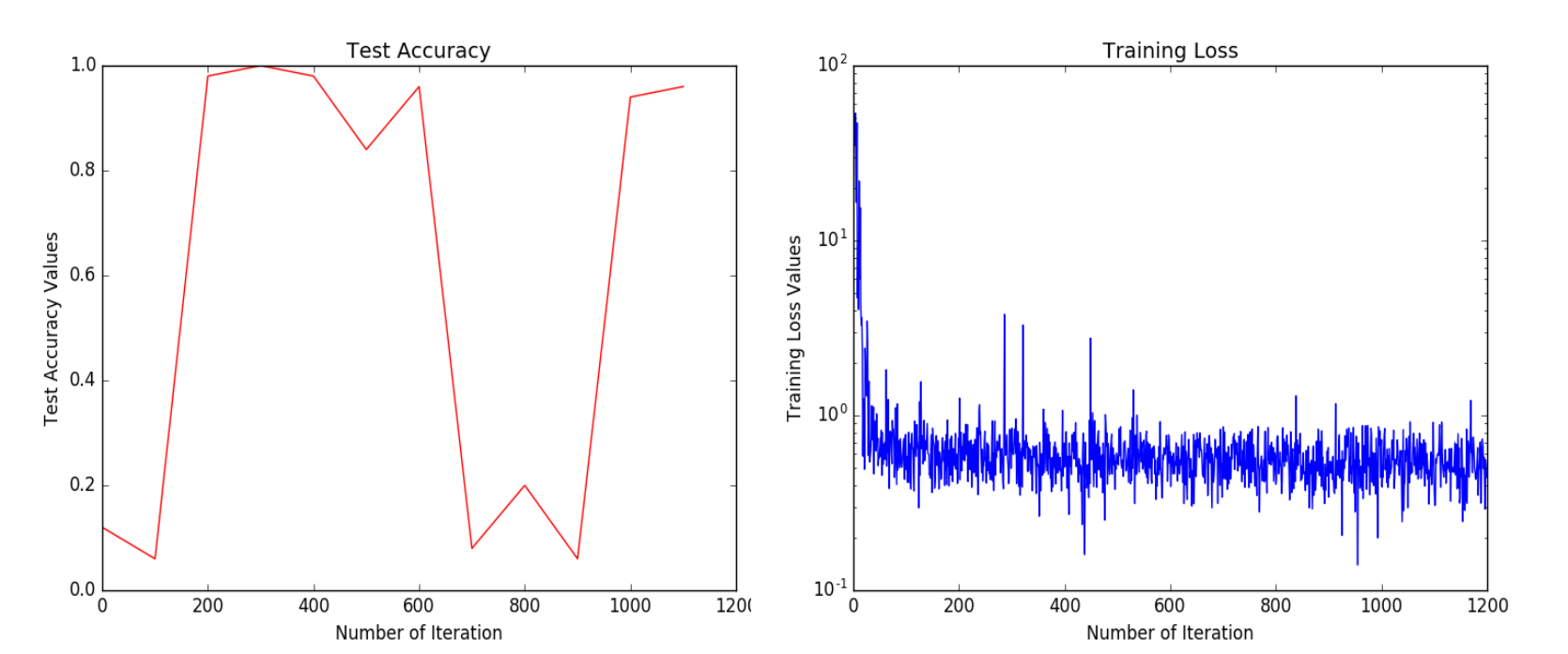


Figure 3: Test Accuracy and Training Loss results of LeNet 2 model

Results - AlexNet

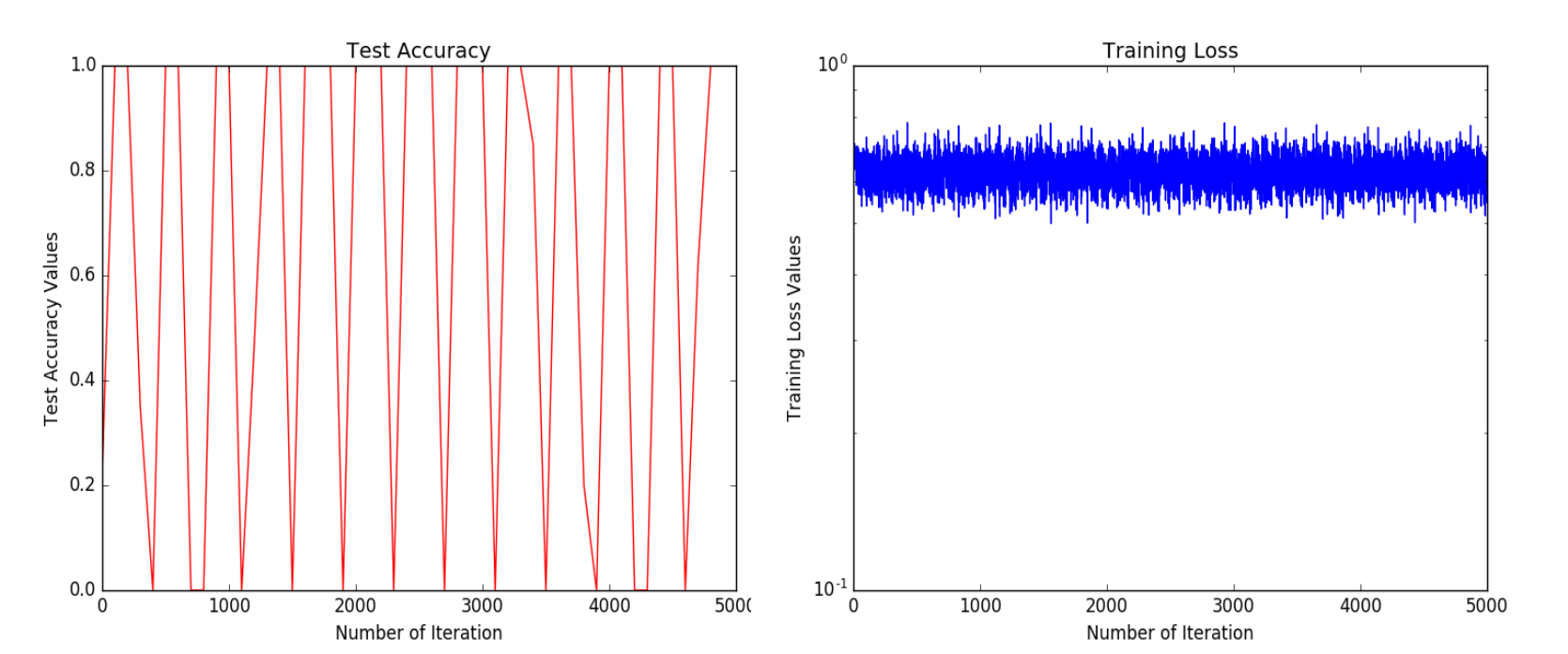


Figure 4: Test Accuracy and Training Loss results of AlexNet model

Results Summary

All of our networks resulted in poor models for our data

- Accuracy scores were not only unstable, but oscillated unrealistically between 0 and 1
- Loss did not generally decrease over time

Possibilities

- Overfitting can be an issue with small data sets and further the data is unbalanced (more dogs than cats)
- Some error in the data pre-processing

Conclusion

Lessons Learned:

Proper documentation is important!

Recommendations for Future Research:

Primarily the issues with these networks!

Focus on the feature maps located within the hidden convolutional layers to determine ability to classify subspecies of dogs and cats. This would require a larger data set so additional data collection or oversampling techniques would be necessary.

Questions?