Road Segmentation of Satellite Images Using Convolutional Neural Networks

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***Abstract*—Outlining roads on satellite images can be useful for creating accurate maps of all four corners of the earth. Machine Learning enables us to automate this task. In fact, convolutional neural networks (CNNs) are a suitable tool for image recognition and thus road segmentation as well. In this project we design a CNN and evaluate the resulting model. We compare our various CNN designs to a baseline model obtained from a basic CNN.**

I. Introduction

II. The Google Maps Satellite Images Data Set

The data set we are given to train a model on consists of 100 satellite images from Google Maps. The pictures look like they were all taken from a very similar locations, probably one single city. As such, the given data set is not very diverse. Furthermore, it is quite limited in size. This explains why we need to enlarge our data set. Note that our training set is a fraction of the same Google Maps satellite images. Thus, we expect that our road classifier can be trained to perform well for segmenting roads of that particular city or similar cities. Its performance when applied to radically different roads and areas can however not be certified.

In section III-A we describe how the data set was enlarged and how we managed to run train CNN on a substantial amount of images, so as to yield proper results.

III. Models and Methods

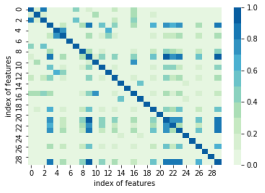

Figure 1: Correlation matrix of all features

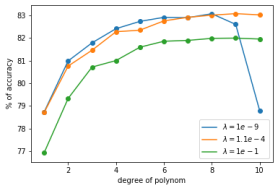

Figure 2: Accuracies obtained for different polynomial extension degrees and λ values

A. Creating a Large Data Set

B. Evolution of our CNN

$$f(x) = \log \frac{1}{1+x} \tag{1}$$

C. Model Validation

IV. Results

Regression Technique	Accuracy (Avg.) - STD
Least Squares GD (and SGD)	68.5% - 0.20%
Least Squares	74.4% - 0.25%
Ridge Regression	74.4% - 0.24%
Logistic Regression	65.7% - 0.29%
Newton Logistic Regression	65.7% - 0.29%
Our Best Regression	81.3% - 0.82%

Table I: Accuracy of Various Models Obtained by Our Regressions

V. Conclusion