

Aarhus University

Deep Learning

PROJECT

Author:

Peter Holst - 20104144
Line Aggerbo - 201302451
Nikolas Bram - 20104278

Supervisor:

Supervisor

December 15, 2015

TABLE OF CONTENTS

1	Introduction	1
2	Exercise 1	2
2.1	section name	2
3	Exercise 2	3
3.1	section name	3
4	Project	4
4.1	Caffe	4
4.2	Convolutional Network architecture	5
4.2.1	Convolutional layers	5
4.2.2	Pooling layers	5
4.2.3	Fully-Connected Layers	5
4.3	Training and testing	5
4.4	The networks	5
4.4.1	The original network	6
4.4.2	Another network	6
4.5	Results	6
4.6	Discussion	7
4.7	Conclusion	7

LIST OF FIGURES

INTRODUCTION

This report is written throughout the reading course 'Deep Learning' at Aarhus University Department of Engineering. The reading course is based of parts of the teaching resources from the CS231n 'Convolutional Neural Networks for Visual Recognition' course at Stanford University taught by Andrej Karpathy.

The report consists of three parts. The first two parts are the group's solutions for two given exercises in the reading course - Exercise 1 and Exercise 2. The exercises are solved in iPython and are a part of the CS231n course as well.

The third part is a project which is chosen by the group. The project chosen is to use the deep learning framework Caffe to classify images from the image database CIFAR-10.

EXERCISE 1

2.1 section name

Q1: Will walk you through implementing a two-layer neural network on CIFAR-10.

Q2: A modular Neural Network implementation. You will implement the forward and backward passes of an affine layer and a ReLU layer

EXERCISE 2

3.1 section name

PROJECT

The project for this reading course is chosen to be carried out using the deep learning framework Caffe. The framework is well known in the deep learning community. It is a rather simple way to obtain a classification convolutional neural network in a very short time, which is the reason why it has been chosen.

The idea of this project is to try out some different neural networks with different values for its hyperparameters and to see which values will obtain the highest accuracy when training and testing on the CIFAR-10 image data set.

The convolutional network used for inspiration is the one introduced in "Alex's CIFAR-10 tutorial, Caffe style"¹ provided by the team behind Caffe. This convolutional network and the changes made to it will be described later on in this chapter along with the architecture and the different types of layers.

4.1 Caffe

Convolutional Architecture for Fast Feature Embedding (Caffe) is a public available framework which makes it possible to design, train and use a convolutional in a rather simple way. The source code is available online and the team behind the framework encourage other people to note or change any errors which they might find. The framework allows you to choose to use either the CPU or the GPU for calculations. In this project the CPU is used.

In order to use Caffe for image classification three files are needed - a `.prototxt` file, a `_solver.prototxt` file and a `.caffemodel` file. These three files together defines the architecture of the network, the hyperparameters and the training and testing strategy.

The `.caffemodel` file defines the architecture of the model e.g. the number and types of layers. An example of a defined layer is shown in

The `.prototxt` file defines ...

The `_solver.prototxt` file defines ...

¹<http://caffe.berkeleyvision.org/gathered/examples/cifar10.html>

4.2 Convolutional Network architecture

A convolutional neural network exists of a number of different layers with different properties. The different layers used in the networks in this project are described in this section.

4.2.1 Convolutional layers

The convolutional layers are often the first layers in the network.

Der skal nok skrives lidt om her ..

The rectified Linear Unit (ReLU) is one of many activation function to choose among. The ReLU activation function is the most common activation function in the lower layers of convolutional neural networks. Other activation functions could be the Sigmoid or the Tanh activation functions.

The ReLU differs from the other mentioned activations function in several ways. First of all it converges faster which results in shorter training time. Second of all the ReLU activation function do not saturate which avoids the problem about the gradient getting killed which would lead to the case where the network stops learning during the training (HENVIS TIL MATERIALE OM AKTIVERINGS FUNKTIONER). This problem is known from the use of the other activation functions.

The formula for the ReLU activation function is $f(x) = \max(0, x)$ and is illustrated in FIGURE..

INDST FIGUR

4.2.2 Pooling layers

4.2.3 Fully-Connected Layers

4.3 Training and testing

De forskellige hyperparametre, regularization, mini ba, epoches,

4.4 The networks

The network from the tutorial described earlier in this report is referred to as the original network. The other networks which are tried out in this project is based on

this network with some changes in the architecture. All networks are described in this section.

4.4.1 The original network

The original network is a six layer network. The network consists of three convolutional layers and three fully connected layers. The layers are as following

- The first layer consists of a convolution with a kernel size of five, a stride of one and a padding of two. The activation function is the ReLU. It also consists of max pooling with a kernel size of three and a stride of two.
- The second layer consists of the same three parts with the same values of strides and kernel sizes.
- The third layer also consists of three parts. The convolutional part and the ReLU is the same as in the earlier layers. But instead of using max pooling, average pooling is used.
- The fourth layer is a normal fully connected layer.
- The fifth layer is also a normal fully connected layer.
- The sixth layer is a fully connected softmax layer.

section 4.4

Beskrivelse af arkitekturen og implementationsfilerne

Beskrivelse af resultaterne

AlexNet: (8 layers, 7 hidden layers)

Conv, Max pool — Conv, Max pool — Conv — Conv — Conv, Max pool — Fully con. — Fully con. — Fully con. (output)

4.4.2 Another network

Beskrivelse af arkitekturen og implementationsfilerne

Beskrivelse af resultaterne

4.5 Results

Sammendrag af alle resultater

Name	Column heading 1	Column heading 2
Cell text	Cell text	Cell text
Cell text	Cell text	Cell text
Cell text	Cell text 576	Cell text

Table 4.1: Long caption

4.6 Discussion

We have experimented with different configurations in the Caffe framework for convolutional neural networks as explained in section 4.4.

- Sammenlign med CIFAR fra exercise 1 Q1, “Train a network” -

4.7 Conclusion

We have..

[1] [2]

Bibliography

- [1] KRIZHEVSKY, A., SUTSKEVER, I., AND HINTON, G. E. Imagenet classification with deep convolutional neural networks. In *Advances in neural information processing systems* (2012), pp. 1097–1105.
- [2] ZEILER, M. D., AND FERGUS, R. Visualizing and understanding convolutional networks. In *Computer Vision—ECCV 2014*. Springer, 2014, pp. 818–833.