EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

MATH. - NATURWISS. FAKULTÄT
FACHBEREICH INFORMATIK
KOGNITIVE SYSTEME · PROF. A. ZELL

Deep Neural Networks

Assignment 11

Assignment due by: 24.07.2018, Discussions on: 24.07.2018

Question 1 Convolutions, padding and stride (2 + 1 points)

(a) You are given a single channel input image of size $x \times x$. You then add p pixels of padding on each side and you want to perform a convolution with a kernel of size $k \times k$. Express the size x' of the output image in terms of x, p and k.

(b) You now want the convolution to be performed with stride s. How will this affect the formula for the output size x'. *Hint:* This can lead to some parts of the image not being used. Example: $x = 5$, $p = 0$, $k = 2$, $s = 2$ results in $x' = 2$.

Question 2 ResNet computational cost (2 + 1 + 1 points)

Look at the paper that introduced the ResNet architecture (Deep Residual Learning for Image Recognition, https://arxiv.org/pdf/1512.03385.pdf), and for the ResNet-50 variant (middle column in table 1) compute (show your calculations not just the answer):

(a) the total number of weights (ignore the biases)

(b) the total number of multiplications to process a single image

(c) the total number of activations that need to be saved for backpropagation for each image in the minibatch

Question 3 Design your own deep network for the CIFAR dataset (13 points)

This task is designing and implementing a deep network and training it on the CIFAR-10 dataset. The dataset consists of small color images of different common objects or animals and is significantly more complex than the MNIST dataset. Since training a network on this dataset takes more computation power, you will be allowed to access new TCML cluster to train your networks.

For this exercise we will only provide some utility for helping load the dataset, most of the implementation is up to you. You are allowed to base your network on existing architectures but you need to fully implement the network and its training by yourself, you can't use a network that is pre-built in tensorflow.

In addition to your python code, you should hand in an explanation of how you chose your architecture and documentation of your training procedure (training parameters, training time, accuracy, etc.). Your code should periodically print out the progress the network is making.

To access the cluster you need credentials. Each team will get a login that they should pick up at the tutorial just after the lecture. If you are unable to attend the tutorial then please send an email to the tutors. Documentation on how to use the cluster is available online (the digital version of this pdf has a link). Since the documentation is also new, we would appreciate feedback on whether it is helpful and how it could be improved.

The points are distributed as follows: 5 points for the explanation and documentation, 3 points for reaching a baseline accuracy of 80% and up to 5 more points for better accuracy up to 90%.