Deep Learning Praktikum

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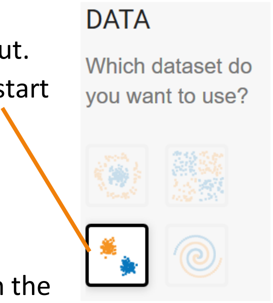
> You can do exercise 1 individually on one of the computers in the lab by starting a BW-Lehrpool virtual environment and opening a browser.

1 Backpropagation Networks

These exercises are performed in the Tensorflow Playground: https://playground.tensorflow.org

1.1 Data

There are four datasets available each of which has a two dimensional input. The network should classify orange points as orange, blue as blue. Please start with the left bottom data set.



DATA

Which dataset do you want to use?

You start, stop and reset learning with the control buttons

The playground shows a visual representation of the output on the right in the output area. It also shows the test loss, i.e. how well the network classifies unknown data, or better to say how small the classification error (loss) still is.

1.2 Tasks

Activation Function

- Please choose activation->Linear. What is the minimum size of the network to learn the chosen input pattern?
- Reset the network (2 Hidden Layers, 4, 2 Neurons). Which of the input patterns can be learned with the linear activation function?
- Now test each pattern with each activation function.

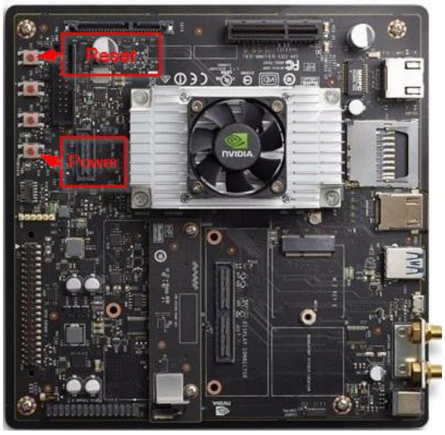
Network Size

Please choose the input pattern on bottom right (spiral).

- Try to find out how the number of neurons and the number of layers influences the learning success.
- Try to achieve the best possible result (test loss) for the spiral pattern with all means available on the page.

For exercise 2 you join in pairs and work with our Jetson Boards.

The Jetson Boards are full-grown computers with integrated graphics card. They are especially efficient for calculating Deep Convolutional Networks. After attaching monitor cable, keyboard-dongle and power cable you start the Jetson Board by pressing the power button (see image).



2 Digit Recognition

One of the first applications of image recognition and nowadays the hello world of deep neural networks is handwritten digit recognition.

2.1 Data

The MNIST dataset contains 70.000 images of handwritten digits. It is integrated into the Keras environment and will be downloaded during first learning.

2.2 Tasks

Please open a terminal (Ctrl-Alt-T) and change to folder ml2_deeplearning_with_keras:

```
cd ./dev/ml2_deeplearning_with_keras /
```

Activate the Python environment:

```
py3_keras
```

Now start the Jupyter Notebook Server

```
jupyter notebook
```

A web page in the browser opens. Navigate to MnistClassification/MnistClassifier.ipynb and open the Book by double clicking. A new browser tab opens.

- Work through the cells one by one by pressing Shift-Enter
- Then check how well the network is able to detect your own handwritten images. To do that, open one of the images in folder data with the Pinta program. Erase the existing digit with black and draw your own digit in white. Save the image as jpg with a new name in the same folder. Now execute the corresponding cell in the Jupyter Notebook again.

3 Recognize RoboCup Objects

The Jetson Board will now use Deep Convolutional Networks to detect objects on images of our soccer-playing robot Sweaty.

3.1 Data

Klasse	Kategorie
0	Ball
1	Goalpost
2	Obstacle
3	L-Line
4	X-Line
5	T-Line
6	Penalty Spot
7	Foot

- The images are already available on the Jetson Boards. Folder training contains the images to use during learning. Folder validation contains images to measure accuracy on unknown images during learning. Folder test contains images to measure accuracy in the end. Notebook MagmaDataset.ipynb already did this for us; it is not required to run here. The learning data are images from the RoboCup domain and shows eight categories of objects.
- There are 4917 color images available
- Images may be augmented (rotation, translation, shearing, scaling, mirroring)

3.2 Tasks

You can continue to work with the running Jupyter Notebook server if still running. Otherwise, follow the steps explained in exercise 2 to start it.

Please open the Jupyter Notebook HsoMagmaClassification/MagmaClassifier.ipynb by clicking on it. A new browser tab opens.

Evaluate the following:

- How does learning success improve with the number of images presented at learning? Systematically increase the number of training images using parameter validation_split and note down the results in the excel result sheet DeepLearning_Magma in Tab Training Data.
- How does learning success depend on the optimizer used for gradient descent? Run learning with all optimizers and note down the result in the Excel file. Do not forget to reset validation_split back to its default value.

If there is still time:

- Change the batchsize
- Switch on augmentation
- Remove or add network layers
- Increase/Decrease the dense layers
- Increase the number of epochs
- …