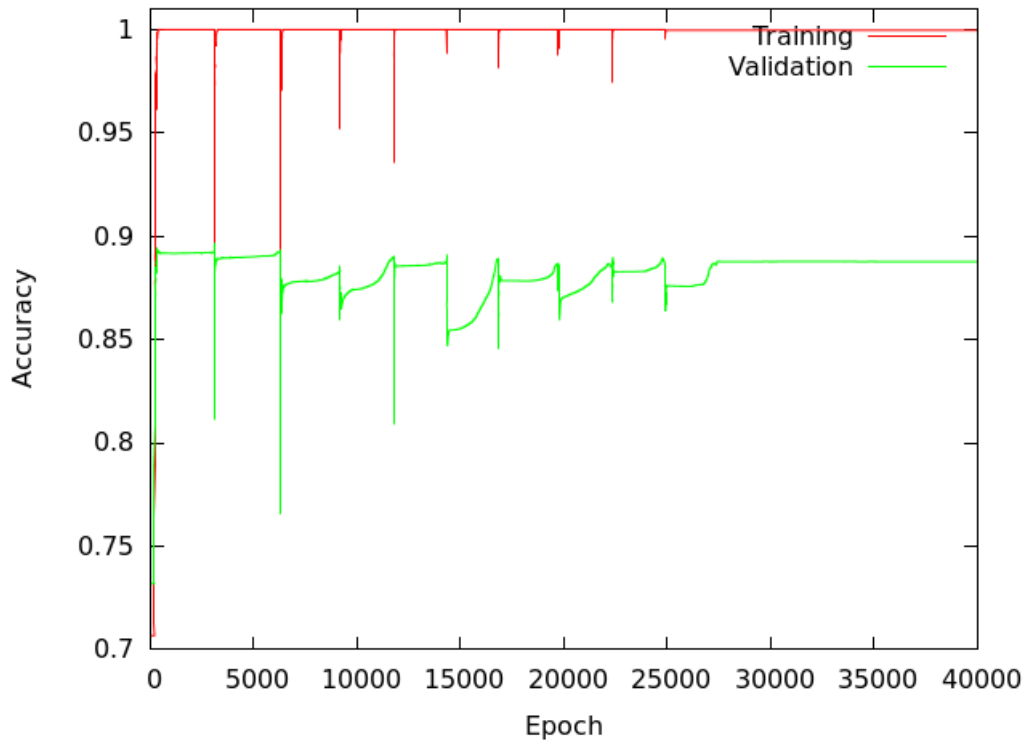# Deep Learning Lab Course – Report for assignment 4

The specification for the neural network used for this assignment can be found in `u_net.json` and passed to `main.py` as command line argument to train the network. The learning curves for the given parameters are shown in figure 1.

Figure 1: Learning curves

Both learning curves start spiking every approximately 2500 iterations and converge again (training accuracy converges very quickly, validation accuracy slowly). I am not sure why these spikes happen; The learning rate is very small and there is only a single training example, so there shouldn't be noisy parameter updates which could cause the network to diverge so far from a local minimum. However after around 27500 iterations, the network converges to a stable accuracy value.

The first 500 iterations are shown in a close up view in figure 2. One can observe that both accuracies start at a similar initial value between around 0.7–0.74, and remain constant for the first 200 iterations. After that, they very quickly reach the maximum validation accuracy (maximum of what is reached during the whole training) already after approximately 350 iterations. I have run the network with the same parameters multiple times, and the validation accuracy always converged very quickly. Therefore I can conclude that 40000 iterations are not necessary to train the network on a single example, as 500 iterations should be sufficient.

The segmentation outputs are visualized in figure 3, which contains random images from the validation set (left), their label (middle) and the segmentation result (right).
One can observe that the network can recognize almost all cells, however the boundaries are often inaccurate. E.g. in the first image, the rightmost cell is only partially recognized. Also, the outlines are not very smooth. In the last image, the network struggles to recognize the four cells in the bottom right corner. One cell is completely overseen (probably because it lies at the border and is not sufficiently visible, and the cell boundary is blurry) and the other three are merged into a single deformed area. This low accuracy is not quite unexpected, since the network was only given a single example to train on.

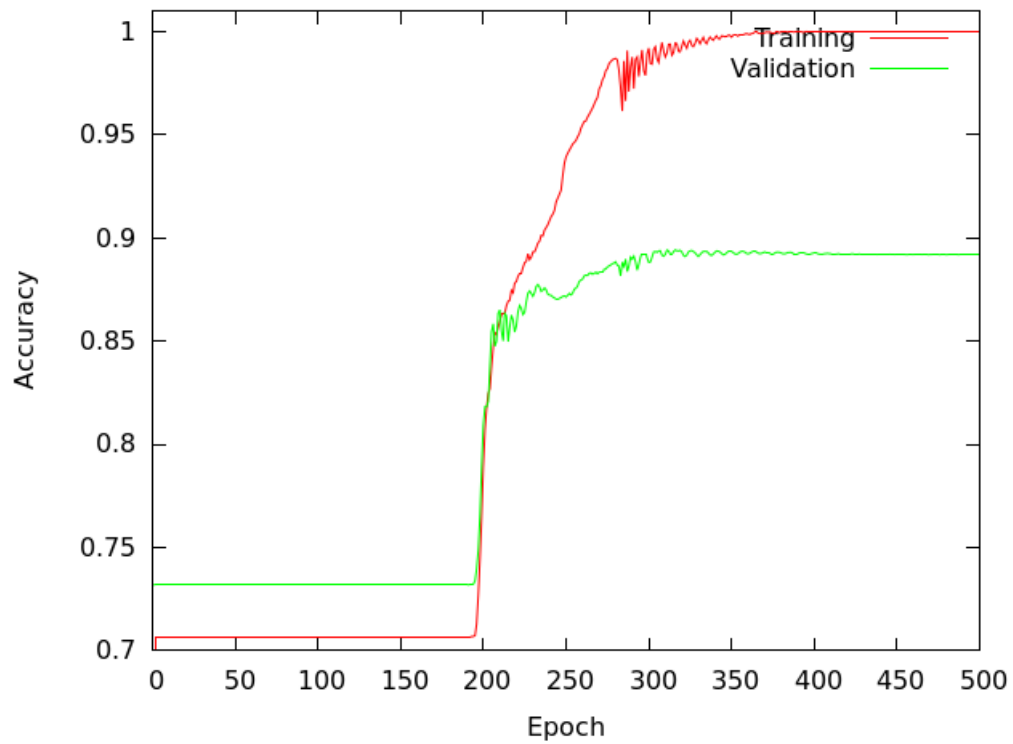Figure 2: Learning curves for the first 500 iterations

Figure 3: Random validation samples, their labels, and the corresponding segmentation result