Programming with neural networks: Exercise sheet 9 SS 2020
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Exercise sheet: 9

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Task 1: CTC algorithm

There are pictures of car signs showing a different number of 29 large letters, 10 digits and spaces (OCR task).

(a) Design a neural network for OCR in pseudo-language that consists of conv- and pooling layers and a bi-directional LSTM („BiLSTM n -nodes ") owns. Reshape channels and height to a dimension to input of the BiLSTM. As an activation function of the output by means of a FC layers (applied per horizontal position) are used to convert a Softmax layer Generate probabilities. For each layer, enter the output dimensions.

Solution:

Input	(W x H x C)
Conv2D 3x3, 20, padding = same	(W x H x 20)
MaxPool2D 2x2	(W / 2 x H / 2 x 20)
Conv2D 3x3, 40, padding = same	(W / 2 x H / 2 x 40)
Reshape W / 2, H / 2 $*$ 40	(W / 2 x (H / 2 $*$ 40))
BiLSTM 50	(W / 2 x 100)
FC 40	(W / 2 x 40)
Softmax	(W / 2 x 40)

Notes: Padding Same is not required. The FC dimension results from since it's the last layer, off the alphabet size. Alternatively, directly a BiLSTM with 40 nodes can be used.

(b) What form of GT data does the CTC loss function expect?

Solution: Pairs of input image and label sequence ($U \leq T$)

(c) Given the label sequence „NEW AR 565 "and the following probabilities time table (output of the Softmax):

Calculate the forward and backward variables, as well as the gradient Updates for the given dates. Which dimensions do α and β have?

When calculating on Paper, make sure that a number of variables are zero! Age- natively they can use the Excel sheet (see Wue campus) to find the solutions Determine algorithm.

Which sequence does the greedy decoder output?

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$P(L, T)$	1	2	3	4th	5	6th	7th	8th	9	10	11	12th	13th	14th	15th	16	17th	18th
-	0.9	0.8	0.3	0.6	0.8	0.9	0.1	0.1	0.99	0.1	0.1	0.8	0.4	0.1	0.3	0.9	0.4	0.9
A.	0	0	0	0	0	0	0	0	0	0	0.9	0.2		0	0	0	0	0	0
B.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E.	0	0	0	0	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
F.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
H	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0	0	0	0	0
I.	0.1	0	0	0	0	0.1	0	0	0	0	0	0	0.3	0	0	0	0	0	0
J	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0	0	0	0	0	0
L.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
M.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
N	0	0.2	0.7	0.4		0	0	0	0	0	0	0	0	0	0	0	0	0	0
O	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
P.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Q	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
R.	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0	0	0	0	0	0
S.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
T	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
U	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
V	0	0	0	0	0	0	0.5	0	0	0	0	0	0	0	0	0	0	0	0
W.	0	0	0	0	0	0	0.4	0.9		0	0	0	0	0	0	0	0	0	0
X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Y	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Z	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4th	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.3	0	0.6	0.1	
6th	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.4	0.1		0	0
7th	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8th	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0.8	0	0	0	0.9	0	0	0	0	0

Solution: See the Excel table