Domácí úkol SSU 1

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Úkol 1 Implementation of classifiers

The task was to implement tree different classifier for recognizing character sequences in an image.

Úkol 1.1 Independent linear multi-class classifier

The independent linear multi-class classifier is the most simple solution of the three. It classifies every character in the sequence independently.

After the classification of the sequence, the accuracy of the estimate is verified using the reference. When the letter estimate is incorrect, the weights are updated using formula in the assignment.

A few more experiments were performed on this classifier. Firstly it was trained with weights without bias, which was much faster, but it presented less accurate results. Bias is therefore not redundant and should be used.

Sedondly, the learning procedure was also conducted on different operating systems (Windows and Linux). The difference is only in different order of loading the training examples. This shows that the classifier is robust to change of the order of input data.

Classifier type	R_{seq}	R_{char}
With bias (Win)	0.74	0.29
Without bias (Win)	0.69	0.259
With bias (Lin)	0.668	0.26

Tabulka 1: Error values

Úkol 1.2 Linear structured classifier modeling pair-wise dependency

This type of classifier includes the pair-wise dependency between the letters, which further improves the estimate accuracy. Firstly, the probabilities of the sequence characters were computed using only the weights (array Q). Secondly, the F values for each letter were computed recursively starting on the first letter. For the computation, the equations from the assignment were used.

When the recursion reached the end of the sequence, the last letter was estimated as the maximum of the F values and the rest of the characters were estimated from the previous F values and the matrix of correct transitions g.

After the estimation, every character was verified and in the case of the wrong estimate, the weights and g were updated. The final results are:

Classifier type	R_{seq}	R_{char}
pair-wise	0.112	0.054

Tabulka 2: Error values

Úkol 1.3 Linear structured classifier for fixed number of sequences

The last classifier is using the information of the estimated sequences. All sequences that can be on the input are stored in an array. The array is sorted so that on every index are all sequences with corresponding length.

Firstly, the values for the sequence are estimated using weights in the same way as the two estimators above. However, then only the characters, that are on the corresponding positions of the words with same length are considered. This restricts the set of possible characters on every position dramatically.

However, if the set of the possible words would be larger, there would be less effect, because there would be more character possibilities, but it would still improve the estimation.

Classifier type	R_{seq}	R_{char}
pair-wise	0.024	0.0203

Tabulka 3: Error values

Úkol 2 Results comparison

Among the three classifiers, the third one performed the best results, however it uses the list of sequences, which works well on small number of words, however, with increasing number of words, the performance will slow down a bit.

For a large number of possible words on the input, the second option would be probably the fastest and more memory efficient than the third one, which stores all words.

Finally for a recognition of a random character sequences (some codes or license plate numbers), the firs solution would be the best option, because the matrix of transitions would have no effect on the accuracy of the estimate and it would only slow down the computation.

Classifier type	R_{seq}	R_{char}
Independent	0.74	0.29
Pair-wise	0.112	0.054
fixed length	0.024	0.0203

Tabulka 4: Error values