Sequence Classification using SENNA



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http://www.deeplearning4nlp.com



Overview

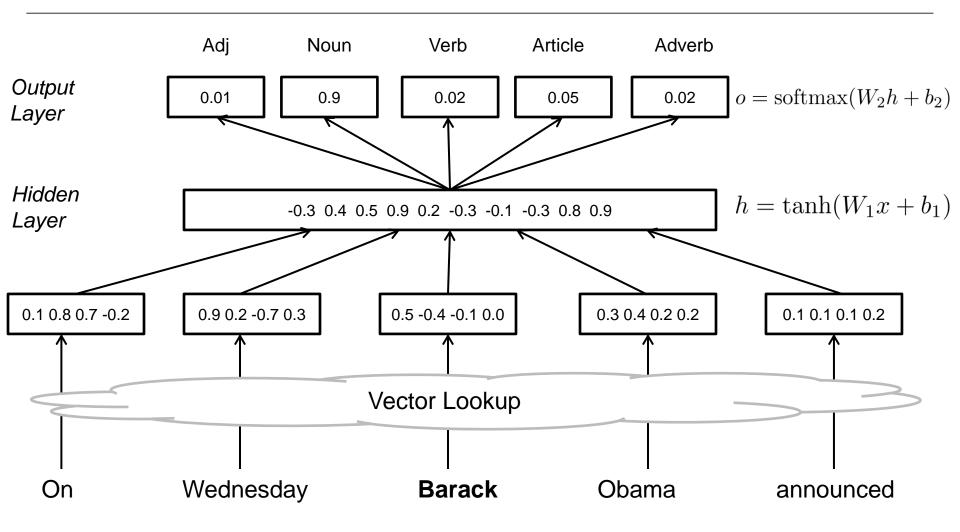


- This session introduces an architecture that can be used for word and sequence classification, e.g. POS-tagging, NER, Chunking.
- The architecture is known as SENNA and was proposed by:
 - Collobert et al., 2011, Natural Language Processing (Almost) from Scratch
- The paper proposes two different architectures:
 - Window-Approach: Suitable if the necessary information is in the direct context of the target word (e.g. NER, POS)
 - Sentence-Approach: Takes the complete sentence into account (e.g. SRL)
- The paper proposes two different learning objectives:
 - Isolated-Tag-Criterion: The output label is optimized for each token individually
 - Sentence-Tag-Criterion: A Hidden Markov Model is added on top



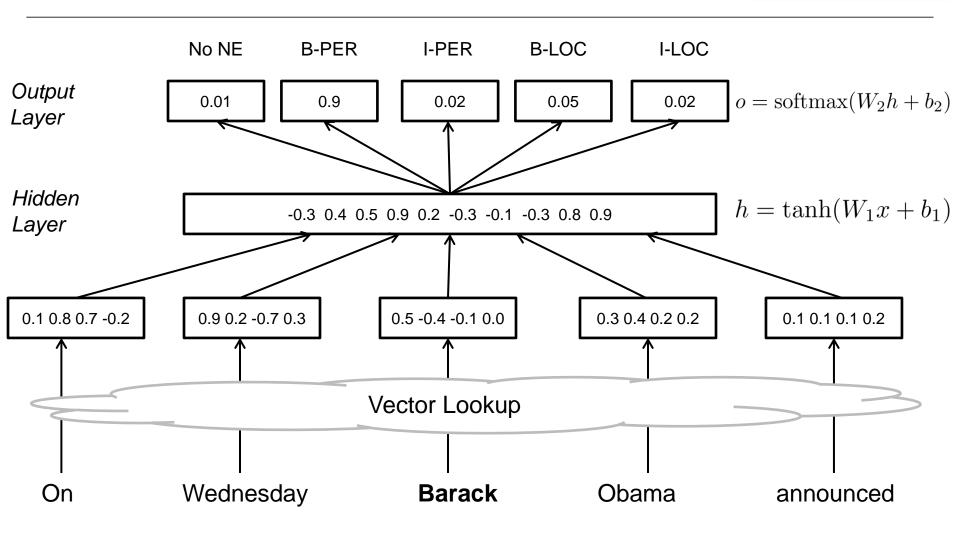
POS-Tagging (Window-Approach + Isolated Tag Criterion)





Can be easily extended to NER (using BIO encoding)

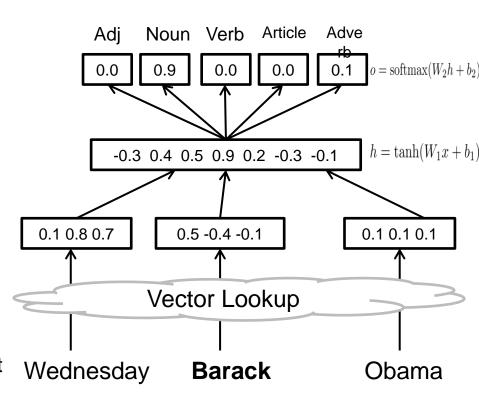




SENNA Step-by-Step



- 1. Select a target word, e.g. **Barack**
- Create a window of n tokens around the target. A window-size=1 would create the tuple (Wednesday, Barack, Obama)
 - Use special PADDING token for tokens at sentence border, e.g. (PADDING, Wednesday, Barack)
- 3. Map each token to its word embedding (e.g. 100 dim. word embedding)
- 4. Concatenate the 3x100 dim. vectors and feed the 300 dim. vector into a dense hidden layer and apply tanh-activation function
- 5. Take the output of the hidden layer, feed it into a dense layer and apply the softmaxactiviation function

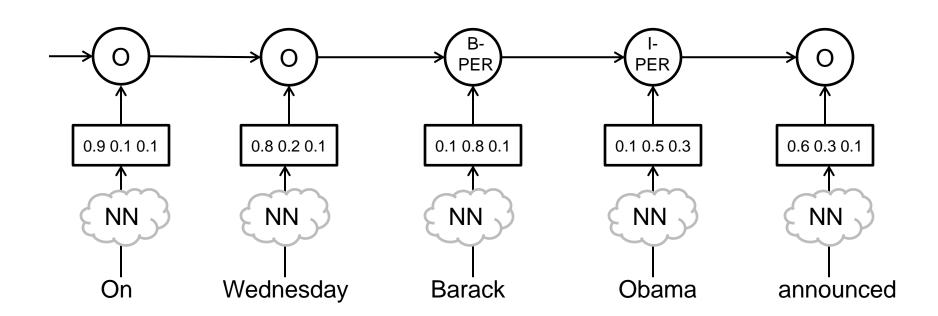




Excursion: Sentence-Tag-Criterion



- Collobert et al. also defines a Sentence-Tag-Criterion (STC), which adds a Hidden Markov Model on top of the neural network
- The tagging sequence of the complete sentence is optimized
- Superior results, but currently no out-of-the-box support in Keras





Implementing this in Python + Keras



- Code consists of two parts:
 - preprocess.py: Creates matrices that we can feed into the network
 - POS.py / NER.py: Our Keras Neural Network implementation
- Bringing the data into the right format is often harder than building and training the network :/



Preprocess.py



We will create a matrix for the tokens, for the casing of the words, and for

the labels

Token Matrix:

$\lceil PADDING ceil$	On	Wednesday
On	Wednesday	Barack
Wednesday	Barack	Obama
	• • •	
PADDING	Second	sentence
Second	sentence	

- Map each token to its index in the word embeddings matrix
- Maybe convert words to lower case

0	15	18
15	18	27
18	27	3
0	54	72
54	72	$4 \rfloor$
•		_



Preprocess.py



- We apply the same technique for word casing information
- Case Matrix:

otag PADDING otag	initial Upper	initial Upper
initial Upper	initial Upper	initial Upper
linitial Upper	initial Upper	initial Upper
PADDING	initial Upper	all Lower
linitial Upper	allLower	other

- Map each casing information to the index in the embedding lookup
- The casing embedding matrix is a hot-one encoding matrix

_
2^{-}
$egin{array}{c} 2 \ 2 \ 2 \end{array}$
2
1
$\frac{1}{5}$



Preprocess.py



■ The labels are converted to an integer vector, each entry specifying the

label for the specific window

Labels:

B - PER I - PER \cdots O O



Each label is mapped to an integer

$$\begin{bmatrix} 0 \\ 1 \\ 2 \\ \dots \\ 0 \\ 0 \end{bmatrix}$$

Preprocess.py - Final Result



