GWV – Grundlagen der Wissensverarbeitung

Tutorial 9 : Hidden Markov Models

Exercise 9.1 : (HMM decoding)

of
0

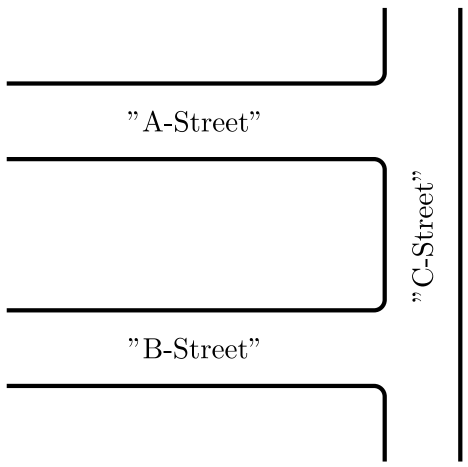
Suppose you have some magical device which can tell you on which street you are based on your surrounding (the Geolocation based on Photographs System). Our world consists of three streets (A-Street, B-Street and C-Street), as depicted below. The GPS takes photos and of the surrounding and guesses which street this photo comes from.

The sensor has the following characteristics: On A-Street and B-Street, 80% of the time it will yield the correct street. Otherwise it will yield the parallel street. The sensor is alway accurate on C-Street.

Use the forward-, forward-backward-, and viterbi algorithm to decode where someone has been at each step for the following observations:

A-Street, B-Street, B-Street

You know that the person could only have stayed in the same street because C-Street ist closed for construction (hence the name). The person either startet in A-Street or B-Street, but you don't know in which one.



A Part-of-Speech(PoS) tagger is a program that assigns word classes (i.e. PoS) to words of a text. For example, for the input

> The dog barked

the corresponding output should be the following[1]:

> The\DET dog\NN barked\VBD

As always, you can find the relevant data at our wiki. The data we use will be one word per line, with each line consisting of word [tab] PoS-tag.

Let

$Word_i$ be the variable denoting the ith Word

Tag_i be the variable denoting the PoS-tag for the ith word

Exercise 9.2: (A simple PoS-Tagger)

of
12

Implement a hidden markov model where the probability distribution of $Word_i$ only depends on the state of Tag_i and Tag_i only depends on Tag_{i-1}. The tagger model (i.e. the transition and emission probabilies) should be trained from the file provided in the wiki. (4 Pt.)

Create a function that takes a list of words (possibly from the command line) and uses filtering to produce a corresponding list of PoS tags. (2 Pt.)

Make sure that your tagger can cope with input that includes words that are not in the training data. (2 Pt.)

Implement either the forward-backward algorithm to output several PoS tags per word or the viterbi algorithm to output the most probable tag sequence. (4 Pt.)

Hint: You can assess how good your tagger is by tagging the test file and comparing the output produced by the tagger with the original file, e.g. with

```
diff -u original_file generated_file | grep '^+' | wc -l
```

Version: December 19, 2016
Achievable score on this sheet: 12

[1]The tags for this example do not correspond to the ones in the data file (because the data we work on is German). The German PoS tags are explained here: `http://www.ims.uni-stuttgart.de/forschung/ressourcen/lexika/TagSets/stts-table.html`