Assignment 6

Computational Intelligence SEW, SS2017

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Hidden Markov Models

Viterbi Algorithm and optimal State Sequence

Table 1: Optimal State Sequence

	X1	**X2**
HMM1	['r', 'r', 's', 's', 's', 's']	['r', 'r', 'f', 'f', 'f', 'r', 'r']
HMM2	['r', 'r', 'f', 'f', 'f', 'r']	['r', 'r', 'f', 'f', 'f', 'r', 'r']

When working with probabilities, for example in the iteration phase of the Viterbi algorithm, a lot of multiplication of probabilities is involved. The problem is that these probabilities sometimes are very close to zero. Computers only have a finite amount of storage to store numbers and therefore cannot distinguish very small numbers from zero. This problem can be bypassed by using the log function and the rule that:

$$log(a) + log(b) = log(ab)$$

Sequence Classification

The formula for $P(X|\Theta_i)$ is:

$$P(X|\mathbf{\Theta}) = \sum_{Q \in \mathcal{Q}^N} P(X, Q|\mathbf{\Theta}) = \sum_{Q \in \mathcal{Q}^N} \left(\pi_{q_1} \cdot b_{q_1}(x_1) \cdot \prod_{n=2}^{N} a_{q_{n-1}, q_n} \cdot b_{q_n, x_n} \right)$$

The reason why this formula is so computationally expensive to solve is because there are a lot of multiplications which aren't necessary. With recursion and the product rule it is possible to reuse calculations and reduce the computation time.

Markov Model

Graphical representation