Maximum Entropy Markov Models for Information Extraction and Segmentation

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Abstract

Hidden Markov models (HMMs) are a powerful probabilistic tool for modeling sequential data, and have been applied with success to many text-related tasks, such as part-of-speech tagging, text segmentation and information extraction. In these cases, the observations are usually modeled as multinomial distributions over a discrete vocabulary, and the HMM parameters are set to maximize the likelihood of the observations. This paper presents a new Markovian sequence model, closely related to HMMs, that allows observations to be represented as arbitrary overlapping features (such as word, capitalization, formatting, part-of-speech), and defines the conditional probability of state sequences given observation sequences. It does this by using the maximum entropy framework to fit a set of exponential models that represent the probability of a state given an observation and the previous state. We present positive experimental results on the segmentation of FAQ's.

for state-transition probabilities and state-specific observation probabilities. Greatly contributing to their popularity is the availability of straightforward procedures for training by maximum likelihood (Baum-Welch) and for using the trained models to find the most likely hidden state sequence corresponding to an observation sequence (Viterbi).

In text-related tasks, the observation probabilities are typically represented as a multinomial distribution over a discrete, finite vocabulary of words, and Baum-Welch training is used to learn parameters that maximize the probability of the observation sequences in the training data.

There are two problems with this traditional approach. First, many tasks would benefit from a richer representation of observations—in particular a representation that describes observations in terms of many overlapping features, such as capitalization, word endings, part-of-speech, formatting, position on the page, and node memberships in WordNet, in addition to the traditional word identity. For example, when trying to extract previously unseen company names from a newswire article, the identity of a word alone is not very predictive; however, knowing that the word is capitalized, that is a noun, that it is used in an