

## 7.1 Viterbi algorithm

In this problem, you will decode an English sentence from a long sequence of non-text observations. To do so, you will implement the same basic algorithm used in most engines for automatic speech recognition. In a speech recognizer, these observations would be derived from real-valued measurements of acoustic waveforms. Here, for simplicity, the observations only take on binary values, but the high-level concepts are the same.

Consider a discrete HMM with  $n = 27$  hidden states  $S_t \in \{1, 2, \dots, 27\}$  and binary observations  $O_t \in \{0, 1\}$ . Download the ASCII data files from the course web site for this assignment. These files contain parameter values for the initial state distribution  $\pi_i = P(S_1 = i)$ , the transition matrix  $a_{ij} = P(S_{t+1} = j | S_t = i)$ , and the emission matrix  $b_{ik} = P(O_t = k | S_t = i)$ , as well as a long bit sequence of  $T = 430000$  observations.

Use the Viterbi algorithm to compute the most probable sequence of hidden states conditioned on this particular sequence of observations. As always, you may program in the language of your choice. Turn in the following:

- (a) a hard-copy print-out of your source code
- (b) a plot of the most likely sequence of hidden states versus time.

To check your answer: suppose that the hidden states  $\{1, 2, \dots, 26\}$  represent the letters  $\{a, b, \dots, z\}$  of the English alphabet, and suppose that hidden state 27 encodes a space between words. If you have implemented the Viterbi algorithm correctly, the most probable sequence of hidden states (*ignoring repeated elements*) will reveal a famous quotation, as well as an interesting commentary on our times.

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