Hidden Markov model

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The HMM is dependent on the Markov chain being supplemented. A Markov chain is a model that explains the probability of sequences of random variables, or states, each of which can take on values from a range of possibilities. Words, tags, or symbols representing anything, such as the weather, can be used to create these sets. A Markov chain makes the extremely strong assumption that all that matters in predicting the future in a sequence is the current state. The states that came before the current state have no bearing on the future unless they are influenced by the current state. It's as if you could look at today's weather to anticipate tomorrow's weather, but you couldn't look at yesterday's.

Consider a set of state variables q1, q2, ... qi in more formal terms. When predicting the future, a Markov model embodies the Markov assumption on the probabilities of this sequence: that the past doesn't matter, only the present. It depicts a Markov chain for assigning a probability to a series of weather events using a vocabulary of HOT, COLD, and WARM. The states are represented as nodes in the graph, whereas the transitions are represented as edges with their probabilities. The transitions are probabilities: the total of the values of the arcs leaving a given stage must equal 1.

Because we're building an inference model based on the assumptions of a Markov process, it's termed a Hidden Markov Model. The "future is independent of the past given the present" is the Markov process assumption. To put it another way, if we know our current condition, we don't need any other prior data to anticipate our future state. Consider the scenario below, in which the hidden variable is the weather, which can be hot, mild, or cold, and the observed variables are the types of clothes worn. Transitions from a hidden state to another hidden state or from a hidden state to an observed variable are represented by the arrows. It's worth noting that, according to the Markov assumption, each state is only dependent on the preceding state and no other prior states.

Models like Markov and Hidden Markov are designed to deal with data that can be described as a "series" of observations across time. The observed data is treated as a series of outputs generated by one of several (hidden) internal states in hidden Markov models. Markov models are built on the basis of two assumptions.

1 Limited Horizon Assumption

Probability of being in a state at a time t depend only on the state at the time (t-1).

That means state at time t represents enough summary of the past reasonably to predict the future. This assumption is an Order-1 Markov process. An order-k Markov process assumes conditional independence of state z_t from the states that are k + 1-time steps before it.

2 Stationary Process Assumption

Conditional (probability) distribution over the next state, given the current state, doesn't change over time.

That means states keep on changing over time but the underlying process is stationary. the Markov property specifies that the probability of a state depends only on the probability of the previous state, but we can build more "memory" into our states by using a higher order Markov model.