DD2380 Artificial Intelligence: Homework 3, Part B, Answers

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Hidden Markov Models

a) Describe what procedures should be used for estimating the model and how training data would be generated.

Det blev ingen CD.

b) If we have no observation, what is the probability of the second state x_2 being LEFT? And the probability of second observation o_2 being H_2? Finally, what is the probability $P(o_2 = H_2 | x_2 = LEFT)$?

First, we iteratively calculate probabilities of $P(x_t = s)$ using

$$P(x_t) = \sum_{i \in S} P(x_{t-1} = i) * P(i \to s)$$

where $S = \{LEFT, RIGHT, STOP, FORWARD\}$, and s a state. That is, the probability of x_t being a certain state s, is the sum of the probabilities of x_{t-1} being each state multiplied by the transition probability between that state and s.

> "It's 50% likely for me to get to a state, and 25% likely for me to enter this state from there. Therefore I'm 12.5% likely to get there from that state."

Note that $P(x_1)$ is the first row of the transition matrix. Because $x_0 = RIGHT$ is known, the probability of x_0 is simply the probability for the transition between $RIGHT$ and the state for that row.

The calculation of $P(x_2 = RIGHT)$ is given with $0.45 * 0.45 + 0.09 * 0.08 + 0.10 * 0.08 + 0.36 * 0.09 = 0.2501$ but was omitted from the table for readability. The values, in order, are: $P(x_1 = RIGHT) * P(RIGHT \to RIGHT) + P(x_1 = LEFT) * P(LEFT \to RIGHT) + \{STOP\} + \{FWD\}$. The same step is repeated for each state.

state	$P(x_0)$	$P(x_1)$	$P(x_2)$
RIGHT	1.0	0.45	0.2501
LEFT	0.0	0.09	0.1344
STOP	0.0	0.10	0.168
FWD	0.0	0.36	0.4475

Similarly, we calculate the probability of observing H_2 from a state, and multiply by the chance of x_2 being that state. These calculations, for all possible states are summed up. Just like before, except we use the probability of observing H_2 instead of transitioning to a state.

$$P(o_2 = H_2) = 0.147333$$

c) Viterbi's Motherfucker

Source: *viterbi.c. gcc -o viterbi viterbi.c; ./viterbi* to run.