CS 730/730W/830: Intro AI

HMMs

Viterbi Decoding

1 handout: slides

Hidden Markov Models

Probabilistic Models

Naive Bayes:

k**-Means:**

Markov chain:

MDPs:

Hidden Markov model:

The Model

$$P(x_t = j) = \sum_i P(x_{t-1} = i)P(x_t = j | x_{t-1} = i)$$

$$P(o_t = k) = \sum_i P(x_t = i)P(o = k | x = i)$$

The Model

$$P(x_t = j) \quad = \quad \sum_i P(x_{t-1} = i)P(x_t = j|x_{t-1} = i)$$

$$P(o_t = k) \quad = \quad \sum_i P(x_t = i)P(o = k|x = i)$$

More concisely:

$$P(x_t) \quad = \quad \sum_{x_{t-1}} P(x_{t-1})P(x_t|x_{t-1})$$

$$P(o_t) \quad = \quad \sum_{x_t} P(x_t)P(o|x)$$

Viterbi Decoding

Properties of HMMs

probability of a sequence multiplies forward in time

dynamic programming backward through time

The Algorithm

given: transition model $T(s, s')$

sensing model $S(s, o)$

observations $o_1, \ldots, o_T$

find: most probable $s_1, \ldots, s_T$

initialize $S \times T$ matrix v with 0s

$v_{0,0} \leftarrow 1$

for each time $t = 0$ to $T - 1$

   for each state s

     for each new state s'

       score $\leftarrow v_{s,t} \cdot T(s, s') \cdot S(s', o_t)$

       if score $> v_{s',t+1}$

         $v_{s',t+1} \leftarrow$ score

         best-parent$(s') \leftarrow s$

trace back from s with max $v_{s,T}$

EOLQs

- What question didn't you get to ask today?
- What's still confusing?
- What would you like to hear more about?

Please write down your most pressing question about AI and put it in the box on your way out.
Thanks!