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DTU/2K16/MC/13

9th November 2020

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NLP Class Assignment
HMM Models
Hidden Markovian Models

- **Probability of output sentence :-**

$$P(O) = \sum_{Q} P(O, Q) = \sum_{Q} P(O|Q) P(Q)$$

- **Joint Probability :-**

$$P(O, Q) = P(O|Q) P(Q) = \prod_{i=1}^{n} P(o_i|q_i) \prod_{i=1}^{n} P(q_i|q_{i-1})$$

Sentence 1 : The old woman ate

$$P(O) = \sum_{Q} P(O, Q)$$

P(O) = P(the old woman ate, Det Adj Noun Verb) +
P(the old woman ate, Det Adj Noun Noun) +
P(the old woman ate, Det Det Det Det) +
.....

and $4^4 \cong 256$ such possibilities, but barring all except one, every probability will be 0

P(O) = P(the old woman ate, Det Adj Noun Verb) + 0
= P(the old woman ate | Det Adj Noun Verb) P(Det Adj Noun Verb)

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P(the|Det) P(old|Adj) P(woman|Noun) P(ate|Verb)
P(Det|<s>) P(Adj|Det) P(Noun|Adj) P(Verb|Noun)

(0.7)(0.4)(0.4)(0.2)(0.7)(0.6)(0.7)(0.8)

= 0.00526848
5.268×10^{-3}

Sentence 2: The Young Child Slept

$P(O) = \sum_{\Theta} P(O, \Theta)$

= P(The young child slept, Det Adj Noun Verb) + ...

$P(O, \Theta) = 0 \quad \forall \quad \Theta \neq$ Det Adj Noun Verb

$P(O) = P(O, \Theta)$ where Θ = Det Adj Noun Verb

= P(the young child slept | Det Adj Noun Verb) P(Det Adj Noun Verb)

P(the|Det) P(young|Adj) P(child|Noun) P(slept|Verb)
P(Det|<s>) P(Adj|Det) P(Noun|Adj) P(Verb|Noun)

(0.7)(0.6)(0.3)(0.5) (0.7)(0.6)(0.7)(0.8)

= 0.0148176
$\simeq 1.481 \times 10^{-2}$

P(the young child slept) = 1.481×10^{-2}
P(the old woman ate) = 5.268×10^{-3}

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P(the young child slept) > P(the old woman ate)

Hence the second sentence "The young child slept" will be chosen with more likelihood.