Artifical Intelligence Problem Set 9

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Problem 1.

dogs $P(S0 \to S1) = 1$ implies that dogs must be a noun.

wag

1. wag is noun with probability 0.2: $P(S1 \to S2) = 0.1$

   tail (a) tail cannot be noun: no state $P(S2 \to S2)$
   (b) tail is verb with probability 0.2: $P(S2 \to S4) = 0.6$
   and is conjunction with probability 1: $P(S4 \to S8) = 0.4$
   i. **bark** is noun with probability 0.2: $P(S8 \to S6) = 0.4$
   ii. **bark** is verb with probability 0.8: $P(S8 \to S7) = 0.6$

2. wag is verb with probability 0.8: $P(S1 \to S4) = 0.7$

   tail (a) tail is noun with probability 0.8: $P(S4 \to S9) = 0.2$
   and is conjunction with probability 1: $P(S9 \to S3) = 0.6$
   i. **bark** is noun with probability 0.2: $P(S3 \to S6) = 0.8$
   ii. **bark** is verb with probability 0.8: $P(S3 \to S7) = 0.2$
   (b) Verb Verb STATE DOES NOT EXIST

Taggings with non-zero probabilities:

1. *START* *START* noun noun verb conjunction noun *END* *END*
2. *START* *START* noun noun verb conjunction verb *END* *END*
3. *START* *START* noun verb noun conjunction noun *END* *END*
4. *START* *START* noun verb noun conjunction verb *END* *END*

$$\frac{P(t|w)}{P(t)}$$

Unnormalized probabalities:

1. $1 \cdot 1 \cdot 0.1 \cdot 0.6 \cdot 0.4 \cdot 0.4 \cdot 0.3 \cdot 1 \cdot \frac{0.8}{0.5} \cdot \frac{0.2}{0.5} \cdot \frac{0.2}{0.4} \cdot \frac{1}{0.1} \cdot \frac{0.2}{0.5} = 0.0036864$
2. $1 \cdot 1 \cdot 0.1 \cdot 0.6 \cdot 0.4 \cdot 0.6 \cdot 0.4 \cdot 1 \cdot \frac{0.8}{0.5} \cdot \frac{0.2}{0.5} \cdot \frac{0.2}{0.4} \cdot \frac{1}{0.1} \cdot \frac{0.8}{0.4} = 0.036864$
3. $1 \cdot 1 \cdot 0.7 \cdot 0.2 \cdot 0.6 \cdot 0.8 \cdot 0.3 \cdot 1 \cdot \frac{0.8}{0.5} \cdot \frac{0.8}{0.4} \cdot \frac{0.8}{0.5} \cdot \frac{1}{0.1} \cdot \frac{0.2}{0.5} = 0.4128768$
4. $1 \cdot 1 \cdot 0.7 \cdot 0.2 \cdot 0.6 \cdot 0.2 \cdot 0.4 \cdot 1 \cdot \frac{0.8}{0.5} \cdot \frac{0.8}{0.4} \cdot \frac{0.8}{0.5} \cdot \frac{1}{0.1} \cdot \frac{0.8}{0.4} = 0.688128$

Problem 2. The following two-word sentence has a non-zero probability in the k-gram model, but is not a possible tagging in the CFG in problem set 1: Dogs bark (noun noun).

Problem 3. The following string of words has a non-zero probability in the k-gram model, but has no parse at all in the CFG in problem set 1: dogs wag dogs bark tail dogs and wag

Problem 4.

S0. *START* *START*

S1. *START* Noun

S2. Noun Prep

S3. Noun Verb

S4. Noun *END*

S5. Verb Noun

S6. Verb Prep

S7. Verb *END*

S8. Prep Noun

S9. *END* *END*