**Assignment 8**

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**Question 1:**

The given grammar is:

s = np vp

vp = v np pp

vp = v np

np = n

np = n pp

pp = p np

Probabilities for the productions obtained from training sentences are:

P(s → np vp) = 1

P(vp → v np pp) = 0.4

P(vp → v np) = 0.6

P(np → n) = 0.8

P(np → n np) = 0.2

P(pp → p np) = 1

The two parses for the sentence “Delis serve pizza with relish” are:

Parse 1:

(s (np (n Delis)) (vp (v serve) (np (n pizza)) (pp (p with)(np (n relish)))))

The probability of Parse 1 is:

P(Parse 1) = P(s → np vp) \* P(np→n) \* P(vp→v np pp) \* P(np→n) \* P(pp →p np) \* P(np → n)

= 1 \* 0.8 \* 0.4 \* 0.8 \* 1 \* 0.8

P(Parse 1) = **0.2048**

Parse 2 : (s (np (n Delis)) (vp (v serve) (np (n pizza) (pp (p with) (np (n relish))))))

The probability of Parse 2 is:

P(Parse 2) = P(s→np vp) \* P(np→n) \* P(vp→v np) \* P(np→n pp) \* P(pp→p np) \* P(np → n)

= 1 \* 0.8 \* 0.6 \* 0.2 \* 1 \* 0.8

P(Parse 2) = **0.0768**

**Parse 1 has higher probability and it will be chosen.**

**Question 2 :**

a.

From given training corpus,

Again we calculate it similar to how we did in question 1. Notice that here we are including the head nodes as well in productions.

P(s → np vp | s) = 5/5 = 1

P(np → n pp | np) = 3/15 = 1/5

P(np → n | np) = 12/15 = 4/5

P(pp → p np | pp) = 5/5 = 1

P(vp → v np | vp, like) = 2/2 = 1

P(vp → v np pp | vp, like ) = 0/2 = 0

P(vp → v np | vp, serve) = 1/3

P(vp → v np pp | vp, serve) = 2/3

Parse 1:

(s (np (n Delis)) (vp (v serve) (np (n pizza)) (pp (p with)(np (n relish)))))

P(Parse 1)=P(s→np vp | s)\*P(np→n | np)\*P(vp→v np pp |vp, serve)\*P(np →n | np)\*P(pp→p np | pp)\*P(np→n | np)

= 1 \* 4/5 \* 2/3 \* 4/5 \* 1 \* 4/5

P (Parse 1) = **0.341**

Parse 2 :

(s (np (n Delis)) (vp (v serve) (np (n pizza) (pp (p with) (np (n relish))))))

P (Parse 2) = P(s → np vp | s) \* P(np → n | np) \* P(vp → v np | vp, serve) \* P(np → n pp | np) \* P(pp → p np | pp) \*

P(np → n | np)

= 1 \* 4/5 \* 1/3 \* 1/5 \* 1 \* 4/5

P (Parse 2) = **0.0426**

**Parse 1 has higher probability and it will be chosen.**

b.

Parse 1: (s (np (n Men)) (vp (v like) (np (n pizza)) (pp (p with) (np (n relish)))))

Parse 2: (s (np (n Men)) (vp (v like) (np (n pizza) (pp (p with) (np (n relish))))))

**Lexicalized Probability**:

P(Parse 1) = P(s → np vp | s) \* P(np → n | np) \* P(vp → v np pp | vp, like) \* P(np → n | np) \* P(pp → p np | pp) \*P(np → n | np)

= 1 \* 4/5 \* 0 \* 4/5 \* 1 \* 4/5

P(Parse 1) = **0**

P(parse 2) = P(s → np vp | s) \* P(np → n | np) \* P(vp → v np | vp, like)\*P(np → n pp | np) \* P(pp → p np | pp) \* P(np → n | np)

= 1\* 4/5 \* 1 \* 1/5 \* 1 \* 4/5

P(Parse 2) = **0.128**

**Parse 2 has higher probability and it will be chosen.**

**Non-lexicalized Probability:**

P(Parse 1) = P(s → np vp) \* P(np → n) \* P(vp → v np pp) \* P(np → n) \* P(pp → p np) \* P(np → n)

= 1 \* 0.8 \* 0.4 \* 0.8 \* 1 \* 0.8

P(Parse 1) = 0.2048

P(Parse 2) = P(s → np vp) \* P(np → n) \* P(vp → v np) \* P(np → n pp) \* P(pp → p np) \* P(np → n)

= 1 \* 0.8 \* 0.6 \* 0.2 \* 1 \* 0.8

P(Parse 2) = 0.0768

**Parse 2 has higher probability and it will be chosen.**

Notice that with lexicalized probability we ended up choosing the right parse but with non-lexicalized we chose wrong parse. Hence, lexicalized is better.