

# Natural Language Processing Assignment 8

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## #1. Probability Assignment of each grammar rule:

$$P(S \rightarrow NP VP) = 1$$

$$P(VP \rightarrow V NP PP) = \frac{P(VP \rightarrow V NP PP | \text{train})}{P(VP | \text{train})} = \frac{2}{5}$$

$$P(VP \rightarrow V NP) = 1 - \frac{2}{5} = \frac{3}{5}$$

$$P(NP \rightarrow N) = \frac{P(NP \rightarrow N)}{P(NP)} = \frac{12}{15} = \frac{4}{5}$$

$$P(NP \rightarrow N PP) = 1 - \frac{12}{15} = \frac{1}{3}$$

$$P(PP \rightarrow P NP) = 1$$

Given the sentence "Delis serve pizza w/ relish", use the above calculated grammar.

Grammar ①:  $VP \rightarrow V NP PP$ : in the parsing:

$$P(S \rightarrow NP VP) \cdot P(NP \rightarrow N) \cdot P(VP \rightarrow V NP PP) \cdot P(NP \rightarrow N) \cdot P(PP \rightarrow P NP) \cdot P(NP \rightarrow N) = 0.8^3 \times 0.4 = 0.2048$$

Grammar ②:  $VP \rightarrow V NP$

$$P(S \rightarrow NP VP) \cdot P(NP \rightarrow N) \cdot P(VP \rightarrow V NP) \cdot P(NP \rightarrow N PP) \cdot P(PP \rightarrow P NP) \cdot P(NP \rightarrow N) = 0.8 \times 0.6 \times 0.2 \times 0.8 = 0.0768$$

## #2. Using lexicalized Probability:

①

— w/ the sentence "Delis serves pizza w/ relish".

$$* P(VP \rightarrow V NP PP | \text{"serve"}) = \frac{2}{3} \quad ①$$

$$P(VP \rightarrow V NP | \text{"serve"}) = 1 - \frac{2}{3} = \frac{1}{3} \quad ②$$

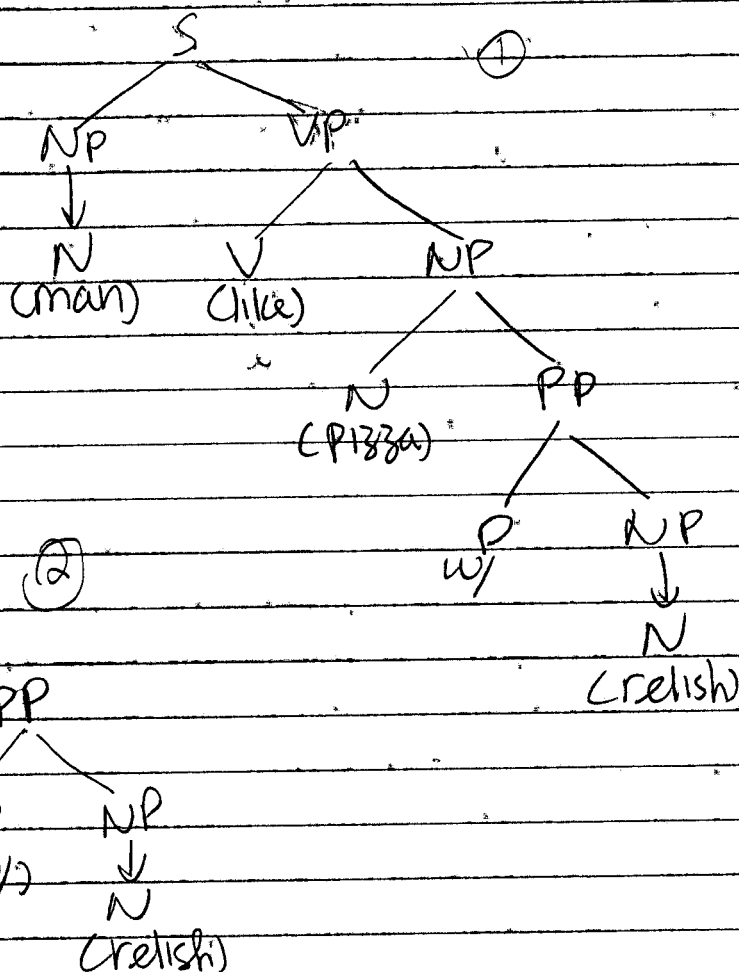
\* Given the updated probability:

$$— P(\text{Tree w/ grammar ①}) = 0.8 \times \frac{2}{3} \times 0.8 \times 0.8 = 0.3413$$

$$— P(\text{Tree w/ grammar ②}) = 0.8 \times \frac{1}{3} \times 0.2 \times 0.8 = 0.043$$

#26 "Men like pizza w/ relish".

\* Two parsing:



\* Non-lexicalized probability:

①  $0.8 \times 0.6 \times 0.2 \times 0.8 = 0.0768$

②  $0.8 \times 0.4 \times 0.8 \times 0.8 = 0.2048$

\* Lexicalized Probability.

$P(VP \rightarrow V NP PP \mid \text{"like"}) = 0$

$P(VP \rightarrow V NP \mid \text{"like"}) = 1$

①  $0.8 \times 0.8 \times 0.8 = 0.8^3$

② 0