

ADVANCED METHODS IN NLP

EXERCISE #x SOLUTION

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Question 1

(a) The program is likely to create long sentences because of the rule [**NP -> NP PP**]. This is a **recursive** rule that may in the “best” case generate 5 terminals: Left hand side NP would derive [Det Noun] and right hand side PP would derive [NP Prep] then the latter NP would again derive [Det Noun]. In this case we would end up with: [Det Noun Prep Det Noun]. But each time we encounter an NP we have a **0.5 probability** to choose the derivation [**NP -> NP PP**] instead, and that would yield another “best case 5” addition.

(b) We may calculate the probability of a double adjective sentence. For such sentence to be generated, our grammar should choose twice consecutively the rule: [**Noun -> Adj Noun**] because then we would end up with [Noun -> Adj Adj Noun] as expected. Note that there are 5 other rules of the form [Noun -> *] which are all deriving terminals. So the probability when encountering a Noun to choose twice the specified rule is $\frac{1}{6} \cdot \frac{1}{6} = \frac{1}{36}$ which is fairly rare.

(c) In order to generate shorter sentences and make it less rare to generate a double adjective sentence, we should change the weights of the rules: [**NP -> Det Noun**] from 1 to 2 and [**Noun -> Adj Noun**] from 1 to 5. This way the probability to derive a recursive NP is $\frac{1}{3}$ and the probability for a double adjective is $\frac{5}{10} = \frac{1}{2}$. Below are the results when running the generator 5 times:

a **perplexed delicious** chief of staff understood the sandwich .

is it true that a **fine perplexed perplexed fine** sandwich understood a pickle ?

is it true that a **delicious perplexed pickled** sandwich under the perplexed floor ate the **fine delicious** sandwich under a pickle ?

a sandwich with a president kissed a **perplexed perplexed** pickle .

every chief of staff under every sandwich wanted the pickle !