Advanced Methods in NLP   Homework 5   Vered Zilberstein 200397354
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<u>(1)</u>

(a). The grammar generates so many long sentences because of the following 3 rules:

1 NP Det Noun
1 NP NP PP
1 PP Prep NP

When NP is called, it has 0.5 probability of calling NP and PP. In which NP is called again twice, because PP has only one rule and that rule calls NP again.

Meaning that the expectation of the number of another NP call after NP call is 1
$$\mathbb{E}[Another\ NP\ call|Now\ in\ NP] = 1$$
and that situation is hard to get out and there are long sentences with a lot of NPs.

The most responsible rule is
1 NP NP PP

(b). The grammar generates multiple adjectives so rarely is because of the following rules:

1 Noun Adj Noun
1 Noun president
1 Noun sandwich
1 Noun pickle
1 Noun chief of staff
1 Noun floor

Meaning that when a noun is called, is has $\frac{1}{6}$ probability of one adjective (the first rule), and $\frac{1}{6} * \frac{1}{6} = \frac{1}{36}$ chances of getting 2 adjectives (the first rule, and for the noun of that rule get another first rule).

(c). I changed the number of the rule
1 Noun Adj Noun
to 5.

Now we get 2 adjectives in a row with at least $\frac{1}{4}$ probability for every noun.

And I changed the number of the rule
1 NP NP PP
to 20.

Now we get shorter sentences with a lot of adjectives.

(2)

(a). See code implementation.

(3)

(a) We will present the modifications and a short explanation:

Rules:

1. ROOT -> S . and ROOT -> S ! were changed to ROOT -> S CNF. (similarly with !) and the rule CNF. -> . was added to support the CNF grammar.
2. We've split the Verb rule to Verb (i.e transitive verbs) and SelfVerb for intransitive verbs to distinguish between verbs like pickled and eating
3. We've added the Entity rule, to support names, descriptions, places etc. (here only sally)
4. We've added the Part, ThatPart , and VerbPart abbreviations to support nested sentences, as described in the examples in question 3.
5. Special "Is" verb to support corner cases not suited to the Verb or SelfVerb situations.
6. ADDVERB – support of non-nested verbs concatenation (e.g. "ran and ate")
7. Very - Verb adjectives (here only very)

Vocabulary:

We've added support for the new words as shown in the examples (Adj -> lazy, Verb -> worked etc.)

(b) We will present the modifications and a short explanation:

Rules:

1. Added S -> VP NP to support reverse order sentences (as provided in this section)
2. To support multi-nested sentences we needed the PART -> PART ThatPart rule.
3. To support phrases like " the president chooses the chief of staff " we needed to add specific support to situations where an ending phrase comes with a present tense verb : VP -> EndNoun VerbPresTen and EndNoun -> Det SpecEntity (here both are only SpecEntity -> president and VerbPresenTen -> chooses)
4. In section (b) explanatory words (e.g. that) came not only before nouns, but also verbs, thus ExplVerb -> Epxl VP and ExplVerb -> Expl Part (here Expl -> that)

Vocabulary:

We've added support for the new words as shown in the examples (Noun -> citizens)

(c) We present all the sentences from section 3, including the example for the ungrammatical sentence (last)

Sents.txt

Sally ate a sandwich .
Sally and the president wanted and ate a sandwich .
the president sighed .
the president thought that a sandwich sighed .
it perplexed the president that a sandwich ate Sally .
the very very very perplexed president ate a sandwich .
the president worked on every proposal on the desk .
Sally is lazy .
Sally is eating a sandwich .
the president thought that Sally is a sandwich .
the pickle kissed the president that ate the sandwich .
the pickle kissed the sandwich that the president ate .
the pickle kissed the sandwich that the president thought that Sally ate .
the citizens choose the president .
the president chooses the chief of staff .
the president and the chief of staff choose the sandwich .

the president thought that a sandwich sighed a pickle .

CKY output:

(ROOT (S (Entity Sally) (VP (Verb ate) (NP (Det a) (Noun sandwich)))) (CNF. .))
(ROOT (S (NP (Entity Sally) (PP (Prep and) (NP (Det the) (Noun president)))) (VP (VerbPart (Verb wanted) (ADDVERB (Prep and) (Verb ate))) (NP (Det a) (Noun sandwich)))) (CNF. .))
(ROOT (S (NP (Det the) (Noun president)) (SelfVerb sighed)) (CNF. .))
(ROOT (S (Part (NP (Det the) (Noun president)) (SelfVerb thought)) (ThatPart (That that) (Part (NP (Det a) (Noun sandwich)) (SelfVerb sighed)))) (CNF. .))
(ROOT (S (Part (VP (Noun it) (SelfVerb perplexed)) (NP (Det the) (Noun president))) (ThatPart (That that) (Part (NP (Det a) (Noun sandwich)) (VP (Verb ate) (Entity Sally))))) (CNF. .))
(ROOT (S (VP (NP (Det the) (NP (Adj (Very very) (Adj (Very very) (Adj (Very very) (Adj perplexed)))) (Noun president))) (Verb ate)) (NP (Det a) (Noun sandwich))) (CNF. .))
(ROOT (S (VP (NP (Det the) (Noun president)) (Verb worked)) (PP (Prep on) (NP (Det every) (NP (Noun proposal) (PP (Prep on) (NP (Det the) (Noun desk))))))) (CNF. .))
(ROOT (S (Entity Sally) (VP (Is is) (Adj lazy))) (CNF. .))
(ROOT (S (Entity Sally) (VP (Is is) (VP (Verb eating) (NP (Det a) (Noun sandwich))))) (CNF. .))
(ROOT (S (Part (NP (Det the) (Noun president)) (SelfVerb thought)) (ThatPart (That that) (Part (Entity Sally) (VP (Is is) (NP (Det a) (Noun sandwich)))))) (CNF. .))
(ROOT (S (VP (NP (Det the) (Noun pickle)) (Verb kissed)) (NP (NP (Det the) (Noun president)) (ExplVerb (Expl that) (VP (Verb ate) (NP (Det the) (Noun sandwich)))))) (CNF. .))
(ROOT (S (VP (NP (Det the) (Noun pickle)) (Verb kissed)) (NP (NP (Det the) (Noun sandwich)) (ExplVerb (Expl that) (VP (NP (Det the) (Noun president)) (Verb ate))))) (CNF. .))
(ROOT (S (VP (NP (Det the) (Noun pickle)) (Verb kissed)) (NP (NP (NP (Det the) (Noun sandwich)) (ExplVerb (Expl that) (Part (NP (Det the) (Noun president)) (SelfVerb thought)))) (ExplVerb (Expl that) (VP (Entity Sally) (Verb ate))))) (CNF. .))
(ROOT (S (VP (NP (Det the) (Noun citizens)) (Verb choose)) (NP (Det the) (Noun president))) (CNF. .))
(ROOT (S (VP (EndNoun (Det the) (SpecEntity president)) (VerbPresTen chooses)) (NP (Det the) (Noun (Chiefof (Chief chief) (Of of)) (Staff staff)))) (CNF. .))
(ROOT (S (VP (NP (Det the) (NP (Noun president) (PP (Prep and) (NP (Det the) (Noun (Chiefof (Chief chief) (Of of)) (Staff staff)))))) (Verb choose)) (NP (Det the) (Noun sandwich))) (CNF. .))
FAILED TO PARSE!