

Non-Classical Parsing

Assignments

1 Non-Context-Free Languages and Mechanisms

1. Prove that the following languages are not context-free.

$$L_1 = \{ a^i b^j c^i d^j \mid i, j \geq 1 \}$$

$$L_2 = \{ a^{2^n} \mid n \geq 0 \}$$

2. Give a matrix grammar (without appearance checking) and a CD grammar system working in =2-mode for the language

$$L_3 = \{ ww \mid w \in \{a, b\}^* \}.$$

3. Give a matrix grammar with appearance checking and a CD grammar system working in t-mode for the language L_2 .
4. Give the 0L system for the snow flake fractal (slight no. 18), that is, specify the axiom (describing the initiator), the rule (describing the generator) and the angle δ in the syntax for turtle graphics.

2 $LL(k)$ CD grammar systems

5. Consider the CD grammar system

$$\Gamma = (\{S, S', S'', A, B, C, A', B', C'\}, \{a, b, c\}, S, P_1, P_2, P_3, P_4)$$

with

$$P_1 = \{S \rightarrow S', S' \rightarrow S'', S'' \rightarrow ABC\},$$

$$P_2 = \{A \rightarrow aA', B \rightarrow bB', C \rightarrow cC'\},$$

$$P_3 = \{A' \rightarrow A, B' \rightarrow B, C' \rightarrow C\},$$

$$P_4 = \{A \rightarrow a, B \rightarrow b, C \rightarrow c\}.$$

- (a) What language is generated in =3-mode using weak leftmost derivations?
 - (b) Give a lookup table proving that Γ satisfies the $LL(2)$ condition.
 - (c) Modify Γ such that it generates the same language in = 2-mode by weak leftmost derivations and still satisfies the $LL(2)$ condition.
6. (**optional, more difficult**) Show that the language $\{ wcw \mid w \in \{a, b\}^* \}$ can be generated by an $LL(2)$ CD grammar system working in =2-mode by weak leftmost derivations.

3 Strong LL(k) grammars and grammar systems

7. Prove that the context-free grammar

$$(\{S, A\}, \{a, b\}, \{S \rightarrow aAaa, S \rightarrow bAba, A \rightarrow b, A \rightarrow \varepsilon\}, S)$$

is LL(2) but not strong LL(2).

8. Give an informal argument why the CD grammar system generating L_1 (that was given in the lecture) is strong LL(1).

What can you say about the CD grammar systems given in assignment 5 ?