CS 3530: Assignment 2a

Fall 2023

Exercise 2.1abcd (10 points)

Problem

Recall the CFG G_4 that we gave in example 2.4. For convenience, let's rename its variables with single letters as follows.

$$E \to E + T | T$$
$$T \to T \times F | F$$
$$F \to (E) | a$$

Give derivations for each string.

a. a

b. $a + a$

c. $a + a + a$

d. $((a))$

Solution

a.

$$E \to T$$
$$E \to F$$
$$E \to a$$

b.

$$E \to E + T$$
$$E \to T + T$$
$$E \to F + T$$
$$E \to a + T$$
$$E \to a + F$$
$$E \to a + a$$

c.

$$E \to E + T$$
$$E \to E + T + T$$
$$E \to T + T + T$$
$$E \to F + T + T$$
$$E \to a + T + T$$

$$E \to a + F + T$$
$$E \to a + a + T$$
$$E \to a + a + F$$
$$E \to a + a + a$$

d.

$$E \to T$$
$$E \to F$$
$$E \to (E)$$
$$E \to (T)$$
$$E \to (F)$$
$$E \to ((E))$$
$$E \to ((T))$$
$$E \to ((F))$$
$$E \to ((a))$$

Exercise 2.4bc (10 points)

Problem

Give context-free grammars that generate the following languages. In all parts, the alphabet Σ is $\{0, 1\}$.

b. $\{w | w$ starts and ends with the same symbol $\}$

c. $\{w |$ the length of w is odd $\}$

Solution

b.

$$S \to 0P0|1P1|0|1$$
$$P \to 0P|1P|\varepsilon$$

c.

$$S \to 0|1|00S|01S|10S|11S$$