

Exercise 3

The goal is to find a grammar that accepts the language $L = \{a^n b^n | n > 0\}$. We define the this grammar as follows:

$$G = \{N, T, P, S\},$$

where S is the start symbol and the only non-terminal symbole (i.e. $N = \{S\}$), $T = \{a, b\}$ is the set of terminal symbols, and the production rules P are given by

$$S \longrightarrow aSb, \tag{1}$$

$$S \longrightarrow ab. \tag{2}$$

P can also be merged to one rule

$$S \longrightarrow aSb \mid ab$$

examples

- Generating the empty string ϵ is not possible
- The string ab can be generated in one step by applying rule (2):

$$S \xrightarrow{(2)} ab$$

- The string $aaabbb$ can be generated as follows:

$$S \xrightarrow{(1)} aSb \xrightarrow{(1)} aaSbb \xrightarrow{(2)} aaabbb$$

- The string $a^n b^n$ can be generated by applying rule (1) $(n - 1)$ times and then applying rule (2) once.