Nico Bachmann
Ruben Hutter

Exercise 3.1

(a) A possible derivation of the word "abaabaaba" is:

$$1\ (aSa) \rightarrow 2\ (abSba) \rightarrow 1\ (abaSaba) \rightarrow 1\ (abaaSaaba) \rightarrow 4\ (abaabaaba)$$

(b) $\mathcal{L}(G)$ is the definition of a Palindrome. The word can always be read either forward or backward and you get the same result.

(c) The Grammar that represents a representation of binary trees is:

$$G = \langle \{\, S \,\},\ \{\, [, \circ, \square,] \,\},\ R,\ S \rangle$$

with R:

1) $S \rightarrow \square$
2) $S \rightarrow [S \circ S]$

Exercise 3.2

(a) To check if $G_1 = \langle \{ S, X, Y \}, \{ a, b \}, R_1, S \rangle$ is a regular language we rewrite the rules set. In a first step we eliminate the start variable from the right-hand side of R_1 and in a second step we eliminate forbidden occurrences of ϵ and obtain:

$$R_1' = \{ S \to aX,\ S \to aS',\ S \to \epsilon,\ S' \to a,\ S' \to aX,\ S' \to aS',\ X \to ba,\ X \to bX \}$$

So we see that this is a regular grammar and therefore of Type-3, and because of Type-3 also of Type-i for $i < 3$.

(b) To-Do

Exercise 3.3

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Exercise 3.4

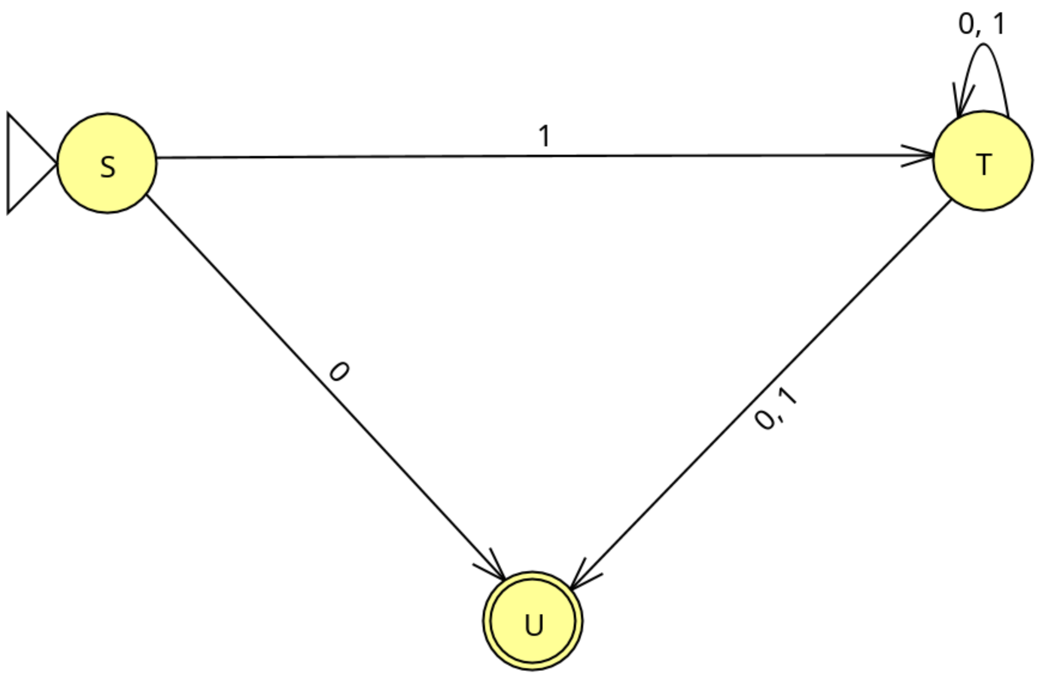

Figure 1: NFA for G