Albert-Ludwigs-Universität, Inst. für Informatik
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Theoretical Computer Science - Bridging Course
Summer Term 2020
Exercise Sheet 3

for getting feedback submit electronically by 12:15 pm, Tuesday, June 2, 2020

Exercise 1: Regular Expressions *(6 Points)*

Consider the following regular expressions. What language do they recognize? Give two strings that are members of the the corresponding language and two strings which are not members – a total of four strings for each part. Assume for the first two parts that the alphabet $\Sigma = \{a, b, c\}$.

(a) $a^*b^*c^*$

(b) $((a \cup c)^*b(a \cup c)^*b(a \cup c)^*b(a \cup c)^*)^*$

Give a regular expression for each of the following languages.

(c) L_1 is the language, over alphabet $\{a, b\}$, of all strings starting and ending with the same symbol.

(d) L_2 is the language, over alphabet $\{0, 1\}$, of all alternating 0 and 1 strings.

Exercise 2: The Pumping Lemma: Sufficiency or Necessity? *(4 Points)*

Consider the language $L = \{c^m a^n b^n \mid m, n \geq 0\} \cup \{a, b\}^*$ over the alphabet $\Sigma = \{a, b, c\}$.

(a) Describe in words (not using the pumping lemma), why L cannot be a regular language.

(b) Show that the property described in the Pumping Lemma is a necessary condition for regularity but not sufficient for regularity.

Hint: Use L as counter example, i.e., show that it can be 'pumped' (in the sense of the pumping lemma), but is still not regular.

Exercise 3: To Be Regular or Not to Be *(6 Points)*

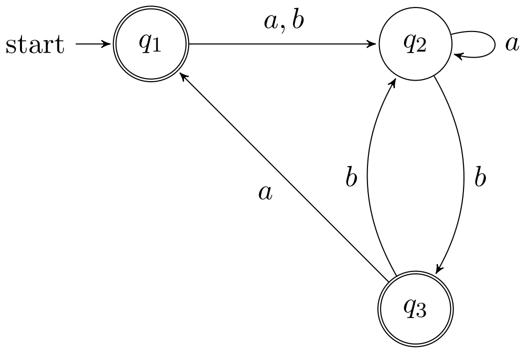
Let $\Sigma = \{0, 1\}$, prove the following:

(a) The language $A = \{0^k w 0^k | k \geq 1 \text{ and } w \in \Sigma^*\}$ is regular.

(b) The language $B = \{0^k 1 w 0^k | k \geq 1 \text{ and } w \in \Sigma^*\}$ is not regular.

Exercise 4: NFAs to Regular Expressions *(4 Points)*

Consider the following NFA:



Give the regular expression defining the language recognized by this NFA by *stepwise* converting it into an equivalent GNFA with only two nodes.