

Homework One
Theory of Computation 2021

Important Note:

The deadline is 14:00, 10/27 (Wednesday). Please take your handwriting pages to lab 65602 during 10/25-10/27 or upload your HW to moodle (Please make sure the resolution is good to read for TAs. It is your responsibility).

Note that Penalty for late submission: 20% per day, and you can only upload HW to moodle after the deadline.

Q1: Give $dfa's$ for the languages

- (a) $L = \{ab^5wb^2 : w \in \{a,b\}^*\}$.
- (b) $L = \{ab^n a^m : n \geq 2, m \geq 3\}$.
- (c) $L = \{w_1abw_2 : w_1 \in \{a,b\}^*, w_2 \in \{a,b\}^*\}$.

Q2: A run in a string is a substring of length at least two, as long as possible and consisting entirely of the same symbol. For instance, the string $abbbaab$ contains a run of $b's$ of length three and a run of $a's$ of length two. Find dfa for the following languages on $\{a,b\}$:

- (a) $L = \{w : w \text{ contains no runs of length less than four}\}$.
- (b) $L = \{w : \text{every run of } a's \text{ has a length of either two or three}\}$.

Q3: Show that the language $L = \{a_n : n \text{ is either a multiple of 3 or a multiple of 5}\}$ is regular.

Q4: Find a dfa that accepts the language defined by the nfa in Figure 1.

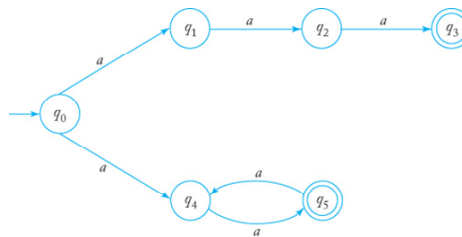


Figure 1: NFA diagram.

Q5: Design an nfa with no more than five states for the set $\{abab^n : n \geq 0\} \cup \{aba^n : n \geq 0\}$

Q6: Find an nfa with three states that accepts the language $L = \{a^n : n \geq 1\} \cup \{b^m a^k : m \geq 0, k \geq 0\}$.

Q7: Convert the following nfa in Figure 2 into an equivalent dfa.

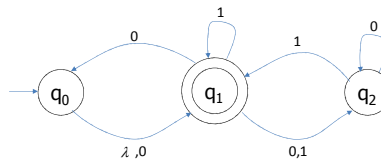


Figure 2: NFA diagram.