Theoretical Computer Science (M21276)

Part A/5: Finite Automata and Regular Languages

(Oct 9-13, 2023)

Question 1. For each of the following regular expressions, construct an NFA using the method described in lecture or your wist.

(i) $(ab)^*$

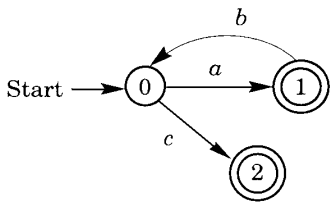
(ii) a^*b^*

(iii) $(a+b)^*$

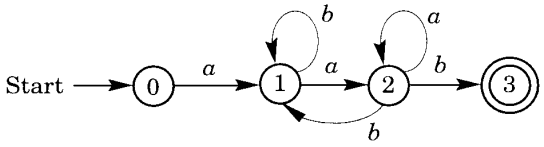
(iv) $a^* + b^*$

Question 2. Find an NFA which accepts the language defined by the regular expression $(a + bb)^*(ba^* + \Lambda)$.

Question 3. Find a regular expression for the language accepted by the following NFA (use the algorithm from the lecture or your wist):



Question 4. Given the following NFA:



Use the algorithm from the lecture to find two regular expressions for the language accepted by the NFA as follows:

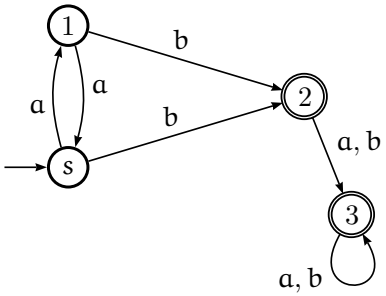
(i) Delete state 1 before deleting state 2.

(ii) Delete state 2 before deleting state 1.

(iii) Prove that the regular expressions obtained in parts (i) and (ii) are equal.

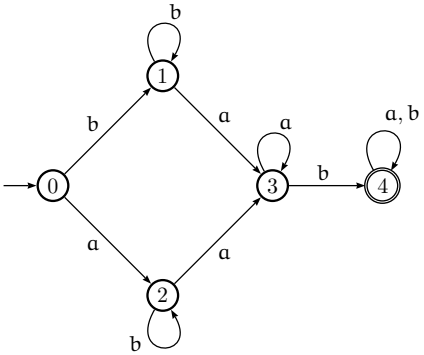
Question 5. Given the DFA over the alphabet $\{a, b\}$ with 5 states 0 (initial), 1, 2 (final), 3, 4 (final) and the following transition function: $T(0, a) = T(1, a) = 1$, $T(2, a) = 2$, $T(3, a) = 3$, $T(4, a) = 4$, $T(0, b) = 2$, $T(1, b) = T(3, b) = 4$, $T(2, b) = 3$, $T(4, b) = 2$. Write down the set of equivalent pairs.

Question 6. Minimise the state in the following DFA:

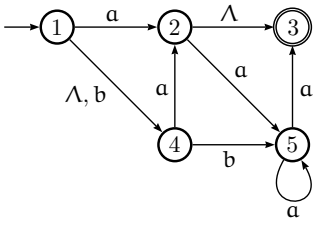


Question 7. For the following DFA over the alphabet $\{a, b\}$ find the minimum-state DFA.
DFA has 5 states: 0 (initial), 1(final), 2, 3 (final), 4 (final) and the following transition function: $T(0, a) = 1$, $T(1, a) = 1$, $T(2, a) = 3$, $T(3, a) = 4$, $T(4, a) = 1$, $T(0, b) = 2$, $T(1, b) = 2$, $T(2, b) = 2$, $T(3, b) = 2$, $T(4, b) = 2$.

Question 8. Compute the minimum-state DFA for the following DFA.



Question 9. Consider the finite automaton below. Construct the minimum-state DFA which accepts the same language. Write down a regular expression that represents the language accepted by your automaton.



Question 10. Transform each NFA from Question 1 into a DFA which will accept the same language, then compute the minimum-state DFA.