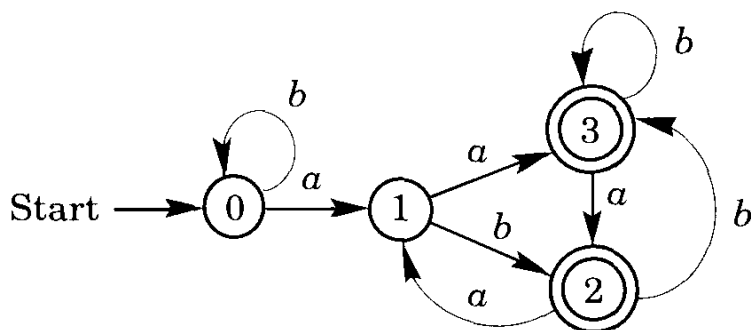


# Theoretical Computer Science (M21276)

## Part A/4: Deterministic and non-deterministic finite automata

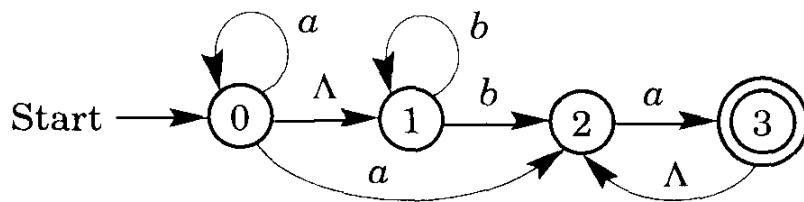
(Oct 2-6, 2023)

**Question 1.** We are given the following DFA over the alphabet  $\{a, b\}$ :



- (i) Decide which of the following strings are accepted by the DFA:  
 $aaa$  and  $aba$ .
- (ii) Give an example of three strings of length at least 5 which are accepted by the DFA:
- (iii) Give an example of three strings of length at least 5 which are not accepted by the DFA:
- (iv) Write down the transition function  $T$  for the DFA.

**Question 2.** We are given the following NFA over the alphabet  $\{a, b\}$ :



- (i) Decide which of the following strings are accepted by the NFA:  
 $aaa$ ,  $ba$ ,  $ab$ .
- (ii) Give an example of a string of length at least 5 which is accepted by the NFA:
- (iii) Give an example of a string of length at least 5 which is not accepted by the NFA:
- (iv) Write down the transition function  $T$  for the given NFA:

**Question 3.** Use your wits to construct a DFA for each of the following regular expressions. You can draw a directed graph or use a formal definition of DFA. Is it important to mention an alphabet?

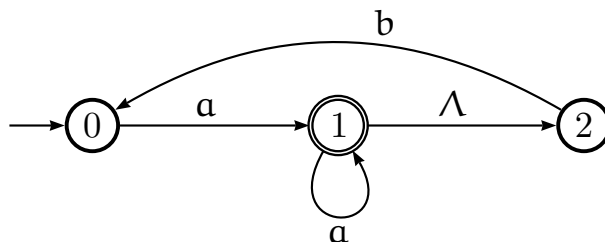
- (i)  $a + b$  over the alphabet  $\Sigma = \{a, b\}$ .
- (ii)  $a + b^*$  over the alphabet  $\Sigma = \{a, b\}$ .
- (iii)  $ab^* + bc^*$  over the alphabet  $\Sigma = \{a, b, c\}$ .

**Question 4.** Use your wits to construct an NFA for each of the following regular expressions.

- (i)  $a^*bc^* + ac$
- (ii)  $(a + b)^*a$
- (iii)  $a^* + ab$

**Question 5.** Use your wits (or use conversion of Q4i) to construct an DFA for the following regular expression  $a^*bc^* + ac$  over the alphabet  $\Sigma = \{a, b, c\}$ .

**Question 6.** Convert the following NFA to an equivalent DFA over the alphabet  $\{a, b\}$ .



**Question 7.** Convert the following NFA to an equivalent DFA over the alphabet  $\{a, b\}$ .

