

Question 1

Let $\Sigma = \{a, b\}$. Define $A = \{w \in \Sigma^* \mid |w| \geq 2, \text{ second-to-last symbol of } w \text{ is } a\}$ (20 marks)

- (a) List the first 4 strings in A in lexicographic order. (4 marks)
- (b) Draw a DFA for A . (16 marks)

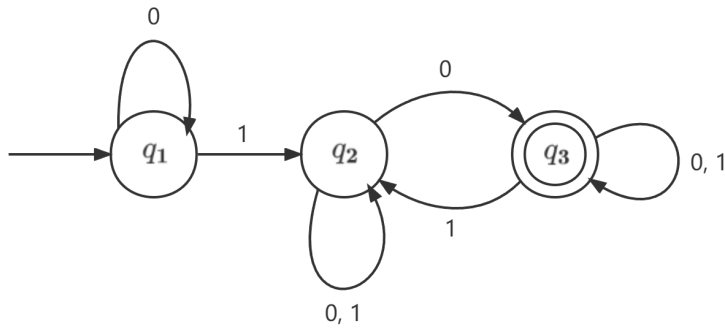
Question 2

Let E, F be regular expressions, and $E = 0, F = 1$. (20 marks)

- (a) Give a DFA that accepts $E \cup F$. (4 marks)
- (b) Give a DFA that accepts EF . (4 marks)
- (c) Give a DFA that accepts $(E \cup F)EF$. (6 marks)
- (d) Give a DFA that accepts $(EF)^*$. (6 marks)

Question 3

Convert the given NFA to its corresponding DFA. (20 marks)



Question 4

Design context free grammars for the following languages (only providing rules). (20 marks)

- (a) The set $\{a^n \mid n \geq 1\}$ (6 marks)
- (b) The set $\{0^n 1^n \mid n \geq 1\}$ (6 marks)
- (c) The set $\{a^i b^j c^i e^2 \mid i, j \geq 0\}$ (8 marks)

Question 5

Let $\Sigma = \{a, b\}$, and consider the language $A = \{w \in \Sigma^* \mid w \text{ has more } b's \text{ than } a's\}$. (20 marks)

- (a) Describe pumping lemma for regular languages. (4 marks)
- (b) Prove that A is not a regular language. (16 marks)