CS 3331a - Assignment 3 - Solutions

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Question 1 - 20 marks

For each language below, let $\Sigma = \{0, 1, 2\}$.

(1) The set of all words that start with a 0 or a 1, end with a 2, and have 201 as a subword,

$$(0+1)(0+1+2)^*(201)(0+1+2)^*(2).$$

(2) The set of all words containing at least three consecutive 2's,

$$(0+1+2)^*(222)(0+1+2)^*.$$

(3) The set of all words of odd length,

$$((0+1+2)(0+1+2))^*(0+1+2).$$

Question 2 - 20 marks

(1) $(a^*b^*)^*$ is the language of all words over $\{a, b\}$.

(2) $(a+b)^*b(a+b)(a+b)(a+b)$ is the language consisting of all words over $\{a, b\}$ whose fourth letter from the right is 'b'.

Question 3 - 20 marks

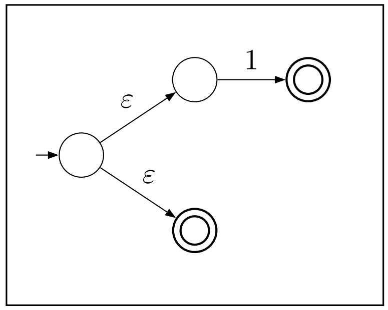
Given the following regular expression E

$$(1+\varepsilon)(0+01)^*$$

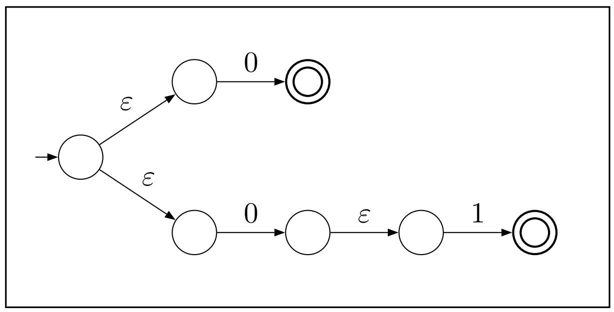
construct an ε-NFA A such that $L(A) = L(E)$.

I follow the procedure on pp. 108-109 of the notes and not *that of the textbook.*

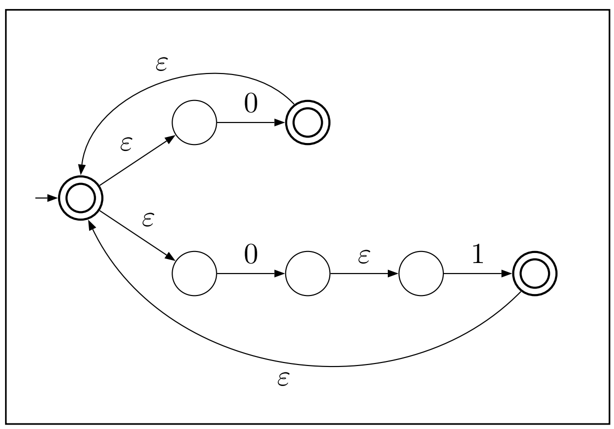
- $(1+\varepsilon)$



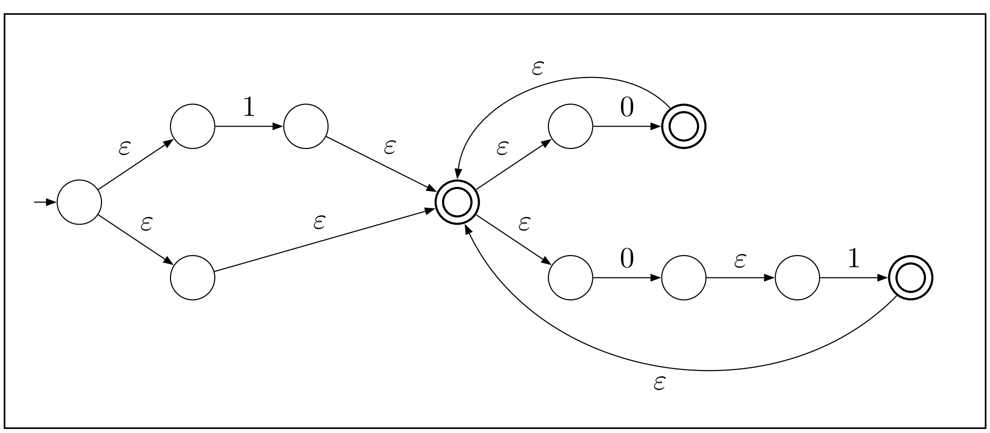
- $(0+01)$



- $(0+01)^*$

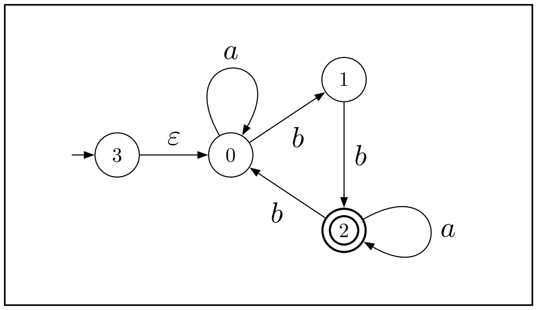


- $(1+\varepsilon)(0+01)^*$

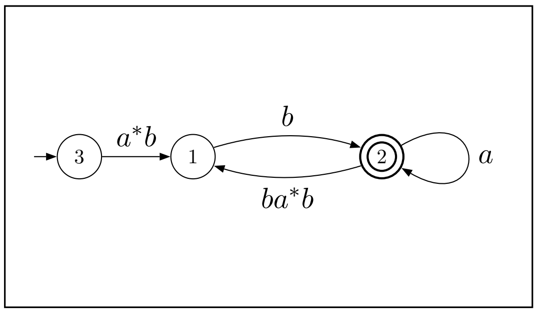


Question 4 - 20 marks

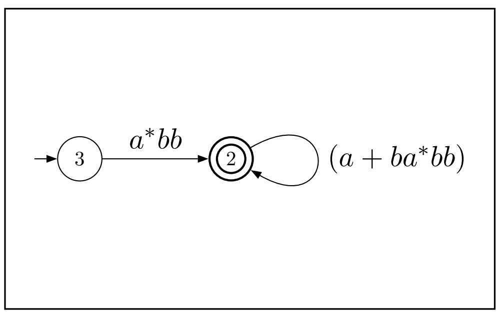
- Add a different initial state.



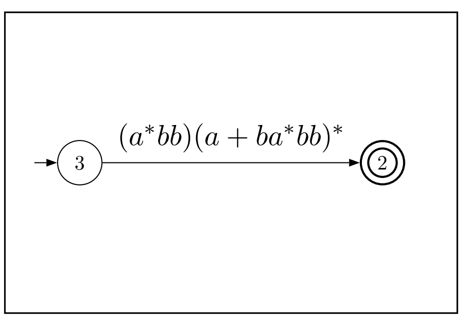
- Eliminate state 0.



- Eliminate state 1.



- Combine remaining state transition rules.



Question 5 - 20 marks

Give a CFG for each of the following languages:

(1) $L_1 = \{0^{i+2}1^i | i \geq 0\}$

$$N = \{S\},\ \Sigma = \{0, 1\}$$
$$P : S \to 0S1 \mid 00$$

(2) $L_2 = \{a^i b^j | 0 \leq i < j\}$

$$N = \{S\},\ \Sigma = \{a, b\}$$
$$P : S \to b \mid Sb \mid aSb$$

(3) $L_3 = \{$ set of all balanced bracketed expressions $\}$

$$N = \{S\},\ \Sigma = \{(,)\}$$
$$P : S \to \varepsilon \mid (S) \mid SS$$

(4) $L_2 = \{0^m 1^{m+n} 0^n | m, n \geq 0\}$

$$\begin{aligned} N =& \{S, A, B\},\ \Sigma = \{a, b\} \\ P : S &\to AB \\ A &\to \varepsilon \mid 0A1 \\ B &\to \varepsilon \mid 1B0 \end{aligned}$$