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7.5

(1) We can show it by contradiction using pigeonhole principle

Assume L_3 is regular, so there is a DFA
$M = (Q, \Sigma, \delta, q_0, F)$ ~~recognizing~~ recognizing L_3
Now define

Pigeons = strings of the form 0^i1 where i is a nonnegative integer, that is, 1, 01, 001, ...
Holes = states

Put pigeon string into hole corresponding to the state it leads to

By the Pigeonhole principle, two pigeons share a hole, say 0^i1 and 0^j1, where $j > i$
So 0^j1 and 0^i1 lead to the same state
M accepts $0^i1\,0^i1$
So M accepts $0^j1\,0^i1$, incorrect, contradiction

(2)

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2) If L were regular, then its compliment, L_1, would be also be regular. L_1 contains all strings over $\{a, b\}$ that are not in L. There are two ways not to be in L: have any a's that occur after any b's (in other words, not have all the a's followed by all the b's) or have an equal number of a's and b's. So now consider

$$L_2 = L_1 \cap a^* b^*$$

L_2 contains only those elements of L_1 in which the a's and b's are in the right order. In other words,

$$L_2 = \{a^n b^n : n \geq 0\}$$

But if L was regular, then L_1 would be regular. Then L_2, since it is the intersection of two regular languages would also be regular. But we have already shown that it $(a^n b^n)$ is not regular. Thus L cannot be regular.

Not necessary!

1.5

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Ans 4- Look at DFA of L. If there is a cycle, then $|L| \geq 6$. Otherwise, check number of all possible paths ending with a final states

Incomplete!

2

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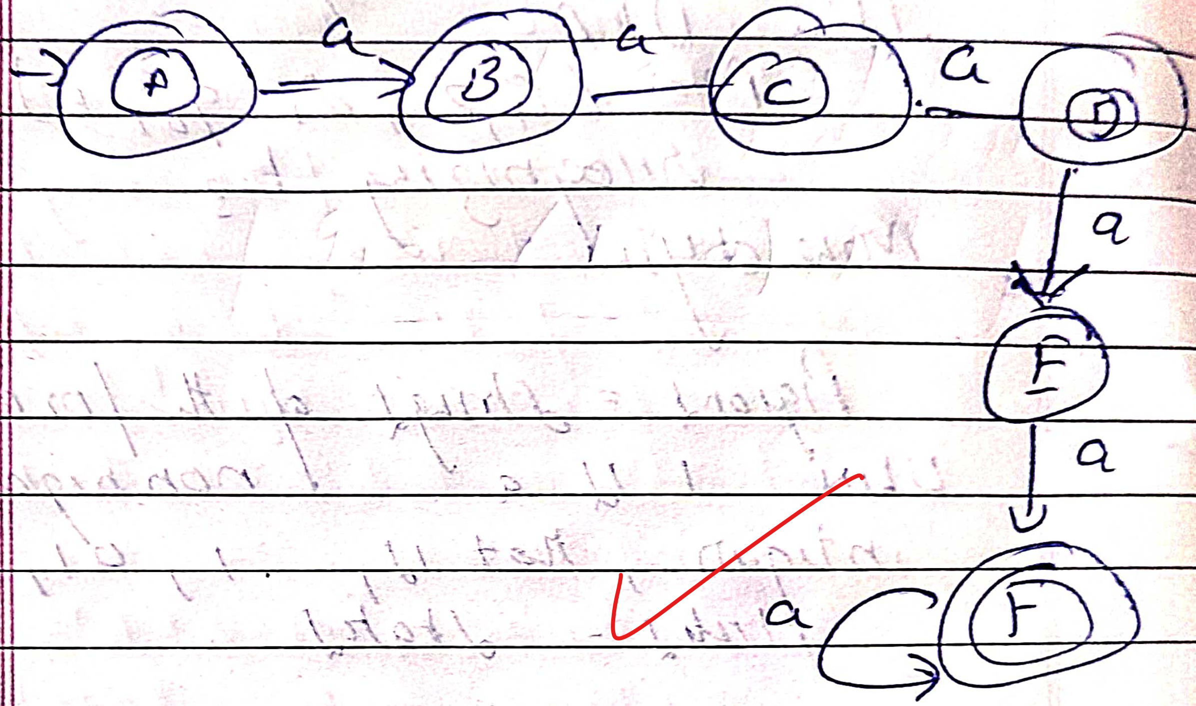
(6) $\Sigma = \{a\}$

$\{ \lambda, a, aa, aaa, aaaa, \ldots \}$



1

your a cannot be accepted
in the condition given
$n \neq 4$ but it can
be more than 4 so
above is our required DFA

Minimal!

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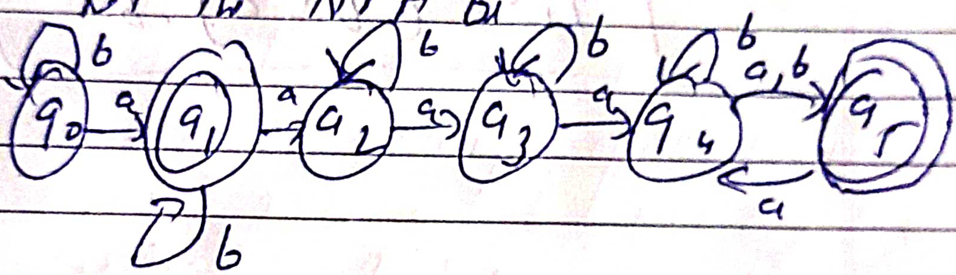
(7) Given

(a) $R = b^* a b^* a b^* a b^* + b^* a b^* a b^* a b^* a b$
$= b^* a b^* a b^* a b^* (\varepsilon + a b)$

$= b^* a b^* a b^* a b^* a b$

(b) Let the NFA be



Equations of each state

$q_0 = \lambda + q_0 b$ — (1)

$q_1 = q_0 a + q_1 b$ — (2)

$q_2 = q_1 a + q_2 b$ — (3)

$q_3 = q_2 a + q_3 b$ — (4)

1

$q_4 = q_3 a + q_4 b + q_5 a$ — (5)

$q_5 = q_4 (a + b)$ — (6)

We need to add q_1, ε, q_5 to get final answer

$q_0 = \lambda + q_0 b$

$q_0 = \lambda \cdot b^*$

$\boxed{q_0 = b^*}$

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Eq (7) in (1)

$$q_1 = q_0 a + q_1 b$$

$$= b_1^* a + q_1 b$$

Arden's theorem

$$\boxed{q_1 = (b^* . a) . b^*}$$