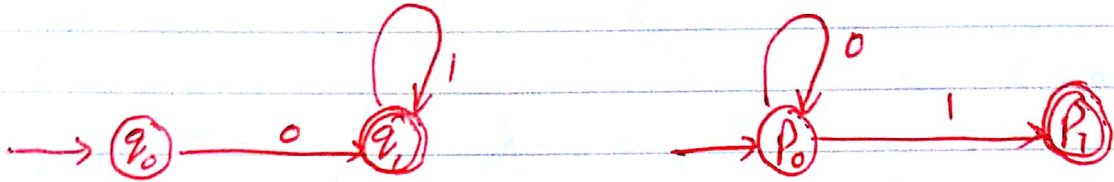


MARCH						
M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

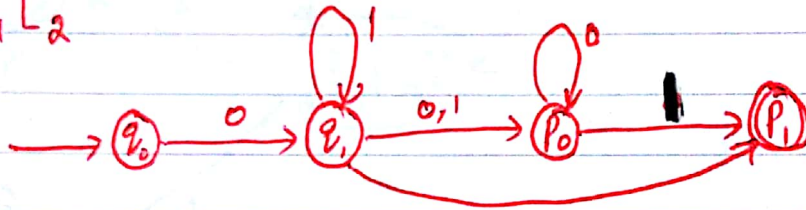
Non Deterministic Finite Automata with Δ transitions



(a) $L_1 = \text{An NFA accepting } \{0\}^* \{1\}^*$

(b) $L_2 = \text{An NFA accepting } \{0\}^* \{1\}$

Then $L_1 L_2$

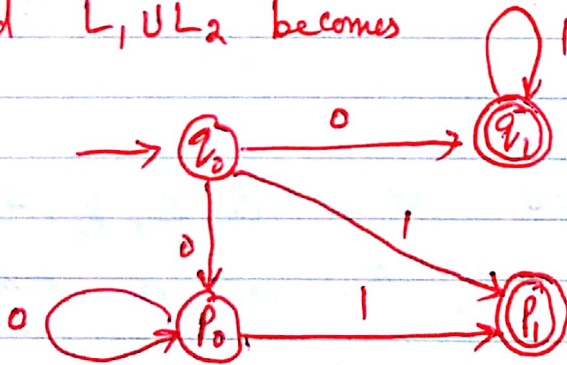


An NFA accepting $\{0\}^* \{1\}^* \{0\}^* \{1\}$

10 WEDNESDAY
ثلاثاء ٢٣

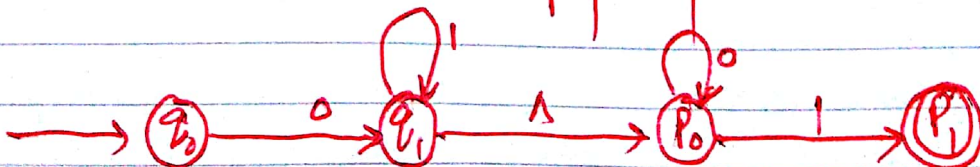
11 THURSDAY
الأربعاء ٢٤

and $L_1 \cup L_2$ becomes



An NFA accepting $\{0\}^* \{1\}^* \cup \{0\}^* \{1\}$

we can solve it simply by Δ transitions

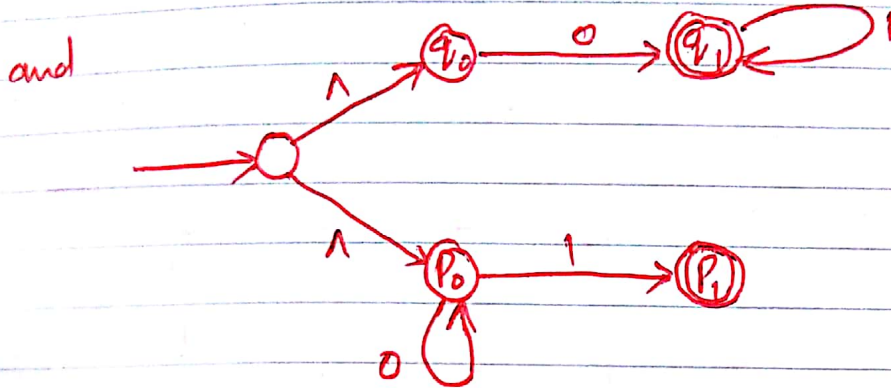


NFA- Δ accepting $0^* 1^* \cup 0^* 1$

MARCH						
M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

ربيع الاول ١٤٣١

MARCH 2010



NFA- Δ accepting $0^* \cup 0^*1$

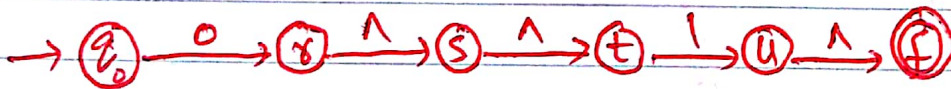
Definition

A NFA with Λ transition (NFA- Λ) is 5 tuple $(Q, \Sigma, q_0, A, \delta)$ where Q and Σ are finite sets $q_0 \in Q$, $A \subseteq Q$ and

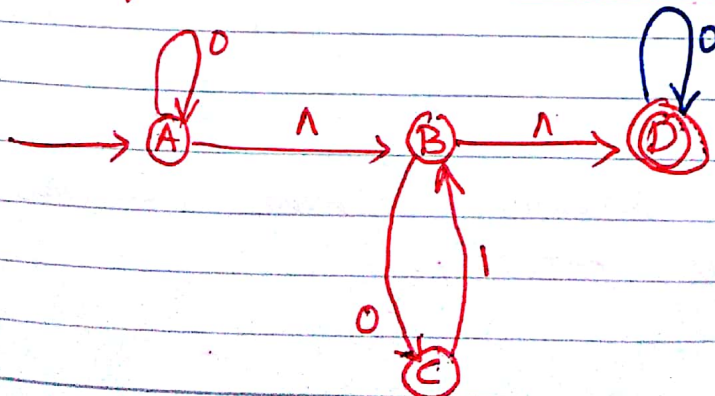
$$\delta: Q \times (\Sigma \cup \{\Lambda\}) \rightarrow 2^Q$$

FRIDAY	12
سبت ٢٥ ربيع الاول	
SUNDAY	14
اتوار ٢٢ ربيع الاول	
SATURDAY	13
جمعة ٢١ ربيع الاول	

Example for string '01'



Converting an NFA- Λ to an NFA



(a)

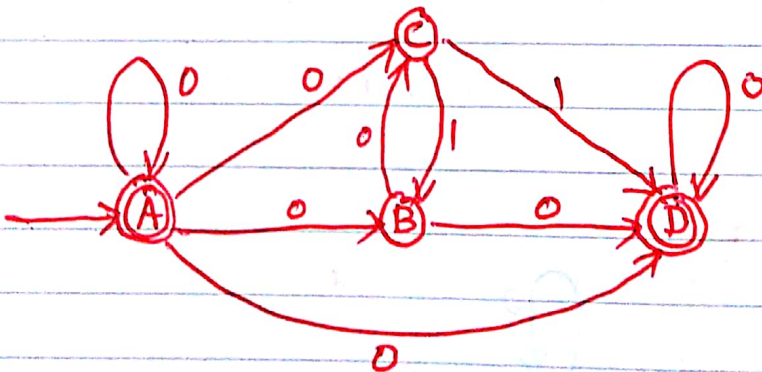
q	$\delta(q, 1)$	$\delta(q, 0)$	$\delta(q, 1)$
A	B	A	\emptyset
B	D	C	\emptyset
C	\emptyset	\emptyset	B
D	\emptyset	D	\emptyset

q	$\delta^*(q, 0)$	$\delta^*(q, 1)$
A	A, B, C, D	\emptyset
B	C, D	\emptyset
C	\emptyset	B, D
D	D	\emptyset

15 MONDAY
28 ربيع الاول

16 TUESDAY
29 ربيع الاول

Now NFA becomes



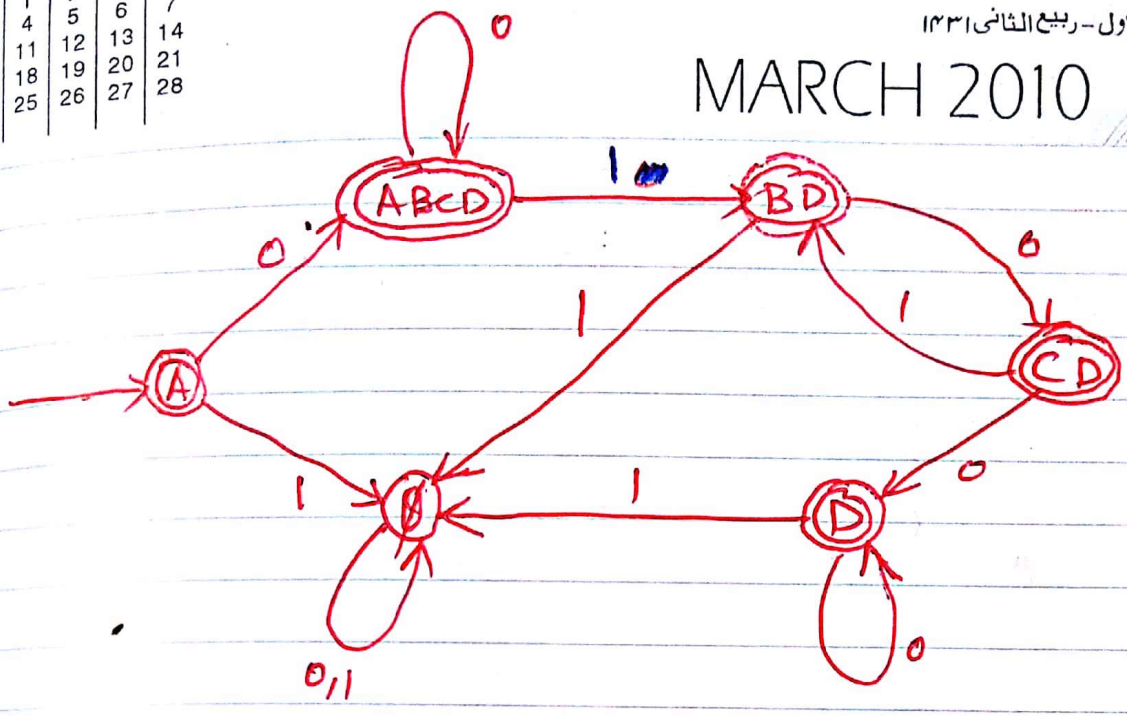
'A' becomes the final state, since A is minimum string in language

Now FA from previous procedure becomes as given in the next page.

MARCH				
T	W	T	F	S
2	3	4	5	6
9	10	11	12	13
16	17	18	19	20
23	24	25	26	27
30	31			

ربيع الاول - ربيع الثاني ١٤٣١

MARCH 2010



Definition (Λ -closure of a Set of states)

Let $M = \{Q, \Sigma, q_0, A, \delta\}$ be an NFA- Λ and let S be any subset of Q . The Λ -closure of S is the set $\Lambda(S)$ defined as follows.

1. Every element of S is an element of $\Lambda(S)$
2. for any $q \in \Lambda(S)$, every element $\delta(q, a)$ is in $\Lambda(S)$.
3. No other elements of Q are in $\Lambda(S)$.

Example

$$\delta^*(q_0, \Lambda) = \Lambda(\{q_0\}) = \{q_0, p, t\}$$

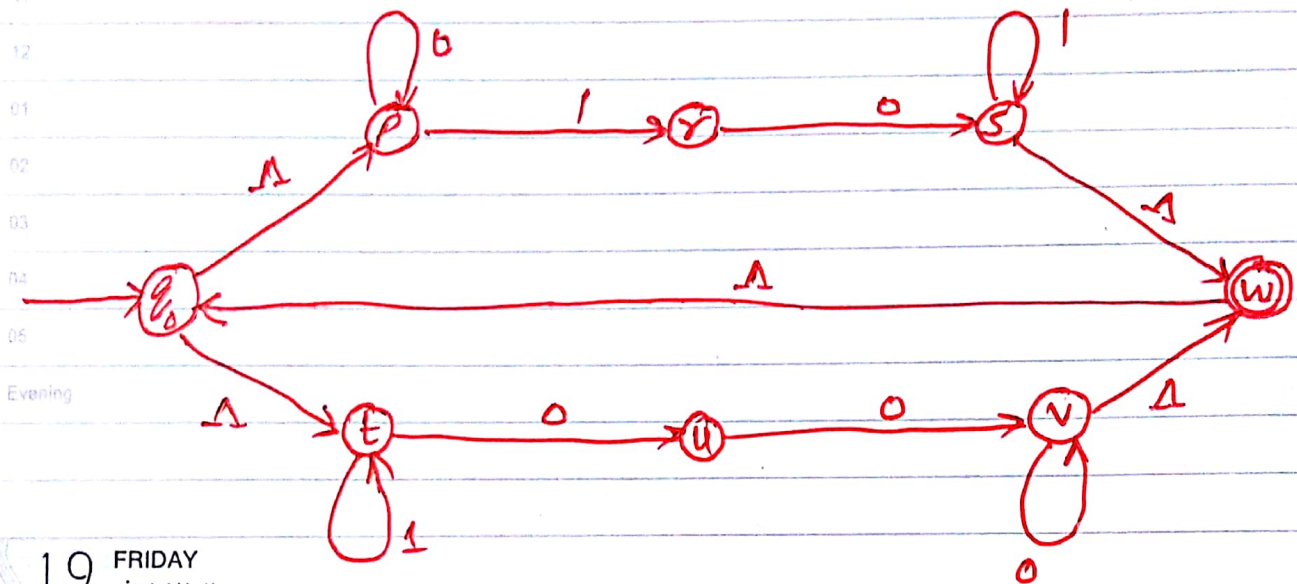
$$\delta^*(q_0, 0) = \Lambda\left(\bigcup_{p \in \delta^*(q_0, \Lambda)} \delta(p, 0)\right)$$

here, q is q-zero

MARCH						
M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

$$= \bigcap (\delta(q_0, 0) \cup \delta(p, 0) \cup \delta(t, 0))$$

$$= \bigcap (\emptyset \cup \{p\} \cup \{t\}) = \bigcap (\{p, t\}) = \{p, t\}$$



19 FRIDAY ربيع الثاني ٢

20 SATURDAY ربيع الثاني ٣ | 21 SUNDAY ربيع الثاني ٤

$$\delta^*(q_0, 01) = \bigcap \left(\bigcup_{p \in \delta^*(q_0, 0)} \delta(p, 1) \right)$$

$$= \bigcap (\delta(p, 1) \cup \delta(t, 1)) = \bigcap (\{\delta\}) = \{\delta\}$$

$$\delta^*(q_0, 010) = \bigcap \left(\bigcup_{p \in \delta^*(q_0, 01)} \delta(p, 0) \right)$$

$$= \bigcap (\delta(r, 0)) = \bigcap (\{s\}) = \{s, w, q_0, p, t\}$$

MARCH						
M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
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29	30	31				

KLEEN'S Theorem

- (i) - Every regular language has an FA
- (ii) - Every ~~language~~^{FA} has some language which is regular.

Regular languages are closed under Union, Concatenation and Kleen*

1. $\{L_1, FA_1\}$ and $\{L_2, FA_2\} \Rightarrow \{L_3, FA_3\}$
 such that $L_3 = L_1 \cup L_2$

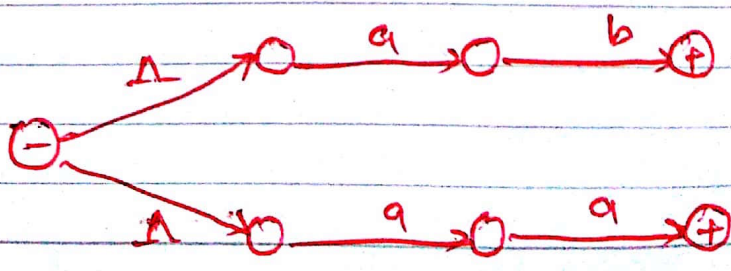
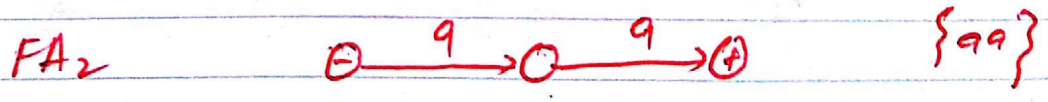
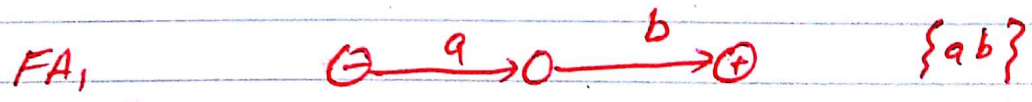
and $L_3 = \bigcirc$ or $L_1 L_2$

2. $\{L_1, FA_1\} \Rightarrow \{L_3, FA_3\}$
 where $L_3 = L_1^*$

MONDAY	22
٥ ربيع الثاني	
TUESDAY	23
٦ ربيع الثاني	

Example

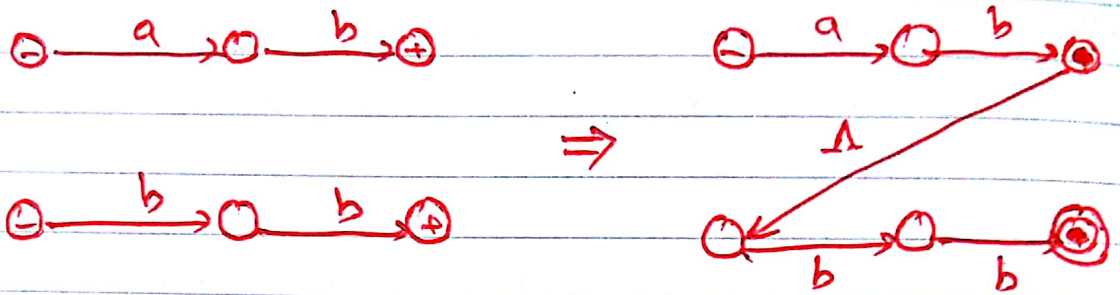
① $FA_1 \cup FA_2 = FA_3$



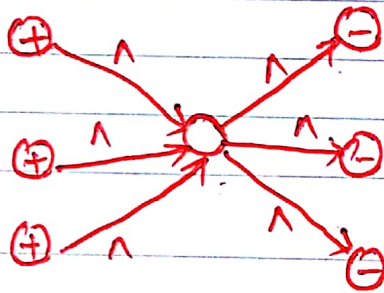
by adding another initial state with Λ transitions

MARCH						
M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

② $FA_1 \cup FA_2 = FA_3$



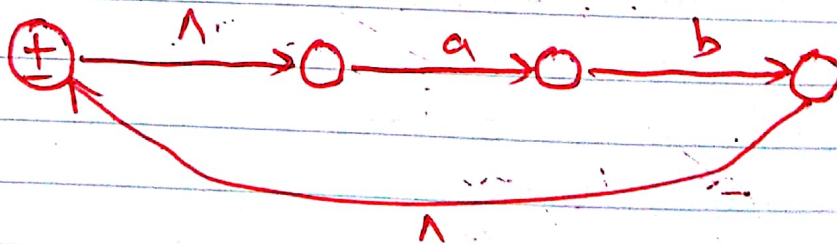
FA_1 FA_2



24 WEDNESDAY
٤ ربيع الثاني

25 THURSDAY
٨ ربيع الثاني

③ $(FA_1)^* = FA_3$

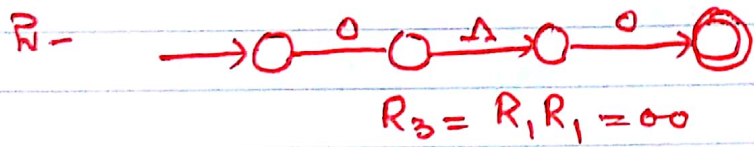
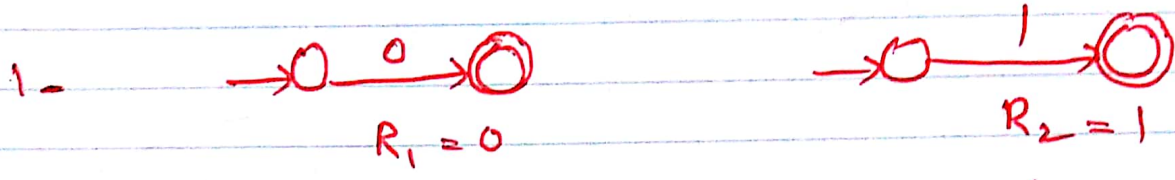


MARCH						
M	T	W	T	F	S	S
1	2	3	4	5	6	7
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15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

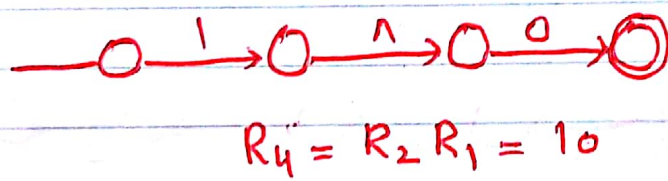
ربيع الثاني ١٤٣١

MARCH 2010

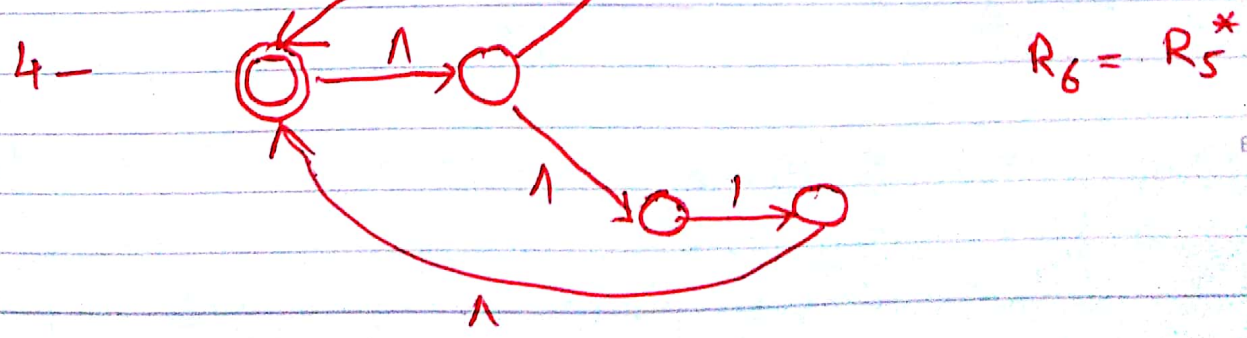
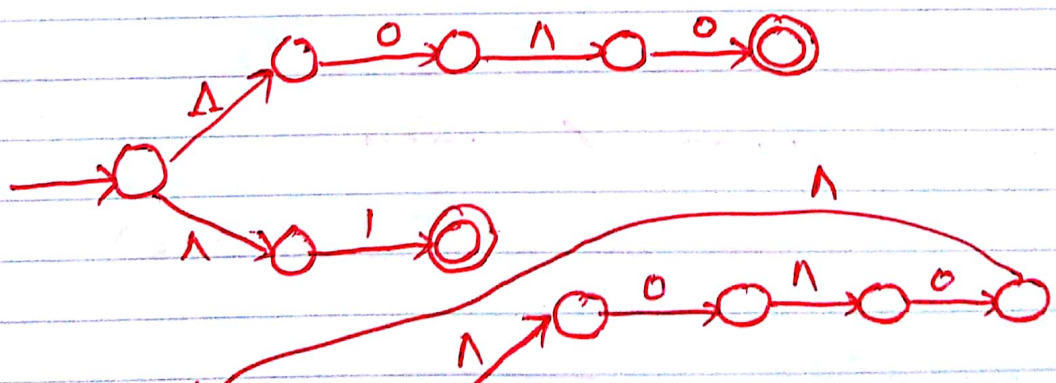
✓ Example (Building an NFA for a regular expression $(00+1)^*(10)^*$)



and



3 - $R_5 = R_3 + R_2$



FRIDAY 26
 ٩ ربيع الثاني
 SUNDAY 28 ١١ ربيع الثاني
 SATURDAY 27 ١٠ ربيع الثاني

Evening

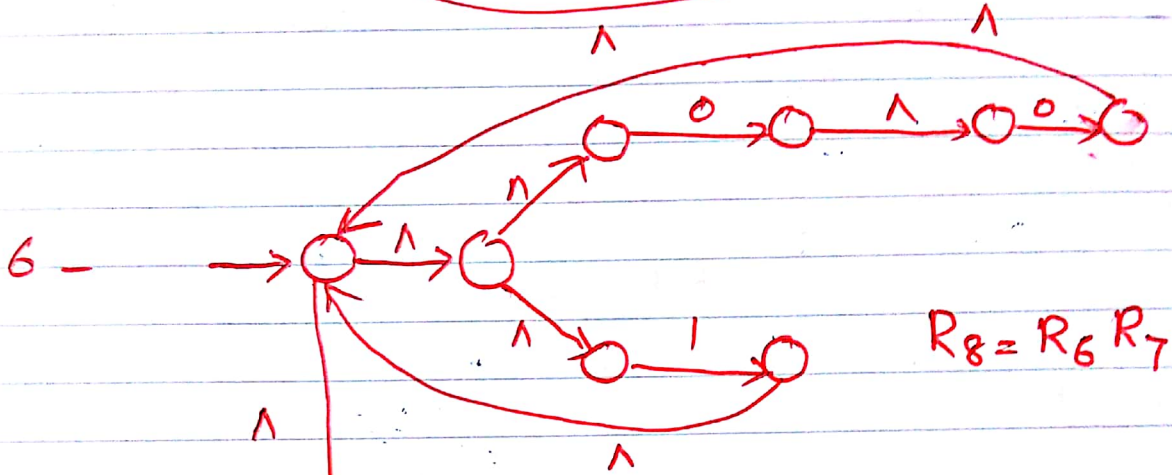
Evening

ربيع الثاني ١٤٣١

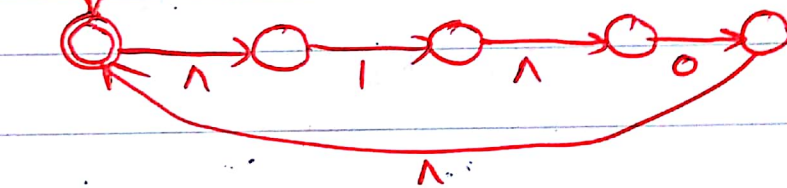
MARCH 2010

MARCH						
M	T	W	T	F	S	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
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29	30	31				

$$R_7 = R_4^*$$



$$R_8 = R_6 R_7$$



29 MONDAY
١٢ ربيع الثاني

30 TUESDAY
١٣ ربيع الثاني

This whole process then can be simplified through removing extra ' λ ' edges

(Can be seen in the book)