Theory Sec "3" - General

* Regular Expressions:
  is often described by means of an algebric expression called regular expression notations.

→ $\emptyset, \lambda, a \in \Sigma$ → primitive Regular expressions
→ if r_1 and r_2 are regular expression, so

$r_1 + r_2$, $r_1 . r_2$, r_1^* , (r_1)

* a string is a Regular Expression if and only if:
  it can be derived from the primitive regular expression by a finite number of rules.

* $L(r)$: language of Regular expression (r)

→ $L(\emptyset) = \emptyset$
→ $L(\lambda) = \{\lambda\}$
$L(a) = \{a\}$

* $L(r_1 + r_2) = L(r_1) \cup L(r_2)$
* $L(r_1 . r_2) = L(r_1) L(r_2)$
* $L(r_1^*) = (L(r_1))^*$
* $L((r_1)) = L(r_1)$

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① RE : $(a+b).a^*$

$$L((a+b).a^*) = L(a+b)\ L(a^*)$$
$$= (L(a) \cup L(b))\ L(a)^*$$
$$= (\{a\} \cup \{b\})\ (\{a\})^*$$
$$= \{a,b\}\ \{\lambda, a, aa, aaa \dots\}$$
$$= \{a, aa, aaa \dots, b, ba, baa \dots\}$$

② RE = $(a+b.c)^*$

$$L((a+b.c)^*) = (L(a) \cup L(b).L(c))^*$$
$$= (\{a\} \cup \{b\}\ \{c\})^*$$
$$= (\{a\} \cup \{bc\})^*$$
$$= \{a, bc\}^*$$
$$= \{\lambda, a, bc, aa, bca, abc \dots$$

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③ RE : $(0+10^*)$

$L(0+1.0^*) = L(0) \cup (L(1)\, L(0)^*)$

$= \{0\} \cup (\{1\}\ \{0\}^*)$

$= \{0\} \cup (\{1\}\ \{\lambda, 0, 00 \dots\})$

$= \{0\} \cup (\{1, 10, 100, 1000, \dots\})$

$= \{0, 1, 10, 100, 1000, \dots\}$

④ RE : $(0^* . 1 . 0^*)$

$L(0^* . 1 . 0^*) = L(0)^*\, L(1)\, L(0)^*$

$= \{0\}^*\ \{1\}\ \{0\}^*$

$= \{\lambda, 0, 00 \dots\}\ \{1\}\ \{\lambda, 0, 00, \dots\}$

$= \{1, 01, 001 \dots, 10, 010, \dots 0010 \dots\}$

$L = \{0^n 1 0^m,\ n, m \geq 0\}$

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(5) RE: $(a+b)^* abb$

$$L((a+b)^*.abb) = L((a+b)^*)\ L(abb)$$
$$= (L(a+b))^*\ L(abb)$$
$$= (L(a) \cup L(b))^*\ L(abb)$$
$$= (\{a\} \cup \{b\})^*\ \{abb\}$$
$$= (\{a,b\})^*\ \{abb\}$$
$$= \{\lambda, a, b, aa, ab, bb ...\}\ \{abb\}$$
$$= \{abb, aabb, aaabb, ababb, ...\}$$

L = set of strings a's and b's end with (abb)

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(6) RE : $(aa)^* (bb)^* b$

$L((aa)^* . (bb)^* . b) =$

$= L(aa)^* L(bb)^* L(b)$

$= \{aa\}^* \{bb\}^* \{b\}$

$= \{\lambda, aa, aaaa ..\} \{\lambda, bb, bbbb, ..\} \{b\}$

$= \{b, aab, aaaab, bbb, aabbb ...\}$

$L = \{a^{2n} b^{2m} b ; n, m \geq 0\}$

OR

language Contains even number of a's followed by odd number of b's

⑦ RE: $(aa+ab+ba+bb)^*$

$L((aa+ab+ba+bb))^* =$

$= (L(aa) \cup L(ab) \cup L(ba) \cup L(bb))^*$

$= (\{aa\} \cup \{ab\} \cup \{ba\} \cup \{bb\})^*$

$= \{aa, ab, ba, bb\}^*$

$= \{\lambda, aa, ab, ba, bb, aaab, aaba, \dots\}$

⑧ RE: $(0+\lambda) \cdot (1+\lambda)$

$L((0+\lambda) \cdot (1+\lambda)) =$

$= L(0+\lambda)\, L(1+\lambda)$

$= (L(0) \cup L(\lambda))\, (L(1) \cup L(\lambda))$

$= (\{0\} \cup \{\lambda\})\, (\{1\} \cup \{\lambda\})$

$= \{0, \lambda\}\, \{1, \lambda\}$

$= \{01, 0, 1, \lambda\}$

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(9) write a regular expression for the language accepts all string which are starting with 1 and ending with 0.

$R = 1.(1+0)^*.0$

(10) write a regular expression for the language starting and ending with a and having any number of b's in between.

$R = a.b^*.a$

(11) write a regular expression of the language, all the string any number of a's followed by any number of b's followed by any number of c's.

$R = a^*b^*c^*$

(12) write a regular ~~language~~ expression for language $\Sigma = \{0\}$ having even number of 0's.

$R = (00)^*$

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(13) R.E : $(b^* . (aaa)^* . b^*)^*$

$L(b^*.(aaa)^*.b^*)^* =$

$= (L(b)^* \; L(aaa)^* \; L(b)^*)^*$

$= (\{b\}^* \; \{aaa\}^* \; \{b\}^*)^*$

$= (\{\lambda, b, bb ...\} \{\lambda, aaa, aaaaaa, ...\} \{\lambda, b, bb, ..\})^*$

language Contains a^{3n} and any number of b's

$L = \{ b^m a^{3n} b^j ; m, n, j \geq 0 \}$

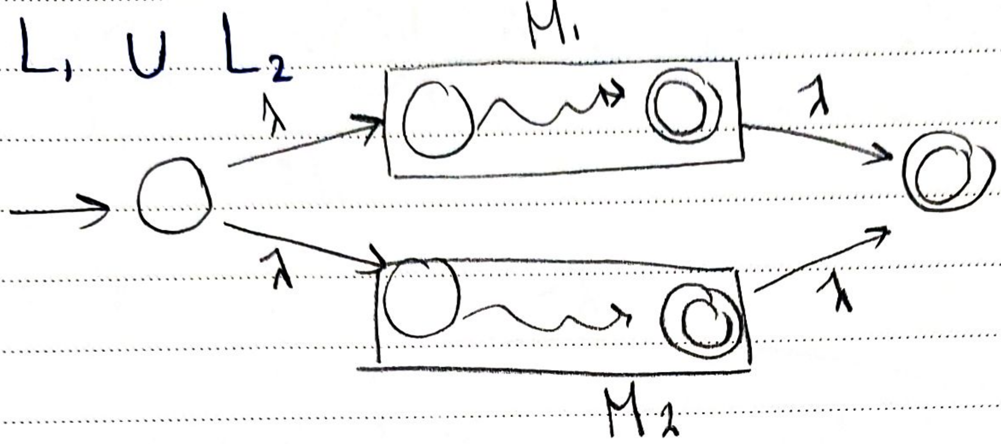
(14) write the regular expression for the language such that the string doesn't Contain (01)

$L = \{\lambda, 0, 1, 00, 11, 10, 100, 1011 ---\}$

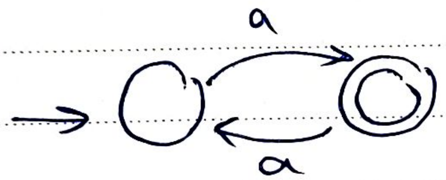
$RE = (1^* 0^*)$

* Convert from Regular Expression to NFA:

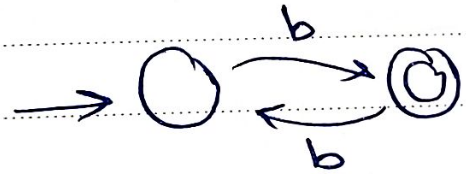
→ $L_1 \cup L_2$



Ex:

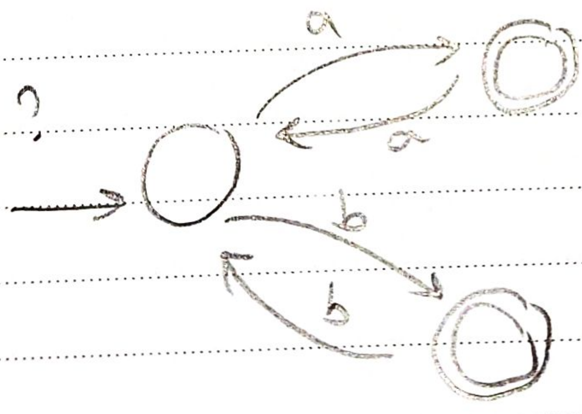


$A = \{a^n \mid n \text{ is odd}\}$



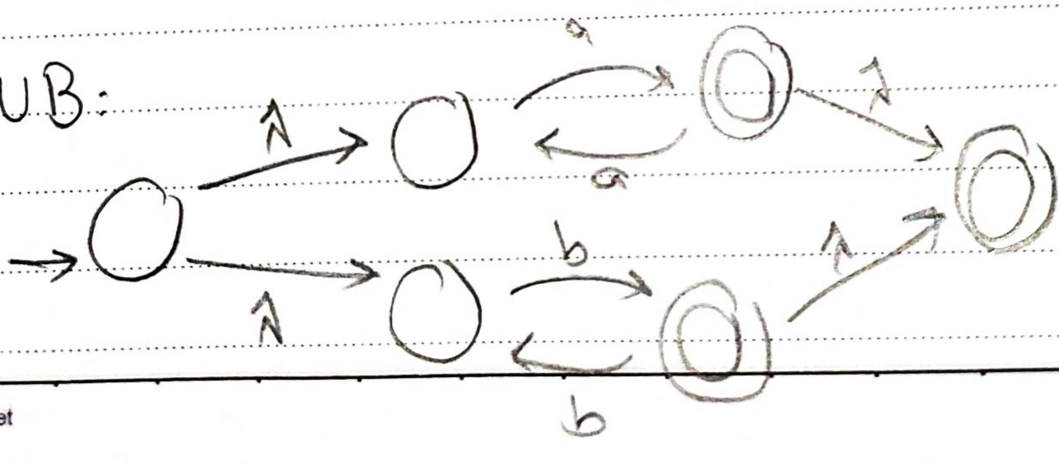
$B = \{b^n \mid n \text{ is odd}\}$

$A \cup B$?

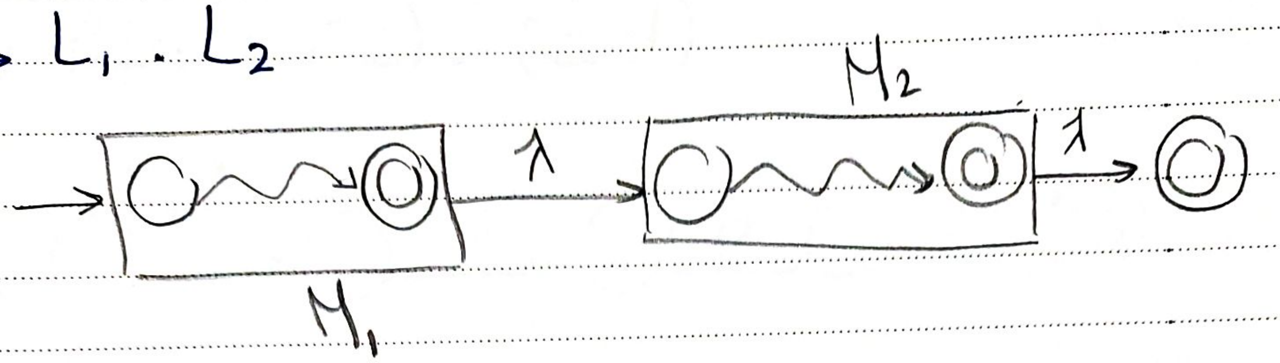


No X
this accepts aab

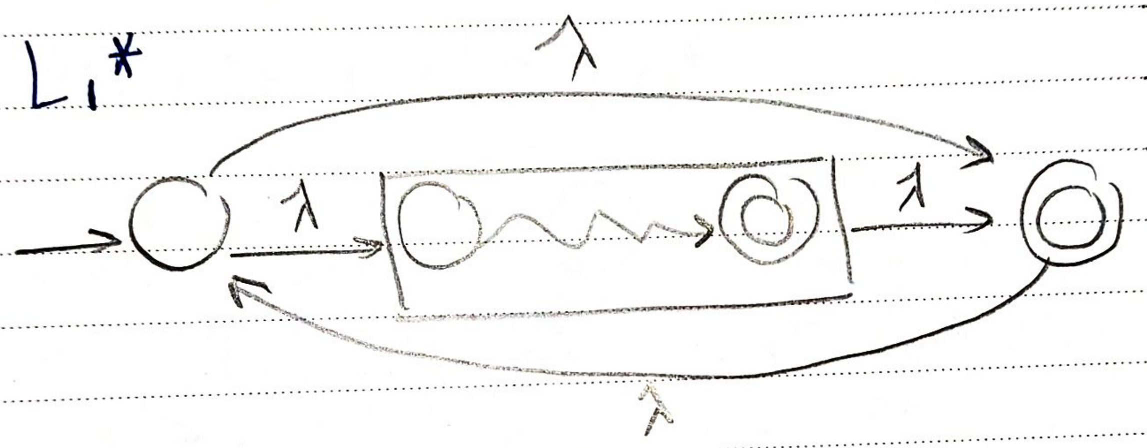
$A \cup B$:



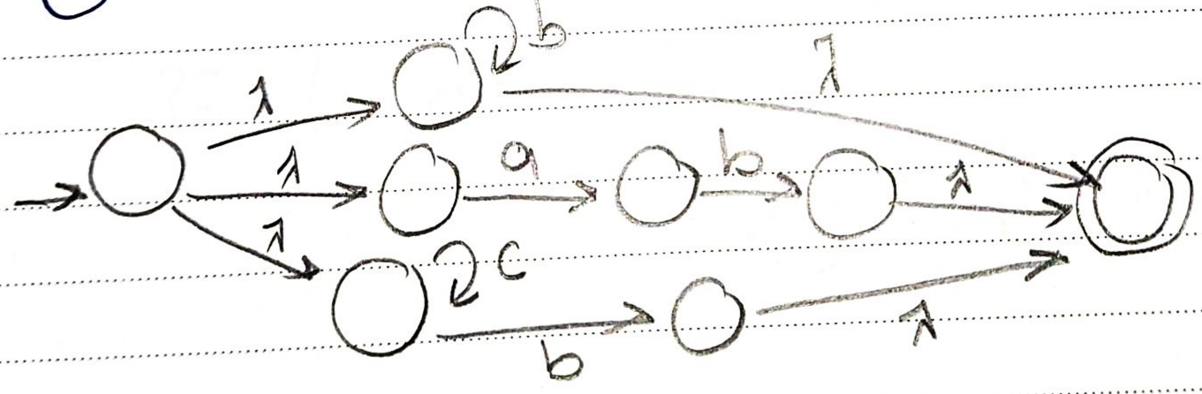
→ $L_1 . L_2$



→ L_1^*



① RE: $b^* + ab + c^*b$



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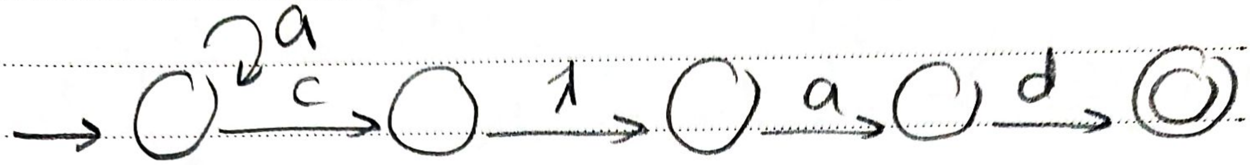
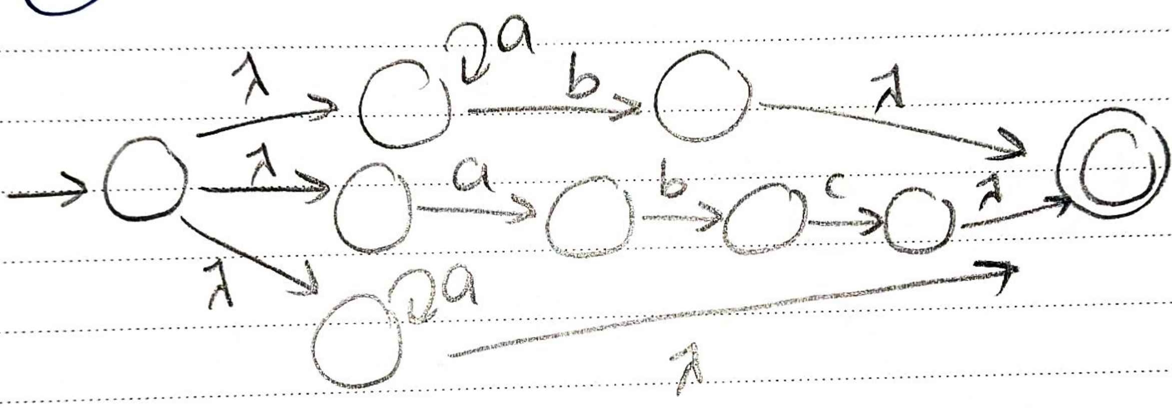
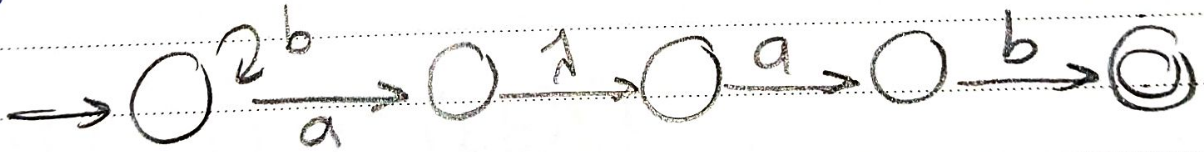
② RE: $(a^*c) \cdot (ad)$



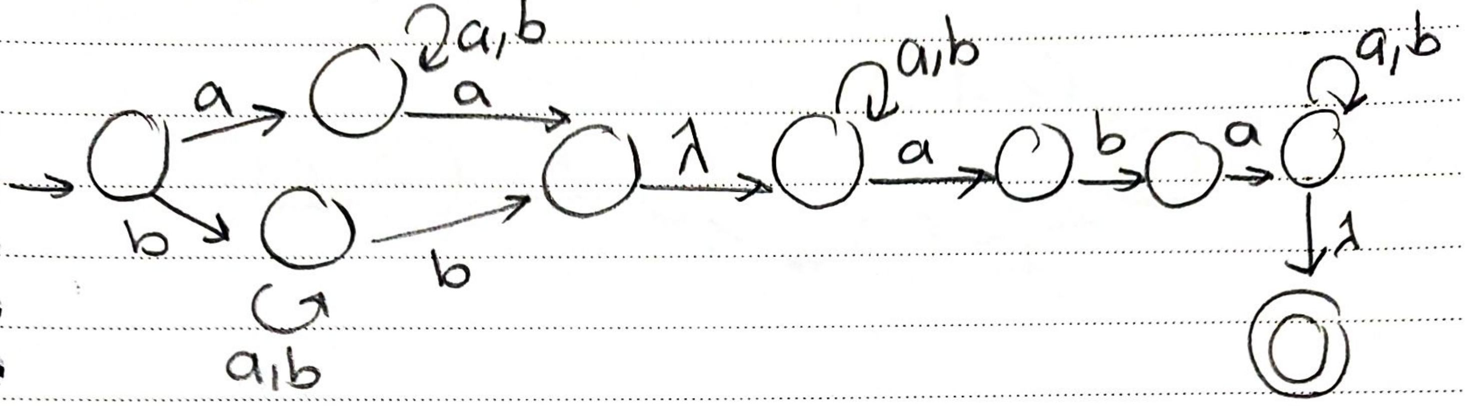
③ RE: $a^*b + abc + a^*$



④ RE = $(b^*a) \cdot (ab)$



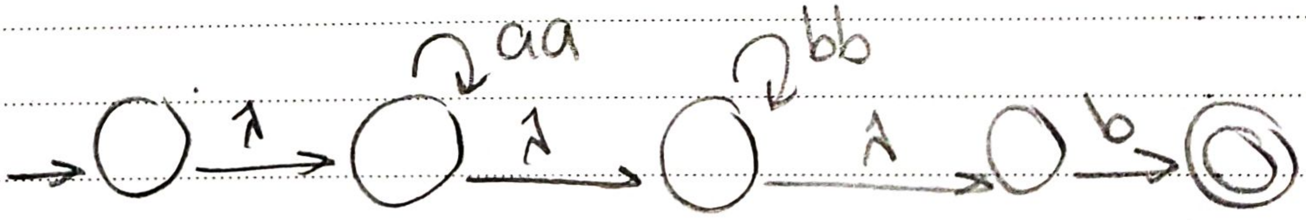
(5) RE: $(a(a+b)^*a + b(a+b)^*b).((a+b)^*aba(a+b)^*)$



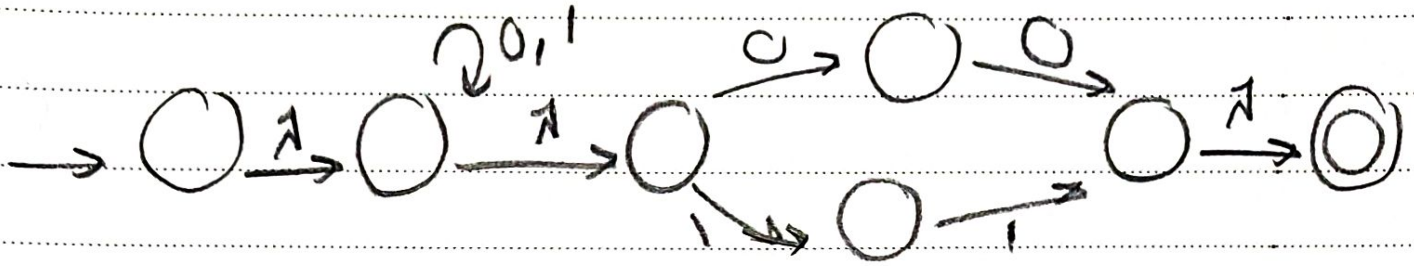
(6) RE: $a(a+b)^*.ab$

(7) RE: $(0+1)^*\,1\,(0+1)^*$

(8) RE: $(aa)^*(bb)^*b$



9) RE: $(0+1)^* . (00+11)$



10) RE: $(a^* + b^*)$