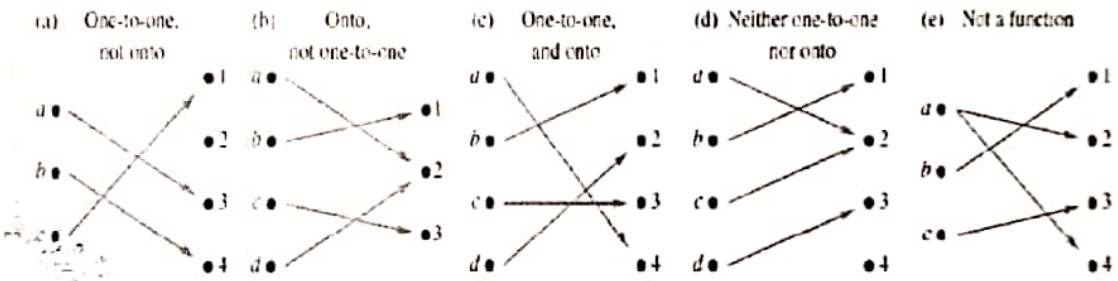
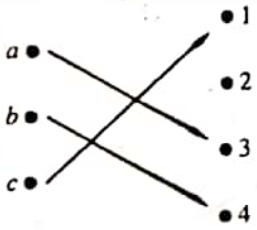
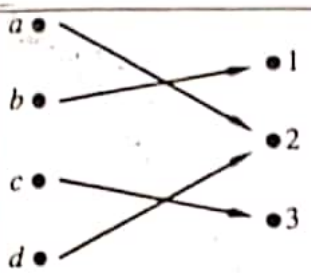
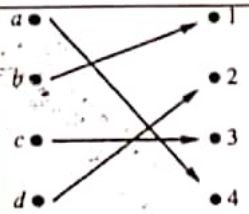
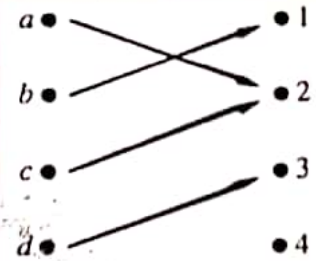
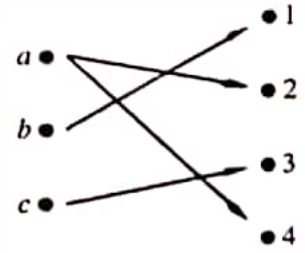
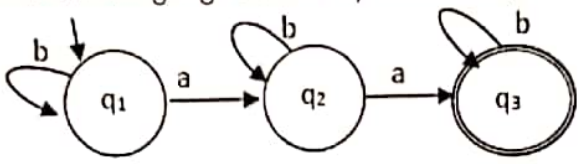
	Automata - Revision (1) - 2020 - Set Operations	
١.	Example(1) Let: U = { a,b,c,d,e,f,g,h,i,j}, A = {a,b,c}, B = {a,f,g}, C = {h,i,f}, Find: • A U B = {a,b,c,f,g} • A ∩ C = {} • A -B = {b, c} • A' U B'={d,e,f,g,h,i,j } U {b,c,d,e,h,i,j} = {b,c,d,e,f,g,h,i,j } • (A U B) ' = {d,e,h,i,j} • |B| = 3, |U| = 10 • P(A) = { Φ , {a}, {b}, {c}, {a,b}, {a,c}, {b,c}, {a,b,c}}, $\|P(A)\| = 8 = 23 = 2^{\|A\|}$	
٢.	Example(2) Find the Cardinality for: ١. Φ = null = 0 ٢. {a, b} = 2 ٣. {1,2,3,4,5,6} = 6 ٤. {Φ} = 1 ٥. {{}} = 1	
٣.	Let the set A is {1, 2, 3} and B is {2, 3, 4}. Then the number of elements in A U B is? a) 4 b) 5 c) 6 d) 7	A
٤.	Let the set A is {1, 2, 3} and B is {2, 3, 4}. Then number of elements in A ∩ B is? a) 1 b) 2 c) 3 d) 4	B
٥.	The intersection of the sets {1, 2, 5} and {1, 2, 6} is the set _____ a) {1, 2} b) {5, 6} c) {2, 5} d) {1, 6}	A
٦.	Two sets are called disjoint if there _____ is the empty set. a) Union b) Difference c) Intersection d) Complement	C
٧.	Which of the following two sets are disjoint? a) {1, 3, 5} and {1, 3, 6} b) {1, 2, 3} and {1, 2, 3} c) {1, 3, 5} and {2, 3, 4} d) {1, 3, 5} and {2, 4, 6}	D

٨.	The difference of {1, 2, 3} and {1, 2, 5} is the set _____ a) {1} b) {5} c) {3} d) {2}	C
٩.	The complement of the set A is _____ a) A – B b) U – A c) A – U d) B – A	B
١٠.	What is the Cardinality of the Power set of the set {0, 1, 2}? a) 8 b) 6 c) 7	A
١١.	7. If A is {{Φ}, {Φ, {Φ}}}, then the power set of A has how many element? a) 2 b) 4 c) 6 d) 8	B
١٢.	Example (3):  	
١٣.	 a. onto b. into c. one to one d. one one onto	C

١٤.	 a. onto b. into c. one to one d. one one onto	A
١٥.	 A. bijective B. injective C. surjective D. composite function	A
١٦.	 A. bijective B. injective C. surjective D. Not bijective	D
١٧.	 A. bijective B. injective C. surjective D. Not a function	D

١٨.	Surjective function is also called _____. A. onto B. into C. one to one D. one one onto	A
١٩.	One to one onto function is also called _____. A. bijective B. injective C. surjective D. composite function	A
٢٠.	Suppose there are 50 people in a room. Then, at least how many people must have their birthday in the same month? a. 50/12 b. 12/50 c. 5 d. 4	C
٢١.	Let A = {0; 1; 2; 3} and R a relation over A: R = {(0; 0); (0; 1); (0; 3); (1; 1); (1; 0); (2; 3); (3; 3)} a. R is reflexive, not symmetric, and not transitive b. R is not reflexive, not symmetric, and transitive c. R is not reflexive, symmetric, and not transitive d. R is not reflexive, not symmetric, and not transitive	B
٢٢.	Let f(x) = 2x + 3 and g(x) = 3x + 2 be functions on N. What is (g o f)(x)? a. (g o f) (x) = 6x + 11. b. (g o f) (x) = 6x + 7. c. (g o f) (x) = 5x + 5. d. (g o f) (x) = 6x + 5.	A
٢٣.	Let L={a,b,c} , w=abb and u=bcaa, Find wu a. abbbcaa b. bcaaabb c. abb+bcaa d. bcaa+abb	A
٢٤.	Let L={a,b,c} , w=abb and u=bcaa, Find |wu| a. 7 b. 3 c. 4	A
٢٥.	Let L={a,b,c} , w=abb and u=bcaa, Find $(wu)^r$ a. abbbcaa b. bcaaabb c. aacbbba d. bcaa+abb	C
٢٦.	If A = {a, ba}, which of the following strings is NOT in A^*: a. bb	A

	b. λ c. aa d. baa	
٢٧.	If Σ = {ab, c}, u = abcc and v = cab, then , |u2 v| equals a. 11 b. 8 c. 7 d. 5	A
٢٨.	What is the language defined by the following DFA:  a. {babab} b. {bn a bn a bn, n)0} c. {bn a bm a, m,n)0} d. {bn a bm a bk, m,n,k)0}	
	Automata – Revision (1) – 2020 – Regular Expression	
٢٩.	Which of the following does not represents the given language? Language: {0,01} a) 0+01 b) {0} U {01} c) {0} U {0}{1} d) {0} {01}	D
٣٠.	According to the given language, which among the following expressions does it correspond to? Language L={x {0,1}|x is of length 4 or less} a)$(0+1+0+1+0+1+0+1)^4$ b)$(0+1)^4$ c)$(01)^4$ d) $(0+1+\varepsilon)^4$	D
٣١.	Which among the following looks similar to the given expression? ((0+1). (0+1)) * a) {x {0,1} *|x is all binary number with even length} b) {x {0,1} |x is all binary number with even length} c) {x {0,1} *|x is all binary number with odd length} d) {x {0,1} |x is all binary number with odd length}	A
٣٢.	Concatenation Operation refers to which of the following set operations: a) Union b) Dot c) Kleene d) Two of the options are correct	B
٣٣.	Concatenation of R with Φ outputs: a) R b) Φ	B

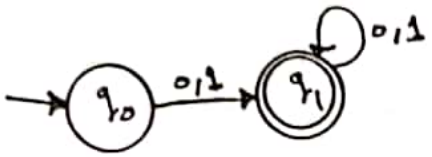
	c) R.Φ d) None of the mentioned	
٣٤.	RR* can be expressed in which of the forms: a) R^+ b) R^- c) $R^+ \cup R^-$ d) R	A
٣٥.	Which among the following are incorrect regular identities? a) εR=R b) ε*=ε c) Φ*=ε d) RΦ=R	D
٣٦.	(0+ε) (1+ε) represents a) {0, 1, 01, ε} b) {0, 1, ε} c) {0, 1, 01 ,11, 00, 10, ε} d) {0, 1}	A
٣٧.	Regular Expression R and the language it describes can be represented as: a) R, R(L) b) L(R), R(L) c) R, L(R) d) All of the mentioned	C
٣٨.	Let for [= {0,1} R= ([[[) *, the language of R would be a) {w | w is a string of odd length} b) {w | w is a string of length multiple of 3} c) {w | w is a string of length 3} d) All of the mentioned	B
٣٩.	If [= {0,1}, then Φ* will result to: a) ε b) Φ c) [d) None of the mentioned	A
٤٠.	The finite automata accept the following languages: a) Context Free Languages b) Context Sensitive Languages c) Regular Languages d) All the mentioned	C
٤١.	Which of the following regular expressions represents the set of strings which do not contain a substring 'rt' if [= {r, t} a) (rt)* b) (tr)*	D

	c) (r^*t^*) d) (t^*r^*)	
٤٢.	Regular expression for all strings starts with ab and ends with bba is. a) aba*b*bba b) ab(ab)*bba c) ab(a+b)*bba d) All of the mentioned	C
٤٣.	There are _____ tuples in finite state machine. a) 4 b) 5 c) 6 d) unlimited	B

Construct the following DFA:

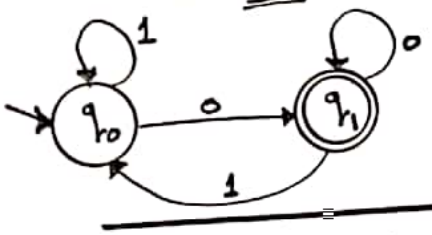
(1) The DFA that accepts the language $L=\{w \in \{0,1\}^+\}$.

Ans.



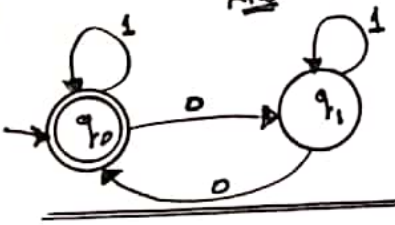
(2) The DFA that accepts the language $L=\{w \in \{0,1\}^* : w$ ends with $0\}$.

Ans.



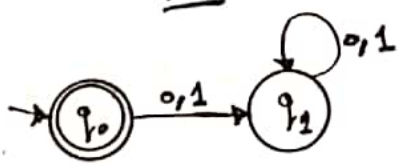
(3) The DFA that accepts the language $L=\{w \in \{0,1\}^* : w$ with even number of 0's$\}$.

Ans.



(4) The DFA that accepts the language $L=\{\varepsilon\}$

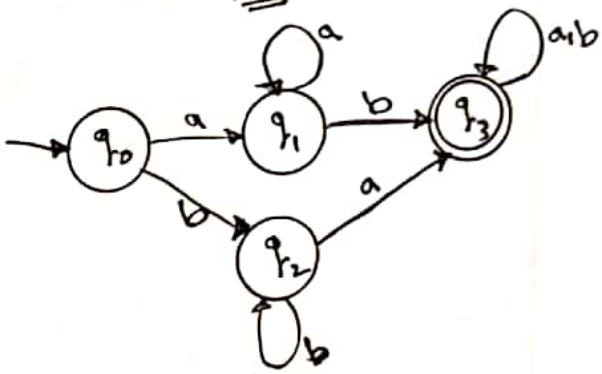
Ans.



(VI) Design a DFA and state its Formal description that accept the following languages :-

(1) The language that contain all strings in the alphabet $\{a,b\}^*$ which contain the substring "ab" or "ba*".

Ans.

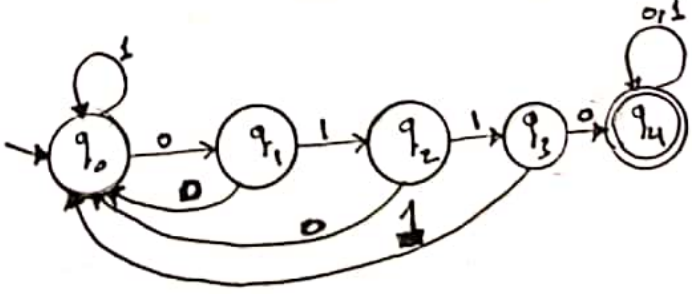


* Formal description :-

δ	a	b
q_0	q_1	q_2
q_1	q_1	q_3
q_2	q_3	q_2
q_3	q_3	q_3

(2) The language that contain all the strings in the alphabet $\{0,1\}^*$ which contains "0110" as substring

Ans.

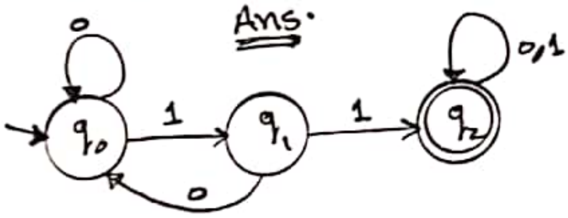


...mal description :-

δ	0	1
q_0	q_1	q_0
q_1	q_0	q_2
q_2	q_0	q_3
q_3	q_4	q_0
q_4	q_4	q_4

(3) The Language that contain all the strings in the alphabet $\{0,1\}^*$ which contain at least two consecutive 1's .

Ans.

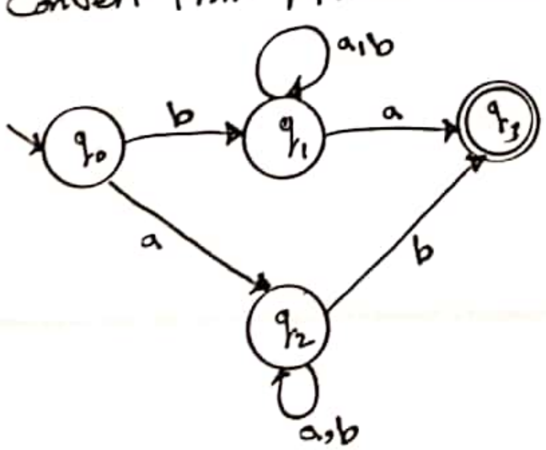


* The formal description :-

δ	0	1
q_0	q_0	q_1
q_1	q_0	q_2
q_2	q_2	q_2

NFA & Convert NFA to DFA

* Ex : Convert From NFA to DFA :-



Ans.

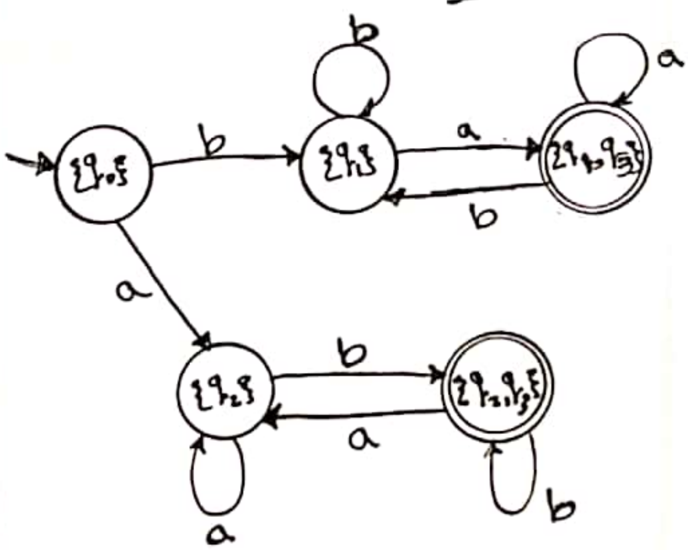
*الخطوة الأولى :-

δ	a	b
q_0	$\{q_2\}$	$\{q_1\}$
q_1	$\{q_1, q_3\}$	$\{q_1\}$
q_2	$\{q_2\}$	$\{q_2, q_3\}$
q_3	Φ	Φ

*الخطوة الثانية :-

δ	a	b
start → $\{q_0\}$	$\{q_2\}$	$\{q_1\}$
$\{q_2\}$	$\{q_2\}$	$\{q_2, q_3\}$
$\{q_1\}$	$\{q_1, q_3\}$	$\{q_1\}$
$\{q_2, q_3\}$	$\{q_2\}$	$\{q_2, q_3\}$
$\{q_1, q_3\}$	$\{q_1, q_3\}$	$\{q_1\}$

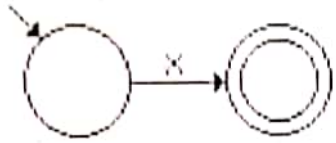
*الخطوة الثالثة :-



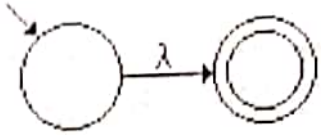
*لازم نحدد ال final state :-

ال state اللي فيها q_3 تبقى Final.

- **From Primitive Regular Expressions to NFAs**



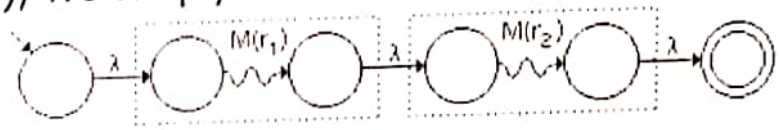
nfa for x



nfa for λ

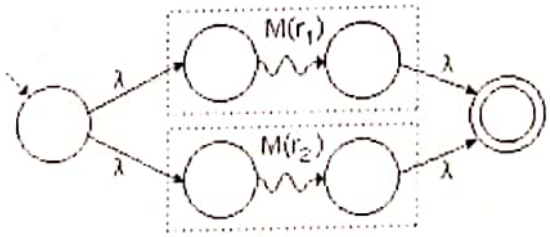
nfa for ∅

- **From Regular Expressions to NFAs**
  - For **concatenation** (strings in L(r1) followed by strings in L(r2), we simply chain the NFAs together, as shown.



nfa for $r_1 r_2$

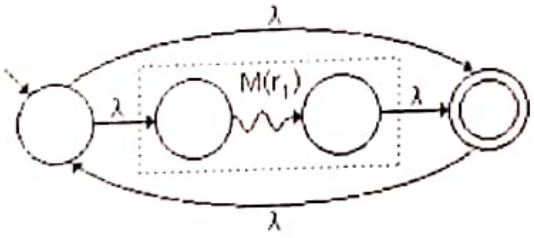
  - The + denotes "**or**" in a regular expression, so it makes sense that we would use an NFA with a choice of paths. (This is one of the reasons that it's easier to build an NFA than a DFA.)



nfa for $r_1 + r_2$

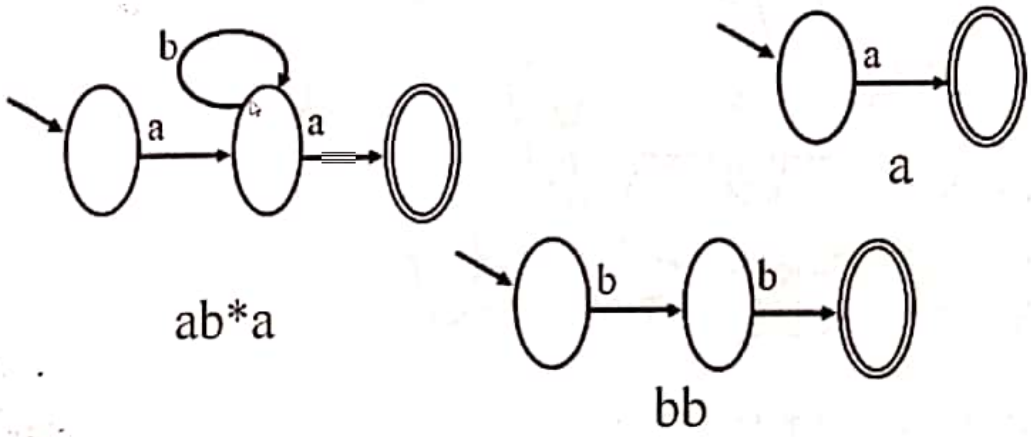
- The **star** denotes zero or more applications of the regular expression, so we need to set up a loop in the NFA.

  We can do this with a backward-pointing and a forward-pointing λ arc to bypass the NFA entirely.



nfa for r_1^*

- **Example**
- Construct an NFA equivalent to the regular expression (show all steps clearly): "ab*a + (a + bb)*"



- **Example**
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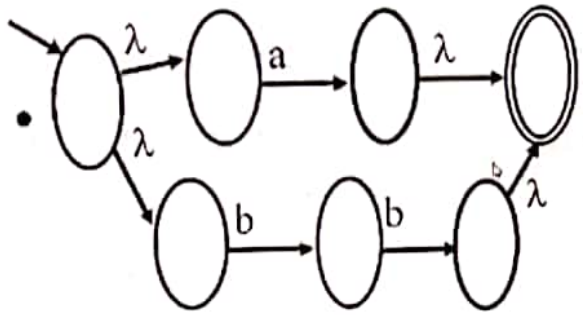
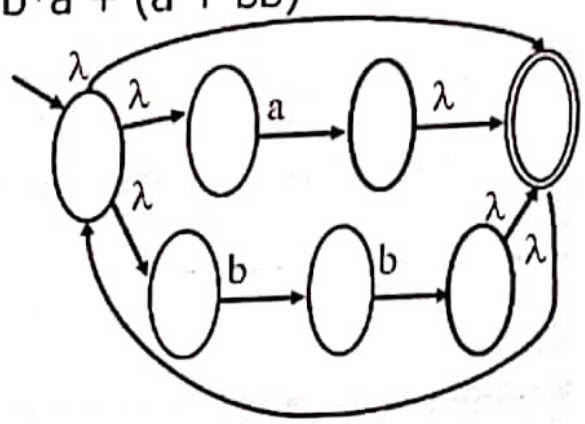


a + bb



(a + bb)*

- **Example**
- Construct an NFA equivalent to the regular expression (show all steps clearly): "ab*a + (a + bb)*"