

## Lecture Four

### Finite Automata (FA)

#### What is Automata?

The term "Automata" is derived from the Greek word "αὐτόματα" which means "self-acting".

Automation "الأتمتة" تدل على التنفيذ التلقائي لعمليات معينة وتوليد نتيجة لهذه العمليات.






An automaton with a finite number of states is called a *Finite Automaton (FA)* or *Finite State Machine (FSM)*.

Finite State Machine (FSM) هي عبارة عن نموذج لجهاز احتسابي بسيط Computational Device تمتلك هذه الاجهزة حجماً صغيراً جداً من الذاكرة و يعالج مدخلاته بصورة مباشرة تعني بهذا أن الجهاز يقرأ رمزاً واحداً خلال وحدة الزمن ويقوم بمعالجته.

- There are two Type of Finite State Machine (FSM):
  - 1- Deterministic Finite Automaton(DFA)
  - 2- Non- deterministic Finite Automaton(NFA)

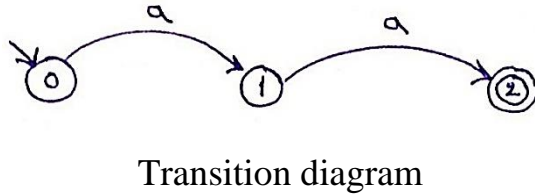
A finite automaton is a collection of three things:

- 1- A finite set of states, one of which is designated as the initial state, called the *start state*, and some of which are designated as *final states*.
- 2- An alphabet  $\Sigma$  of possible input letters, from which are formed strings, that are to be read one letter at a time.
- 3- A finite set of *transitions* that tell for each state and for each letter of the input alphabet which state to go to next.

- 1- Start state denoted by  or 
- 2- Final state denoted by  or  or 
- 3- There is one letter input per connection at a time.

**Example:** Draw Finite Automata (FA) transition diagram and transition table for the following Regular Expressions (RE).

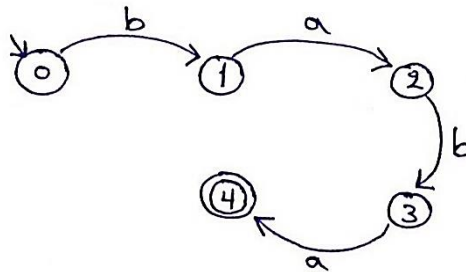
1- aa



Transition Table

	a
0	{1}
1	{2}
2	—

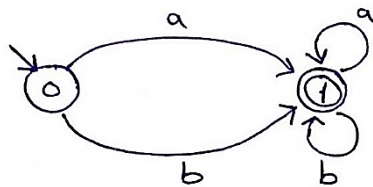
2- baba



Transition Table

	a	b
0	—	{1}
1	{2}	—
2	—	{3}
3	{4}	—
4	—	—

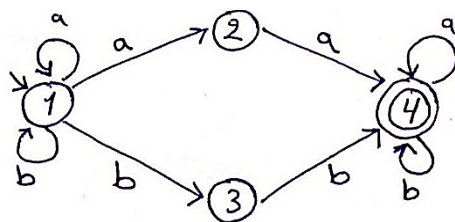
3-  $(a + b)(a + b)^* \equiv (a + b)^+$



Transition Table

	a	b
0	{1}	{1}
1	{1}	{1}

4-  $(a + b)^* (aa + bb) (a + b)^*$



Transition Table

	a	b
1	{1, 2}	{1, 3}
2	{4}	—
3	—	{4}
4	{4}	{4}

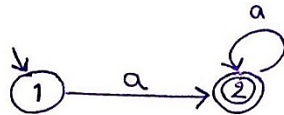
5-  $(a + b)^*$



Transition Table

	a	b
S	{S}	{S}

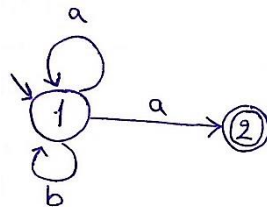
6-  $aa^*$



Transition Table

	a
1	{2}
2	{2}

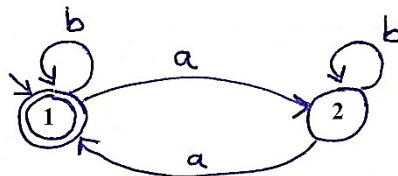
7-  $(a + b)^*a$



Transition Table

	a	b
1	{1, 2}	{1, 2}
2	-	-

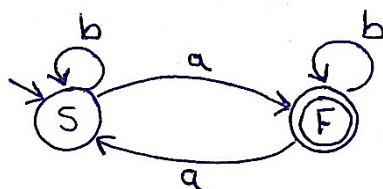
8- {a is even number}



Transition Table

	a	b
1	{2}	{1}
2	{1}	{2}

9- {a is odd number}



Transition Table

	a	b
S	{F}	{S}
F	{S}	{F}

**Homework:** Draw Finite Automata (FA) transition diagram for the following Regular Expressions (RE).

1-  $\Lambda$

2-  $(a + b)^*aa(a + b)^*$

3-  $a(aa)^*$

4-  $a(a + b)^*a$

5-  $(a + b)^*abb$