Q1. Factorial is the product of all positive integers less than or equal to a given positive integer and denoted by that integer and an exclamation point. Define the factorial in aspects of the following Automata Methods/Languages.

i. Recursive Language   ii. Descriptive Language

- **Defining the language $\{a^n b^n\}$, n=1,2,3,… , of strings defined over Σ={a,b}**

Step 1:

   ab is in $\{a^n b^n\}$

Step 2:

   if x is in $\{a^n b^n\}$, then axb is in $\{a^n b^n\}$

Step 3:

        No strings except those constructed in above, are allowed to be in $\{a^n b^n\}$

Descriptive Language

- Example: The language **factorial**, of strings defined over $\Sigma=\{1,2,3,4,5,6,7,8,9\}$ *i.e.*

  $\{1,2,6,24,120,\ldots\}$

- Example: The language **FACTORIAL**, of strings defined over $\Sigma=\{a\}$, as

  $\{a^{n!} : n=1,2,3,\ldots\}$, can be written as

  $\{a,aa,aaaaaa,\ldots\}$. It is to be noted that the language FACTORIAL can be defined over any single letter alphabet.

The Language ODD LENGTH defined over $\Sigma = \{a, b\}$, can be written as
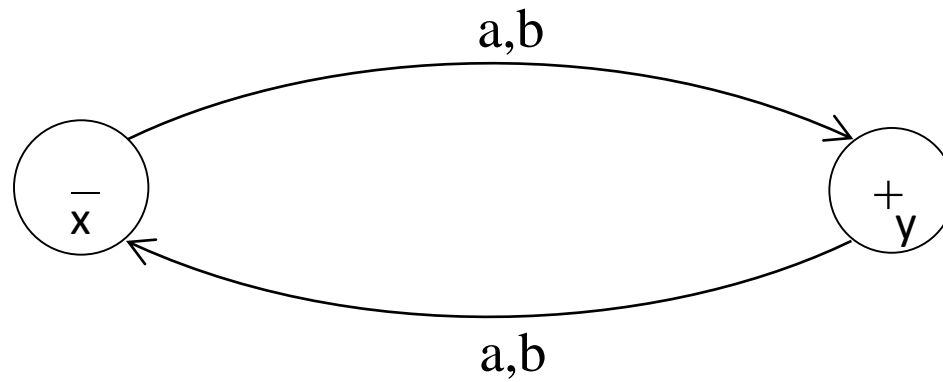$$L = \{\lambda, a, b, aaa, aab, baa, bab, bbb, \ldots\}$$
Define the following methods/languages on the above given descriptive language.

i. Regular Expression
ii. FA: Transition Diagram
iii. FA: Transition Table

- Now consider another language L, of odd length, defined over Σ = {a, b}, then it's regular expression may be

$(a+b)((a+b)(a+b))^*$ or

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

FA: Transition Diagram

FA Transition Table

OLD STATE	NEW STATE	
	Reading a	Reading b
X	Y	Y
Y	X	X