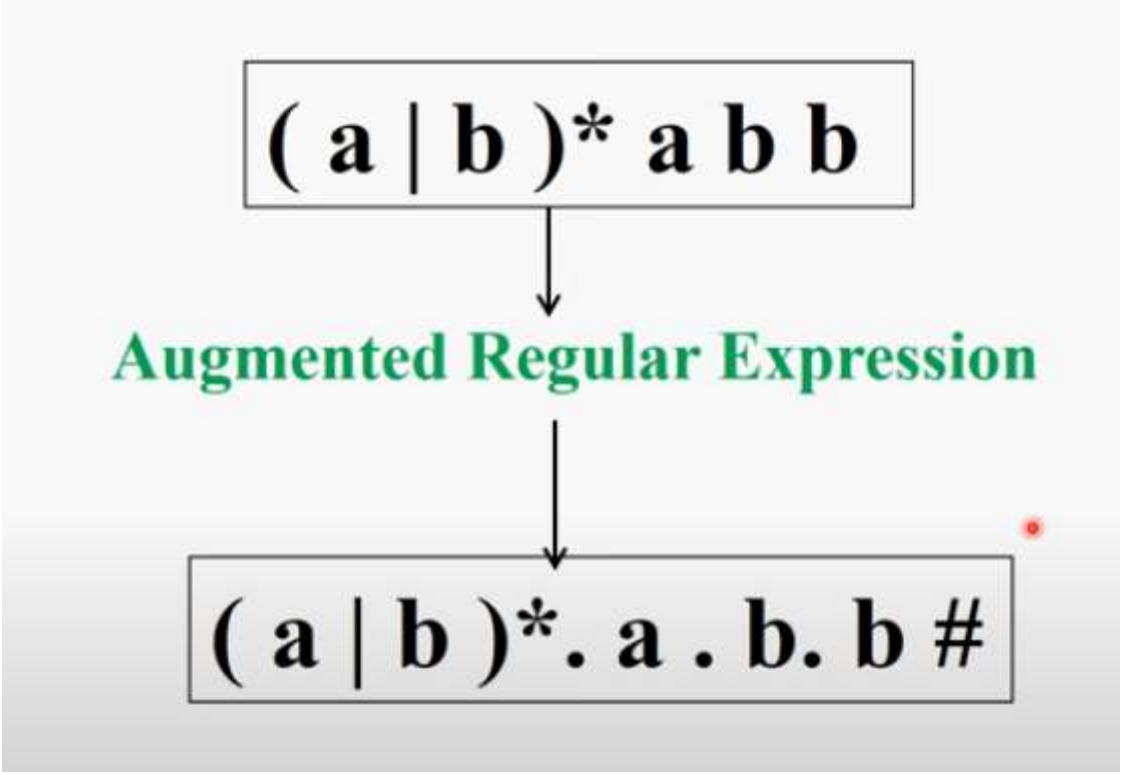
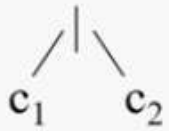
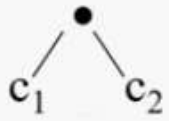
Regular Expression to DFA (Direct Method)

- Regular Expression to Augmented Regular Expression
- Augmented RE to syntax tree
- Nullable, First pos, Last pos, Followpos
  - Nullable →* and Empty
  - Followpos →* (closure) and Concatenation (.)
- Construct DFA

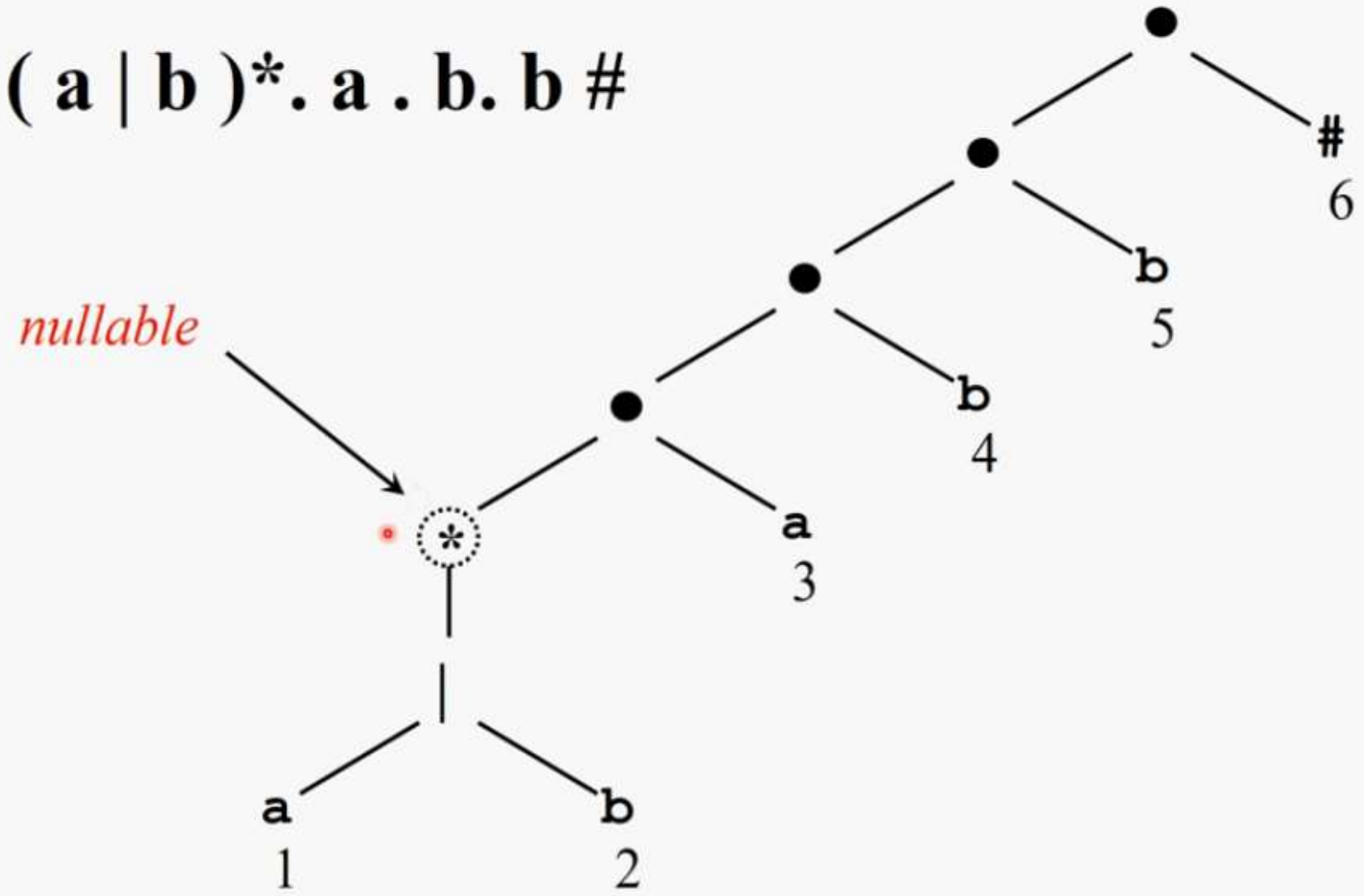
Regular Expression to DFA (Direct Method)
Example 1: (a|b)*abb



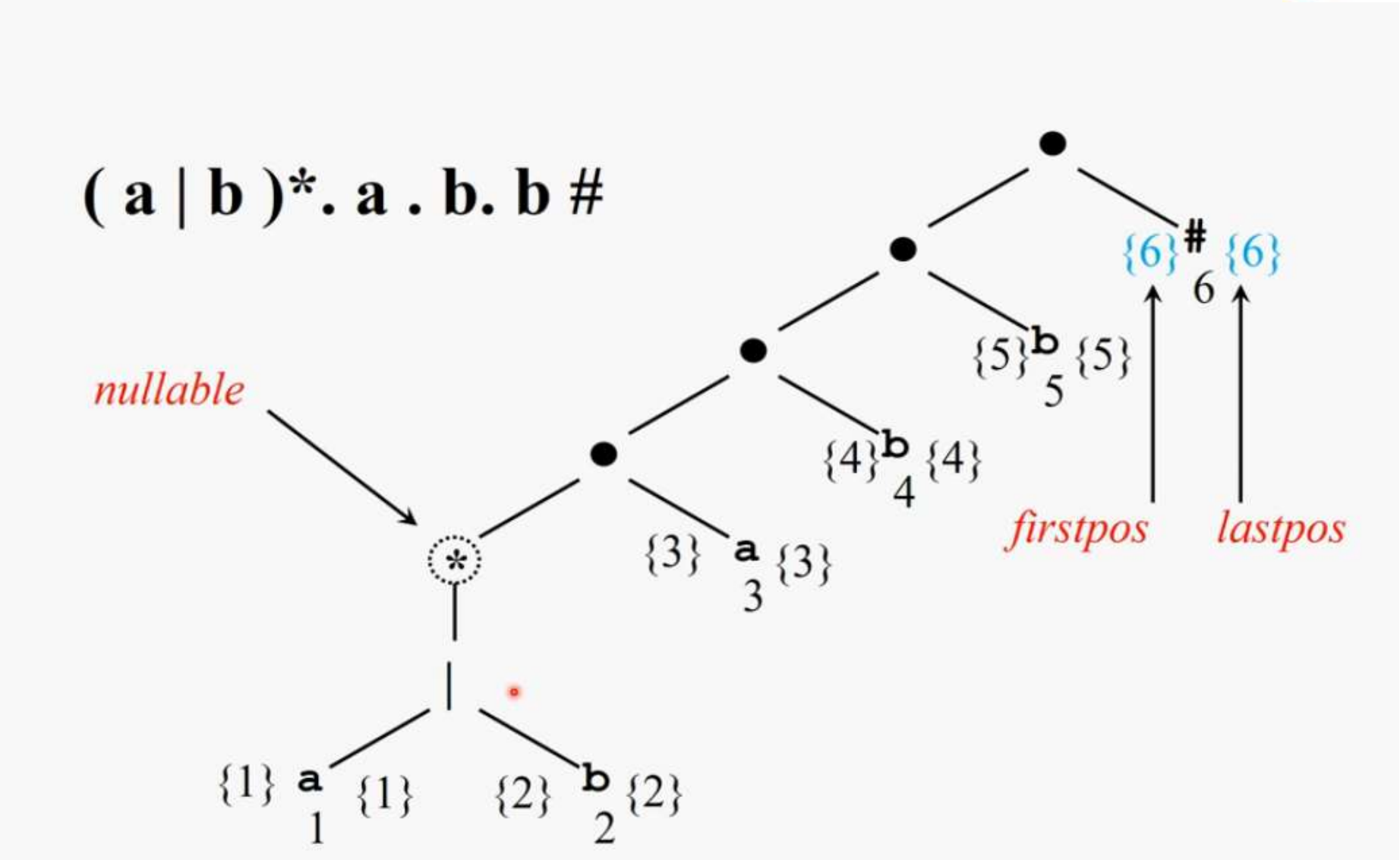
Rules for Computing the Function

Node n	nullable(n)	firstpos(n)	lastpos(n)
A leaf labeled by ε	**true**	$\varnothing$	$\varnothing$
A leaf with position ***i***	**false**	$\{i\}$	$\{i\}$
	$nullable(c_1)$ **or** $nullable(c_2)$	$firstpos(c_1) \cup firstpos(c_2)$	$lastpos(c_1) \cup lastpos(c_2)$
	$nullable(c_1)$ **and** $nullable(c_2)$	**if** ($nullable(c_1)$) $firstpos(c_1) \cup firstpos(c_2)$ **else** $firstpos(c_1)$	**if** ($nullable(c_2)$) $lastpos(c_1) \cup lastpos(c_2)$ **else** $lastpos(c_2)$
	*true*	$firstpos(c_1)$	$lastpos(c_1)$

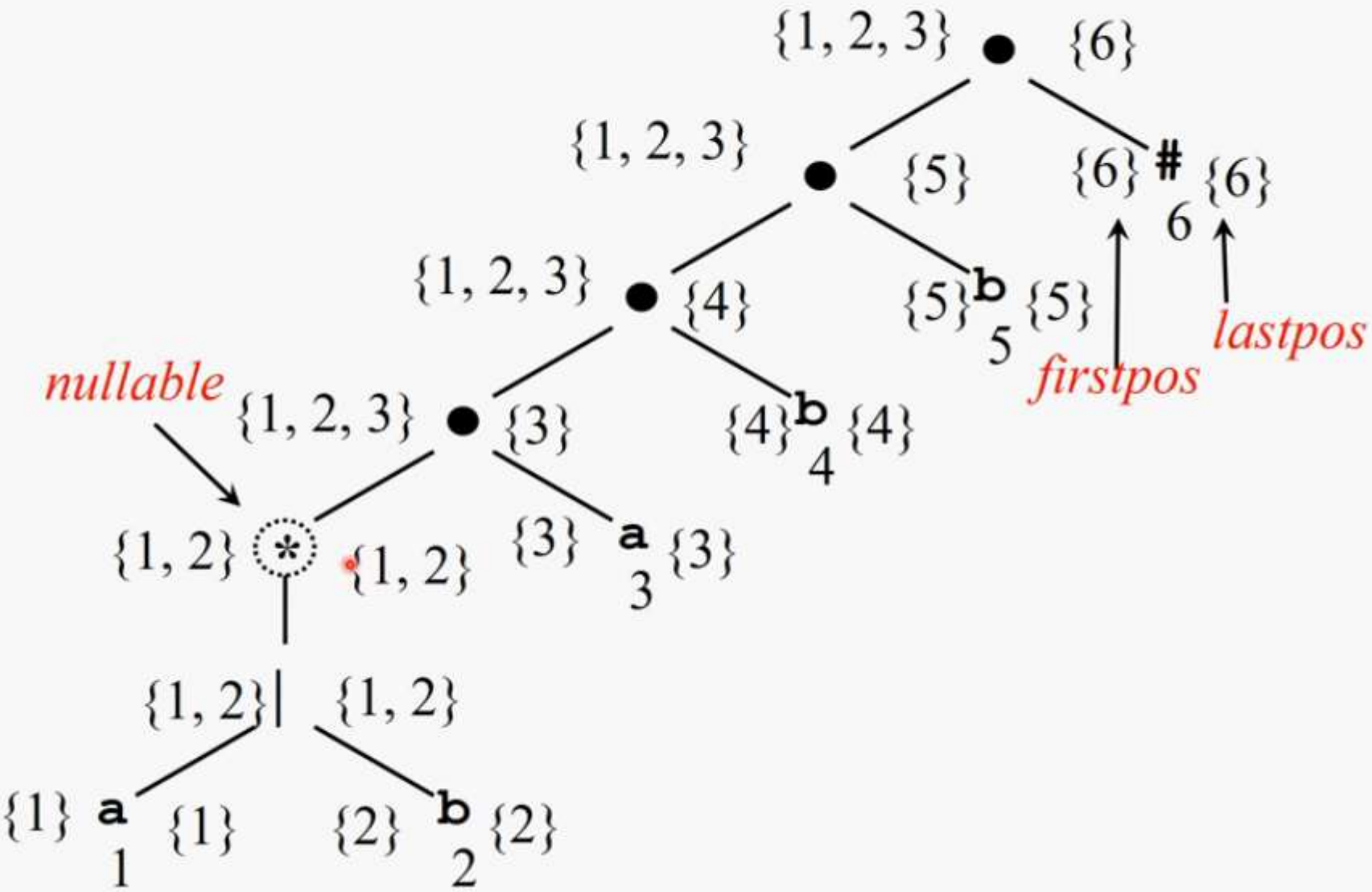
Syntax Tree



Firstpos and Lastpos of operands



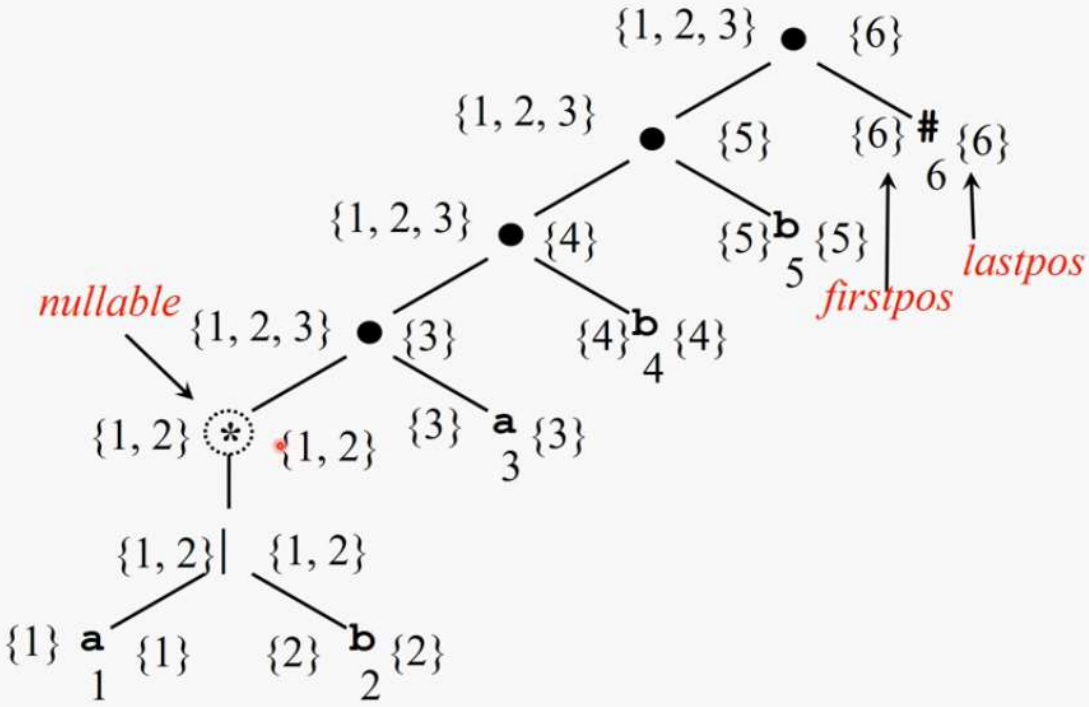
Firstpos and Lastpos of Operators



Followpos

(a | b)*. a . b. b #

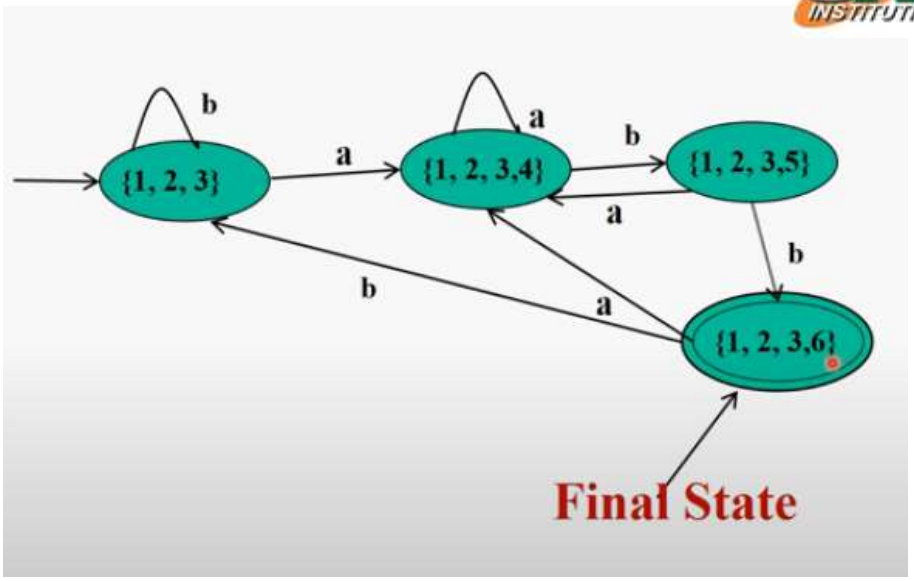
1 2 3 4 5 6

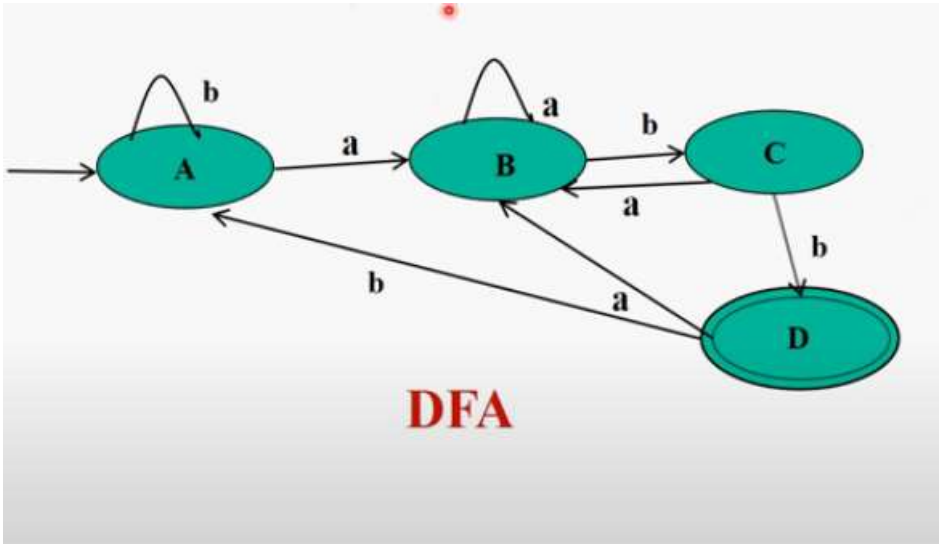


		Followpos
a	1	1,2,3
b	2	1,2,3
a	3	4
b	4	5
b	5	6
#	6	-

DFA Construction

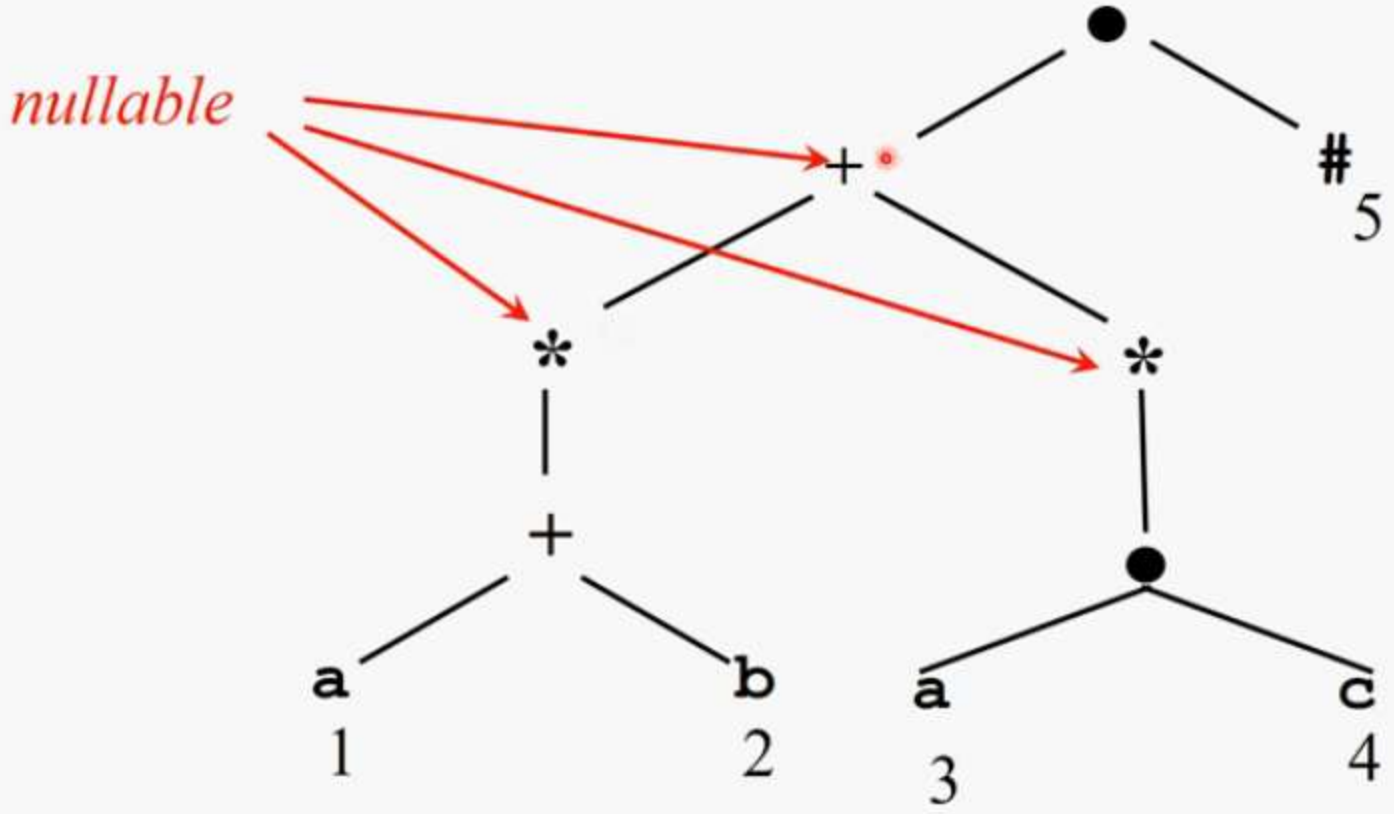
	Node	*followpos*
a	1	1,2,3
b	2	1,2,3
a	3	4
b	4	5
b	5	6
#	6	-



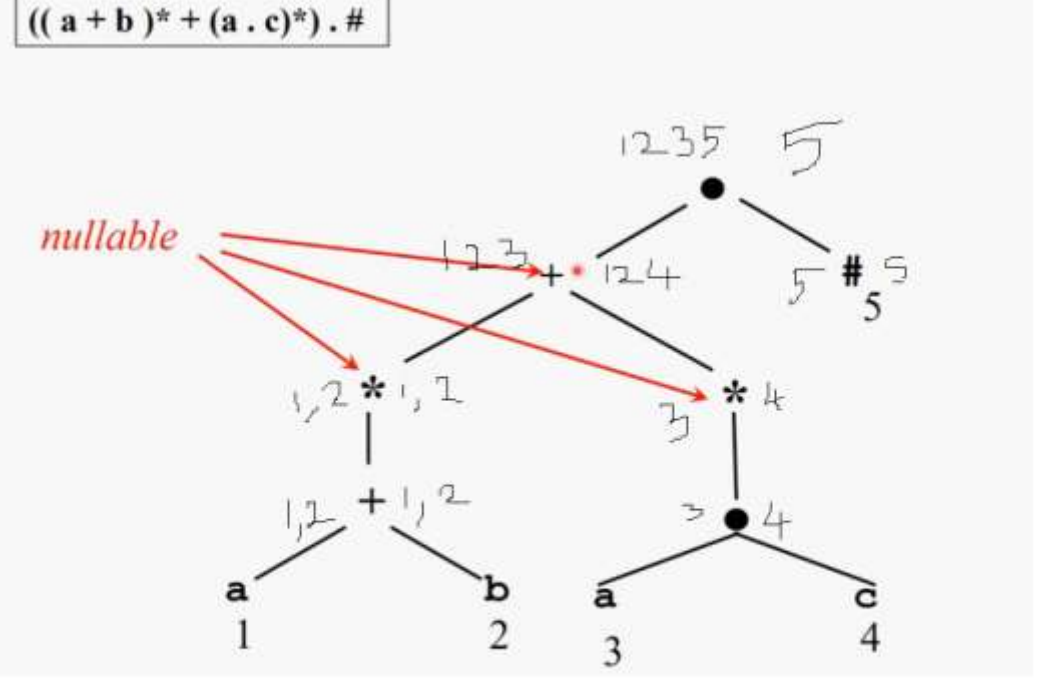


Assignment - Example 2

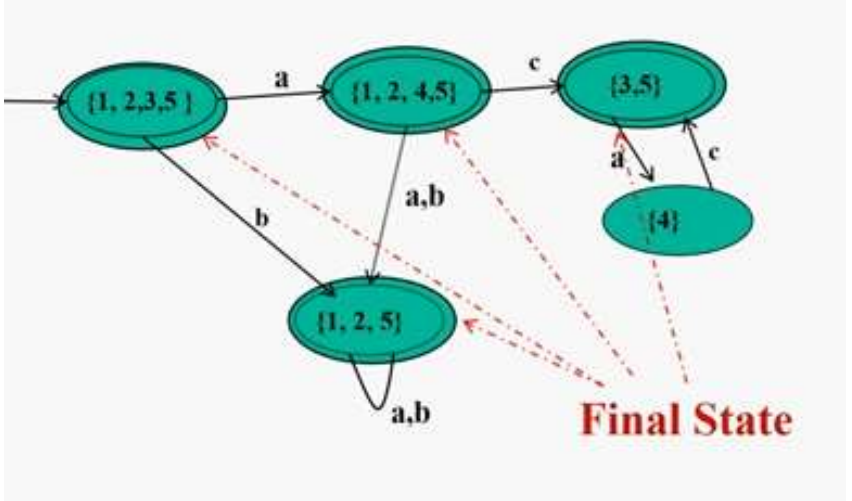
((a + b)* + (a . c)*) . #

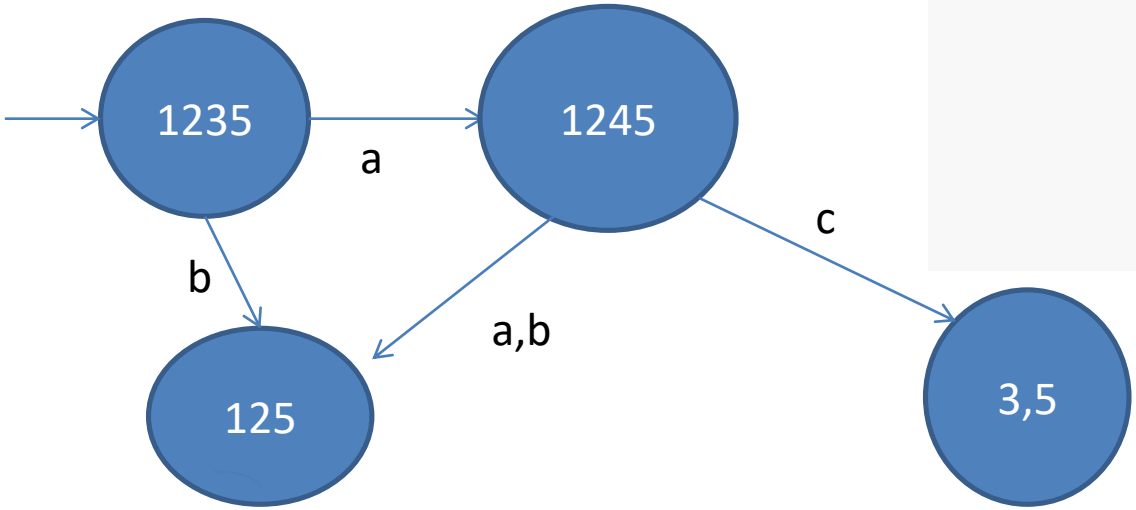


((a + b)* + (a . c)*) . #



		FOLLOWPOS (*,.)
a	1	1,2,5
b	2	1,2,5
a	3	4
c	4	3,5
#	5	-



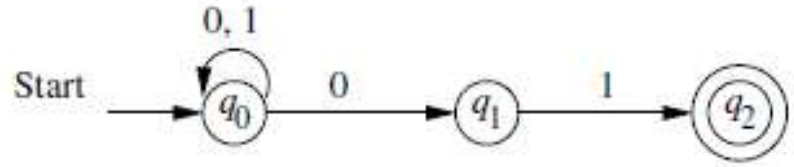


- **Topics covered**

1. Regular expression to Automata
2. Regular expression to **ε-**NFA (Thompsons construction)
3. ε-NFA to DFA
4. Regular Expression to DFA
    1. Direct conversion of Regular Expression to DFA
    2. NFA to DFA (Subset Construction Method) – UNIT I

Equivalence of NFA & DFA/ *NFA to DFA*

- ***NFA which accepts all the strings ending with 01***

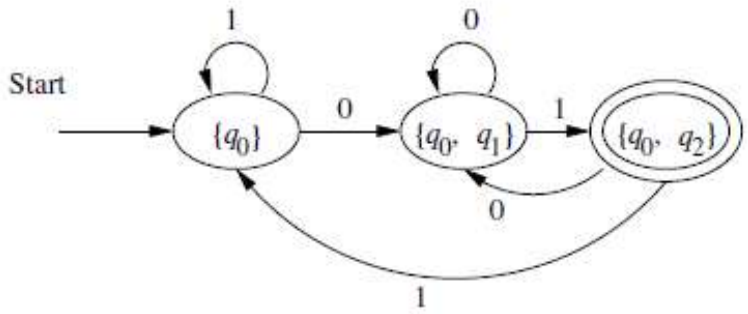


	0	1
q_0	q0, q1	q0
q_1	-	q2
q_2	-	-

- States →q0,q1,q2 →3 states

  →{null, q0,q1,q2,q0q1,q0q2,q2q3,q0q1q2}

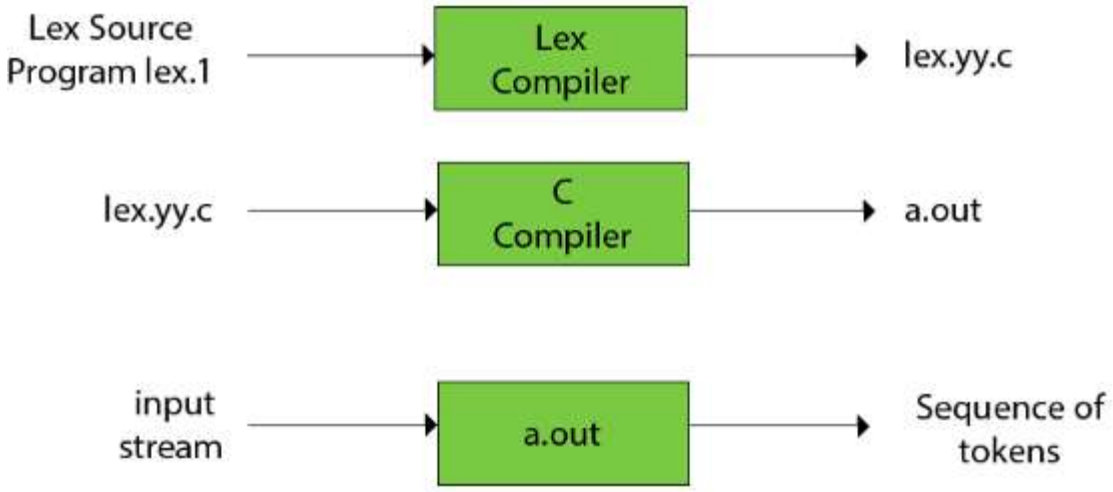
- ***DFA Construction***
  - Q' =NULL
  - Q'={q0,{q0,q1},{q0,q2}}



	0	1
(initial) q_0	{q0, q1}	q0
{q0, q1}	{q0,q1}	{q0,q2}
(Final) {q0,q2}	{q0,q1}	q0

Tool for generating Lexical Analyzer

- LEX
  - Program – lexical analyzer. YACC parser generator



- Flex (Fast Lexical Analyzer Generator)
- https://www.geeksforgeeks.org/flex-fast-lexical-analyzer-generator/

Summary (UNIT II)

- Phases of compiler
- Lexical Analysis / Tokenizer / scanner
- Lexemes → Tokens
- (Type 3) – Regular Grammar - FSA
  - DFA
  - NFA
  - Epsilon NFA
  - Conversion
    - RE to NFA
    - RE to DFA
      - Direct Method
      - Subset Construction