

# Compiler Theory Project

Team ID : G3 63

TA : Samar Aly

Name	ID	Section No
محمد حمد ابراهيم	20201700684	7
محمد حسن يحيي	20201700683	7
محمد أبو العلا علي	20201700654	7
مازن مدحت محمد	20201700643	6
فرحة مختار عبد العزيز	20201700584	6
فرح حسن اسماعيل	20201700578	6

## 1-Number:

Digit = [0 - 9] , Letter = [a - z]

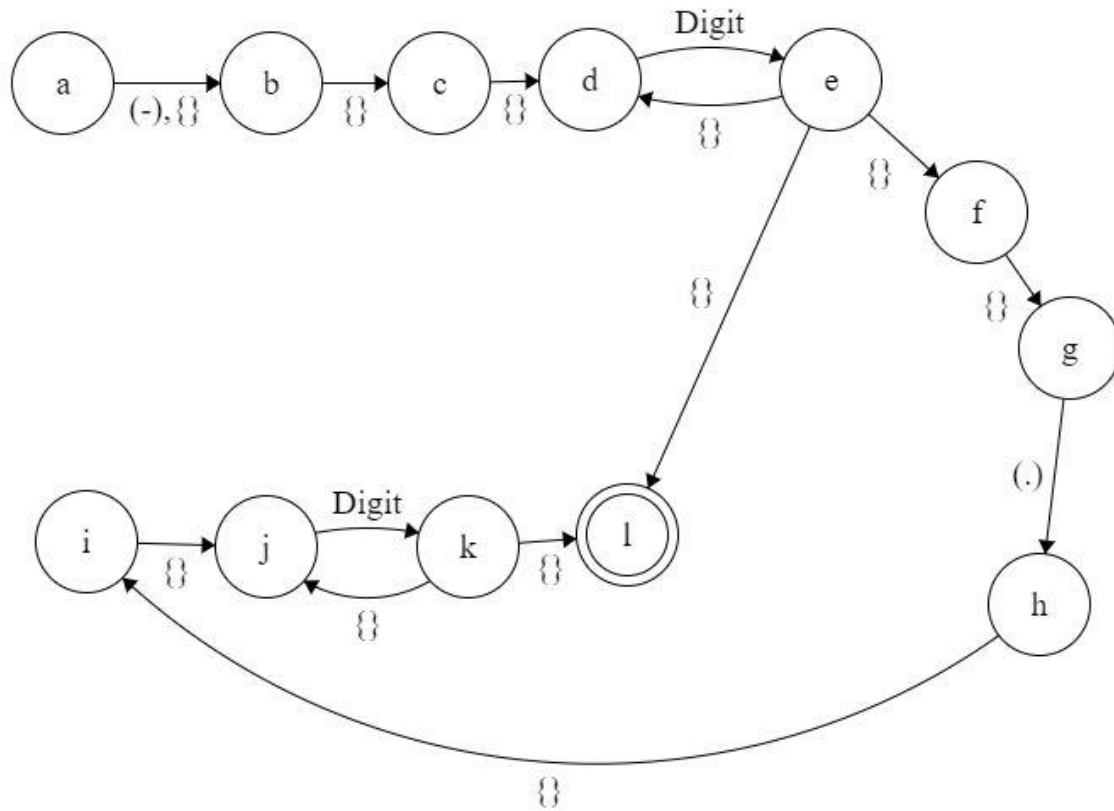
Re := -? Digit<sup>+</sup> ("." Digit<sup>+</sup>)?

## Subset Construction:

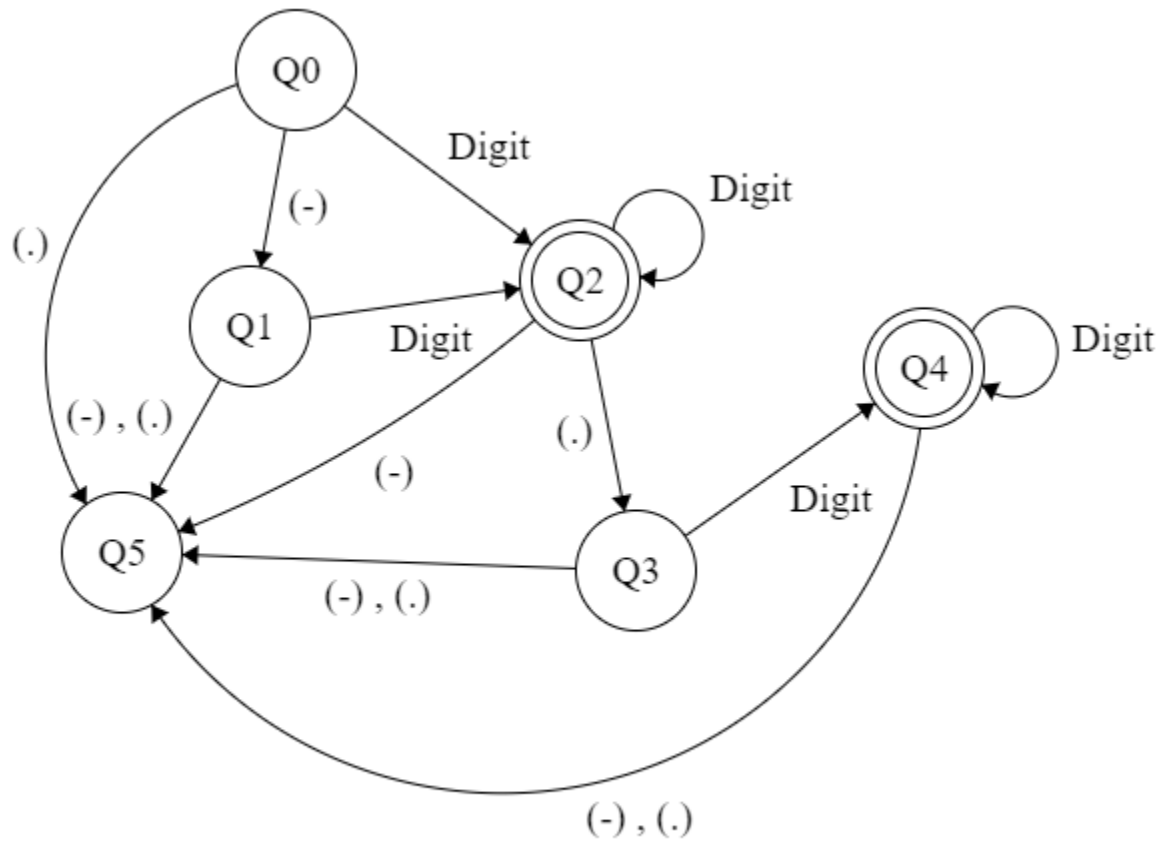
DFA	NFA	(-)	Digit	(.)
Q0 (Start)	{a,b,c,d}	b $\epsilon$ closure={b,c,d}	e $\epsilon$ closure={e,f,g}	$\emptyset$
Q1	{b,c,d}	$\emptyset$	e $\epsilon$ closure={e,f,g}	$\emptyset$
Q2	{e,f,g}	$\emptyset$	e $\epsilon$ closure={e,f,g}	h $\epsilon$ closure={h,i,j}
Q3	{h,i,j}	$\emptyset$	k $\epsilon$ closure={k,l}	$\emptyset$
Q4 *	{k,l}	$\emptyset$	k $\epsilon$ closure={k,l}	$\emptyset$
Q5	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

DFA	NFA	(-)	Digit	(.)
(Start) Q0	{a,b,c,d}	Q1	Q2	$\emptyset$
Q1	{b,c,d}	$\emptyset$	Q2	$\emptyset$
Q2*	{e,f,g}	$\emptyset$	Q2	Q3
Q3	{h,i,j}	$\emptyset$	Q4	$\emptyset$
Q4 *	{k,l}	$\emptyset$	Q4	$\emptyset$
Q5	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

## NFA Using Thompson's Construction:



### DFA using subset construction:



### Minimized DFA:




## 2-Condition Operators:

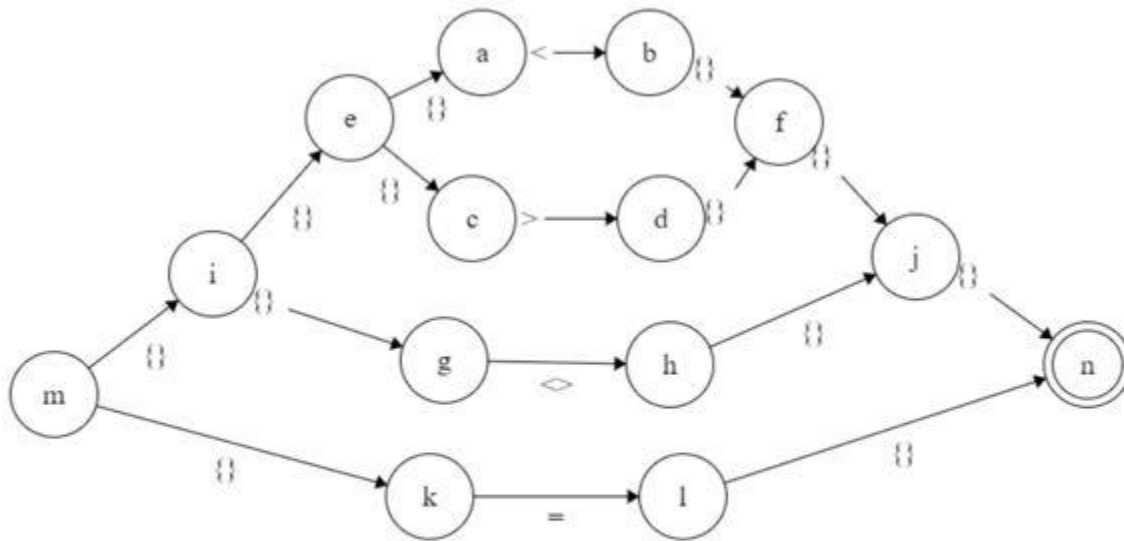
Re:= (<|>|<>|=)

### Subset Construction:

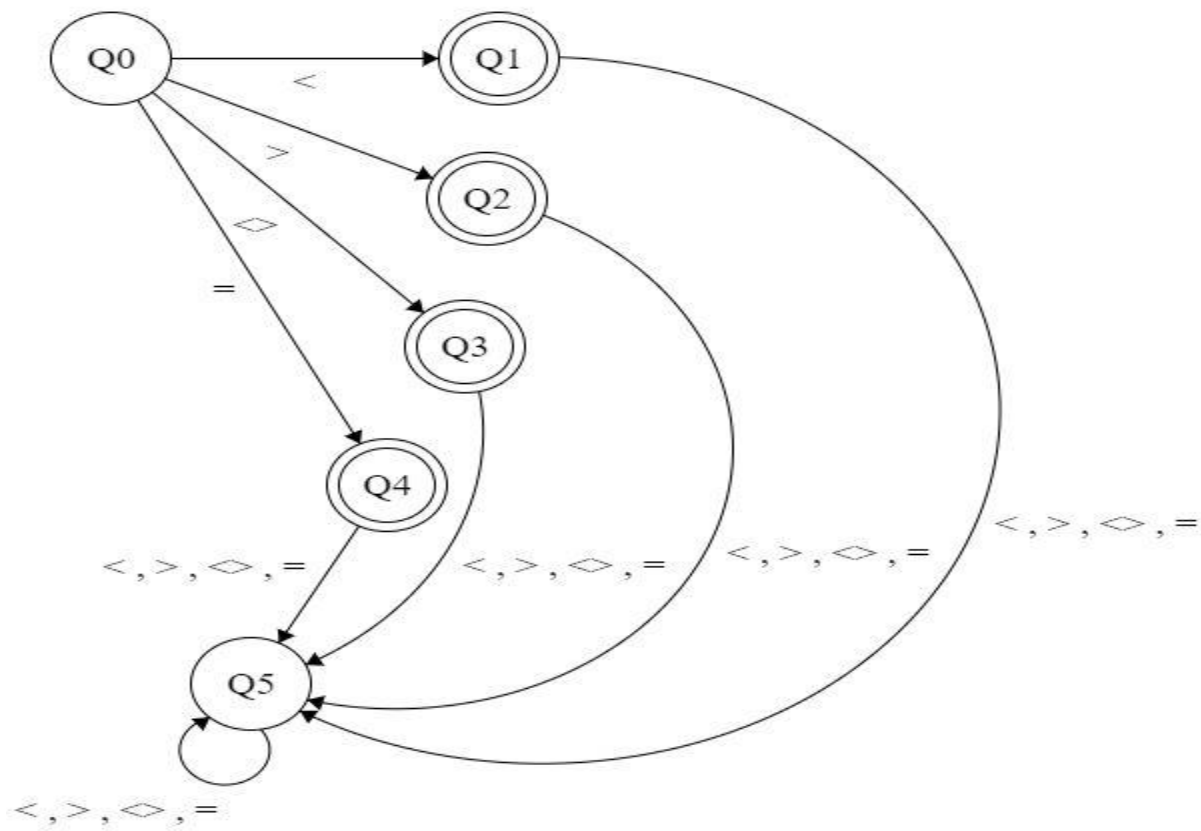
DFA	NFA	<	>	<>	=
Q0 (start)	{a,c,e,g,l,k,m}	b $\epsilon$ closure= {b,f,j,n}	d $\epsilon$ closure= {d,f,j,n}	h $\epsilon$ closure= {h,j,n}	l $\epsilon$ closure= {l,n}
Q1*	{b,f,j,n}	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
Q2*	{d,f,j,n}	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
Q3*	{h,j,n}	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
Q4*	{l,n}	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
trap	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

DFA	NFA	<	>	<>	=
Q0 (start)	{a,c,e,g,l,k,m}	Q1	Q2	Q3	Q4
Q1*	{b,f,j,n}	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
Q2*	{d,f,j,n}	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
Q3*	{h,j,n}	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
Q4*	{l,n}	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
trap	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

## NFA using Thompson's construction:



### DFA using subset construction:



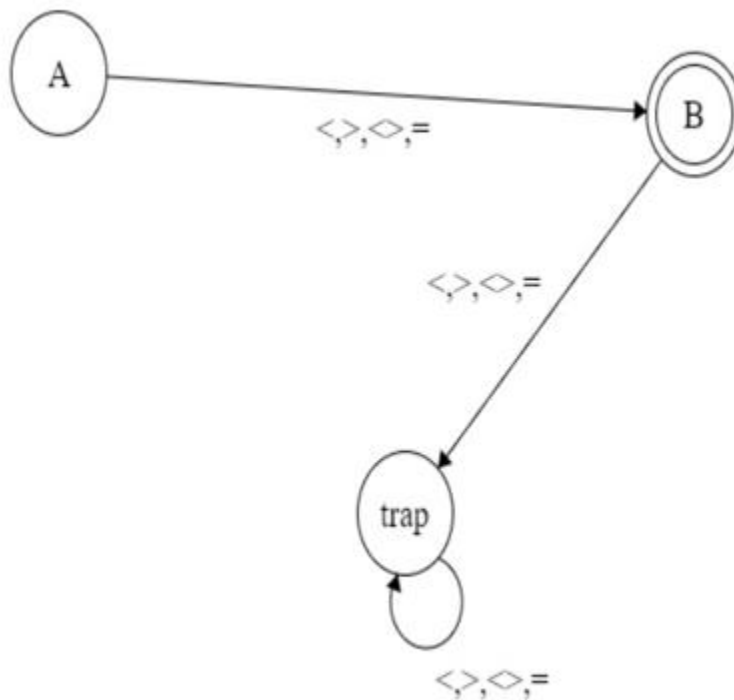
### Minimized DFA:

Equivalence0	{q0,trap} {q1,q2,q3,q4}
Equivalence1	{q0} {trap} {q1,q2,q3,q4}
Equivalence2	{q0} {trap} {q1,q2,q3,q4}

Minimized	DFA	<	>	<>	=
-----------	-----	---	---	----	---



Start A	Q0	B	B	B	B
B*	q1,q2,q3,q4	∅	∅	∅	∅
Trap	Trap	∅	∅	∅	∅



### 3-Arithmetic Operator

Re:= (+|-|/|\*)

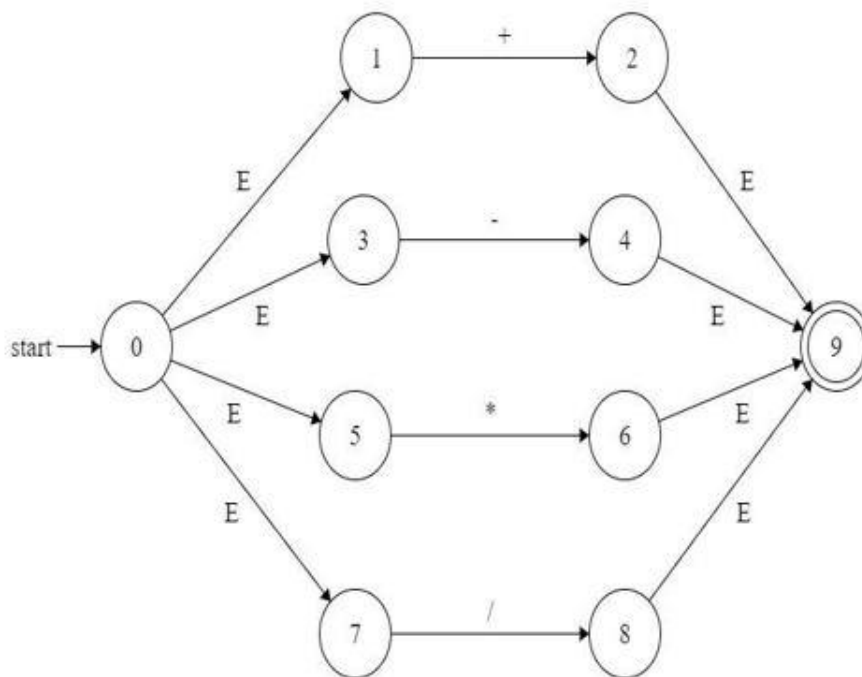
Subset construction:

DFA	NFA	+	-	*	/
A (start)	{0,1,3,5,7}	{2,9}*	{4,9}*	{6,9}*	{8,9}*
B*	{2,9}*	∅	∅	∅	∅
C*	{4,9}*	∅	∅	∅	∅
D*	{6,9}*	∅	∅	∅	∅

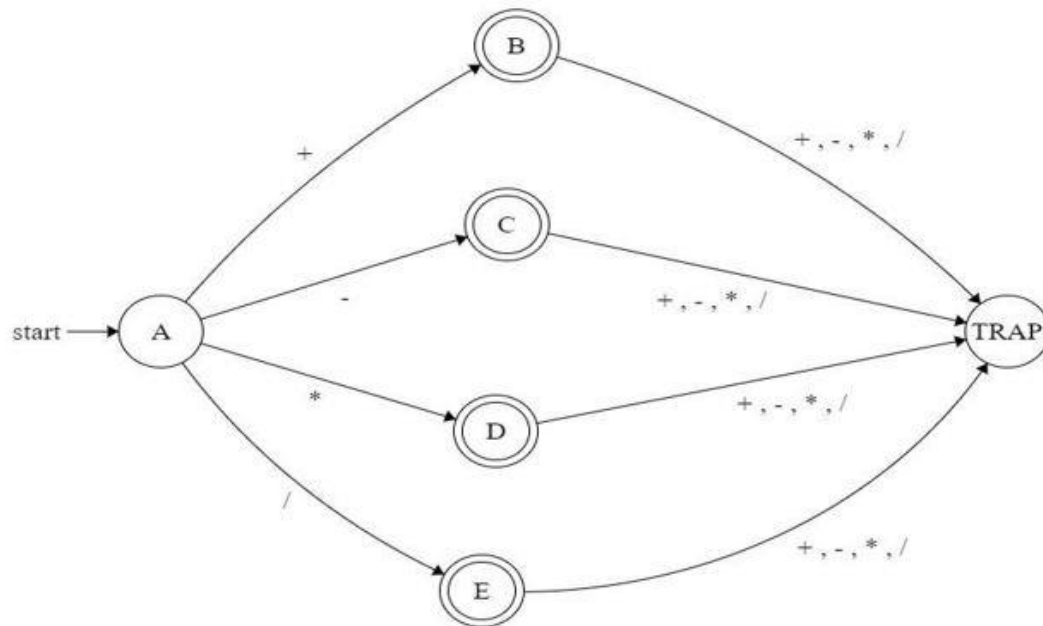
$E^*$	$\{8,9\}^*$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

DFA	NFA	+	-	*	/
A(start)	$\{0,1,3,5,7\}$	$B^*$	$C^*$	$D^*$	$E^*$
$B^*$	$\{2,9\}^*$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
$C^*$	$\{4,9\}^*$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
$D^*$	$\{6,9\}^*$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
$E^*$	$\{8,9\}^*$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

### NFA using Thompson Construction:

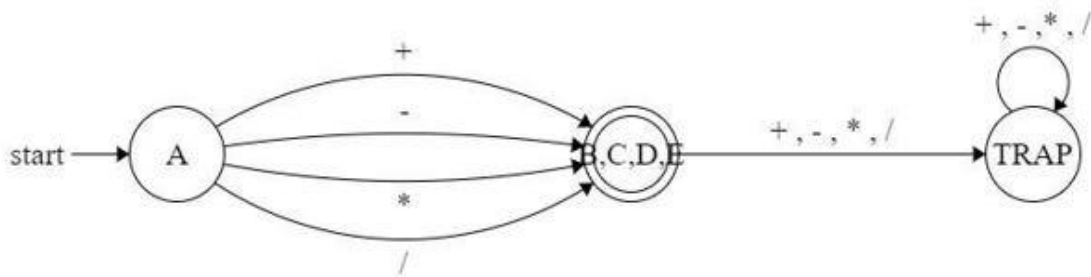


## DFA using subset construction:



## Minimized DFA

Equivalence 0	$\{A, \emptyset\} \{B, C, D, E\}^*$
Equivalence 1	$\{A\} \{\emptyset\} \{B, C, D, E\}^*$
Equivalence 2	$\{A\} \{\emptyset\} \{B, C, D, E\}^*$



#### 4-Boolean operators:

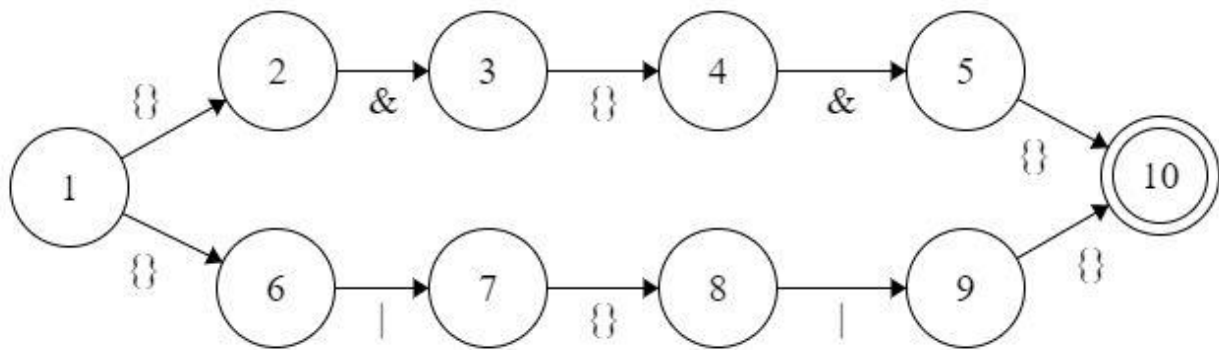
Re:= ( && | /||| )

#### Subset construction:

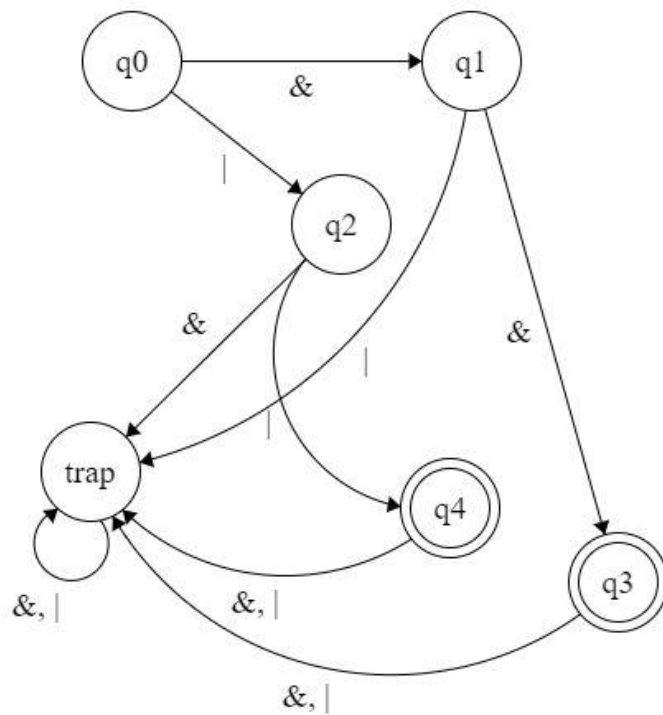
DFA	NFA	&	
Start q0	{1,2,6}	3 $\epsilon=\{3,4\}$	7 $\epsilon=\{7,8\}$
Q1	{3,4}	5 $\{5,10\}$	$\emptyset$
Q2	{7,8}	$\emptyset$	9 $\epsilon=\{9,10\}$
Q3*	{5,10}	$\emptyset$	$\emptyset$
Q4*	{9,10}	$\emptyset$	$\emptyset$
trap	$\emptyset$	$\emptyset$	$\emptyset$

DFA	NFA	&	
q0 (start)	{1,2,6}	Q1	Q2
q1	{3,4}	Q3	$\emptyset$
q2	{7,8}	$\emptyset$	Q4
q3*	{5,10}	$\emptyset$	$\emptyset$
q4*	{9,10}	$\emptyset$	$\emptyset$
trap	$\emptyset$	$\emptyset$	$\emptyset$

### NFA using Thompson's construction:



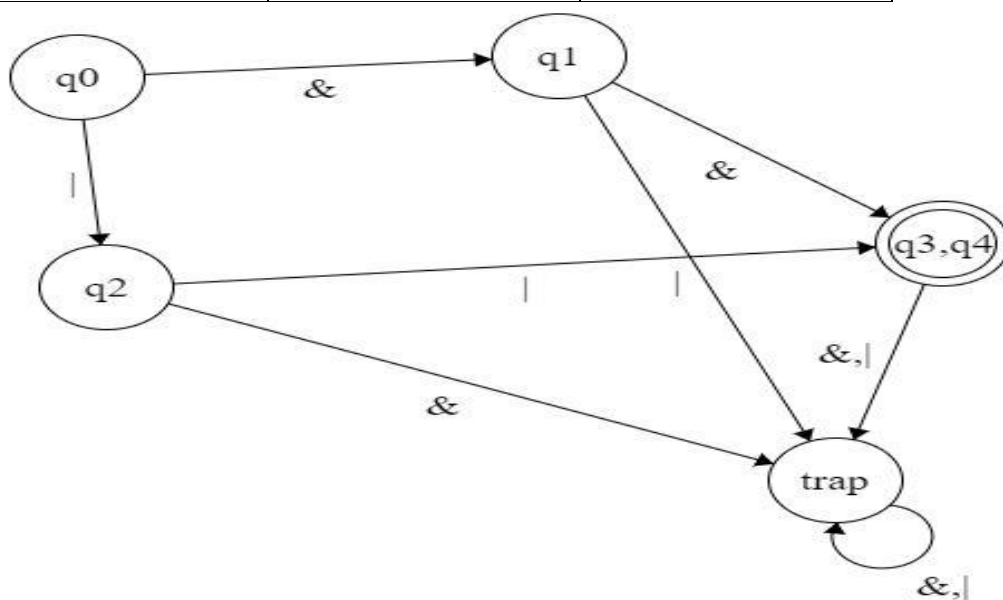
### DFA using subset construction:



## Minimized DFA :

Equivalence 0	$\{q_0, q_1, q_2, \text{trap}\} \{q_3, q_4\}$
Equivalence 1	$\{q_0, q_2, \text{trap}\} \{q_1\} \{q_3, q_4\}$
Equivalence 2	$\{q_0\} \{q_1\} \{q_2\} \{\text{trap}\} \{q_3, q_4\}$
Equivalence 3	$\{q_0\} \{q_1\} \{q_2\} \{\text{trap}\} \{q_3, q_4\}$

DFA	&	
Q0	Q1	Q2
Q1	Q3,Q4	$\emptyset$
Q2	$\emptyset$	Q3,Q4
Q3,Q4	$\emptyset$	$\emptyset$
trap	$\emptyset$	$\emptyset$



## 5-Identifier:

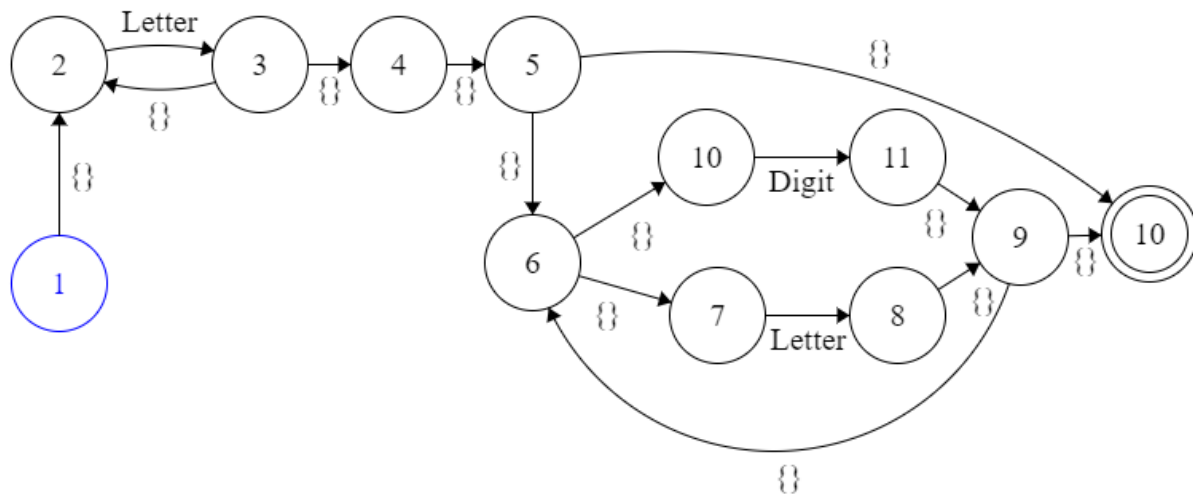
$Re := [A - z]^+ ( [0 - 9] \mid [A - z] )^*$

### Subset construction:

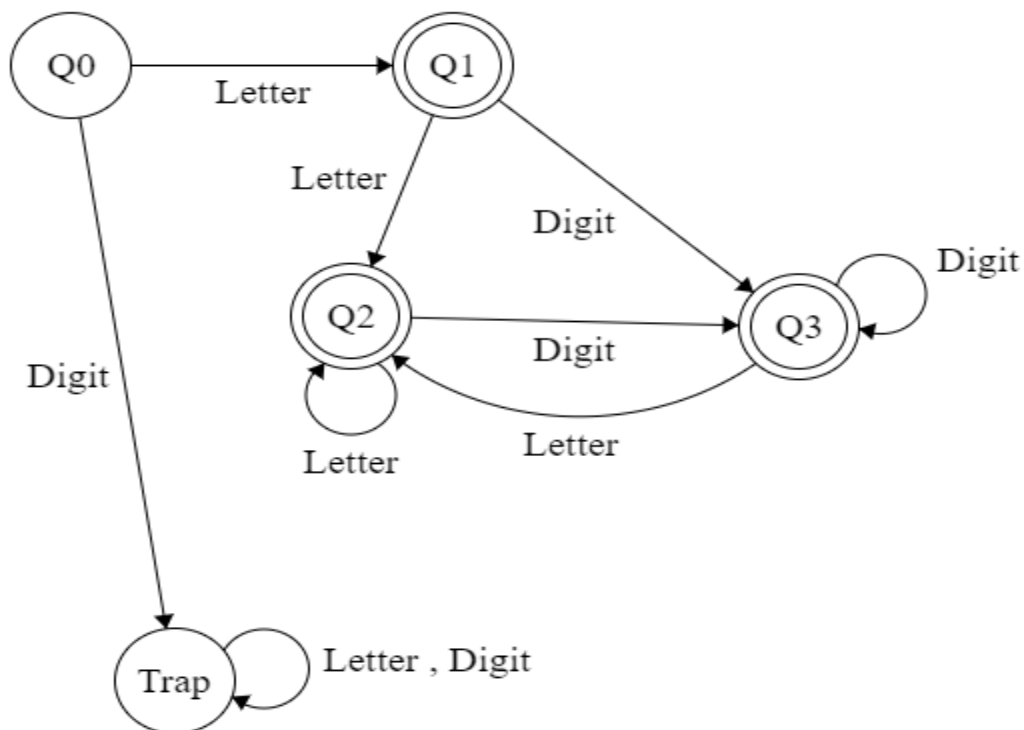
DFA	NFA	LETTER	DIGIT
Start Q0	{1,2}	3 $\epsilon\text{closure}=\{3,4,5,6,7,10,12\}$	$\emptyset$
Q1*	{3,4,5,6,7,10,12}	8 $\epsilon\text{closure}=\{8,9,12,6,10,7\}$	11 $\epsilon\text{closure}=\{11,9,12,6,10,7\}$
Q2*	{6,7,8,9,10,12}	8 $\epsilon\text{closure}=\{8,9,12,6,10,7\}$	11 $\epsilon\text{closure}=\{11,9,12,6,10,7\}$
Q3*	{6,7,9,10,11,12}	8 $\epsilon\text{closure}=\{8,9,12,6,10,7\}$	11 $\epsilon\text{closure}=\{11,9,12,6,10,7\}$
$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

DFA	LETTER	DIGIT
Start Q0	Q1	$\emptyset$
Q1*	Q2	Q3
Q2*	Q2	Q3
Q3*	Q2	Q3
$\emptyset$	$\emptyset$	$\emptyset$

### NFA using Thompson's construction:



### DFA using subset construction:

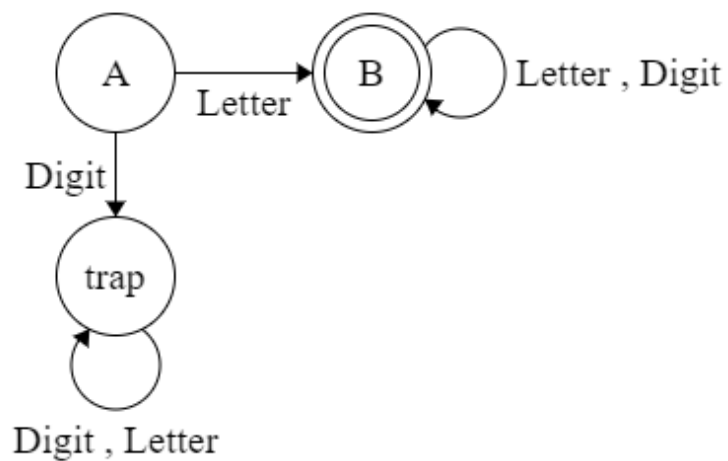




### Minimized DFA:

Equivalence 0	$\{q_0, \emptyset\} \{q_1, q_2, q_3\}$
Equivalence 1	$\{q_0\} \{\emptyset\} \{q_1, q_2, q_3\}$
Equivalence 2	$\{q_0\} \{\emptyset\} \{q_1, q_2, q_3\}$

minimized	DFA	Letter	digit
Start A	Q0	B	$\emptyset$
B*	Q1, Q2, Q3	B	B
TRAP	$\emptyset$	$\emptyset$	$\emptyset$



## 6-Comment

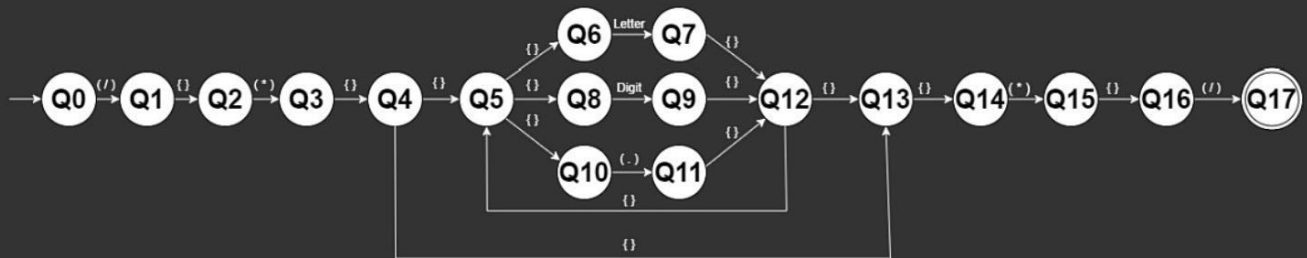
Re:= /\* ( [0-9] | [A-z] | . ) \* \*/

### Subset Construction:

dfa	Nfa	( / )	( * )	letter	digit	( . )
a (start)	{Q0}	b $\epsilon$ closure={Q1,Q2}	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
b	{Q1,Q2}	$\emptyset$	c $\epsilon$ closure={Q3,Q4,Q5,Q6,Q8,Q10,Q13,Q14}	$\emptyset$	$\emptyset$	$\emptyset$
c	{Q3,Q4,Q5,Q6,Q8,Q10,Q13,Q14}	$\emptyset$	d $\epsilon$ closure={Q15,Q16}	e $\epsilon$ closure={Q7,Q12,Q13,Q14,Q5,Q6,Q8,Q10}	f $\epsilon$ closure={Q10,Q13,Q14,Q15,Q6,Q7,Q9,Q11}	g $\epsilon$ closure={Q12,Q13,Q14,Q15,Q6,Q7,Q9,Q11}
d	{Q15,Q16}	h $\epsilon$ closure={Q17}	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
e	{Q7,Q12,Q13,Q14,Q5,Q6,Q8,Q10}	$\emptyset$	d $\epsilon$ closure={Q16,Q17}	e $\epsilon$ closure={Q7,Q12,Q13,Q14,Q5,Q6,Q8,Q10}	f $\epsilon$ closure={Q9,Q12,Q13,Q14,Q5,Q6,Q8,Q10}	g $\epsilon$ closure={Q11,Q12,Q13,Q14,Q5,Q6,Q8,Q10}
F	{Q9,Q12,Q13,Q14,Q5,Q6,Q8,Q10}	$\emptyset$	d $\epsilon$ closure={Q16,Q17}	e $\epsilon$ closure={Q7,Q12,Q13,Q14,Q5,Q6,Q8,Q10}	f $\epsilon$ closure={Q9,Q12,Q13,Q14,Q5,Q6,Q8,Q10}	g $\epsilon$ closure={Q11,Q12,Q13,Q14,Q5,Q6,Q8,Q10}
g	{Q11,Q12,Q13,Q14,Q5,Q6,Q8,Q10}	$\emptyset$	d $\epsilon$ closure={Q16,Q17}	e $\epsilon$ closure={Q7,Q12,Q13,Q14,Q5,Q6,Q8,Q10}	f $\epsilon$ closure={Q9,Q12,Q13,Q14,Q5,Q6,Q8,Q10}	g $\epsilon$ closure={Q11,Q12,Q13,Q14,Q5,Q6,Q8,Q10}
h*	{Q17}	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$
Trap	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$	$\emptyset$

dfa	Nfa	( / )	( * )	letter	digit	( . )
a (start)	{Q0}	b	∅	∅	∅	∅
b	{Q1,Q2}	∅	c	∅	∅	∅
c	{Q3,Q4, Q5,Q6, Q8,Q10, Q13,Q14}	∅	d	e	f	g
d	{Q15,Q16}	h	∅	∅	∅	∅
e	{Q7,Q12, Q13,Q14, Q5,Q6, Q8,Q10}	∅	d	e	f	g
f	{Q9,Q12, Q13,Q14, Q5,Q6, Q8,Q10}	∅	d	e	f	g
g	{Q11,Q12, Q13,Q14, Q5,Q6, Q8,Q10}	∅	d	e	f	g
h*	{Q17}	∅	∅	∅	∅	∅
Trap	∅	∅	∅	∅	∅	∅

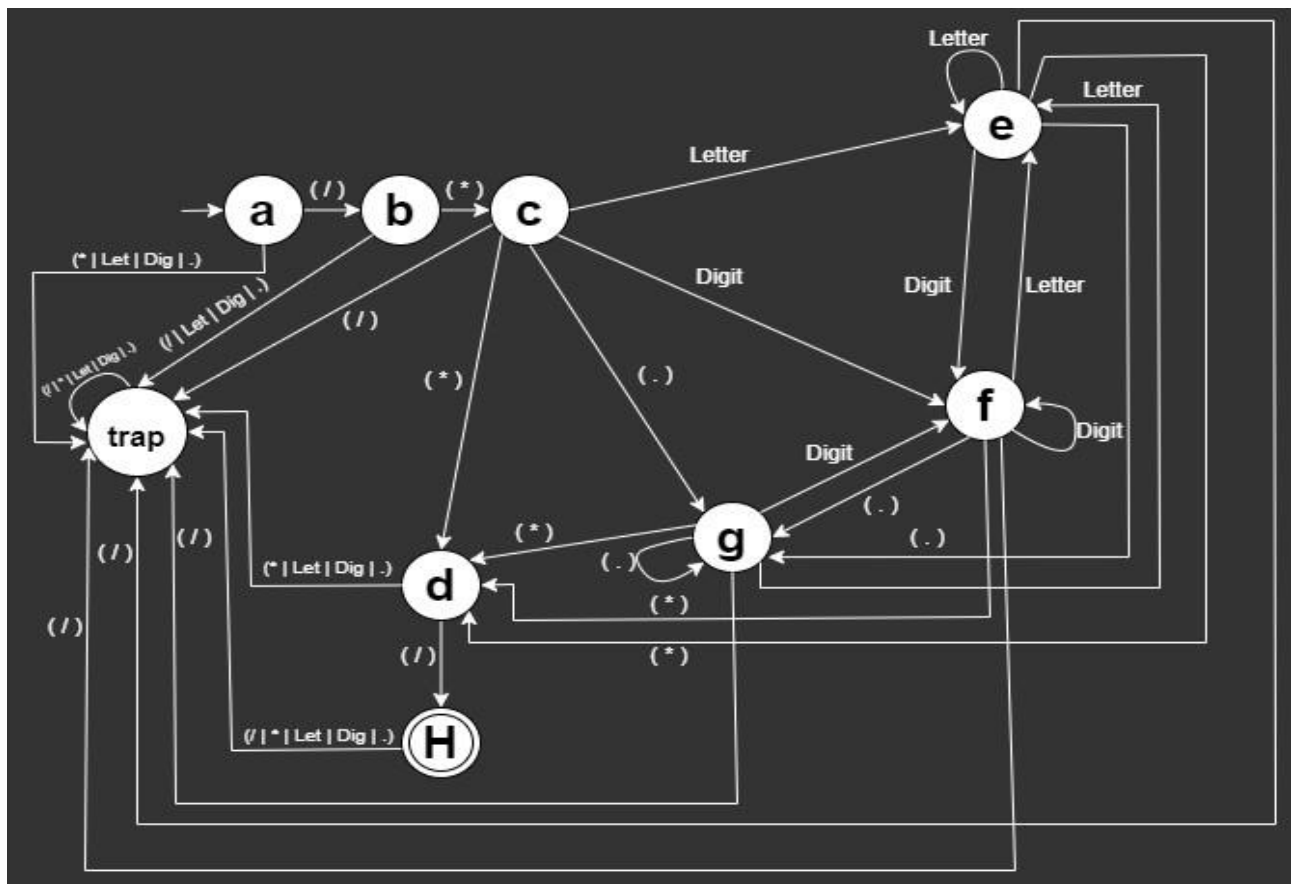
## NFA using Thompson's Construction:



## Minimized DFA:

Eque 0	{a,b,c,d,e,f,g,Trap} {h}*
Eque 1	{a,b,c,e,f,g,Trap} {d} {h}*
Eque 2	{a,b,e,f,g,Trap} {c} {d} {h}*
Eque 3	{a,e,f,g,Trap} {b} {c} {d} {h}*
Eque 4	{a,f,g,Trap} {e} {b} {c} {d} {h}*
Eque 5	{a,Trap} {f} {e} {b} {c} {d} {h}*
Eque 6	{a,Trap} {g} {f} {e} {b} {c} {d} {h}*
Eque 7	{a} {Trap} {g} {f} {e} {b} {c} {d} {h}*

## DFA using Subset Construction:



## 7-String:

Re:= " ( [0-9] | [A-z] | ~["] ) \* "

## Subset Construction:

DFA	NFA	LETTER	DIGIT	~["]	"
a	{0}	∅	∅	∅	b eClosure= {1,2,3, 4,5,7, 9,13,14}
b	{1,2,3,4,5,7,9,13,14}	c eClosure= {6,11,12, 13,14,3, 4,5,7,9}	d eClosure= {8,11,12, 13,14,3, 4,5,7,9}	e eClosure= {10,12, 13,14,3, 4,5,7,9}	f* eclosure={15}
c	{6,11,12,13,14,3,4,5,7,9}	c eClosure= {6,11,12, 13,14,3, 4,5,7,9}	d eClosure= {8,11,12, 13,14,3, 4,5,7,9}	e eClosure= {10,12, 13,14,3, 4,5,7,9}	f* eclosure={15}
d	{8,11,12,13,14,3,4,5,7,9}	c eClosure= {6,11,12, 13,14,3, 4,5,7,9}	d eClosure= {8,11,12, 13,14,3, 4,5,7,9}	e eClosure= {10,12, 13,14,3, 4,5,7,9}	f* eclosure={15}
e	{10,12,13,14,3,4,5,7,9}	c eClosure= {6,11,12, 13,14,3, 4,5,7,9}	d eClosure= {8,11,12, 13,14,3, 4,5,7,9}	e eClosure= {10,12, 13,14,3, 4,5,7,9}	f* eclosure={15}
f	{15}	∅	∅	∅	∅
Trap	∅	∅	∅	∅	∅

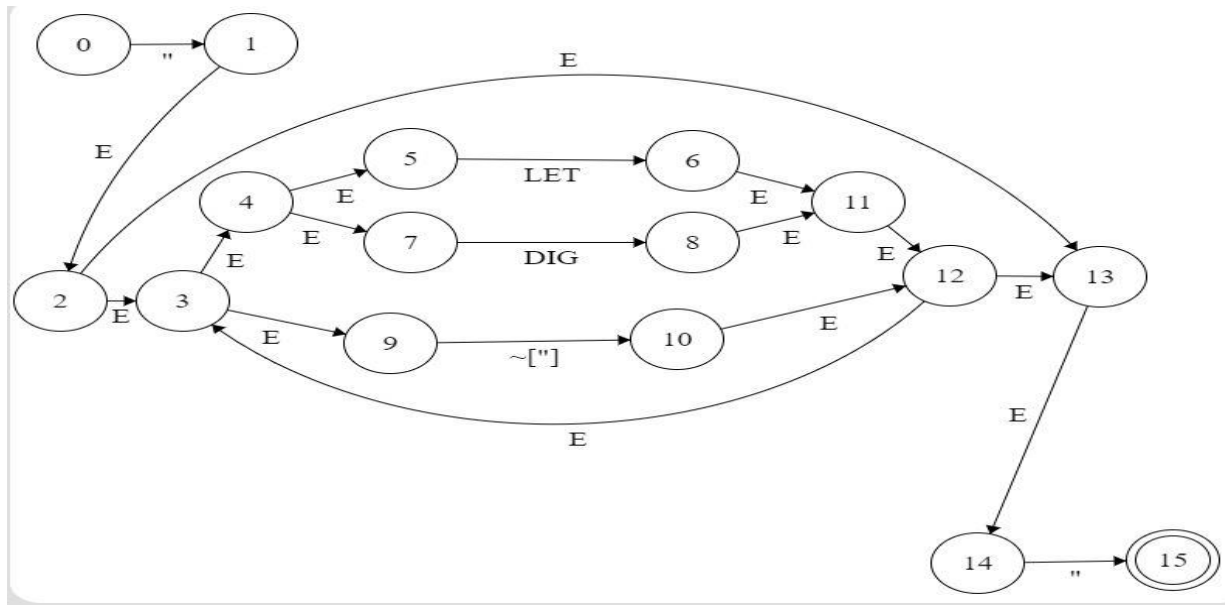
DFA	NFA	LETTER	DIGIT	~["]	"
a	{0}	∅	∅	∅	b
b	{1,2,3,4,5,7,9,13,14}	c	d	e	f*
c	{6,11,12,13,14,3,4,5,7,9}	c	d	e	f*

d	{8,11,12,13,14,3,4,5,7,9}	c	d	e	f*
e	{10,12,13,14,3,4,5,7,9}	c	d	e	f*
f	{15}	∅	∅	∅	∅
Trap	∅	∅	∅	∅	∅

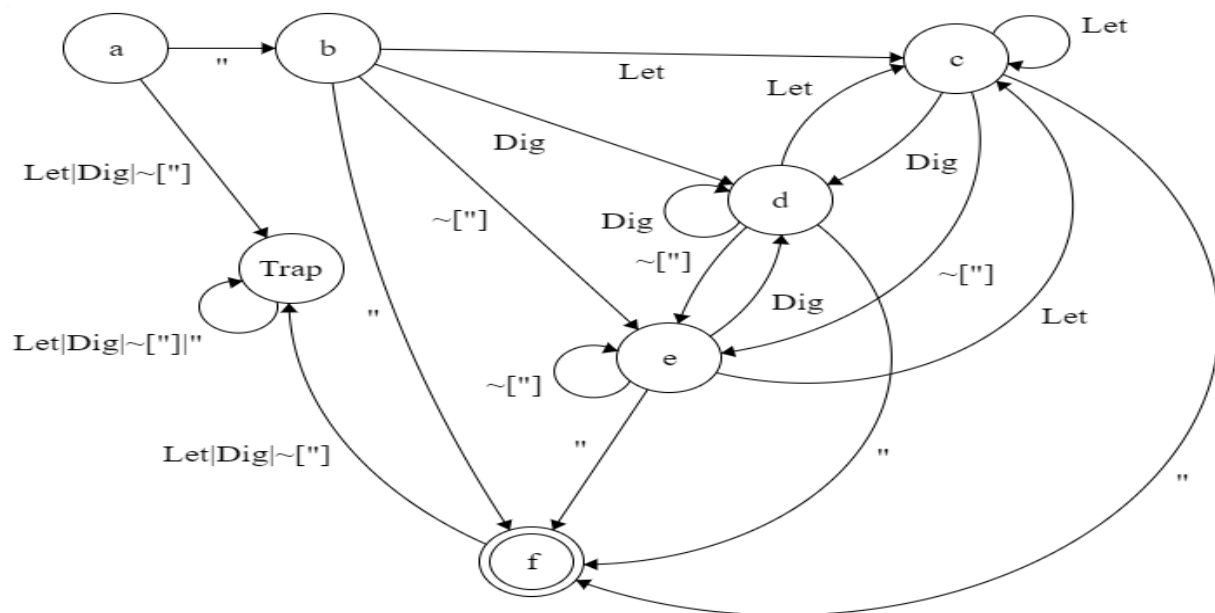
### Minimized DFA :

Eque 0	{a,b,c,d,e,Trap} {f*}
Eque 1	{a,c,d,e,Trap} {b} {f*}
Eque 2	{a,d,e,Trap} {c} {b} {f*}
Eque 3	{a,e,Trap} {d} {c} {b} {f*}
Eque 4	{a,Trap} {e} {d} {c} {b} {f*}
Eque 5	{a} {Trap} {e} {d} {c} {b} {f*}
Eque 6	{a} {Trap} {e} {d} {c} {b} {f*}

### NFA using Thompson's construction:



## DFA using subset construction:



## Regular Expression for the rest of tokens:

8) Reserved Keywords = ( int | float | string | read | write | repeat | until | if | elseif | else | then | return | endl )

9) assign operator = :=

10) semi colon = ;

11) LEFTCURLYBRACKETS = {

12) RIGHTCURLYBRACKETS = }

13) LEFTPARENTHESSES = (

14) RIGHTPARENTHESSES = )

15) Comma = ,



## DFA:

