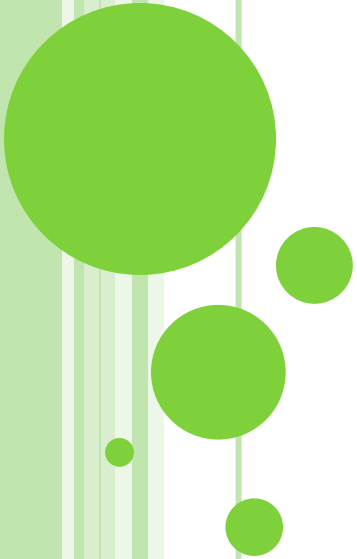
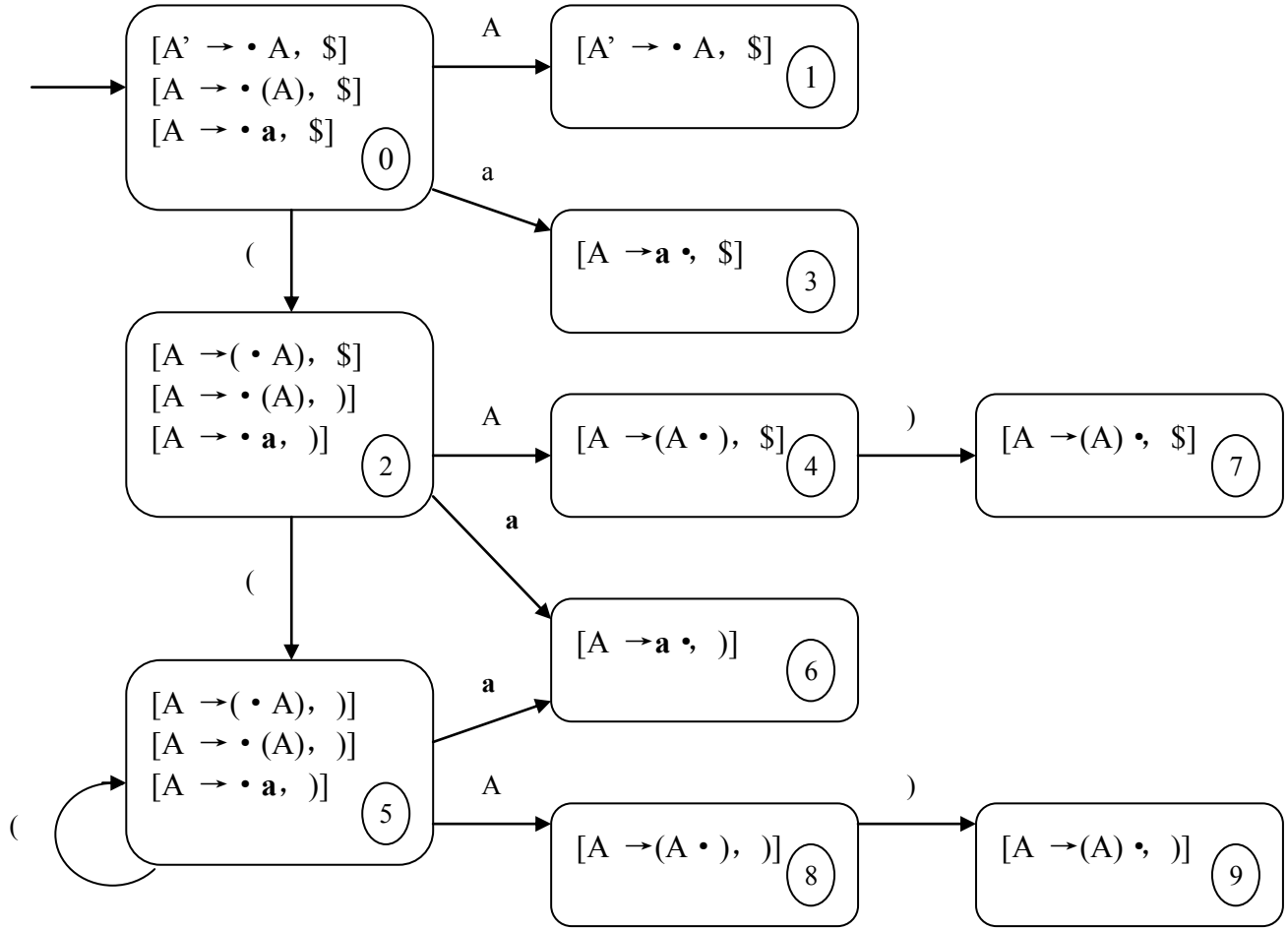


# Canonical LR(1)

# A→(A) | a　　LR(1) DFA



The Grammar:
(1) A→(A)
(2) A→ **a**

Parse table

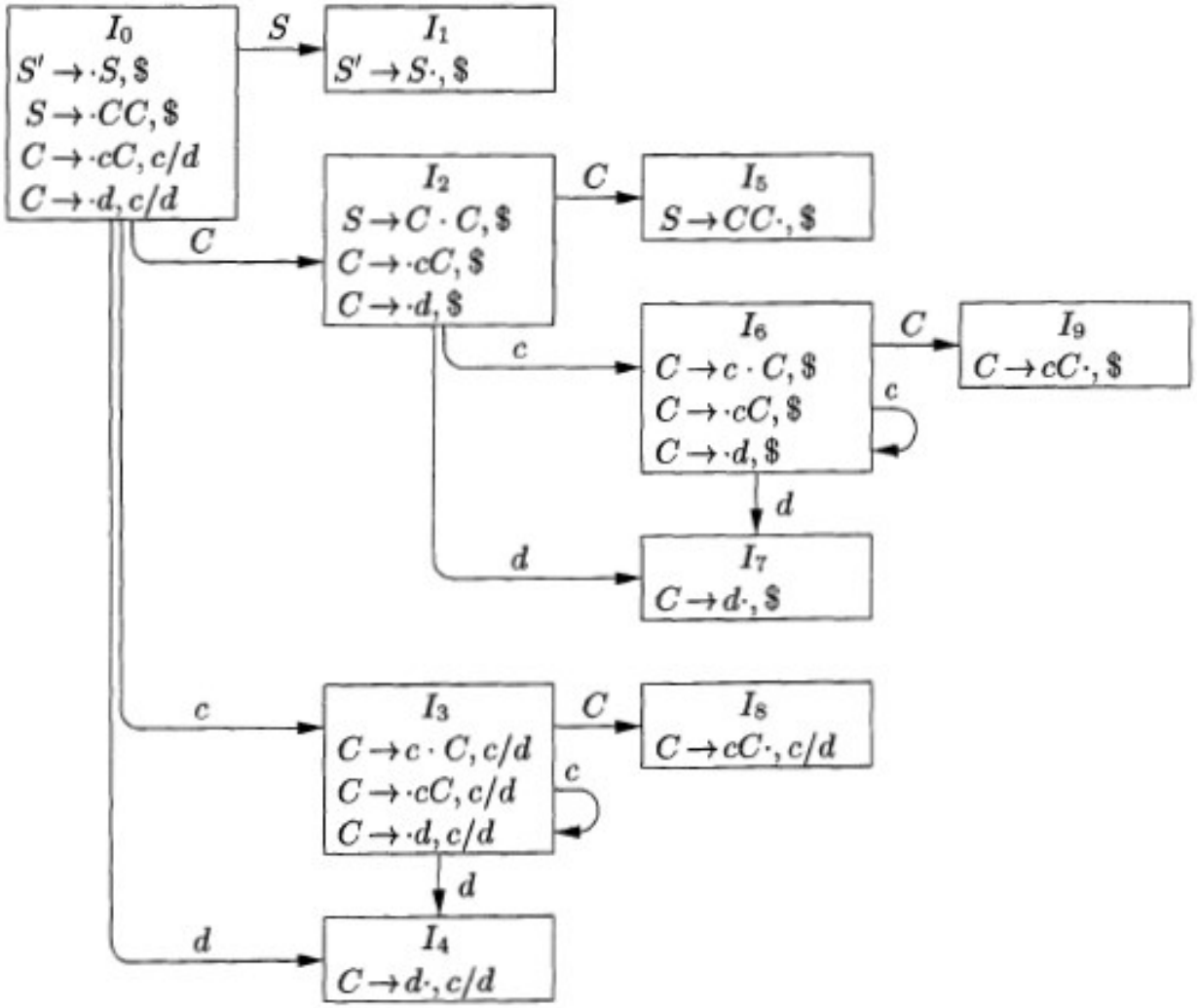
| State | Input | | | | Goto |
|---|---|---|---|---|---|
| | ( | a | ) | $ | A |
| 0 | s2 | s3 | | | 1 |
| 1 | | | | accept | |
| 2 | s5 | s6 | | | 4 |
| 3 | | | | r2 | |
| 4 | | | s7 | | |
| 5 | S5 | S6 | | | 8 |
| 6 | | | r2 | | |
| 7 | | | | r1 | |
| 8 | | | s9 | | |
| 9 | | | r1 | | |

# Parsing action

| Stack | Symbols | Input | Action |
|---|---|---|---|
| $0 | | (a)$ | shift |
| $02 | ( | a)$ | Shift |
| $026 | (a | )$ | Reduce A->a |
| $024 | (A | )$ | Shift |
| $0247 | (A) | $ | Reduce A->(A) |
| $0 1 | A | $ | accept |

S->CC

C->cC | d LR(1) DFA



# Parse table

| State | ACTION | | | GOTO | |
|---|---|---|---|---|---|
| | $c$ | $d$ | \$ | $S$ | $C$ |
| 0 | s3 | s4 | | 1 | 2 |
| 1 | | | acc | | |
| 2 | s6 | s7 | | | 5 |
| 3 | s3 | s4 | | | 8 |
| 4 | r3 | r3 | | | |
| 5 | | | r1 | | |
| 6 | s6 | s7 | | | 9 |
| 7 | | | r3 | | |
| 8 | r2 | r2 | | | |
| 9 | | | r2 | | |

# Parsing Action

| Stack | Symbols | Input | Action |
|---|---|---|---|
| $0 | | ccdd$ | Shift |
| $03 | c | cdd$ | shift |
| $033 | cc | dd$ | shift |
| $0334 | ccd | d$ | reduce C->d |
| $033 8 | ccC | d$ | reduce C->cC |
| $03 8 | cC | d$ | reduce c->cC |
| $02 | C | d$ | shift |
| $027 | Cd | $ | reduce C->d |
| $02 5 | CC | $ | reduce S->CC |
| $0 1 | S | $ | Accept |

# SLR(1)

S → L=R
S → R
L → *R
L → id
R → L

$I_0$: S' → .S
S → .L=R
S → .R
L → .*R
L → .id
R → .L

$I_1$: S' → S.

$I_2$: S → L.=R
R → L.

$I_3$: S → R.

$I_4$: L → *.R
R → .L
L → .*R
L → .id

$I_5$: L → id.

$I_6$: S → L=.R
R → .L
L → .*R
L → .id

$I_7$: L → *R.

$I_8$: R → L.

$I_9$: S → L=R.

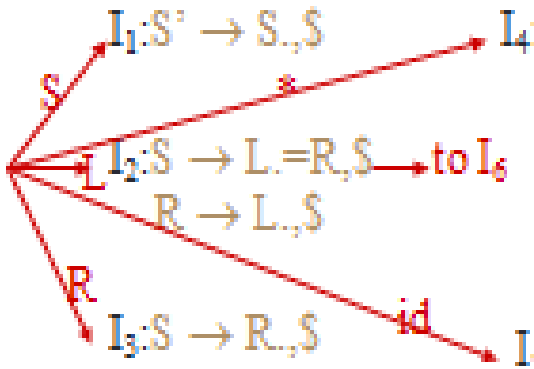
Problem

FOLLOW(R)={=,$}
= shift 6
reduce by R → L
shift/reduce conflict

# Canonical LR(1) Collection

S' → S
1) S → L=R
2) S → R
3) L → *R
4) L → id
5) R → L

$I_0$: S' → .S,$
S → .L=R,$
S → .R,$
L → .*R,$/=
L → .id,$/=
R → .L,$

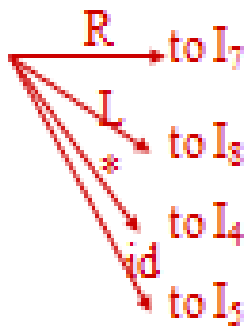



$I_1$: S' → S.,$

$I_2$: S → L.=R,$ → to $I_6$
R → L.,$

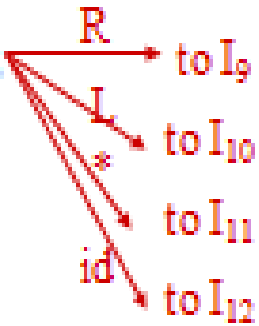
$I_3$: S → R.,$

$I_4$: L → *.R,$/=
R → .L,$/=
L → .*R,$/=
L → .id,$/=




$I_5$: L → id.,$/=

$I_6$: S → L=.R,$
R → .L,$
L → .*R,$
L → .id,$



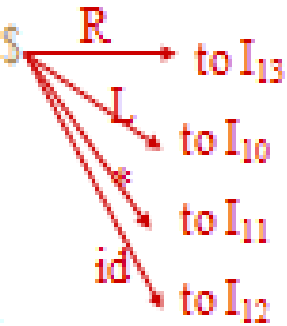

$I_7$: L → *R.,$/=

$I_8$: R → L.,$/=

$I_9$: S → L=R.,$

$I_{10}$: R → L.,$

$I_{11}$: L → *.R,$
R → .L,$
L → .*R,$
L → .id,$




$I_{12}$: L → id.,$

$I_{13}$: L → *R.,$

$I_4$ and $I_{11}$

$I_5$ and $I_{12}$

$I_7$ and $I_{13}$

$I_8$ and $I_{10}$

| | id | * | = | $ | S | L | R |
|---|---|---|---|---|---|---|---|
| 0 | s5 | s4 | | | 1 | 2 | 3 |
| 1 | | | | acc | | | |
| 2 | | | s6 | r5 | | | |
| 3 | | | | r2 | | | |
| 4 | s5 | s4 | | | | 8 | 7 |
| 5 | | | r4 | r4 | | | |
| 6 | s12 | s11 | | | | 10 | 9 |
| 7 | | | r3 | r3 | | | |
| 8 | | | r5 | r5 | | | |
| 9 | | | | r1 | | | |
| 10 | | | | r5 | | | |
| 11 | s12 | s11 | | | | 10 | 13 |
| 12 | | | | r4 | | | |
| 13 | | | | r3 | | | |

# LOOKAHEAD LR TECHNIQUE[LALR(1)]

- Often used in practice
- Parse table is smaller than CLR
- Most of the syntactic constructs can be expressed by LALR
- For a grammar, both SLR and LALR has same number of states.
- Every SLR(1) grammar is unambiguous, but there are unambiguous grammar that are not SLR(1)
- Shift reduce conflicts may arise unambiguous grammar as well.

# LOOKAHEAD LR TECHNIQUE[CONTD..]

- We go for more powerful parsers -> CLR and LALR.
- LALR is more powerful than SLR -> LR(1) items

## Advantages

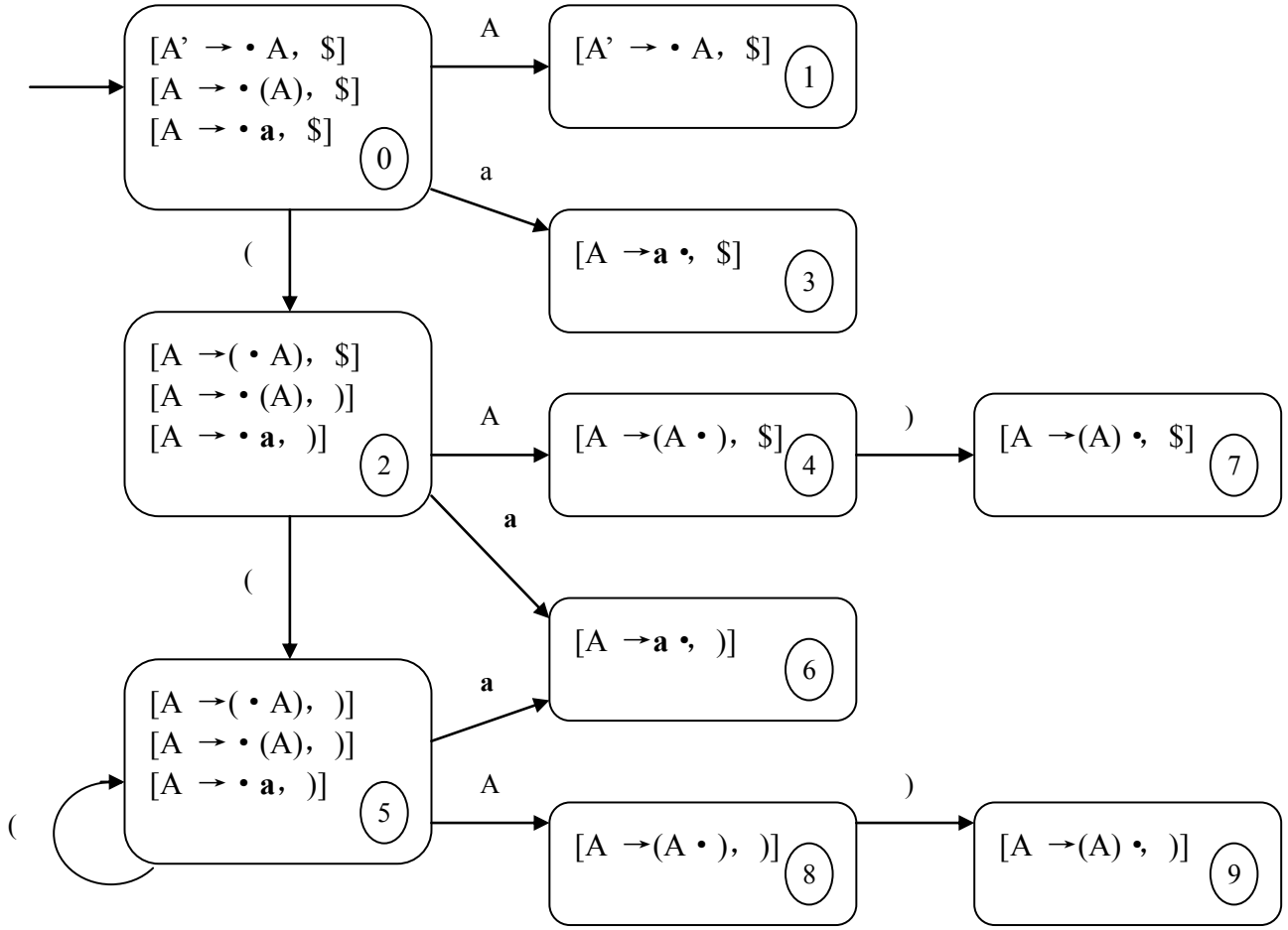
- There can never be shift reduce conflict
- We merge states
- But, still there may be reduce -reduce conflict.
- None of the parsers eliminate reduce – reduce conflict.

# LOOKAHEAD LR TECHNIQUE[CONTD..]

- How to merge states?
- Identify the states to be merged
- Merge states which has 1st part in common i.e LR(0) item but with different Lookahead , include both lookaheads in new merged state.

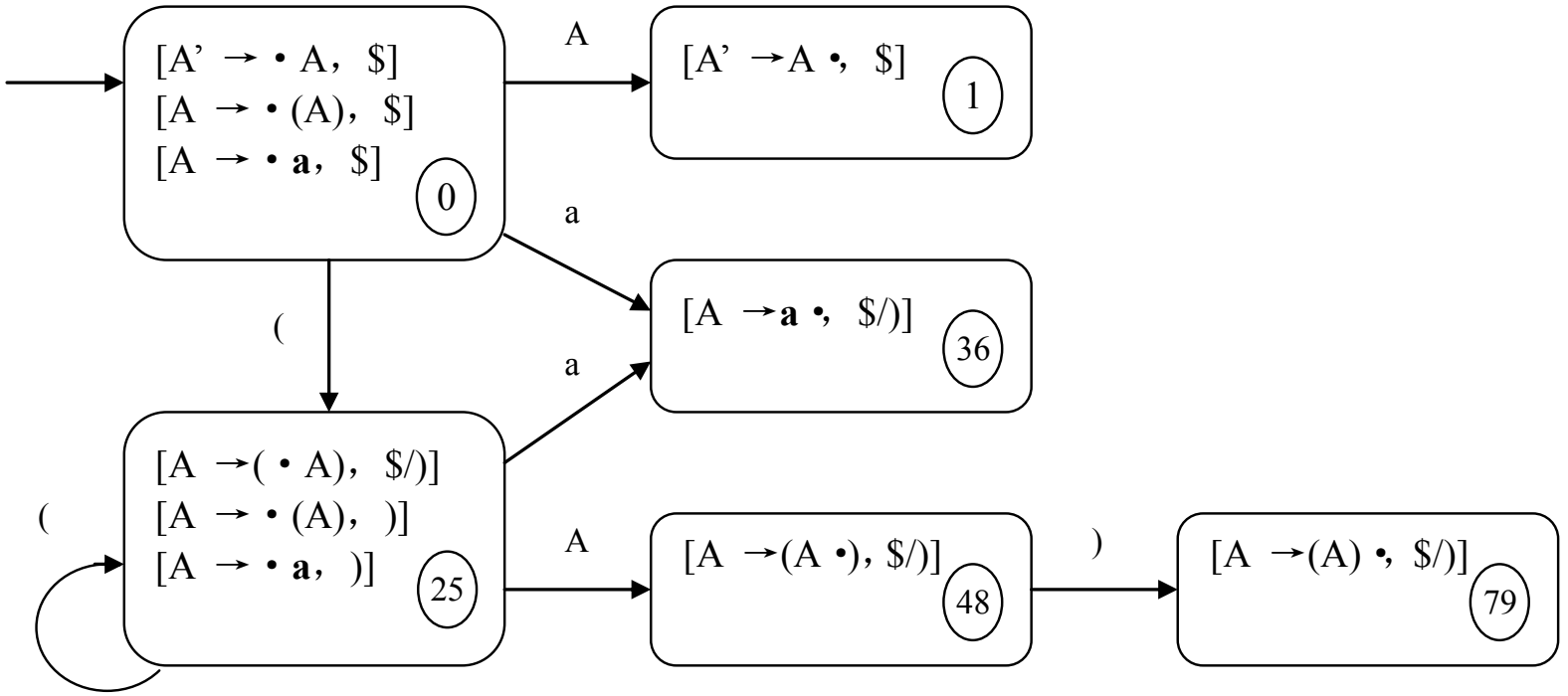
States 3 and 6
States 4 and 8
States 7 and 9
States 2 and 5

# LR(1)



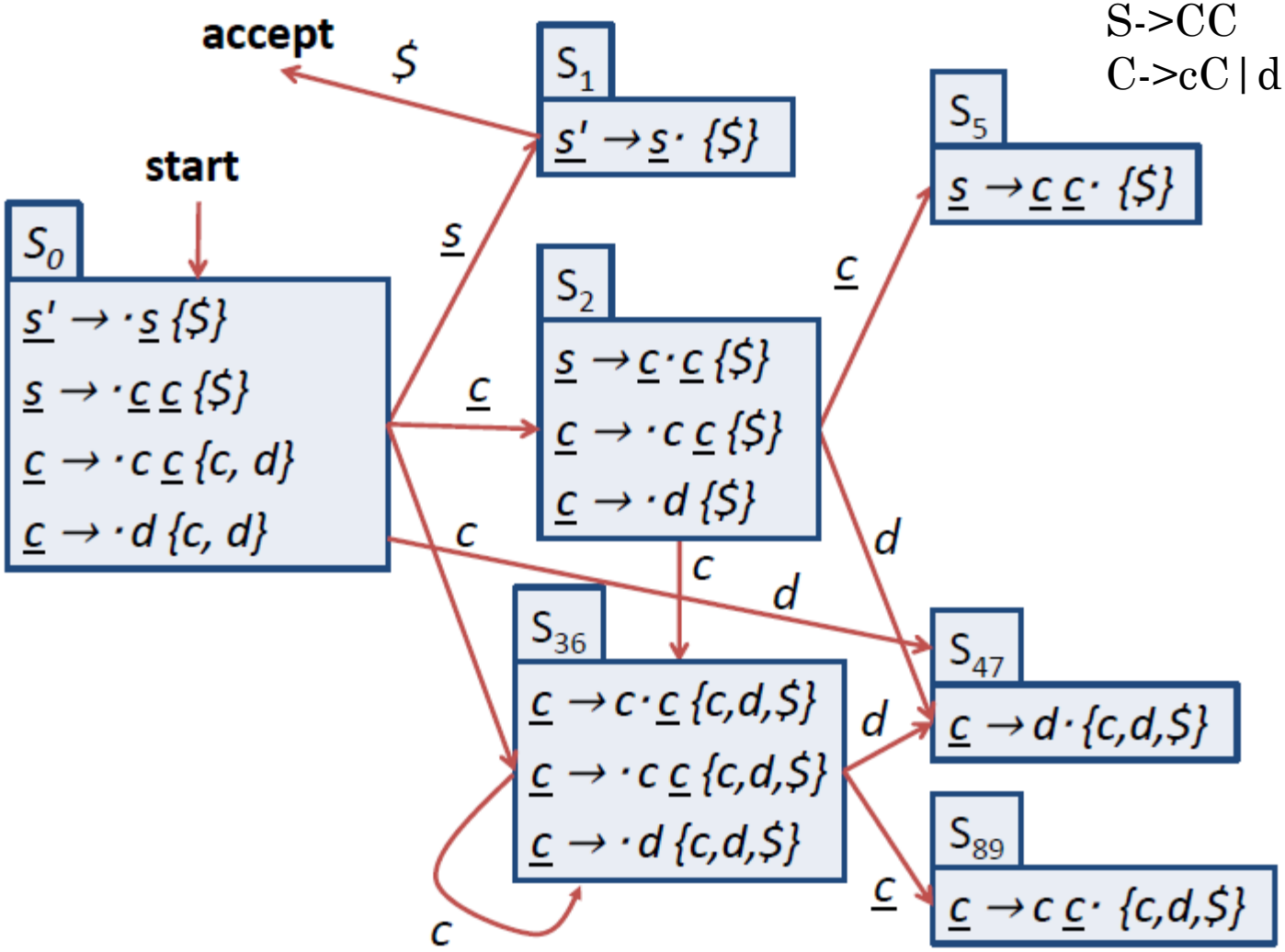
# LALR(1) DFA

A->(A) | a



# LALR(1) Automaton

S->CC
C->cC | d



# PARSE TABLE

| STATE | ACTION | | | GOTO | |
|---|---|---|---|---|---|
| | **c** | **d** | **$** | **S** | **C** |
| 0 | s36 | s47 | | 1 | 2 |
| 1 | | | accept | | |
| 2 | s36 | s47 | | | 5 |
| 36 | s36 | s47 | | | 89 |
| 47 | r3 | r3 | r3 | | |
| 5 | | | r1 | | |
| 89 | r2 | r2 | r2 | | |

# DRAW SLR, CLR AND LALR

1. S-> id | V:=E

   V->id

   E-> V | n

2. S->a | ↑ | ( R )

   T->S,T | S

   R->T

5) $T \to \cdot S$ 6) $R \to \cdot T$

LR(1)