CS & IT ENGINEERING

Compiler Design

Lexical and Syntax Analysis

Lecture No. 9

By- DEVA Sir

CLR and LALR CFG

How to check given CFG is CLR (LR(1)) or not?

Step 1: Construct CLR DFA

Step 2: Check SR and RR conflicts.

If no conflicts, then CFG is CLR.

How to construct CLR(1) parsing DFA ?

→ Use LR(1) Items

LR(0) Item

$X \to \alpha . \beta$

LR(1) Item

$X \to \alpha . \beta$, f

$X \to \alpha . \beta$: Actual Rule

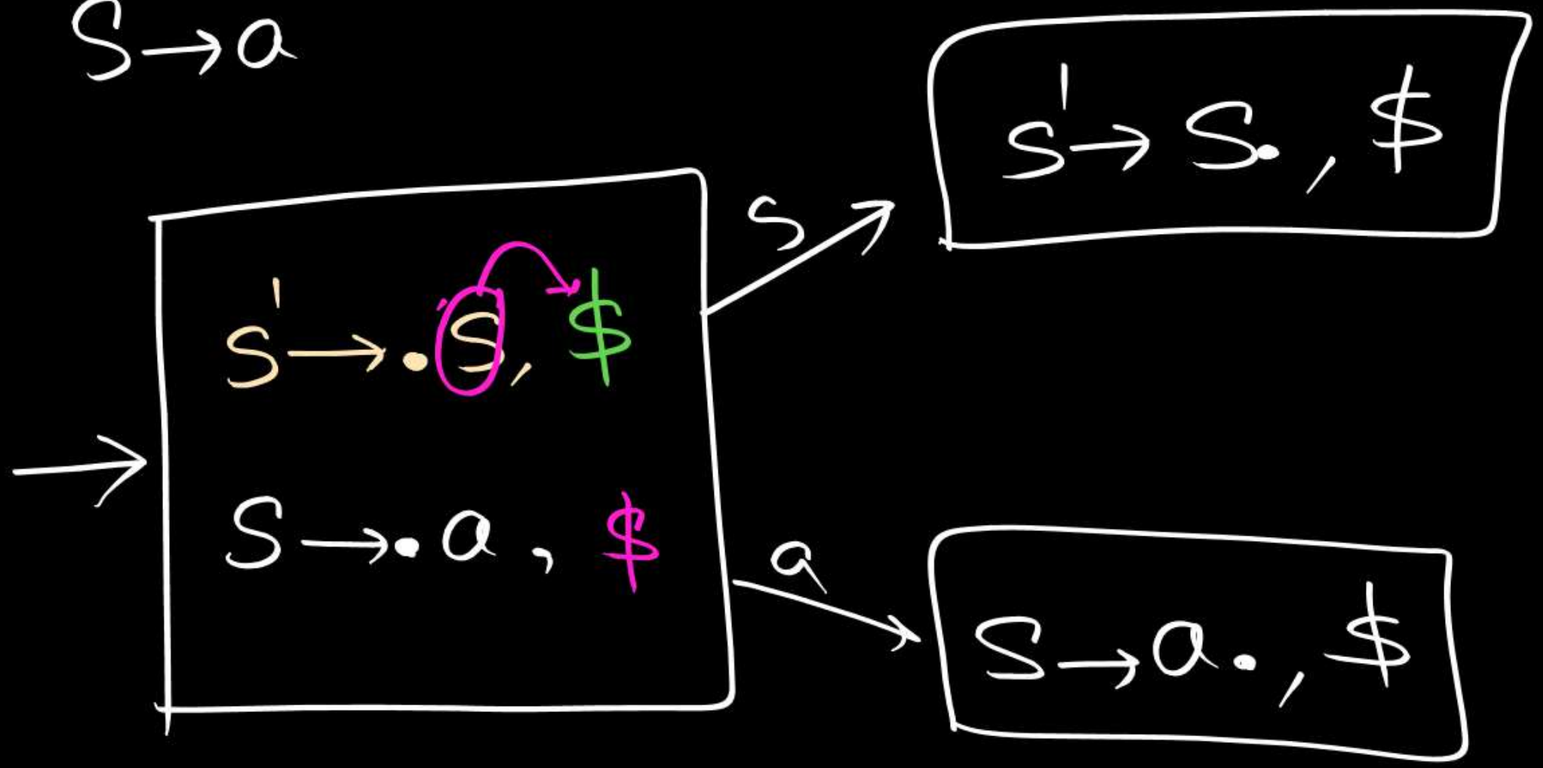
f : Look-a-heads

How to Compute Look-a-heads of Y in LR(1) Item?

$X \rightarrow \alpha . Y \beta , L_1$

$Y \rightarrow \square$, Look-a-heads of Y $= First(\beta L_1)$

① $S \to a$

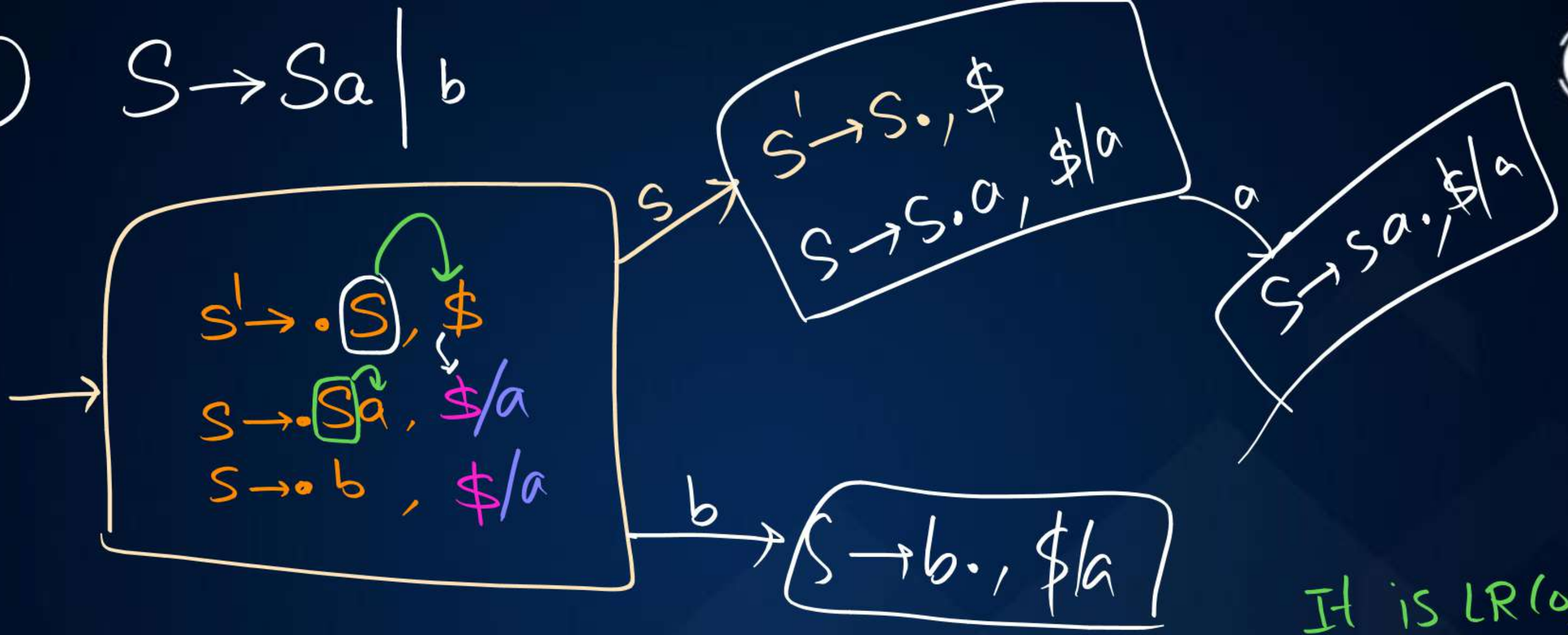


It is CLR(1) DFA
It is LALR(1) DFA

It is LR(0)
(SLR, LALR, CLR)

It is CLR.

② $S \to Sa \mid b$



It is LR(0)
(SLR, LALR, CLR)

$S' \rightarrow .S, \$$

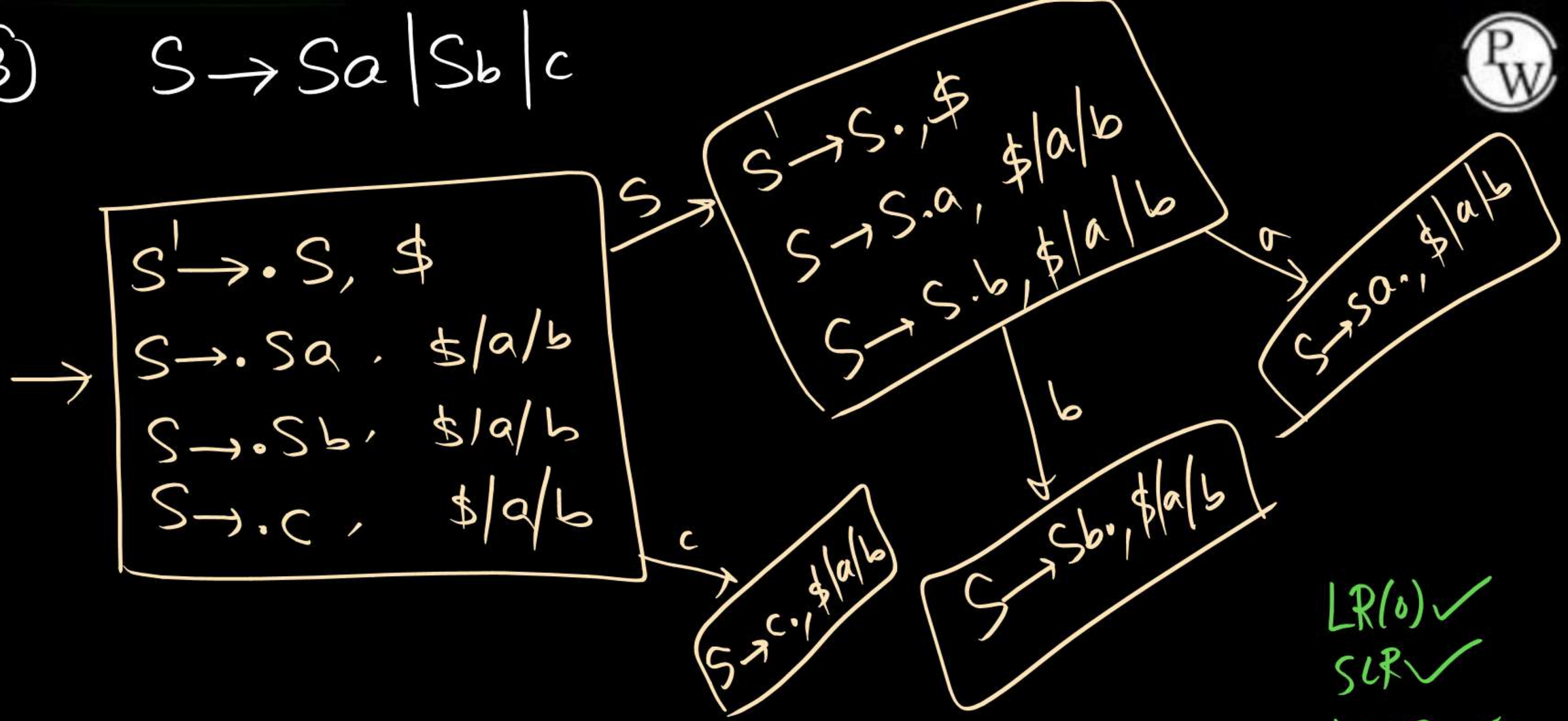
Now, we should write all S productions with look-a-head $

$S \rightarrow .Sa, \$/a$

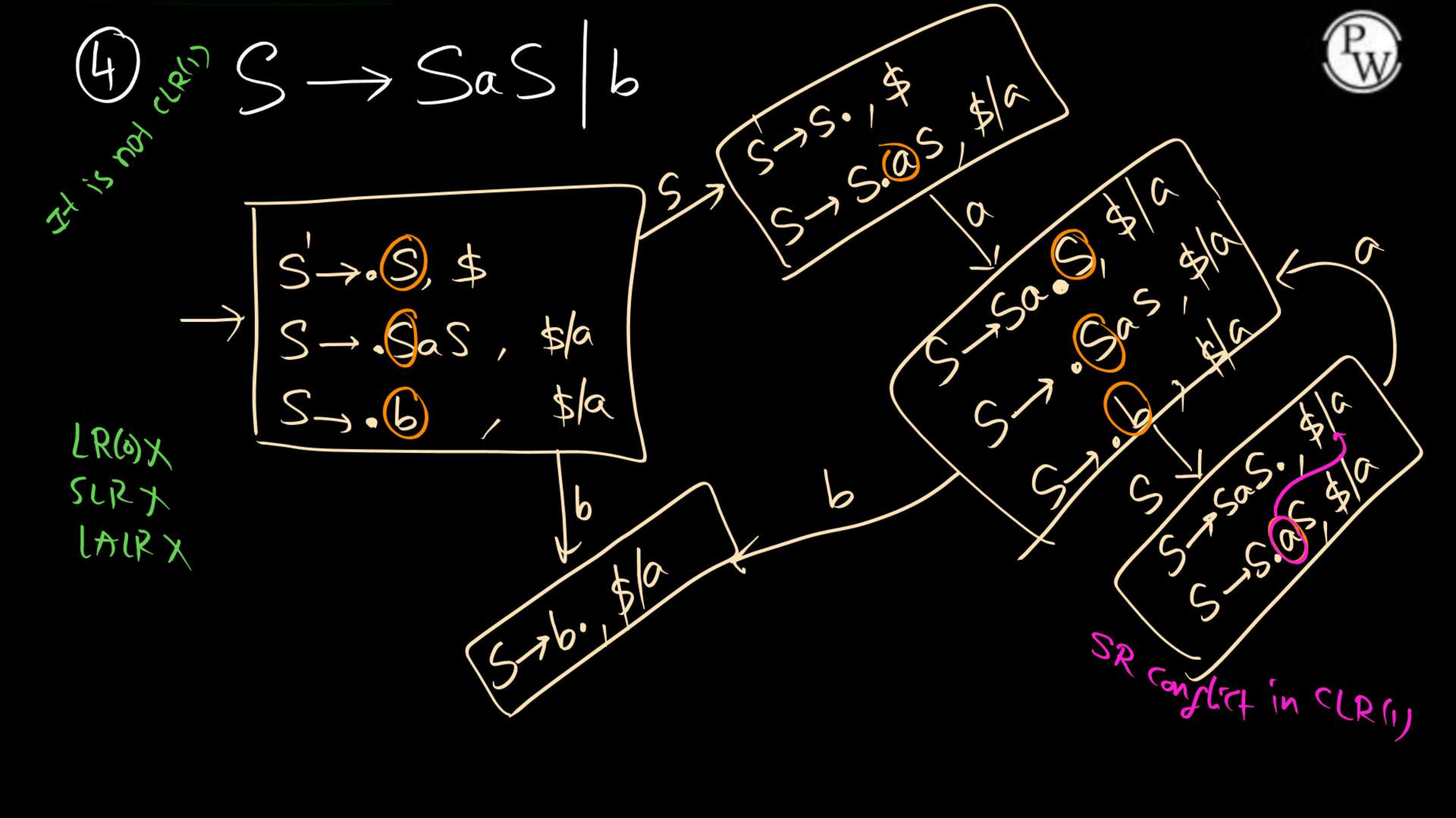
Now, we have to write S productions with look-a-head a.

$S \rightarrow .0, \$/1$

③ $S \to Sa \mid Sb \mid c$



LR(0) ✓
SLR ✓
LALR ✓
CLR ✓


④ S → SaS | b
It is not CLR(1)
LR(0) ✗
SLR ✗
LALR ✗
S' → .S , $
S → .SaS , $/a
S → .b , $/a
S
S → S. , $
S → S.aS , $/a
a
S → Sa.S , $/a
S → .SaS , $/a
S → .b , $/a
b
S → b. , $/a
S → SaS. , $/a
S → S.aS , $/a
SR conflict in CLR(1)

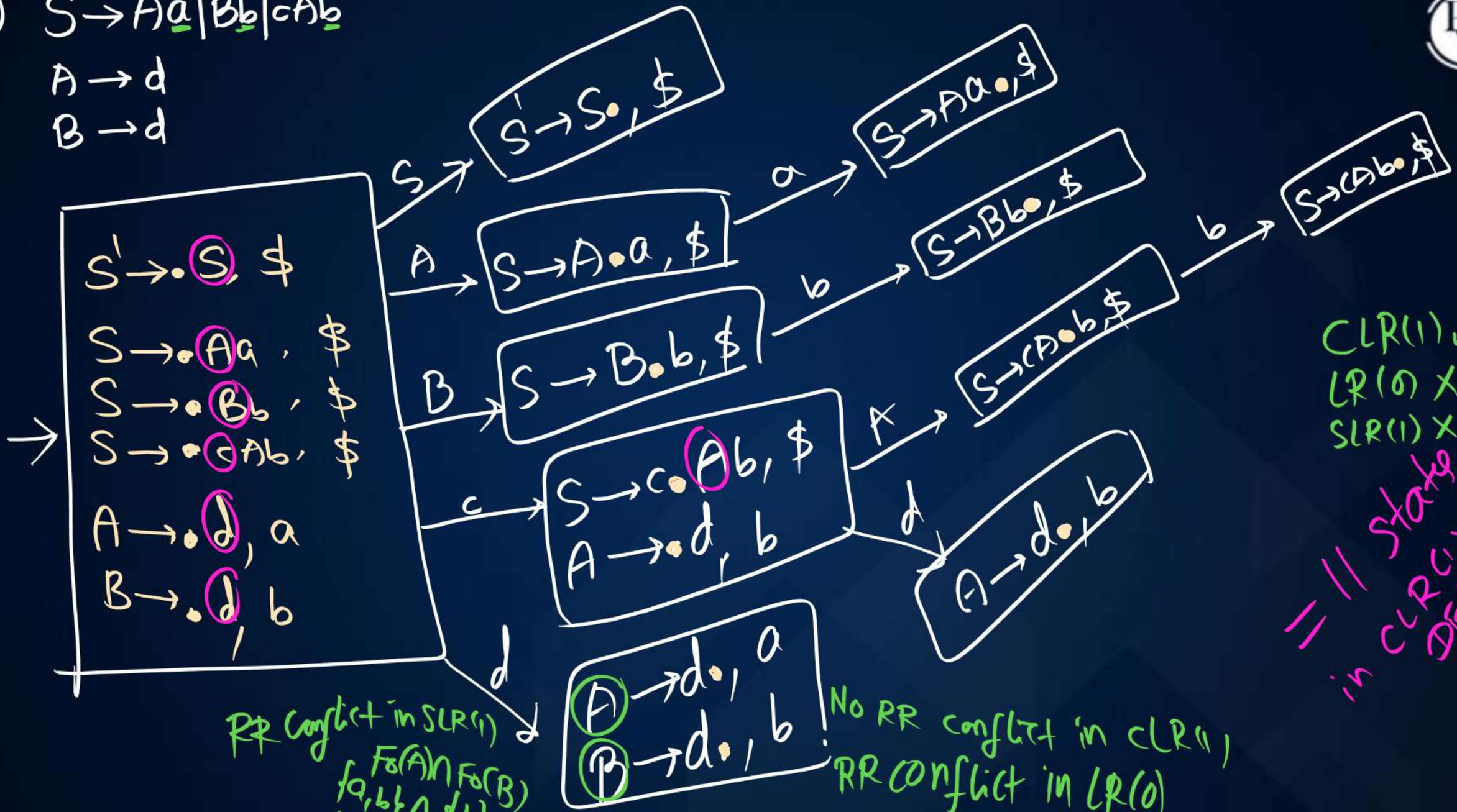
(5) $S \to SS \mid a$

It is not CLR(1)

⑥ $S \to Aa \mid Bb \mid cAb$

$A \to d$

$B \to d$



CLR(1) ✓
LR(0) ✗
SLR(1) ✗

= # states in CLR(1) DFA

Conflicts	LR(0)	SLR	CLR and LALR
SR conflict	$X \to \alpha . t \beta$ $Y \to \alpha .$ ⋮ State has both Shift & Reduced items	If $t \in$ Follow(Y) then SR conflict	$X \to \alpha . t \beta$, L_1 $Y \to \alpha .$, L_2 ⋮ If $t \in L_2$ then SR conflict
RR conflict	$X \to \alpha .$ $Y \to \alpha .$ ⋮ State has min 2 reduced items	If $Fo(X) \cap Fo(Y)$ is not empty then RR conflict	$X \to \alpha .$, L_1 $Y \to \alpha .$, L_2 ⋮ If $L_1 \cap L_2 \neq \phi$ then RR conflict

How to check given CFG is LALR(1) or not ?

Step1: construct CLR(1) DFA

Step2: We can construct LALR(1) DFA by merging states if they have same items where look-a-heads may be different

$A \to d\cdot, a$

$A \to d\cdot, c$

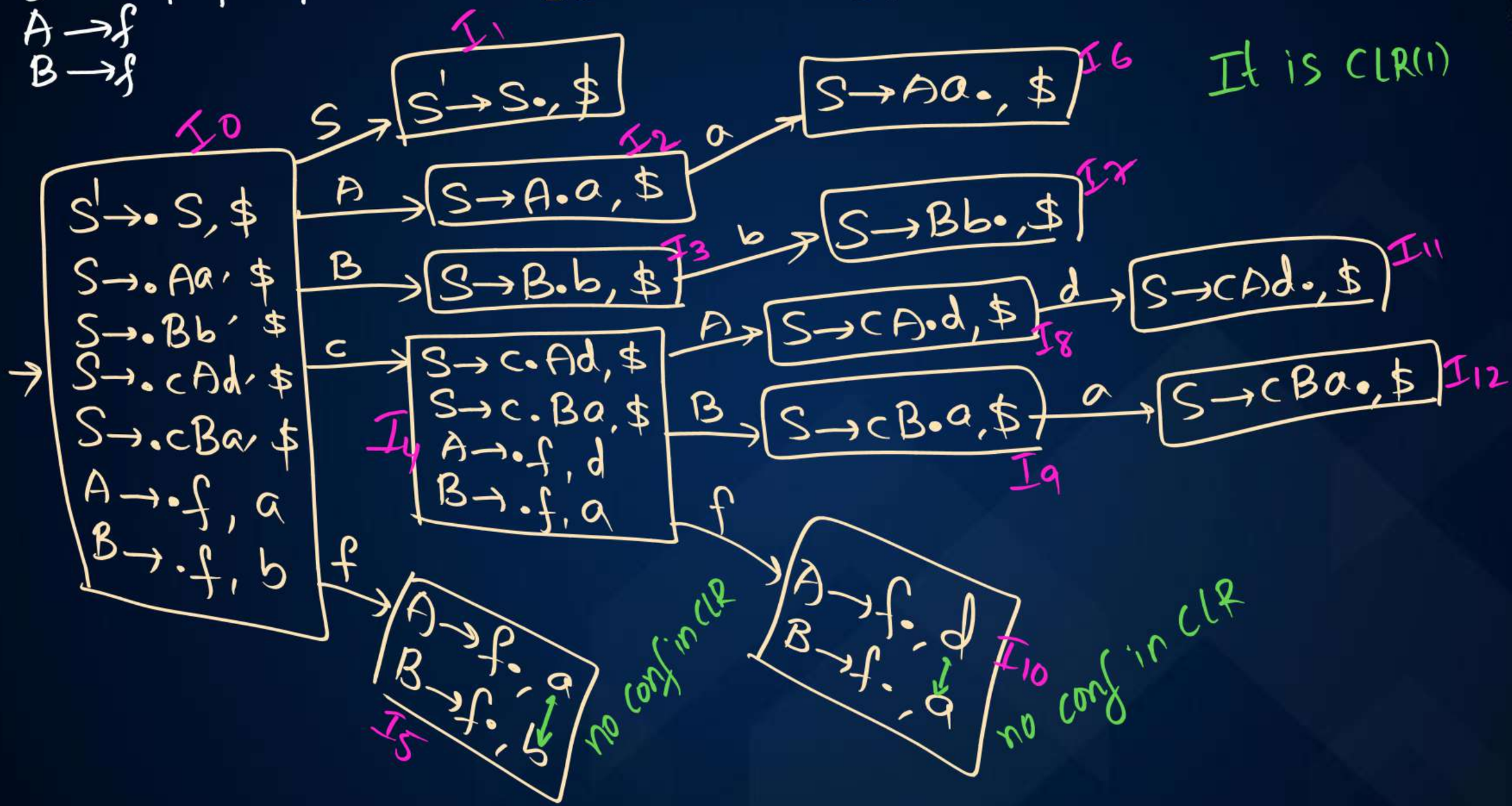
CLR(1) states

LALR(1) state

$A \to d\cdot, a/c$

$S \to Aa \mid Bb \mid cAd \mid cBa$
$A \to f$
$B \to f$

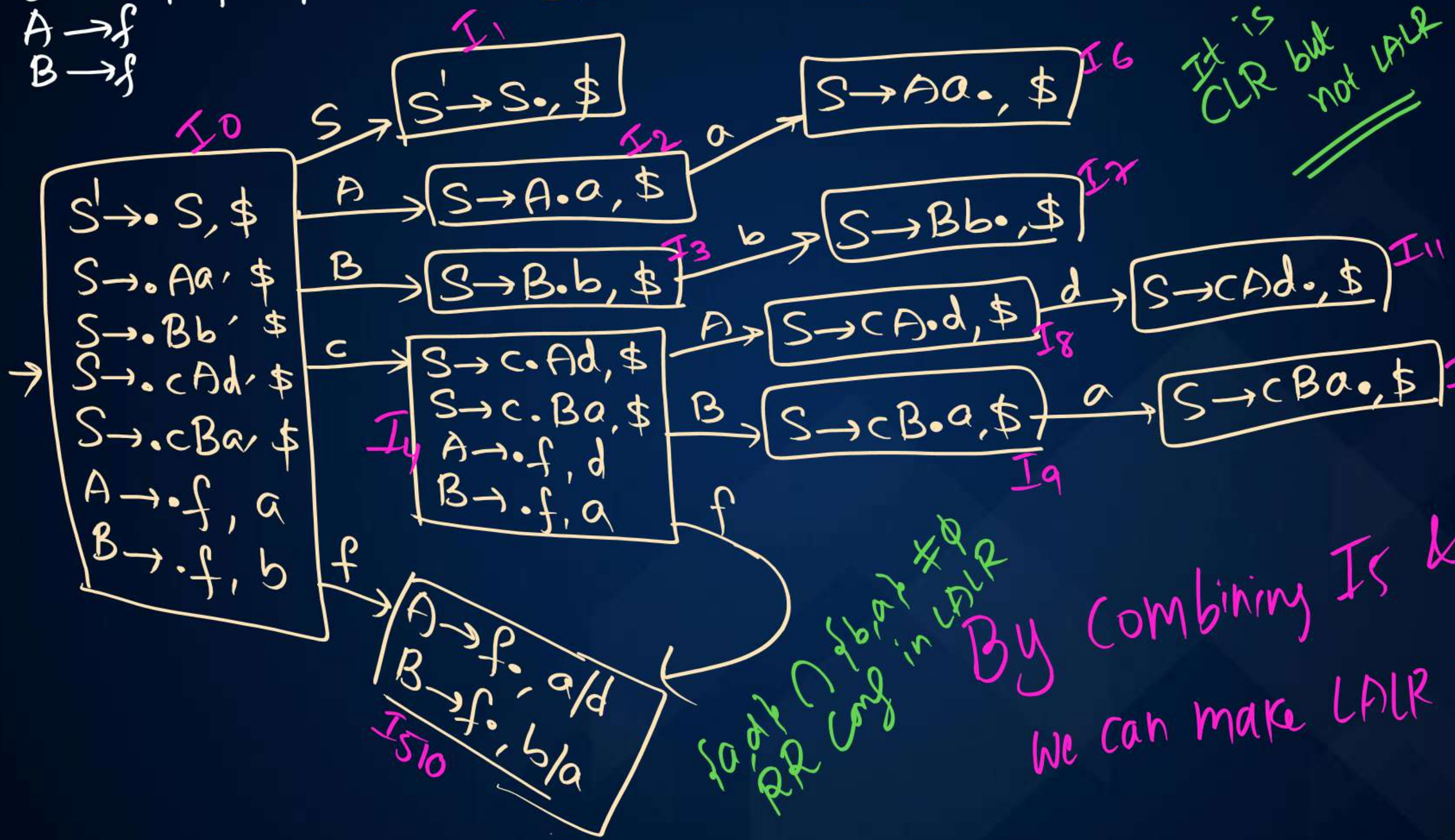
Construct CLR(1) DFA



It is CLR(1)

$S \to Aa \mid Bb \mid cAd \mid cBa$
$A \to f$
$B \to f$

Construct CLR(1) DFA



It is CLR but not LALR

$\{a, d\} \cap \{b, a\} \neq \phi$
RR Conf in LALR

By Combining I_5 & I_{10}

We can make LALR DFA.

No. of states :

$$n(\text{LR(0)}) = n(\text{SLR}) = n(\text{LALR}) \leq n(\text{CLR})$$

Power of parser :

$$\underbrace{\text{LR(0)}}_{\text{Less Powerful}} < \text{SLR} < \text{LALR} < \underbrace{\text{CLR}}_{\text{more Powerful}}$$

Summary

- CLR ✓
- LALR ✓
- Relations, Tables, Also. } Next


THANK YOU
GW
SOLDIERS !