CS 480

Translators (Compilers)


```
mov      rax, 0x0a687f
push     rax
xor      rax, rax
mov      rsi, rsp
mov      rdi, 1
mov      rdx, 8
call     write
```
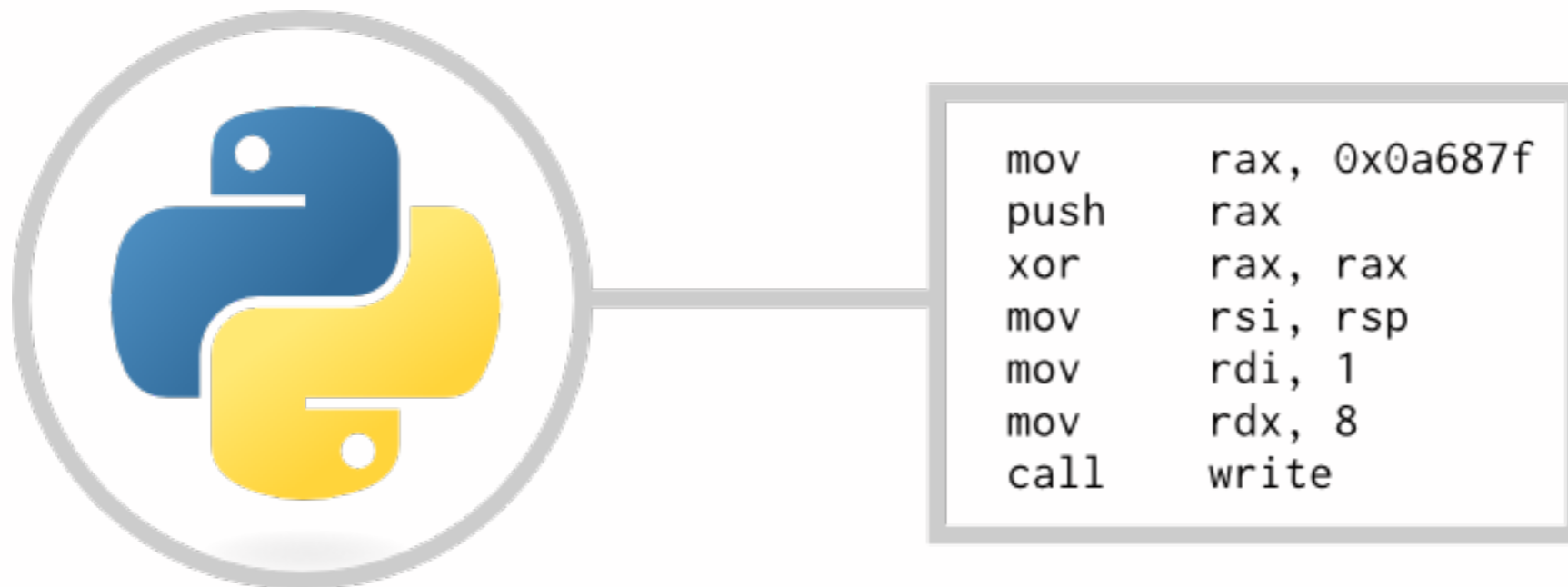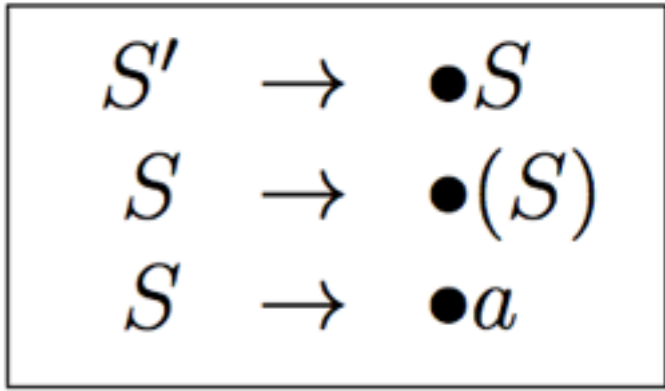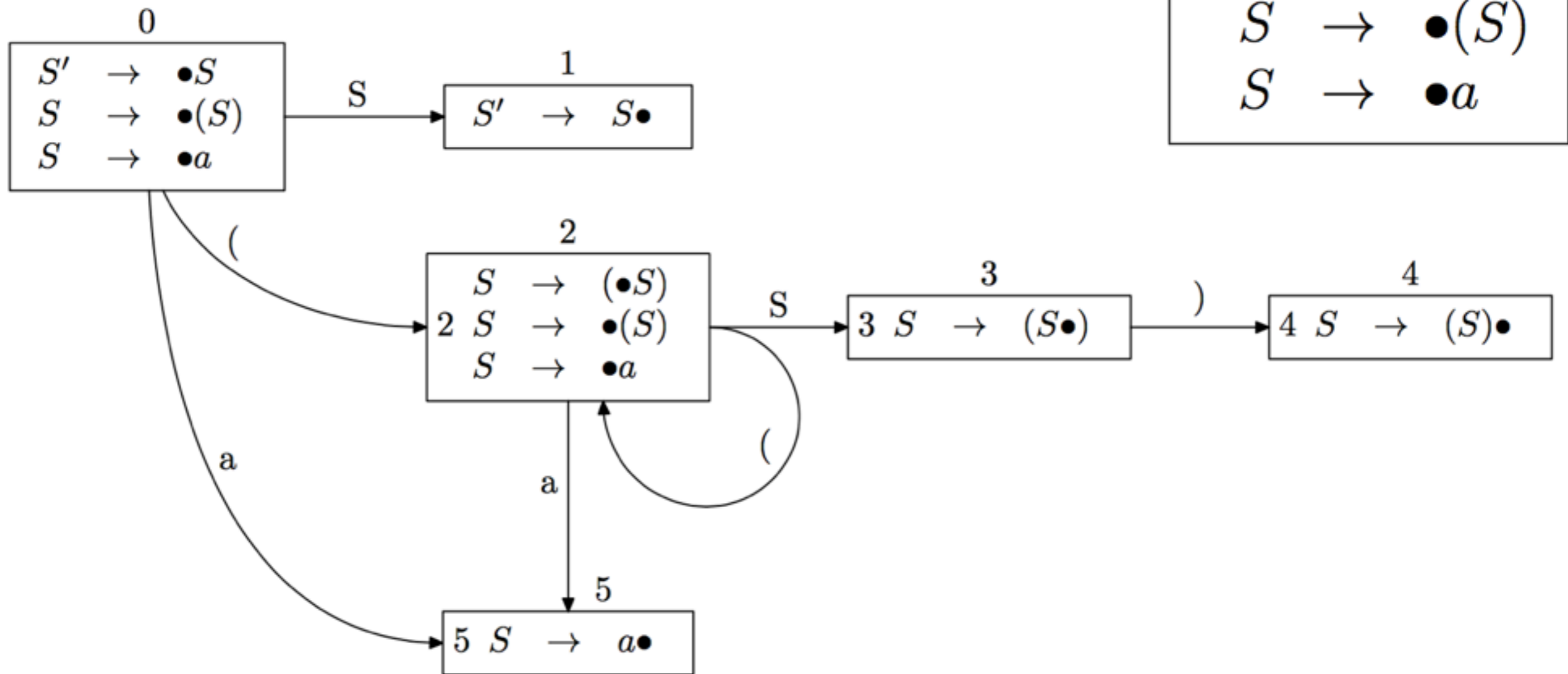
extra slides on LR(0), SLR(1), and LR(1) parsing

Instructor: Liang Huang

(materials extracted from David L. Hill's notes from Stanford CS 143)

LR(0) Parsing (no lookahead)

- very few grammars are in LR(0)

$$S' \rightarrow \bullet S$$
$$S \rightarrow \bullet (S)$$
$$S \rightarrow \bullet a$$

0

$$
\begin{array}{lcl}
S' & \rightarrow & \bullet S \\
S & \rightarrow & \bullet (S) \\
S & \rightarrow & \bullet a
\end{array}
$$

S

1

$$S' \rightarrow S\bullet$$

2

$$
\begin{array}{lcl}
S & \rightarrow & (\bullet S) \\
2\ S & \rightarrow & \bullet (S) \\
S & \rightarrow & \bullet a
\end{array}
$$

S

3

$$3\ S \rightarrow (S\bullet)$$

$)$

4

$$4\ S \rightarrow (S)\bullet$$

$($

(

a

a

5

$$5\ S \rightarrow a\bullet$$

LR(0) Fails on...

- a state has both shift and reduce or two reduces

State 0:
$$S' \to \bullet S$$
$$S \to \bullet Aa$$
$$S \to \bullet Bb$$
$$S \to \bullet ac$$
$$A \to \bullet a$$
$$B \to \bullet a$$

State 1:
$$S' \to S\bullet$$

State 2:
$$S \to A \bullet a$$

State 3:
$$S \to Aa\bullet$$

State 4:
$$S \to B \bullet b$$

State 5:
$$S \to Bb\bullet$$

State 6:
$$S \to a \bullet c$$
$$A \to a\bullet$$
$$B \to a\bullet$$

State 7:
$$S \to ac\bullet$$

Grammar:
$$0 \quad S' \to S$$
$$1 \quad S \to Aa$$
$$2 \quad S \to Bb$$
$$3 \quad S \to ac$$
$$4 \quad A \to a$$
$$5 \quad B \to a$$

3
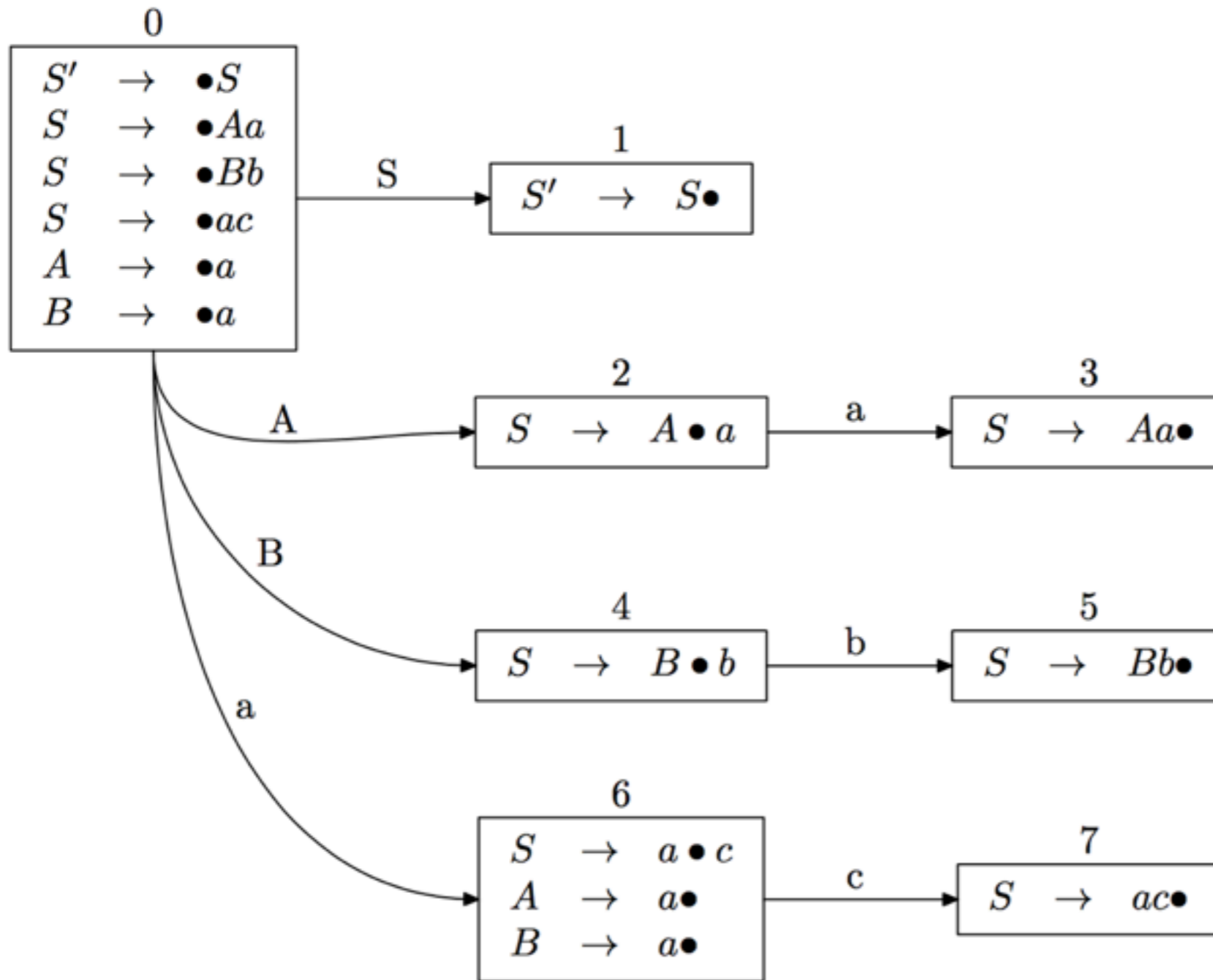
SLR(1) -- use FOLLOW sets

- FOLLOW sets are precomputed

0

S'	$\rightarrow$	$\bullet S$
S	$\rightarrow$	$\bullet Aa$
S	$\rightarrow$	$\bullet Bb$
S	$\rightarrow$	$\bullet ac$
A	$\rightarrow$	$\bullet a$
B	$\rightarrow$	$\bullet a$

S

1

$S' \rightarrow S\bullet$

2

$S \rightarrow A\bullet a$

a

3

$S \rightarrow Aa\bullet$

A

B

4

$S \rightarrow B\bullet b$

b

5

$S \rightarrow Bb\bullet$

a

6

S	$\rightarrow$	$a\bullet c$
A	$\rightarrow$	$a\bullet$
B	$\rightarrow$	$a\bullet$

c

7

$S \rightarrow ac\bullet$

S	$\rightarrow$	$a\bullet c$
A	$\rightarrow$	$a\bullet,$ $\{a\}$
B	$\rightarrow$	$b\bullet,$ $\{b\}$
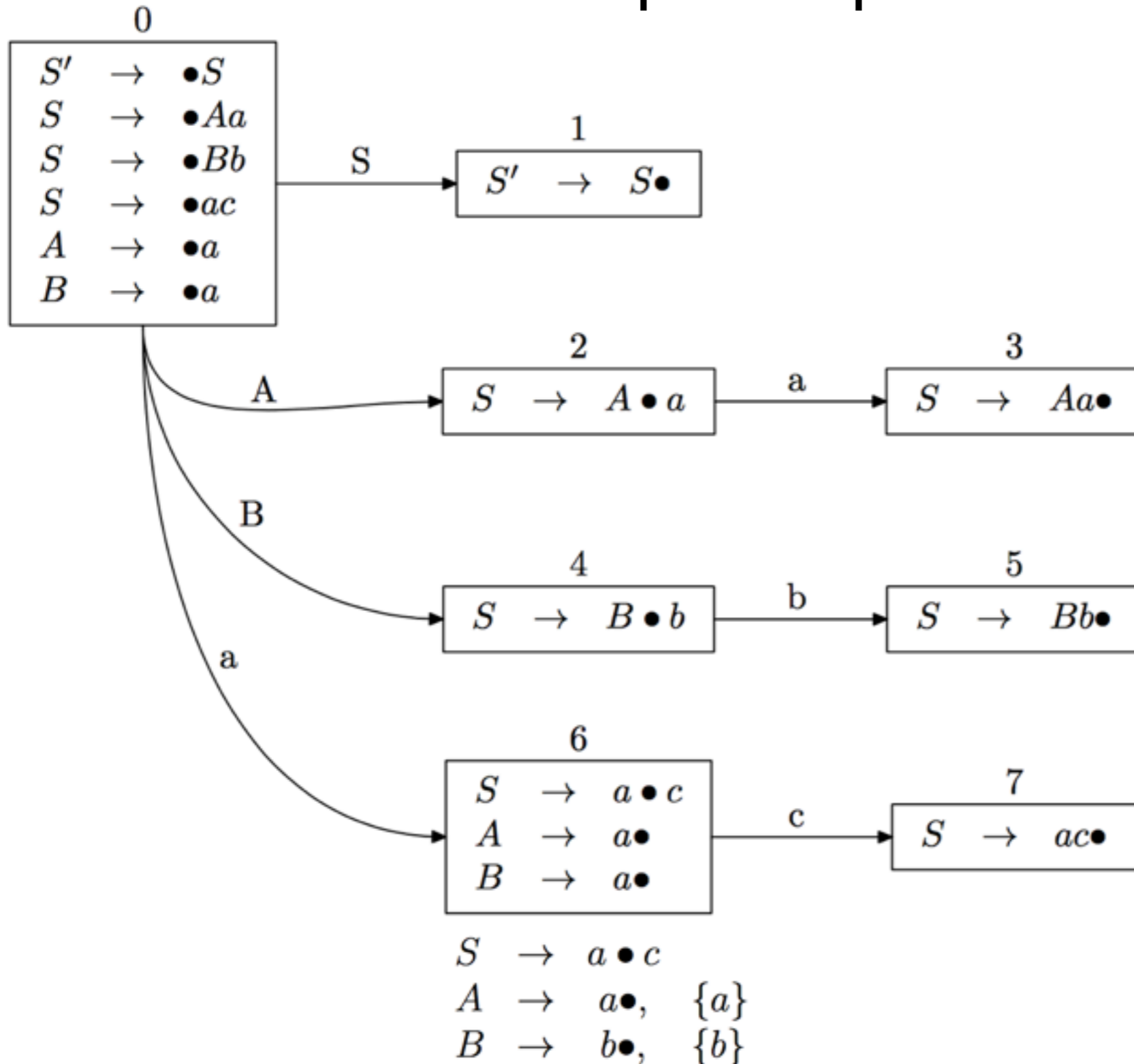
0	S'	$\rightarrow$	S
1	S	$\rightarrow$	Aa
2	S	$\rightarrow$	Bb
3	S	$\rightarrow$	ac
4	A	$\rightarrow$	a
5	B	$\rightarrow$	a

	ACTION				GOTO		
	a	b	c	$	S	A	B
0	s6				1	2	4
1				acc			
2	s3						
3				r1			
4		s5					
5				r2			
6	r4	r5	s7				
7				r3			

SLR(1) Fails on...

- unnecessary conflicts

$$
\begin{array}{rcl}
S' & \to & \bullet S \\
S & \to & \bullet Aa \\
S & \to & \bullet Bb \\
S & \to & \bullet bAb \\
A & \to & \bullet a \\
B & \to & \bullet a
\end{array}
$$

$$
\begin{array}{rcl}
A & \to & a\bullet \\
B & \to & a\bullet
\end{array}
$$

$$
\begin{array}{rcl}
S & \to & Aa \\
S & \to & Bb \\
S & \to & bAb \\
A & \to & a \\
B & \to & a
\end{array}
$$

LR(1)