# CS480
# Translators

What is Bottom Up Parsing?

Chap. 4

Oregon State University

# Quiz #6 (Answers)

$S \underset{rm}{\Rightarrow} 0S1 \Rightarrow 00S11 \Rightarrow 000111$

- S->0S1 | 01  Indicate the handle for:
  - 000111
  - 00S11

right sentential form

- S->SS+ | SS* | a  Indicate the handle for:
  - SSS+a*+
  - SS+a*a+
  - aaa*a++

$S \underset{rm}{\Rightarrow} SS+ \Rightarrow SSS*+ \Rightarrow SSa*+$
$\Rightarrow S\boxed{SS+}a*+$

- Give a bottom up parse for 000111 and aaa*a++

# LR(0) Conditions

on all symbols

1. For any configurating set containing the item A –> u•xv there is no complete item B –> w• in that set. In the tables, this translates to no shift-reduce conflict on any state. This means the successor function from that set either shifts to a new state or reduces, but not both.

2. There is at most one complete item A –> u• in each configurating set. This translates to no reduce-reduce conflict on any state. The successor function has at most one reduction.

$E \to E + T$
$E \to T$
$T \to (E)$
$T \to id$

# Create a LR(0) Parse Table

| State on Stack | id | + | ( | ) | $ | E | T |
|---|---|---|---|---|---|---|---|
| 0 | s4 | | s3 | | | 1 | 2 |
| 1 | | s5 | | | accept | | |
| 2 | r2 | r2 | r2 | r2 | r2 | | |
| 3 | s4 | | s3 | | | 6 | 2 |
| 4 | r4 | r4 | r4 | r4 | r4 | | |
| 5 | s4 | | s3 | | | | 8 |
| 6 | | s5 | | s7 | | | |
| 7 | r3 | r3 | r3 | r3 | r3 | | |
| 8 | r1 | r1 | r1 | r1 | r1 | | |

- Let’s parse: id + (id)

# What if we change the grammar?

E'->E

1 E -> E**+**T

2 E -> T

3 T -> **(**E**)**

4 T -> **id**

5 T -> **id[**E**]**

LR(0) grammar

why not LR(0)?

added a production

$I_0$ $E' \to .E$ $I_1$
$E \to .E+T$ $I_1$
$E \to .T$ $I_2$
$T \to .(E)$ $I_3$
$T \to .id$ $I_4$
$T \to .id[E]$ $I_4$

$I_1$ $E' \to E.$ Accept
$E \to E.+T$ $I_5$

$I_2$ $E \to T.$ R2

# Collection of Configurating Sets

| *Configurating set* | *Successor* |
|---|---|
| I0: E' –> •E | I1 |
| 1 E –> •E+T | I1 |
| 2 E –> •T | I2 |
| 3 T –> •(E) | I3 |
| 4 T –> •id | I4 |
| 5 T –> •id[E] | I4 |
| I1: E' –> E• | Accept |
| E –> E•+T | I5 |
| I2: E –> T• | Reduce 2 |
| I3: T –> (•E) | I6 |
| E –> •E+T | I6 |
| E –> •T | I2 |
| T –> •(E) | I3 |
| T –> •id | I4 |
| T –> •id[E] | I4 |
| I4: T –> id• | Reduce 4 |
| T –> id•[E] | I9 |

+, ), ], $

| *Configurating set* | *Successor* |
|---|---|
| I5: E –> E+•T | I8 |
| T –> •(E) | I3 |
| T –> •id | I4 |
| T –> •id[E] | I4 |
| I6: T –> (E•) | I7 |
| E –> E•+T | I5 |
| I7: T –> (E)• | Reduce 3 |
| I8: E –> E+T• | Reduce 1 |
| I9: T –> id[•E] | I10 |
| E –> •E+T | I10 |
| E –> •T | I2 |
| T –> •(E) | I3 |
| T –> •id | I4 |
| T –> •id[E] | I4 |
| I10: T –> id[E•] | I11 |
| E –> E•+T | I5 |
| I11: T –> id[E]• | Reduce 5 |

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# Construct SLR(1) Table

1. Construct F = $\{I_0, I_1, \ldots I_n\}$, the collection of configurating sets for G'.

2. State i is determined from $I_i$. The parsing actions for the state are determined as follows:

   a) If A –> $\underline{u}$• is in $I_i$ then set Action[i,a] to reduce A –> $\underline{u}$ for all a in Follow(A) (A not equal to S').

   b) If S' –> S• is in $I_i$ then set Action[i,$] to accept.

   c) If A –> $\underline{u}$•a$\underline{v}$ is in $I_i$ and successor($I_i$, a) = $I_j$, then set Action[i,a] to shift j (a is a terminal).

3. The goto transitions for state i are constructed for all nonterminals A using the rule: If successor($I_i$, A) = $I_j$, then Goto [i, A] = j.

4. All entries not defined by rules 2 and 3 are errors.

5. The initial state is the one constructed from the configurating set containing S' –>S.

# What are the Follows?

Is it SLR(1)?

E'->E

E -> E**+**T

E -> T

T -> **(**E**)**

T -> **id**

T -> **id[**E**]**

- Follow(E)? = { +, ), ], $ }
- Follow(T)?

start

# SLR(1) Parse Table

| State on Stack | id | + | ( | ) | [ | ] | $ | E | T |
|---|---|---|---|---|---|---|---|---|---|
| 0 | s4 | | s3 | | | | | 1 | 2 |
| 1 | | s5 | | | | | accept | | |
| 2 | | r2 | | r2 | | r2 | r2 | | |
| 3 | s4 | | s3 | | | | | 6 | 2 |
| 4 | | r4 | | r4 | s9 | r4 | r4 | | |
| 5 | s4 | | s3 | | | | | | 8 |
| 6 | | s5 | | s7 | | | | | |
| 7 | | r3 | | r3 | | r3 | r3 | | |
| 8 | | r1 | | r1 | | r1 | r1 | | |
| 9 | s4 | | s3 | | | | | 10 | 2 |
| 10 | | s5 | | | | s11 | | | |
| 11 | | r5 | | r5 | | r5 | r5 | | |

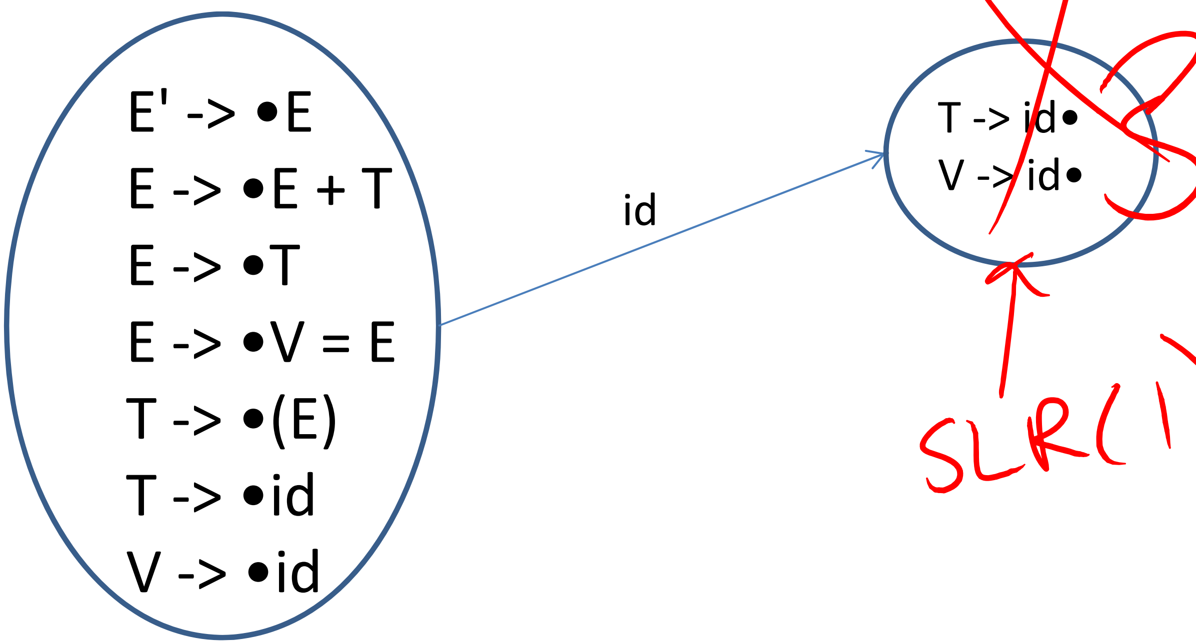
# Let’s consider another example

E' –> E

E –> E + T | T | V = E

T –> (E) | id

V –> id




~~LR(0)~~

Follow(E) = {+, ), $}

Follow(T) 〃

Follow(V) = {=}

SLR(1)

# SLR(1) Conditions

1. For any item A –> u•xv in the set, with terminal x, there is no complete item B –>w• in that set with x in Follow(B). In the tables, this translates no shift-reduce conflict on any state. This means the successor function for x from that set either shifts to a new state or reduces, but not both.

2. For any two complete items A –> u• and B –> v• in the set, the follow sets must be disjoint, e.g. Follow(A) ∩ Follow(B) is empty. This translates to no reduce-reduce conflict on any state. If more than one nonterminal could be reduced from this set, it must be possible to uniquely determine which using only one token of lookahead.

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# Quiz #7

Follow(S) = {$}

- Determine if the grammar is LR(0) or SLR(1)

S' -> S

1 *S*->**real** *IDLIST*

2 *IDLIST*->*IDLIST*, *ID*

3 *IDLIST*->*ID*

4 *ID*->**A**|**B**|**C**|**D**

$I_0$ S' -> .S $I_1$
S -> .real IDLIST $I_2$

$I_1$ S' -> S. Accept

$I_2$ S -> real .IDLIST $I_3$
IDLIST -> .IDLIST , ID $I_3$
-> .ID $I_4$
ID -> .A|B|C|D $I_5$

- Construct the corresponding parse table for the grammar.
- Show how you would parse **real A, B, C**

$I_3$ S -> real IDLIST . R1
IDLIST -> IDLIST . , ID $I_6$