

CMSC 430, Practice Problems 2

1. Bottom up parsing

- a. Describe the difference between bottom-up and top-down parsing with respect to a grammar production $A \rightarrow \beta$
- b. Define handle
- c. Explain why bottom-up parsers result in right-most derivations in reverse.
- d. Given the following ACTION/GOTO table, perform a parse of “a”, assuming 0 is the start state. Show the contents of the stack, remaining input, and action performed at each step of the shift-reduce parse.

State	Action		Goto	
	a	\$	A	B
0	shift 1	reduce $B \rightarrow \epsilon$	2	3
1	shift 3	reduce $A \rightarrow a$	0	
2		accept	3	0
3	shift 1	accept		1

2. LR parsing

- a. What is the canonical set of LR(k) items for a grammar?
- b. What are ACTION/GOTO tables of an LR(k) parser for a grammar?
- c. Given an LR(k) item $[A \rightarrow \alpha \bullet \gamma, \delta]$ from a production $A \rightarrow \beta$, describe the role of $A, \alpha, \gamma, \delta$
- d. Given an LR(k) item $[A \rightarrow \alpha \bullet \gamma, \delta]$, what lookahead allows a shift to be performed (ignoring any other LR(k) items added to the state by closure)?
- e. Given an LR(k) item $[A \rightarrow \alpha \bullet \gamma, \delta]$, what LR(k) items must be added to the closure?
- f. If the parser is in a state containing an LR(k) item $[A \rightarrow \alpha \bullet \gamma, \delta]$, what must be at the top of the stack, and why?
- g. Describe what constitutes a shift/reduce conflict
- h. Give an example of two LR(1) items causing a reduce/reduce conflict.
- i. Explain why there are no shift/shift conflicts

3. LALR parsing.

Consider the following sets of LR(1) items in the states of a LR(1) parser.

State 0:

$[A \rightarrow \bullet a, b]$
 $[A \rightarrow a \bullet, c]$
 $[B \rightarrow a \bullet, b]$

State 2:

$[A \rightarrow \bullet a, c]$
 $[A \rightarrow a \bullet, b]$
 $[B \rightarrow a \bullet, a]$

State 1:

$[A \rightarrow \bullet a, a]$
 $[A \rightarrow \bullet a, b]$
 $[B \rightarrow a \bullet, b]$

State 3:

$[A \rightarrow \bullet a, b]$
 $[B \rightarrow \bullet a, b]$

- a. Find all shift/reduce and reduce/reduce conflicts. List the LR(1) items and lookaheads causing conflicts.
 - b. What states would be merged in a LALR(1) parser?
 - c. Are any new reduce/reduce conflicts introduced in the LALR(1) parser?
 - d. Explain why LALR(1) parsers will not introduce new shift/reduce conflicts.
 - e. What is the relationship between LALR(1) and SLR(1) parsers?
4. Consider the following grammar: $S \rightarrow abS \mid acS \mid c$
- a. Compute FOLLOW(S)
 - b. Compute the canonical set of LR(0) items for the grammar
 - c. Build the ACTION/GOTO table using LR(0) + FOLLOW
 - d. Explain why the grammar is or is not SLR(1)
 - e. Use the ACTION/GOTO table to parse the string “abc”
5. Consider the following grammar: $S \rightarrow Sa \mid Sc \mid c$
- a. Compute the canonical set of LR(1) items for the grammar
 - b. Build the ACTION/GOTO table for the grammar
 - c. Explain why the grammar is or is not LR(1)
 - d. Use the ACTION/GOTO table to parse the string “caca”
6. Consider the following grammar: $S \rightarrow S + S \mid S * S \mid (S) \mid \text{num}$
- a. Compute the canonical set of LR(1) items for the grammar
 - b. Build the ACTION/GOTO table for the grammar
 - c. Explain why the grammar is or is not LR(1)
 - d. Explain how to use the ACTION/GOTO table so that
 - i. * has higher precedence than + and *, + are both left associative
 - ii. * has higher precedence than +, * is left associative, and + is right associative
 - iii. + has higher precedence than * and *, + are both right associative
7. Consider the following grammar: $S \rightarrow AS \mid b \quad A \rightarrow SA \mid a$
- a. Compute the canonical set of LR(0) items for the grammar
 - b. Build the ACTION/GOTO table for the grammar
 - c. Compute the canonical set of LR(1) items for the grammar
 - d. Build the ACTION/GOTO table for the grammar
8. Consider the following grammar: $S \rightarrow S ; a \mid a$
- a. Is the grammar SLR(1)? Is it LR(1)?
9. Consider the following grammar: $S \rightarrow aAd \mid bBd \mid aBe \mid bAe \quad A \rightarrow c \quad B \rightarrow c$
- a. Is the grammar LR(1)? Is it LALR(1)?
10. Consider the following grammar: $S \rightarrow Aa \mid bAc \mid Bc \mid bBa \quad A \rightarrow d \quad B \rightarrow d$
- a. Is the grammar LR(1)? Is it LALR(1)?