CMPT 379: Principles of Compiler Design

Syntax Analysis Worksheet (Answers)

1. Given language $\left\{wcw^R | w \in (a|b)*\right\}$ (w^R is w in reverse), write a CFG which produces this language.

2. Given language $\left\{a^n b^m c^m d^n | n \geq 1, m \geq 1\right\}$, write a CFG which produces this language.

3. Does bottom-up parsing create a rightmost or leftmost derivation?

4. Where is a handle located?

5. Given the production rules in table 1, write out the parse tree for the string $id + id * id$.

Figure 1: Question 5: Production Rules

$$E \to E + E$$
$$E \to E * E$$
$$E \to id$$

6. Given the production rules in table 2, write out the parse tree for the string $int * int + int$.

Figure 2: Question 6: Production Rules

$$E \to T + E$$
$$E \to T$$
$$T \to int$$
$$T \to int * T$$
$$T \to (E)$$

7. Given the production rules and action/goto table in figure 3, write the trace of the LR(0) parse.

Figure 3: Question 7: Production Rules and Action/Goto Table

	Production Rules
1	$T \rightarrow F$
2	$T \rightarrow T * F$
3	$F \rightarrow id$
4	$F \rightarrow (T)$

States	**Actions**					**Gotos**	
	*	(	)	id	$	T	F
0		S5		S8	2	1	
1	R1	R1	R1	R1	R1		
2	S3				ACC		
3		S5		S8		4	
4	R2	R2	R2	R2	R2		
5		S5		S8		6	1
6	S3		S7				
7	R4	R4	R4	R4	R4		
8	R3	R3	R3	R3	R3		

8. Given the set of production rules and dotted rule in figure 4, find the configuration set resulting from the closure of the dotted rule.

Figure 4: Question 8: Closure

Production Rules	$T \rightarrow F$
	$T \rightarrow T * F$
	$F \rightarrow id$
	$F \rightarrow (T)$
Dotted Rule	$T \rightarrow T * \bullet F$

9. Given a set of production rules, a configuration set, and a successive character in figure 5, apply the successor function to create a new configuration set.

Figure 5: Question 9: Successor

Production Rules	$S' \to T$
	$T \to F$
	$T \to T * F$
	$F \to id$
	$F \to (T)$
Configuration set I	$S' \to \bullet T$
	$T \to \bullet F$
	$T \to \bullet T * F$
	$F \to \bullet id$
	$F \to \bullet (T)$

10. Given a set of production rules in figure 6, find the First and Follow sets of the non-terminal symbols.

Figure 6: Question 10: First/Follow

Production Rules:	$A \rightarrow Bc \vert d$
	$B \rightarrow e$

11. Given the set of production rules in figure 7, find the First and Follow sets of the non-terminal symbols.

Figure 7: Question 11: First/Follow

Production Rules:	$A \rightarrow Bc$
	$B \rightarrow d \vert BC \vert Be$
	$C \rightarrow f$

12. Given a set of production rules in figure 8, find the First and Follow sets of the non-terminal symbols.

Figure 8: Question 12: First/Follow

Production Rules	$S \rightarrow AB$
	$A \rightarrow c \vert \epsilon$
	$B \rightarrow cbB \vert a$

13. Given a set of production rules in figure 9, find the First and Follow sets of the non-terminal symbols.

Figure 9: Question 13: First/Follow

Production Rules	$S \rightarrow cAa$
	$A \rightarrow cB \vert B$
	$B \rightarrow bcB \vert \epsilon$

14. Given left-recursive grammar $A \rightarrow A*B|B; B \rightarrow a$, create an equivalent grammar which is no longer left-recursive.

15. Given grammar $A \rightarrow Bc|D; B \rightarrow ef; D \rightarrow e$, left-factor this grammar.

16. Given the set of production rules in figure 10, remove left-recursion from the grammar.

Figure 10: Question 16: Production Rules

Production Rules	$S \rightarrow Aa \mid b$
	$A \rightarrow Ac \mid Sd \mid \epsilon$

17. Given the set of production rules in table 11) which form an $LL(1)$ grammar, find the following symbols upon which the production rule $Y \rightarrow \epsilon$ is the valid option.

Figure 11: Question 17: LL(1) Conflict Resolution

Production Rules	$E \rightarrow TX$
	$X \rightarrow \epsilon$
	$X \rightarrow +E$
	$T \rightarrow (E)$
	$T \rightarrow idY$
	$Y \rightarrow *T$
	$Y \rightarrow \epsilon$