

CS 502 – Compiling and Programming Systems

Mid-term Examination, 10/21/09

Instructions: Read carefully through the whole exam first and plan your time. Note the relative weight of each question and part (as a percentage of the score for the whole exam). The total points is 100 (*ie*, your grade will be the percentage of your answers that are correct).

This exam is **open book, open notes**. You are free to refer to any book or other study materials you bring to the exam room.

You have **55 minutes** to complete all seven (7) questions. Write your answers on this paper (use both sides if necessary).

Name:

Student Number:

Signature

Consider the following grammar for Pascal-style variable declarations:

1	$S \rightarrow L$
2	$L \rightarrow D ; L$
3	$\quad \quad \quad \quad D$
4	$D \rightarrow V : id$
5	$V \rightarrow V , id$
6	$\quad \quad \quad \quad id$

1. (Top-down parsing; 10%) This grammar is not LL. Transform this grammar so that it can be parsed by a top-down (LL) parser.

Answer:

1	$S \rightarrow L$
2	$L \rightarrow D L'$
3	$L' \rightarrow ; L$
4	$\quad \quad \quad \quad \epsilon$
5	$D \rightarrow V : id$
6	$V \rightarrow id V'$
7	$V' \rightarrow , id V'$
8	$\quad \quad \quad \quad \epsilon$

2. (LL parsing; 25%) Construct the LL(1) parsing table for your transformed LL grammar.

Answer:

Here are the FIRST and FOLLOW sets, and the LL(1) parse table:

	FIRST	FOLLOW	;	:	,	id	\$
S	id	\$				1	
L	id	\$				2	
L'	;ε	\$	3				4
D	id	;\$				5	
V	id	:				6	
V'	,ε	:		8	7		

3. (LR parsing; 25%) Construct the LR(0) item sets for the *original non-LL* grammar.

Answer:

I_0	$S \rightarrow \bullet L$
	$L \rightarrow \bullet D ; L$
	$L \rightarrow \bullet D$
	$D \rightarrow \bullet V : id$
	$V \rightarrow \bullet V , id$
	$V \rightarrow \bullet id$
I_1	$S \rightarrow L \bullet$
I_2	$L \rightarrow D \bullet ; L$
	$L \rightarrow D \bullet$
I_3	$D \rightarrow V \bullet : id$
	$V \rightarrow V \bullet , id$
I_4	$V \rightarrow id \bullet$
I_5	$L \rightarrow D ; \bullet L$
	$L \rightarrow \bullet D ; L$
	$L \rightarrow \bullet D$
	$D \rightarrow \bullet V : id$
	$V \rightarrow \bullet V , id$
	$V \rightarrow \bullet id$
I_6	$D \rightarrow V : \bullet id$
I_7	$V \rightarrow V , \bullet id$
I_8	$L \rightarrow D ; L \bullet$
I_9	$D \rightarrow V : id \bullet$
I_{10}	$V \rightarrow V , id \bullet$

4. (LR(0) parsing; 5%) Can the *original non-LL* grammar be parsed bottom-up without lookahead? Why, or why not?

Answer:

No, there is an LR(0) shift-reduce error in state 2.

5. (SLR(1) parsing; 25%) Construct the SLR(1) parse table for the *original non-LL* grammar.

Answer:

	\$;	:	,	id	S	L	D	V
0					s4	1	2	3	
1	a								
2	r3	s5							
3			s6	s7					
4			r6	r6					
5					s4	8	2	3	
6					s9				
7					s10				
8	r2								
9	r4	r4							
10			r5	r5					

6. (Regular expressions; 5%) Give a regular expression for this language.

Answer:

$$\text{id} (, \text{id})^* : \text{id} [; \text{id} (, \text{id})^* : \text{id}]^*$$

7. (Language classes; 5%) Is this *language*:

- (a) regular,
- (b) context-free, or
- (c) both regular and context-free?

Answer:

Both. It is regular, so also context-free.