

Mid-term Exam

COSE312 Compilers, Spring 2017

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Problem 1. Consider the regular expression $a \cdot (b \mid c)^*$.

- Convert the regular expression to an NFA via Thompson's construction.
- Convert the NFA to a DFA via subset construction.

Problem 2. (Top-down Parsing) Consider the following grammar for lists:

$$\begin{aligned}
 E &\rightarrow [L] \mid a \\
 L &\rightarrow ET \\
 T &\rightarrow ;L \mid \epsilon
 \end{aligned}
 \tag{1}$$

E denotes a single element, either an atom a or a bracketed list $[L]$. L is a list, which consists of an element and a tail. T is a tail, either empty or a semicolon followed by a list. E is the start variable.

- Compute the *FIRST* and *FOLLOW* sets of the grammar:
 - $FIRST(E)$: $\{[, a\}$
 - $FIRST(L)$: $\{[, a\}$
 - $FIRST(T)$: $\{;, \epsilon\}$
 - $FOLLOW(E)$: $\{\$, ;, ;\}$
 - $FOLLOW(L)$: $\{\}$
 - $FOLLOW(T)$: $\{\}$

2. Construct the LL parsing table for the grammar:

	a	$[$	$]$	$;$	$\$$
E					
L					
T					

	a	$[$	$]$	$;$	$\$$
E	$E \rightarrow a$	$E \rightarrow [L]$			
L	$L \rightarrow ET$	$L \rightarrow ET$			
T			$T \rightarrow \epsilon$	$T \rightarrow ;L$	

3. Show the parsing sequence for string $[a; [a; a]]$:

Stack	Input
$E\$$	$[a; [a; a]]\$$

Stack	Input
$E\$$	$[a; [a; a]]\$$
$[L]\$$	$[a; [a; a]]\$$
$L]\$$	$a; [a; a]]\$$
$ET]\$$	$a; [a; a]]\$$
$aT]\$$	$a; [a; a]]\$$
$T]\$$	$; [a; a]]\$$
$;L]\$$	$; [a; a]]\$$
$L]\$$	$[a; a]]\$$
$ET]\$$	$[a; a]]\$$
$[L]T]\$$	$[a; a]]\$$
$L]T]\$$	$a; a]]\$$
$ET]T]\$$	$a; a]]\$$
$aT]T]\$$	$a; a]]\$$
$T]T]\$$	$; a]]\$$
$;L]T]\$$	$; a]]\$$
$L]T]\$$	$a]]\$$
$ET]T]\$$	$a]]\$$
$aT]T]\$$	$a]]\$$
$T]T]\$$	$]]\$$
$]T]\$$	$]]\$$
$T]\$$	$]\$$
$]\$$	$]\$$
$\$$	$\$$

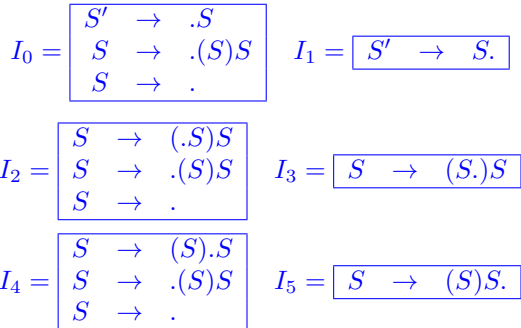
4. Is the grammar in (1) LL(1)?

Problem 3. (Bottom-up Parsing) Consider the grammar:

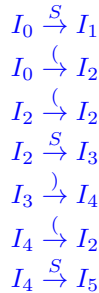
- (1) $S' \rightarrow S$
- (2) $S \rightarrow (S)S$
- (3) $S \rightarrow \epsilon$

1. Construct the LR(0) automaton for the grammar.

DFA states:



DFA edges:



- 2. Construct the LR(0) parsing table.
- 3. Construct the SLR parsing table.

State	()	\$	S
0	s2	r3	r3	g1
1			accept	
2	s2	r3	r3	g3
3		s4		
4	s2	r3	r3	g5
5		r2	r2	

4. Show the SLR parsing sequence for string $()()$.

Stack	Symbols	Input	Action
\$0	\$	$()()$ \$	

Stack	Symbols	Input	Action
\$0	\$	$()()$ \$	shift 2
\$02	$\$($	$)()$ \$	reduce 3
\$023	$\$(S$	$)()$ \$	shift 4
\$0234	$\$(S)$	$()$ \$	shift 2
\$02342	$\$(S)($	$)$ \$	reduce 3
\$023423	$\$(S)(S$	$)$ \$	shift 4
\$0234234	$\$(S)(S)$	$\$$	reduce 3
\$02342345	$\$(S)(S)S$	$\$$	reduce 2
\$02345	$\$(S)S$	$\$$	reduce 2
\$01	$\$S$	$\$$	accept

Problem 4. Consider the expression grammar:

$$E \rightarrow E + E \mid E * E \mid (E) \mid \text{id}$$

1. The SLR parsing for string $\text{id} + \text{id} * \text{id}$ encounters the following shift/reduce conflict:

Stack	Input	Action
$E + E$	$*\text{id}$	shift or reduce

Assuming the conventional precedence, which action is correct? Explain the reason intuitively and clearly.

2. The SLR parsing for string $\text{id} + \text{id} + \text{id}$ encounters the following shift/reduce conflict:

Stack	Input	Action
$E + E$	$+\text{id}$	shift or reduce

Assuming the conventional associativity, which action is correct? Explain the reason intuitively and clearly.