Homework 2 - Compiler Theory

Isfahan University of Technology
Faculty of Electrical and Computer Engineering
Compiler Theory Course
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Question 1

Perform the requested operations on the given grammars and provide a detailed explanation:

a) **Left Recursion Elimination**

$S \rightarrow SaS \mid AbS$
$A \rightarrow SaA \mid B$
$B \rightarrow bS \mid c$

b) **Left Factoring**

$S \rightarrow abcA \mid abcB \mid abC$
$A \rightarrow abA \mid abBA \mid abBC$
$B \rightarrow b$
$C \rightarrow c$

Question 2

Compute First and Follow sets for each variable in the given grammar:

```
Program → { Statements } eof

Statements → Statement Statements | epsilon

Statement → id = Expression ; | if ( Expression ) Statement

Expression → id Tail
```

```
Tail → + Expression | - Expression | epsilon
```

Write an LL(1) recursive descent parser for the above grammar in pseudocode.

Question 3

Given the grammar:

$$
\begin{aligned}
S &\rightarrow if\ E\ then\ S \mid id\ I \\
I &\rightarrow = \ E \mid \varepsilon \\
E &\rightarrow T\ E' \\
E' &\rightarrow +\ T\ E' \mid \varepsilon \\
T &\rightarrow F\ T' \\
T' &\rightarrow *\ F\ T' \mid \varepsilon \\
F &\rightarrow (E) \mid id \mid num
\end{aligned}
$$

a) Compute the First and Follow sets for each variable.

b) Construct the LL(1) parsing table for the grammar.

c) Perform an LL(1) parsing trace for the string:

```
if id then id = (num * id) + num
```

Display the steps in a tabular format showing matched, stacked, input, and action.

Question 4

Consider the following grammar:

$$
\begin{aligned}
S &\rightarrow iEtS \mid iEtSeS \mid a \\
E &\rightarrow b
\end{aligned}
$$

(a) Construct the DFA diagram for this grammar.

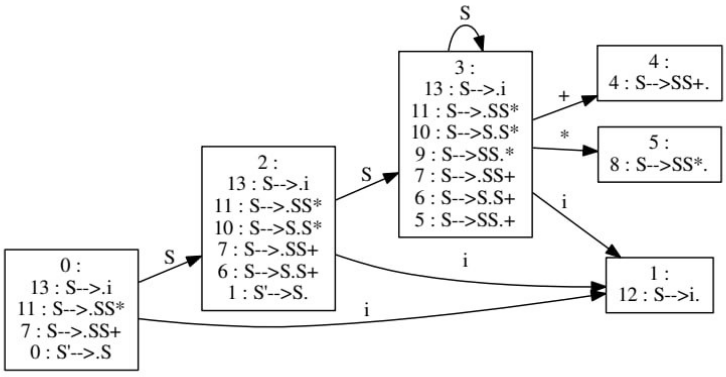
(b) Construct the parsing table for this grammar. (Apply Left Factoring or Left Recursion Elimination if necessary before constructing the parsing table)

Question 5

Consider the following grammar:

$$S \to i \mid SS+ \mid SS*$$

Here is a DFA for the LR(0) items of this grammar.



(a) Using the DFA, construct the LR(0) `ACTION` and `GOTO` tables for this grammar. Explain your work.

(b) Show a trace of parsing for the input string $w = iii*i+*$, justifying every step.

Question 6

Consider the following grammar:

$$\begin{aligned} S &\to XdY \\ X &\to aX \\ X &\to \epsilon \\ Y &\to bYS \\ Y &\to \epsilon \end{aligned}$$

Determine whether this grammar is LR(0). Justify your answer and provide a complete explanation of your reasoning.