National University of Computer and Emerging Sciences

Compiler Construction (CS-4031)

Date: February 27th 2024

Course Instructor(s)

Dr. Faisal Aslam

Sessional-I Exam

Total Time: 1 Hours
Total Marks: 31
Total Questions: 08

Semester: SP-2024
Campus: Lahore
Dept: Computer Science

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Student Name	Roll No	Section	Student Signature

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1. Create LL(1) parsing table for the following CFG. Must clearly show first and follow set of each non-terminal. [5 Marks]

$$
\begin{aligned}
E &\rightarrow TE' \\
E' &\rightarrow +TE' \mid \varepsilon \\
T &\rightarrow FT' \\
T' &\rightarrow FT' \mid \varepsilon \\
F &\rightarrow id \mid (E)
\end{aligned}
$$

First(F) $= \{id, (\}$
First(T') $= \{id, (, \varepsilon\}$
First(T) $= \{id, (\}$
First(E') $= \{+, \varepsilon\}$
First(E) $= \{id, (\}$

$Follow(F) = First(T') \cup Follow(T) \cup Follow(T') = \{id, (, +, \$\}$
$Follow(T') = Follow(T) = \{+, \$,)\}$
$Follow(T) = First(E') \cup Follow(E) = \{+, \$,)\}$
$Follow(E') = Follow(E) = \{\$,)\}$
$Follow(E) = \{\$,)\}$

	+	**id**	(	)	$
E		TE'	TE'		
E'	$+TE'$			ε	ε
T		FT'	FT'		
T'	ε	FT'	FT'	ε	ε
F		id	(E)		

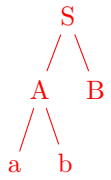
Table 1: Parsing Table

2. Given the following LL(1) parsing table, create parse tree for the input string **abde**. Must clearly show each stage of the stack, input consumed, and all the actions performed. [5 Marks]

	a	b	c	d	e	f	$
S	S→AB		S→AB		S→eDa		
A	A→ab		A→c				
B		B→dC					
C					C→eC		C→€
D	D→€					D→fD	

Stack	**inputs**	**Actions**
S$	abde$	$S \rightarrow AB$
AB$	abde$	$A \rightarrow ab$
abB$	abde$	Match
bB$	bde$	Match
B$	de$	Reject

Partial Parse tree is as follows: (NOT COMPLETE)



3. Show that the following grammar is ambiguous for string $int---int-int$ [5 Marks]

$$
\begin{aligned}
S &\rightarrow E \\
E &\rightarrow E - E \\
&\quad | - - E \\
&\quad | int
\end{aligned}
$$

I create two different parse trees for the string using the CFG as follows:

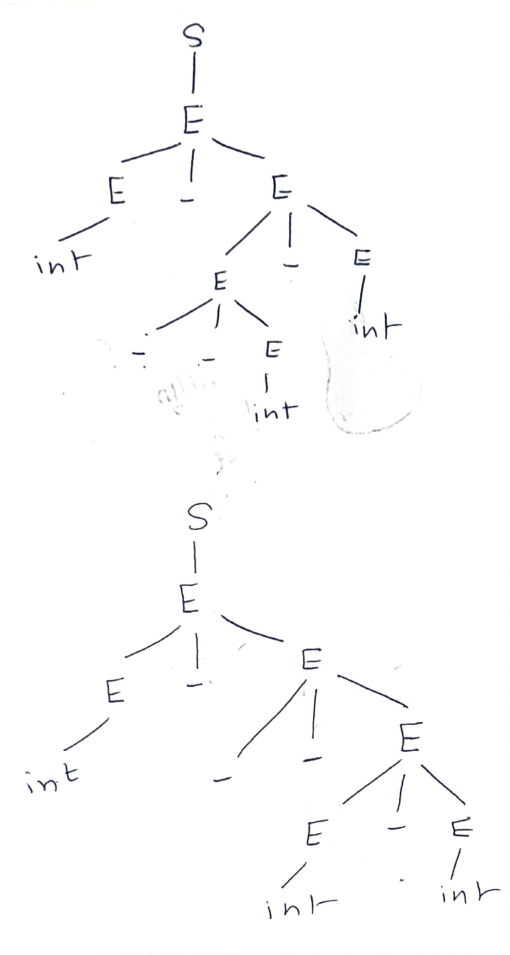


Figure 1: Two parse trees for the same input string

4. Perform left factoring on the following context-free grammar. [3 Marks]

$$
\begin{aligned}
A \rightarrow & aBx \\
& | aBy \\
B \rightarrow & cdg \\
& | cd
\end{aligned}
$$

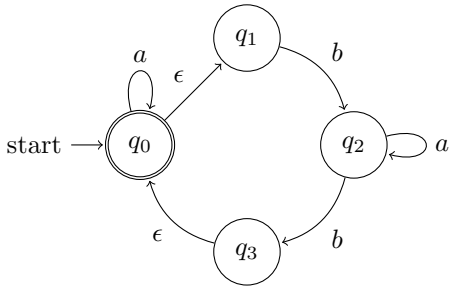
$$
\begin{aligned}
A &\rightarrow aBA' \\
A' &\rightarrow x \mid y \\
B &\rightarrow cdB' \\
B' &\rightarrow g \mid \varepsilon
\end{aligned}
$$

5. Change the following CFG to eliminate left recursion [3 Marks]

$$
\begin{aligned}
S \rightarrow & S \ and \ S \\
& \mid T \mid m \\
T \rightarrow & true \mid false
\end{aligned}
$$

$$
\begin{aligned}
S \rightarrow & TS' \mid mS' \\
S' \rightarrow & and \ S \ S' \mid \varepsilon \\
T \rightarrow & true \mid false
\end{aligned}
$$

6. Convert the following NFA to DFA. Please show all the steps. [5 Marks]



7. Write all the phases of compiler and input/output of each phase. [2 Marks]
   Are not that obvious.

8. Write a CFG that starts with one or more y followed by twice as many x or z. Examples of string accepted by the grammar are: **yxx**, **yzz**, **yzx**, **yxx**, **yyxzzx**, **yyzxzx**, **yyyxxxxxx**, $\cdots$ [3 Marks]

$$S \to ySxx \mid ySzz \mid ySzx \mid ySxz$$
$$\mid yxx \mid yzz \mid yzx \mid yxz$$