CS251: Introduction to Language Processing
Mid Semester Examination Solutions (2023-24-M Semester)

Max. Points: 100   **Duration:** 1 hour 30 minutes

October 4, 2023

Question-1 (Lexical Analysis)

[18 Marks]

Letter = [a-zA-Z]
Digit=[0-9]
NAME= (Letter|Digit)+
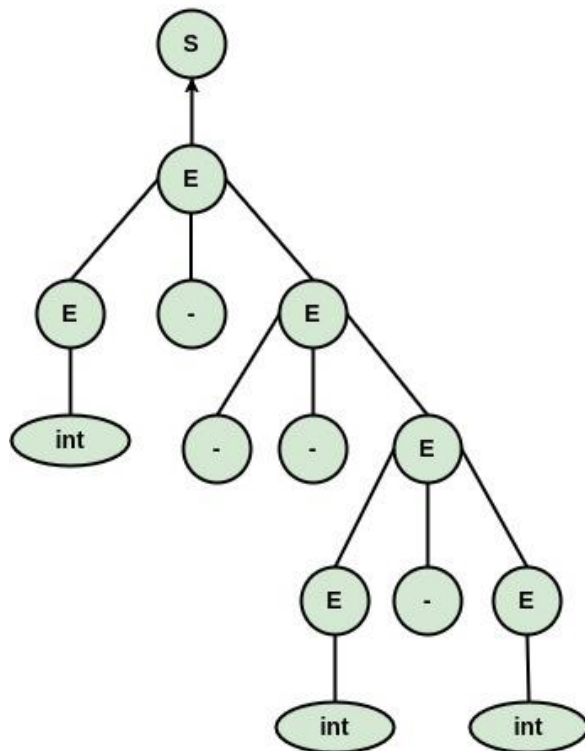BACKDIR=..
EXT: .txt|.dat
VALID_NAME= (NAME|BACKDIR)

(/VALID_NAME)+(EXT)?   VALID_PATH
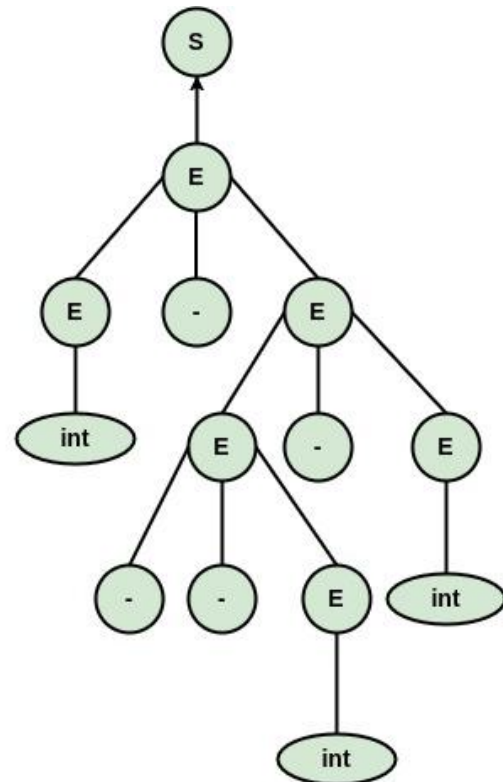.|\n   INVALID_PATH

Question has 5 rules: each rule that is followed for VALID_PATH carries 3 marks.
INVALID_PATH token carries 3 marks.

Question-2 (Context Free Grammar)

1. **[5 marks]:** 2.5 marks each tree

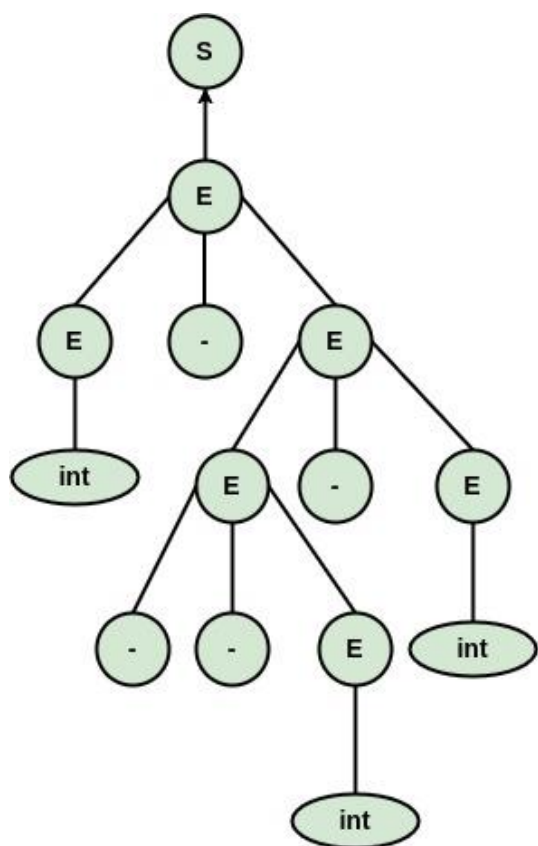Left most derivation tree 1

Left most derivation tree 2

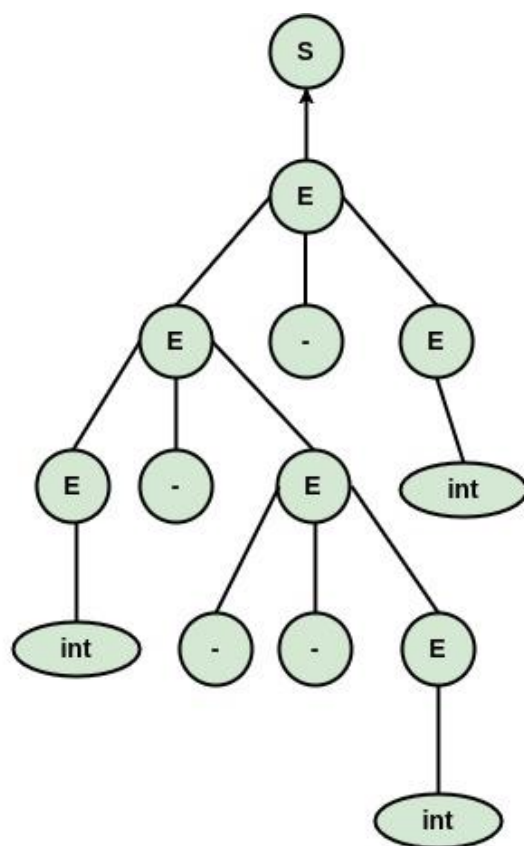2. **[3 Marks]** Define your precedence and associative rules that removes the ambiguity.
   Higher Precedence - - (higher precedence is evaluate first)

3. **[2 Marks]** Draw the unique parse trees, by applying leftmost or rightmost derivation, for the string int − − − int − int using the above rules.

Associative : right to left   **Associative : left to right**

Question-3 (Bottom Up Parsing):

(1) **[2 Marks]** Assume that a number can contain only digit 1 of any length > 0. Then, the given grammar accepts all the following:
   - (a) Multiplication of negative number with negative number (or)
   - (b) Multiplication of negative number with positive number (or)

(2) **[3 Marks]** Yes, it accepts the string. The bottom up parse tree is listed below [We need to reverse the below picture]
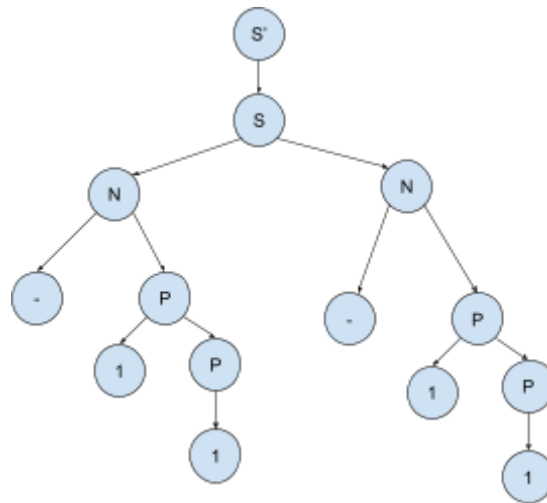
(3) **[20 Marks]** DFA for LR(0). Each correct state carries 2 Marks
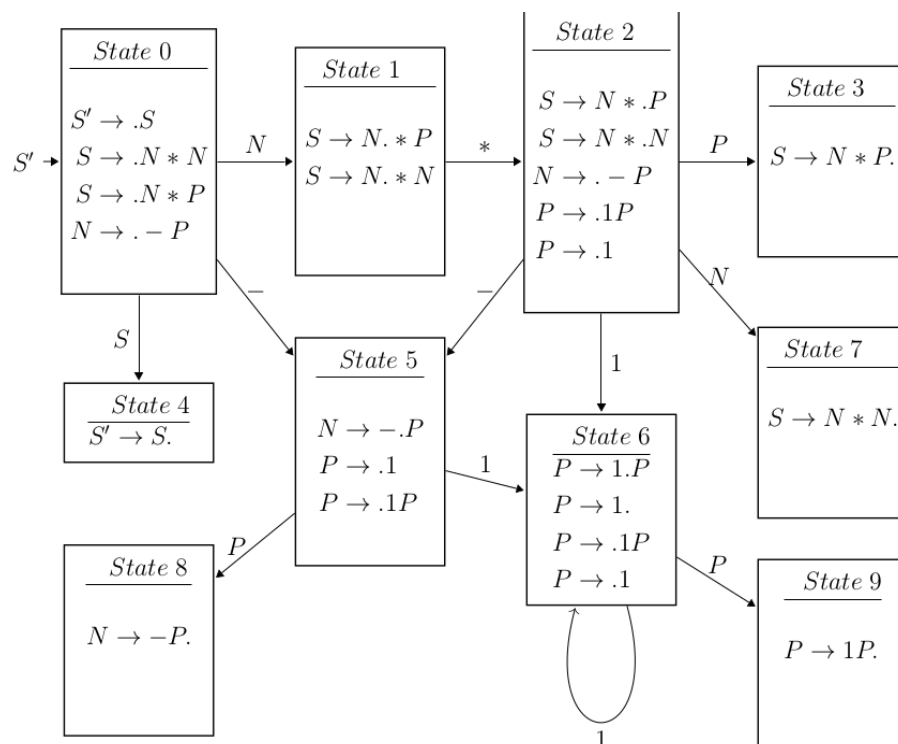
(4) **[12 Marks]:** LR(0) Parer table. There are 6 production rules, each correct reduction carries 1 Marks. There are 12 shift actions, each correct action carries 0.5 Marks.

State	Action				Goto			
	1	**-**	*****	**$**	**S'**	**S**	**N**	**P**
S0		S5				S4	S1	
S1			S2					
S2	S6	S5					S7	S3
S3	r3	r3	r3	r3				
S4	r1	r1	r1	r1				
S5	S6							S8
S6	S6/r6	r6	r6	r6				S9
S7	r2	r2	r2	r2				
S8	r4	r4	r4	r4				
S9	r5	r5	r5	r5				

(5) **[1 Marks]** The grammar is not LR(0) as there is shift/reduce conflict at S6 on seeing the next token 1.

(6) **[6 Marks]**

Visited Token stream	Not visited Token Stream	State
	-11*-11	S0
-	11*-11	S5
-1	1*-11	S6

Currently, the state is S6, since the next token is 1, we have a shift/reduce conflict here.

Question-4 (Top Down Parsing):

Consider the following grammar

E → FH
H → *E|∈
F → F!|G
G → n|(E)

(1) FIRST and FOLLOW sets: **Total 12 Marks. The table has 8 entries, each correct entry carries 1.5 Marks.**

	FIRST	FOLLOW
E	{n, (}	{$,)}
H	{*, ∈}	{$,)}
F	{n, (}	{!, *, $,)}
G	{n, (}	{!, *, $,)}

(2) LL(1) parser table: **Total 11 Marks. Each correct entry fetches 1 Marks**

	*	!	n	(	)	$
E			E→ FH	E→ FH		
H	H→ *E				H → ∈	H → ∈
F			F→ F! F→ G	F→ F! F→ G		
G			G → n	G → (E)		

(3) The grammar is not LL(1) because the grammar is left recursive so the LL1(1) parser table has at least one cell with more than one entry.
Marks: 1 Marks

(4) E → FH
   H → *E|∈
   F → GK
   K → !K|∈
   G → n|(E)

This part carries: 4 Marks