DEPARTMENT OF COMPUTER SCIENCE
CARLOS III UNIVERSITY OF MADRID

Computer Science
Language Processors

Rules

- The duration of the test is **60 minutes**
- Questions will not be answered during the test
- One cannot re-enter the classroom after leaving it
- The answers must be written using a pen (not a pencil)

1.- Given the grammar:

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D ::= bA | cX | d
X ::= MbA | BF
M ::= cM | l
A ::= MBj | F
B ::= c | l
F ::= fA | l
```

a) Calculate the FIRST and FOLLOW sets.

FIRST(D) = {b, c, d}
FIRST(X) = {b, c, f, λ}
FIRST(M) = {c, λ}
FIRST(A) = {c, f, j, λ}
FIRST(B) = {c, λ}
FIRST(F) = {f, λ}

FOLLOW(D) = {$}
FOLLOW(X) = {$}
FOLLOW (M) = {b, c, j}
FOLLOW (A) = {$}
FOLLOW (B) = {j, f, $}
FOLLOW (F) = {$}

b) Using the algorithm, determine if it is an LL(1) grammar.

For a grammar to be a LL(1) grammar, it must fulfill that there are not two or more productions in any cell of the analysis table. This condition will occur when:

$\forall$ production $A ::= \alpha_i|\ldots|\alpha_n$:

- $FIRST(\alpha i) \cap FIRST(\alpha i) = 0 \ \forall i \neq j$
- If $\alpha i ::= \lambda$ then $FIRST(\alpha i) \cap FOLLOW(A) = 0 \ \forall i \neq j$

For the given grammar:

FIRST (bA) ∩ FIRST(cX) ∩ FIRST(d) = 0
FIRST (MbA) ∩ FIRST(BF) = {c, b} ∩ {c, f, ∩} ∩ 0
FIRST (cM) ∩ FIRST(λ) = 0
FIRST (cM) ∩ FOLLOW(M) = {c} ∩ {c, j} ∩ 0
FIRST (MBj) ∩ FIRST(F) = {c, ∩} ∩ {f, ∩} ∩ 0
FIRST (c) ∩ FIRST(λ) = 0
FIRST (c) ∩ FOLLOW(B) = {c} ∩ {j, f, $} = 0
FIRST (fA) ∩ FOLLOW(λ) = 0
FIRST (fA) ∩ FOLLOW(F) = {f} ∩ {$} = 0

Then, the grammar is not an LL(1) grammar.

c) Construct the analysis table for the LL(1) table-driven top-down predictive parsing.

The parsing table for the grammar is:

	b	c	d	j	f	$
D	D → bA	D → cX	D → d			
X	X → MbA	X → MbA X → BF			X → BF	X → BF
M	M → λ	M → cM M → λ		M → λ		
A		A → MBj		A → MBj	A → F	A → F
B		B → c		B → λ	B → λ	B → λ
F					F → fA	F → λ