Question B2

Below is a context-free grammar for a language of assignments that includes arrays:

1. stmtList → stmt stmtList
2. → ε

3. stmt → ID = exp ;

4. array → [rowList]

5. rowList → nonEmpty
6. → ε

7. nonEmpty → row moreRows

8. moreRows → ; nonEmpty
9. → ε

10. row → exp more

11. more → , row
12. → ε

13. exp → term tail

14. tail → + term tail
15. → ε

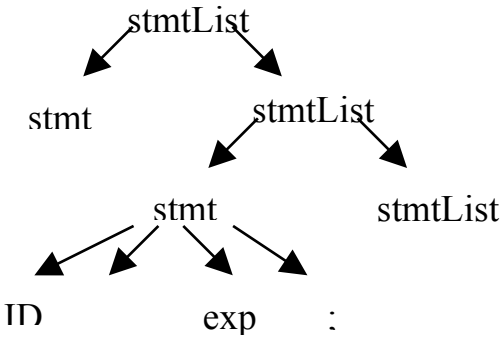
16. term → ID
17. → INTLIT
18. → array

Here are the *FIRST* and *FOLLOW* sets for all of the non-terminals:

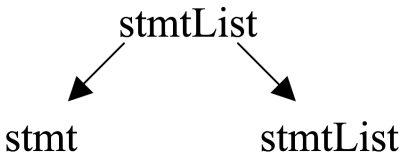
Non-terminal *X*	***FIRST*(*X*)**	***FOLLOW*(*X*)**
stmtList	ID ε	EOF
stmt	ID	ID EOF
array	[	+ , ;]
rowList	ID INTLIT [ε	]
nonEmpty	ID INTLIT [	]
moreRows	; ε	]
row	ID INTLIT [	;]
more	, ε	;]
exp	ID INTLIT [	, ;]
tail	+ ε	, ;]
term	ID INTLIT [	+ , ;]

(5 points)
Part B2a

Recall that terminal *t* is in *FOLLOW*(*X*) if in some partial parse tree with the start non-terminal at the root, *X* is one leaf of the tree and *t* is the next non-epsilon leaf immediately to the right. For example, the following partial parse tree justifies the fact that for the CFG given above, terminal ID is in *FOLLOW*(stmt):



Complete the partial parse tree below to justify the fact that terminal ; is in *FOLLOW*(term).



(20 points)
Part B2b
Fill in the parse table below using the numbers of the grammar rules rather than the rules themselves.
Is the grammar LL(1)?

	ID	INTLIT	=	+	;	,	[	]	EOF
stmtList									
stmt									
array									
rowList									
nonEmpty									
moreRows									
row									
more									
exp									
tail									
term									

Question B3

Consider the following grammar

$$
\begin{array}{rcl}
\mathit{File} & \rightarrow & \mathit{Record} \\
 & | & \mathit{Record}\ \mathit{File} \\
\mathit{Record} & \rightarrow & \textbf{name}\ \textbf{idnum}\ \mathit{OptGrades} \\
\mathit{OptGrades} & \rightarrow & \mathit{Grades} \\
 & | & \varepsilon \\
\mathit{Grades} & \rightarrow & \mathit{OneGrade} \\
 & | & \mathit{OneGrade}\ \textbf{comma}\ \mathit{Grades} \\
\mathit{OneGrade} & \rightarrow & \textbf{intlit}\ \mathit{OptLate} \\
\mathit{OptLate} & \rightarrow & \mathit{Stars} \\
 & | & \varepsilon \\
\mathit{Stars} & \rightarrow & \textbf{star} \\
 & | & \mathit{Stars}\ \textbf{star}
\end{array}
$$

where *File* is the start non-terminal, and symbols in **bold** are terminals.

(10 points)
Part B3a
Apply the transformations learned in class to *left factor* the grammar above and write the results below. Give the entire grammar, not the just the transformed rules.

(10 points)

Part B3b

If the grammar you wrote above has any immediate left recursion, apply the transformation learned in class to remove it and write the result below. You do not need to give the entire grammar, you can just give the transformed rules.

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