

LL (1) GRAMMAR

GROUP NO : 13

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Assumptions

- ① Since $\langle \text{defineTypeStmnt} \rangle$ does not occur on the R.H.S of any rule in the given grammar (in the language specification document), and since $\langle \text{defineTypeStmnt} \rangle$ can occur before / in between / after $\langle \text{typeDefinition} \rangle(s)$ (in the examples given in the language specification document), it has been incorporated in the R.H.S of the $\langle \text{typeDefinition} \rangle$ rule.
- ② Precedence of operators has been incorporated into the grammar rules

$\langle \text{program} \rangle \rightarrow \langle \text{otherFunctions} \rangle \langle \text{mainFunction} \rangle$

$\langle \text{mainFunction} \rangle \rightarrow \text{TK_MAIN} \langle \text{stmts} \rangle \text{TK_END}$

$\langle \text{otherFunctions} \rangle \rightarrow \langle \text{function} \rangle \langle \text{otherFunctions} \rangle \mid \epsilon$

$\langle \text{Functions} \rangle \rightarrow \text{TK_FUNID} \langle \text{input_par} \rangle \langle \text{output_par} \rangle \text{TK_SEM} \langle \text{stmts} \rangle \text{TK_END}$

$\langle \text{input_par} \rangle \rightarrow \text{TK_INPUT} \text{TK_PARAMETER} \text{TK_LIST} \text{TK_SQL} \langle \text{parameter_list} \rangle \text{TK_SQL}$

$\langle \text{output_par} \rangle \rightarrow \text{TK_OUTPUT} \text{TK_PARAMETER} \text{TK_LIST} \text{TK_SQL} \langle \text{parameter_list} \rangle \text{TK_SQL} \mid \epsilon$

$\langle \text{parameter_list} \rangle \rightarrow \langle \text{datatype} \rangle \text{TK_ID} \langle \text{remaining_list} \rangle$

$\langle \text{datatype} \rangle \rightarrow \langle \text{primitiveDatatypes} \rangle \mid \langle \text{constructed Datatype} \rangle$

$\langle \text{primitiveDatatypes} \rangle \rightarrow \text{TK_INT} \mid \text{TK_REAL}$

$\langle \text{constructed Datatype} \rangle \rightarrow \text{TK_RECORD} \text{TK_RUID} \mid \text{TK_UNION} \text{TK_RUID}$

$\langle \text{remaining_list} \rangle \rightarrow \text{TK_COMMA} \langle \text{parameter_list} \rangle \mid \epsilon$

$\langle \text{stmts} \rangle \rightarrow \langle \text{typeDefinitions} \rangle \langle \text{declarations} \rangle \langle \text{otherStmts} \rangle \langle \text{returnStmnt} \rangle$

$\langle \text{typeDefinitions} \rangle \rightarrow \langle \text{typeDefinition} \rangle \langle \text{typeDefinitions} \rangle \mid \epsilon$

$\langle \text{typeDefinition} \rangle \rightarrow \text{TK_RECORD} \text{TK_RUID} \langle \text{fieldDefinitions} \rangle \text{TK_ENDRECORD} \mid$
 $\text{TK_UNION} \text{TK_RUID} \langle \text{fieldDefinitions} \rangle \text{TK_ENDUNION} \mid$
 $\langle \text{defineTypeStmnt} \rangle \text{TK_SEM}$

$\langle \text{fieldDefinitions} \rangle \rightarrow \langle \text{fieldDefinition} \rangle \langle \text{fieldDefinitions} \rangle \langle \text{moreFields} \rangle$

$\langle \text{fieldDefinition} \rangle \rightarrow \text{TK_TYPE} \langle \text{primitive Datatype} \rangle \text{TK_COLON} \text{TK_FIELDID} \text{TK_SEM}$

$\langle \text{moreFields} \rangle \rightarrow \langle \text{fieldDefinition} \rangle \langle \text{moreFields} \rangle \mid \epsilon$

$\langle \text{declarations} \rangle \longrightarrow \langle \text{declaration} \rangle \langle \text{declarations} \rangle \mid \epsilon$

$\langle \text{declaration} \rangle \longrightarrow \text{TK-TYPE} \langle \text{dataType} \rangle \text{TK-COLON} \text{TK-ID} \text{TK-COLON} \langle \text{global-or-not} \rangle \text{TK-SEM}$

$\langle \text{global-or-not} \rangle \longrightarrow \text{TK-GLOBAL} \mid \epsilon$

$\langle \text{other Stmts} \rangle \longrightarrow \langle \text{stmt} \rangle \langle \text{other Stmts} \rangle \mid \epsilon$

$\langle \text{stmt} \rangle \longrightarrow \langle \text{assignment Stmt} \rangle \mid \langle \text{iterative Stmt} \rangle \mid \langle \text{conditional Stmt} \rangle \mid \langle \text{io stmt} \rangle \mid \langle \text{funCall Stmt} \rangle$

$\langle \text{assignment Stmt} \rangle \longrightarrow \langle \text{single Or Rec Id} \rangle \text{TK-ASSIGNOP} \langle \text{arithmetic Expression} \rangle \text{TK-SEM}$

$\langle \text{single Or Rec Id} \rangle \longrightarrow \text{TK-ID} \langle \text{after Single} \rangle$

$\langle \text{after Single} \rangle \longrightarrow \text{TK-DOT} \text{TK-FIELD ID} \mid \epsilon$

$\langle \text{funCall Stmt} \rangle \longrightarrow \langle \text{output Parameters} \rangle \text{TK-CALL} \text{TK-FUNID} \text{TK-WITH} \text{TK-PARAMETERS} \langle \text{input Parameters} \rangle$

$\langle \text{output Parameters} \rangle \longrightarrow \text{TK-SQL} \langle \text{idList} \rangle \text{TK-SQR} \text{TK-ASSIGNOP} \mid \epsilon$

$\langle \text{input Parameters} \rangle \longrightarrow \text{TK-SQL} \langle \text{idList} \rangle \text{TK-SQR}$

$\langle \text{iterative Stmt} \rangle \longrightarrow \text{TK-WHILE} \text{TK-OP} \langle \text{boolean Expression} \rangle \text{TK-CL} \langle \text{stmt} \rangle \langle \text{other Stmts} \rangle \text{TK-ENDWHILE}$

$\langle \text{conditional Stmt} \rangle \longrightarrow \text{TK-IF} \langle \text{boolean Expression} \rangle \text{TK-THEN} \langle \text{stmt} \rangle \langle \text{other Stmts} \rangle \langle \text{after Conditionals} \rangle$

$\langle \text{after Conditionals} \rangle \longrightarrow \text{TK-ELSE} \langle \text{other Stmts} \rangle \text{TK-ENDIF} \mid \text{TK-ENDIF}$

$\langle \text{io Stmt} \rangle \longrightarrow \text{TK-READ} \text{TK-OP} \langle \text{var} \rangle \text{TK-CL} \text{TK-SEM} \mid \text{TK-WRITE} \text{TK-OP} \langle \text{var} \rangle \text{TK-CL} \text{TK-SEM}$

$\langle \text{boolean Expression} \rangle \longrightarrow \text{TK-OP} \langle \text{boolean Expression} \rangle \text{TK-CL} \langle \text{logical Op} \rangle \text{TK-OP} \langle \text{boolean Expression} \rangle \text{TK-CL} \mid \langle \text{var} \rangle \langle \text{relational Op} \rangle \langle \text{var} \rangle \mid \text{TK-NOT} \langle \text{boolean Expression} \rangle$

$\langle \text{var} \rangle \rightarrow \text{TK-ID} \mid \text{TK-NUM} \mid \text{TK-RNUM}$

$\langle \text{logicalOp} \rangle \rightarrow \text{TK-AND} \mid \text{TK-OR}$

$\langle \text{relationalOp} \rangle \rightarrow \text{TK-LT} \mid \text{TK-LE} \mid \text{TK-EQ} \mid \text{TK-GT} \mid \text{TK-GE} \mid \text{TK-NE}$

$\langle \text{returnStmt} \rangle \rightarrow \text{TK-RETURN} \langle \text{optionalReturn} \rangle \text{TK-SEM}$

$\langle \text{optionalReturn} \rangle \rightarrow \text{TK-SQL} \langle \text{idList} \rangle \text{TK-SQR} \mid \epsilon$

$\langle \text{idList} \rangle \rightarrow \text{TK-ID} \langle \text{moreIds} \rangle$

$\langle \text{moreIds} \rangle \rightarrow \text{TK-COMMA} \langle \text{idList} \rangle \mid \epsilon$

$\langle \text{defineTypeStmt} \rangle \rightarrow \text{TK-DEFINETYPE} \langle A \rangle \text{TK-RUID TK-AS TK-RUID}$

$\langle A \rangle \rightarrow \text{TK-RECORD} \mid \text{TK-UNION}$

$\langle \text{arithmeticExpression} \rangle \rightarrow \langle \text{AE1} \rangle \langle \text{AE2} \rangle$

$\langle \text{AE1} \rangle \rightarrow \langle \text{AE3} \rangle \langle \text{AE4} \rangle$

$\langle \text{AE2} \rangle \rightarrow \text{TK-PLUS} \langle \text{AE1} \rangle \langle \text{AE2} \rangle \mid \text{TK-MINUS} \langle \text{AE1} \rangle \langle \text{AE2} \rangle \mid \epsilon$

$\langle \text{AE3} \rangle \rightarrow \text{TK-OP} \langle \text{arithmeticExpression} \rangle \text{TK-CL} \mid \langle \text{var} \rangle$

$\langle \text{AE4} \rangle \rightarrow \text{TK-MUL} \langle \text{AE3} \rangle \langle \text{AE4} \rangle \mid \text{TK-DIV} \langle \text{AE3} \rangle \langle \text{AE4} \rangle \mid \epsilon$

FIRST SETS

GROUP 13
Ashwin Kiran Godbole
Samarth Krishna Morthy

- $\langle \text{Program} \rangle \Rightarrow \{ \text{TK_FUNID}, \text{TK_MAIN} \}$
- $\langle \text{mainFunction} \rangle \Rightarrow \{ \text{TK_MAIN} \}$
- $\langle \text{otherFunctions} \rangle \Rightarrow \{ \text{TK_FUNID}, \epsilon \}$
- $\langle \text{function} \rangle \Rightarrow \{ \text{TK_FUNID} \}$
- $\langle \text{input-par} \rangle \Rightarrow \{ \text{TK_INPUT} \}$
- $\langle \text{output-par} \rangle \Rightarrow \{ \text{TK_OUTPUT}, \epsilon \}$
- $\langle \text{Parameter_list} \rangle \Rightarrow \{ \text{TK_INT}, \text{TK_REAL}, \text{TK_RECORD}, \text{TK_UNION} \}$
- $\langle \text{datatype} \rangle \Rightarrow \{ \text{TK_INT}, \text{TK_REAL}, \text{TK_RECORD}, \text{TK_UNION} \}$
- $\langle \text{Primitive Datatype} \rangle \Rightarrow \{ \text{TK_INT}, \text{TK_REAL} \}$
- $\langle \text{constructed Datatype} \rangle \Rightarrow \{ \text{TK_RECORD}, \text{TK_UNION} \}$
- $\langle \text{remaining-list} \rangle \Rightarrow \{ \text{TK_COMMA}, \epsilon \}$
- $\langle \text{stmts} \rangle \Rightarrow \{ \text{TK_RECORD}, \text{TK_UNION}, \text{TK_TYPE}, \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN}, \text{TK_DEFINETYPE} \}$
- $\langle \text{type Definitions} \rangle \Rightarrow \{ \text{TK_RECORD}, \text{TK_UNION}, \text{TK_DEFINETYPE}, \epsilon \}$
- $\langle \text{type Definition} \rangle \Rightarrow \{ \text{TK_RECORD}, \text{TK_UNION}, \text{TK_DEFINETYPE} \}$
- $\langle \text{field Definitions} \rangle \Rightarrow \{ \text{TK_TYPE} \}$
- $\langle \text{field Definition} \rangle \Rightarrow \{ \text{TK_TYPE} \}$
- $\langle \text{more Fields} \rangle \Rightarrow \{ \text{TK_TYPE}, \epsilon \}$
- $\langle \text{declarations} \rangle \Rightarrow \{ \text{TK_TYPE}, \epsilon \}$
- $\langle \text{declaration} \rangle \Rightarrow \{ \text{TK_TYPE} \}$
- $\langle \text{global-or-not} \rangle \Rightarrow \{ \text{TK_GLOBAL}, \epsilon \}$
- $\langle \text{other Stmt} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \epsilon \}$
- $\langle \text{stmt} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL} \}$
- $\langle \text{assignment Stmt} \rangle \Rightarrow \{ \text{TK_ID} \}$
- $\langle \text{singleORRecId} \rangle \Rightarrow \{ \text{TK_ID} \}$
- $\langle \text{after Single} \rangle \Rightarrow \{ \text{TK_DOT}, \epsilon \}$
- $\langle \text{fun Call Stmt} \rangle \Rightarrow \{ \text{TK_SQL}, \text{TK_CALL} \}$
- $\langle \text{output Parameters} \rangle \Rightarrow \{ \text{TK_SQL}, \epsilon \}$
- $\langle \text{input Parameters} \rangle \Rightarrow \{ \text{TK_SQL} \}$
- $\langle \text{iterative Stmt} \rangle \Rightarrow \{ \text{TK_WHILE} \}$
- $\langle \text{conditional Stmt} \rangle \Rightarrow \{ \text{TK_IF} \}$
- $\langle \text{after Conditional} \rangle \Rightarrow \{ \text{TK_ELSE}, \text{TK_ENDIF} \}$
- $\langle \text{io Stmt} \rangle \Rightarrow \{ \text{TK_READ}, \text{TK_WRITE} \}$
- $\langle \text{arithmetic Expression} \rangle \Rightarrow \{ \text{TK_OP}, \text{TK_ID}, \text{TK_NUM}, \text{TK_RNUM} \}$
- $\langle \text{boolean Expression} \rangle \Rightarrow \{ \text{TK_OP}, \text{TK_ID}, \text{TK_NUM}, \text{TK_RNUM}, \text{TK_NOT} \}$
- $\langle \text{var} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_NUM}, \text{TK_RNUM} \}$
- $\langle \text{logical OP} \rangle \Rightarrow \{ \text{TK_AND}, \text{TK_OR} \}$
- $\langle \text{relational OP} \rangle \Rightarrow \{ \text{TK_LT}, \text{TK_LE}, \text{TK_EQ}, \text{TK_NE}, \text{TK_GT}, \text{TK_GE} \}$
- $\langle \text{return Stmt} \rangle \Rightarrow \{ \text{TK_RETURN} \}$
- $\langle \text{optional Return} \rangle \Rightarrow \{ \text{TK_SQL}, \epsilon \}$
- $\langle \text{id List} \rangle \Rightarrow \{ \text{TK_ID} \}$
- $\langle \text{more-ids} \rangle \Rightarrow \{ \text{TK_COMMA}, \epsilon \}$

$\langle \text{define type stmt} \rangle \Rightarrow \{ \text{TK_DEFINE TYPE} \}$

$\langle A \rangle \Rightarrow \{ \text{TK_RECORD}, \text{TK_UNION} \}$

$\langle \text{AE1} \rangle \Rightarrow \{ \text{TK_OP}, \text{TK_ID}, \text{TK_NUM}, \text{TK_RNUM} \}$

$\langle \text{AE2} \rangle \Rightarrow \{ \text{TK_PLUS}, \text{TK_MINUS}, \epsilon \}$

$\langle \text{AE3} \rangle \Rightarrow \{ \text{TK_OP}, \text{TK_ID}, \text{TK_NUM}, \text{TK_RNUM} \}$

$\langle \text{AE4} \rangle \Rightarrow \{ \text{TK_MUL}, \text{TK_DIV}, \epsilon \}$

FOLLOW SETS

Group 13

Ashwin Kiran Godbole
Samarth Krishna Murthy

$\langle \text{Program} \rangle \Rightarrow \{ \$ \}$

$\langle \text{mainFunction} \rangle \Rightarrow \{ \$ \}$

$\langle \text{other Functions} \rangle \Rightarrow \{ \text{TK_MAIN} \}$

$\langle \text{Function} \rangle \Rightarrow \{ \text{TK_FUNID}, \text{TK_MAIN} \}$

$\langle \text{input-par} \rangle \Rightarrow \{ \text{TK_OUTPUT}, \text{TK_SEM} \}$

$\langle \text{output-par} \rangle \Rightarrow \{ \text{TK_SEM} \}$

$\langle \text{parameter-list} \rangle \Rightarrow \{ \text{TK_SQL} \}$

$\langle \text{dataType} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_COLON} \}$

$\langle \text{primitiveDatatype} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_COLON} \}$

$\langle \text{constructedDatatype} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_COLON} \}$

$\langle \text{remaining-list} \rangle \Rightarrow \{ \text{TK_SQL} \}$

$\langle \text{stmts} \rangle \Rightarrow \{ \text{TK_END} \}$

$\langle \text{typeDefinitions} \rangle \Rightarrow \{ \text{TK_TYPE}, \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN} \}$

$\langle \text{typeDefinition} \rangle \Rightarrow \{ \text{TK_RECORD}, \text{TK_UNION}, \text{TK_DEFINETYPE}, \text{TK_TYPE}, \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN} \}$

$\langle \text{field Definitions} \rangle \Rightarrow \{ \text{TK_ENDRECORD}, \text{TK_ENDUNION} \}$

$\langle \text{fieldDefinition} \rangle \Rightarrow \{ \text{TK_ENDRECORD}, \text{TK_ENDUNION}, \text{TK_TYPE} \}$

$\langle \text{more Fields} \rangle \Rightarrow \{ \text{TK_ENDUNION}, \text{TK_ENDRECORD} \}$

$\langle \text{declarations} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN} \}$

$\langle \text{declaration} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN}, \text{TK_TYPE} \}$

$\langle \text{global-or-not} \rangle \Rightarrow \{ \text{TK_SEM} \}$

$\langle \text{other Stmt} \rangle \Rightarrow \{ \text{TK_RETURN}, \text{TK_ENDWHILE}, \text{TK_ELSE}, \text{TK_ENDIF} \}$

$\langle \text{stmt} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN}, \text{TK_ENDWHILE}, \text{TK_ELSE}, \text{TK_ENDIF} \}$

$\langle \text{Assignment Stmt} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN}, \text{TK_ENDWHILE}, \text{TK_ELSE}, \text{TK_ENDIF} \}$

$\langle \text{singleORRecId} \rangle \Rightarrow \{ \text{TK_ASSIGNOP} \}$

$\langle \text{afterSingle} \rangle \Rightarrow \{ \text{TK_ASSIGNOP} \}$

$\langle \text{Funcall Stmt} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN}, \text{TK_ENDWHILE}, \text{TK_ELSE}, \text{TK_ENDIF} \}$

$\langle \text{outputParameters} \rangle \Rightarrow \{ \text{TK_CALL} \}$

$\langle \text{inputParameters} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN}, \text{TK_ENDWHILE}, \text{TK_ELSE}, \text{TK_ENDIF} \}$

$\langle \text{iterative Stmt} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN}, \text{TK_ENDWHILE}, \text{TK_ELSE}, \text{TK_ENDIF} \}$

$\langle \text{conditional Stmt} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN}, \text{TK_ENDWHILE}, \text{TK_ELSE}, \text{TK_ENDIF} \}$

$\langle \text{after Conditional} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN}, \text{TK_ENDWHILE}, \text{TK_ELSE}, \text{TK_ENDIF} \}$

$\langle \text{io Stmt} \rangle \Rightarrow \{ \text{TK_ID}, \text{TK_WHILE}, \text{TK_IF}, \text{TK_READ}, \text{TK_WRITE}, \text{TK_SQL}, \text{TK_CALL}, \text{TK_RETURN}, \text{TK_ENDWHILE}, \text{TK_ELSE}, \text{TK_ENDIF} \}$

$\langle \text{arithmetic Expression} \rangle \Rightarrow \{ \text{TK-SEM}, \text{TK-CL} \}$

$\langle \text{boolean Expression} \rangle \Rightarrow \{ \text{TK-CL}, \text{TK-THEN} \}$

$\langle \text{var} \rangle \Rightarrow \{ \text{TK-CL}, \text{TK-PLUS}, \text{TK-MUL}, \text{TK-MINUS}, \text{TK-DIV}, \text{TK-SEM}, \text{TK-THEN}, \text{TK-LT}, \text{TK-LE}, \text{TK-EQ}, \text{TK-NE}, \text{TK-GT}, \text{TK-GE} \}$

$\langle \text{logical Op} \rangle \Rightarrow \{ \text{TK-OP} \}$

$\langle \text{relational Op} \rangle \Rightarrow \{ \text{TK-ID}, \text{TK-NUM}, \text{TK-RNUM} \}$

$\langle \text{return Stmt} \rangle \Rightarrow \{ \text{TK-END} \}$

$\langle \text{optional Return} \rangle \Rightarrow \{ \text{TK-SEM} \}$

$\langle \text{idList} \rangle \Rightarrow \{ \text{TK-SQR} \}$

$\langle \text{more_ids} \rangle \Rightarrow \{ \text{TK-SQR} \}$

$\langle \text{define type stmt} \rangle \Rightarrow \{ \text{TK-SEM} \}$

$\langle A \rangle \Rightarrow \{ \text{TK-RUID} \}$

$\langle AE1 \rangle \Rightarrow \{ \text{TK-PLUS}, \text{TK-MINUS}, \text{TK-CL}, \text{TK-SEM} \}$

$\langle AE2 \rangle \Rightarrow \{ \text{TK-CL}, \text{TK-SEM} \}$

$\langle AE3 \rangle \Rightarrow \{ \text{TK-MUL}, \text{TK-DIV}, \text{TK-PLUS}, \text{TK-MINUS}, \text{TK-CL}, \text{TK-SEM} \}$

$\langle AE4 \rangle \Rightarrow \{ \text{TK-PLUS}, \text{TK-MINUS}, \text{TK-CL}, \text{TK-SEM} \}$