ULB
INFO-F403 - Introduction to language theory and compiling
Introduction to language theory and compiling

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Academic year 2015-2016 - November 24, 2015

Chapter 1

Part 2 - Grammar

1.1 The modified grammar

This is our new modified grammar we ended up with :

```
 [1] <Program>-> begin <Code> end
 [2] <Code>-> Epsilon
 [3] -> <InstList>
 [4] <InstList>-> <Instruction> <NextInst>
 [5] <NextInst>-> Epsilon
 [6] -> ; <InstList>
 [7] <Instruction>-> <Assign>
 [8] -> <If>
 [9] -> <While>
[10] -> <For>
[11] -> <Print>
[12] -> <Read>
[13] <Assign>-> [VarName] := <ExprArith>
[14] <ExprArith>-> <Term> <ExprArith2>
[15] <ExprArith2>-> <TermOp> <Term> <ExprArith2>
[16] -> Epsilon
[17] <Term>-> <Factor> <Term2>
[18] <Term2>-> <FactorOp> <Factor> <Term2>
[19] -> Epsilon
[20] <Factor>-> (<ExprArith>)
[21] -> - <ExprArith>
[22] -> [VarName]
[23] -> [Number]
[24] <TermOp>-> +
[25] -> -
[26] <FactorOp>-> *
[27] -> /
[28] <If>-> if <Cond> then <Code> <EndIf>
[29] <EndIf>-> fi
```

```
[30] -> else <Code> fi
[31] <Cond>-> <AndCond> <Cond2>
[32] <Cond2>-> or <AndCond> <Cond2>
[33] -> Epsilon
[34] <AndCond>-> <CondTerm> <AndCond2>
[35] <AndCond2>-> and <CondTerm> <AndCond2>
[36] -> Epsilon
[37] <CondTerm>-> <SimpleCond>
[38] -> not <SimpleCond>
[39] <SimpleCond>-> <ExprArith> <Comp> <ExprArith>
[40] <Comp>-> =
[41] -> >=
[42] -> >
[43] -> <=
[44] -> <
[45] -> /=
[46] <While>-> while <Cond> do <Code> od
[47] <For>-> for [VarName] from <ExprArith> by <ExprArith> to
<ExprArith> do <Code> od
[48] <Print>-> print([VarName])
[49] <Read>-> read([VarName])
```

Removing unreachable and/or unproductive variables wasn't much of an issue but only a bit of work. The real deal in this part was to handle the correct associativity while removing left-recursion. Keeping the order of priority was not a problem. The problem is that we lost the associativity to the left when we tried to remove left-recursions. We tried multiple solutions to keep left associativity while removing left-recursions but none worked. So from here, we only could satisfy one of those constraints. We choosed to remove left-recursion because otherwise the algorithm wouldn't work. This means that our compiler works but is kind of false because left associativity is not respected.

1.2 The action table

To have the action table, we first needed to calculate the first and follow sets. Our grammar is LL(1), this means that LL(1) parsing uses only one symbol of input to predict the next grammar rule that should be used. Therefore each cell of our action table contains at most one rule.

```
FIRST :
-------
Program : {begin}
Code : {Epsilon,FIRST(InstList)}
InstList : {FIRST(Instruction)}
NextInst : {Epsilon,;}
Instruction :{FIRST(Assign,If,While,For,Print,Read)}
Assign : {VarName}
ExprArith : {FIRST(Term)}
ExprArith2 : {Epsilon, FIRST(TermOp)}
Term : {FIRST(Factor)}
```

```
Term2 : {Epsilon, FIRST(FactorOp)}
Factor : {(, -, VarName, Number}
TermOp : {+, -}
FactorOp : {*, /}
If : {if}
EndIf : {fi, else}
Cond : {FIRST(AndCond)}
Cond2 : {Epsilon, or}
AndCond : {FIRST(CondTerm)}
AndCond2 : {Epsilon, and}
CondTerm : {not, FIRST(SimpleCond)}
SimpleCond : {FIRST(ExprArith)}
Comp : {=, >=, >, <=, <, /=}
While : {while}
For : {for}
Print : {print}
Read : {read}


Follow:
------
Program : {$}
Code : {end, FIRST(EndIf), fi, od}
InstList : {FOLLOW(Code)}
NextInst : {FOLLOW(InstList)}
Instruction : {FIRST(NextInst)}
Assign : {FOLLOW(Instruction)}
ExprArith : {), by, to, do, FOLLOW(Assign,Factor, SimpleCond), FIRST(Comp)}
ExprArith2 : {FOLLOW(ExprArith)}
Term : {FIRST(ExprArith2)}
Term2 : {FOLLOW(Term)}
Factor : {FIRST(Term2)}
TermOp : {FIRST(Term)}
FactorOp : {FIRST(Factor)}
If : {FOLLOW(Instruction)}
EndIf : {FOLLOW(If)}
Cond : {then, do}
Cond2 : {FOLLOW(Cond)}
AndCond : {FIRST(Cond2)}
AndCond2 : {FOLLOW(AndCond)}
CondTerm : {FIRST(AndCond2)}
SimpleCond : {FOLLOW(CondTerm)}
Comp : {FIRST(ExprArith)}
While : {FOLLOW(Instruction)}
For : {FOLLOW(Instruction)}
Print : {FOLLOW(Instruction)}
Read : {FOLLOW(Instruction)}
```

	VARNAME	NUMBER	BEG	END	SEMICOLON	ASSIGN	LEFT_PARENTHESI	RIGHT_PARENTHESI	MINUS	PLUS	TIMES	DIVIDE	IF	THEN	FI	ELSE	NOT	AND	OR	EQUAL	GREATER_EQUA	GREATER	SMALLER_EQUA	SMALLER	DIFFERENT	WHILE	DO	OD	FOR	FROM	BY	TO	PRINT	READ	$
Program	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Code	3	-	-	2	-	-	-	-	-	-	-	-	3	-	2	2	-	-	-	-	-	-	-	-	-	3	-	2	3	-	-	-	3	3	-
InstList	4	-	-	-	-	-	-	-	-	-	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	4	-	-	4	-	-	-	4	4	-
NextInst	-	-	-	5	6	-	-	-	-	-	-	-	-	-	5	5	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-
Instruction	7	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	10	-	-	-	11	12	-
Assign	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ExprArith	14	14	-	-	-	-	14	-	14	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ExprArith2	16	16		16	16		16	16	15	15	16	16		16	16	16	16	16	16	16	16	16	16	16	16		16	16			16	16			
Term	17	17	-	-	-	-	17	-	17	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Term2				19	19			19	19	19	18	18		19	19	19		19	19	19	19	19	19	19	19		19	19			19	19			
Factor	22	23	-	-	-	-	20	-	21	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TermOp	-	-	-	-	-	-	-	-	25	24	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FactorOp	-	-	-	-	-	-	-	-	-	-	26	27	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
If	-	-	-	-	-	-	-	-	-	-	-	-	28	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EndIf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	29	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cond	31	31	-	-	-	-	31	-	31	-	-	-	-	-	-	-	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cond2	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-	-	32	-	-	-	-	-	-	-	33	-	-	-	-	-	-	-	-
AndCond	34	34	-	-	-	-	34	-	34	-	-	-	-	-	-	-	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
AndCond2	-	-	-	-	-	-	-	-	-	-	-	-	-	36	-	-	-	35	36	-	-	-	-	-	-	-	36	-	-	-	-	-	-	-	-
CondTerm	37	37	-	-	-	-	37	-	37	-	-	-	-	-	-	-	38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SimpleCond	39	39	-	-	-	-	39	-	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Comp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	41	42	43	44	45	-	-	-	-	-	-	-	-	-	-
While	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46	-	-	-	-	-	-	-	-	-
For	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47	-	-	-	-	-	-
Print	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	48	-	-
Read	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	49	-