

Theory of Computation Assignment 2

December 13, 2022

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2 Grammar

2.1 Terminals

2.1.1 Operators

$+, -, *, /, =, >, ==, (,)$

2.1.2 Delimiters

$;',', '{', '}'$

2.1.3 Keywords

$\text{'for', 'write', 'read', 'int'}$

2.1.4 $\langle \text{variable} \rangle$

$\langle \text{variable} \rangle = \{a - z\}^+$

2.1.5 $\langle \text{constant} \rangle$

$\langle \text{constant} \rangle = \{0 - 9\}^+$

2.2 Variables

- P - program (start variable)
- S - statement
- D - declaration
- F - for loop
- A - assignment
- R - read
- W - write
- E - expression
- T_1, T_2, T_3 - helper variables for expression
- N - constant
- I - variable
- L - variable list

2.3 Productions

2.3.1 Constant

A constant is a numeric literal.

$$N \rightarrow \langle \text{constant} \rangle$$

2.3.2 Variable

A string of alphabets which is not a keyword is a variable.

$$I \rightarrow \langle \text{variable} \rangle$$

2.3.3 Variable list

A variable list is either a variable, or a variable followed by a comma which is followed by another variable list.

$$L \rightarrow I \mid I, L$$

2.3.4 Declaration

A declaration is the keyword ‘int’ followed by a variable list L .

$$D \rightarrow \text{int } L$$

2.3.5 Read

A read statement is the keyword ‘read’ followed by a variable I .

$$R \rightarrow \text{read } I$$

2.3.6 Write

A write statement is the keyword ‘write’ followed by either a variable or a constant.

$$W \rightarrow \text{write } I \mid \text{write } N$$

2.3.7 Expression

An expression can be branched into subparts, which in turn can be non-terminals that can further lead to parts which can be evaluated. For our grammar, the definition of an expression goes up to four levels, defining operator precedence at each level. The lower the level, the higher the precedence.

$$\begin{aligned} E &\rightarrow E > T_1 \mid E == T_1 \mid T_1 \\ T_1 &\rightarrow T_1 + T_2 \mid T_1 - T_2 \mid T_2 \\ T_2 &\rightarrow T_2 * T_3 \mid T_2 / T_3 \mid T_3 \\ T_3 &\rightarrow (E) \mid I \mid N \end{aligned}$$

2.3.8 Assignment

An assignment statement is a variable followed by an equals sign followed by an expression.

$$A \rightarrow I = E$$

2.3.9 Loop

A for loop starts with the keyword ‘for’, then opening parentheses, an assignment, an expression, an assignment, then closing parentheses. This is followed by opening braces, a statement, then closing braces.

$$F \rightarrow \text{for}(A; E; A)\{S\}$$

2.3.10 Statement

A statement can be an assignment, a read, a write, a for loop, followed by a semicolon as the delimiter, optionally followed by another statement.

$$S \rightarrow A; \mid R; \mid W; \mid F; \mid A; S \mid R; S \mid W; S \mid F; S$$

2.3.11 Program

Program is the starting symbol of the grammar. It is either a declaration optionally followed by a statement or just a statement.

$$P \rightarrow D; \mid D; S \mid S$$