

# Compiler Construction (CS F363)

## Assignment -1



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Under the supervision of  
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Submitted by

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# CONTEXT FREE GRAMMAR (CFG)

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## Language Specification

- `<lowercase>` → a | b | c | d | e | f | g | h | i | j | k | l | m | n | o | p | q | r | s | t | u | v | w | x | y | z
- `<digits>` → 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9
- `<special>` → + | - | % | / | \* | < | > | = | \_ | ( | ) | ; | , | : | { | }
- `<alpha>` → @
- `<int_const>` → (`<decimal>`, 10) | (`<octal>`, 8) | (`<binary>`, 2)
- `<decimal>` → `<digits>``<decimal>` | `<digits>`
- `<octal>` → `<o>` `<octal>` | `<o>`
- `<o>` → 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7
- `<binary>` → `<b>` `<binary>` | `<b>`
- `<b>` → 0 | 1
- `<char>` → '`<c>`'
- `<c>` → `<lowercase>` | `<digits>` | `<nL>` | `<tab>`
- `<nL>` → \n
- `<tab>` → \t
- `<string>` → "`<s>`"
- `<s>` → `<s1>` `<s>` | `<s1>`
- `<s1>` → `<lowercase>` | `<digits>` | `<special>` | `<alpha>`
- `<keyword>` → int | char | if | else | while | for | main | begin | end | print | scan | VarDecl |  
program | inc | dec
- `<type>` → int | char
- `<var_name>` → `<lower_case>` `<rest_no_underscore>`
- `<rest_no_underscore>` → `<alpha_num>` `<rest_no_underscore>` |  
\_ `<rest_with_underscore>` | ε

- $\langle \text{rest\_with\_underscore} \rangle \rightarrow \langle \text{alpha\_num} \rangle \langle \text{rest\_with\_underscore} \rangle \mid \epsilon$
- $\langle \text{alpha\_num} \rangle \rightarrow \langle \text{lower\_case} \rangle \mid \langle \text{digit} \rangle$

## Start

- $\langle \text{program} \rangle \rightarrow \text{begin program : } \langle \text{statements} \rangle \text{ end program}$

## Statement Block

- $\langle \text{statements} \rangle \rightarrow \langle \text{statement} \rangle \langle \text{statements} \rangle \mid \langle \text{statement} \rangle$
- $\langle \text{statement} \rangle \rightarrow \langle \text{assignment} \rangle \mid \langle \text{if\_statement} \rangle \mid \langle \text{for\_statement} \rangle \mid \langle \text{while\_statement} \rangle \mid \langle \text{Var\_Dec} \rangle \mid \langle \text{blk\_stmt} \rangle \mid \langle \text{print\_stmt} \rangle \mid \langle \text{scan\_stmt} \rangle \mid \epsilon$
- $\langle \text{blk\_stmt} \rangle \rightarrow \text{begin } \langle \text{statements\_1} \rangle \text{ end}$
- $\langle \text{statements\_1} \rangle \rightarrow \langle \text{stmt\_1} \rangle \langle \text{statements\_1} \rangle \mid \langle \text{stmt\_1} \rangle$
- $\langle \text{stmt\_1} \rangle \rightarrow \langle \text{assignment} \rangle \mid \langle \text{print\_stmt} \rangle \mid \langle \text{scan\_stmt} \rangle$
- $\langle \text{Var\_Dec} \rangle \rightarrow \text{begin VarDecl : } \langle \text{decl} \rangle \text{ end VarDecl}$
- $\langle \text{decl} \rangle \rightarrow (\langle \text{var\_name} \rangle, \langle \text{type} \rangle); \langle \text{decl} \rangle \mid (\langle \text{var\_name} \rangle, \langle \text{type} \rangle);$

## Conditional Statement: if

- $\langle \text{if\_statement} \rangle \rightarrow \text{if } \langle \text{relational} \rangle \text{ begin } \langle \text{statements\_1} \rangle \text{ end; } \mid$   
 $\text{if } \langle \text{relational} \rangle \text{ begin } \langle \text{statements\_1} \rangle \text{ end else begin } \langle \text{statements\_1} \rangle \text{ end ;}$

## For and While Loop

- $\langle \text{for\_statement} \rangle \rightarrow \text{for } \langle \text{var\_name} \rangle := \langle \text{expr} \rangle \langle \text{to\_part} \rangle \langle \text{update} \rangle \langle \text{int\_const} \rangle \text{ do begin } \langle \text{statements\_1} \rangle \text{ end ;}$
- $\langle \text{to\_part} \rangle \rightarrow \text{to } \langle \text{expr} \rangle \mid \epsilon$
- $\langle \text{update} \rangle \rightarrow \text{inc} \mid \text{dec}$
- $\langle \text{while\_statement} \rangle \rightarrow \text{while } (\langle \text{relational\_x} \rangle) \text{ begin } \langle \text{statements\_1} \rangle \text{ end ;}$

- $\langle \text{relational\_x} \rangle \rightarrow \langle \text{relational} \rangle \mid \langle \text{var\_name} \rangle \langle \text{rel\_op} \rangle \langle \text{omg} \rangle \mid \langle \text{omg} \rangle \langle \text{rel\_op} \rangle \langle \text{var\_name} \rangle$
- $\langle \text{omg} \rangle \rightarrow \langle \text{decimal} \rangle \mid \langle \text{int\_const} \rangle$
- $\langle \text{rel\_op} \rangle \rightarrow = \mid > \mid < \mid \leq \mid \geq \mid <>$

## Print and Scan

- $\langle \text{print\_stmt} \rangle \rightarrow \text{print} ( \langle \text{string} \rangle , \langle \text{additional} \rangle ) ; \mid \text{print} ( \langle \text{string} \rangle ) ;$
- $\langle \text{additional} \rangle \rightarrow \langle \text{xyz} \rangle , \langle \text{additional} \rangle \mid \langle \text{xyz} \rangle$
- $\langle \text{xyz} \rangle \rightarrow \langle \text{var\_name} \rangle \mid \langle \text{int\_const} \rangle \mid \langle \text{char} \rangle$
- $\langle \text{scan\_stmt} \rangle \rightarrow \text{scan} ( " \langle \text{pqr} \rangle " , \langle \text{additional\_1} \rangle ) ;$
- $\langle \text{pqr} \rangle \rightarrow \langle \text{alpha} \rangle , \langle \text{pqr} \rangle \mid \langle \text{pqr} \rangle$
- $\langle \text{additional\_1} \rangle \rightarrow \langle \text{var\_name} \rangle , \langle \text{additional\_1} \rangle \mid \langle \text{var\_name} \rangle$

## Arithmetic / Assignment and Relational Operators

- $\langle \text{assignment} \rangle \rightarrow \langle \text{var\_name} \rangle \langle \text{assignment\_op} \rangle \langle \text{expr} \rangle$
- $\langle \text{expr} \rangle \rightarrow \langle \text{int\_const} \rangle \mid \langle \text{var\_name} \rangle \mid \langle \text{arithmetic} \rangle$
- $\langle \text{arithmetic} \rangle \rightarrow \langle \text{arithmetic} \rangle + \langle \text{arithmetic\_1} \rangle \mid \langle \text{arithmetic} \rangle - \langle \text{arithmetic\_1} \rangle \mid \langle \text{arithmetic\_1} \rangle$
- $\langle \text{arithmetic\_1} \rangle \rightarrow \langle \text{arithmetic\_1} \rangle * \langle \text{arithmetic\_2} \rangle \mid \langle \text{arithmetic\_1} \rangle / \langle \text{arithmetic\_2} \rangle \mid \langle \text{arithmetic\_1} \rangle \% \langle \text{arithmetic\_2} \rangle \mid \langle \text{arithmetic\_2} \rangle$
- $\langle \text{arithmetic\_2} \rangle \rightarrow \langle \text{int\_const} \rangle \mid \langle \text{var\_name} \rangle \mid \langle \text{decimal} \rangle$
- $\langle \text{relational} \rangle \rightarrow \langle \text{relational} \rangle = \langle \text{relational\_1} \rangle \mid \langle \text{relational} \rangle <> \langle \text{relational\_1} \rangle \mid \langle \text{relational\_1} \rangle$
- $\langle \text{relational\_1} \rangle \rightarrow \langle \text{relational\_1} \rangle < \langle \text{relational\_2} \rangle \mid \langle \text{relational\_1} \rangle \leq \langle \text{relational\_2} \rangle \mid \langle \text{relational\_1} \rangle > \langle \text{relational\_2} \rangle \mid \langle \text{relational\_1} \rangle \geq \langle \text{relational\_2} \rangle \mid \langle \text{relational\_2} \rangle$
- $\langle \text{relational\_2} \rangle \rightarrow \langle \text{int\_const} \rangle \mid \langle \text{var\_name} \rangle \mid \langle \text{decimal} \rangle \mid \langle \text{arithmetic} \rangle$