

Grammars and Derivations

- A Grammar is generative Device for defining languages.
- The Sentences of the language are generated through a Sequence of applications of the rules, beginning with a Special nonterminal of the grammar called **Start symbol**.
- This sequence of rule applications is called a **Derivation**.

$\langle \text{program} \rangle \rightarrow \text{begin } \langle \text{stmt_list} \rangle \text{ end}$

$\langle \text{stmt_list} \rangle \rightarrow \langle \text{stmt} \rangle \mid \langle \text{stmt} \rangle ; \langle \text{stmt_list} \rangle$

$\langle \text{stmt} \rangle \rightarrow \langle \text{var} \rangle = \langle \text{expression} \rangle$

$\langle \text{var} \rangle \rightarrow A \mid B \mid C$

$\langle \text{expression} \rangle \rightarrow \langle \text{var} \rangle + \langle \text{var} \rangle \mid \langle \text{var} \rangle$
 $\mid \langle \text{var} \rangle$



Derivation :

$\langle \text{program} \rangle \Rightarrow \text{begin } \langle \text{stmt_list} \rangle \text{ end}$

$\Rightarrow \text{begin } \langle \text{stmt} \rangle ; \langle \text{stmt_list} \rangle \text{ end}$

$\Rightarrow \text{begin } \langle \text{var} \rangle = \langle \text{expression} \rangle ; \langle \text{stmt_list} \rangle \text{ end}$

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- ⇒ begin $A = \langle \text{expression} \rangle; \langle \text{stmt_list} \rangle$ end
- ⇒ begin $A = \langle \text{var} \rangle + \langle \text{var} \rangle; \langle \text{stmt_list} \rangle$ end
- ⇒ begin $A = B + \langle \text{var} \rangle; \langle \text{stmt_list} \rangle$ end
- ⇒ begin $A = B + C; \langle \text{stmt_list} \rangle$ end
- ⇒ begin $A = B + C; \langle \text{stmt} \rangle$ end
- ⇒ begin $A = B + C; \langle \text{var} \rangle = \langle \text{expression} \rangle$ end
- ⇒ begin $A = B + C; B = \langle \text{expression} \rangle$ end
- ⇒ begin $A = B + C; B = \langle \text{var} \rangle$ end
- ⇒ begin $A = B + C; B = C$ end.

The symbol \Rightarrow is read "derives".

Each of the strings in the derivation, including $\langle \text{program} \rangle$ is called a Sentential form.



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Example of another Grammar

$\langle \text{assign} \rangle \rightarrow \langle \text{id} \rangle = \langle \text{expr} \rangle$

$\langle \text{id} \rangle \rightarrow A | B | C$

$\langle \text{expr} \rangle \rightarrow \langle \text{id} \rangle + \langle \text{expr} \rangle |$

$\langle \text{id} \rangle * \langle \text{expr} \rangle |$

$(\langle \text{expr} \rangle) |$

$\langle \text{id} \rangle$

$A = B * (A + C)$

$\langle \text{assign} \rangle \Rightarrow \langle \text{id} \rangle = \langle \text{expr} \rangle$

$\Rightarrow A = \langle \text{expr} \rangle$

$\Rightarrow A = \langle \text{id} \rangle * \langle \text{expr} \rangle$

$\Rightarrow A = B * \langle \text{expr} \rangle$

$\Rightarrow A = B * (\langle \text{expr} \rangle)$

$\Rightarrow A = B * (\langle \text{id} \rangle + \langle \text{expr} \rangle)$

$\Rightarrow A = B * (A + \langle \text{expr} \rangle)$

$\Rightarrow A = B * (A + \langle \text{id} \rangle)$

$\Rightarrow A = B * (A + C)$



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