

CmpE 260 - Principles of Programming Languages
Spring 2019
Assignment 1

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Solution 1

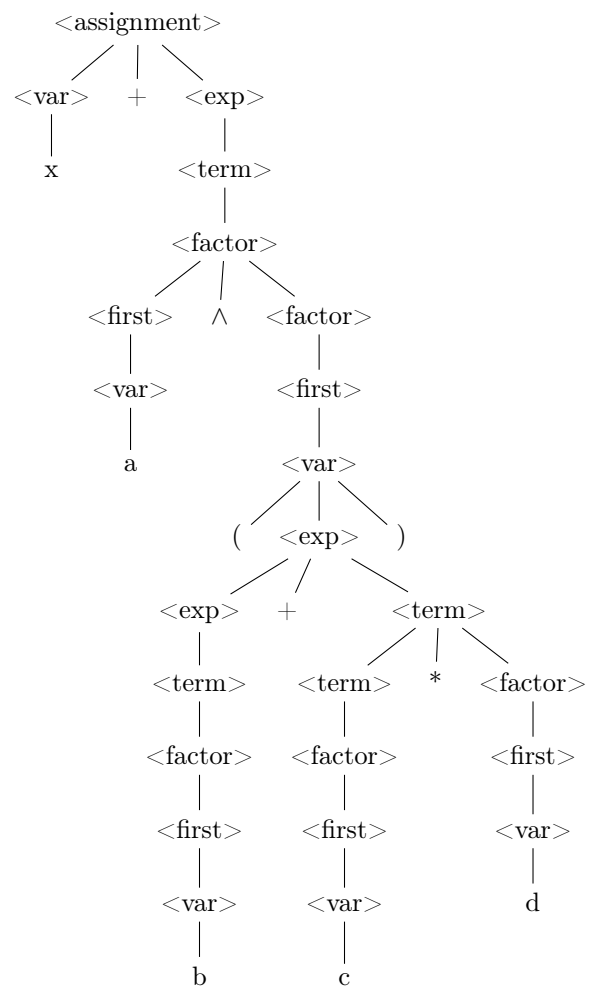
1.a

$\langle assignment \rangle \rightarrow \langle var \rangle = \langle exp \rangle$
 $\langle exp \rangle \rightarrow \langle exp \rangle + \langle term \rangle \mid \langle exp \rangle - \langle term \rangle \mid \langle term \rangle$
 $\langle term \rangle \rightarrow \langle term \rangle * \langle factor \rangle \mid \langle term \rangle / \langle factor \rangle \mid \langle factor \rangle$
 $\langle factor \rangle \rightarrow (\langle exp \rangle) \mid \langle var \rangle$
 $\langle var \rangle \rightarrow a|b|c|d|e|f|g|h|i|j|k|l|m|n|o|p|q|r|s|t|u|v|w|x|y|z$

1.b

$\langle assignment \rangle \rightarrow \langle var \rangle = \langle exp \rangle$
 $\langle exp \rangle \rightarrow \langle exp \rangle + \langle term \rangle \mid \langle exp \rangle - \langle term \rangle \mid \langle term \rangle$
 $\langle term \rangle \rightarrow \langle term \rangle * \langle factor \rangle \mid \langle term \rangle / \langle factor \rangle \mid \langle factor \rangle$
 $\langle factor \rangle \rightarrow \langle first \rangle \wedge \langle factor \rangle \mid \langle first \rangle$
 $\langle first \rangle \rightarrow (\langle exp \rangle) \mid \langle var \rangle$
 $\langle var \rangle \rightarrow a|b|c|d|e|f|g|h|i|j|k|l|m|n|o|p|q|r|s|t|u|v|w|x|y|z$

1.c



Solution 2

$$\begin{aligned}
 M_r(\text{repeat } \langle st - list \rangle \text{ until } \langle bool \rangle, s) \equiv \\
 & \text{if } M_{sl}(\langle st - list \rangle, s) = \text{error} \\
 & \quad \text{then error} \\
 & \quad \text{else if } M_b(\langle bool \rangle, M_{sl}(\langle st - list \rangle, s)) = \text{error} \\
 & \quad \quad \text{then error} \\
 & \quad \quad \text{else if } M_b(\langle bool \rangle, M_{sl}(\langle st - list \rangle, s)) = \text{true} \\
 & \quad \quad \quad \text{then } M_{sl}(\langle st - list \rangle, s) \\
 & \quad \quad \quad \text{else } M_r(\text{repeat } \langle st - list \rangle \text{ until } \langle bool \rangle, M_{sl}(\langle st - list \rangle, s))
 \end{aligned}$$

$$\begin{aligned}
 M_b(\langle var \rangle_1 = \langle var \rangle_2, s) \equiv \\
 & \text{if } VarMap(\langle var \rangle_1, s) = \text{undef} \\
 & \quad \text{then error} \\
 & \quad \text{else if } VarMap(\langle var \rangle_2, s) = \text{undef} \\
 & \quad \quad \text{then error} \\
 & \quad \quad \text{else if } VarMap(\langle var \rangle_1, s) = VarMap(\langle var \rangle_2, s) \\
 & \quad \quad \quad \text{then true} \\
 & \quad \quad \quad \text{else false}
 \end{aligned}$$

$$\begin{aligned}
 M_{sl}(\langle assign - st \rangle \langle st - list \rangle, s) \equiv \\
 & \text{if } M_a(\langle assign - st \rangle, s) = \text{error} \\
 & \quad \text{then error} \\
 & \quad \text{else } M_{sl}(\langle st - list \rangle, M_a(\langle assign - st \rangle, s))
 \end{aligned}$$

$$\begin{aligned}
 M_{sl}(\langle assign - st \rangle, s) \equiv \\
 & \text{if } M_a(\langle assign - st \rangle, s)
 \end{aligned}$$

$$\begin{aligned}
 M_a(\langle var \rangle_1 = \langle var \rangle_2, s) \equiv \\
 & \text{if } VarMap(\langle var \rangle_2, s) = \text{undef} \\
 & \quad \text{then error} \\
 & \quad \text{else } \langle i_1, v_1 \rangle, \dots, \langle i_n, v_n \rangle \text{ where} \\
 & \quad \quad v_j = VarMap(i_j, s) \quad , \text{if } i_j \neq \langle var \rangle_1 \\
 & \quad \quad VarMap(\langle var \rangle_2, s), \text{if } i_j = \langle var \rangle_1
 \end{aligned}$$

Solution 3

$\langle declaration \rangle \rightarrow \langle section_k \rangle \langle section_t \rangle \langle section_z \rangle \langle section_a \rangle$
 $\langle section_k \rangle .num = \langle section_a \rangle .num$
 $\langle section_t \rangle .num = \langle section_a \rangle .num$
 $\langle section_z \rangle .num = \langle section_a \rangle .num$

$\langle section_k \rangle \rightarrow katara \langle element - list \rangle$
 $\langle section_k \rangle .num \leftarrow \langle element - list \rangle .num$
 $\langle element - list \rangle .type \leftarrow W$

$\langle section_t \rangle \rightarrow toph \langle element - list \rangle$
 $\langle section_t \rangle .num \leftarrow \langle element - list \rangle .num$
 $\langle element - list \rangle .type \leftarrow E$

$\langle section_z \rangle \rightarrow zuko \langle element - list \rangle$
 $\langle section_z \rangle .num \leftarrow \langle element - list \rangle .num$
 $\langle element - list \rangle .type \leftarrow F$

$\langle section_a \rangle \rightarrow aang \langle avatar - list \rangle$
 $\langle section_a \rangle .num \leftarrow \langle avatar - list \rangle .num$

$\langle element - list \rangle_1 \rightarrow \langle element \rangle \langle element - list \rangle_2$
 $\langle element - list \rangle_1 .num \leftarrow if(\langle element - list \rangle .type = \langle element \rangle .type)$
 $\quad then(\langle element - list \rangle_2 .num + 1) else(\langle element - list \rangle_2 .num)$

$\langle element - list \rangle \rightarrow \langle element \rangle$
 $\langle element - list \rangle .num \leftarrow if(\langle element - list \rangle .type = \langle element \rangle .type) then(1) else(0)$

$\langle avatar - list \rangle_1 \rightarrow \langle element \rangle \langle avatar - list \rangle_2$
 $\langle avatar - list \rangle_1 .num \leftarrow \langle avatar - list \rangle_2 .num + 1$

$\langle avatar - list \rangle \rightarrow \langle element \rangle$
 $\langle avatar - list \rangle .num \leftarrow 1$

$\langle element \rangle \rightarrow W$
 $\langle element \rangle .type \leftarrow W$
 $\langle element \rangle \rightarrow E$
 $\langle element \rangle .type \leftarrow E$
 $\langle element \rangle \rightarrow F$
 $\langle element \rangle .type \leftarrow F$
 $\langle element \rangle \rightarrow A$
 $\langle element \rangle .type \leftarrow A$