

F#. Homework 7

Artyom Kopan

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1 Grammar

$$\begin{aligned}\langle \text{program} \rangle &::= \{ \text{let } \langle \text{variable} \rangle = \langle \text{expression} \rangle \mid \langle \text{expression} \rangle \} \\ \langle \text{expression} \rangle &::= \langle \text{expression}' \rangle \mid \langle \text{abstraction} \rangle \mid \langle \text{application} \rangle \\ \langle \text{expression}' \rangle &::= \langle \text{variable} \rangle \mid (\langle \text{expression} \rangle) \\ \langle \text{abstraction} \rangle &::= \lambda \langle \text{variable} \rangle \{ \langle \text{variable} \rangle \}. \langle \text{expression} \rangle \\ \langle \text{application} \rangle &::= \langle \text{expression}' \rangle \langle \text{expression}' \rangle \mid \langle \text{expression} \rangle \langle \text{application} \rangle \\ \langle \text{variable} \rangle &::= \langle \text{letter} \rangle \{ \langle \text{letter} \rangle \mid \langle \text{digit} \rangle \} \\ \langle \text{letter} \rangle &::= A \mid B \mid \dots \mid Z \mid a \mid b \mid \dots \mid z \\ \langle \text{digit} \rangle &::= 1 \mid 2 \mid \dots \mid 9\end{aligned}$$

2 Example 1

$$\begin{aligned}\text{let } A &= \lambda x. x \ x \implies \\ \langle \text{program} \rangle & \\ \text{let } \langle \text{variable} \rangle &= \langle \text{expression} \rangle \\ \text{let } \langle \text{letter} \rangle \{ \langle \text{letter} \rangle \mid \langle \text{digit} \rangle \} &= \langle \text{expression} \rangle \\ \text{let } \langle \text{letter} \rangle &= \langle \text{expression} \rangle \\ \text{let } A &= \langle \text{expression} \rangle \\ \text{let } A &= \langle \text{abstraction} \rangle \\ \text{let } A &= \lambda \langle \text{variable} \rangle \{ \langle \text{variable} \rangle \}. \langle \text{expression} \rangle \\ \text{let } A &= \lambda \langle \text{variable} \rangle. \langle \text{expression} \rangle \\ \text{let } A &= \lambda \langle \text{letter} \rangle \{ \langle \text{letter} \rangle \mid \text{digit} \}. \langle \text{expression} \rangle \\ \text{let } A &= \lambda \langle \text{letter} \rangle. \langle \text{expression} \rangle \\ \text{let } A &= \lambda x. \langle \text{expression} \rangle \\ \text{let } A &= \lambda x. \langle \text{application} \rangle \\ \text{let } A &= \lambda x. \langle \text{expression}' \rangle \langle \text{expression}' \rangle\end{aligned}$$

$let\ A = \lambda x. \langle variable \rangle \langle expression' \rangle$
 $let\ A = \lambda x. \langle letter \rangle \{ \langle letter \rangle \mid \langle digit \rangle \} \langle expression' \rangle$
 $let\ A = \lambda x. \langle letter \rangle \langle expression' \rangle$
 $let\ A = \lambda x. x \langle expression' \rangle$
 $let\ A = \lambda x. x \langle variable \rangle$
 $let\ A = \lambda x. x \langle letter \rangle \{ \langle letter \rangle \mid \langle digit \rangle \}$
 $let\ A = \lambda x. x \langle letter \rangle$
 $let\ A = \lambda x. x\ x \blacksquare$

3 Example 2

$let\ B = \lambda xy. x\ (y\ x) \implies$
 $\langle program \rangle$
 $let\ \langle variable \rangle = \langle expression \rangle$
 $let\ \langle letter \rangle \{ \langle letter \rangle \mid \langle digit \rangle \} = \langle expression \rangle$
 $let\ \langle letter \rangle = \langle expression \rangle$
 $let\ A = \langle expression \rangle$
 $let\ A = \langle abstraction \rangle$
 $let\ A = \lambda \langle variable \rangle \{ \langle variable \rangle \}. \langle expression \rangle$
 $let\ A = \lambda \langle letter \rangle \{ \langle letter \rangle \mid \langle digit \rangle \} \{ \langle variable \rangle \}. \langle expression \rangle$
 $let\ A = \lambda \langle letter \rangle \{ \langle variable \rangle \}. \langle expression \rangle$
 $let\ A = \lambda x \{ \langle variable \rangle \}. \langle expression \rangle$
 $let\ A = \lambda x \langle letter \rangle \{ \langle letter \rangle \mid \langle digit \rangle \}. \langle expression \rangle$
 $let\ A = \lambda x \langle letter \rangle. \langle expression \rangle$
 $let\ A = \lambda xy. \langle expression \rangle$
 $let\ A = \lambda xy. \langle expression \rangle$
 $let\ A = \lambda xy. \langle application \rangle$
 $let\ A = \lambda xy. \langle expression' \rangle \langle expression' \rangle$
 $let\ A = \lambda xy. \langle variable \rangle \langle expression' \rangle$
 $let\ A = \lambda xy. \langle letter \rangle \{ \langle letter \rangle \mid \langle digit \rangle \} \langle expression' \rangle$
 $let\ A = \lambda xy. \langle letter \rangle \langle expression' \rangle$
 $let\ A = \lambda xy. x \langle expression' \rangle$
 $let\ A = \lambda xy. x (\langle expression \rangle)$
 $let\ A = \lambda xy. x (\langle application \rangle)$
 $let\ A = \lambda xy. x (\langle expression' \rangle \langle expression' \rangle)$
 $let\ A = \lambda xy. x (\langle variable \rangle \langle expression' \rangle)$
 $let\ A = \lambda xy. x (\langle letter \rangle \{ \langle letter \rangle \mid \langle digit \rangle \} \langle expression' \rangle)$
 $let\ A = \lambda xy. x (\langle letter \rangle \langle expression' \rangle)$

$let\ A = \lambda xy.x\ (y\langle expression'\rangle)$
 $let\ A = \lambda xy.x\ (y\langle expression'\rangle)$
 $let\ A = \lambda xy.x\ (y\langle variable\rangle)$
 $let\ A = \lambda xy.x\ (y\langle letter\rangle\{\langle letter\rangle\ |\ \langle digit\rangle\})$
 $let\ A = \lambda xy.x\ (y\langle letter\rangle)$
 $let\ A = \lambda xy.x\ (y\ x)\ \blacksquare$