

計算の理論 後半課題 1

司馬博文 J4-190549

2020 年 6 月 10 日

1. $(\lambda x. \lambda y. x)yx$

$$\begin{aligned} (\lambda x. \lambda y. x)yx &\xrightarrow{\alpha} (\lambda x. \lambda z. x)yx \\ &\xrightarrow{\beta} (\lambda z. y)x \\ &\xrightarrow{\beta} y \end{aligned}$$

2. $(\lambda b. \lambda x. \lambda y. bxy)(\lambda x. \lambda y. y)xy$

$$\begin{aligned} (\lambda b. \lambda x. \lambda y. bxy)(\lambda x. \lambda y. y)xy &\xrightarrow{\beta} (\lambda b. \lambda x. \lambda y. bxy)(\lambda y. y)y \\ &\xrightarrow{\alpha} (\lambda b. \lambda x. \lambda y. bxy)(\lambda z. z)y \\ &\xrightarrow{\beta} (\lambda b. \lambda x. \lambda y. bxy)y \\ &\xrightarrow{\alpha} (\lambda b. \lambda x. \lambda z. bxz)y \\ &\xrightarrow{\beta} \lambda x. \lambda z. yxz \\ &\xrightarrow{\eta} \lambda x. yx \\ &\xrightarrow{\eta} y \end{aligned}$$

3. $(\lambda f. \lambda x. f(f(x)))(\lambda f. \lambda x. f(f(x)))$

$$\begin{aligned} (\lambda f. \lambda x. f(f(x)))(\lambda f. \lambda x. f(f(x))) &\xrightarrow{\alpha} (\lambda f. \lambda y. f(f(y)))(\lambda f. \lambda x. f(f(x))) \\ &\xrightarrow{\beta} \lambda y. (\lambda f. \lambda x. f(f(x)))(\lambda f. \lambda x. f(f(x)))(y) \\ &\xrightarrow{\beta} \lambda y. (\lambda f. \lambda x. f(f(x)))(\lambda x. y(yx)) \\ &\xrightarrow{\alpha} \lambda y. (\lambda f. \lambda z. f(f(z)))(\lambda x. y(yx)) \\ &\xrightarrow{\beta} \lambda y. (\lambda z. (\lambda x. y(yx))((\lambda x. y(yx))(z))) \\ &\xrightarrow{\beta} \lambda y. (\lambda z. (\lambda x. y(yx))(y(yz))) \\ &\xrightarrow{\beta} \lambda y. (\lambda z. (y(y(yz)))) \end{aligned}$$