Exercises Semantics

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1. Compute the denotational semantics of
   $f(3)$ **where** $f(x) =$ **if** $x = 0$ **then** 0 **else** $f(x+1)$
2. Compute the denotational semantics of
   $f(3)$ **where** $f(x) =$ **if** $x = 0$ **then** 0 **else** $f(f(x-1))$
3. Consider the applicative structure $(\Lambda, \cdot)$ of untyped lambda terms with application and with $=_{\beta\eta}$ as equality.
   (a) Is it extensional?
   (b) Is it combinatory complete?
4. Consider the applicative structure $(\{a,b\}^*, \cdot)$ of strings over $\{a,b\}$ with concatenation and string equality.
   (a) Is it extensional?
   (b) Is it combinatory complete?
5. Consider the applicative structure of combinatory logic: terms built from $\mathbf{K}$ and $\mathbf{S}$ usinf application as equality $\mathbf{K}\,x\,y = x$, $\mathbf{S}\,x\,y\,z = x\,z\,(y\,z)$.
   (a) Is it extensional?
   (b) Is it combinatory complete?