Serie 5 - Lambda Calculus

Exercise 1

Consider the following λ-expressions. Indicate which occurrences of variables are bound and which ones are free in the expressions.

1. `(λ a b . c d a b) a b (λ c d . d c)(λ e f . f) e`

2. `{(λ u v . λ w . w (λ x . x(u)) (v)) (y)} (λ z . λ y . z(y))`

3. `λ y . (λ x . z(x(λ x . y(z)))) (λ z . y(x(z)))`

Exercise 2

Define `true`, `false`, `and`, `or`, `not` and `xor` in Lambda Calculus.

Exercise 3

Reduce the following λ-expressions to their normal form whenever possible.

a. `P ≡ (λ x . x (x y)) I` where `I ≡ λ u . u`

b. `Y ≡ λ f . Q Q` where `Q ≡ (λ x . f(x x))`

c. `L ≡ (λ x . x x y) (λ x . x x y)`

d. `(λ x . x L) M` where `M ≡ λ x . y` and `L ≡ (λ x . x x y) (λ x . x x y)`

e. `{{λ u v . {λ w . w (λ x . x(u))} (v)} (y)} (λ z . λ y . z(y))`