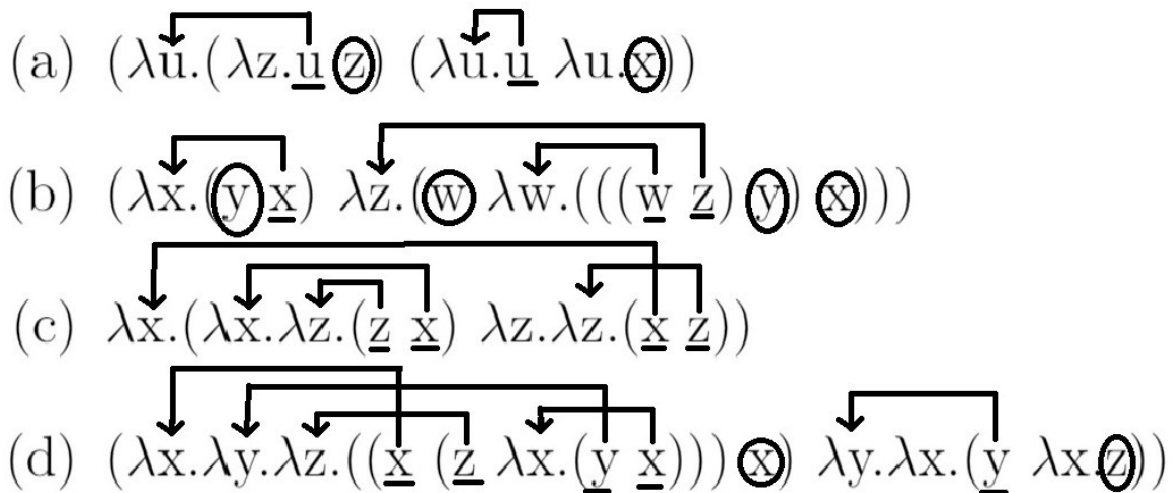


# CS 331 - A5

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2.



3. (a)  $\text{subst}(\underline{u}, \underline{v}, \lambda \underline{u}. \underline{v}) = \lambda \underline{a}. \underline{u}$  [case 2c]
- (b)  $\text{subst}(\underline{u}, \underline{v}, \lambda \underline{v}. \underline{u}) = \lambda \underline{v}. \underline{u}$  [case 2a]
- (c)  $\text{subst}(\underline{u}, \underline{v}, \lambda \underline{v}. \underline{w}) = \lambda \underline{v}. \underline{w}$  [case 2a]
- (d)  $\text{subst}(\underline{u}, \underline{v}, \lambda \underline{w}. \underline{v}) = \lambda \underline{w}. \underline{u}$  [case 2b]
- (e)  $\text{subst}(\underline{u}, \underline{v}, \lambda \underline{u}. \underline{u}) = \lambda \underline{a}. \underline{a}$  [case 2c]
- (f)  $\text{subst}(\underline{u}, \underline{v}, \lambda \underline{v}. \underline{v}) = \lambda \underline{v}. \underline{v}$  [case 2a]
- (g)  $\text{subst}(\underline{u}, \underline{v}, \lambda \underline{w}. \underline{w}) = \lambda \underline{w}. \underline{w}$  [case 2b]

4. (a)  $\text{subst}(g\ y, x, (\lambda f.\lambda y.(g\ x)\ y)) = (\lambda f.\lambda a.(g\ (g\ y))\ y)$
- (b)  $\text{subst}(w, x, ((x\ \lambda x.(x\ w))\ \lambda z.((x\ w)\ z))) = ((w\ \lambda x.(w\ w))\ \lambda z.((w\ w)\ z))$
- (c)  $\text{subst}(v, u, \lambda v.\lambda u.((g\ v)\ u)) = \lambda a.\lambda u.((g\ a)\ u)$
- (d)  $\text{subst}(f\ x, g, (\lambda x.(\lambda f.(f\ g)\ (g\ x))\ \lambda g.(f\ x))) = (\lambda a.(\lambda b.(b\ (f\ x))\ ((f\ x)\ a))\ \lambda g.(f\ x))$
- (e)  $\text{subst}(\lambda x.(y\ y), x, \lambda y.\lambda x.\lambda y.z) = \lambda a.\lambda x.\lambda y.z$