Extra out-of-class practice 2

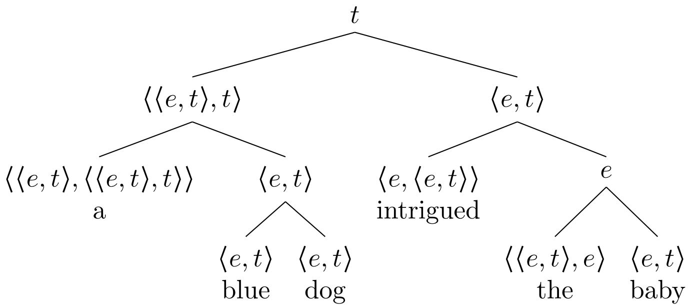
Applied exercises

Provide a full lambda computation of the following sentences, including a tree annotated with types, the lexical entries, and a step-by-step computation. Ignore tense.

1. A blue dog intrigued the baby
2. Hanna is not a Canadian athlete (*is* and *a* are meaningless)

Solution

1. ⟦A blue dog intrigued the baby⟧



$[\![\text{baby}]\!] = \lambda y[BABY(y)]$

$[\![\text{blue}]\!] = \lambda y[BLUE(y)]$

$[\![\text{dog}]\!] = \lambda y[DOG(y)]$

$[\![\text{intrigue}]\!] = \lambda y[\lambda z[INTRIGUE(z,y)]]$

$[\![\text{the}]\!] = \lambda f_{\langle e,t\rangle}[\iota x[f(x)]]$

$[\![\text{a}]\!] = \lambda f_{\langle e,t\rangle}[\lambda g_{\langle e,t\rangle}[\exists y[f(y)\ \&\ g(y)]]]$

(a) $[\![\text{the baby}]\!]$
$= [\![\text{the}]\!]([\![\text{baby}]\!])$
$= \lambda f_{\langle e,t\rangle}[\iota x[f(x)]]([\![\text{baby}]\!])$
$= \iota x[[\![\text{baby}]\!](x)]$
$= \iota x[\lambda y[BABY(y)](x)]$
$= \iota x[BABY(x)]$
$= b$

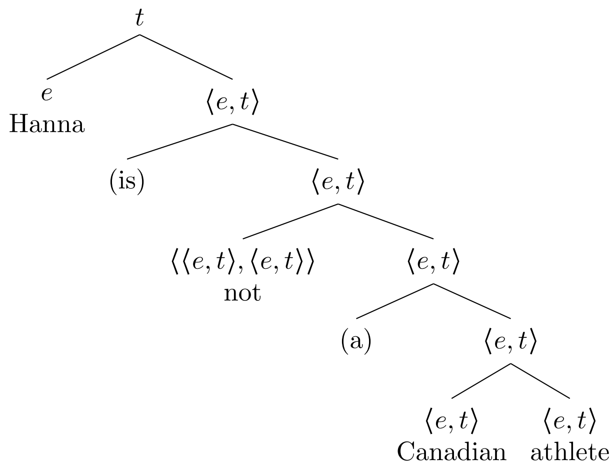
(b) $[\![\text{intrigued the baby}]\!]$
$= [\![\text{intrigue the baby}]\!]$
$= [\![\text{intrigue}]\!]([\![\text{the baby}]\!])$
$= [\![\text{intrigue}]\!](b)$
$= \lambda y[\lambda z[INTRIGUE(z,y)]](b)$
$= \lambda z[INTRIGUE(z,b)]$

(c) $[\![\text{blue dog}]\!]$
$= \lambda x[[\![\text{blue}]\!](x)\ \&\ [\![\text{dog}]\!](x)]$ (via PM)
$= \lambda x[\lambda y[BLUE(y)](x)\ \&\ [\![\text{dog}]\!](x)]$
$= \lambda x[BLUE(x)\ \&\ [\![\text{dog}]\!](x)]$
$= \lambda x[BLUE(x)\ \&\ \lambda y[DOG(y)](x)]$
$= \lambda x[BLUE(x)\ \&\ DOG(x)]$

(d) $[\![\text{a blue dog}]\!]$
$= [\![\text{a}]\!]([\![\text{blue dog}]\!])$
$= \lambda f_{\langle e,t\rangle}[\lambda g_{\langle e,t\rangle}[\exists y[f(y)\ \&\ g(y)]]]([\![\text{blue dog}]\!])$
$= \lambda g_{\langle e,t\rangle}[\exists y[[\![\text{blue dog}]\!](y)\ \&\ g(y)]]$
$= \lambda g_{\langle e,t\rangle}[\exists y[\lambda x[BLUE(x)\ \&\ DOG(x)](y)\ \&\ g(y)]]$
$= \lambda g_{\langle e,t\rangle}[\exists y[[BLUE(y)\ \&\ DOG(y)]\ \&\ g(y)]]$

(e) $[\![\text{a blue dog intrigued the baby}]\!]$
$= [\![\text{a blue dog intrigue the baby}]\!]$
$= [\![\text{a blue dog}]\!]([\![\text{intrigue the baby}]\!])$
$= \lambda g_{\langle e,t\rangle}[\exists y[[BLUE(y)\ \&\ DOG(y)]\ \&\ g(y)]]([\![\text{intrigue the baby}]\!])$
$= \exists y[[BLUE(y)\ \&\ DOG(y)]\ \&\ [\![\text{intrigue the baby}]\!](y)]$
$= \exists y[[BLUE(y)\ \&\ DOG(y)]\ \&\ \lambda z[INTRIGUE(z,b)](y)]$
$= \text{T iff } \exists y[[BLUE(y)\ \&\ DOG(y)]\ \&\ INTRIGUE(y,b)]$

2. $[\![$Hanna (is) not (a) Canadian athlete$]\!]$



$[\![$Hanna$]\!] = h$

$[\![$Canadian$]\!] = \lambda y[CANADIAN(y)]$

$[\![$athlete$]\!] = \lambda y[ATHLETE(y)]$

$[\![$not$]\!] = \lambda f_{\langle e,t\rangle}[\lambda y[\neg f(y)]]$

(a) $[\![$Canadian athelete$]\!]$

$= \lambda x[[\![\text{Canadian}]\!](x)\ \&\ [\![\text{athlete}]\!](x)]$ (via PM)
$= \lambda x[\lambda y[CANADIAN(y)](x)\ \&\ [\![\text{athlete}]\!](x)]$
$= \lambda x[CANADIAN(x)\ \&\ [\![\text{athlete}]\!](x)]$
$= \lambda x[CANADIAN(x)\ \&\ \lambda y[ATHLETE(y)](x)]$
$= \lambda x[CANADIAN(x)\ \&\ ATHLETE(x)]$

(b) $[\![$not (a) Canadian athlete$]\!]$

$= [\![\text{not}]\!]([\![\text{Canadian athlete}]\!])$
$= \lambda f_{\langle e,t\rangle}[\lambda y[\neg f(y)]]([\![\text{Canadian athlete}]\!])$
$= \lambda y[\neg[[\![\text{Canadian athlete}]\!](y)]]$
$= \lambda y[\neg[\lambda x[CANADIAN(x)\ \&\ ATHLETE(x)](y)]]$
$= \lambda y[\neg[CANADIAN(y)\ \&\ ATHLETE(y)]]$

(c) $[\![$Hanna (is) not (a) Canadian athlete$]\!]$

$= [\![\text{not (a) Canadian athelte}]\!]([\![\text{Hanna}]\!])$
$= [\![\text{not (a) Canadian athelte}]\!](h)$
$= \lambda y[\neg[CANADIAN(y)\ \&\ ATHLETE(y)]](h)$
$=$ T iff $\neg[CANADIAN(h)\ \&\ ATHLETE(h)]$

★ Fun fact: This is logically equivalent to $\neg CANADIAN(h) \vee \neg ATHLETE(h)$

★ Make sure that the negation is negating the entire conjoined proposition (i.e., the end result in (c) is not the same thing as $\neg CANADIAN(h)\ \&\ ATHLETE(h)$ 'Hanna is a non-Canadian athlete'!)