1 Semantic Types (Heim & Kratzer 1998: p.40)

Replace "?" in each of the following statements (you can use the shorthand $et := \langle e, t\rangle$)
e.g. $[\lambda f \in D_{\langle e,t\rangle}.[\lambda x \in D_e.\ 1 \text{ iff } f(x) = 1 \text{ and } x \text{ is gray}]] \in D_?$ — $\langle\langle e, t\rangle, \langle e, t\rangle\rangle$ (or $\langle et, et\rangle$)

i) $[\lambda f \in D_{\langle e,\langle e,t\rangle\rangle}.[\lambda x \in D_e.\ 1 \text{ iff } f(x)(\text{Ann}) = 1]] \in D_?$

ii) $[\lambda y \in D_e.[\lambda f \in D_{\langle e,t\rangle}.[\lambda x \in D_e.\ 1 \text{ iff } f(x) = 1 \text{ and } x \text{ is in } y]]] \in D_?$

iii) $[\lambda f \in D_{\langle e,t\rangle}.\ 1 \text{ iff there is some } x \in D_e \text{ such that } f(x) = 1] \in D_?$

iv) $[\lambda f \in D_{\langle e,t\rangle}.\ \text{Mary}] \in D_?$

v) $[\lambda f \in D_{\langle e,t\rangle}.[\lambda g \in D_{\langle e,t\rangle}.\ 1 \text{ iff there is no } x \in D_e \text{ such that } f(x) = 1 \text{ and } g(x) = 1]] \in D_?$

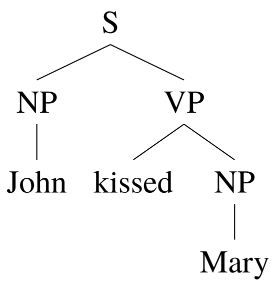
2 Computation

Assume the following lexical entries.

$[\![\text{John}]\!]^{M_1} = j$
$[\![\text{Mary}]\!]^{M_1} = m$
$[\![\text{kissed}]\!]^{M_1} = [\lambda y \in D_e.\ [\lambda x \in D_e.\ 1 \text{ iff } x \text{ kissed } y \text{ in } M_1]]$

Using the two compositional rules, the Branching Node Rule and Non-Branching Node Rule, compute the denotation of (1) in model M_1. Do not omit any step, i.e. in each step you may perform only one replacement. You can do the computation top-down or bottom-up.

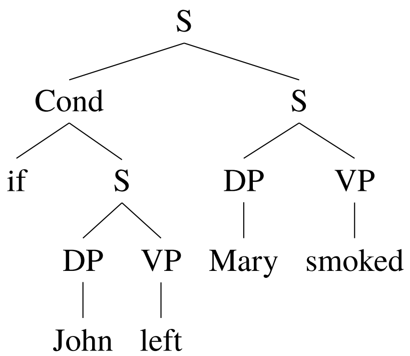
(1)



3 (Optional) 'If'

In the lecture, we analyzed the denotations of 'and' and 'or' based on the meanings of logical connectives $\wedge$ and $\vee$, respectively. In this optional exercise, you will develop a similar analysis for 'if', based on logical connective $\rightarrow$.
Firstly, let us assume the following syntax.

(2)

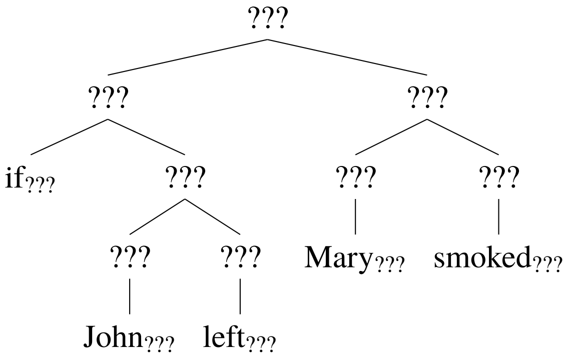


In order to generate this sentence, we need the following syntactic rules:

(3) a. S → Cond S
  b. Cond → if S

i) The first thing to do is to figure out the semantic type of 'if'. Annotate each constituent in the following tree with its semantic type. Don't leave out the semantic types of the terminal nodes.

(4)



ii) Recall that the logical connective → has the following meaning.

$$\text{`}p \rightarrow q\text{' is true iff } p = 0 \text{ or } q = 1$$

Based on this, formulate the denotation of 'if'.
For any model M, $[\![\text{if}]\!]^M$ = ???