Semantic Theory 2025: Practice Exam Key

Question 1: Predicate Logic (10)

a. Translate the following sentences into first-order predicate logic:

   i. *Every student doesn't read a book*
   Any one of the following:
   $\neg\forall x[student(x) \rightarrow \exists y[book(y) \wedge read(x,y)]]$
   $\neg\exists y[book(y) \wedge \forall x[student(x) \rightarrow read(x,y)]]$
   $\forall x[student(x) \rightarrow \neg\exists y[book(y) \wedge read(x,y)]]$
   $\exists y[book(y) \wedge \neg\forall x[student(x) \rightarrow read(x,y)]]$
   $\forall x[student(x) \rightarrow \exists y[book(y) \wedge \neg read(x,y)]]$
   $\exists y[book(y) \wedge \forall x[student(x) \rightarrow \neg read(x,y)]]$

   ii. *John and Bill love every city they visit*
   Any one of the following:
   $\forall x[(city(x) \wedge visit(b',x) \wedge visit(j',x)) \rightarrow (love(b',x) \wedge love(j',x))]$
   $\forall x[city(x) \rightarrow (visit(j',x) \rightarrow love(j',x) \wedge visit(b',x) \rightarrow love(b',x))]$

Question 2: Type Theory (10)

a. Provide the derivations (type inferencing) of each of the following sentences. Brackets indicate the combinatorics, and subscripts indicate the types of (some of) the expressions—the rest must be deduced. You can treat "the food" as the single term f' in (i).

   i. [*Some* $cat_{\langle e,t\rangle}$] [$ate_{\langle e,\langle e,t\rangle\rangle}$ $\underline{\textit{the food}}_e$]

$$\dfrac{\dfrac{some :: \langle\langle e,t\rangle,\langle\langle e,t\rangle,t\rangle\rangle \quad cat :: \langle e,t\rangle}{some(cat) :: \langle\langle e,t\rangle,t\rangle} \qquad \dfrac{eat :: \langle e,\langle e,t\rangle\rangle \quad f' :: e}{eat(f') :: \langle e,t\rangle}}{some(cat)(eat(f')) :: t}$$

ii. [*Mary hates a book*] *and*$_{\langle t,\langle t,t\rangle\rangle}$ [*Steve hates a movie*]

$$\dfrac{\dfrac{\wedge :: \langle t, tt\rangle \qquad \dfrac{\dfrac{\dfrac{a :: \langle et, \langle\langle e, et\rangle, et\rangle\rangle \quad B :: et}{a(B) :: \langle\langle e, et\rangle, et\rangle} \qquad H :: \langle e, et\rangle}{a(B)(H) :: et} \qquad m' :: e}{a(B)(H)(m') :: t}}{\wedge(a(B)(H)(m')) :: tt} \qquad \dfrac{\dfrac{\dfrac{a :: \langle et, \langle\langle e, et\rangle, et\rangle\rangle \quad M :: et}{a(M) :: \langle\langle e, et\rangle, et\rangle} \qquad H :: \langle e, et\rangle}{a(M)(H) :: et} \qquad s' :: e}{a(M)(H)(s') :: t}}{\wedge(a(B)(H)(m'))(a(M)(H)(s')) :: t}$$

Question 3: λ-Calculus (10)

a. Given the types that you determined (or were given) for the terms in (2a), derive the corresponding λ-expressions for the following terms:

   i. *some* $\lambda P_{\langle e,t\rangle} \lambda R_{\langle e,t\rangle}.\exists x[P(x) \wedge R(x)]$

   ii. *cat* $\lambda x_e.cat^*(x)$

   iii. *eat* $\lambda x_e \lambda y_e.eat^*(x)(y)$

   iv. *and* $\lambda P_t \lambda R_t.[R \wedge P]$

   v. *a* $\lambda P_{\langle e,t\rangle} \lambda R_{\langle e,\langle e,t\rangle\rangle} \lambda x_e.\exists y[P(y) \wedge R(y)(x)]$

Question 4: Generalized Quantifiers (20)

Consider the following sentence: *Only George can solve the problem*

a. Give the generalized quantifier definition of the noun phrase *"only George"*.
$[\![only\ George]\!]^M = \{P \subseteq U_M \mid |P| = 1 \wedge [\![George]\!]^M \in P\}$

b. What are the monotonicity properties (left and right) of *only*? Show how you derived these properties.
Left upward:
only good students came to the party $\vDash$ *only students came to the party*
Right downward:
only athletes ran $\vDash$ *only athletes ran quickly*

Question 5: Event Semantics (20)

a. Translate the following sentences into Davidsonian (event semantics) representations, **including** temporal information. <u>Underlined</u> expressions may be treated as a single term with the specified type.

   i. *Mary cut every page with* $\underline{\textit{scissors}}_e$ *on Friday*

Any one of the following:

$\exists e[e < e_u \wedge \mathit{on}(e, \mathit{friday}) \wedge \mathit{with}(e, \mathit{scissors}) \wedge \forall x[\mathit{page}(x) \rightarrow \mathit{cut}(e, m', x)]]$

$\forall x[\mathit{page}(x) \rightarrow \exists e[\mathit{cut}(e, m', x) \wedge \mathit{with}(e, \mathit{scissors}) \wedge e < e_u \wedge \mathit{on}(e, \mathit{friday})]]$

$\exists e[e < e_u \wedge \mathit{time}(e, \mathit{friday}) \wedge \mathit{inst}(e, \mathit{scissors}) \wedge \forall x[\mathit{page}(x) \rightarrow \mathit{cut}(e) \wedge \mathit{ag}(e, m') \wedge \mathit{pat}(e, x)]]$

$\forall x[\mathit{page}(x) \rightarrow \exists e[\mathit{cut}(e) \wedge \mathit{ag}(e, m') \wedge \mathit{pat}(e, x) \wedge \mathit{inst}(e, \mathit{scissors}) \wedge e < e_u \wedge \mathit{time}(e, \mathit{friday})]]$

ii. *Susan arrived before Harold* $\underline{\textit{fell asleep}}_{\langle e,\langle e,t\rangle\rangle}$

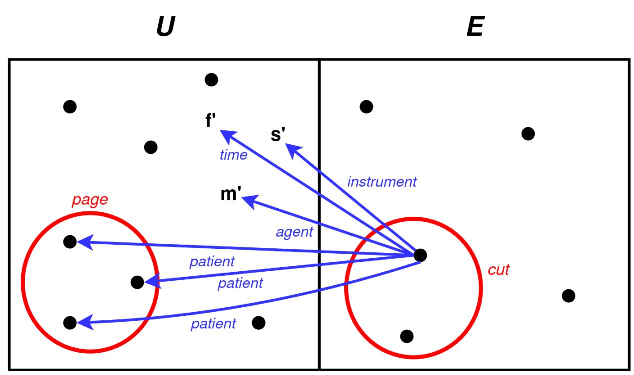
Any one of the following:

$\exists e_1 \exists e_2[\mathit{arrive}(e_1, s') \wedge e_1 < e_u \wedge \mathit{fall\text{-}asleep}(e_2, h') \wedge e_2 < e_u \wedge e_2 < e_1]$

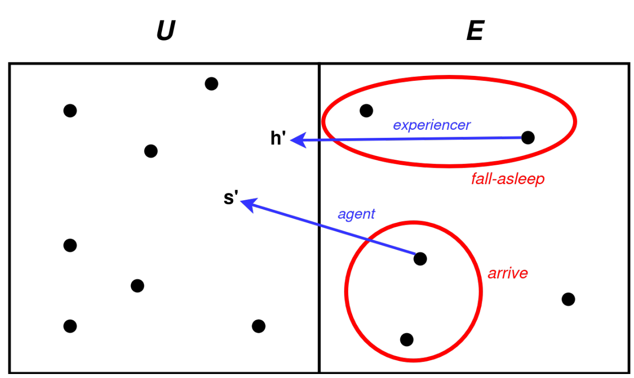
$\exists e_1 \exists e_2[\mathit{arrive}(e_1) \wedge \mathit{ag}(e_1, s') \wedge e_1 < e_u \wedge \mathit{fall\text{-}asleep}(e_2)) \wedge \mathit{exp}(e_2, h') \wedge e_2 < e_u \wedge e_2 < e_1]$

b. For each sentence in (a), draw a Davidsonian model structure in which the sentence holds. You may ignore the temporal aspects of the sentences here.

i. I chose the third reading ("$\exists e[e < e_u \wedge \mathit{time}(e, \mathit{friday}) \ldots$"):



ii.



Question 6: Lexical Semantics (20)

Consider the following sentence: $S =$ *"three fans met the actor"*

a. How many readings does the sentence S have? List all possible readings in natural language. Treat "the actor" as the named entity a'.

1. Three fans met the actor together
2. Each of the three fans met the actor individually

b. Translate each reading of S to the extended first-order logic for plural terms, where variables $\mathrm{X}, \mathrm{Y}, \mathrm{Z}, \ldots$ range over proper sums, $\mathrm{X} \oplus \mathrm{Y}$ denotes the group consisting of X and Y, $\lhd$ denotes the part-of-relation, and $N(\mathrm{X}) = |\{y \mid At(y) \wedge y \lhd \mathrm{X}\}|$ takes a proper sum X and returns the number of atoms in X.

1. $\exists \mathrm{X}[fan_{PL}(\mathrm{X}) \wedge N(\mathrm{X}) = 3 \wedge meet(\mathrm{X} \oplus a')]$
2. $\exists \mathrm{X}[fan_{PL}(\mathrm{X}) \wedge N(\mathrm{X}) = 3 \wedge \forall y[(At(y) \wedge y \lhd \mathrm{X}) \rightarrow meet(y \oplus a')]]$

Question 7: Dynamic Semantics (10)

Translate the following natural language utterances into Dynamic Predicate Logic. You may treat underlined expressions as named entities (e.g. *"cookies"* $\Rightarrow c'$), *"bring"* as the three-place predicate $bring(x, y, z)$ in (i), and *"will be fined"* as the one-place predicate $fined(x)$ in (ii).

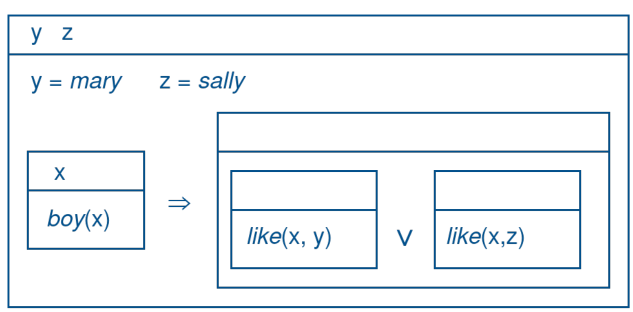
i. *Sarah brings cookies to work. Everyone likes her.*
$bring(s', c', w') \cdot \sim(\exists x \cdot person(x) \cdot \sim like(x, s'))$

ii. *If a driver breaks the law, they will be fined. Nobody breaks the law.*
$\sim(\exists x \cdot driver(x) \cdot break(x, law) \cdot \sim fined(x)) \cdot \sim(\exists y \cdot person(y) \cdot break(y, law))$

Question 8: DRT (20)

a. Give DRS representations for the following sentences:

i. *Every boy likes Mary or Sally*



ii. *Bill and Yvonne don't eat salad*

$$
\begin{array}{|l|}
\hline
\text{x} \quad \text{y} \\
\hline
\text{x} = \textit{bill} \qquad \text{y} = \textit{yvonne} \\
\neg \begin{array}{|l|}
\hline
\text{z} \\
\hline
\textit{salad}(\text{z}) \\
\textit{eat}(\text{x, z}) \\
\hline
\end{array} \\
\neg \begin{array}{|l|}
\hline
\text{w} \\
\hline
\textit{salad}(\text{w}) \\
\textit{eat}(\text{y, w}) \\
\hline
\end{array} \\
\hline
\end{array}
$$

b. Give the truth-conditions for one of the DRSs in (a) (you pick). Use verifying embeddings to arrive at the model-theoretic interpretation.

A DRS $K = (U_K, C_K)$ is true in a model $M = (U_M, V_M)$ iff there exists $f\colon U_D \nrightarrow U_M$ such that:

- $U_K \subseteq dom(f)$
- f verifies K in M ($f \models_M K$)

i. Let $K = (\{y, z\}, \{y = mary, z = sally, K_1 \Rightarrow K_2\})$, $K_1 = (\{x\}, \{boy(x)\})$, $K_2 = (\varnothing, \{K_3 \vee K_4\})$, $K_3 = (\varnothing, \{like(x, y)\})$, and $K_4 = (\varnothing, \{like(x, z)\})$. Then $f \models_M K$ iff:
   - $f(y) = mary$ and $f(z) = sally$
   - for all $g_1 \supseteq_{\{x\}} f$ such that $g_1 \models_M K_1$, there exists $g_2 \supseteq_{\varnothing} g_1$ such that $g_2 \models_M K_2$.
     $g_1 \supseteq_{\{x\}} f$ and $g_1 \models_M K_1$ iff:
     - $g_1(y) = f(y)$ and $g_1(z) = f(z)$
     - $g_1(x) \in V_M(boy)$

     $g_2 \supseteq_{\varnothing} g_1$ and $g_2 \models_M K_2$ iff:
     - $g_2(x) = g_1(x)$, $g_2(y) = g_1(y)$, $g_2(z) = g_1(z))$
     - there exists $g_3 \supseteq_{\varnothing} g_2$ such that $g_3 \models_M K_3$, i.e.:
       * $g_3(x) = g_2(x)$, $g_3(y) = g_2(y)$, $g_3(z) = g_2(z))$
       * $(g_3(x), g_3(y)) \in V_M(like)$

       or there exists $g_4 \supseteq_{\varnothing} g_2$ such that $g_4 \models_M K_4$, i.e.:
       * $g_4(x) = g_2(x)$, $g_4(y) = g_2(y)$, $4_3(z) = g_2(z))$
       * $(g_4(x), g_4(z)) \in V_M(like)$

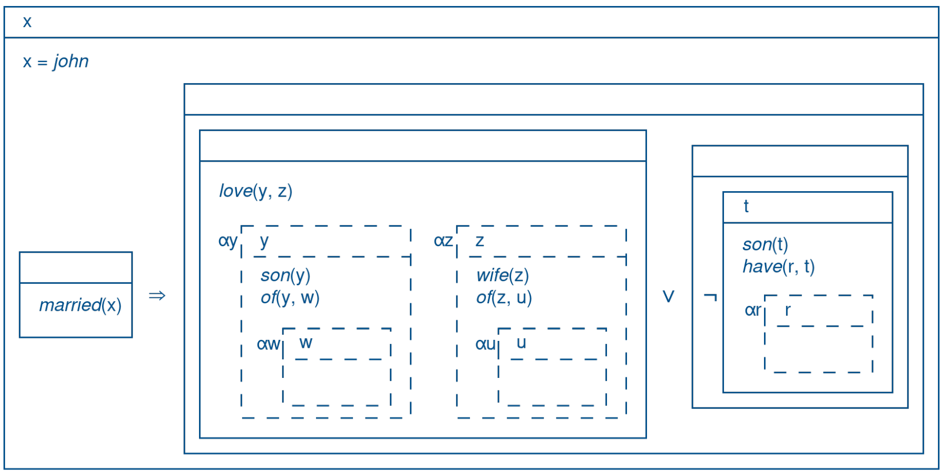
ii. Let $K = (\{x, y\}, \{x = bill, y = yvonne, \neg K_1, \neg K_2\})$, $K_1 = (\{z\}, \{salad(z), eat(x, z)\})$, and $K_2 = (\{w\}, \{salad(w), eat(y, w)\})$. Then $f \models_M K$ iff:
   - $f(x) = bill$ and $f(y) = yvonne$
   - there is no $g_1 \supseteq_{\{z\}} f$ such that $g_1 \models_M K_1$, i.e.:
     - $g_1(x) = f(x)$ and $g_1(y) = f(y)$
     - $g_1(z) \in V_M(salad)$
     - $(g_1(x), g_1(z)) \in V_M(eat)$
   - there is no $g_2 \supseteq_{\{w\}} f$ such that $g_2 \models_M K_2$, i.e.:
     - $g_2(x) = f(x)$ and $g_2(y) = f(y)$

- $g_2(w) \in V_M(salad)$
- $(g_2(x), g_2(w)) \in V_M(eat)$

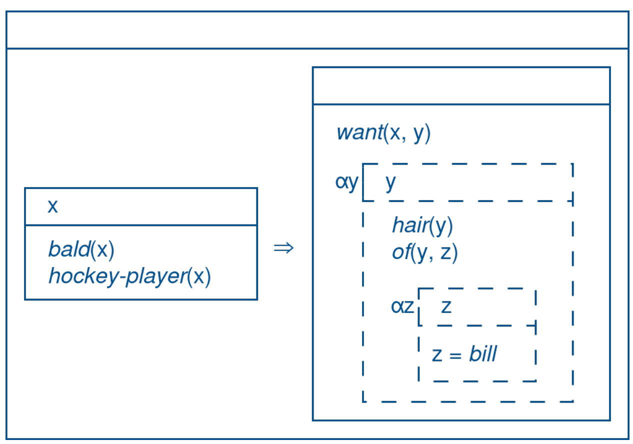
Question 9: Presuppositions (20)

a. Give proto-DRSs for the following sentences:

i. *"If John is married, his son loves his wife or he doesn't have a son"*

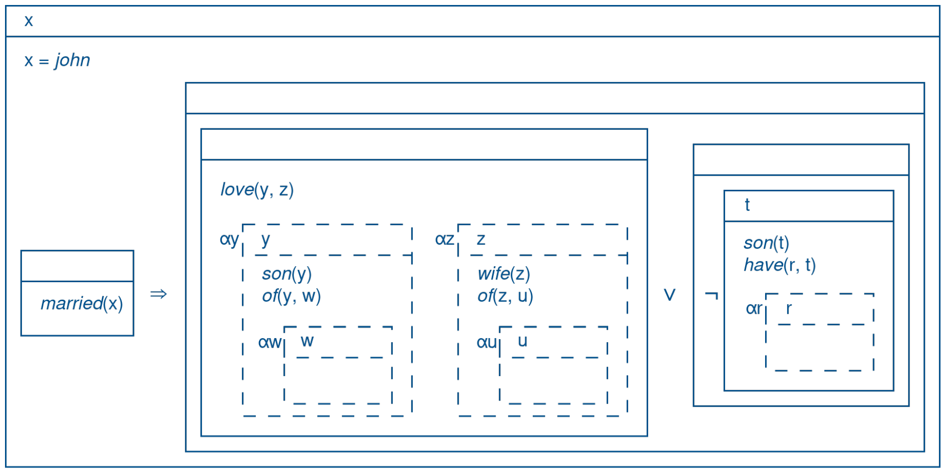


ii. *"Every bald hockey player wants Bill's hair"*

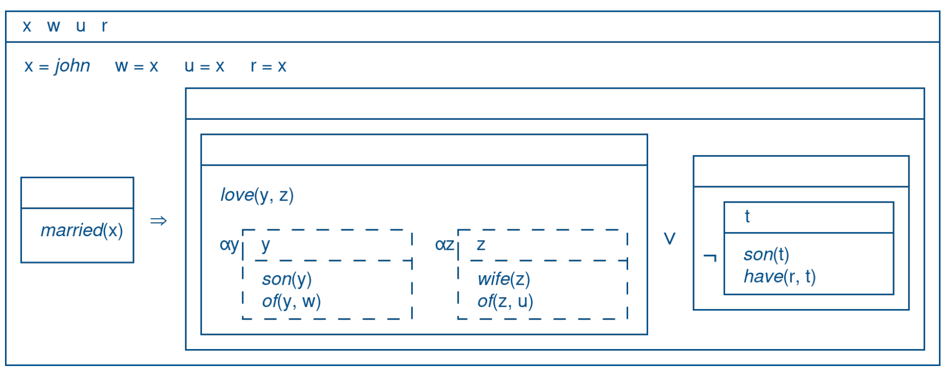


b. Resolve the proto-DRSs in (a). Explicitly describe the resolution constraints you apply.

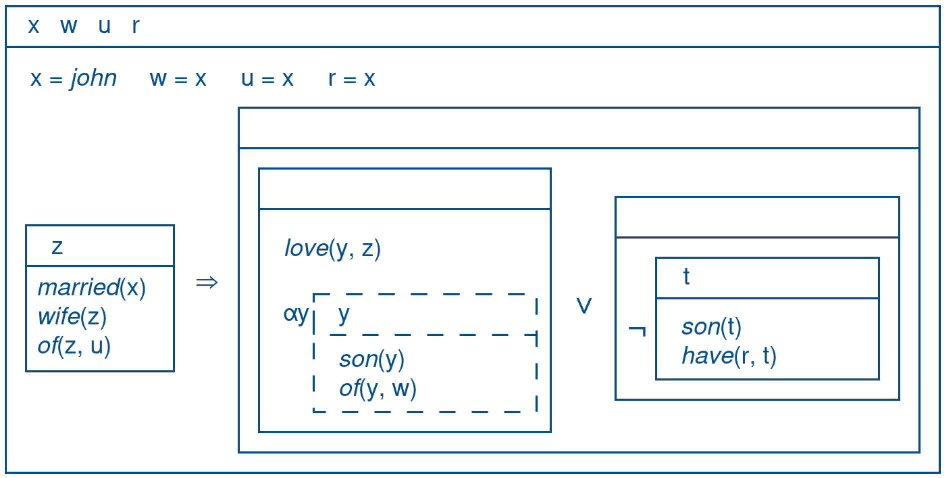
i. First, we accommodate αx, because there is no anaphor it can bind to. The highest possible DRS is preferred for accommodation, so we accommodate in the top-level DRS:



Now, we can resolve αw, αu, and αr: we cannot resolve αy or αz yet, because they must first be α-free (α-DRSs are resolved "from the inside out"). All three are have a possible anaphor (*john*), so we resolve by binding at the top-level DRS (because there are no closer possible anaphors):

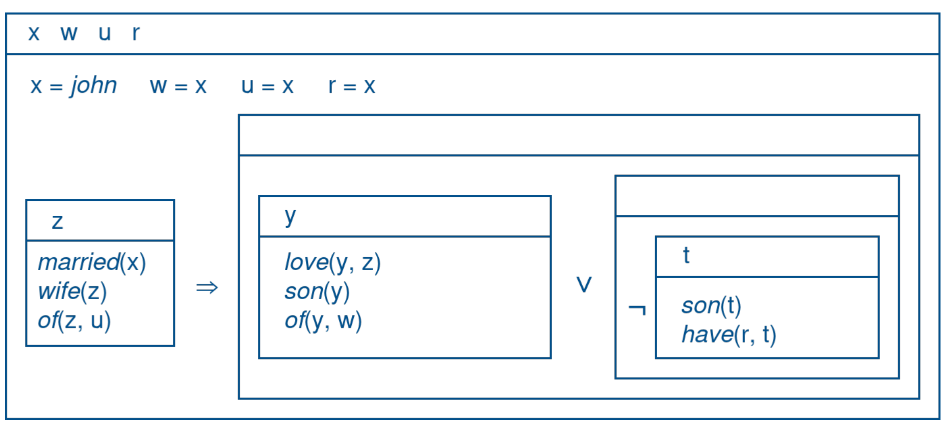


Now let's resolve αz: there is no possible anaphor, so we must accommodate. We cannot accommodate at the top-level DRS, because this would violate the local informativity constraint: $\mathit{wife}(z) \wedge \mathit{of}(z, \mathit{john}) \rightarrow \mathit{married}(\mathit{john})$. So we accommodate at the next-highest DRS along the accessibility relation:



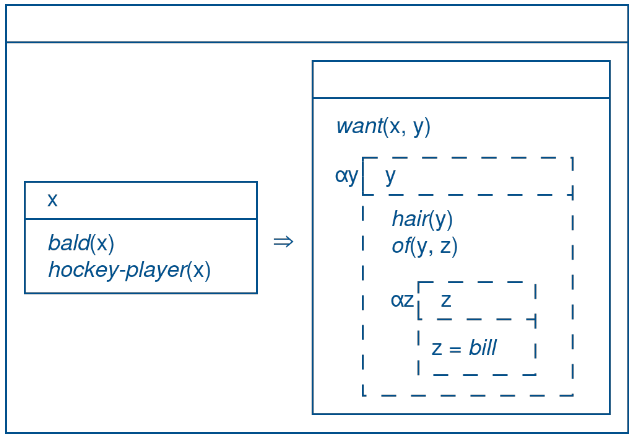
Finally, we resolve αy: there is no possible anaphor, and accommodation at the top-level DRS would be inconsistent with the right-hand disjunct (i.e. violate the local consistency constraint).

Accomodation at the left-hand side of $\Rightarrow$ violates the informativity constraint: $A \rightarrow (B \vee \neg A) = (A \rightarrow B) \vee (A \rightarrow \neg A)$, and $A \rightarrow \neg A$ is a contradiction. Accommodation at the right-hand side of $\Rightarrow$ obviously violates the local consistency constraint. This leaves only accommodation at the left-hand side of $\vee$:

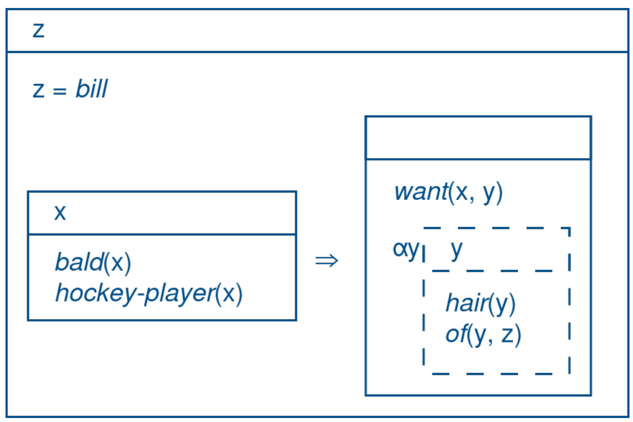


This is truth-conditionally equivalent to the FOL statement:
$\forall z[(M(j') \wedge W(z) \wedge \mathit{of}(z, j')) \rightarrow (\exists y[S(y) \wedge \mathit{of}(y, j') \wedge L(y, z)] \vee \neg\exists t[S(t) \wedge H(j', t)]])]$

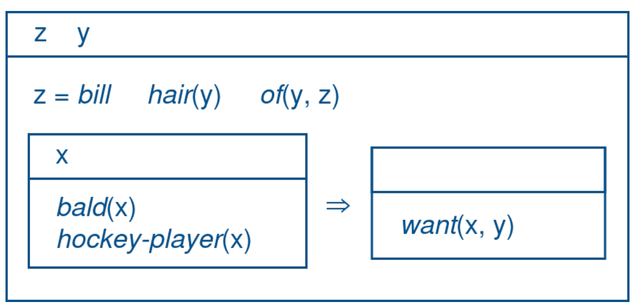
ii. (I'm duplicating the figure here, because the first one is far away)



We have to resolve αz first, so that αy can be α-free. There is no possible anaphor, and resolving at the top-level DRS does not violate any constraints:



Now we can resolve αy. Again, there is no possible anaphor, and resolving at the top-level DRS does not violate any constraints:



This is truth-conditionally equivalent to the FOL statement:
$\exists y[hair(y) \wedge of(y, b') \wedge \forall x[(hockey\text{-}player(x) \wedge bald(x)) \rightarrow want(x, y)]]$