Practice problems #1

Semantics II // February 9, 2018

Here are some exercises that'll give you an opportunity to practice using our intensional semantics. Feel free to work together on them (in fact, I encourage that), but please write up your answers individually. The official due date is February 16, 2018. If you need a bit more time, that's fine. Just let me know (but don't fall behind!).

(A) **Warm up.** Here is the (static) semantics we've posited for a possibility modal:

$$[\![\text{may}]\!]^{g,w} = \lambda B.\lambda p.\exists v \in B\,w : p\,v$$

As noted in class, this entry has a somewhat peculiar property: it makes sure that the accessibility relation B is fed the evaluation world w. In every other case we've seen, though, our composition rules ensure that the evaluation world gets passed to whatever needs it. What's special about accessibility relations (hint: think about their lexical semantics: $[\![\text{B}]\!]^{g,w} = ?$).

(B) **Definites and scope.** Sentence (1) is ambiguous. Suppose that Al thinks Clinton's president. Then (1) could tell us what Al thinks about Trump (the actual president), or what he thinks about Clinton (the person Al thinks is president).

(1) Al thinks the president is terrible.

Your task: derive this ambiguity using our static intensional semantics, along with the following lexical entry for *thinks* (recall that $\mathsf{Bel}_{x,w}$ is the set of worlds compatible with that x believes in w):

$$[\![\text{thinks}]\!]^{g,w} = \lambda p.\lambda x.\forall v \in \mathsf{Bel}_{x,w} : p\,v$$

You'll need two LFs (the title of the problem gives a hint about how they should differ). Do a semantic calculation for each. Justify each step in your calculations (e.g., by appeal to FA, IFA, and so on).

(C) **Thinking *might*.** Give a semantic calculation for (2). (Assume that the syntax of the embedded clause is '[might B] [raining]'.) By the way, Uni is a cat. Does the result of that calculation seem plausible to you? Pay special attention to what Miss Uni's belief-state is supposed to be like, according to your calculation.

(2) Uni thinks it might be raining.

Now consider a case like (3). What meaning does our theory assign to it (you can just give the result, no need to include the full calculation)? As with (2), assume that the syntax of the embedded clause is '[might B] [Nathan Chen win]'. Does this result seem correct? If not, what's wrong with it?

(3) Everybody thinks Nathan Chen might win.

(D) **Compositional dynamics.** As the previous problem hopefully brought out, there are some issues with our baseline treatments of attitudes and modals. These issues can be remedied by moving to a dynamic semantics. See Table 1 for a small dynamic fragment with epistemic and attitudinal vocabulary.

In this fragment, sentence meanings are update functions, type $\mathsf{d} ::= \{\mathsf{s}\} \to \{\mathsf{s}\}$. (This entails, inter alia, that we're working with a simplified interpretation function, one that just does forward or backward functional application and doesn't worry about worlds or assignments.) For example the meaning of *Uni*

Word	**Meaning**	**Type**
Uni	u	e
(be) raining	$\lambda s.\{w \in s \mid \mathsf{rain}_w\}$	d
win	$\lambda x.\lambda s.\{w \in s \mid \mathsf{win}_w\, x\}$	$\mathsf{e} \to \mathsf{d}$
likes	$\lambda x.\lambda y.\lambda s.\{w \in s \mid \mathsf{likes}_w\, x\, y\}$	$\mathsf{e} \to \mathsf{e} \to \mathsf{d}$
might	$\lambda p.\lambda s.\begin{cases} s \text{ if } p\, s \neq \emptyset \\ \emptyset \text{ otherwise} \end{cases}$	$\mathsf{d} \to \mathsf{d}$
thinks	$\lambda p.\lambda x.\lambda s.\{w \in s \mid p\, \mathsf{Bel}_{x,w} = \mathsf{Bel}_{x,w}\}$	$\mathsf{d} \to \mathsf{e} \to \mathsf{d}$
everybody	$\lambda f.\lambda s.\{w \in s \mid \forall x \in \mathsf{person}_w : f\, x\, \{w\} = \{w\}\}$	$(\mathsf{e} \to \mathsf{d}) \to \mathsf{d}$

Table 1: A compositional dynamic semantics for epistemic and attitudinal vocabulary, with $\mathsf{d} ::= \{\mathsf{s}\} \to \{\mathsf{s}\}$.

likes Nathan Chen will be calculated as below. The result is an update function that filters out worlds in which Uni doesn't like Nathan Chen.

$$\begin{aligned}
[\![\text{Uni likes Nathan Chen}]\!] &= [\![\text{likes Nathan Chen}]\!]\,\mathsf{u} && \text{BA, Lex}\\
&= [\![\text{likes}]\!]\,\mathsf{n}\,\mathsf{u} && \text{FA, Lex}\\
&= (\lambda x.\lambda y.\lambda s.\{w \in s \mid \mathsf{likes}_w\, x\, y\})\,\mathsf{n}\,\mathsf{u} && \text{Lex}\\
&= \lambda s.\{w \in s \mid \mathsf{likes}_w\,\mathsf{n}\,\mathsf{u}\} && \beta \times 2
\end{aligned}$$

Your task: use the dynamic semantics in Table 1 to calculate meanings for sentences (2) and (3). Say how the results you obtain improve on the static treatment.