Ling 320: Semantics. Lecture Notes. 13 Nov 2007.

1. Assignment 9. The truth conditions you should end up with for (9) are as follows:

$\{x \mid x \text{ is a student in } s\} \cap \{x \mid \{y \mid y \text{ is a professor in } s\} \subseteq \{y \mid x \text{ emailed } y \text{ in } s\}\} \neq \varnothing$

It may help you to look at the solution to Part 3 of the Exam, which is posted online.

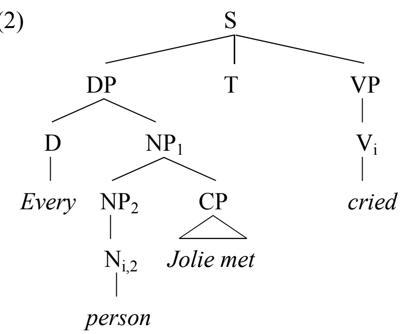
2. Relative Clauses as Modifiers. In the following, the phrase within brackets is called a relative clause:

(1) Every person [Jolie met] cried.

We have analyzed relative clauses just like other modifiers of NP, in that:

(a) They are sister to NP:

(2)



(b) They denote sets of individuals: $\{x \mid \text{Jolie met } x \text{ in } s\}$

(c) They combine with the NP they modify by set intersection, i.e., rule (i):

(3) $[\![\text{NP}_1]\!]^s =$

$[\![\text{NP}_2]\!]^s \cap [\![\text{CP}]\!]^s$	(i)
$\{x \mid x \text{ is a person in } s\} \cap [\![\text{CP}]\!]^s$	(b) x 2, (c)
$\{x \mid x \text{ is a person in } s\} \cap \{x \mid \text{Jolie met } x \text{ in } s\}$	assumed denotation for CP

3. The Internal Structure of Relative Clauses. How do we derive the denotation of the whole relative clause from its parts?

Relative clauses come in three forms: in addition to (5a), they may be introduced by a *wh*-word such as *who*, as in (5b), or the complementizer *that*, as in (5c).

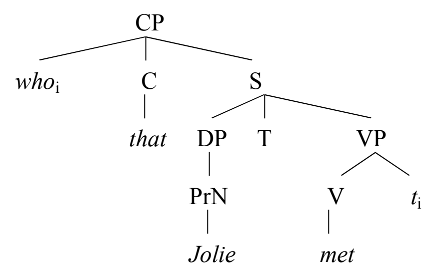
(4) a. Every person [$_{CP}$ Jolie met] cried.
b. Every person [$_{CP}$ who Jolie met] cried.
c. Every person [$_{CP}$ that Jolie met] cried.

All three seem to have the same semantics:

(5) $\{x \mid \text{Jolie met } x \text{ in } s\}$

We will adopt a uniform syntactic analysis of all three types, by which they are CPs and involve *wh*-movement: all three have the structure in (6), where a *wh*-word has moved to the left of S, leaving behind a co-indexed trace in its original position:

(6)



We will further assume that in English, it is optional to pronounce *who*$_i$ or *that*, and that some syntactic constraint rules out both being pronounced at the same time:

(7) *person [$_{CP}$ who$_1$ that Jolie met t$_1$]

Given the structure in (6), how do we derive the denotation of the CP from its parts?

We know what we want to come out on top: The CP should be a set of individuals: $\{x \mid \text{Jolie met } x \text{ in } s\}$. We also know what DP denotes, as well as what V denotes: $[\![\text{DP}]\!]^s = \{A \mid \text{Jolie} \in A\}$ and $[\![\textit{met}]\!]^s = \{\langle x,y\rangle \mid x \text{ met } y \text{ in } s\}$.

But what is the semantic value of a trace?

4. Variables. The denotation of a pronoun may vary depending on the context in which it is uttered (i.e., depending on the *utterance situation*). For example, the denotation of *she* may vary depending on the utterance situation:

(8) She left.

Like a proper noun, *she* denotes an individual; but unlike a proper noun, *she* does not always pick out the same individual. The standard notational device to distinguish uses of pronouns is to use subscript numerals, or *indices*:

(9) She_1 left. (10) She_2 stayed.
(11) She_1 helped her_2.

How can we revise our system to interpret pronouns, and handle their variation?
One common approach is to say that a pronoun denotes an individual, but only *relative to* a *choice of an assignment of a value*.

What is a value assignment for a variable?

An assignment is a *mapping* (i.e., a *function*) from numerals to individuals. For example, the following is an assignment:

(12) $[1 \rightarrow \text{Cat}, 2 \rightarrow \text{Reesa}]$

This particular assignment maps 1 to Cat and 2 to Reesa. When an assignment *applies* to an index, it outputs an individual as its value:

(13) $[1 \rightarrow \text{Cat}, 2 \rightarrow \text{Reesa}](1) = \text{Cat}$
$[1 \rightarrow \text{Cat}, 2 \rightarrow \text{Reesa}](2) = \text{Reesa}$

From now on, our interpretations will always be relativized to an assignment. We will indicate an assignment as a superscript on the interpretation brackets:

(14) $[\![\ ]\!]^{s,\, [1 \rightarrow \text{Cat},\, 2 \rightarrow \text{Reesa}]}$

Pronouns will denote whatever individual the assignment maps its index to:

(15) $[\![she_1]\!]^{s,\, [1 \rightarrow \text{Cat},\, 2 \rightarrow \text{Reesa}]} = [1 \rightarrow \text{Cat}, 2 \rightarrow \text{Reesa}](1) = \text{Cat}$

(16) $[\![she_2]\!]^{s,\, [1 \rightarrow \text{Cat},\, 2 \rightarrow \text{Reesa}]} = [1 \rightarrow \text{Cat}, 2 \rightarrow \text{Reesa}](2) = \text{Reesa}$

Assignments can vary depending on the utterance situation, so that different assignments assign potentially different individuals to different numerical indices. For example, in another utterance situation, our assignment could look different:

(17) $[\![she_1]\!]^{s,\, [1 \rightarrow \text{Emily},\, 2 \rightarrow \text{Grace}]} = [1 \rightarrow \text{Emily}, 2 \rightarrow \text{Grace}](1) = \text{Emily}$

(18) $[\![she_2]\!]^{s,\, [1 \rightarrow \text{Emily},\, 2 \rightarrow \text{Grace}]} = [1 \rightarrow \text{Emily}, 2 \rightarrow \text{Grace}](2) = \text{Grace}$

We can write a general lexical entry for the denotation of *she*, using *g* as a variable over assignments:

(19) For any situation *s* and assignment *g*, $[\![she_i]\!]^{s,g} = g(\text{i})$.

Pronunciation: $[\![she_i]\!]^{s,\, g}$ reads as 'the denotation of she_i in *s* under *g*'.
g(i) reads as 'g of i'.

Pronouns, then, are *assignment dependent*; they depend on the assignment function for their semantic value.

All of our composition rules will now have to be formulated with respect to an assignment, as we have to allow the denotations of larger phrases that contain pronouns to be assignment-relative as well.

5. Some Terminology. Recall that there are at least two ways to specify sets:

-By list notation, i.e., listing the elements: {Mars, Leo, *you*).
-By predicate notation, i.e., stating a condition that must be satisfied by all and only the elements of the set: $\{x \mid x \text{ is a planet}\}$.

The letter *x* here does not stand in for some particular object. Rather, it functions as a place-holder, or *variable*. We use this variable to specify the set: To determine the membership of the set, one has to plug in the names of different objects for the *x* in the condition *x is a planet*.

This second way of specifying a set is also sometimes called *abstraction*, and we say that we *abstract over* the variable *x*.

We also say that the *x* to the left '|' *binds* all instances of *x* to the right of '|', and that all instances of *x* to the right of '|' are *bound* by the *x* to the left of '|'.

6. Class Grammar.

<u>(i) Lexicon</u>

(a) *Lexical items:*

PrN: $[\![Laure]\!]^{s,g}$ = Laure, …

N_i: $[\![girl]\!]^{s,g} = \{x \mid x$ is a girl in $s\}$, …

N_t: $[\![governor]\!]^{s,g} = \{<x, y> \mid x$ is a governor of y in $s\}$, …

V_i: $[\![laugh]\!]^{s,g} = \{x \mid x$ laughs in $s\}$, …

V_t: $[\![save]\!]^{s,g} = \{<x, y> \mid x$ saves y in $s\}$, …

A_i: $[\![brave]\!]^{s,g} = \{x \mid x$ is brave in $s\}$, …

A_t: $[\![fond]\!]^{s,g} = \{<x, y> \mid x$ is fond of y in $s\}$, …

P_i: $[\![out]\!]^{s,g} = \{<x, y> \mid x$ is out in $s\}$, …

P_t: $[\![behind]\!]^{s,g} = \{<x, y> \mid x$ is behind y in $s\}$, …

Conj: $[\![and]\!]^{s,g} = \cap$, $[\![or]\!]^{s,g} = \cup$ Neg: $[\![not]\!]^{s,g} = '$

D: $[\![every]\!]^{s,g} = \{<A, B> \mid A \subseteq B\}$, $[\![no]\!]^{s,g} = \{<A, B> \mid A \cap B = \varnothing\}$,

$[\![some]\!]^{s,g} = \{<A, B> \mid A \cap B \neq \varnothing\}$

Pronoun: $[\![she_i]\!]^{s,g} = g(i)$, $[\![he_i]\!]^{s,g} = g(i)$, $[\![it_i]\!]^{s,g} = g(i)$

Semantically vacuous: Main V *be*; the P *of*; the D *a*; the C *that*.

(b) *Lexical rules:*

Existential object drop (eod).
If V is a relation, $[\![V_{eod}]\!]^{s,g} = \{x \mid \exists y[<x,y> \in [\![V]\!]^{s,g}]\}$.
Condition: Only applies to certain verbs in the lexicon: *eat*, *bake*, *read*…

Reflexive object drop (refl).
If V is a relation, $[\![V_{refl}]\!]^{s,g} = \{x \mid <x,x> \in [\![V]\!]^{s,g}\}$.
Condition: Only applies to certain verbs in the lexicon: *shave*, *hid*, *undress*…

Passive (*pass*).
If V is a relation, $[\![V_{pass}]\!]^{s,g} = \{x \mid \exists y[<y,x> \in [\![V]\!]^{s,g}]\}$.

<u>(ii) Syntactic rules</u>

(a) *Phrase Structure rules*:

S	$\rightarrow$	DP (T) VP		
DP	$\rightarrow$	D NP	PrN	Pron
NP	$\rightarrow$	N_i	N_t PP	
		NP PP	AP PP	
VP	$\rightarrow$	V_i	V_t DP	V_c {AP/PP/DP}
AP	$\rightarrow$	A_i	A_t PP	
PP	$\rightarrow$	P_i	P_t DP	
XP	$\rightarrow$	XP Conj XP	where X $\in$ {V, A, P, N, D}	
XP	$\rightarrow$	Neg XP	where X $\in$ {V, A, P, D}	

PrN $\rightarrow$ *Laure*, …		
$N_i \rightarrow$ *guy*, …	$N_t \rightarrow$ *governor*…	
$V_i \rightarrow$ *laugh*, …	$V_t \rightarrow$ *save*, …	
$A_i \rightarrow$ *brave*…	$A_t \rightarrow$ *fond*, …	
$P_i \rightarrow$ *out*, …	$P_t \rightarrow$ *behind*…	
Neg $\rightarrow$ *not*	$V_c \rightarrow$ *be*	
D $\rightarrow$ *every*, *some*, *no*	$D_c \rightarrow$ *a*	T $\rightarrow$ *be*
Pron $\rightarrow$ *she*, *he*, *her*, *him*, *it*		

(b) *Transformations*:

V-to-*T Movement*: Raise main verb *be* to T, if T is empty.

<u>(iii) Semantic rules of composition</u>.

For any situation *s* and assignment *g*,

(a) $[\![[_S \text{ DP T VP}]]\!]^{s,g} = 1$ iff $[\![\text{VP}]\!]^{s,g} \in [\![\text{DP}]\!]^{s,g}$

(b) If α is a non-branching node whose daughter node is β, $[\![\alpha]\!]^{s,g} = [\![\beta]\!]^{s,g}$.

(c) If α is a terminal node, $[\![\alpha]\!]^{s,g}$ is specified in the lexicon.

(d) $[\![[_{XP1}\ XP_2 \text{ Conj } XP_3]]\!]^{s,g} = [\![XP_2]\!]^{s,g}\ [\![\text{Conj}]\!]^{s,g}\ [\![XP_3]\!]^{s,g}$

(e) $[\![[_{XP1} \text{ Neg } XP_2]]\!]^{s,g} = ([\![XP_2]\!]^{s,g})\ [\![\text{Neg}]\!]^{s,g}$

(f) $[\![[_{YP}\ Y_t\ ZP]]\!]^{s,g} = \{x \mid <x, [\![ZP]\!]^{s,g}> \in [\![Y_t]\!]^{s,g}\}$

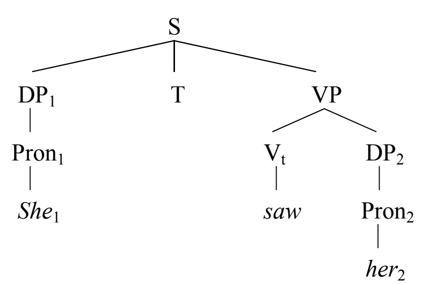
(g) $[\![[_{DP}\ D\ NP]]\!]^{s,g} = \{A \mid <[\![NP]\!]^{s,g}, A> \in [\![D]\!]^{s,g}\}$

(h) $[\![[_{DP}\ X]]\!]^{s,g} = \{A \mid [\![X]\!]^{s,g} \in A\}$
Condition: Only applies to DPs in subject position.

(i) $[\![[_{NP}\ XP\ YP]]\!]^{s,g} = [\![XP]\!]^{s,g} \cap [\![YP]\!]^{s,g}$

Example Derivation

(20)



Two ways of representing the derivation here:

Given a particular situation s_0, in which $g = [1\to\text{Cat}, 2\to\text{Reesa}]$,

$[\![S]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]} = 1$ iff	
$[\![VP]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]} \in [\![DP_1]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]}$	(a)
$[\![VP]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]} \in \{A \mid [\![Pron_1]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]} \in A\}$	(h)
$[\![Pron_1]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]} \in [\![VP]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]}$	∈
$[\![\textit{she}_1]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]} \in [\![VP]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]}$	(b)
$\text{Cat} \in [\![VP]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]}$	(c)
$\text{Cat} \in \{x \mid <x, [\![Pron_1]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]}> \in [\![V_t]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]}\}$	(f)
$\text{Cat} \in \{x \mid <x, \text{Reesa}> \in [\![V_t]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]}> \}$	(c)
$<\text{Cat, Reesa}> \in [\![V_t]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]}$	∈
$<\text{Cat, Reesa}> \in [\![\textit{saw}]\!]^{s0, [1\to\text{Cat}, 2\to\text{Reesa}]}$	(b)
$<\text{Cat, Reesa}> \in \{<x, y> \mid x \text{ saw } y \text{ in } s_1\}$	(c)
Cat saw Reesa in s_1	∈

For any *s*, *g*,

$[\![S]\!]^{s,g} = 1$ iff	
$[\![VP]\!]^{s,g} \in [\![DP_1]\!]^{s,g}$	(a)
$[\![VP]\!]^{s,g} \in \{A \mid [\![Pron_1]\!]^{s,g} \in A\}$	(h)
$[\![Pron_1]\!]^{s,g} \in [\![VP]\!]^{s,g}$	∈
$[\![\textit{she}_1]\!]^{s,g} \in [\![VP]\!]^{s,g}$	(b)
$g(1) \in [\![VP]\!]^{s,g}$	(c)
$g(1) \in \{x \mid <x, [\![Pron_1]\!]^{s,g}> \in [\![V_t]\!]^{s,g}\}$	(f)
$g(1) \in \{x \mid <x, g(2)> \in [\![V_t]\!]^{s,g}\}$	(c)
$<g(1), g(2)> \in [\![V_t]\!]^{s,g}$	∈
$<g(1), g(2)> \in [\![\textit{saw}]\!]^{s,g}$	(b)
$<g(1), g(2)> \in \{<x, y> \mid x \text{ saw } y \text{ in } s\}$	(c)
$g(1)$ saw $g(2)$ in s	∈