Lgcs 106, Semantics. Lecture Notes. 3 Feb 2010.

1. Truth-conditions and Compositionality (Review)

Proposal: To know the meaning of a sentence is to know its truth conditions. Consider:

(1) Emery is sitting.

In knowing what (1) means, you have the ability to determine, given a possible situation, whether or not (1) is true or false in that situation. Based on this ability, we can say that knowing the meaning of a sentence involves *at least* knowing the conditions under which a sentence is true.

We want a theory of sentence meaning, then, that pairs sentences with their truth conditions. We want a theory that gives us, for any situation *s*, and any sentence *S*:

(2) *S* is true in *s* iff *p*.

Where *p* describes the conditions that must obtain for *S* to be true in *s*.

Because there are an infinite number of sentences in English, we cannot just have memorized the truth conditions for every sentence. Rather, we must have some way of deriving the truth conditions of a sentence based on the semantic contributions of its parts, and they way in which they are assembled syntactically.

<u>Principle of Compositionality</u>: The meaning of a sentence is computed from the meanings of its parts, and the way those parts are assembled syntactically.

But what are the parts of a sentence, and how are those parts combined? And what does each part mean? In order to state general rules for interpreting sentences, we need to establish some assumptions about syntactic structure.

2. Syntax. We will start out with very simple sentences whose subject is a proper noun (a name), and whose predicate is an intransitive verb, as in (3).

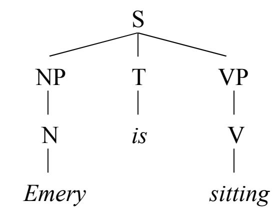
(3) a. Emery is sitting.
b. Blendia is laughing.

We will adopt some general phrase structure rules for generating such sentences:

(4) S → NP T VP
NP → N
VP → V
N → *Emery, Blendia, Joel,* etc.
T → *is*
V → *sitting*, *laughing*

These rules generate sentences that can represented in the form of a tree structure:

(1’)



===**Terminology**===

The lines are called *branches*. The endpoints of branches are called *nodes*. The lowest nodes are called *terminal nodes*. If a node X immediately dominates a node Y, then X is the mother of Y, and Y is the daughter of X. For example, in (1’), S is the *mother* of N and V, and N and V are *daughters* of S.

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Our goal in modeling the syntactic component of grammar is to come up with a set of rules and principles that generate *all and only* those sentences that are judged grammatical by native speakers. Clearly, our current set of rules both undergenerates and overgenerates. We will be revising our syntactic rules throughout the semester, as we try to account for more and more sentences of English.

For example, our rules do not yet generate the following sentences of English:

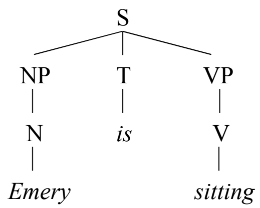
(5) Joel is laughing and screaming.
(6) Karen is laughing or crying.

How can we revise our rules to account for these cases?

3. Semantics

Having established some syntactic rules, we now need rules for interpreting the structures that the syntactic rules output. For example, we want to derive the truth conditions for the sentence in (1'), based on the meaning of its parts:

(1')



We need, then, a set of rules that assign to each part of this sentence—that is, each syntactic node—its meaning.

A starting point: Names stand for things in the actual world. For example:

(7) *Emery* stands for Emery.
Kristen stands for Kristen etc.

We will distinguish linguistic expressions (*Kristen*) from the things they refer to (Kristen) using italics, underlining, or boldface:

Kristen is a word.	Kristen is a person.
Kristen has 2 vowels and 5 consonants.	Kristen has two arms.

More terminology. Expressions that are italicized are *object language* expressions. The language we will use for theoretical statements is the *metalanguage*. Given that we are observing English, so far our object language has been English. And given that we are using English to communicate in this class, our metalanguage is English, as well (but will include some technical vocabulary and notational conventions.)

Instead of the verbs *stand for* or *mean* we will use the more technical term *denote*. Instead of the noun *meaning,* we will use the term *denotation*.

Notation: $[\![\alpha]\!]^s$ symbolizes the denotation of α in situation s.
It reads as "The denotation of α in s."

Proper nouns denote individuals (the same individual in any situation):

For any situation s, $[\![\textit{Emery}]\!]^s$ = Emery.

We will ignore the semantic contribution of T (Tense) for the time being. We will assume that our semantic rules simply "don't see" the T node.

Sentences denote truth values – true (1) or false (0) – relative to a situation:

For any situation s, $[\![\text{S}]\!]^s$ = 1 iff

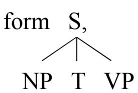
Intransitive verbs denote… ?

For any situation s, $[\![\textit{sitting}]\!]^s$ =

Given this much, we can now posit some general rules.

For any situation s,

(a) If α has the form



$[\![\alpha]\!]^s$ = 1 iff

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

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

4. A Grammar of a Fragment of English

Our aim in building a grammar of English is to model a native speaker's ability to produce and interpret sentences. We want ultimately to develop a system of rules that generate and interpret *all and only* sentences of English. We will constantly be revising our grammar to account for more and more sentences.

Our grammar has four components:

(i) An *inventory of denotations*.

(ii) A *lexicon*, which states the category and denotation of each word;

(iii) A set of *syntactic rules*, which assemble words into sentences; and

(iv) A set of *semantic rules of composition*, which interpret the structures derived by the syntactic rules.

(i) *Inventory of denotations*

Let D be the set of all individuals that exist in the real world. Possible denotations are:

Elements of D, the set of actual individuals.
Elements of {0,1}, the set of truth-values.
Subsets of D.

(ii) *Lexicon*

N: $[\![Emery]\!]^s$ = Emery, $[\![Blendia]\!]^s$ = Blendia, …
V: $[\![sitting]\!]^s = \{x \mid x \text{ is sitting in } s\}$, $[\![smiling]\!]^s = \{x \mid x \text{ is smiling in } s\}$, …
T: *be* (We will neglect for now the semantic contribution of the T node.)

(iii) *Syntactic rules*

(8) S → NP T VP
NP → N VP → V
N → *Emery, Blendia* etc.
T → *is*
V → *sitting, smiling, whispering, sleeping*

(iv) *Semantic rules of composition*

For any situation *s*,

(a) If α has the form S (with daughters NP T VP), $[\![\alpha]\!]^s = 1$ iff $[\![NP]\!]^s \in [\![VP]\!]^s$.

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

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

5. Example derivation of truth-conditions for (1')

For any *s*, $[\![S]\!]^s = 1$ iff

$[\![NP]\!]^s \in [\![VP]\!]^s$	by (a)
$[\![N]\!]^s \in [\![VP]\!]^s$	by (b)
$[\![Emery]\!]^s \in [\![VP]\!]^s$	by (b)
Emery $\in [\![VP]\!]^s$	by (c)
Emery $\in [\![V]\!]^s$	by (b)
Emery $\in [\![sitting]\!]^s$	by (b)
Emery $\in \{x \mid x \text{ is sitting in } s\}$	by (c)

6. What we've gained (adapted from Chierchia & McConnell Ginet, Chapter 2)

One of our basic semantic abilities is that of matching sentences with situations. Our grammar can be seen as a way of representing our capacity to pair sentences with the situations that they describe.

Sentence content can be regarded as a relation between sentences and situations, or circumstances. Our notation $[\![S]\!]^s = 1$ (or 0) can be interpreted as saying that S correctly characterizes or describes (or does not correctly describe) situation *s*.

The theory makes empirically testable claims, since the pairing of sentences with the truth conditions generated by the theory can clash or agree with our intuitions.

7. Expanding the Grammar

Our grammar does not yet account for the following sentences:

(9) Christian is ecstatic.
(10) Christian is a student.
(11) Vivian is not speaking.
(12) Vivian is not being nice.
(13) Vivian is laughing and crying.
(14) Vivian is not laughing or crying.

How can we revise it so that it does?

8. Entailment

We can now provide a formal definition of entailment:

(15) S_1 *entails* S_2 iff for every situation *s*, if $[\![S_1]\!]^s = 1$, then $[\![S_2]\!]^s = 1$.

Can we show that (a) entails (b) (and (c)) for the following?

(16) a. Vivian is laughing and crying.
b. Vivian is laughing.

Similarly, we can define a number of other semantic notions closely related to entailment:

(17) S_1 is *logically equivalent* to S_2 iff S_1 entails S_2 and S_2 entails S_1.

(18) S is *contradictory* iff there is no situation *s*, such that $[\![S]\!]^s = 1$.

(19) S is *logically true* (or *valid*) iff there is no situation *s*, such that $[\![S]\!]^s = 0$.

9. Semantically Vacuous Words.

Certain lexical items are commonly assumed to make no semantic contribution to the structure in which they occur.

One case is the copula *be* in predicative sentences such as *Christian is ecstatic* and *Christian is around*. We would want the following equalities, for example:

(20) $[\![\textit{is ecstatic}]\!]^s = [\![\textit{ecstatic}]\!]^s$ (21) $[\![\textit{is around}]\!]^s = [\![\textit{around}]\!]^s$

Another case is the indefinite article *a* when it occurs in predicate nominals such as:

(22) Christian is a student. (23) Kaline is a cat.

Here too we want the following equalities:

(24) $[\![\textit{a student}]\!]^s = [\![\textit{student}]\!]^s$ (25) $[\![\textit{a cat}]\!]^s = [\![\textit{cat}]\!]^s$

We will assume then that the semantic component simply "doesn't see" the copula *be* or the indefinite article *a*. As a result, a structure that is binary branching may be treated as non-branching by the semantic rules, in that a branch occupied by a vacuous item doesn't count.