# Tutorial “Quantification and binding" and "Intensionality”

Session 5

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# Our agenda today

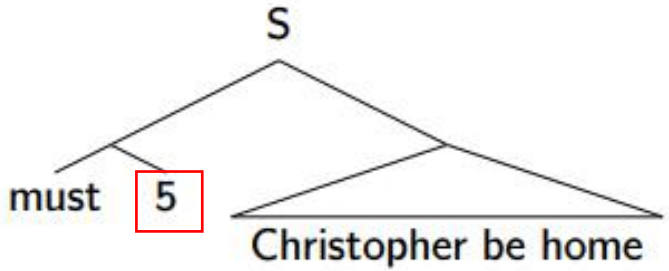
- **Key concepts**
- **Assignment 2 (Intensionality)**
- **Q&A**

# The restrictor analysis: Modality

Up to now, we analyse several intensional operators as **restrictor:**

- Modals as quantifiers over worlds given accessibility relations from *D*<s,<s,t>> provided by an index, which are computed from conversational backgrounds/modal base.

(2) (Given what we know,) Christopher must be home.




$[\![(2)]\!]^{w,g} = 1$ iff $\forall w'[g(5)(w)(w') = 1 \rightarrow$ Chris is home in $w']$

$\mathcal{R}_{[\![\text{what we know}]\!]_c} = \lambda w.\ [\lambda w'\ .\ \forall p[p$ is in the set of propositions known in $w \rightarrow p(w') = 1]]$

$[\![(2)]\!]^{w,g} = 1$ iff $\forall w'[w'$ is compatible with what we know in $w \rightarrow$ Chris is home in $w']$

# The restrictor analysis: Conditionals

Three analyses of *if*:

The material implication analysis: $[\![\text{if}]\!] = \lambda p \in D_t \,.\, [\lambda q \in D_t \,.\, p = 0 \text{ or } q = 1]$

Wrong prediction under negation.

The strict implication analysis: *if* as a necessity modal "must"

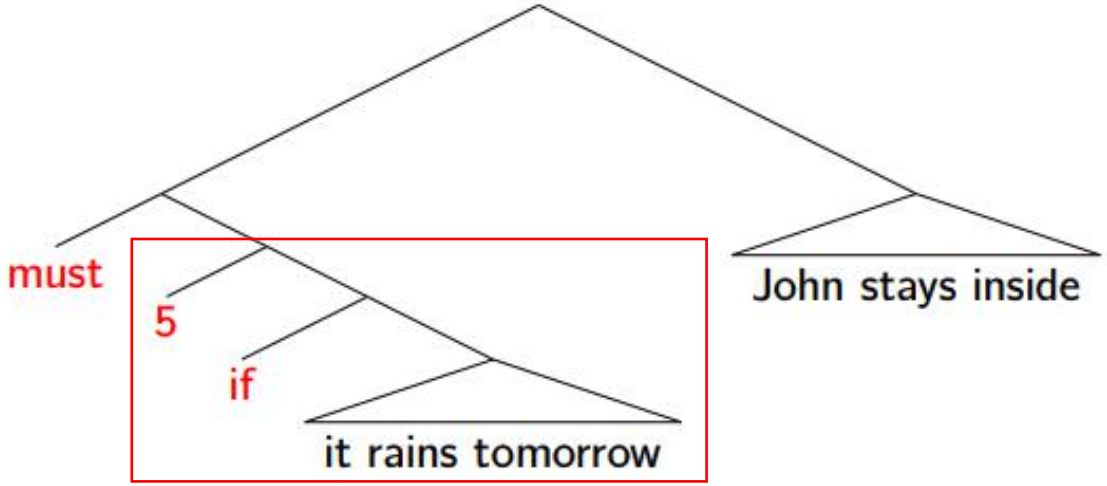
Fix the negation problem: not must ≡ may not $\neg\Box(p \rightarrow q) \equiv \Diamond\neg(p \rightarrow q)$

But still problematic when embedded under a modal:

(3) Maybe if it rains tomorrow, I stay inside.

# The restrictor analysis: Conditionals

The restrictor analysis: The *if*-clause serves to restrict a (potentially covert) modal. *if* takes the antecedent clause and modifies the accessibility relation with it.




$$[\![\text{if}]\!] = \lambda p \in D_{\langle s,t\rangle} \,.\, [\lambda R_{\langle s,\langle s,t\rangle\rangle} \,.\, [\lambda w \,.\, [\lambda w' \,.\, R(w)(w') = p(w') = 1]]]$$

# The restrictor analysis of *if* -clause as problematic

Assume $g(5) = \lambda w\ .\ [\lambda w'\ .\ w'$ is compatible with the evidence available in $w]$

$= 1$ iff $\forall w'[w'$ is compatible with the evidence available in $w$ and
$[\![\text{it rains tomorrow}]\!]^{w',g} = 1 \rightarrow [\![\text{John stays inside}]\!]^{w',g} = 1]$

The **restrictor analysis** conditionals licenses the problematic inference. Because we treat *if*-clause as modal restrictor. A modal must be present at LF. If the modal is not overt (like *maybe*), it is a covert necessity modal.

If it rains tomorrow, John stays at home →
If it rains tomorrow, John must/will stays at home.

# The restrictor analysis of *if* -clause as problematic

A solutuion:

Modals do not quantify over all accessible worlds but rather over subsets, i.e. best of the accessible worlds selected by *maxP*.

$$[\![\textbf{must}]\!]^w = \lambda R \in D_{\langle s,\langle s,t\rangle\rangle} \,.\, [\lambda p \in D_{\langle s,t\rangle} \,.\, \forall w'[w' \in max_{\mathcal{P}}(R(w)) \rightarrow p(w') = 1]]$$

Even if A is a subset of B, the best worlds of A given a certain accessibility relation is not necessarily a subset of the set of the best worlds of B. (The “strike a match” example)

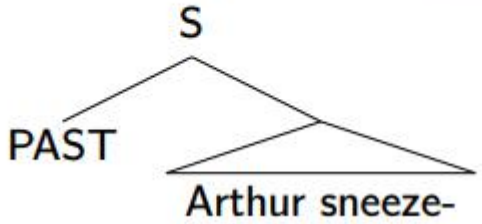
# The restrictor analysis: Tense

A new parameter t to shift the the evaluation time.

The pair of $w$ and $t$, $\langle w, t \rangle$ is called an index $i$.

$w_i$ picks out the world in $i$ and $t_i$ the time: $\langle w_i, t_i \rangle = i$

$$[\![\text{PAST}]\!]^i = \lambda p \in D_{\langle s,t \rangle} \,.\, \exists t[t < t_i \wedge p(\langle w_i, t \rangle) = 1]$$

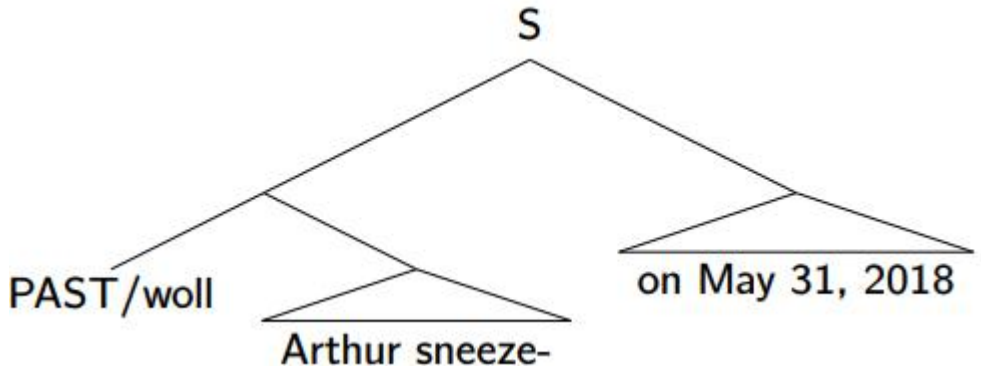


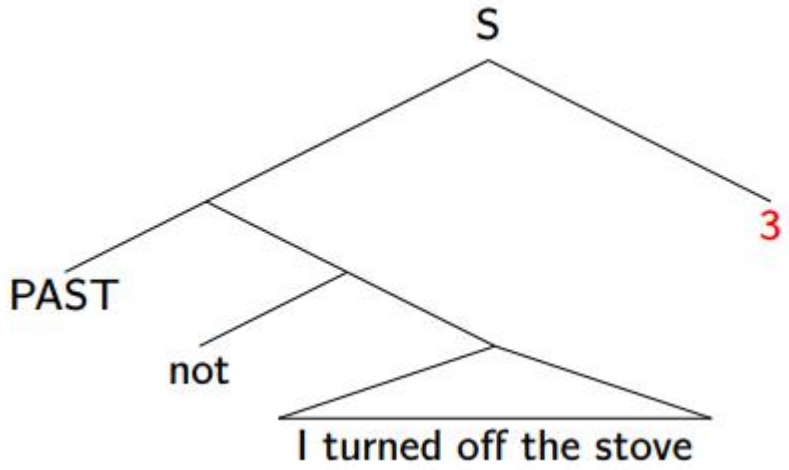

$$[\![\alpha]\!]^{i,a} = [\![\alpha]\!]^{\langle w_i, t_i \rangle, a}$$

No pesent tense. **PAST** and **woll** shifts the evaluation time to some time t either preceding or following the the utterance time ti.

# The restrictor analysis: Tense

To avoid presupposition failure and capture the referentiality of tense, PAST and woll need extra restrictions from either time frame adverbials or an index.




$$[\![\text{PAST}]\!]^i = \lambda p \in D_{\langle s,t\rangle} \,.\, [\lambda q \in D_{\langle s,t\rangle} : \exists t[t < t_i \wedge q(\langle w_i, t\rangle) = 1] \,.\, \exists t[t < t_i \wedge p(\langle w_i, t\rangle) = q(\langle w_i, t\rangle) = 1]]$$

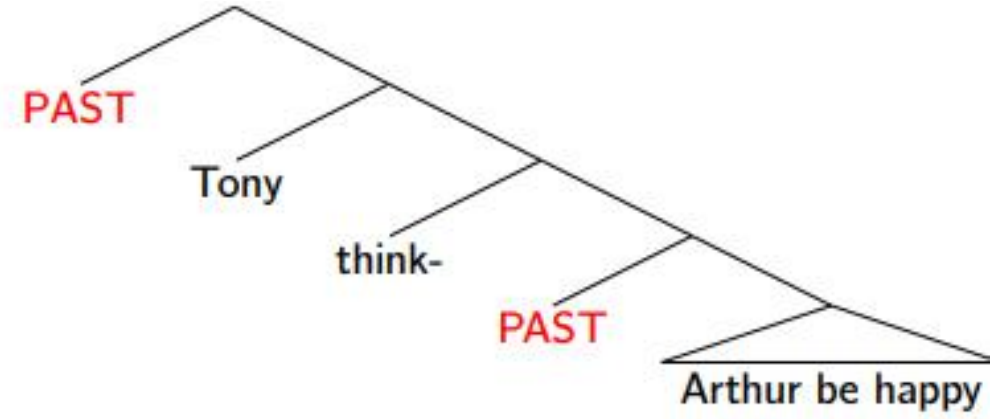
$$[\![\text{woll}]\!]^i = \lambda p \in D_{\langle s,t\rangle} \,.\, [\lambda q \in D_{\langle s,t\rangle} : \exists t[t_i < t \wedge q(\langle w_i, t\rangle) = 1] \,.\, \exists t[t_i < t \wedge p(\langle w_i, t\rangle) = q(\langle w_i, t\rangle) = 1]]$$

# The restrictor analysis: Tense

For embedded tense, we need our semantics to allow a reading where the embedded clause is evaluated relative to the utterance time (More details next week).

(5) Tony thought that Arthur was happy.

The LF with two PAST-operators doesn't allow the simultaneous reading.



# The intensional vs. extensional framework

We extensionalize our intensional system**.**

Intensional: Intensional operators shift the evaluation w and t.

$$[\textbf{smokes}]^i = \lambda x \in D_e \ . \ x \text{ smokes in } w_i \text{ at } t_i \qquad D_{\langle e,t\rangle}$$
$$[\textbf{student}]^i = \lambda x \in D_e \ . \ x \text{ is a student in } w_i \text{ at } t_i$$

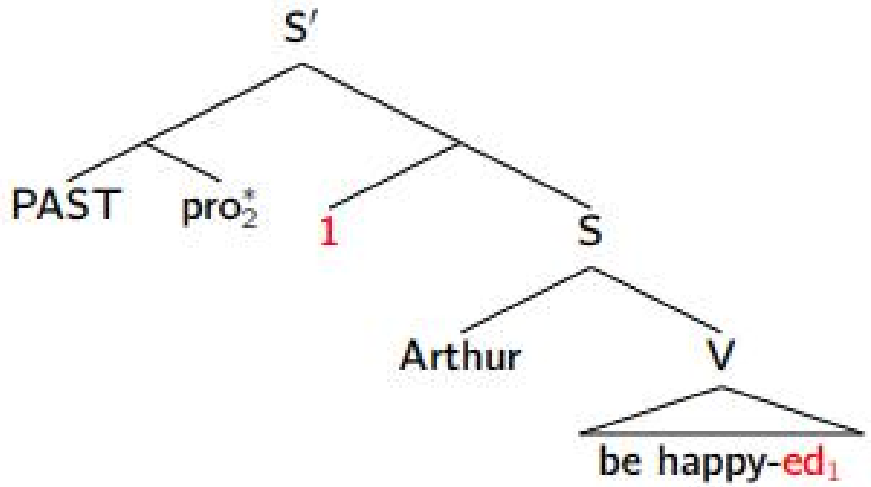
Extensional:  Each w, t dependent element  has next to it an index pronoun.

$$[\textbf{smoke-}] = \lambda i \in D_s \ . \ [\lambda x \in D_e \ . \ x \text{ smokes in } w_i \text{ at } t_i] \qquad D_{\langle s,\langle e,t\rangle\rangle}$$
$$[\textbf{student}] = \lambda i \in D_s \ . \ [\lambda x \in D_e \ . \ x \text{ is a student in } w_i \text{ at } t_i]$$

$e$, $t$, and $s$ are semantic types.

# The intensional vs. extensional framework

Accordingly, we need to modify our assignment function, PA and MA to include the domain *Di* that contains all possible indices.




The tense operators denote now functions from $D_{\langle s,\langle\langle s,t\rangle,t\rangle\rangle}$.

$[\![\text{PAST}]\!] = \lambda i \in D_s \,.\, [\lambda p \in D_{\langle s,t\rangle} \,.\, \exists t[t < t_i \wedge p(\langle w_i, t\rangle) = 1]]$

$[\![\text{woll}]\!] = \lambda i \in D_s \,.\, [\lambda p \in D_{\langle s,t\rangle} \,.\, \exists t[t_i < t \wedge p(\langle w_i, t) = 1]]$

Note: **PAST** is different from **-ed** on the verb. The interpretable features on -ed are checked via agreement with the uninterpretable features on PAST.

# A summary

Modals as operators that shift the the evaluation world with restrictions from conversational backgrounds/modal bases.

*if*-clause restricts a modal (covert/overt).

Tense shifts the evaluation time to **a particular time** with restrictions from either overt time frame adverbials or an index.

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# Exercise 1

**Exercise 1** Give an LF for (1) conforming to the restrictor analysis for conditionals and compute its truth-conditions. Think of a typical situation where John's father utters to John **If you mow the lawn, you get five Euros**, i.e., one where the five Euros are not forthcoming unless the lawn is mowed. Are the truth-conditions of (1) adequate for reporting such a situation?

(1) **If John mows the lawn, he gets five Euros.**

Recall the LF for the restrictor analysis for conditionals we just discussed.

Think about what kind of reading is compatible the situation provided.

# Exercise 2

**Exercise 2** Think of a lexical entry for the modifier **future** using our theory of tense interpretation (this can be done either in the intensional or the extensional framework). That is, the lexical entry should allow for the inference of (2) that William is not a king now but will be. Compute the truth-conditions for (2) using your entry. (Remember the copula and the post-copular indefinite article are semantically vacuous.)

(2) **William is a future king.**

*future* as a normal adjective? Maybe not.
William will be a king (in the future).

Give an LF first depends on which framework you adopt.

# Our agenda today

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**Any questions?**

Thanks and see you next week!