The Difference that matters for Semantic Information

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What is Semantic Information?

"what we mean by information – the elementary unit of information – is a difference which makes a difference."
(Bateson, 1972: 457 –9)

What is the difference that makes a difference when it comes to semantic information?

What is Semantic Information?

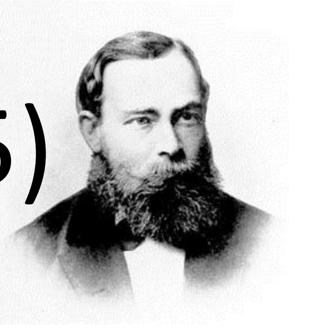
Starting point: declarative sentences.

(a) John saw Mary at the conference.
(b) Mary was seen by John at the conference.
(c) Mary saw John at the conference.

Why does the difference between (a) and (b) not matter, whereas that between (a)/(b) and (c) does?

What does it mean for (a) and (b) to mean the same thing?

Gottlob Frege (1848 - 1925)

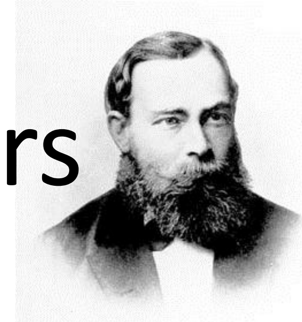


- Begriffschrift published in 1879, introducing “a formalized Language of pure Thought”.
- It aims to abstract over different ways in which the same information can be packaged for the convenience of speakers and hearers.

The Difference that Matters

Terminology: A sentence carries semantic information. The assertion of a sentence, i.e., the expression of its truth, is called a **judgement**.

The Difference that Matters



Two judgements J_1 and J_2 ***differ*** in semantic information IF AND ONLY IF *the set of judgements that follow from* J_1 *is not equal to the set of judgements that follows from* J_2, i.e.,

$$\{J \mid J \text{ follows from } J_1\} \neq \{J \mid J \text{ follows from } J_2\}$$

The Difference that Matters

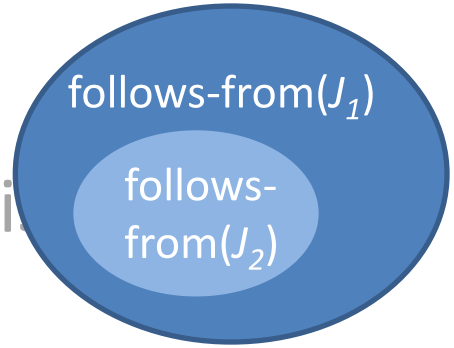
DEFINITION: follows-from(J') = {*J* | *J* follows from *J'*}

Two judgements J_1 and J_2 carry the ***same*** semantic information IF AND ONLY IF

follows-from(J_1) = follows-from(J_2)

J_1 carries ***more*** semantic information than J_2 IF AND ONLY IF

follows-from(J_2) $\subset$ follows-from(J_1)



CONSTRAINT: For all J: follows-from(J) i

The Difference that Matters

DEFINITION: follows-from(J') = {J | J follows from J'}

Two judgements J_1 and J_2 carry the ***same*** semantic information IF AND ONLY IF

$$\text{follows-from}(J_1) = \text{follows-from}(J_2)$$

J_1 carries ***more*** semantic information than J_2 IF AND ONLY IF

$$\text{follows-from}(J_2) \subset \text{follows-from}(J_1)$$

CONSTRAINT: For all J: follows-from(J) is consistent

The Difference that Matters

We have a notion of more information, but it is not necessarily quantitative. Note that

$$\text{follows-from}(J_1) \subset \text{follows-from}(J_2)$$

does not necessarily mean that

$$|\,\text{follows-from}(J_1)\,| < |\,\text{follows-from}(J_2)\,|$$

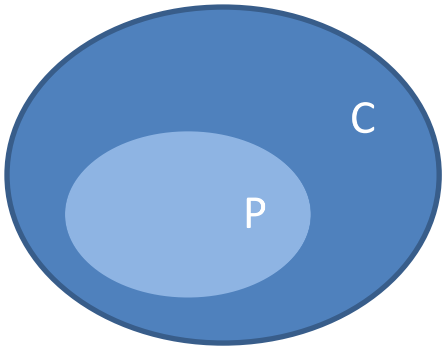
At least under a classical interpretation of "follows from", an infinite number of things follow from both "P" and "P and Q", e.g., from P it follows that P, P or P, P or P or P, …

But what about “follows from”?

Truth-conditional Semantics (Tarski)

C follows from *P* IFF

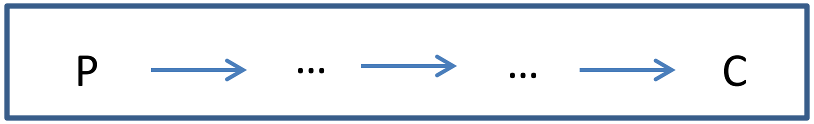
whenever *P* is true, *C* is true also.



Inferential Semantics (Gentzen)

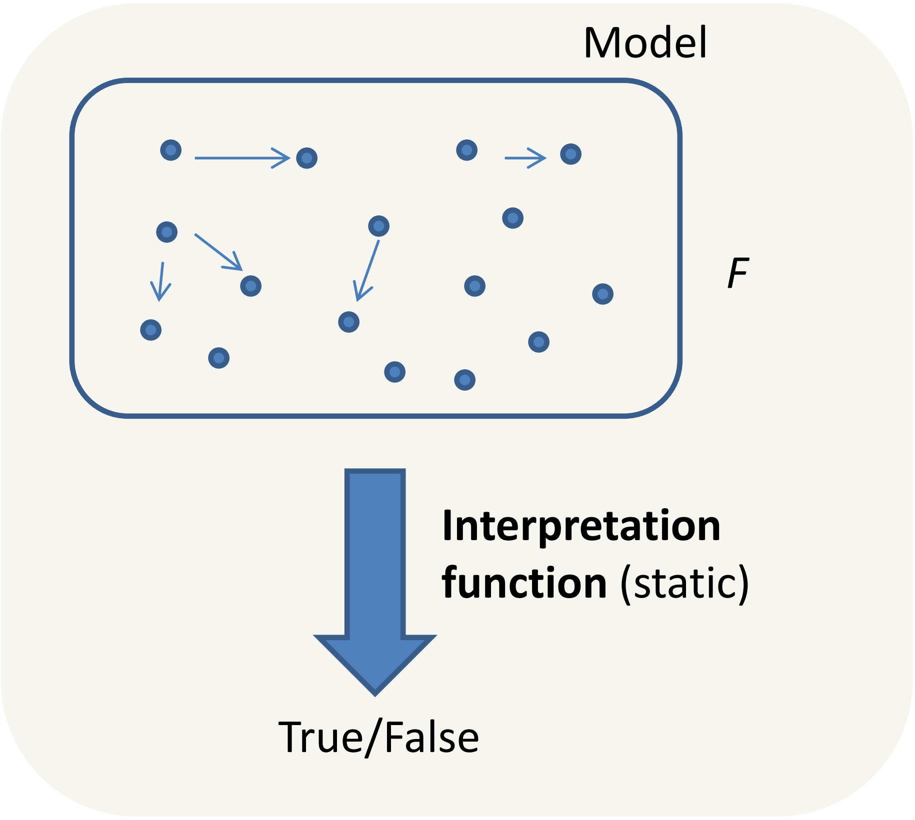
C follows from *P* IFF

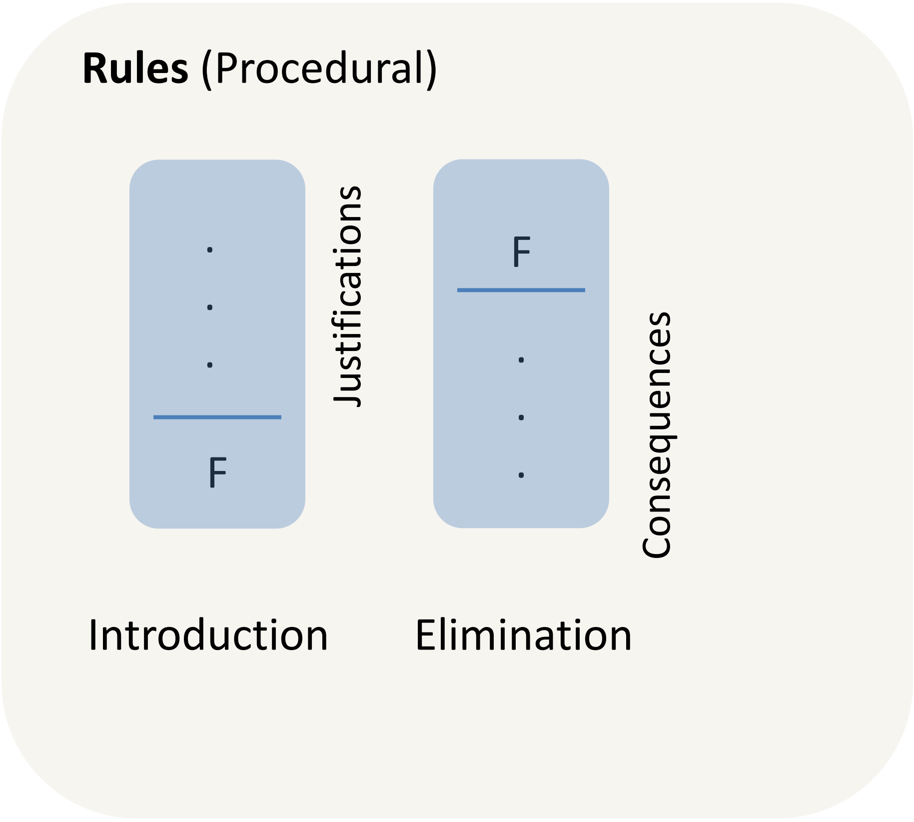
there is a chain of correct inference steps from *P* to *C*.



Commonalities and Differences

- Map natural language sentence *S* to formula *F* in an unambiguous formal language.





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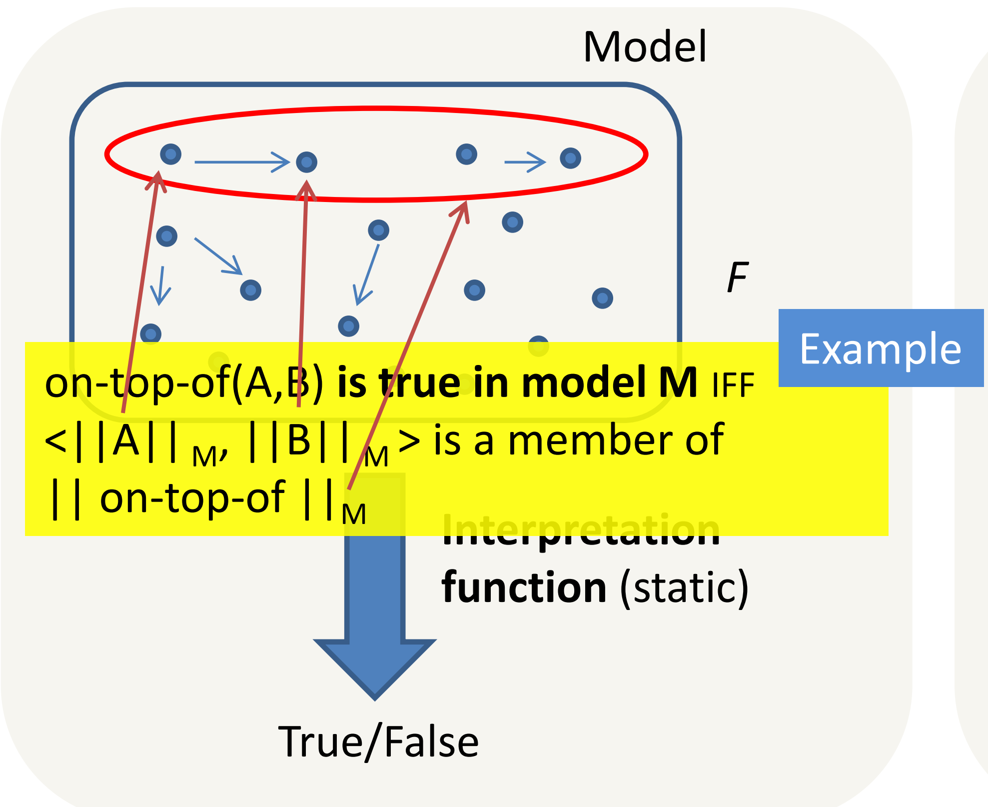
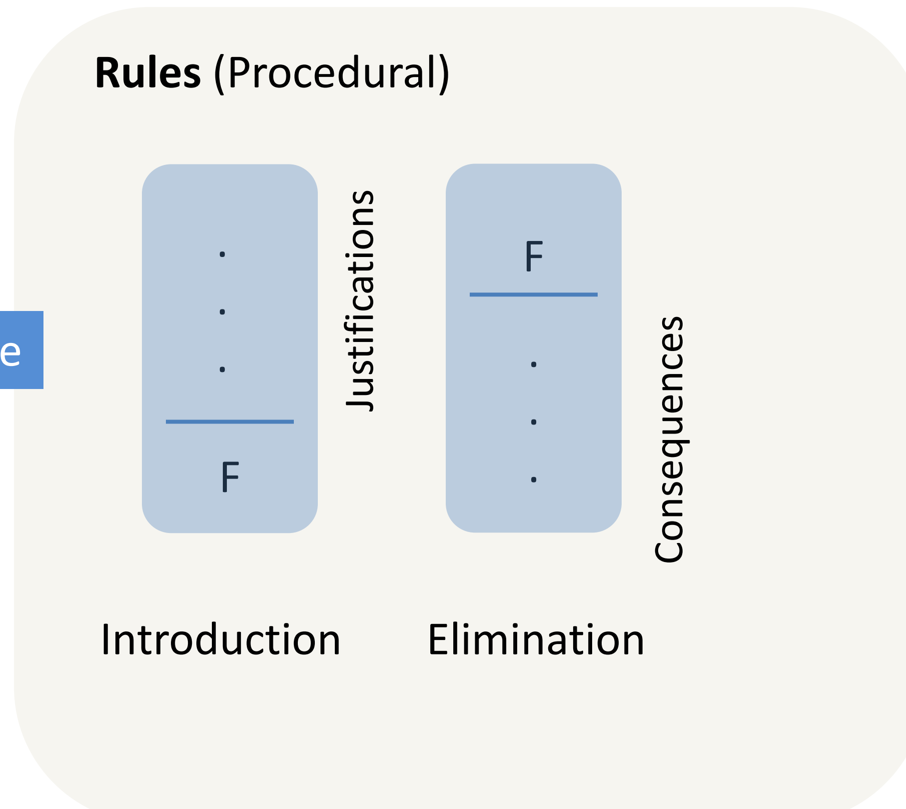
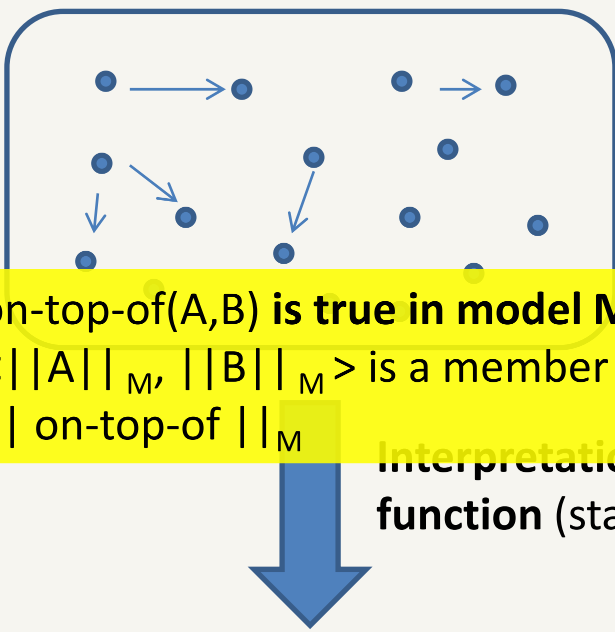




Commonalities and Differences

- Map natural language sentence *S* to formula *F* in an unambiguous formal language.

Model



F

on-top-of(A,B) **is true in model M** IFF $<||A||_M, ||B||_M>$ is a member of $||$ on-top-of $||_M$

Interpretation function (static)

True/False

Rules (Procedural)

Example

Introduction	**Elimination**
underneath(A,B)	on-top-of(B,A)
on-top-of(B,A)	underneath(A,B)

Justifications

Consequences

Introduction Elimination

Commonalities and Differences

- Map natural language sentence *S* to formula *F* in an unambiguous formal language.

Model

Rules (Procedural)

Truth-conditional/Formal Semantics

Initiated by Richard Montague (Montague Semantics).

Extended by Kamp (1981) (Discourse Representation Theory), Barwise & Perry (1983) (Situation Semantics), …

Inferential Semantics

Championed in the philosopher Robert Brandom's (1994) "Making it Explicit".

Computational/formal implementations by Ranta (1994) and DenK project (1994-1998) (Ahn, Kievit, Piwek), Piwek (to appear, Synthese Journal 2012)

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