

Q1.

Reduce the following term

$$(\lambda f \lambda g \lambda x. f x (g x)) (\lambda y. y x) (\lambda x. s x)$$

Q2.

In the last hour we switched our perspective from sets to functions. In this setting, we can think of verb phrases like *walks* as a function from individuals to truth values, represented as $\lambda x. walk'x$, ignoring tense and aspect for now. When you apply this function to the meaning of an individual, say John, represented as *john'*, you get the logical form $walk'john'$, which stands for the proposition that John walks. In terms of the model structure, this proposition amounts to saying that the individual, named John in natural language, is a member of the set of walkers. We say that the sentence *John walks* is interpreted as $walk'john'$. To save some typing, we depict this relation as:

$$(1) \quad \llbracket \text{John walks} \rrbracket = walk'john'$$

In this framework, given a natural language expression as a sequence of words, the task of interpretation involves the following sub-tasks:

- (2) a. What are the interpretations of the individual words?
- b. What is the applicative structure of the expression?

What the heck is applicative structure? Assume you are given a sequence of terms:

$$\lambda x. x^2, 7, \lambda x. x \times 3$$

and asked to compute the result. To be able to that, you need to know the applicative structure of this sequence. It has two distinct applicative structures that makes sense – certain applicative structures are meaningless.

- (3) a. $(\lambda x. x \times 3)((\lambda x. x^2)7)$
- b. $(\lambda x. x^2)((\lambda x. x \times 3)7)$

Therefore, the meaning of a sequence of terms depends on the meaning of the terms and the applicative structure imposed on the sequence. In our way of thinking, the meaning of a natural language expression is no different. It depends on the meaning of the terms and their applicative structure.

What we call syntax is the process or system that maps a sequence of terms to its applicative structure.

When there are only two words in an expression, as in our example *John walks*, once the meaning of the terms are made clear, the applicative structure is automatically determined; but as the expression gets crowded, you need syntactic rules and principles that deliver the right applicative structure.

Now comes the question. Given the sentence,

- (4) John walks slowly.

Give the interpretation of the terms, the applicative structure of the sentence, and comment on what these interpretations correspond to in the model of the world.