A variable that ranges over the *metalanguage* (the notation of a description), not the *object language* (the language being defined).

"The collection of true statements that we can make about some particular logical system (or programming language)--and, by extension, the study of such statements."

The definitions actually describe trees. Parens are simply a way of resolving ambiguities when a term is represented a string.

- Using a grammar, in BNF form for example.
- By defining terms inductively.
- Using inference rules.
- By defining a procedure for generating all possible phrases.

... *axioms*.

They may reference metavariables. Hence each may be instantiated to any of an infinite set of *concrete rules* containing phrases in place of metavariables.

- Operational semantics.
- Denotational semantics.
- Axiomatic semantics.

An approach to formalizing semantics that specifies the behavior of a programming language by defining a simple abstract machine to it. The abstract machine uses the terms of the language itself (or higher level structures) as states and defines a transition function between states. The meaning of a term is the final state reached when starting with that term as the initial state.

Proofs of the correctness of the implementation of the language.

An approach to formalizing semantics that takes meanings of terms to be mathematical objects.

Finding a collection of *semantic domains* and then defining an *interpretation function* mapping terms into elements of these domains.

The search for appropriate semantic domains for modeling various language features.

An approach to formalizing semantics that takes laws themselves as the definition of the language. The meaning of a term is just what can be proved about it.

- Denotational semantics: nondeterminism and concurrency
- Axiomatic semantics: procedures