First-order logic is not the only system of logic of interest: there are many
extensions and variations of first-order logic. A logic typically consists of the
formal specification of a language, usually, but not always, a deductive system,
and usually, but not always, an intended semantics. But the technical use of
the term raises an obvious question: what do logics that are not first-order
logic have to do with the word “logic,” used in the intuitive or philosophical
sense? All of the systems described below are designed to model reasoning of
some form or another; can we say what makes them logical?

No easy answers are forthcoming. The word “logic” is used in different
ways and in different contexts, and the notion, like that of “truth,” has been
analyzed from numerous philosophical stances. For example, one might take
the goal of logical reasoning to be the determination of which statements are
necessarily true, true a priori, true independent of the interpretation of the
nonlogical terms, true by virtue of their form, or true by linguistic convention;
and each of these conceptions requires a good deal of clarification. Even if
one restricts one’s attention to the kind of logic used in mathematics, there is
little agreement as to its scope. For example, in the *Principia Mathematica*,
Russell and Whitehead tried to develop mathematics on the basis of logic,
in the *logicist* tradition begun by Frege. Their system of logic was a form
of higher-type logic similar to the one described below. In the end they were
forced to introduce axioms which, by most standards, do not seem purely logical
(notably, the axiom of infinity, and the axiom of reducibility), but one might
nonetheless hold that some forms of higher-order reasoning should be accepted
as logical. In contrast, Quine, whose ontology does not admit “propositions”
as legitimate objects of discourse, argues that second-order and higher-order
logic are really manifestations of set theory in sheep’s clothing; in other words,
systems involving quantification over predicates are not purely logical.

For now, it is best to leave such philosophical issues for a rainy day, and
simply think of the systems below as formal idealizations of various kinds of
reasoning, logical or otherwise.

**Photo Credits**

**Bibliography**