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An Introduction to Description Logics

The introduction is presenting Description Logics (DL) as a formal way to represent knowledge for use in building intelligent applications. Knowledge was formerly represented using logic-based formalisms (variants of first-order predicate calculus) and other non-logical approaches such as semantic networks and frame systems. The latter group (both network-based structures) were often considered more appealing and more effective from a practical standpoint than the former due to their more human-centered origins, however they were not fully satisfactory because every system behaved differently than the others.

Description Logics are more or less a culmination of the two – they are hierarchical networks of concepts (sets of individuals) related by an underlying logical system. Implicit relationships can be deduced from explicit ones using specialized reasoning techniques, without necessarily requiring first-order logic theorem provers. Not only are concepts and roles in DL's defined by set theory operators (union, complement, intersection, etc.) but also have value restrictions (e.g. number restrictions to restrict the cardinality of a role) among other things (e.g. an operator for subsumption), depending on the expressiveness of the DL.

A DL knowledge base is comprised of two parts – the TBox, which contains intensional knowledge (e.g. a Woman is a Person and a Female) in the form of a terminology, and the ABox, which contains extensional knowledge (e.g. Anna is a Woman) that is specific to the domain. The two, in conjunction, can be used to infer relationships between the concepts that are not explicitly defined (e.g. Anna is a Person).

DL's are commonly used in application areas such as Natural Language Processing, Software Engineering, Medicine, and Web-Based Information Systems, Planning, and Data Mining.

Some problems with DL's might be high worst-case complexity, although there have been significant improvements in algorithms since the writing of this book, and empirical tests have shown that the worst-case rarely occurs in practice.