

Managing and Communicating Identities in Knowledge Representation and Information Systems

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David Toman and Grant Weddell

Cheriton School of Computer Science, University of Waterloo
200 University Ave W., Waterloo, ON N2L3G1, Canada
{david, gweddell}@cs.uwaterloo.ca

Abstract

The tutorial introduces the audience to the concept of *referring expressions*, formulæ that can be used to communicate identities of otherwise abstract objects/individuals. The formalism provides foundations for a successful and unambiguous exchange of information about individuals between agents sharing common knowledge about such individuals, a task that is indispensable in most modern applications of knowledge representation.

Description and Objectives of the Tutorial

A *referring expression* in linguistics is any noun phrase identifying an object in a way that will be useful to interlocutors. In the context of knowledge representation and information systems, *constant symbols* occurring in an underlying knowledge base are the artifacts usually used to identify a subset of the objects for which the knowledge base captures knowledge.

This tutorial explores how the set of objects that can be syntactically identified within a knowledge base can be extended by allowing more general expressions in the underlying logical language of the knowledge base, called *singular referring expressions* (or *denoting expressions*), to add to the usual constant symbols that commonly serve as identifiers of such objects. Expanding the possibilities of identifying possibly implicitly defined objects serves numerous purposes, ranging from enabling query answers to contain additional results which would otherwise not be possible due to a lack of constant symbols denoting (components of) such results, to answers that are more informative, to decisions on how to communicate references to objects among various cooperating agents, and to identification issues related to physical data representation in computer storage, for example, to *addresses* of records located in main-memory databases. The idea of referring expressions itself circumvents the need for artificially-invented identifiers, such as URIs, that are commonly opaque to the user that interacts with the knowledge base.

The tutorial has two main goals: (1) to review the history of approaches to identifying individuals/objects, in particular in the area at the intersection between logic-based approaches to knowledge representation and the areas of natural languages and philosophy, approaches that can be traced back to Russell [Russell, 1905], Frege, and Strawson [Strawson, 1950, Strawson, 1956] including the use of such expressions in NLP systems [Dale and Haddock, 1991, Reiter and Dale, 1992, Dale and Reiter, 1995], and (2) to present a modern unifying approach to referring expressions based on logical methods originating in logic-based approaches to Knowledge Representation with clear and direct applications to many practical areas of Information systems and Computer Science in general.

Interestingly, the approach to object identification discussed in the tutorial naturally and seamlessly complements standard approaches in conceptual and ontology design methodologies. The tutorial is thus of interest both to researchers in knowledge representation and to practitioners in the wide area of information management.

Previous Presentations of the Tutorial

The authors, together with Alexander Borgida (Rutgers), have introduced referring expressions in the area of Knowledge Representation and Ontology-based Data Access [Borgida et al., 2016a] and were awarded the *Ray Reiter Best Paper prize* at KR 2016 for this work. They have extended this work to the area of conceptual modelling [Borgida et al., 2016b] and other areas connected with ontological reasoning and knowledge representation. Subsequently, with their coauthors, they were awarded the *2018 Bob Wielinga Best Paper Award* for the [Ma et al., 2018] paper furthering the use of referring expressions in conceptual modelling. The authors have presented earlier versions of this tutorial, e.g., at ECAI'24, KR'22, and IJCAI'19.

About the Tutorial Presenters

Presenters' Affiliation

Name: David Toman and Grant Weddell
Affiliation: Cheriton School of Computer Science, University of Waterloo
Postal address: 200 University Ave W., Waterloo, ON N2L3G1, Canada
E-mail address: {david,gweddell}@uwaterloo.ca
Home page: <https://cs.uwaterloo.ca/~{david,gweddell}>

Presenters' Short Bio

Dr. David Toman and Dr. Grant Weddell are professors of Computer Science at the University of Waterloo, Canada. They have published and presented results in the area of knowledge representation over the last 25 years at premier AI conferences (including another *Ray Reiter Prize* in 2010 [Kontchakov et al., 2010] and *Best Paper Prize* and ISWC 2013 [Lutz et al., 2013]); Dr. Toman has also given tutorials in the area of temporal representation and reasoning and temporal databases and information systems that has led to an invited chapter in the *Handbook of Temporal Reasoning in Artificial Intelligence*.

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