# Eddy: A Graphical Editor for OWL 2 Ontologies

**Domenico Lembo, Daniele Pantaleone, Valerio Santarelli, Domenico Fabio Savo**
Dipartimento di Ingegneria Informatica, Automatica e Gestionale "A. Ruberti"
Sapienza Università di Roma
⟨lastname⟩@dis.uniroma1.it

## Abstract

We demonstrate Eddy, a new tool for designing ontologies specified in the GRAPHOL language. GRAPHOL is completely visual and fully captures OWL 2. Thus Eddy is the first ontology editor that allows to create OWL 2 ontologies by only using simple graphical editing features.

## 1 Introduction

Ontology development is a complex activity that is usually carried out with the help of ontology engineering tools that in particular allow editing and browsing of ontologies, among their basic functionalities (see, e.g., Protègè[1], TopBraid Composer®[2], or OntoStudio®[3]). Such tools usually also offer visualization services, providing overviews of portions of the ontology in some graphical format (see, e.g., [Lanzenberger *et al.*, 2009]). However, they have little or no graphical editing features, and thus basically require designers to be able to specify ontologies in terms of logic formulae, especially for asserting complex axioms. In fact, several graphical models for knowledge representation have been proposed during the years, in many areas of computer science, but none of them succeeded to impose itself as a reference graphical language (whereas instead a huge standardization effort led to establish OWL[4] as a reference formal language for ontologies, equipped with textual standard syntaxes). Among the most recent proposals, there are interesting efforts to extend to the OWL expressiveness diagrammatic conceptual modeling languages, such as the UML class diagram or the Entity-Relationship (ER) model, i.e, the de facto standard for software and database design. Such extensions however typically require using textual formulas besides the graphical representation of the ontology (see, e.g., [Falco *et al.*, 2014; Fillottrani *et al.*, 2012; Guizzardi, 2005]), and in some cases did not evolve towards OWL 2, the current version of the standard for ontologies [Brockmans *et al.*, 2004].

In our demonstration we will present Eddy, a novel tool for ontology editing. Eddy aims to overcome the main drawbacks of previous proposals by providing a completely graphical environment for ontology specification. Notably, in Eddy OWL 2 ontologies can be specified in a fully diagrammatic way through GRAPHOL, a recent visual ontology language [Console *et al.*, 2014; Lembo *et al.*, 2016]. GRAPHOL basic elements are borrowed from the ER model, to facilitate its usage and understanding by non-experts in logic and ontologies but with some skills in conceptual modeling languages. GRAPHOL has formal syntax and semantics, and a precise relationship with Description Logics (DLs), OWL 2, UML, and ER, and has been successfully used in industrial projects (cf. [Lembo *et al.*, 2016]).

## 2 The Eddy Tool

Eddy is a stand-alone software written in Python 3, with a GUI implemented through the PyQt5 bindings for the Qt5 framework, and distributed under the GPL v3 license[5]. It presents a central viewport area for drawing GRAPHOL ontologies through point-and-click and drag-and-drop mechanisms, based on the selection of GRAPHOL symbols from a palette in the left-hand side docking area, shown in Figure 1.

Concepts, roles, and attributes are represented in GRAPHOL with rectangles, diamonds, and circles, respectively, as in ER diagrams. Complex OWL expressions are built through graphical operators taking as input other expressions. This is rendered by dashed directed edges terminating with a small diamond going from an expression to the operator. Only two shapes are used for operators, boxes (blank or solid) and hexagons. Labels allow to distinguish between operators. For instance, the label **or** for a hexagon indicates union, whereas the label **exists** for a blank (resp. solid) box indicates an existential restriction over a role or attribute (resp. the inverse of a role or attribute). Solid directed arrows specify inclusions between expressions. For example, the ontology in Figure 1 asserts that the union of VegetarianPizza and CheesePizza is contained in Pizza, that Pizza is contained in the unqualified existential restriction on hasTopping, i.e., each pizza has at least a topping, that the unqualified existential restriction on the inverse of hasTopping is contained in Topping, i.e., every individual in

[1] http://protege.stanford.edu/
[2] http://www.topquadrant.com/tools
[3] http://www.semafora-systems.com/en/products/ontostudio/
[4] https://www.w3.org/TR/owl2-syntax/
[5] http://www.dis.uniroma1.it/graphol/download.html

the range of hasTopping is a topping, that CheeseTopping is contained in Topping, and that a cheese pizza must have at least a cheese topping (corresponding to the OWL formula, in DL syntax, CheesePizza $\sqsubseteq \exists$hasTopping.CheeseTopping).

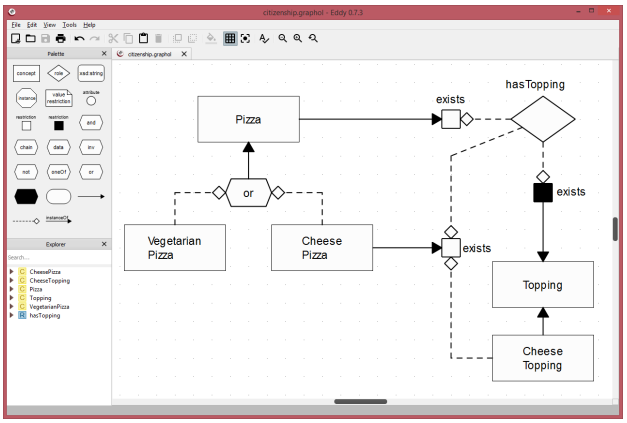


Figure 1: Eddy viewport and docking areas.

## 3 Evaluation Study

We conducted a first evaluation study for Eddy, involving ten participants from the industrial world, who have some background in conceptual design, which is basically the know-how we assume for Eddy users. After a brief introduction to GRAPHOL and Eddy, participants were asked to perform ten editing tasks on the Pizza ontology[6] specified in GRAPHOL. Each user was also asked to indicate the time it took him to complete the task, how clear it was to him how to perform the task, and how easy it was to carry out the task. In Figure 2 we

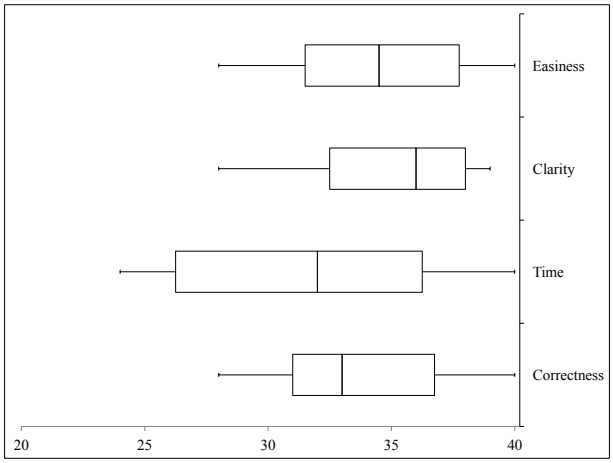


Figure 2: Results of the Eddy user evaluation.

show a synthesis of the results. Clearness, easiness and correctness are scored on a scale from 0, worst, to 4, best, so the max possible total score is 40. Moreover, the predetermined benchmark average for time per task was set at 3.5 minutes. Each box plot in the figure shows the full range of variation, from minimum to maximum, indicated by the whiskers, the likely range of variation, indicated by the two boxes, and the median value. The test results show a good ability in performing the required tasks through the editor. The high scores for clarity and easiness also indicate that the users were able to understand what they were required to do in each task and that Eddy allowed them to achieve their goal comfortably.

[6] http://protege.stanford.edu/ontologies/pizza/pizza.owl

## 4 Demonstrating Eddy

We plan to both show the usage of Eddy and involve attendees in testing our tool. In particular, they will be able to use Eddy to create, modify, and export ontologies. We will prepare a set of small GRAPHOL models, featuring excerpts of some popular ontologies, such as Pizza, which describe real-world domains that can be easily understood by the participants, and assign a set of model editing tasks on these ontologies. By performing these tasks, users will exploit Eddy's advanced drawing functionalities, custom-tailored for quickly and effectively constructing GRAPHOL diagrams. We will also demonstrate Eddy's syntactic validation functionalities, which will guide the user in designing a syntactically correct OWL 2 ontology. After completing the tasks, users will export the GRAPHOL ontologies in the standard OWL 2 syntax.

The demonstrators will provide laptops, GRAPHOL ontologies, the tasks to perform, and a link to download Eddy and the material handed out during the demonstration.

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