

Yorùbá Noun Ontology from Functional Perspectives

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Abstract

The present shift in language analysis from theoretical and descriptive analysis to applied, adaptable and implementation design has been the practice resulting from modern Information and Communication Technology world. It is noteworthy that Awobuluyi as a renowned Yorùbá scholar have always maintained the position that a good grammar of any language should be from functional perspectives. Eventually, Ontological annotation as a modern practice by which theoretical knowledge occurring in its implicit form is prepared in both human and machine readable format to aid Natural Language Processing (NLP) is an edge in development. However, the fact that Yorùbá Scholars have considered other perspectives to identify and classify Yorùbá Noun make the knowledge heterogeneous and a big challenge for machine accessibility. This study in order to meet this challenge, extracts the implicit knowledge of Yorùbá nouns being described from Awobuluyi's functional perspectives, to implement an ontology annotation model named Yorùbá Noun Ontology according to Awobuluyi (YORNOA), in an explicit, formal and machine readable format which make the knowledge available for NLP. The data for this study is the classification of Yorùbá noun as contained in Awobuluyi (1978)'s *Essentials of Yorùbá Grammar* and Awobuluyi (2013)'s *Èkọ́ Gírámà Yorùbá*. An additional 106 Nouns were purposively selected from *Modern Yorùbá Dictionary* to complement the twenty three (23) concept term extracted from the original text. Methontology as proposed by Gómez-Pérez, Fernandez-Lopez, and Corcho (2004) was followed to design the annotation, and Protégé 4.5 was used to implement the model. From the implementation thirteen (13) subclasses were specified of which two (2) are contrastive, the rest were non-contrastive because the (+) value that is returned for Human nouns cannot be returned for Non- Human nouns, (-) value was returned. This study demonstrate and concludes that the knowledge issues proposed from Awobuluyi functional perspectives can be extracted and presented in the format to shore up knowledge representation for NLP activities.

Keywords: *Yorùbá noun, Ontological Annotation, Awobuluyi functional perspectives*

Introduction

Research activities in Yorùbá studies have started over a century ago, with many publications in Yorùbá language, literature, film studies, drama, culture and social life. These research studies have fostered a measurable development in Yorùbá life in all ramifications. However, the wide gap in the area of employing Information and Communication Technology (ICT) to enhance African languages in general and with specific reference to Yorùbá Language

needs to be filled. Interestingly, few individuals have responded to the clarion call of employing computational methods to analyse Yorùbá language. Research in this area includes: Yoruba text to speech conversion system (Iyanda 2014), Automated Speech Recognition (ASR) for Yorùbá Tone Systems in order to build capacity in human language (Adegbola 2006, 2008, and 2009), Machine Translations (Hassan 2009, Odoje 2010, 2017), Ifẹ̀ CISRG (Computing and Intelligent Systems Research Group) in the collaborative efforts of Ọ̀dẹ̀jọ̀bí, Hassan and a host of others, Yorùbá cultural knowledge-based system (Emuoyibofarhe, Adebayo, Lala, and Aremu 2015), and an Introductory work on Yorùbá Ontology development. Aina (2017). These efforts have contributed in its own ways, to the call to save our indigenous language with the use of modern technology.

Furthermore, Scholars have presented Yorùbá nouns on different perspectives such as descriptive, morphological and so on. Some of this works includes: Abrahams (1965), Bamgbose (1965, 1990), Johnsons (1921), Awobuluyi (1978, 2008, 2011, 2013), Táíwò (2006a, 2006b), Owolabi (1976). But Awobuluyi have always maintained the position that a good grammar of any language should be from functional perspectives. As noble as this fact is, the knowledge of core grammar even from functional perspectives is still implicit on pages of literatures and it has to be brought up and prepared for machine use. Equally, ontology models are solely dependent on annotations of the inherent knowledge of language user and of course, this is a big challenge.

Based on these background facts, there is the need for more knowledge-based models to be developed on the core grammar of Yorùbá language. Many more artificial intelligent and Natural Language Processing Techniques are still needed to enable and fast track developments. This study attempts to extract the implicit knowledge of Yorùbá nouns which are described from functional perspectives in order to delineate it from annotations that could be developed from other non-functional Scholars perspectives.

This paper designs and implements an ontology annotation model named Yorùbá Noun Ontology according to Awobuluyi (YORNOA) based on the prose narratives of Awobuluyi's work making it explicit, formal and machine readable. Some of the questions this paper seeks to answer are: What are the identifying features of a noun in Awobuluyi's view? How can we design a model based on his perspectives? What are the methods and materials employable to achieve this feat?

Literature review

The focus of this section is to examine works that are related to the objective of this study. The conceptual terms: Ontology, NLP and Yorùbá nouns as different variables of the study are examined. Consideration of these related works helps to situate this study in its proper place among the existing others.

Gruber (1993:200) defines Ontology as the "Specification of a conceptualization". When used in the context of knowledge sharing, the author admits that Ontology involves formal

specification (like a program) designed for the concepts and relationship that can exist for an agent or community of agents. This definition relates more with the usage of Ontology as set-of-concept definitions and incorporates more of Artificial Intelligence (AI) tasks. It is also employed for pragmatic activities in which Ontology definitions are more of formal vocabulary. In the field of AI, what exists is what can be represented. When declarative formalism is employed to represent the knowledge of a particular domain, the set of objects represented in that order is known as ‘the universe of discourse’. The set of objects and the relationship described among them are featured in one to one representational vocabulary and are formalized into a knowledge based program as Ontology. Then knowledge sharing and reuse becomes easily accessible by queries and assertions that can be exchanged among agents. However, all these works on Ontology as a concept points to its relevance to knowledge based system (KBS) and AI.

Ontology according to Lawson (2004:2)’s etymology, is the term derived from the Greek word with “onto” meaning “being” and “logos” usually interpreted as “science”, thus traditionally, ‘Ontology is the science or study of being’. Lawson’s meaning of the word being has two senses:

1. Something that is, or exist, an entity or thing; and
2. What it is to or to exist, what all the things that are have in common.

Then if Ontology is the study of being, it is then both (1). The study of what is or what exist, the study of entities or things, and (2) the study of what it is to be or to exist, what all the things that are have in common. Elements of ontology are: Concepts, attributes, instances relations and axioms

Pareja-Lora (2012) submits that Ontology is very useful in solving computer related integration and interoperation problems. Hence, Ontology had risen to take care of what he called ‘cascaded errors’ that existed when attempting to incorporate and interlink various annotation and linguistic instrument in a row.

In a nutshell, ontology is a means to an end by which existing human knowledge and conceptualization of an entity is formally represented in human cum machine readable format which web searching agents, knowledge systems, artificial intelligent systems and NLP agents can explore for further computational activities.

Uses of ontology are outlined by Noy and McGuinness (2000) as:

- Defining a common vocabulary for researchers that needed to share information in a domain; hence, Ontology enhances sharing common understanding of the structure of that information for both humans and software agents.
- Enablement of reuse of domain knowledge. Several developers can either integrate existing ontologies indicating the specific portions of interest or extend an existing Ontology to describe our domain of interest.
- Since domain assumptions underlying systems changes from time to time, Ontology makes explicit these assumptions, therefore making it easy to change over time, unlike hard-coding in which underlying assumptions are hard to find and change especially for non-programming experts. But Ontology provides flexibility to those basic underlying assumptions.

- Ontology is also useful for separating the domain knowledge from the operational knowledge.
- Ontology makes it possible to analyse domain knowledge once a declarative specification of the terms is available.

The formal analysis of terms in a domain is mostly valuable when attempting to either reuse already existing Ontology or extending them. Ontologies are useful for maintaining inter-operability between systems for translating modelling methods, paradigms, languages and software tools. (Uschold and Gruninger (1996).

Hassan, Odejobi, Ogunfolakan and Adejuwon (2013) is the first and only attempt (as far as we know) to apply ontology into a Yorùbá concept. The work used formal concept analysis to analyse the data in Yorùbá cultural domain. The terms of Yorùbá cultural domain, such as agogo, 'gong', bàtà, 'footwear', ẹdan ògbóni, 'symbol for ògbóni fraternity' were gathered. The combination of observation, consultation, documented materials and prototyping was used to elicit samples of antiquities of Yorùbá cultural artefact. The cultural heritage samples were designed into taxonomy and protégé was used for the implementation of the prototype.

The ontology was validated by the domain and ontology expert, but the end product of it was a software model for the development of semantic application for cultural heritage. Our research is similar in that our domain of interest is Yorùbá nouns and protégé which was used for the implementation of Yorùbá Cultural Heritage is also the editor we applied to implement Yorùbá nouns. But because of the grammatical intricacies in our domain of application, our annotation design follows methontology since this is the analysis design that is suitable for morphosyntactic data.

Eludiora (2012) noted the importance of Machine Translation (MT) on the Internet especially that the web has become a useful resources for all human activities. The work observed that the MT Services based in web are still very poor, much of the language used on the Internet is still very colloquial, incoherent, ungrammatical, and full of acronyms, abbreviations, allusions, puns and jokes. The Internet has encouraged companies and individuals to offer online versions of electronic dictionaries as translation system but which anyone using such products for translating full sentences is bound to get unsatisfactory results. For that as a reason, ontology being at the backbone of these resources makes inter-operability possible and this in effect solves the problem. The ontology resources are specifically designed to aid Natural Language Processing (NLP) activities as Resource-Based Management Techniques (RBMT).

Iyanda (2014) develops a system for generating phonemic description of sounds corresponding to a piece of Yorùbá text. Yorùbá texts were gathered from textbooks and newspapers and digitised text was recorded as speech data. The recorded speech data was then analysed and annotated using PRAAT speech software. The grapheme to phoneme (G2P) system was designed with finite state transducer (FST), using Java Formal Language to automate the package and FESTIVAL engine environment was used to implement the system. This work is an eye-opener as much as Yorùbá language is concerned. Such

application that converts Yorùbá text to speech has not been developed using these computational resources as much as we know. However, it is observed that the primary standard Yorùbá corpus was not well projected in the linguist's lenses. They were discussed in ordinary layman perspectives. This is an area where thorough interdisciplinary research comes in. Our stake is that, the phoneme set needed ontological annotations at the background, the schematic annotation of those few standard Yorùbá syllable could be formally specified within ontological perspective so that web intelligent agent can share and interoperate the resources especially nowadays that more text to speech applications are been built and they are semantic web-based. After all, the Interactive Development Environment (IDE) used was web-based.

Materials

Protégé 4.5 and its constructs, the Web Ontology Language (OWL) and the plugins are the materials employed for implementing the ontology model. Protégé is an open source, feature rich ontology development environment for the Web which makes creation, uploading, modifying, and sharing of ontologies for collaborative works easily achievable. It has a full support for the Web Ontology Language (OWL), and direct in-memory connections to description logic reasoners. With its customizable user interface one can create and edit ontologies in any compatible single workspace. Protégé 4.5 desktop can be installed on various platforms like XMaCOSX, Windows, Linux, Unix Platform, Solaris, HPUX, AIX and other JAVA enabled environment. It is distributed in the form of a ZIP file from the [main Protege website](#), and includes the 64-bit Java Runtime Environment (JRE). So, it is not necessary to have Java pre-installed on your computer to run Protégé. Just Open your browser and go to the Protégé 4.5 web site at <http://protege.cim3.net/download/old-releases/>, click on the download button and after the displayed, click run. This launches the install wizard. Follow the on-screen instructions to install Protégé in your Program /Files folder on your C:drive by clicking 'Next' for pre-install screens and then install when prompted. Installation steps are documented and available on the above stated website.

The Web Ontology Language (OWL) is an international standard and semantic language for encoding and exchanging ontologies on the World Wide Web. It became a World Wide Web Consortium (W3C) Recommendation in February 2004. As such, it was designed to be compatible with the eXtensible Markup Language (XML), as well as other W3C standards for not just the World Wide Web but the Semantic Web. The emphasis on the Semantic Web is such that information could be uploaded for human to search and make queries ordinarily, but beyond this information should be given explicit meaning in some formal presentation so that machines can process it more intelligently.

Data for this Research

The data for this research is contained in Awobuluyi (1978)'s *Essentials of Yorùbá Grammar* and Awobuluyi (2013)'s *Èkó Gírámà Yorùbá*. The selection of the texts is justified for the

fact that they are straightforward description of Yorùbá language grammar from functional perspectives, the language is precise and detailed enough with simplified linguistics rudiments and quite simple to assist learners who seek to understand the core grammar of Yorùbá language. The conceptual knowledge of Yorùbá nouns was isolated and classified being the data for the design and implementation of YORNOA. The prose narratives of the book were extracted and reduced to minimal token to form the knowledge of Yorùbá nouns. The identified properties of each entity in the prose is described as a prototype of the knowledge, these properties are then modelled as the artificial representation of the entities combined to make whole of the domain. The tokens are arranged to design an intermediate representation (IR) which carries all the semantic representation of the knowledge from the texts and served as resource knowledge base. The IR can be graphical or tabular representation but the intermediate representation used for this design is tabular. This is because the refined grains of this procedure are closer to human readability than graphical since the objective of our formalism is to enable both human and machine readability. The specific relations are defined before the ontology is implemented. This paper therefore presents the designed tabular intermediate representation developed from the prose narratives from Awobuluyi's functional perspectives¹. These tabular representations form the major input data for this work.

Methodology

Generally, methodology in research is a comprehensive, integrated series of techniques or methods created upon a general systems theory which shows how a class of thought-intensive work ought to be performed. Various steps were taken to implement ontology for Yorùbá nouns using the knowledge from Awobuluyi (1978) as the data extracted forms the knowledge resource. The goal of the paper is to develop a conceptual ontology-based annotation model for Awobuluyi's description of nouns in Yorùbá language from functional perspectives. Hence, the text (Awobuluyi (1978) is purposively selected as the resources used for knowledge abstraction.

Our method of achieving this goal is highlighted below as:

- Extraction of the knowledge of Yorùbá noun class as the data for knowledge resources.
- The knowledge extracted was defined into intermediate Representations (IRs) of the domain following methontology.
- The classes and sub classes of Yorùbá nouns is implemented using Protégé 4.0 as the editing tool.

This study followed Corcho and Gomez-Perez (2001) and Gómez-Pérez, Fernandez-Lopez, and Corcho (2004)'s METHONTOLOGY in designing our ontological annotations. Accordingly, Pareja-Lora (2012) mentions that methontology proposes ontological development life span which relies on prototype evolved. Terms in each new version, that is the prototype is allowed to be added, changed, and removed. Pre-existing ontologies could

¹ The reader is implored to read Awobuluyi (1978 &2013) for full details of the prose narratives of Yoruba nouns according to this scholar

be reused at any possible point in time in the evolved prototype life cycle, but it must be evaluated and adapted as needed the case may be. And if reuse is not feasible, then another one has to be created afresh. The constituents found in ontology developed implemented in methontology are: concepts, relations and taxonomies.

Finally, methontology rules are expressions, usually specified with the template ‘if <conditions> then<consequent>’, which are widely utilized to derive knowledge in the ontology, this element consists of attribute values, relation instances, expressions and so on. For example, the following rule

if (language=Yorùbá) \wedge word class (Token, lexical item,) \wedge takes
(token, Lemma, ‘noun qualifier’) \wedge then Value (Token, Category,
‘Noun’)

fixes the statement that the ‘linguistic value category Noun of a linguistic item attribute takes a noun qualifier.’ In other words, the rule above was just the expression of the statement on quote in the immediate previous sentence

METHONTOLOGY conceives every fresh ontologies with the use of a set of tabular and graphical intermediate representations. These are obtained after each of the eleven tasks for ontology conceptualization is performed. These eleven tasks are known as methontology. When these tasks are properly executed the tabular and graphical intermediate representations included in the ontology will be fully completed. Such intermediate representations allow modelling of the different components of the concepts in the domain.

The eleven tasks of METHONTOLOGY according to Pareja-Lora (2012) are the following:

- Creating the glossary of terms for the (sub)-domain being conceptualised.
- Building the sub-classification (taxonomy) of the concepts found in the domain.
- Isolating the ad hoc (binary) relations that hold between the concepts.
- Building the concept dictionary, which stores for each concept and describing in detail, the instances, the class, the instance attributes, and the ad hoc relations.
- Creating the individual concept ad hoc relation.
- Building each instance attribute.
- Isolating each class attribute.
- Identifying each constant in the concept dictionary.
- Description of the formal axioms
- Forming the rules that hold for the concepts in the (sub-) domain in question, and optionally,
- Introducing in the ontology information about instances.

However, more of these tasks could be performed simultaneously and the representation could be encompassing. YORNOA is constructed based on these methods and it covers over the five processes namely, specification, conceptualization, formalization and implementation and maintenance. The intermediate representations derived in the conceptualization of YORNOA according to the adopted text are shown below. It features the components resulting from the application of methontology for each of the concepts, relations, instances and attributes.

Task 1-9 Designing the Glossary of terms, groups, attributes etc.

The glossary of the conceptual terms of this ontology is presented in the following tabular intermediate representation. It identifies the set of all the relevant terms of the Yorùbá noun domain being conceptualised from Awobuluyi prose narratives. Their natural language definitions are provided as well as their synonyms and acronyms, the type of term they belong to, namely, concept in Table1, groups in Table2, attributes in Table 3, Class Instance attributes in Table 4 and relations in Table 5.

Table 1. YORNOA glossary of terms (extracted from Awobuluyi Prose Narratives) – Concepts

Name	Synonyms	Acronyms	Description	Type
Noun (Oro Oruko)		OR	Any word that can stand independently or take qualifier in a noun phrase.	Concept
Noun phrase (Àpólà Orúko)		APOR	A group of words that has a noun as its head and it can take other satellite.	Concept
Qualifier (Èyán)		EY	A content word that qualifies the meaning of a noun or verb	Concept
Noun qualifier (Èyán ajóruko)		EYAJ	Any word that can qualify another word is a noun qualifier.	Concept
Pronoun Qualifier (Èyán Arópò Orúko)	--	--	Pronoun that can qualify another word as a qualifier.	Concept
Subject of a verb	---	----	The subject is the person or thing doing something. The who/what which the sentence is about. The person, place, thing or idea that is doing something. You can find the subject if you can find the verb. Ask the question, 'who or what verbs or verbed?' and the answer to that question is the subject of the verb	Concept
Object of a verb	Direct object	DO	The item that receives the direct action of the verb in a sentence. It is a noun (or pronoun) that is governed by a verb. There are three kinds of objects: a direct object, an indirect object and an object of a preposition. You can find the direct object by finding the verb and asking 'what' or 'whom'	Concept

Pronouns		PRO	Pronouns are used in place of a noun that has already been mentioned or that is already known, often to avoid repeating the noun. Any of a small set of words in a language that are used as substitutes for nouns or noun phrases and whose referents are named. Pronouns have traditionally been regarded as one of the part of speech, but some modern theorists would not consider them to form a single class, in view of the variety of functions they perform.	Concept
Potential Nouns			All the words or sounds in the language can function as nouns. Sounds being 'b', 't', 'd' etc. Words being 'wá', 'rè' 'şe' etc. Each of these potential nouns can function with or without accompanying qualifiers in the functions of subject and /or object.	Concept
Nouns only as object of preposition 'ní'			Some nouns cannot function as subject and object of verbs. These nouns can only function as object of preposition 'ní'	Concept
Human Nouns			The nouns in this category refer to human beings. A sub class of them are traditionally known as proper nouns.. Another sub class of them are traditionally known as emphatic pronouns.	Concept
Non-Human nouns			These nouns refer to things other than human beings. They are questioned by means of the noun 'ki' (what)	Concept
Value nouns			These nouns refer to sums of money. They are questioned by means of the noun 'èlò. They are most commonly preceeded by the particle 'ní'.	Concept
Quantity Nouns			Nouns in this category refer to numerals, They are questioned by means of the noun 'mélòó' (how many)	Concept
Demonstrative Nouns			Most of these nouns are derived from qualifiers They are used to specify or point out elements rather than to name them	Concept
Place Nouns			The nouns refer to places or location	Concept
Manner Nouns			These are nouns that imprecisely refer to the manner an event took place.	Concept
Relativ Head Nouns			The main attribute of these nouns is that they can only be used with relative clause qualifier in the meanings or senses given	Concept
Genitival Head Nouns			These nouns function as heads of genitival phrases.	Concept

Polymorphic Nouns			The meaning of this class of nouns indicates that they have many forms of morpheme in different contexts. There are six nouns in this class. Most of them have three different forms that they take when functioning as subject, object, and genitival qualifiers.	Concept
Interrogative Nouns			These nouns have interrogative meanings. They are used for asking questions about members of five of the sub-classes of the nouns already exemplified. They combine the interrogative function with their normal function as subject and/or object.	Concept
Count Nouns			These nouns are those that can be counted.	Concept
Mass Nouns			Mass nouns cannot be (or are not normally) counted. They are the opposite of count nouns. They are questioned differently from count nouns.	Concept

Twenty three (23) concept terms were extracted to build YORNOA, Thirteen (13) of it are subclasses of Yorùbá noun of which two (2) are contrastive, that is Human vs Non- Human nouns, Count vs Mass noun such that one stands in contrasts to the other. For example, the value (+) that is returned for Human nouns cannot be returned for Non- Human nouns but (-), the rest eleven subclasses do not have such opposition.

Table 2. YORNOA glossary of terms (extracted from Awobuluyi Prose Narratives) –Groups

Name	Synonyms	Acronyms	Description	Type
Yorùbá Noun Group by existence			Human and Non- Human	Group
Yorùbá Noun Group by value			Value nouns	Group
Yorùbá Noun Group by quantity			Quantity Nouns	Group
Yorùbá Noun Group Demonstrative			Demonstrative Nouns	Group
Yorùbá Noun Group by place			Place Nouns	Group
Yorùbá Noun Group by Manner			Manner Nouns	Group
Yorùbá Noun Group by Headedness			Relatival and Genitival Head Nouns	Group
Yorùbá Noun Group by Morphemic Formation			Polymorphic Nouns	Group
Yorùbá Noun Group Interrogative			Interrogative Nouns	Group

Yorùbá Noun Group by Number			Count and Mass Nouns	Group
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Ten (10) groups were identified from Awobuluyi prose narratives for YORNOA

Table 3. YORNOA glossary of terms (extracted from Awobuluyi Prose Narratives) – Attributes

Name	Synonyms	Antonyms	Description	Type
Human Nouns: isHuman		Non-Human Nouns	The isHuman attributes specifies that the noun is human. It is identified in reply to 'ta' interrogative marker.	Concept Type Attributes
Non-Human Nouns: isNonHuman		Human Nouns	The isNonHuman attributes specifies that the noun is a Non -human living things. It is identified in reply to 'kí' interrogative marker.	Concept Type Attributes
Value Nouns: isQuestionedBy 'èlò'			This attribute specifies that this noun can be identified by Questioning it with the wh interrogative 'èlò' and be preceded with the partcle 'ní'	Concept Type Attributes
Quantity Nouns: isQuantity			The isQuantity attribute specifies that the noun quantifies the item following it.	Concept Type Attributes
Demonstrative Nouns: isDemonstrative			The isDemonstrative attribute that the refer nouns are used to specify or point out elements rather than to name them. Most of the nouns in this sub-class are derived from qualifiers They	Concept Type Attributes
Place Nouns: isPlace			The isPlace attribute specifies that the nouns in this class refer to places or location.	Concept Type Attributes
Manner Nouns: isManner			The isManner attribute specifies the nouns that imprecisely refer to the manner in which an event took place.	Concept Type Attributes
Relational Head Nouns:			This refer attribute specifies that these nouns can only be used with relative clause qualifier in the meanings or senses given	Concept Type

isRelativelyHeaded By				Attributes
Genitival Head Nouns: isGenitivelyHeadedBy			The isGenitivelyHeadedBy attribute specifies that these nouns function as heads of genitival phrases.	Concept Type Attributes
Polymorphic Nouns: isPolymorphic			The isPolymorphic attribute specifies that these nouns have many forms of morpheme in different contexts. They have three different forms that they take when functioning as subject, object, and genitival qualifiers.	Concept Type Attributes
Interrogative Nouns: isInterrogative			This referred attribute specifies that these nouns are used for asking questions about members of other sub-classes of the nouns. It also specifies that they combine the interrogative function with their normal function as subject and/or object.	Concept Type Attributes
Count Nouns: isCountable	Countable Nouns	Mass Nouns	The isCountable attribute specifies that the nouns in this class are those that can be counted	Concept Type Attributes
Mass Nouns: isNon-Countable	Non-Countable	Count Nouns	The isNon-Countable attribute specifies that the nouns cannot be (or are not normally) counted. They are questioned differently from count nouns.	Concept Type Attributes

Properties of instances and concepts are described in Attributes component. Thirteen (13) attributes were extracted from Awobuluyi prose narratives for YORNOA. Next in Table 4 is the class instance attributes:

Table 4. YORNOA glossary of terms (extracted from Awobuluyi Prose Narratives)- Class instance Attribute

Name	Synonyms	Acronyms	Description	Type
Human Nouns The proper nouns: Òjọ́, Dàda, Ọba (king), tíṣà (Teacher), adájọ́ (judge). The emphatic pronouns: Èmi (I), Ọun/ó (He/ She), mo (I),			The nouns in this category refers to human beings A sub class of them are traditionally known as proper nouns. Another sub class of them are traditionally known as emphatic pronouns.	Class Instance Attributes

<p>Non-Human nouns èní (today), òun/ó (it), èjì, eéjì (two), ẹranko (animal) àìmò(ignorance), kí (what) kí ní (thing), pé kí á ẹsọra (that we must be careful) ẹyẹ (bird), iṣẹ́jú (minute) Kí ní (what is it?) Ẹyẹ ní (It's a bird)</p>			<p>The nouns in this sub-class refer to things other than human beings. They are questioned by means of the noun 'ki' (what).</p>	<p>Class Instance Attributes</p>
<p>Value nouns Kòbò (kobo), àpò (£100 or ₦200), Náírà (Naira) ẹgbèrin (two and a half pence, 2½d), tórò (three pence), ẹgbàárùn- ún (2s,6d. or 25k), sísi (six pence, five kobo, èlò (how much),, sílè (shilling, ten kobo), ọkẹ (5s or 50k), èlò ní (How much is it), sísi ní (It's five kobo.)</p>			<p>The nouns in this class refer to sums of money. They are questioned by means of the noun 'èlò. They are most commonly preceded by the particle 'ní'.</p>	<p>Class Instance Attributes</p>
<p>Quantity Nouns ìkan (One) ọgbòn (thirty) mélòó (how many), irinwó (four hundred), mẹ́ta (three) ẹgbẹ́ta (six hundred) mélòò ní (How many are they?) mẹ́fa ní (They are six)</p>			<p>Nouns in in this class refer to numerals, They are questioned by means of the noun 'mélòó' (how many). The derived form of the numerals is a combination of the now obsolete verb 'mú' and the underived form</p>	<p>Class Instance Attributes</p>
<p>Demonstrative Nouns Èyí (this one) dúdú (the black one), iyen (that one), funfun (the white one), ikínní (the first one), èwo (which one?) Examples of usage are: Èwo ní (which one is it) Iyen ní (It's that one)</p>			<p>Most of the nouns in this sub-class are derived from qualifiers They are used to specify or point out elements rather than to name them.</p>	<p>Class Instance Attributes</p>
<p>Place Nouns Ibi (place, location) Ibẹ ní ó ti bá mí (He found me there) Àárín ọgbà ní kí o rìn. (Go through the middle of the yard.) Àárín ọgbà ní kí o ti rìn. (Walk/stroll in the middle of the yard.)</p>			<p>The nouns in this class refer to places or location.</p>	<p>Class Instance Attributes</p>

<p>Manner Nouns Bí/bá (manner, way), kólíé (tiny), títi (period), fòò (red manner), Ọgán (suddenness), ọ̀kò̀òkán (one by one), Ọ̀jìjì (suddenness), ojoojúmọ́ (day by day), Kíákíá, (quick manner), ẹ̀yẹ̀yọ (piece by piece), diédíé (little by little), ẹ̀ṣẹ̀ṣẹ (line by line), kitàkità (struggle) (no convenient English translation. Others like ségesège, jẹ́jẹ́, diédíé, fòò, kitàkità are also nouns</p>			<p>These are nouns that imprecisely refer to the manner an event took place. That some nouns of this category can be preceded by preposition ‘ní’ makes them nouns.</p>	<p>Class Instance Attributes</p>
<p>Relational Head Nouns Èyí (instead), Títí (while, until), kàkà (instead), idi (reason), Ìgbà(time), Examples of isages are: Ìgbà tí mo fi máa dé ibẹ́ ... (by the time I got there) Èyí tí ò bá fi lo wéré ... (instead of going without delay) Ìdí tí ó fi pè mí ní bọ̀lọ́ ... (why you call me a fool)</p>			<p>The main attribute of these nouns is that they can only be used with relative clause qualifier in the meanings or senses given</p>	<p>Class Instance Attributes</p>
<p>Genitival Head Noun ẹ̀bá(vicinity), Kíkì(only), Ọ̀dọ̀(presence), ti (possession, own), Gbogbo (entirety), idá (essence), Gbogbo ị̀ṣu náà (all the yam) Ti ọ̀jọ́ (ojo’s own) Ọ̀dọ́ mí (my presence) Ẹ̀ṣà wọn (a few of them) Kíkì idá agbára (strength alone) Ìdà kíkì agbára (strength a lone) Kíkì idá rẹ́ (it alone)</p>			<p>These nouns function as heads of genitival phrases.</p>	<p>Class Instance Attributes</p>
<p>Polymorphic Nouns mo (I), o(You), ó (He) a (We), ẹ (You), wọn (They) (This is in first, second and third person plural respectively</p>			<p>The meaning of this class of nouns indicates that they have many forms of morpheme in different contexts</p>	<p>Class Instance Attributes</p>

<p>Interrogative Nouns Ta (who?) for questioning Human Nouns Kí (what?) for questioning Non-human Nouns. Èwo (which one?) for questioning Demonstrative Nouns. Èlò for questioning Value Nouns. Mélòò (how many?) for questioning Quantity Nouns. They are used as in the following structures. Ta ni o rí? (Whom did you see?) Kí ni o n wá? (what are you looking for?) Èwo ni o fê? (Which one do you want?) Èlò ni o fê? (How much do you want?) Mélòò ni o mú? (how many did you take?)</p>			<p>These nouns have interrogative meanings. They are used for asking questions about members of five of the sub-classes of the nouns already exemplified. They combine the interrogative function with their normal function as subject and/or object.</p>	<p>Class Instance Attributes</p>
<p>Count Nouns ilé (house), ọkọ (vehicle), àga (chair), ọmọ (child), ilú (town), igi (tree), ẹyẹ (bird), ọ̀nà (road, path), ọjà (market), èrò (thought). They are used as in the following examples: O ni to ile mefa (he owns up to six houses) Ko bi omo pupo (He did not have many children) Mo ra aga mewaa (I bought ten chairs) Igi meloo ni o ge How many trees did you fell?)</p>			<p>The nouns in this class are those that can be counted.</p>	

<p>Mass Nouns àlàáfíà (good health, peace), omi (water), epo (oil), òjò (rain), eérú (ashes), oúnjẹ (food), obẹ (stew, soup), iyà (suffering), aféfé (air), ẹmu (palm wine) Examples of its usage in the sentences are: Mo mu ẹmu díẹ. (I drank some palmwine) Ìyà púpò ni ó jẹ ẹ (He suffered a great deal) Oúnjẹ kékeré kó ni ó jẹ (He ate a lot of food) Báwo ni oúnjẹ náà ti tóbi tó? (How much food was it?)</p>			<p>Mass nouns cannot be (or are not normal) counted. They are the opposite of count nouns. They are questioned differently from count nouns</p>	<p>Class Instance Attributes</p>
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A close observation of these tables reveals differences between the attributes in Tables 2 and 4. The former is the concept type attributes while the latter is the class instance attributes. The concept type attributes state the property and the function which the class instance attribute performs, whereas the class instance attributes state the specific instance values of the identified concept type attributes. Relations, as an ontology element, represent a type of link between concepts of the domain. The following items in Tables 5 are the relations that hold for YORNOA.

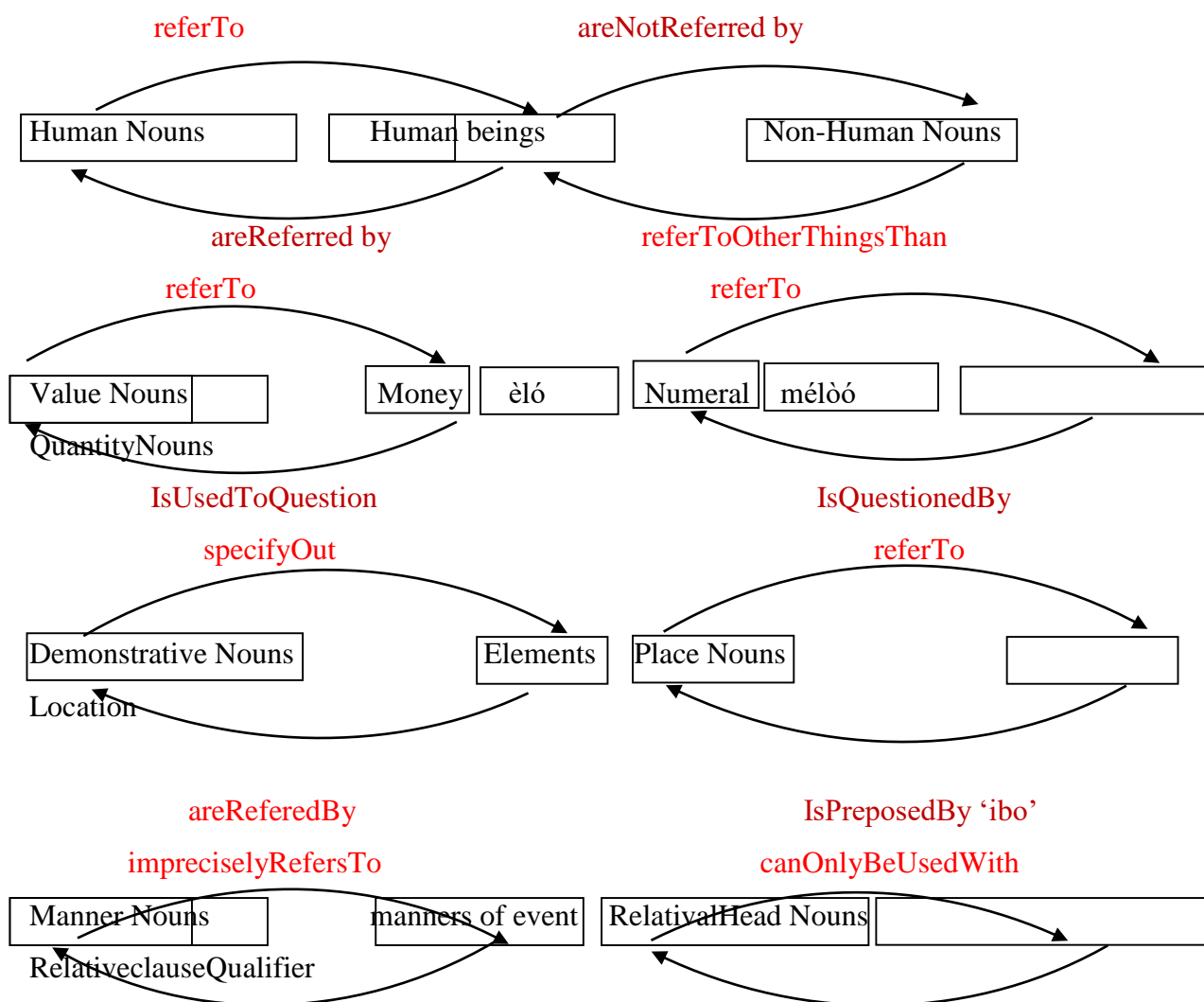
Table 5. YORNOA glossary of terms (extracted from Awobuluyi Prose Narratives) – Relations

Name	Synonyms	Antonyms	Description	Type
refersTo (Human Nouns, Human beings)	--	Non-Human Nouns	--	Relation
refersToOtherThingsThan (Non-Human Nouns, Human beings)	--	Human	--	Relation
refersToSumOf (Value Nouns, Money)	--	--	--	Relation
refersTo (Quantity Nouns, Numeral)	---	---	---	Relation
specifyOut (Demonstrative Nouns, Elements)				Relation
refersTo (Place Nouns, Location)	---	---	---	Relation
impreciselyRefersTo (Manner Nouns, manners of event)	---	---	---	Relation
onlyBeUsed (RelationalHead Nouns, Relative clause Qualifier)	---	---	---	Relation
functionAsHeadOf (Genitival Head Nouns, Genitival phrases)	---	---	---	Relation

hasManyFormsOf (PolymorphicNouns, morpheme)	---	---	---	Relation
usedForAsking (Interogative Nouns, Questions)	---	---	---	Relation
refersToItemThatCanBe (CountNouns,Counted	Countable	Uncountable	---	Relation
refersToItemThatCanNotBe (Mass Noun, Counted)	Uncounable	Countable	---	Relation

Formal Entity- Relation Diagram

The utmost goal of this task is to provide the detailed description of all the ad hoc relations in the concept dictionary and to construct the ad hoc relation in form of entity-relationship (E-R) diagrams. Figure1 below is the E-R diagram of the identified ad hoc relations in YORNOA.



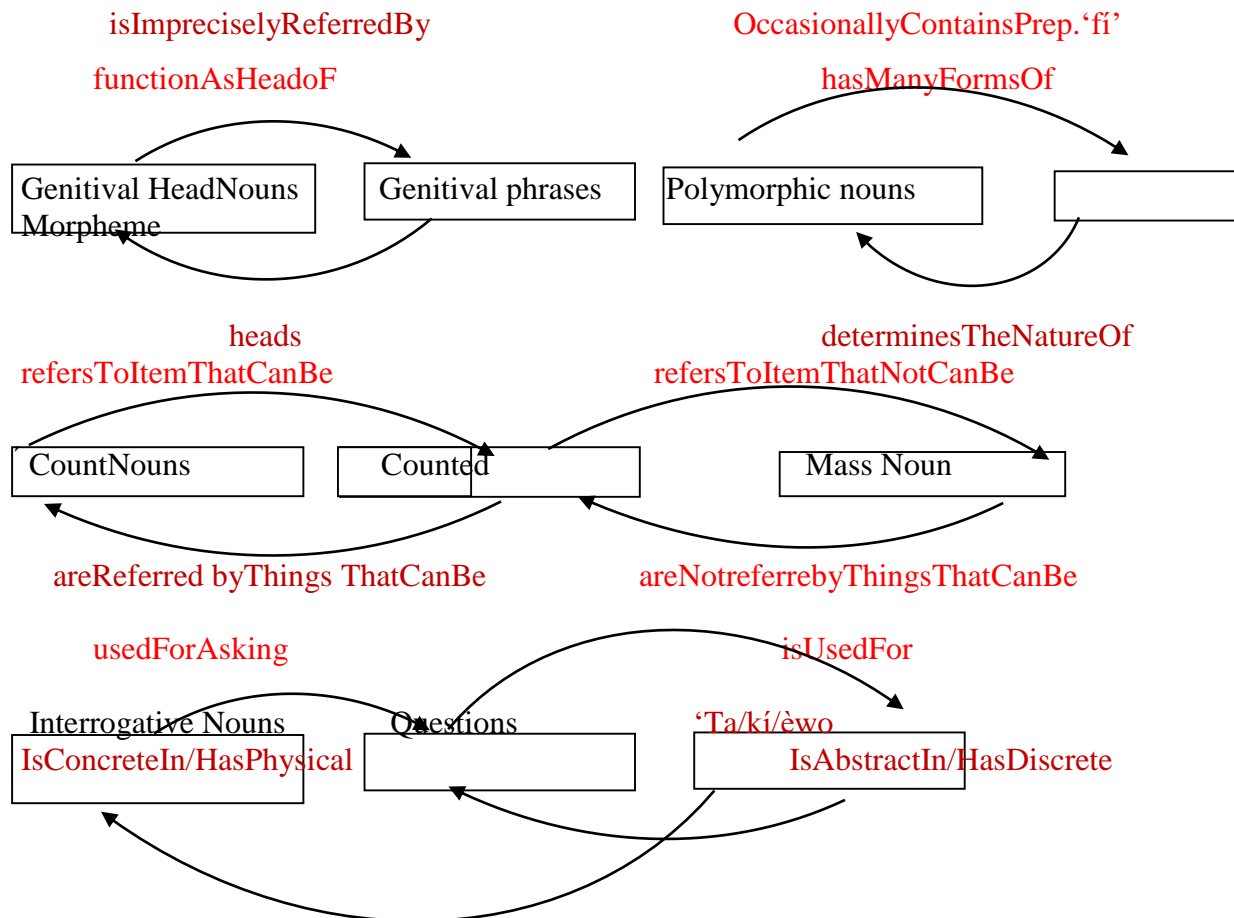


Figure 1. Entity Relation (ER) Diagram for YORNOA extracted from Awobuluyi Prose Narratives

Implementation of Yorùbá Noun Ontology According to Awobuluyi (YORNOA)

The procedures we follow are outlined below:

- Start protégé. You will see the welcome to protégé dialing
- When the Welcome to Protege dialog box appears, press the 'Create New OWL
- Ontology' button.
- A 'Create Ontology URI Wizard will appear'. Every ontology is named using a Unique Resource Identifier (URI). Replace the default URI with <http://www.yornoa@awobuluyi.com/ontologies/yornoa.owl> and press 'Next'.
- I save the Ontology to a file on my PC, browsing to the hard disk to save the ontology to a new file, named 'yorno.owl'. Once a file is chosen then one can press 'Finish'.

From these procedure, the implementation of the Yorùbá noun ontology proceeds. For YORNOA, thirteen classes were specified of which the data primer were 106 terms spread across the thirteen classes and the distribution is shown in table 6 below:

Table 6. Distribution of Classes in YORNOA

	Data Primer	Dictionary entry
Human Nouns	16	Many
Non-Human Nouns	12	Many
Value nouns	11	None
Quantity Nouns	8	8
Count Nouns	10	Many
Demonstrative Nouns	6	1
Genitival Head nouns	7	None
Interrogative Nouns	5	None
Manner nouns	18	1
Mass Nouns	9	Many
Place Nouns	2	Many
Polymorphic Nouns	6	None
Relational head Nouns	5	Many

The following figures show some of the implementation of the elicited and designed concepts in YORNOA:

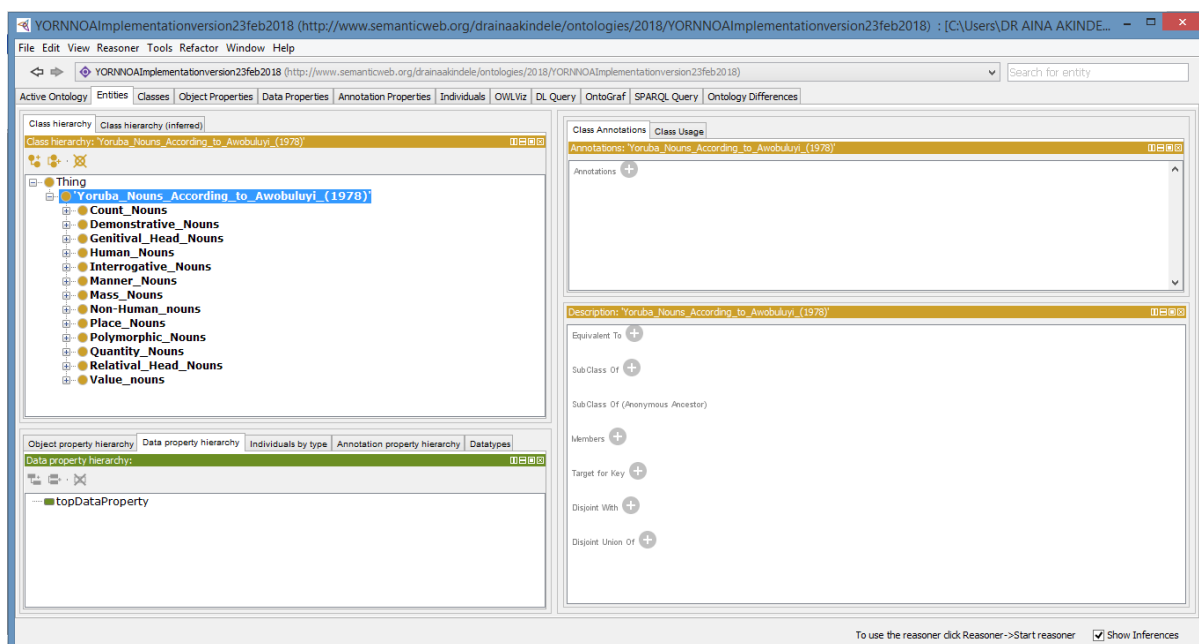


Figure 2. The class Hierarchy of (YORNOA)

Figure 3 below shows the class hierarchy view, the annotation view and the description view of a subclass ‘Demonstrative nouns’ and its relationship with other classes:

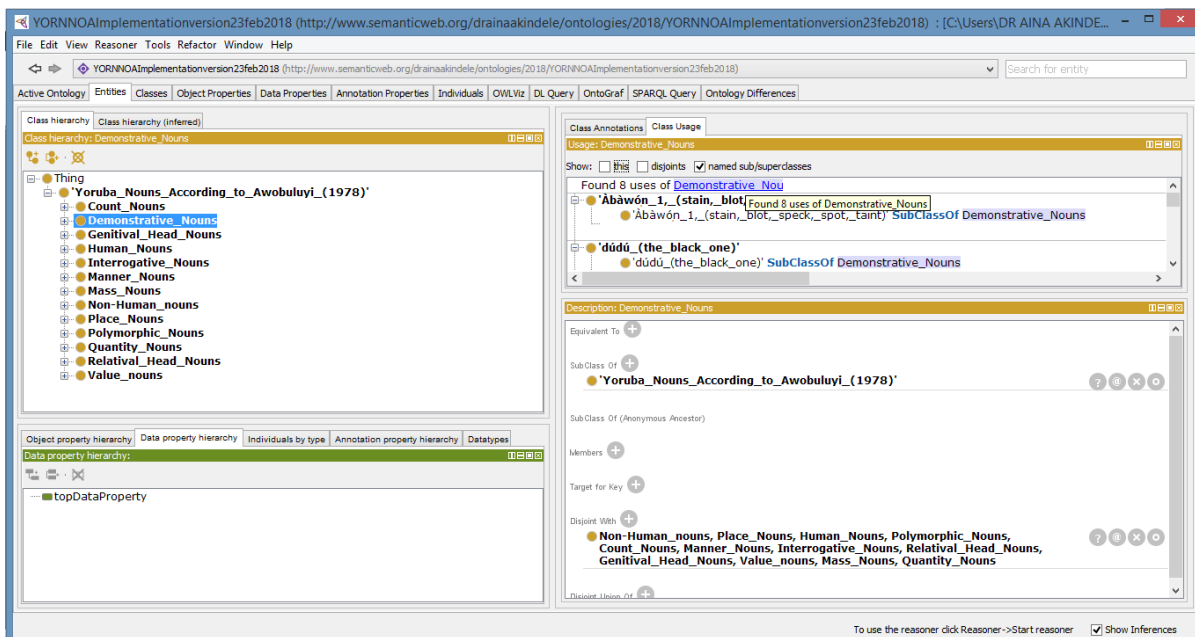


Figure 3. The class Hierarchy, Annotation and the Description view of YORNOA

Apart from the hierarchy display at the hierarchy view pane, the annotation view pane shows all the instances of the subclass Demonstrative noun, while the Description view pane shows that Demonstrative noun is a subclass of Yorùbá nouns and is at disjoint with the other subclasses like Non-Human Nouns, Place Nouns and so on. That means an item cannot be a subclass of Demonstrative noun and be a subclass of other subclasses at the same time. But some cases of homonyms are resolved in YORNO ahead.

OWL Properties Implemented for YORNOA

OWL Properties represent relationships between classes. There are two main types of properties: Object properties and Datatype properties. Object properties are relationships between two individuals. Object properties link an individual to an individual. OWL also has a third type of property called Annotation properties. Annotation properties can be used to add information (metadata, that is data about data) to classes, individuals and object/datatype properties.

Properties may be created using the 'Object Properties' tab in Protégé. Figure 4 shows the buttons located in the top left hand corner of the 'Object Properties' tab that are used for creating OWL properties. As can be seen from this illustration, there are buttons for creating Datatype properties, Object properties and Annotation properties. All properties created in this implementation are object properties. Figure 4 below shows examples of relations that link each type of property in the model.

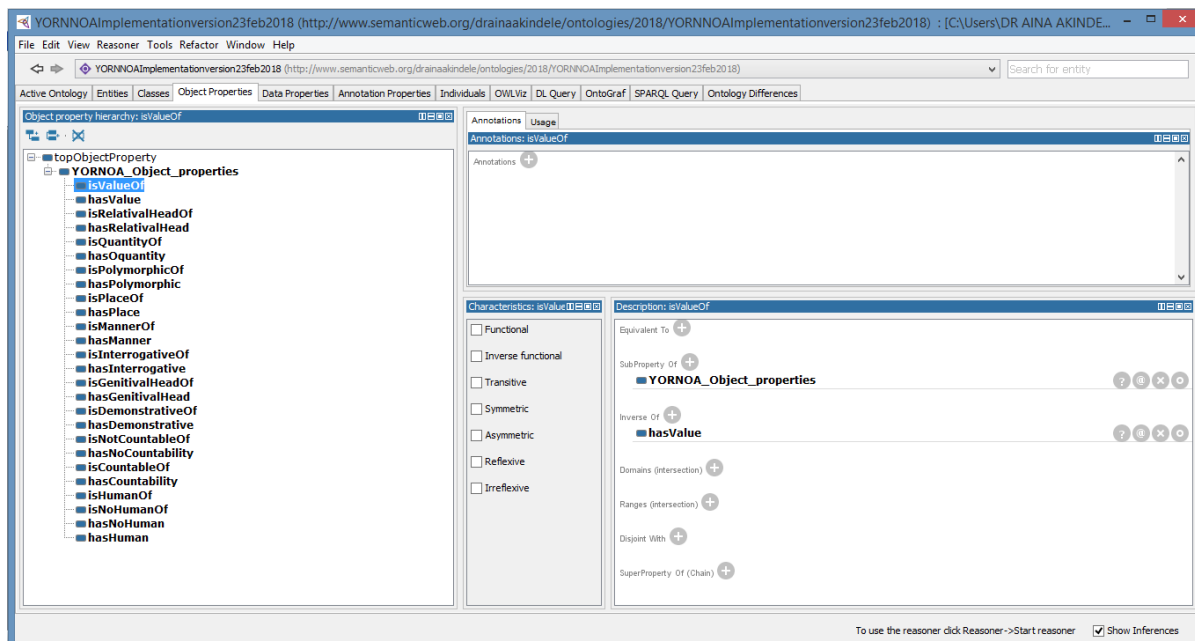


Figure 4.4. The Relations Linking the Object Properties of YORNOA

Conclusions

This study has demonstrated that linguistics concepts such as Yorùbá nouns and the knowledge issues proposed from functional perspectives by Awobuluyi can be extracted from resources and modelled in both human and machine readable format to meet the emerging technological advancement. The standard techniques, principles and methods that have been in existence have it made possible to process morphosyntactic knowledge in a way that will be useful for artificial Intelligent Systems and Natural Language Processing Systems. There are many robust Yorùbá grammatical concepts that could be annotated into Ontology for knowledge sharing, inter-operability, portability and reuse. The study demonstrated that protégé as an editing tool is a useful modern tool that is available to implement Ontology for Yorùbá nouns making it accessible for the global community. Development in language accessories and its accessibility on the web can contribute to national development.

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