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Building an Ontology in Educational Domain Case Study for the University of Palestine

Professor Samy S. Abu Naser[1], Rasha R. Atallah[2], Sahar Hamo[2]
[1](Faculty of Engineering and Information Technology, Al Azhar University –Gaza, Palestine)
[2](Faculty of Information Technology, The University of Palestine, Gaza, Palestine)

ABSTRACT *: The current web is based on HTML which cannot be demoralized by information retrieval techniques and therefore processing of information on the web is generally restricted to manual keyword searches which results in unrelated information retrieval, so the semantic web was founded to resolve this problem; furthermore, ontology is used to capture knowledge about any domain of interest with the goal of integrating the machine understandable data on the current human-readable web. Web Ontology Language (OWL) is a semantic markup language for sharing ontologies on the web. In this paper, the education domain and the development of a University Ontology using Protégé 4.1 Editor is considered. The University of Palestine was chosen as an example for the Ontology Development and the diverse aspects: super class and sub class hierarchy, creating a sub class, instances for classes illustration, query retrieval process using the Unified Process for Building the Ontology (UPON) technique.*

Keywords *- Education Domain, Semantic web, Ontology, OWL, Methodology*

I. INTRODUCTION

Ontology is the main term in the semantic web. Protégé tool is the mainly accepted and broadly used tool for ontology development. This tool for developing university ontology is used. Much ontology has been projected for semantic web. In the university domain thus much ontology developed. In this paper a different relationship in different concepts which include in university was focused on. The paper is organized as follows: the first section shows the literature review, the second section defines some concepts in semantic web, the third section explains our work and the fourth section outlines the conclusion and the future work.

The case study in this paper is the University of Palestine which is a Palestinian private institution of higher education located in Al-Zahra' (south of Gaza City)[11,12], the university was established in 2005.

II. RELATED WORKS

According to KUMAR et. al, the education domain ontology gives some essential ideas of how classes are correlated to each other in ontologies. On an important concept such as education‖ created on the basis of university. Since different groups of developers create their own university ontology. Many times they are different, furthermore there are always some missing concepts or relationship or even classes in different ontologies.

Ontology is a widely used term including a broad range of actions, complexities and issues in which Ontology Development is one of the mainly essential and significant concern. There may be a range of methodologies or tools for ontology development. They considered the education domain and demonstrated the development of an University Ontology using Protégé 3.4 Editor. Indraprastha University, Delhi, India has been taken as an example for the Ontology Development and various aspects like super class and sub class hierarchy, creating a sub class, instances for classes illustration, query retrieval process, Graph corresponding to a sub-class using TGViz have been demonstrated.[1]

Boyce and Pahl, stated that ontologies have the prospective to play an significant role in instructional design and the development of course content. They can be used to embody knowledge about content, supporting instructors in constructing content or learners in accessing content in a knowledge-guided means. Despite the fact that ontologies exist for many subject domains, their quality and suitability for the educational context might be vague. For various subjects, ontologies do not exist. A method for domain experts rather than ontology engineers to develop ontologies for use in the delivery of courseware content were presented.[2]

Mesari and Duki talked about economic curricula on faculties of economic in the Republic of Croatia reveals the problem of taxonomic shortcomings in economics as academic regulation. Numerous courses in economic curricula demonstrate the trends to interest of economic knowledge but that also point out on lessening capabilities of complex problem solving. The major idea was to research and to define appropriate approach to ontology development helpful for representing the institutions of economic curricula which can provide to prospective students in making the option of their attractive courses, representing academic

discipline, documenting the data and creating meta data about learning and management systems. The approach was based on multiphase process of ontology creation and multilevel approach to common vocabulary creation and it was tested on the faculties of economics at the universities in Croatia.[3]

Protégé is the most popular tool for editing and developing ontologies. It has a GUI which enables ontology developers to focus on theoretical terms without thinking about syntax of an output language. Protégé has elastic knowledge model and extensible plug-in architecture. The developer of Protégé tool explains the terms of university through university ontology. They focus on creating a university ontology using protégé. Rajiv Gandhi Technical University Bhopal, India has been taken an example for the ontology development and various aspects like: super class and subclass hierarchy, creating a subclass instances for class illustration, query retrieval process visualization view and graph view have been demonstrated.[4]

III. CONCEPTS IN SEMANTIC WEB

A. Semantic Web

The Semantic Web is a collaborative group led by the World Wide Web Consortium (W3C) that support common formats for data on the World Wide Web by encouraging the addition of semantic content in web pages, the Semantic Web intend for converting the current web of unstructured documents into a "web of data". It builds on the W3C's Resource Description Framework (RDF) [5]. According to the W3C, "The Semantic Web provides a common framework that allows data to be shared and reused across application, enterprise, and community boundaries." [5].

The term was coined by Tim Berners-Lee,[6] the originator of the World Wide Web and chief of the World Wide Web Consortium ("W3C"), which oversees the development of projected Semantic Web standards. He defines the Semantic Web as "a web of data that can be processed directly and indirectly by machines."

As Tim burners lee say ―the semantic web is an extension of the current web in which information is given well defined meaning.

B. Ontology

Ontologies are becoming the corner stone of the semantic web. Ontologies aspire for capturing domain knowledge in a generic way and supply a commonly agreed understanding of a domain. It shared conceptualizations of a field. Owl language has lots of advanced features rather than other languages of ontology like rdf, rdfs.[7]

Ontologies play a essential role in providing a vocabulary comprising unambiguous definitions for terms that can fundamentally serve as a formal support for communication among software agents. They provide a communication mechanism for users and software agents, clearly define the semantics for diverse domains for the reason of interactions on the web, and help in creating a knowledge base that will permit people to work on a particular domain.[8]

C .Owl Language

Owl language is the advanced edition of DAML+Oil. Owl language illustrates more vocabulary and more effective relationship of any particular domain, recommendation from W3C, is extensively used to construct a domain ontology. In order to be able to carry out useful automatic reasoning tasks on web data, there is a need to go further than the basic semantics of XML Schema and RDF Schema and there is a need for further expressive and reasoning language which enhances the RDF with more vocabulary. Web Ontology Language(OWL), recommendation from W3C, is widely used to develop ontologies. The OWL (Web Ontology Language) language is divided into three syntax classes:

1. **OWL-Lite** - OWL Lite supports those users primarily needing a classification hierarchy and simple constraints. For example, while it supports cardinality constraints, it only allows cardinality values of 0 or 1. It should be easier to provide tool support for OWL Lite than its more expressive relatives, and OWL Lite provides a quick migration path for thesauri and other taxonomies. Owl Lite also has an inferior formal complexity than OWL DL.
2. **OWL-DL** – OWL-DL helps users who desire the utmost expressiveness while keeping computational completeness (all conclusions are certain to be computable) and decidability (all computations will come to an end in limited time). OWL-DL contains all OWL language constructs, but they might be used only under definite restrictions (for example, while a class may be a subclass of numerous classes, a class cannot be an instance of another one). OWL-DL is so called due to its correspondence with description logics, a field of research that has studied the logics that form the formal foundation of OWL.
3. **OWL-Full** – OWL-Full is intended for users who desire maximum expressiveness and the syntactic freedom of RDF with no computational assurances. For instance, in OWL-Full a class can be taken care of simultaneously as a group of individuals and as an individual in its own right. OWL-Full permits an

ontology to supplement the meaning of the pre-defined (RDF or OWL) vocabulary. It is not likely that any reasoning software will be able to support full reasoning for every feature of OWL- Full.

Particularly, OWL-Lite and OWL-DL members of the description logics [9] from the presented tools (e.g. Web Onto, Onto Edit), Protégé is selected for implementation since it permits the construction of domain ontologies, and tailored data entry forms to enter data. Protégé permits the definition of classes, class hierarchies, variables, variable-value restrictions, and the relationships between classes and properties of these relationships.

In addition to the significant role of Ontology in semantic web, a variety of other factors playing a key job towards the accomplishment of intelligent or efficient retrieval of information on web. XMLS(XML Schema) broadens the capabilities of XML where XML(Extensible Markup Language) is for data exchange and to put in meaning to data. RDFS(RDF schema) is to symbolize the web resource where RDF(Resource Description Framework) is for representing the knowledge resources on the web and employs the web identifier URI (Uniform Resource Identifier) to recognize the resources.

D. PROTÉGÉ Tool

Protégé is an ontology and knowledge base editor produced by Stanford University. Protégé is a tool that enables the construction of domain ontologies, tailored data entry forms to enter data. Protégé permits the definition of classes, class hierarchies, variables, variable-value restrictions, and the relationships among classes and the properties of these relationships. Protégé comes with visualization packages all of these assist the user visualize ontologies with the aid of diagrams. The key strong point of Protégé is that it supports at the same time tool builders, knowledge engineers and domain specialists.[10]

A few of ontology editors are available for developing an ontology, e.g, Protégé, OntoEdit, Altova. In this paper it was used Protégé which is a an open source freely available ontology editor and knowledge base framework .

IV. CASE STUDY APPLICATION

This section represents the methodology that was used to build the ontology and ontology itself.

A. Methodology for building the Ontology

In this paper we selected the UNIFIED process for Building the ontology (UPON) as shown in Fig. 1 which represent the phases of building the ontology methodology, it took two months to build.

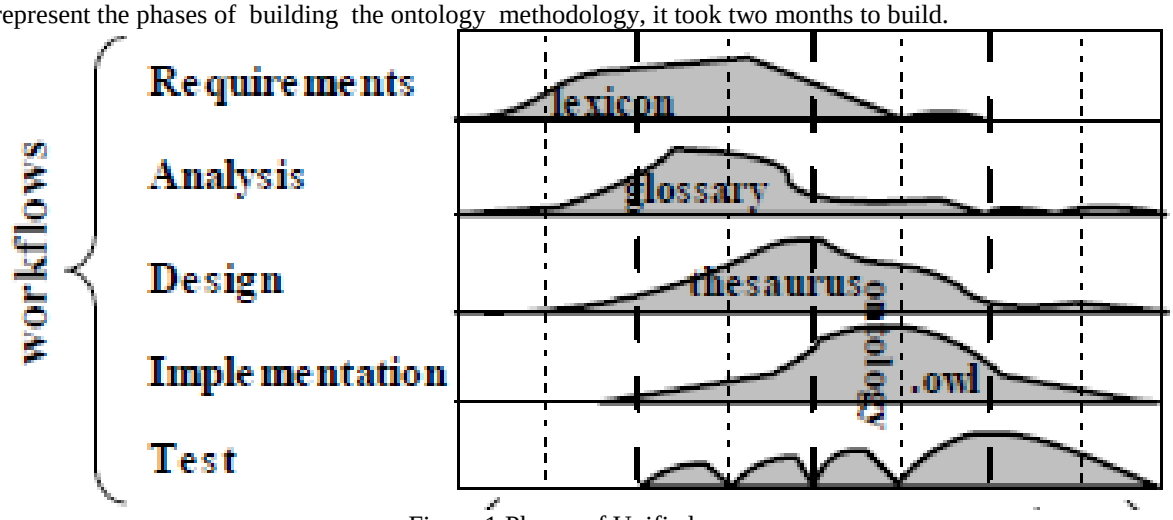

Figure 1:Phases of Unified process

-The First phase is Requirement:

This phase is the important phase that must collect the requirement from the university, which consist from the employees and the stockholders , It took two weeks.

- Determining the domain of interest which was the university
- The purpose that we wanted to build ontology for university of Palestine which is specific for this university
- The scope of the ontology was the structure of the university (employees, student, registration process, publication, faculty).

-The Second phase Analysis:

In this phase the analysis for the requirement was done, and the main requirement for the ontology was determined, this phase took one week.

- The Third phase Design :

Our ontology was built from scratch. So firstly our ontology was drawn on papers, its hierarchy, classes, subclass and proprieties. This phase took one week

- The Fourth phase Implementation:

After finishing the design phase the implementation of building ontology, using protégé software was started. This phase took three weeks .

- The Fifth phase :

In this phase, we tested the ontology using the protégé software either from graph to emphases that our work that was correct or from SPARQL query. This phase took 2 days for testing the ontology.

B. PROPOSED WORK for Implemented the ontology at the university of Palestine – A case study

Illustrating ontology development using protégé 4.1, to build ontology for the University of Palestine which has been taken as an example for the ontology development using the protégé editor.

STEP- I Classes and class hierarchy

The first step was to give the university related classes or concepts. All the concepts are mainly focused on the student, teacher and course based, as shown in Fig. 2.

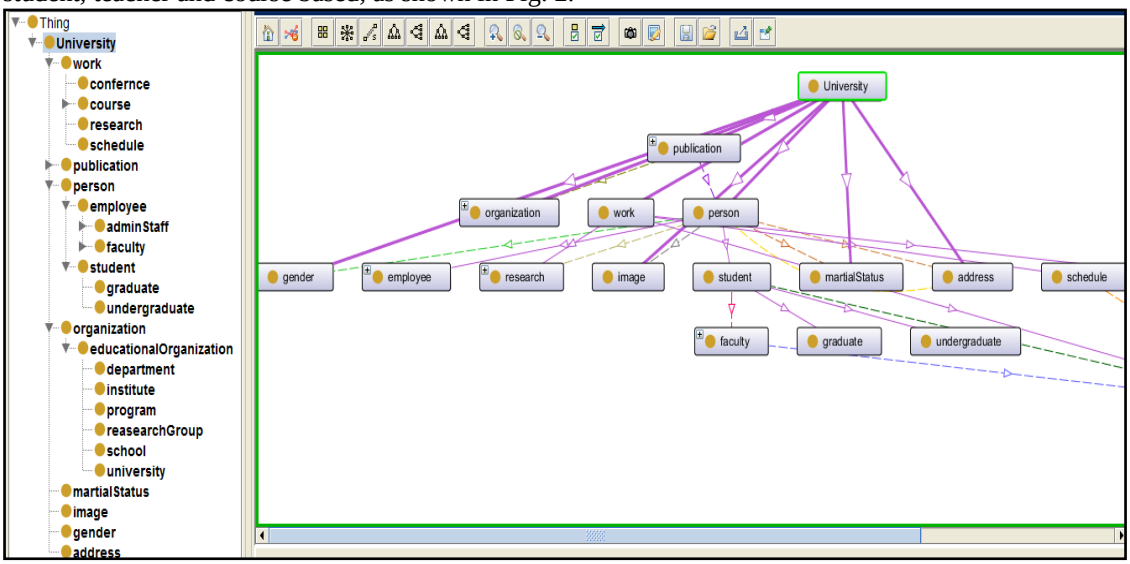

Figure 2 : The class and subclass of ontology

STEP – II : Object properties of ontology

Defining the object properties according to the relationship which we want to add among classes as shown in Fig. 3 that represented the properties.

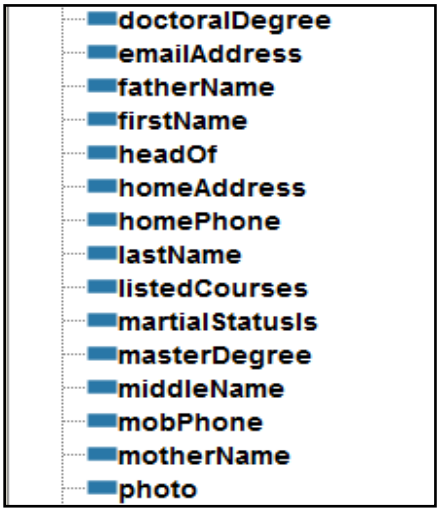

Figure 3 : The properties of objects

STEP –III The instance of ontology

Defining the instance (individual), first you should select the right class, and then create its instances for the class Use rdf: type to state its class, and one instance can be-long to many classes or many class belong to same in-stances, for example:

</owl: thing rdf: id=‖CS102‖>
<rdf: type rdf: resource=‖#subject‖/>
<rdf: type rdf: resource=‖#student‖/>
</owl: thing>

STEP –IV The reasoning of ontology

For building correct and consistent ontology, reasoning is the most important part. Reasoner checks consistency and finds the logic contradictions implicit in the definitions, as shown in Fig. 4. Some tests were done on the ontology.

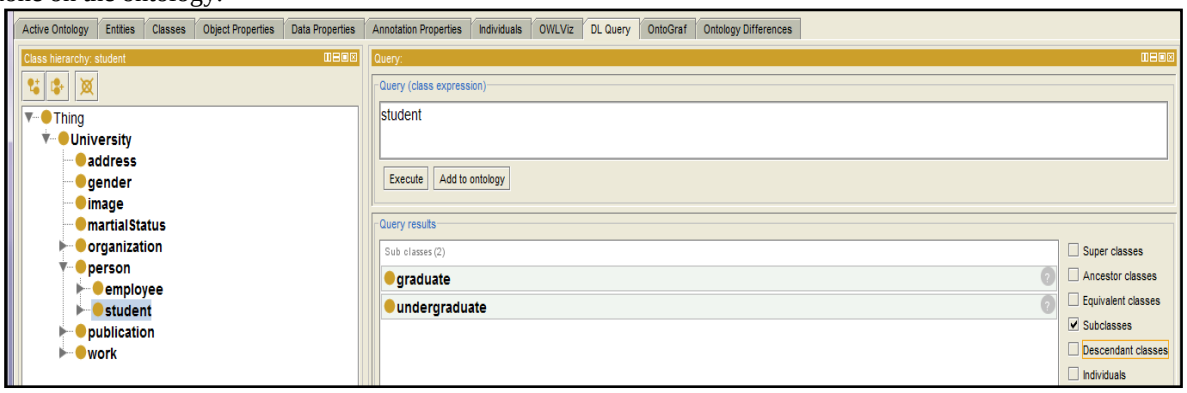

Figure 4 : Some test for the ontology

C .Visualization view

Here we add important concepts or classes and add important subclasses of Palestine university. Fig. 5 shows in the visualization view using OWLViz. Which is visualization plug-in of protégé tool.

Here we display some visualization results of Palestine university ontology. Asserted view display classes graph which we define in the ontology and after reasoned protégé tool give its result according to our relationship. Below we display asserted view and inferred view of concepts(sew Fig. 5 –Fig. 8).

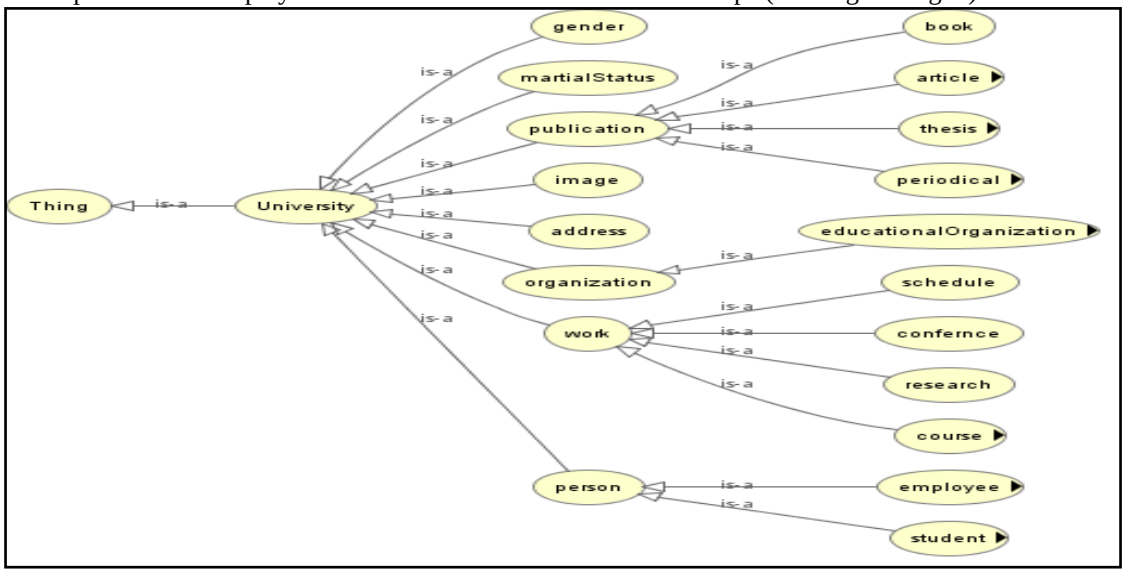

Figure 5 : Asserted Model for the ontology

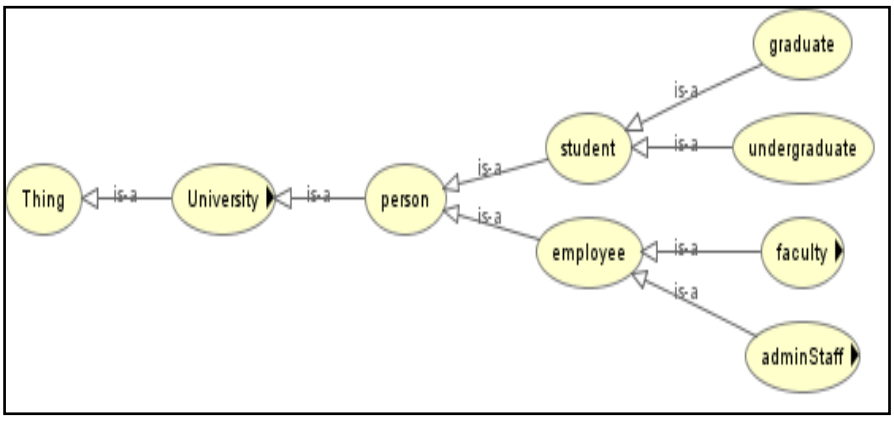

Figure 6 : Asserted Model for person

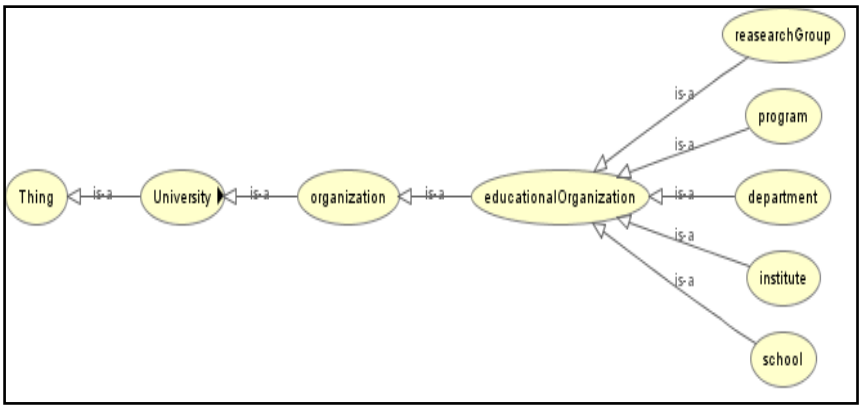

Figure 7 : Asserted Model for organization

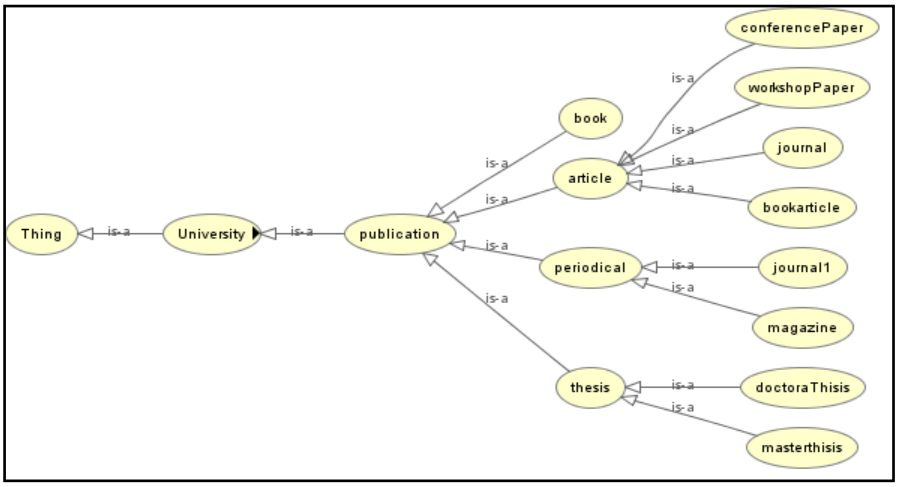

Figure 8 : Asserted Model for publication

V. CONCLUSION

Semantic web wants to carry the present web to a state where besides humans, machines also understand and perform a range of tasks which involves diverse complexities and challenges. A variety of issues which play a key role in realizing the vision of semantic web are : XML(Extensible Markup Language) and XML Schema, RDF(Resource Description Framework and RDF Schema, URI(Uniform Resource Identifier), Unicode and SPARQL(Standard Protocol for RDF Query language), Search Engines and Agents, Logic, Proof and Trust , Web Browsers, Semantic Annotation.

This paper may be useful for researchers who are willing to work in Ontology development and the work can be extended to the development and deployment of large and complex ontologies for the university.

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