Analyzing the Cultural Universals of the Folklore of Peoples of Siberia and the Far East*

Anna Grinevich[1][0000−0002−7607−8387] and Alexey Sery[2][0000−0001−8275−4700]

[1] Institute of Philology of Siberian Branch of Russian Academy of Science, Novosibirsk, Russia
anngrinevich@gmail.com
https://www.philology.nsc.ru/index_en.php
[2] A.P. Ershov Institute of Informatics Systems, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia
alexey.seryj@iis.nsk.su

Abstract. The article describes an ontological approach to presentation of folklore of the Siberian peoples from the point of view of cultural universals, which are both widespread concepts that form the linguistic picture of the world and the methods of preserving oral traditional culture, as well as the poetics and form of folklore phenomena. The proposed approach is to formalize the subject domain of cultural universals using one or more ontologies and to build an information system providing tools for research and analysis on the basis of these ontologies. The paper discusses the designed domain ontologies and development of the information system. An attention is paid to how the system provides access to its resources, which are folklore works of various kinds, and how it keeps ontologies.

Keywords: Siberian folklore · Subject domain · Ontology · Cultural universals · Folklore genre · Ritual.

1 Introduction

Currently, there is a social order in folklore studies for digitizing and providing public access to the accumulated materials that are stored in the archives or are scattered across hard-to-reach small-circulation publications. Systematizing and integrating folklore resources into the common scientific space is still an unsolved problem of Siberian folklore studies. Modern methods of ontological engineering and corpus linguistics effectively solve this problem.

Ontologies are becoming in great demand in the humanities, and in particular in cultural studies and folklore studies. Researchers in different countries are working to digitize and share the cultural heritage of their people [1–3]. Archives, libraries, and museums are figuring out ways to present their data in RDF triples [4].

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In Russia an attempt to systematize photo, audio, video and text materials related to the folklore of the indigenous peoples of Siberia is the electronic portal "Folklore of the peoples of Siberia" [5]. Being more than just a repository of resources, it provides tools for annotating texts based on an ontology of a subject domain. For the multilanguage Siberian region the systematizing and accessing the traditional cultural heritage is a pressing matter.

Siberia is a region of close contacts of various ethnic groups, a place where a unique fusion of cultures and traditions was formed. The folklore text as a representative of the ethnos worldview contains all the richness of cultural and linguistic meanings. In the conditions of cultural interaction, due to territorial proximity and social contacts, ethnocultural constants appear, which play an important role in the formation of the socio-cultural landscape of the region.

We use the term *cultural universals* on the one hand as widespread concepts that form the linguistic picture of the world. Currently there are many theoretical studies in this area [6–10]. The authors of these studies are experts in such interdisciplinary humanitarian fields as ethnolinguistics, cultural linguistics, and cognitive linguistics. On the other hand, the methods of preserving oral traditional culture, as well as the poetics and form of folklore phenomena, are also universal [11–14].

In this article, the authors address the problem of identifying and analyzing common universal cultural constants in the verbal traditions of the peoples of Siberia and the Far East. The study of cultural universals shows the similarity of the worldview and common ways of keeping the ethnic traditions. The approach proposed in the article is aimed to formalize the subject domain of cultural universals using one or more ontologies and then develop an information system providing tools for research and analysis on its basis. The complexity of the problem is, first of all, that the subject area is weakly formalized.

The rest of the paper is organized as follows. The second chapter presents descriptions of ontologies used to formalize the domain. The third chapter presents the general architecture of the developed information system. The fourth chapter is devoted to the description of the data storage organization and data access. The fifth chapter discusses the system development process. Conclusion summarizes the results and outlines the future prospects.

2 Formalizing Subject Area

While developing the information system mentioned in the previous section, we distinguish two types of ontologies. Meta-ontology provides a formal description of a collection of materials and forms a navigation basis. The ontology of universals or subject domain ontology contains linguistic folklore concepts that are universal and widespread in folklore of Siberian macroregion. Subject domain ontology (or domain ontology) is used when annotating folklore texts. The system can contain multiple domain ontologies.

It was an issue to draw a boundary line between the domain and meta-ontologies during development. For example, form is an important criterion for

distinguishing folklore genres, but the lower level of genre classification is usually semantically conditioned. Genres differ in the type of plot, or the type of characters. Typical plots, themes, motives are genre determined. This is how folktales in indexes differ, and the same is true for historical songs and other genres (for ex. historical songs about the anger of Ivan the Terrible's at his son or tales of robbers).

The boundary line is quite formal. The entities required to describe the meta-information of resources (place, time of recording, performer, collector, genre, etc.) were placed in the meta-ontology. The concepts used for navigating the inner structure of the texts are part of the subject domain ontology (for example, a personage system). Meta-ontology describes resources and events related to collecting and preparing, forming the basis for navigation and interface. Subject domain ontologies provide navigation within the resources and are thematically oriented.

2.1 Subject Domain Ontology

To support the study of the cultural universals, it is necessary to formalize the subject domain and related materials: texts, multimedia resources, scientific articles and participants of the study.

As mentioned above, the subject area of cultural universals is weakly formalized. Materials differing in nature could be classified by various criteria. The description of folklore materials is carried out both through the characteristics of the form and its internal conceptual analysis. For this reason, the subject area cannot be described with a single ontology and represented by a variety of ontologies, each of which describes a specific part of the subject area.

The notions of meta-ontology characterize the whole resource. The domain ontology was developed for annotating texts. For example, the Personage system is a semantic characteristic of a folklore work. As a part of the domain ontology it allows revealing a typical personages in the texts and perform an annotation-based search in the texts. Domain ontology is established to reveal typical elements in texts on national languages. Outlook is one of the criterions to present personage. The Personage system differs People, Gods and Animals. Description also contains a list of roles (priest, king, fool, forest giant, etc.). Thus, the search of cultural universals is a central task for developed ontologies, the personage system is supplemented with such common roles as Trixter, Culture hero, Great Mother, etc., which allow researchers to compare different traditions.

The archive of the folklore materials, which are the subject of research, is also described as an ontology. The archive contains a corpus of materials in Russian, Khanty, Alyutor, Buryat, Khakass, Shor, Altai and Koryak languages.

We developed three interrelated models for the genre attribution of the portal resources: universal genre model, local genre model and system of genre characteristics. A scalable folklore genre classification should provide the researcher with a variety of navigation tools. The models are developed in Russian, English and national languages. They are shown on Fig. 1, 2 and 3.

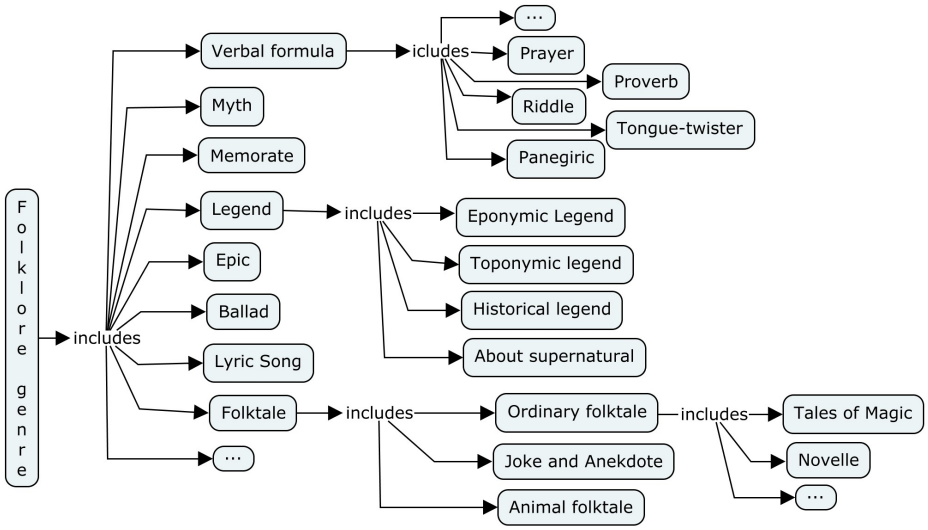

Fig. 1. Taxonomy of universal genres.

The universal genre model is a nominalistic system of genres close to the ideal types of L. Honko [15]. Historically some genres may be related (e.g. epic and ballad) but the ontology does not reflect this. Russian-language folkloristics distinguishes the legend (as a narration about the supernatural) from the narration of the past, a genre that is commonly called *predanije*. English-speaking folkloristic tradition refers all these narratives to legends. Since Russian is the second international language of the system we are developing we use both notions, setting them equal to each other. The lowest level of genre taxonomy is generally based on character type, plot, or theme. The legend itself splits thematically into legends of supernatural beings (spirits, deities, monsters), about people related to the otherworldly (shamans, healers, sorcerers), or about people endowed with unusual, magical abilities (blacksmiths, wonderful craftsmen, heroes, fortune tellers). We attributed the lowest level of genre taxonomy to the subject ontology.

As known, national traditions also have their own genre classifications [16, 17]. National folk classifications are generally inconsistent and contradictory. A random attribute is often chosen as a classification one. However, the very elements of the system are well understood and distinguished by the tradition bearers (possibly due to the social context of folklore performance). The ontological model of the local system of genres is fully based on the national nomenclature. This part of the ontology is rather informative and can be easily recognized by native bearers of the language and tradition. However, if requested, it can also be used for navigation. As an example, a fragment of the Khanty folklore genre system using national terminology is shown (Fig. 2). A slash separates the translation, as well as commonly used folkloristic genre definitions that most

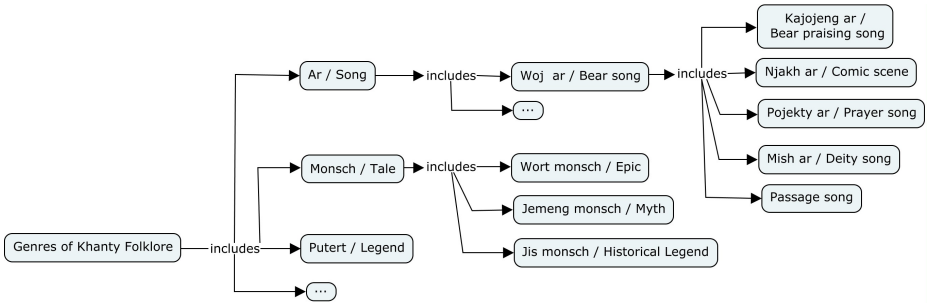

Fig. 2. Local genre taxonomy.

closely correspond to national terms. So, according to the native classification, epic (or perhaps heroic legend) *Worth monsch*, myths *Jemeng monsch* and historical legends *Jis monsch* belong to folktales. The term *Monsch* itself (literally "folktale") in this context can be interpreted as a narrative, and not necessarily prosaic, since *Wort Monsch* can be performed in song form (as well as folktales *Monsch*). Typical examples of ordinary tales or animal tales will also belong to the *Monsch* class. Tradition does not rank *Putert* among the folktales, although these are typical prosaic narratives, which in the Russian-speaking folkloristics are referred to as non-fabulous prose (*neskazotchnaja proza*). These are eyewitness stories, which in Russian folklore are called *bylichki* or *byvalschini*.

To solve the problem of interference and mutual influence of genres we developed a system of genre characteristics (Fig. 3). A bunch of distinctive genre features characterizes each text and multimedia resource on the portal. For example, we apply the characteristic *narrative* (having a plot) to myth, legend, folktale, ballad, epic, etc. Myth and legend will also be characterized as *factual*, and myth will also be classified as *sacred*.

According to this ontological model each resource can have multiple characteristics assigned to it. For example, the Khanty bear songs *Kajojeng ar* are very heterogeneous and diverse, some of the songs are myths and are evaluated as *true*, the others recall the sacred history of the community (*historical*, *true*). These songs are *narrative*, they have a plot. They are performed by *singing*. Their verses are *formulaic* and *alliterative*. The songs suggest a reduced level of involvement (*vicarious involvement*), in contradiction to the comic scenes *Njakh ar*, which erase the boundary between spectators and listeners and the audience actively participates in the performance, communicating with the actors (*active involvement*). These songs are associated (*linked to ritual*) with the Bear Feast.

Linked to ritual is a relationship in the ontology that connects a particular resource with a specific ritual. The performance of folklore pieces is contextually conditioned. To categorize resources depending on the social context, the branch *Ritual* is being developed.

We consider *ritual* to be a broad term that incorporates not only sacred actions, but any other typified and repetitive communicative acts [18]. It allows us

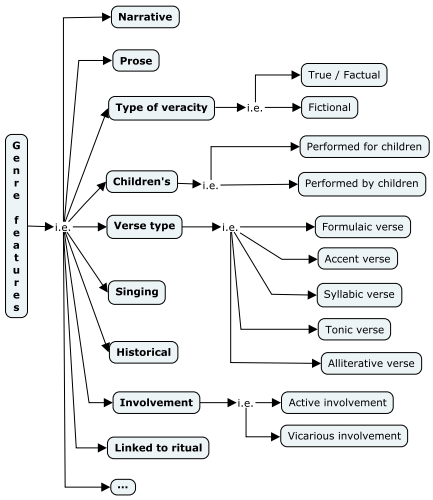

Fig. 3. Taxonomy of genre features.

to classify as rituals, for example, Russian *vecherka* — youth gatherings characterized by their own set of actors (young girls and boys), repertoire (games, round dances, *vecherka* songs), time (winter evening time) and place (so called "connected house" (*svyaznoy dom*), which the young men rent in rotations from one of the villagers). A children's play, a round dance, and a sacrifice will also be rituals. The classification of rituals is a system of features designed to characterize a particular folklore resource in terms of the context it is performed in. One and the same ritual could relate to different classes, which may indicate its complex syncretic nature. For example, one can see features of both a hunting rite and a rite of passage (in particular a funeral) in the Ob Ugrians Bear Feast ritual.

2.2 Meta-ontology

The meta-ontology was developed on the basis of CIDOC-CRM standard ontology (CIDOC Conceptual Reference Model) [19] — a formal ontology intended to facilitate the integration, mediation and interchange of heterogeneous cultural heritage information. This model is an international standard certified by the ISO [20].

The main concepts of the CIDOC-CRM are *Events* related to *Actors*, *Time-Spans* and *Places*. We adapted *Events* to describe a process of collecting and preparing folklore resources. An event is defined by its time-span, place, actor and result. *Actors* are persons who are performing actions, i.e. persons involved in the preparation of materials: collectors, translators, people responsible for transcribing audio recordings, etc. The model is also suitable for describing the *Ritual*, which is also characterized by a set of roles, time and place.

Some properties related to Actors, Places and some other entities could not be expressed in CIDOC-CRM in an appropriate way, so we enriched it with properties we needed. Some of these properties were imported from the FOAF, DBpedia and GeoNames, the rest are new properties we created for this ontology.

The FOAF ontology describes two subject areas: social media and biographical data [27]. DBpedia covers many domains [21]. We were most interested in the properties related to *Persons*, *Publications* and *Geographic Objects*.

From the FOAF ontology we imported person names *foaf:firstName* and *foaf:lastName* and person-image relation *foaf:depicts*, which is used to insert photos into the Person's profile. From the DBpedia we picked *dbp:education* and *dbp:religion* for persons, as well as *dbo:title* and *dbo:originalTitle* to express two titles of a folklore text: one for the title in Russian, and the other for the original title written in national language. Geographic properties were picked from GeoNames. These are *name*, *lat*, *long* — the name of the geographical location, its latitude and longitude correspondingly.

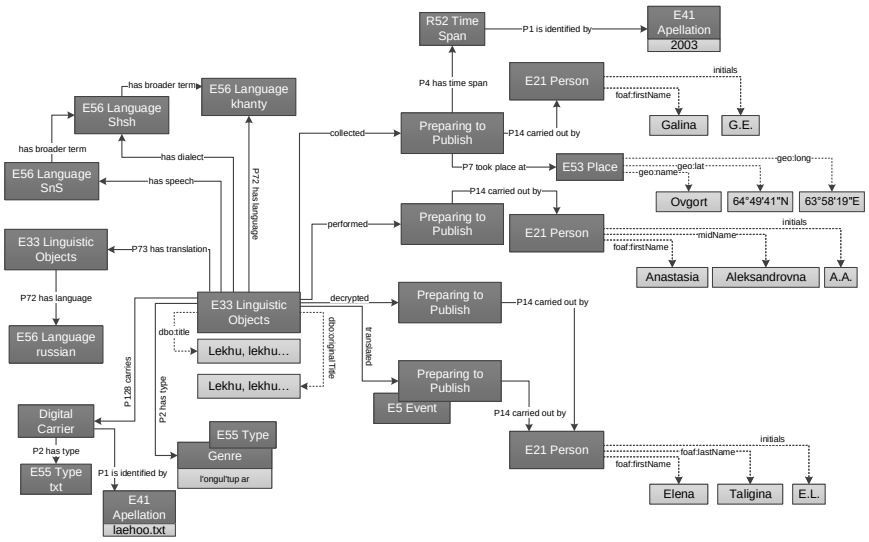

Fig. 4. An instance of *Linguistic Object* described in the meta-ontology.

Fig. 4 shows an example of a description of a folklore work preparation as an event.

Folklore resource (*E33 Linguistic Object*) which genre is *l'ongul'tup ar* meaning "easy song" (*P2_has_type Genre*) with original name *dbo:originalTitle* "Lekhu, lekhu..." and its translation into Russian *dbo:title* (in this case, the original name matches the translation) is written in Khanty language (*P72_has_language*),

Shuryshkarsky dialect (*has dialect*), Synsky speech (*has speech*). Languages, dialects and speeches form a hierarchical structure via the relationship *P127 has broader term*. The text itself is stored (*P128 carries*) by a carrier (*Digital Carrier*), having type (*E55 Type*) **txt**, which is identified by name (*P1_identified_by*) **laehoo.txt**. The piece is translated into Russian language (*P73 has translation*).

The process of preparing a resource for publication is represented by many events of the type *Preparing to Publish*, which are special cases of *E55 Event*. The role of the resource in the event is determined by the type of connection between them. Fig. 4 shows four events. The resource was *performed*, *collected*, *decrypted* and *translated*. The corresponding *Actor* is indicated for each event (*P14 carried out by*). The collection event has *Time-Span* and *Place* (*P4 has time span, P7 took place at*). The example shows that the resource was recorded during the expedition in 2003 in the village Ovgort.

The next section discusses the architecture of the system.

3 Information System Architecture

The first step in the implementation of the system is the development of its general architecture, showing the mandatory blocks that should ensure the solution of the assigned tasks:

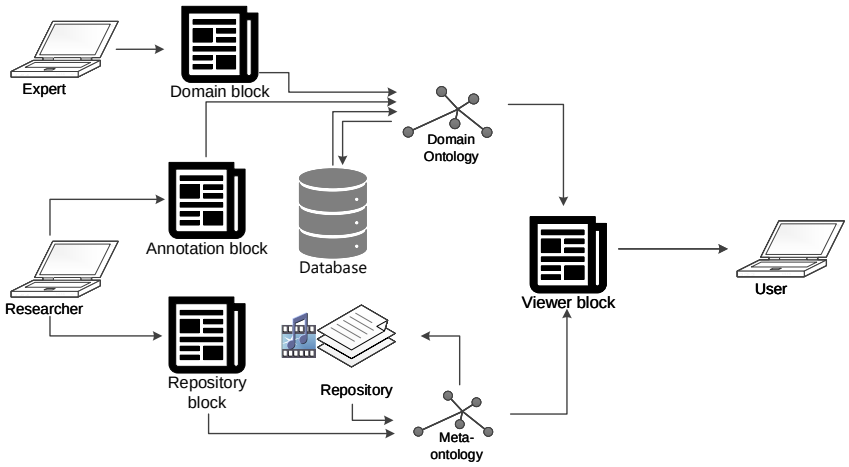

Fig. 5. System architecture.

– Creating and maintaining the repository of resources based on the CIDOC-CRM ontology enriched with FOAF, DBpedia, GeoNames and other elements.

– Creating subject domain ontologies. Note that the system does not mean to provide a full-fledged ontology editor like Protégé. We provide a short version, facilitating only the most general operations such as creating classes, properties and individuals.
– Supporting navigation and providing access to resources and data.

Fig. 5 shows the architecture consisting of the four main parts or blocks. These are Repository Block (**ReB**), Domain Block (**DoB**), Annotation Block (**AnB**) and Viewer Block (**ViB**). There are 3 roles of the system users. Domain experts develop and maintain the domain ontologies. Researchers populate the repository with new resources and annotate folklore texts. An expert could be a researcher at the same time, but not vice versa. PhD students could be assigned as researchers to create an annotated corpus. Each block interacts with a part of the data storage. As it is shown on Fig. 5 **DoB** provides an expert with tools to maintain domain ontologies, **AnB** and **ReB** serve as interfaces between a researcher and annotation database and the repository of resources correspondingly. Note that **AnB** and **ReB** do not directly interact with the storage but do so through the corresponding ontologies.

In the next section the system data storage will be discussed in more detail.

4 Ontology and Data Storage

Folklore texts were digitized as tables in .docx (XML) files. Each table has 3 columns: the first column contains a string of folklore text in the national language, the second column contains translation of this string into Russian, and the third column is either empty or contains commentaries to the string, made by an expert. Thus, the texts are presented in a line-by-line way.

Populating the repository with new resources is a semi-automatic process. **ReB** includes a parser that reads an input document and extracts national text, translation and commentaries line by line. A user has to fill a form, providing resource description in accordance with the meta-ontology: title, relations with events and other properties. After a user submits a form **ReB** creates 3 text files, places them into the filesystem, and creates a description in the meta-ontology, linking it with the corresponding *Actors*, *Events*, and other objects as Fig. 4 shows.

Users annotate texts manually. Before a user is allowed to annotate a text, he/she should select a domain ontology. When the subject domain is defined, the user utilizes the annotating tools to select text spans, where the universals from the domain ontology occur and make connections between the spans and the corresponding domain entities. Annotating tools are part of the **AnB**.

As Fig. 6 shows, annotations and resources are stored in a relational database and a file system correspondingly. There are ways other than the filesystem to store folklore materials. For example we could use a document database for this task. One of the most popular databases is MongoDB with GridFS specification [22]. Although MongoDB allows data sharding and supports millions of

files, currently we decided it redundant to utilize such a powerful tool. MongoDB might be of use when scaling the system as the amount of data increases.

To design a storage for the ontologies, however, was not an easy task. The standard way to store ontologies is a Relational Database, or TripleStore such as Jena Fuseki [23] and OpenLink Virtuoso [24]. Triple Store provides a SPARQL-endpoint to access the data, and some of them provide logic reasoning machines.

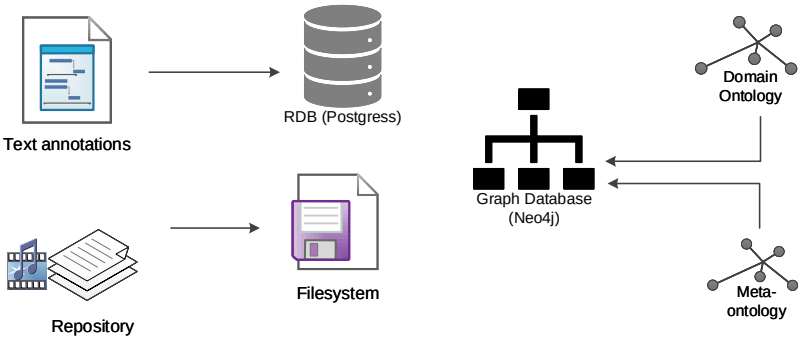

Fig. 6. System data.

In many cases, however, TripleStores do not perform fast enough to provide real-time access to ontologies and data, especially if data is updated frequently. It is mostly the case for SPARQL-endpoints. Moreover, not all TripleStores support transactions. For example, Jena Fuseki supports transactions only if accessing data via the Jena API. For this and other reasons many Semantic Web researchers switched from TripleStores to Graph Databases to store RDF. Given that in most cases an ontology could be represented with a graph, it is quite convenient. Graph Databases provide high performance, transactions and indexing out of the box.

We used Neo4j Graph Database to store our ontologies [25]. Neo4j represents data as a Labeled Property Graph (LPG). It has good performance, provides a convenient administrator interface and a simple and powerful Cypher query language.

We compared the performance of the Triple Store Apache Jena Fuseki 3.17.0 and Neo4j Database 4.2.5 on some of the most frequently used queries: get ontology class hierarchy (denoted as **GetTree**), get ontology class properties (**GetClsProps**), get ontology class relations (**GetClsRels**), get individuals of the selected class (**GetClsInds**), get first N or last N individuals satisfying a filter (**GetFirstN** and **GetLastN**), get properties of the selected individual (**GetIndProps**) and search an individual by its properties (**SearchInd**). Table 1 shows the results. Time is in milliseconds.

Table 1. Storage performance comparison.

Query	**Neo4j**	**Fuseki**
GetTree	5	21
GetClsProps	10	55
GetClsRels	8	24
GetClsInds	7	196
GetFirstN	17	101
GetLastN	25	137
GetIndProps	8	5
SearchInd	13	3

All queries were run on an ontology consisting of 63035 triples and on a machine with 32 GB RAM, Intel Core i7 processor.

Neo4j officially provides drivers for .Net, Java, Javascript, Go and Python, but there are community-supported drivers for almost every popular programming language. Most of them mimic existing database driver idioms and approaches. A free community version is available that allows storing graphs with a capacity up to 34 billion nodes. There is the officially supported Neosemantics plugin [26], which is designed to facilitate the Semantic Web features, such as import and export RDF triples to and from the database. This plugin allows compatibility with OWL. It is also possible to configure a SPARQL-endpoint at the basis of the Neo4j database, therefore providing data access in accordance with principles of Linked Data.

Neo4j also supports data sharding with shards spread across many machines, which allows to address the scaling problem. This technology is called Neo4j Fabric.

5 Building up the System

As mentioned above, the system includes four blocks. The Repository Block includes an XML parser and a service for generating meta descriptions of resources. A user uploads the DOCX table, fills out the form and saves the resource in the system repository.

Multimedia resources associated with texts are added similarly. The connections between the texts and multimedia are quite important for folklore research, since multimedia materials, as a rule, are expedition records. A folklore text usually has a bunch of materials attached to it, such as videos where the corresponding folklore tale or song is performed by a native language speaker. The repository also includes information about the researchers who took part in the preparation of the materials and the locations of the expeditions and works.

Annotation Block implements tools for representing subject domain ontologies and text annotations and provides ontology-based navigation through the text annotations (see Fig. 7). The user of the system can mark up classes, prop-

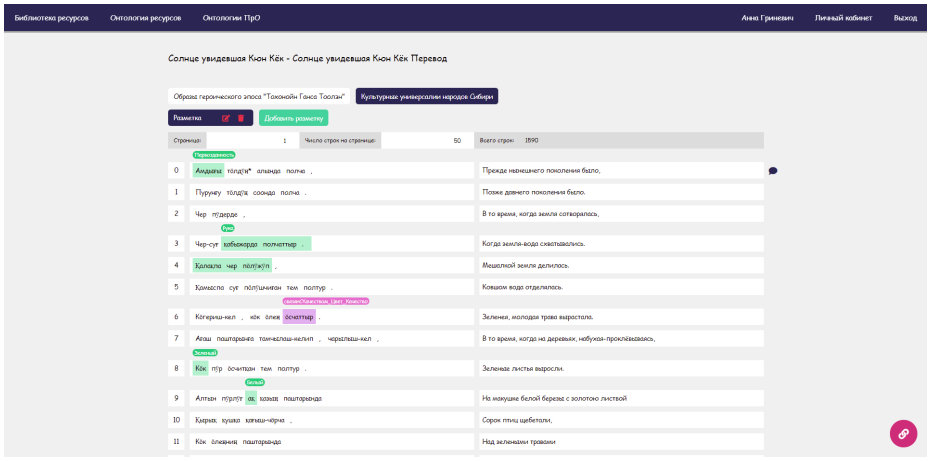

Fig. 7. Annotation page.

erties and instances of subject ontologies in the text and indicate relationships between marked entities, which will be displayed in the annotation.

Since the system is primarily intended to support the study of cultural universals, i.e. concepts common to different traditions and cultures, then an important aspect is the search for entry of the same entities in the texts of different corpora.

The implementation of the **DoB** (Fig. 8) is one of the distinctive features of the system. It provides the ability to edit subject ontologies using the systems interface. The expert can add new concepts and relations, which then can be marked in the texts.

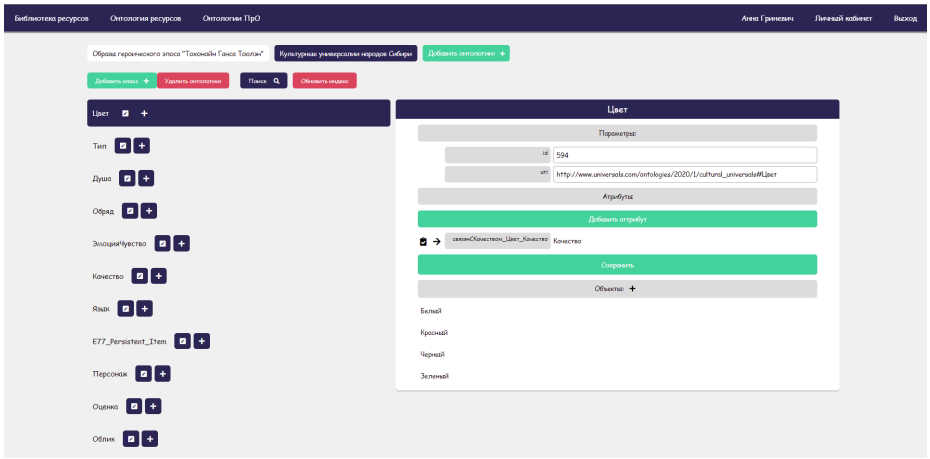

Fig. 8. Domain ontology page.

System blocks interact with the storage via python-script, which, upon receiving a request, collects data from different DBMS and file system and generates a JSON response. The system interface is the main part of the ViB and is implemented using the ReactJS framework.

The presented approach implements the means of supporting research on the cultural universals of the peoples of Siberia and the Far East. The system we are developing is aimed to familiarize people that are not humanitarian scientists with folklore traditions and materials, contributing to the dissemination and preservation of the linguistic and cultural heritage of the indigenous peoples of Russia.

6 Conclusion

This work is aimed at formalizing the description of the cultural universals of the peoples of Siberia and the Far East, creating an information system that would integrate disparate folklore materials in the languages of Siberian ethnic groups, accumulated over a long time. Such a system should expand the range of available resources and provide experts with new opportunities to analyze the cultural constants of Siberian peoples, raising the study of Siberian folklore to a new level.

In this paper, we presented an ontology of folklore resources based on the CIDOC-CRM ontology in combination with separate fragments of the FOAF, DBpedia and GeoNames ontologies. Ontologies are stored in the graph DBMS Neo4j.

In the future, the system will be supplemented with thesauri and dictionaries, and will also develop towards crowdsourcing. We will strive to develop the system towards a community building platform and form a virtual research environment [28] in the field of Siberian minority languages linguistics and folklore study.

We also believe this project being of great social significance for the bearers of the minority languages of Russia, who at present are almost deprived of the means of representing their culture in the World Wide Web, and for whom, the search for self-expression and self-determination is strongly relevant. An information system that allows native speakers to read, post and annotate resources in the national language should increase the prestige of the native language and culture, as well as provide a unique view of traditional culture through the eyes of an insider. For researchers such a system provides opportunities for collaborative research, which is not widely used in humanities. Implementing a virtual research environment for keeping and presenting data has already shown a positive effect in the studies of antiquity, where *methods and outputs have become more complex and multi-modal, and less-attributable to the labors of an individual scholar* [29]. The collaborative approach changed the methodology of ancient studies. Concerning folklore studies, we think that integrating various materials and resources in a single environment will open up opportunities to carry out comparative research on a fundamentally new level.

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