Formal Representation of Socio-Legal Roles and Functions for the Description of History

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Abstract. We propose a modeling approach for formal descriptions of historical material. In our previous work, we defined the formal structures of social entities such as roles, rights and obligations, activities, and processes which appear in the Roman Constitution, as an application of Basic Formal Ontology (BFO). In this paper, we extend that approach by incorporating aspects of the Information Artifact Ontology (IAO) and the emerging Document Acts Ontology (DAO). We use these to describe relationships among realizable entities (role and function), rights and obligations that are aligned to Socio-Legal Generically Dependent Continuants (SGDCs) of DAO, and activities as subtypes of directive information entity of IAO. Two examples are discussed: a passage from a digitized historical newspaper and a description of citizenship in ancient Rome.

Keywords: Community models · Direct representation · Legal and political ontologies · Rich semantics · Roman republic

1 Introduction

Many ontologies for history such as HEML [10] focus on high-level named historical events and eras. We have been exploring ways to provide more detailed coverage with rich semantics. For instance, in organizing and indexing the history of communities described in the millions of pages of newspapers which have now been digitized, we believe that the best approach is creating "community models" which are rich semantic descriptions of those communities [4]. Similarly, we have considered the possibility of rich semantics for organizing the history of "the decline and fall of the Roman Empire" along with commentary about that history from Gibbon [9]. Specifically, in [7], we modeled the formal structure of roles, activities and procedures for describing governmental structures of the Roman Empire. The models of communities and of historical analysis, along with other work on modeling scientific communications, are examples of an approach we call "direct presentation" [2].

In this paper, we extend the analysis of social roles in [7] to include not only the relationships between social roles and socio-legal entities (e.g., rights and obligations) but also the relationships among social functions of institutions that compose a society. We concretize it by using the structures of the Information Artifact Ontology (IAO) and by considering how the emerging Document Acts Ontology (DAO) might be applied. We consider two applications: first, descriptions of the contents of a digitized historical newspaper and second, descriptions of citizenship in ancient Rome.

2   Rich Semantics

2.1   The Basic Formal Ontology (BFO) and the Information Artifact Ontology (IAO)

Ontological realism views ontologies as representations of the reality that is described by science to ensure mutual consistency of ontologies over time and to ensure that ontologies are maintained in such a way as to keep pace with advances in empirical research [12]. Bioinformatics has found great success in building ontologies such as the GO (Gene Ontology) which is based on the realist Basic Formal Ontology (BFO). [7] was the first study to consider how the BFO could be applied to historical modeling.

BFO has been extended with the Information Artifact Ontology (IAO) [13]. The IAO considers the ways information artifacts relate to the *Independent Continuants* with which they are associated. IAO defines *Information Content Entities* as a subtype of a *Generically Dependent Continuant* that is dependent on independent continuants that can serve as its bearers, and that migrates from one bearer to another. Using concepts from the IAO we can update our previous model. We align activities to *Action Specification* and procedures to *Plan Specification* that are subtypes of *Information Content Entity* in the IAO.

2.2   Towards a Document Acts Ontology (DAO)

Social entities do not fit in a purely realist ontology. To model social entities such as rights and obligations, Smith and his colleagues have explored approaches which go beyond the realist BFO. Indeed, [11] proposes that some social entities are "quasi-abstract". Document Acts, which are formal and often legally binding, actions based on written agreements, are central to this approach. [6] took initial steps towards a Document Acts Ontology (DAO). DAO is focused on socio-legal entities such as claims (or more precisely, rights) and obligations. These entities presuppose the existence of a person (or other legal agent) whose rights or obligations they are, and can be reassigned from one person to another. Thus, the Document Acts Ontology defines these entities as *Socio-legal Generically Dependent Continuants* (SGDCs) which is a subtype of *Generically Dependent Continuants* (GDCs) that depend on *specifically dependent continuants* (SDCs). Although G*enerically dependent continuants* are not realizable entities [5], IAO allows concretization of GDCs as realizable entities by not restricting *concretized* to hold only between GDCs and qualities. That means that socio-legal entities such as rights and obligations can be realized through their bearer's roles by allowing concretization of GDCs.

Using the concept of concretization, DAO identifies the relationships between realizable entities and SGDCs. We extend our previous work [7] by describing the way that social roles concretize SGDCs. Thus, we propose a formal structure describing the relationships among realizable entities (*role* and *function*), SGDCs, and *activity and procedure* as subtypes of *directive information entity* of IAO (see Fig. 1). Socio-Legal Roles are defined as the specifications of rights and obligations that the bearer of a role can (or should) exercise. In turn, rights and obligations can be expressed by the activities describing what one is allowed (or required to do).

In contrast with Socio-Legal Roles, Socio-Legal Functions "inhere in" the bearer by virtue of the bearer's make-up and support achievement of the bearer's goal. Social Functions are concretized as processes to achieve the bearer's goal and realized in some process in which their bearer participates. For instance, schools are a kind of social institution which has the goal of educating students. People employed to teach students have a Teacher Role and Rights. Their rights specify activities in accordance with the teaching plans of the schools that concretize the social function of education. Ultimately, the legitimacy of the Superintendent and Teacher Roles extends back to the government which underwrites the legitimacy of many Document Acts [3, 14]. We also recognize that people's activities may not follow formal specifications even if they are complying with the expectations of a role [8].
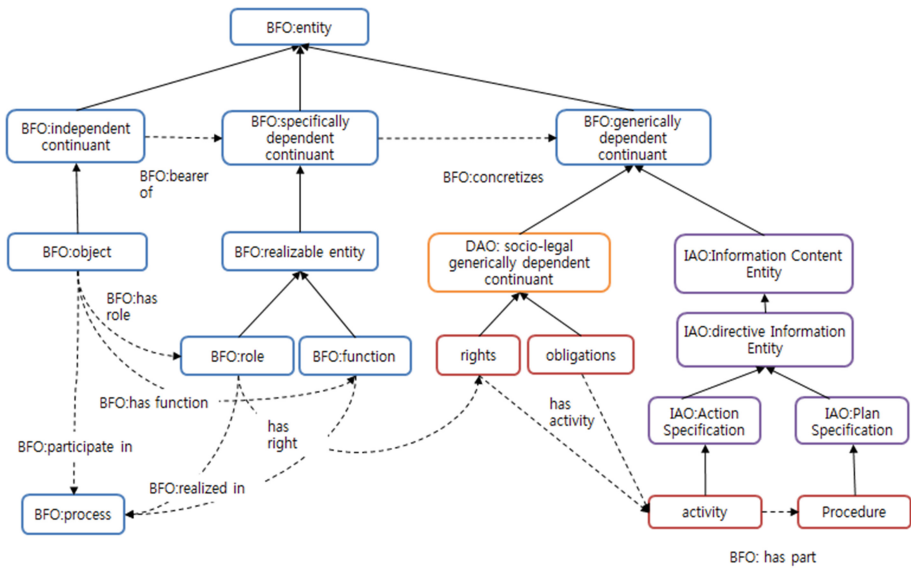

Fig. 1. Proposed representation of relationships among social roles, activities and procedures using constructs from the IAO and the evolving DAO.

3   Toward a Community Model for Norfolk, Nebraska

We now consider specific examples for applying the approaches derived from the IAO and DAO to historical descriptions. Some aspects of society and social activities such as school buildings and the fact that students attend schools can fit under a realist ontology, but a more complete analysis of social objects needs to include intangible aspects such as rights, roles, and obligations.

As mentioned above, we have been exploring the development of historical models to support interaction with the large number of digitized historical newspapers and other historical materials. To focus that work, we have been developing a testbed collection for the town of Norfolk, Nebraska [1]. In this section, we consider the

activities of a specific person in that town. We picked an individual who was mentioned several times in the *Norfolk Weekly News Journal* from about 1895 to 1905. This was D.C. O'Connor who was the School Superintendent for the City of Norfolk, Nebraska[1]. While some social roles and functions are ad hoc and implicit, the roles of a School Superintendent are generally well delineated. We did not find documentation of the job requirements for the Superintendent of Schools of Norfolk Nebraska. But, we did find several accounts of O'Connor's activities based on that role. For instance, he made reports at School Board meetings and there is a description of a trip he took from Norfolk to Lincoln (capital of Nebraska) to hire a new teacher to replace one who had left. We have modeled this latter activity in Fig. 2. We also found descriptions of O'Connor chairing a session at an annual state-teachers association meeting. This could also be modeled as an activity which was associated with the Superintendent's role. While these analyses are simple, they suggest the outlines of an educational-institution ontology.
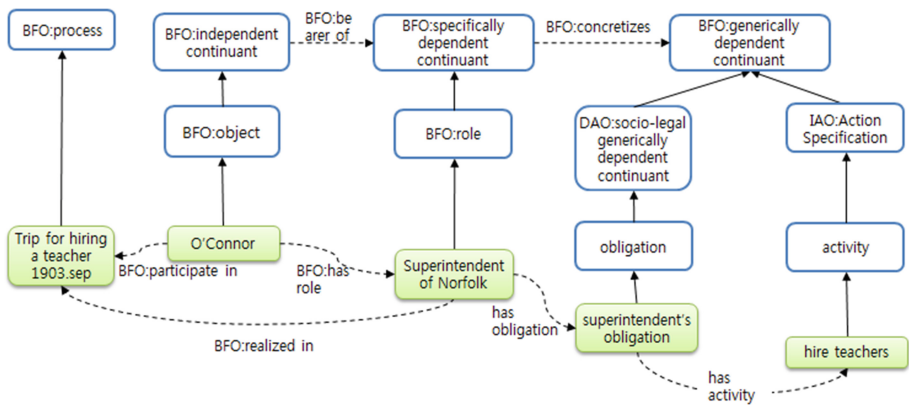

Fig. 2. Obligations and activities of a School Superintendent. Note that these elements are based on the DAO and IAO.

4   Rights and Roles of Citizens in the Roman Republic

We also modeled a description of citizenship for an adult male in the Roman Republic.[2] The legal status of Roman citizenship was a prerequisite for many important legal rights such as the right to trial and appeal, to marry, to hold office, and to enter binding

[1] *The Norfolk Weekly News Journal* (Norfolk, Neb.), 29 March 1900. *Chronicling America: Historic American Newspapers*. Library of Congress. http://chroniclingamerica.loc.gov/lccn/sn95070060/1900-03-29/ed-1/seq-7/ *The Norfolk Weekly News-Journal*. (Norfolk, Neb.), 04 Sept. 1903. *Chronicling America: Historic American Newspapers*. Library of Congress. http://chroniclingamerica.loc.gov/lccn/sn95070058/1903-09-04/ed-1/seq-6/.

[2] Roman Republic: Legislative Assemblies, https://en.wikipedia.org/wiki/Roman_Republic#Legislative_Assemblies (accessed 18. Mar. 2016).

contracts, and to eligibility for special tax exemptions. A citizen has the political right to vote for assemblies. In turn, these assemblies elected magistrates, enacted legislation, and presided over trials of capital cases. As shown in Fig. 3, activities and procedures are modeled with elements of IAO while rights are modeled with the extended DAO. In Fig. 3, an adult male has a citizen role which is comprised of political rights and legal rights. These rights specify permitted activities such as to stand trial and to participate in electing assemblies. The assemblies elected by Roman citizens have the socio-legal function of governing the Roman Republic. This includes activities such as electing magistrates, enacting legislation, and presiding over trials. Note that we do not necessarily agree with some of the distinctions made between political rights and legal rights in the source article but we reflect those here as written. Ultimately, procedures will be needed for validating the content of the ontologies and the coordination of sets of interlocking ontologies.
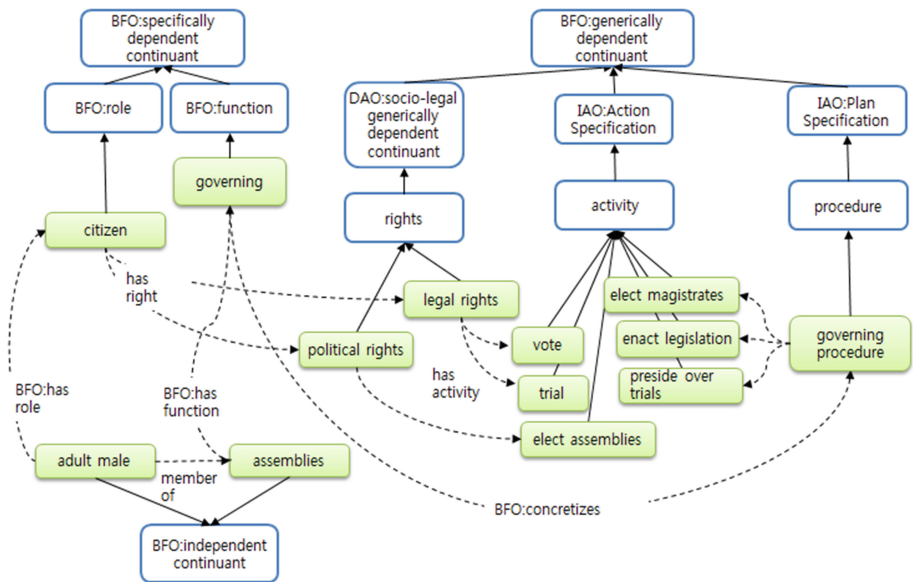

Fig. 3. Representation of rights, activities, and procedures associated with Roman citizenship and institutions.

5   Discussion and Conclusion

This proposal is a step in developing techniques for rich semantic modeling of historical scenarios. We illustrate this approach with examples from digitized historical newspapers and from a description of the rights and obligations of citizens of the Roman Republic. We can begin to consider a rich set of domain ontologies which build on the emerging Document Acts Ontology. A set of inter-related social and community ontologies could be coordinated just as the Open Biological Ontology (OBO) Foundry

[13] is developing a growing set of ontologies for the life sciences. This approach supports a relatively flexible modular approach to modeling complex environments. An initial set of ontologies based on IAO/DAO could be applied to systems of Social Rights such as those explicitly stated in the U.S. Bill of Rights. However, the line between political rights and legal rights is fuzzy and the sub-ontologies may have to be closely coordinated. Indeed, we view the coordination of multiple sub-ontologies, whether biological or social ontologies, as major future issue for information organization. In addition, while this approach can capture formally specified social entities, activities, functions, and roles, there will almost certainly be inconsistencies in such formal specifications. Even when there is a formal prescription, actual behavior may not reflect those expectations. Furthermore, in writing histories, there are many details which will never be known. In developing systems to describe history, we will have to go beyond the basic approaches to ontology by supporting alternative explanations, state-changes, probabilities, versioning, and argumentation.

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