OWLFCAView Tab: A Visualization and Modeling Tool for Composite Expressions of SNOMED CT using Formal Concept Analysis (FCA)

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Introduction

Modern terminologies have advanced well beyond simple one-dimensional subsumption relationships through the introduction of composite expressions. The ability to form composite expressions opens a whole new realm of expressive possibility. Meanwhile, it also brings the great challenges to the terminology service software. In clinical domain, SNOMED-CT [1] now provides a platform where composite expressions have the potential to be used in clinical situations. The complexity, however, of using SNOMED-CT in its tabular form can still be quite daunting and the need for an intermediate service layer is becoming an absolute necessity. Our general hypothesis is that reformulating the rules of composition and compositional transformations in the language of lattice theory will possibly provide a solution for the challenges described above. Formal concept analysis (FCA) provides a fertile ground for exploitation with its generic structure of lattice building algorithms to visualize the consequences of partial order that the underlying mathematical lattice theory builds on [2-3]. In this study, we developed a visualization and modeling tool for the composite expressions of SNOMED-CT using FCA technique and discussed the issues related to the future potentials of the FCA-based approaches.

Materials

A subset of 2006 US edition of SNOMED-CT with OWL format was used. The concepts of SNOMED-CT fall into two types: primitive concepts and fully-defined concepts. For the former, the asserted conditions of the concepts are necessary but not sufficient and for the latter, the asserted conditions are both necessary and sufficient.

System Construction

The visualization and modeling tool was developed as a Protégé Tab Plug-in called "OWLFCAView Tab" in a Protégé OWL platform. The Protégé platform is an ontology edit environment which was developed by Stanford Medical Informatics [4]. The JAVA API of an open source software Concept Explorer version 1.2 was integrated to generate the cross-table context and the concept lattice [5].

Based on analysis of the asserted conditions of composite expressions represented in OWL file of SNOMED-CT, three basic specifications were implemented in current version of our tool. The first perspective focused on one of properties in a selected set of the SNOMED-CT composite expressions. Here, the selected set of the expressions was used as the formal objects and the fillers of the restriction of the selected property were used as the formal attributes. The second one focused on all asserted restrictions in a selected set of the composite expressions. Here, the selected set of the expressions was used as the formal concepts and the fillers of all asserted restrictions defined for the expressions were used as the formal attributes. The third one focused on all super-classes of a selected set of the composite expressions. Here, the selected set of the expressions was used as the formal objects and the super-classes of each expression were used as the formal attributes.

Results & Discussions

One of the main features in this study is that we developed a property-oriented way for visualization of Protégé OWL ontologies using the FCA technique, especially focusing on the composite expressions of SNOMED-CT. Although there exists several other kinds of visualization tools (e.g. built-in OWLViz Tab plug-in [4]), however, most of them are class-oriented. Through the property-oriented way, the visualization could become more flexible and scalable. For example, there is a specific property named "RoleGroup" assigned to most of the composite expressions. Guiding by the "RoleGroup", we could easily identify graphically in a concept lattice whether the definitions of the "RoleGroup" among the composite expressions at question are the same or not. Therefore, through capturing every granularity of the composite expression, our FCA-based visualization tool could provide foundations to achieve our goal of seeking solutions to the challenges of the current terminology services facing on. In addition, the current version of our visualization tool has been generalized for the Protégé OWL ontologies and available in the plug-in library of Protégé [4].

References

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[4] URL: http://protege.stanford.edu/; last visited: April 14, 2006.
[5] URL: http://sourceforge.net/projects/conexp; last visited: April, 2006.