A Common Model of Events based on DOLCE

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1 Introduction

The explicit modeling of events and event-based systems are gaining widespread attention by research and industry. The event detection, clustering, and annotation in such systems is and will be realized in many different software components and proprietary solutions using a large variety of internal data models for events, making their integration a challenging task. Existing solutions typically focus on the technical level of event management. In this paper, we present an approach for describing events on domain-level and as occurrences in the real world, respectively. This is important in a variety of domains such as emergency response, sports, news, law, and others. Events may be very complex and linked to a variety of modeling aspects. This makes the communication between different event-based systems and components a challenging task. In particular, considering the ad-hoc and idiosyncratic nature of today's event models.

2 Requirements for a Common Model

To alleviate this situation, we have derived the requirements for a common model of events from existing models in various domains such as music, journalism, multimedia, news, cultural heritage, and knowledge representation [8, 7, 4, 2, 6, 3, 5]. Identified requirements are representing (1) participation of living and non-living objects in events, (2) temporal duration of events, and (3) spatial extension of objects. In addition, three kind of event relationships shall be supported, namely (4a) mereological (composition of events), (4b) causal, and (4c) correlation. The common model shall also support the experiential aspect, i.e., the (5) annotation of events with sensor data such as media data, and allow for (6) different interpretations of events. Existing models almost fully support participation, time and space, and the experiential aspect. However, they substantially lack in the mereological, causal, and correlation relationships and event interpretations.

3 Common Model of Events

Our common model of events bases on the foundational ontology DOLCE and DOLCE+ Ultra Light (DUL, `http://wiki.loa-cnr.it/index.php/LoaWiki:DOLCE-UltraLite`), respectively. The model is called F and follows the pattern-oriented ontology design of DUL. More precisely, we use specializations of the *descriptions and situations* (DnS) ontology pattern. The DnS pattern allows for representing different opinions about events and their participating objects. Thus, we can provide formally precise representations of different contextualized views on events. This is important, as the events we are modeling are subject to discussion and interpretation and may not be objectively observable. With respect to the requirements, we introduced specialized instantiations of the DnS ontology pattern. Here, the participation of objects in events (1) is implemented

by the participation pattern. It also provides for modeling the absolute time and location of events (2) and objects (3). The mereology pattern, causality pattern, and correlation pattern implement the structural relationships between events (4a-4c). In addition, the mereology pattern allows for modeling the relative temporal relations and relative spatial relations between events (2) and objects (3). In order to express such relative temporal relations between events, one can facilitate the provided means of DOLCE such as the formalization of Allen's Time Calculus (`http://wiki.loa-cnr.it/index.php/LoaWiki:Ontologies`). The documentation pattern provides for annotating events (5). It can be seamlessly linked with other ontologies, e.g., the Core Ontology for Multimedia [1] for precisely describing digital media data like images and videos. Finally, the interpretation pattern supports different event interpretations (6).

With F, we can create and exchange sophisticated descriptions of real world events. For example, in the domain of emergency response one can model the participation of citizens in an emergency incident using an instantiation of the participation pattern. If the incident is a flood, one may speculate about the cause for the flood applying an instantiation of the causality pattern and possibly also using the correlation pattern. A flood may typically be composed of multiple events, which is modeled using instantiations of the composition pattern. Thus, for describing an event, different instantiations of the F patterns are combined, each providing a specific part of the event description. As there might be different opinions about the cause of the flood, there can be multiple instantiations of the causality pattern. To manage these multiple instantiations of the causality pattern (or other patterns), the event interpretation pattern is used to form different nexuses of the pattern instantiations and providing different views onto the same event. Thus, the interpretation pattern supports reusing parts of event descriptions on the level of pattern instantiations. In emergency response, typically several professional entities are involved such as emergency hotline, police department, fire department, and emergency control center. All these entities need to exchange event descriptions like the one above. However, they typically use different systems and applications with their own proprietary data models for events. Using the formal model F instead, these systems can be integrated and effectively communicate event descriptions. The F ontology and examples are available from `http://isweb.uni-koblenz.de/eventmodel`.

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