Research on Events in Computer Science

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1 Introduction

Humans think in terms of events and objects. Events provide a natural abstraction of happenings in the real world. Objects are participating in events. They can be living objects like persons and non-living objects. The concept of events has a long history in foundational sciences such as philosophy and linguistics. Computer science research first developed object-based approaches and is now addressing the concept of events and building many applications that consider events at least as important as objects. Consequently, we find many different solutions and approaches for modeling, detecting, and processing events. In addition, we find different applications that are based on events and make use of events.

2 Research on Events

Today’s workshops and conferences on events in computer science such as the ACM International Distributed Event-based Systems (DEBS)\(^1\) conference and the Event-driven Business Process Management Workshop (edBPM)\(^2\) are typically dealing with the capturing, processing, and management of low-level events. Here, an event is considered the existence or non-existence of a signal within some computerized system. Relevant work are, e.g., publish/subscribe systems and middleware solutions [1], complex event processing [2] and event stream processing [3], Semantic Web services [4], and reactivity for the Semantic Web [5]. Thus, the focus is on technical events that happen within computerized systems.

This work is very essential for an efficient execution of the applications build on top of such approaches. However, the understanding of the concept of events is disconnected from the domain-level events that the actual users of such applications have to deal with. On the domain-level, events are understood as the occurrences in which humans participate. This notion of events can be applied to capture and represent human experience. Such high-level events are subject to discussions and interpretations by humans. They may be very complex and a variety of aspects need to be considered. Models of events exist in various domains

\(^1\) http://debs10.doc.ic.ac.uk/
\(^2\) https://www-927.ibm.com/ibm/cas/cascon/displayWorkshop?PublicView=true&Num=59
like the Eventory [6] system for journalism, the Event Ontology [7] as part of a music ontology framework, the ISO-standard of the International Committee for Documentation on a Conceptual Reference Model (CIDOC CRM) [8,9] for cultural heritage, the event markup language EventML [10] for news, the event calculus [11,12] for knowledge representation, the Semantic-syntactic Video Model (SsVM) [13] and Video Event Representation Language (VERL) [14,15] for video data, and the event model E [16,17] for event-based multimedia applications. From this related work one can derive that for domain-level events aspects such as time and space, objects and persons involved, as well as mereological, causal, and correlative relationships between events have to be considered [18]. Domain-level events are important in a large variety of domains such as lifelogs, cultural heritage, sports, news, law, surveillance, emergency response, and others.

3 Modeling Domain-Level Events with the Event-Model-F

With the Event-Model-F, we have created a formal ontology of events on domain level [18]. The Event-Model-F bases on the foundational ontology DOLCE+DnS Ultralight (DUL)\(^3\) [19] and follows a pattern-oriented design approach for ontologies. More precisely, we use specializations of the *descriptions and situations* (DnS) ontology pattern [20]. 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 aspects of events, we introduced specialized instantiations of the DnS ontology pattern. Here, the participation of objects in events is implemented by the participation pattern. It also provides for modeling the absolute time and location of events and objects. The mereology pattern, causality pattern, and correlation pattern implement the structural relationships between events. In addition, the mereology pattern allows for modeling the relative temporal relations and relative spatial relations between events and objects. 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\(^4\). The documentation pattern provides for annotating events. It can be seamlessly linked with other ontologies, e.g., the Multimedia Metadata Ontology (M3O) [21] for precisely describing digital media data like images and videos. Finally, the interpretation pattern supports different event interpretations.

With the Event-Model-F, we can create and exchange sophisticated descriptions of real world events. For example, in the domain of emergency response of the EU project WeKnowIt\(^5\) one can model the participation of citizens in an emergency incident using an instantiation of the participation pattern.

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\(^5\) [http://www.weknowit.eu/](http://www.weknowit.eu/)
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 mod-
eled using instantiations of the composition pattern. Thus, for describing an
event, different instantiations of the Event-Model-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 dif-
f erent 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, typi-
cally 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 Event-Model-F ontology
and examples are available from http://isweb.uni-koblenz.de/eventmodel.

4 Conclusions

This paper discusses the different notions of events in computer science and
briefly presents a model of events, the Event-Model-F [18]. The goal for future
work should be to understand the different notions of events in computer science
and to promote the importance of events on domain level. In addition, research
paths have to be shown up to bring together the low-level events and domain-
level events. Here, researchers from the different communities in computer science
have to be brought together that deal with events.

One step towards this vision is the 1st ACM International Workshop on
Events in Multimedia (EiMM) [22] that has been held conjunct with the
ACM Multimedia conference in Beijing, China in 2009. The EiMM workshop
aims at the detection, processing, and representation of events in multimedia
data. Researchers from different fields in computer science participated in
this workshop such as computer vision, multimedia, Semantic Web, databases,
and computer networks. Details about the workshop can be found online at
http://www.uni-koblenz.de/confsec/eimm09/.

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References

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