Knowledge-Based Complex Event Processing

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Events play an important role in many different areas of computer systems, from small embedded applications to large heterogeneous distributed systems. Events are real-world occurrences that are happening over space and time. In computer science an event can be defined as any transient occurrence of a happening of interest that can be observed from within a computer system. In many of current computer systems, permanent stream of huge amount of events need an intelligent real-time event processor. Event processing means computing that performs operations on events, including reading, creating, transforming, and deleting events.

The capability of complex event detection and processing is one of the critical success factors of event-driven systems. Complex events can be composed or derived (synthesized) from raw simple events based on their incoming sequence, their syntax and semantics. The existing complex event processing engines process events as plain data without much knowledge (metadata) about them. Semantic (meta) models of events can improve the quality of event processing by using event metadata in combination with ontologies and rules (knowledge bases). An event instance is a concrete semantic object containing data describing the event.

Using semantics of events is one of the promising approaches for detection of real-world complex events. Knowledge about event types and their hierarchies i.e. specialization, generalization, or other forms of relations between events can be useful. For example one might define that in a supermarket, theft alarm *is the same as* fire alarm. Knowledge representation goes beyond event types and their hierarchies, more interesting are the relationships of events to other non-event concepts which specify more complex events and reactions. For example, one might define that in the case of a theft alarm only staff members who had special security courses, should be informed about the alarm. In this example we have non-event concepts such as person, education, course. Our research aims to develop a knowledge representation methodology for complex event processing (CEP) which integrates the domain and application specific ontologies for events, processes, states, actions, and other concepts that relate to change over time. Specific domain, task and application ontologies need to be dynamically connected and integrated into the respective event processing applications, which also leads to a modular integration approach for these ontologies. Capturing domain-specific complex events and generating complex reactions based on them is a fundamental challenge which we address in this Ph.D thesis.