

## A Temporal Representation of Point-Interval Relations including Calendar Events

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**Abstract.** In this paper we shall discuss knowledge discovery problems arising in time series. A relation algebra is applied for the purpose of representing both dependencies among single items and dependencies between single items and intervals. This enables one to specify and recognise even complex interrelationships among items in data streams. In addition, intervals like calendar events can be incorporated into the patterns. An example is set for the case of thrown alarms in communication networks<sup>1</sup>.

**Keywords:** Temporal Patterns, Calendar Events, Temporal Reasoning

### 1 Introduction

The representation of relationships in temporal data mining approaches is a big issue and has great impact on the expressiveness of patterns [10]. In several domains such expressive patterns are of great use, e.g. for the discovery of alarm patterns in the context of fault management, namely to improve the understanding of the network and in order to generate fault prediction rules; but also for such diverse purposes as for the identification of proteins on the basis of amino acids and for the prediction of financial and stock markets. Commonly, a temporal order is imposed on these data streams and we are normally concerned with long sequences of events. The temporal information of one event is often composed of a date and a time of day. In particular, date and time can be used to associate events to certain calendar events, such as days, weeks, months or even public holidays. These calendar events can considerably increase the diversity of detected patterns, even if nothing else is known about the events. In addition to calendar events, temporal data mining approaches normally contain a sliding time window which is scanned for new patterns (1) in order to reduce the complexity of the search space and (2) in order to include the fact that patterns are generally more reasonable if they include events which are temporally

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