

# Chapter 7

## Modeling Temporal Information With JSON

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### ABSTRACT

*As a ubiquitous form of data in human natural life, time has been widely used in military, finance, medical treatment, environment and other fields. Therefore, temporal data models used to express the dynamic development process of data have been proposed constantly. Currently, the main research achievements focus on temporal database and temporal XML. With the rapid development and popularization of network technology, the requirement of efficiency and security is getting higher and higher. JSON, a new generation of data exchange language, has been widely used because of its lightweight, fast parsing and high transmission efficiency. However, modeling temporal information with JSON has not been studied enough. The chapter proposes a temporal data model based on JSON. What is more, the temporal query language and the JSON Schema is also mentioned.*

### INTRODUCTION

With the popularity and development of the Internet, amount of data onto all domains is growing exponentially. According to the data volume growth report that released by China Cloud Computing Conference Website in 2018, the amount of Web data in 2020 will be 44 times that of today. Due to the increasing amount of data volume and the improvement in software and hardware computing capability, cloud computing, big data, data mining, machine learning, and other intelligent technologies has developed rapidly, therefore it is very valuable and necessary to use these technologies excavating the hidden trends and laws behind a large number of data (Han, 2005; Mitsa, 2010; Chen & Petrounias, 1998). Time as an omnipresent property of the realistic natural world, it has a great significance when studying the ceaseless application area. Meanwhile, mining the laws behind time dimension from a large number of data have received wide attention in academia and industry (Mitsa, 2010). As early as in 1998, A framework

DOI: 10.4018/978-1-5225-8446-9.ch007

## ***Modeling Temporal Information With JSON***

for temporal data mining has raised (Chen & Petrounias, 1998). In the field of medicine, describes the temporal data mining aspects of a research project that deals with the definition of methods and tools for the assessment of the clinical performance of hemodialysis (HD) services (Chittaro, Combi, & Trapasso 2003; Bellazzi, et al. 2005). What is more, spatio-temporal data mining for typhoon image collection may forecast the typhoon trends (Kitamoto, 2002). Summarizing industry's work, the work in the paper shows how to mine the temporal laws behind temporal information about SOM, SVM, temporal periodic pattern algorithm and so on (Post & Jr, 2008). Furthermore, the intelligent technology of big data, Hadoop, spark, druid, has been widely applied in temporal field.

The JavaScript Object Notation (JSON) has presented by Douglas Crockford to IETF RFC draft (Bray, 2014).

1. It is a lightweight data-interchange format based on the pro-type of the JavaScript programming language;
2. It is easy for human to read and write and easy for machine to parse and generate;
3. JSON is a text format that is completely language independent but uses conventions that are familiar to programmers of the C-family of languages.

These characteristics make JSON an ideal data-interchange language. In addition, JSON has higher flexibility and scalability when compared with XML (Lin, et al. 2012). Therefore, JSON has been widely used. It is currently the predominant format for sending API requests and responses over the HTTP or HTTPS protocol for its high data transmission efficiency (Sheth, Henson & Sahoo, 2008). JSON data format obtains a wide application. Research on the applications of JSON data interchange format in heterogeneous system integration (Gu & Shen, 2012; Wang & Zhu, 2018). There is a way to realize Android efficiently and safely accessing from a remote database by using JSON format (Soewito, et.al, 2017). JSON was also applied in asynchronous distributed genetic algorithms (Merelo, et.al, 2008). What is more, the implementation of document database in non-relational database classification, MongoDB, CouchDB, are all based on JSON grammar format (Bellazzi, et.al 2016; Boicea, et.al,2012). But the real world is changing over time, non-temporal data model can not well reflect the development and change process of data.

In this paper, we propose a temporal data model based on JSON. First, we introduce a non-temporal data model based on JSON, then we obtain our temporal model by adding validity time to model that represents the history of a fact in the modeled reality. Finally, we make a formal definition of our temporal data model. The main contributions of this paper are summarized as follows:

1. We propose a temporal data model based on JSON that can reflect the change of the JSON document, the temporal model greatly reduces data redundancies.
2. On the basis of the temporal JSON data model proposed in this paper, we briefly discussed the query language upon the temporal model. To the best of our knowledge, it is the first effort to present query language for temporal JSON data model.

The remainder of this paper is organized as follows. The second section presents the related work in the temporal database and temporal XML. The third section simply explains the time domain, syntax and data types of the JSON model. The fourth section formally introduces a temporal JSON data model by extending a non-temporal JSON data model and proposes physical implements of our model. Query

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