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The Role of Knowledge Representation in Cadastre

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Extended Abstract:

Models for temporal reasoning have been developed in artificial intelligence (AI) for a variety of applications. On one hand, some models apply either a change-based approach, such as situation calculus[1] and the dynamic logic[2], or a time-based approach such as the models introduced by McDermott (81)[3], Allen (84)[4], and Shoham et al. (88)[5]. On the other hand, the temporal-based models apply a point-based approach, an interval-based approach, or a combination of both.

In parallel to the temporal-reasoning models developed in AI, temporal databases have also been developed by researchers in database management systems (DBMS). These databases store, retrieve, and manipulate temporal information. They are often subdivided into three categories: historic, rollback, or temporal database[6]. They vary with respect to their representation of time perspectives and their treatment of erroneous data. Examples of different time perspectives are *transaction* and *valid* time.

Since, in this paper, we focus on the engineering applications to these models, we have selected cadastral systems as a rich example that

strongly requires temporal reasoning and heavily rely on the knowledge representation of its rules. In a world where we utilize computers for record keeping of real estate properties, we need more than a storage media and a fast access to these records. We need a reasoning mechanism to assist the user in making the right decision when purchasing or mortgaging a real estate property. Such decisions require a thorough and precise search and inspection of the history and abstract of the property to determine the rights on it[7].

Consider, for example, the process of titling for real estate in the United States, where a deed recording system is applied, the title to a property is a *derived* [8]fact and not a prime fact on itself; a chain of deeds and claims that contain facts about the transfer of ownership of a certain property will determine its owner. A good title to a property can be acquired only after a set of several legal acts have been made, such as obtaining and recording deeds. Often, the temporal component of a deed is the dominant factor to determine a good title to the property, such as in the race statute and in the race-notice statute[9], and to determine senior titles for boundary disputes[10] among neighbors.

There are several basic and minimal requirements to any temporal system that handles cadastral records: it should handle more than a single time perspective; it should support the time-intervals and time dates; and it should incorporate knowledge and allow inferences based on it. Possible perspectives of time in such systems are the occurrence (when a deed was done) and the recording time (when it was recorded in the registry deed office). The two time-perspectives are both necessary since the determination of a good title, in the various title-statutes, is defined in terms of both time-perspectives. The time-date (possibly discrete) is essential since it is used as a basic recording datum for cadastral records. The reasoning process is required to infer and conclude facts that are not explicitly stated in the records, such as the owner, the mortgager, and the like. Often, a user does not know which records (s)he is looking for. The search is conducted in a cyclical process where a recently earned knowledge dictates the next searching step.

For a temporal cadastral system, such as a deed recording system, techniques from both DBMS, to handle a variety of time perspectives, and from AI, to allow a knowledge-based reasoning process, are needed. The selection and determination of the tools that are required are not unique and have yet to be determined. The aim of this paper is to discuss and present a conceptual and knowledge-based temporal cadastral system, examine the applicability of available reasoning tools, and to demonstrate its reasoning process.

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