Design of a Spatio-Temporal Ontology
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1 Introduction
In the Semantic Web which handles the meanings of information, an ontology is generally used to describe metadata. However, since usual ontologies are not enough to represent time and space, we have restrictions of knowledge expressions. So, we develop a spatio-temporal ontology by formalizing spatial and temporal concepts and introducing them into the ontology.

2 Spatio-Temporal Ontology
We specify knowledge about time and space, and develop a spatio-temporal ontology. Various researches which introduce spatial and temporal concepts into ontologies exist [1, 2, etc.]. We civilize the concepts based on the ideas of these researches and develop a spatio-temporal ontology. The features of this ontology are as follows:

- Spatial and temporal concepts are represented uniformly: each has Entities and Descriptions.
- Providing such information for themes and triples enables us to reuse knowledge easily.

For the temporal information, the basic representation of time consists of Instant, Interval and Cycle. Instant means a certain point of time (e.g., year-month-day format and clock time), and Interval means a extent of time (e.g., from one day to another day and for hours). Cycle intends to express a periodic time by describing a frequency repeated at regular intervals and a term that the frequency is valid. As long as we know, the concept of Cycle is novel. Introducing them will allow us to represent knowledge such as “every Wednesday” and “ten o’clock every three days.” For describing the order relations between two different temporal information, the ontology defines some properties such as before and after.

Spatial information are basically represented by Location and Symbol. Location consists of AbsoluteLocation and RelativeLocation. AbsoluteLocation expresses a spatial coordinate using a longitude, a latitude and an altitude. RelativeLocation expresses a space from a base location using a distance. Symbol means the concrete name of a space (e.g., Sendai and Ichibancho). Some spatial information added to thematic information are useful for defining spatial mapping between different representations. In addition, introducing some properties such as covers and inside between spatial information allows us to express a spatial hierarchy in the real world.

3 Conclusion
In this paper, we have presented the development of a spatio-temporal ontology which allows us to express spatial and temporal information uniformly and flexibly. Our future work includes verifying expressiveness and validity of the defined ontology.

References