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Upravljanje jezikovnih virov - Ogrodje za semantično označevanje (SemAF) - 14. del: Prostorska semantika

Language resource management — Semantic annotation framework (SemAF) — Part 14: Spatial semantics

Gestion des ressources linguistiques — Cadre d'annotation sémantique (SemAF) — Partie 14: Sémantique spatiale

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Language resource management — Semantic annotation framework (SemAF) —

Part 14:
Spatial semantics

Gestion des ressources linguistiques — Cadre d'annotation sémantique —

Partie 14: Sémantique spatiale

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Contents

Page

Foreword

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 37, *Language and Terminology,* Subcommittee SC 4, *Language resource management*

ISO 24617 consists of the following parts under the general title Language resource management — Semantic annotation framework (SemAF):

— Part 1: Time and events (SemAF-Time, TimeML)

— Part 2: Dialogue acts (DA)

— Part 3: Named entity

— Part 4: Semantic roles (SR)

— Part 5: Discourse structures (DS)

— Part 6: Principles of semantic annotation (SemAF Principles)

— Part 7: Spatial information

— Part 8: Semantic relations in discourse, core annotation schema (DR-core)

— Part 9: Reference annotation framework (RAF)

— Part 10: Visual information (VoxML)

— Part 11: Measurable quantitative information (MQI)

— Part 12: Quantification

— Part 13: Gestures

— Part 14: Spatial semantics

Introduction

This document provides a semantic ground for supporting ISO 24617-7 Spatial information, which provides an abstract syntax for the annotation of spatial information in language. It also provides a way of translating the annotation structures generated by the abstract syntax of ISO 24617-7 into well-formed logical forms. These logical forms are to be represented in a type-theoretic first-order predicate logic and made interpretable according to a model.

This document needs to be an ISO standard for at least two reasons. First, it validates the abstract specification of ISO 24617-7 for the annotation of spatial information in language on semantic grounds. Second, it provides an interoperable format for interpreting spatial information, both static and dynamic. Dynamic spatial information involves spatio-temporal information as well as information about motions in space and time. This document aims at satisfying such needs.

Language resource management — Semantic annotation framework (SemAF) —

Part 14:
Spatial semantics

1 Scope

This document provides a formal semantics for the abstract syntax of ISO 24617-7 that specifies ways of annotating spatial information in natural language such as English. The task of the proposed semantics is of two kinds: (1) translation of annotation structures to logical forms and (2) model-theoretic interpretation of logical forms. Logical forms are represented in a type-theoretic first-order predicate logic (FOL). These logical forms are then interpreted with respect to a model for part of the world to which an annotated language is referentially, or denotationally, anchored.

NOTE The basic framework and content of this document is based on,[1] a paper presented at the ISO/TC 37/SC 4/WG 2 workshop, 2019, Santa Fe, U.S.A.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 24617-7:2020, *Language resource management — Semantic annotation framework — Part 7: Spatial information*

3 Terms and definitions

3.1
annotation structure *a*
information structure created by marking up some linguistic expressions with relevant (semantic) information

Note 1 to entry: ISO 24617-7:2020, for instance, creates such annotation structures by marking up place names or motions and their spatial relations with relevant spatial information.

3.2
convex hull of a shape
smallest *convex set* (3.3) that contains it

3.3
convex set
subset of a Euclidean space such that, given any two points, it contains the whole line segment that joins them

3.4
eigenplace
eigenspace
region or path occupied by an object

Note 1 to entry: A region may be considered as a particular finite path matching to an interval [x,x] such that its start and endpoint match or are identical.

3.5
event-path
region of space occupied by a mover (moving object) throughout an event

3.6
first-order logic
first-order predicate logic with quantification
FOL
formal language, artificially built for reasoning, with the values of its terms, particularly variables, ranging over individuals only

Note 1 to entry: Second-order variables like *P*, which ranges over properties of an individual, are temporarily introduced to allow the λ-operation in the process of deriving logical forms (see Example 6).

3.7
interpretation $[\![\sigma(\mathbf{a})]\!]^{M}$
valuation of a *logical form σ(a)* (3.8) with respect to a *model M* (3.9)

3.8
logical form σ(**a**)
representation of the semantic content of an *annotation structure a* (3.1) of expressions in natural language

3.9
model *M*
set-theoretical construct that represents part of the real or possible world denoted by the *logical forms (a)* (3.8)

4 Overview

4.1 Purpose and justification

An understanding of information in natural language is necessary for many computational linguistics and artificial intelligence applications. An explicit semantics is necessary for the specification provided by ISO 24617-7 Spatial information, as the representations created in accord with that language will not have a significant impact on artificial intelligene (AI) and automatic inferencing without explicit interpretation.

Relevant affected stakeholder categories with expected benefits and impacts include: Amazon Echo, Microsoft, Google Cloud Computing and other related industrial and commerce sectors with geo-location applications, navigation, home appliance reasoning, and Internet of Things, organizations like MITRE providing semantic interoperability with natural language processing (NLP) applications, Government organizations like DARPA, ARL, iARPA, ONR, NSF, and National Geospatial Agency with impacts on interpretation layer for interoperability between standards used in spatial platforms. Academic and research bodies such as Brandeis University, Stanford University, KAIST or Korea University will benefit from spatial metadata enhancement for library special collections and archives and other managements of bigdata. Even on-governmental organizations like WGBH get help with spatial metadata indexing over their audio-video archival assets.

4.2 Metamodel

This document outlines the basic semantic structure for the abstract syntax of ISO 24617-7 for easy reference, which specifies an annotation scheme for the markup of spatial relations, both static and

dynamic, as expressed in text and other media. This specification distinguishes six major categories of spatially relevant elements for markup in natural language:

(1) Categories of markable expressions in ISO 24617-7:

a. **spatial entities**:

natural or artificial locations in the world that include **places**, **paths,** and **event-paths**, as well as **individual entities** participating in spatial relations.

b. **spatial relators (signals):**

linguistic markers that establish relations between places and spatial entities.

c. **spatial measures**:

quantitative information associated with spatial entities

d. **events and motions**:

eventualities either static or dynamic. Unlike static eventualities such as referring to states, dynamic eventualities (**motions**) involve movement from one location to another triggering a trajectory (**event-path)**.

e. **static spatial relations:**

specific **qualitative configurational**, **orientational**, and **metric relations** between objects.

f. **dynamic spatial relations**:

movement of an object triggered by a motion from one location to another creating an **event path**.

The corresponding metamodel for these categories is represented in Figure 1 below.

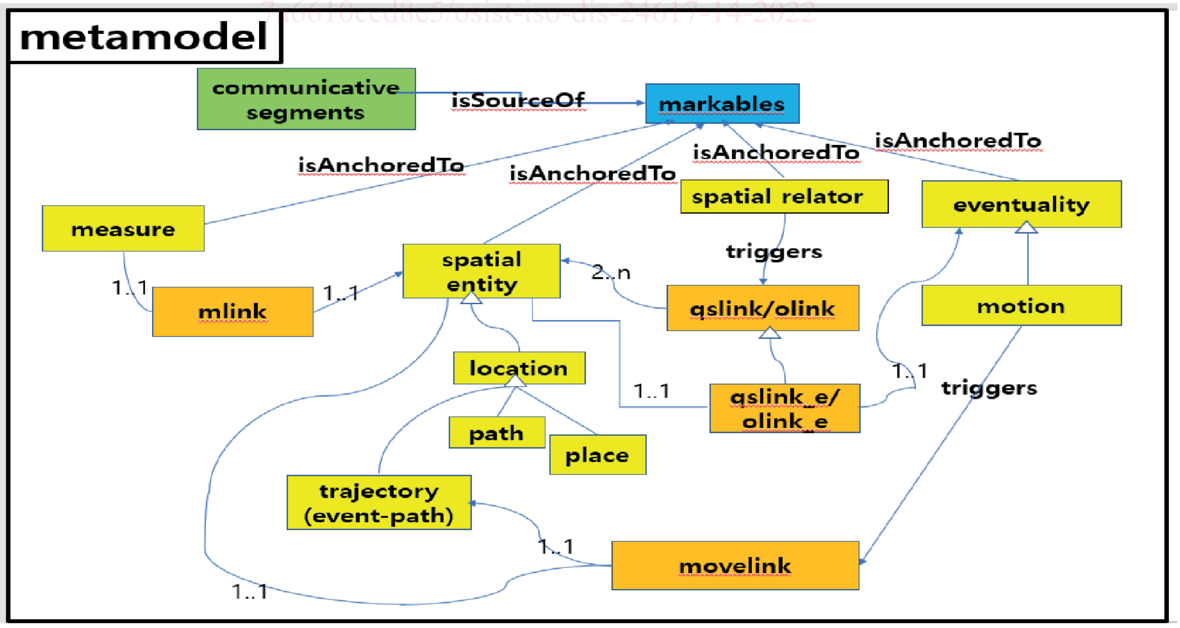

Figure 1 — Metamodel

NOTE 1 Figure 1 is taken from[2] with some modifications.