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Language resource management — Semantic annotation framework —

Part 7: Spatial information (ISOspace)

Gestion des ressources linguistiques — Cadre d'annotation sémantique —

Partie 7: Information spatiale (ISOspace)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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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, *Terminology and other language and content resources*, 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, ISO-TimeML)*

— *Part 2: Dialogue acts*

— *Part 4: Semantic roles (SemAF-SR)*

— *Part 5: Discourse structures (SemAF-DS)*

— *Part 6: Principles of semantic annotation (SemAF-Basics)*

— *Part 7: Spatial information (ISOspace)*

— *Part 8: Semantic relations in discourse (SemAF-DRel)*

Introduction

The automatic recognition of spatial information in natural language is currently attracting considerable attention in the fields of computational linguistics and artificial intelligence. The development of algorithms that exhibit "spatial awareness" promises to add needed functionality to NLP systems, from named entity recognition to question-answering and text-based inference. However, in order for such systems to reason spatially, they require the enrichment of textual data with the annotation of spatial information in language. This involves a large range of linguistic constructions, including spatially anchoring events, descriptions of objects in motion, viewer-relative descriptions of scenes, absolute spatial descriptions of locations, and many other constructions.

This part of ISO 24617 was developed in collaboration with the ISOspace working group at Brandeis University with the aim to provide an International Standard for the representation of spatial information relating to locations, motions and non-motion events in language.

NOTE The ISOspace Working Group is headed by James Pustejovsky, jampesp@cs.brandeis.edu, Brandeis University, Waltham, MA, U.S.A.

This part of ISO 24617 provides normative specifications and guidelines not only for spatial information, but also for information content in motion and various other types of event in language.

The main parts of this part of ISO 24617 consist of the following:

a) Scope;

b) Normative references;

c) Terms and definitions;

d) List of tags or names of elements;

e) Overview;

f) Motivation and requirements;

g) Specification of the ISOspace annotation structure;

h) Representation of ISOspace-conformant annotations.

Clause 8 introduces an XML-based concrete syntax for representing spatial-related or motion-related annotations based on the annotation structure of ISOspace that is presented in Clause 7 with a UML-based metamodel.

A formal semantics for ISOspace will be provided as part of a future new work item within the semantic annotation framework. This will be coordinated with the temporal semantics and specification of ISO 24617-1 (SemAF-Time, ISO-TimeML), thereby producing a rich semantics that will be directly useable by practitioners in computational linguistics and other communities (see Clause 6). The multilingual extension of ISOspace will also be treated in a separate part of the ISO 24617- series in the near future.

NOTE Although the schema and DTD are not part of the present document as normative annexes, they will both be found in a webpage relating to the ISOspace specification.

Normative Annex A is an integral part of ISO 24617 and provides core annotation guidelines.

Language resource management — Semantic annotation framework —

Part 7: Spatial information (ISOspace)

1 Scope

This part of ISO 24617 provides a framework for encoding a broad range not only of spatial information, but also of spatiotemporal information relating to motion as expressed in natural language texts. This part of ISO 24617 includes references to locations, general spatial entities, spatial relations (involving topological, orientational, and metric values), dimensional information, motion events, and paths.

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 24617-1, *Language resource management — Semantic annotation framework (SemAF) — Part 1: Time and events (SemAF-Time, ISO-TimeML)*

ISO/IEC 14977, *Information technology — Syntactic metalanguage — Extended BNF*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 24617-1 and the following apply.

3.1
document creation location
dcl
unique place or set of places associated with a document that represents the *location* (3.7) in which the document was created

Note 1 to entry: Some collaboratively written documents, such as GoogleDoc[1)] documents and chat logs, might refer not only to a single location but also to a set of locations spread out across the world. Besides, for example, the creation place of the Hebrew bible or the creation place of each of the books in it is uncertain. The attribute @ dcl will, therefore, have the value “false” which is to be understood to mean “unspecified”, while the value “true” is to be understood to mean “specified”.

3.2
event
eventuality
something that can be said to obtain or hold true, to happen or to occur

Note 1 to entry: This is a very broad notion of event, also known in the literature as “eventuality” and includes all kinds of actions, states, processes, etc. It is not to be confused with the narrower notion of event (as opposed to the notion of “state”) as something that happens at a certain point in time (e.g. the clock striking two or waking up) or during a short period of time (e.g. laughing). In ISO-TimeML, the term *event* is used in a broader sense and is equivalent to the term *eventuality*.

1) GoogleDoc is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products.

[SOURCE: ISO 24617-1:2012]

3.3
event-path
path (3.13) or trajectory followed by a *spatial entity* (3.17) coincident with a *motion-event* (3.9)

3.4
extent
textual segment which is string of character segments in text to be annotated

EXAMPLE Tokens, words, and non-contiguous phrases (e.g. a complex verb like “look ... up”) are extents.

3.5
figure
spatial entity (3.17) that is considered to be the focal object, which is related to some reference object

3.6
ground
spatial entity (3.17) that acts as reference for a *figure* (3.5)

3.7
location
point or finite area that is positioned within a *space* (3.16)

3.8
measure
magnitude of a spatial dimension or relation

EXAMPLE Distance is a spatial relation.

3.9
motion
motion-event
action or process involving the translocation of a spatial object, transformation of some spatial property of an object, or change in the conformation of an object

Note 1 to entry: A *motion* (3.9) in ISOspace is a particular kind of *event* (3.2).

3.10
motion-signal
adjunct
motion-adjunct
path (3.13) of motion and/or manner of motion information contributed by a particle or by a prepositional, adverbial phrase, in conjunction with a *motion* (3.9)-related text

Note 1 to entry: This terminology is specific to ISOspace and is different from the general term “adjunct” which is used to describe optional syntactic elements.

3.11
non-cosuming tag
tag (3.19) that has no associated *extent* (3.4)

Note 1 to entry: The *extent* (3.4) of a non-consuming tag is a “null” string.

EXAMPLE In *John ate an apple but Mary a pear*, there are at least two ways of marking up the non-consuming <event> tag:

a) John ate_{e1} an apple, but Mary $\emptyset_{e2}$ a pear;

b) 1) <event xml:id=”e1” markable=”ate”/>

2) <event xml:id=”e2” markable=” “/> (non-consuming <event> tag)

3.12
orientation
orientation(al) relation
relation between a *figure* (3.5) and a *ground* (3.6) that expresses the spatial disposition or direction of a spatial object within a frame of reference

3.13
path
location (3.7) that consists of a series of *locations* (3.7)

Note 1 to entry: A spatial object *path* is a location where the focus is on the potential for traversal or which functions as a boundary. This includes common nouns like *road*, *coastline,* and *river* and proper names like *Route 66* and *Kangamangus Highway*. Some nouns, such as *valley*, can be ambiguous. It can be understood as a path in *we walked down the valley* or as a *place* (3.14) in *we live in the valley*.

Note 2 to entry: A path might be represented as an undirected graph whose vertices are *locations* (3.7) and whose edges signify continuity; that is to say, a path has no inherent directionality.

3.14
place
geographic or administrative entity that is situated at a *location* (3.7)

3.15
region
connected, non-empty point-set defined by a domain and its boundary points

Note 1 to entry: The term "region" as defined here does not refer to a political or administrative region such as "the Canary Islands" or "Hong Kong, SAR", where SAR is the acronym of "Special Administrative Region".

3.16
space
dimensional extent in which objects and *events* (3.2) have a relative position and direction

3.17
spatial entity
object that is situated at a unique *location* (3.7) for some period of time, and typically has the potential to undergo translocation

Note 1 to entry: A spatial entity can also be understood as an object that participates in a spatial relation. In *John is sitting in a car*, both *John* and *car* could be understood as *spatial entities* or as being the *figure* (3.5) and the *ground* (3.6), respectively, of the sitting-in situation.

3.18
spatial signal
segment or series of segments of a text that rebounds to *orientational* (3.12) or *topological relations* (3.20)

3.19
tag
element name
name associated with textual segments for annotation or for a relation between these segments

Note 1 to entry: The following are two kinds of tag for annotation:

a) extent tag, which is associated with textual segments referring to basic entities or signals;

b) link tag, for representing spatial relations.

3.20
topological relation
relation that expresses the connectedness or continuity of *spaces* (3.16)

4 List of tags

4.1 General

The tag in angled brackets stands for the name of an XML element. See 8.2.

4.2 Extent tags: Basic entities and signals

4.2.1

measure
<measure>

extent tag representing some *measure* (3.8)

4.2.2

motion
<motion>

extent tag representing a *motion* (3.9)

4.2.3

motionSignal
<motionSignal>

extent tag representing a *motion-signal* (3.10)

4.2.4

non-motion event
<event>

extent tag representing a *non-motion event* (3.9)

4.2.5

path
<path>

extent tag that represents a *path* (3.13)

4.2.6

place
<place>

extent tag that represents a *place* (3.14)

4.2.7

spatialEntity
<spatialEntity>

extent tag that represents a *spatial entity* (3.17)

4.2.8

spatialSignal
<spatialSignal>

extent tag that represents a *spatial signal* (3.18)

4.3 Link tags

4.3.1

mLink
<mLink>

linking tag that represents some *measure* (3.8)

4.3.2

moveLink
<moveLink>

linking tag that represents a relation between a *motion* (3.9) and participant *spatial entities* (3.17)

4.3.3

oLink
<oLink>

linking tag that represents an *orientation relation* (3.12) between a *figure* (3.5) and a *ground* (3.6)

4.3.4

qsLink
<qsLink>

linking tag that represents a *topological relation* (3.20)

NOTE The tag qsLink or <qsLink> stands for a qualitative spatial link.

4.4 Root element

4.4.1

isoSpace
<isoSpace>

root element in which all ISOspace tags are embedded

NOTE In ISOspace annotations, all of the extent and link tags listed above are embedded in the tag <isoSpace>.

5 Overview

Human languages impose diverse linguistic constructions for expressing concepts of space, of spatially-anchored events, and of spatial configurations that relate in complex ways to the situations in which they are used. One area that deserves further development regarding the connection between natural language and formal representations of space is the automatic enrichment of textual data with spatial annotations. There is a growing demand for such annotated data, particularly in the context of the semantic web. Moreover, textual data routinely make reference to objects moving through space over time. Integrating such information derived from textual sources into a geosensor data system can enhance the overall spatiotemporal representation in changing and evolving situations, such as when tracking objects through space with limited image data. It follows that verbal subjective descriptions of spatial relations need to be translated into metrically meaningful positional information. A central research question currently hindering progress in interpreting textual data is the lack of a clear separation of the information that can be derived directly from linguistic interpretation and further information that requires contextual interpretation. In order to avoid building incorrect deductions into the annotations themselves, mark-up schemes should avoid over-annotating the text. Solutions to the language-space mapping problem and its grounding in geospatial data are urgently required for this purpose.

There are many applications and tasks that would benefit from a robust spatial mark-up language, such as ISOspace. These applications and tasks include the following:

a) creating a visualization of objects from a verbal description of a scene;

b) identifying the spatial relations associated with a sequence of processes and events from a news article;

c) determining an object location or tracking a moving object from a verbal description;

d) translating viewer-centric verbal descriptions into other relative descriptions or absolute coordinate descriptions;

e) constructing a route given a route description;

f) constructing a spatial model of an interior or exterior space given a verbal description;

g) integrating spatial descriptions with information from other media.

The goal of ISOspace is not to provide a formalism that fully represents the complexity of spatial language but rather to capture these complex constructions in text in order to provide an inventory of how spatial information is presented in natural language. For example, many texts have no explicit frame of spatio-temporal reference, thus, making it impossible to annotate such an unspecified frame of reference. The interpretation of spatial prepositions, such as *on* in *a book on the desk* vs *a picture on the wall* requires a handbook of its own dealing with different senses or uses of spatial prepositions beyond a set of annotation guidelines. Any detailed classification of motion verbs in English alone is again beyond the scope of this International Standard.

All of the examples in the current version of part of ISO 24617 are from English datasets. The specification language proposed in this International Standard can be seen as a version of ISOspace for English only and its applicability to other languages is still pending. A multilingual extension of ISOspace is necessary if the document is to be verified, but this is expected to immediately follow preliminary rigorous work on establishing the first edition of this part of ISO 24617 as an International Standard for spatial and motion-related annotation.

6 Motivation and requirements

This International Standard aims to formulate the requirements for spatiotemporal annotation standards and to develop the ISOspace standard to meet these requirements. It assumes ISO 24612 and builds on previous work, including ISO 24617-1 and other spatial representations and calculi.

Natural language abounds with descriptions of motion. Our experience of our own motion, together with our perception of motion in the world, have given human languages substantial means to verbally express many different aspects of movement, including its temporal circumstances, spatial trajectory and manner. In every language on earth, verbalizations of motion can specify changes in the spatial position of an object over time. In addition to when and where the motion takes place, languages additionally characterize how the motion takes place (e.g., its path, its manner, and how it was caused). In particular, the path of motion involves conceptualizations of the various spatial relationships that an object can have to other objects in the space in which it moves. An understanding of such spatial information in natural language is necessary for many computational linguistics and artificial intelligence applications.

Any specification language for spatial information in language will need to support the following computational tasks:

— identification of the appropriate topological configuration between two regions or objects (e.g. containment, identity, disjointedness, connectedness, overlap, and closure over these relations, when possible);

— identification of directional and orientational relations between objects and regions, including the distinction between frames of reference;

— identification of metric properties of objects and metric values between regions and objects, when possible (e.g. distance, height and width);

— identification of the motion of objects through time and a characterization of the nature of this movement;

— the provision of clear interoperable interfaces to existing representations and geo-databases (e.g. GeoNames, ArcGIS, and Google Earth[2)]).

NOTE 1 Texts are often completely unspecified for frames of reference (texts are, so to speak, “not situated”) and it, therefore, appears that the annotation of a frame of reference cannot be provided for many texts.

2) GeoNames, ArcGIS, and Google Earth are examples of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products.

NOTE 2 Measure expressions, such as *20 miles*, have two attributes, numeric @value "20" and @unit "miles", but expressions like *near* and *far* have no unit specified. The annotation scheme proposed in this International Standard can only state that they are measure-related expressions only with its attribute @value specified, say with "near" or "far". As will be seen, many of the annotation cases are left underspecified.

7 Specification of ISOspace for spatial annotation

7.1 Overview: annotation vs. representation

As with other areas of work on semantic annotation carried by the ISO Working Group (IS0/TC 37/SC 4/WG 2), ISOspace draws a fundamental distinction between the concepts of annotation and representation; ISO 24612 does likewise. The term "annotation" is used to refer to the process of adding information to segments of language data or to refer to that information itself. This notion is independent of the format in which this information is represented. The term "representation" is used to refer to the format in which an annotation is rendered (for instance, in XML) independent of its content. According to ISO 24612, annotations are the proper level of standardization, not representations. This part of ISO 24617 therefore, defines a specification language for annotating documents with information about spatial entities and spatial relations at the level of annotations and then for representing these annotations in a specific way, either with XML or with a predicate-logic-like format, as used in Annex A. This language is called "ISOspace".

However, the current version of ISOspace does not offer a formal specification of its annotation structure with an abstract syntax and a formal semantics. This task will be taken up in a proposed work item, ISO PWI 24617-9, aims to achieve a full development of spatial semantics. Instead, ISOspace will simply specify a concrete XML-based syntax in 8.2 and a set of core annotation guidelines in Annex A.

7.2 Abstract syntax for the ISOspace annotation structure

An abstract syntax provides a theoretical basis for deriving various versions of a concrete syntax. In this part of ISO 24617, the abstract syntax of ISOspace is schematically represented by the UML-based metamodel (Figure 1), which specifies an annotation structure for spatial information consisting of two substructures: an entity structure and a link structure. The entity structure of ISOspace consists of basic spatial entities that are anchored to textual fragments called "markables" or "extents"; the link structure relates these spatial entities and assigns a specific relation-type to each relation.

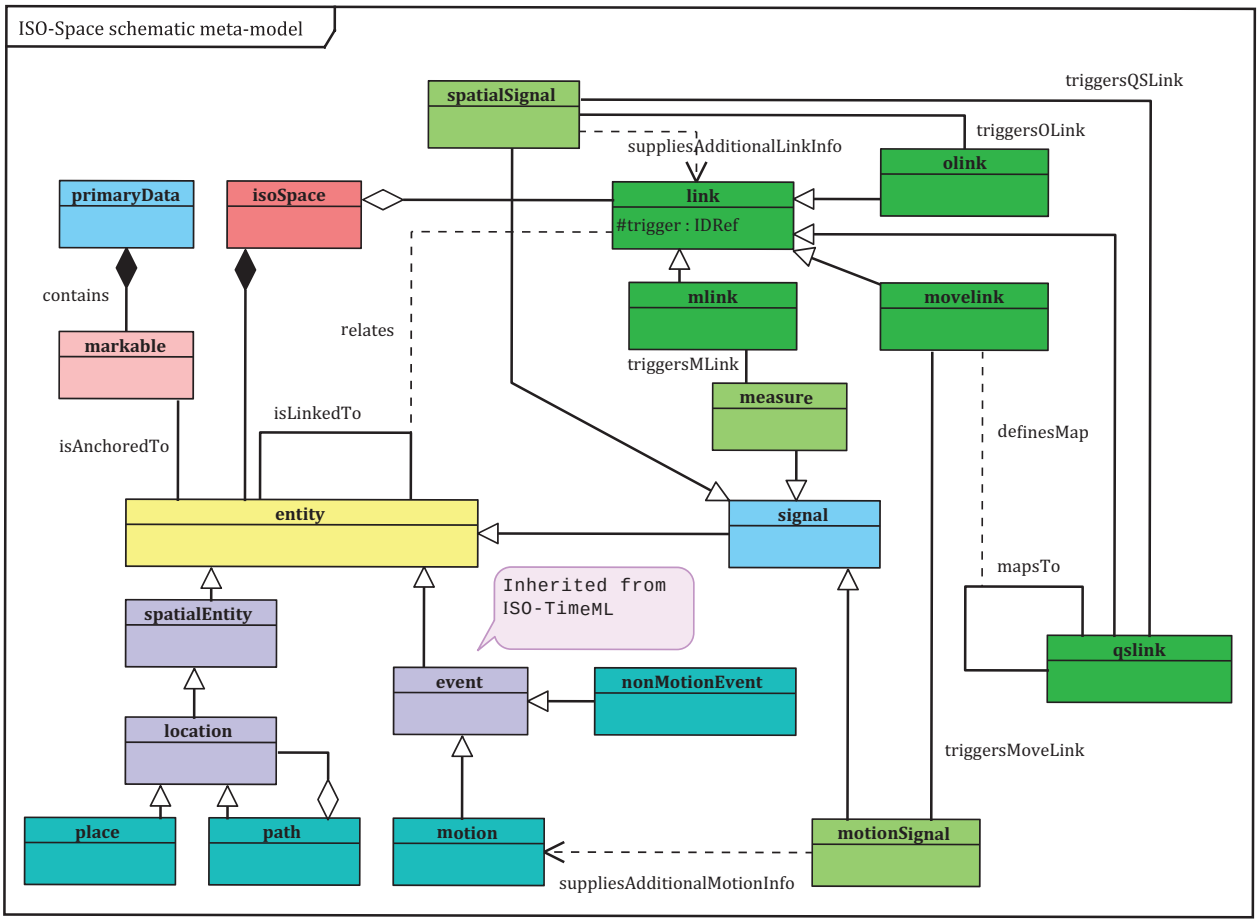

Figure 1 — Schematic metamodel of ISOspace

As Figure 1 shows, the annotation structure of ISOspace consists of the following three classes of entities and four types of links:

a) three major basic semantic entities: **spatial entity**, **event**, and **signal** with their respective subclasses:

   1) **spatial entity**: location: place and path;

   2) **event**: motion and non-motion event;

   3) **signal**: spatial signal, motion-signal, and measure;

b) four types of links: **qsLink**, **oLink**, **moveLink,** and **mLink**.

NOTE In earlier versions of ISOspace, the basic entity, **motion-signal**, was treated as part of **spatial signals**. However, in the current version, it is treated differently because of its specific function to motions that provides either additional information on either the *path* or the *manner* of motions. It is therefore called a *motion signal,* a *motion adjunct*, or simply an *adjunct* so that it is not confused with spatial signals.

8 Representation of ISOspace-conformant annotations

8.1 XML-based concrete syntax: outline

8.1.1 Overview

The version of ISOspace's concrete syntax in Clause 8 is an XML serialization of the spatial annotation structure or of abstract syntax informally presented in Clause 7 with a UML-based metamodel. The

concrete syntax of ISOspace consists of *basic entities* (8.1.2), *signals* (8.1.3), *links* (8.1.4), and the *root element* (8.1.5).

8.1.2 Basic entitles

There are five basic entity tags: <place>, <path>, <spatialEntity>, <motion>, and <event>.

NOTE The <place> and <path> tags are subclasses of a location, but the location itself is not introduced as forming its own element in this XML-based ISOspace. Non-location spatial entities are tagged simply as <spatialEntity>. There is no tag <nonLocationEntity> as such. The tag <event> is inherited from ISO 24617-1:2012(E) ISO-TimeML, but is understood in ISOspace to stand for the class of non-motion events.

8.1.3 Signals

There are three signal tags: <spatialSignal>, <motionSignal>, and <measure>.

8.1.4 Links

There are four links: <qsLink>, <oLink>, <moveLink>, and <mLink>.

In 8.4, the four links specified in ISOspace's link structure are represented by their respective XML tags.

8.1.5 Root element

Each bundle of XML elements forms a tree-like structure called an "XML document". This part of ISO 24617 has a single element called a "root element" that encloses all the other elements in the document.

For each ISOspace document, its root element is called"<isoSpace>".

EXAMPLE

```
<isoSpace>
<CONTENT of ISOspace annotations/>
</isoSpace>
```

8.2 Conventions for tagging

8.2.1 Naming conventions

Naming conventions can be quite complex. Here are four basic guidelines:

a) This part of ISO 24617 follows medial capitalization, also called "CamelCase", thus avoiding the use of the hyphen "-" or the underscore "_" in concatenating more than two words.

   EXAMPLE 1 <spatialEntity>, <motionSignal>, or @relatedToEvent, instead of <SPATIAL_ENTITY>, <MOTION_SIGNAL>, or @related_to_event.

b) This ISO 24617 also avoids the use of uppercase unless it is absolutely necessary (e.g. acronyms such as "XML" and UML class names such as "Entity" as a class).

   EXAMPLE 2 <isoSpace>, <semAF>, <motion>, <qsLink> instead of <ISOSpace>, <SemAF>, <MOTION>, or <QSLINK>.

   NOTE 1 "ISO" in "ISOspace" is the Greek prefix *iso-*, meaning "equal". "AF" is the acronym for "Annotation Framework".

   NOTE 2 ISOspace refers to this part of ISO 24617 and to the specification language for the annotation of motion, together with other type event-related spatial information presented in the ISO document; the element <isoSpace> refers to an XML tag for a concrete annotation of a textual fragment based on ISOspace.

c) This part of ISO 24617 therefore allows both lowerCamelCase and UpperCamelCase, although the XML serialization of ISOspace adopts lowerCamelCase for the representation of element names and tags.

d) The values of the various ID attributes are specified as beginning with one or more lowercase alphabetical characters, followed by an integer. This scheme is mandated by the syntax of XML.

EXAMPLE 3

```
<event xml:id="e12".../>, <place xml:id="pl23".../>
```

NOTE 3 "pl23'' is a valid XML ID, but "23'' is not.

Names for elements, attributes, and their values might be mentioned or listed in the documents. Where this occurs, the following mentioning conventions are followed:

— element names are braced with a pair of angled brackets;

EXAMPLE 4 <place>, <motion>, and <spatialEntity>

— attribute names are prefixed with @;

EXAMPLE 5 @value, @referencePt, and @frameType.

NOTE 4 @ is not part of attribute names.

— values of attributes are in double quotes.

EXAMPLE 6 birthPlace="Boston" and xml:id="e1".

NOTE 5 Some attribute values might refer to an ID value that occurs somewhere in the annotation, that is to say, an IDRef value. In cases such as this, the "#" symbol is prefixed to it.

EXAMPLE 7

```
<word xml:id="w2" pos="verb" lemma="run" tense="past"/>
<motion xml:id="m1" markable="#w2" .../>
```

8.2.2 Convention for inline tagging extents

For illustration, extents in a sample text are often inline tagged with their identifiers or some other tag names. Here are some conventions for such tagging:

a) Style guides generally do not recommend boldface text for providing emphasis. Hence, the use of boldface is discouraged.

EXAMPLE 1 Tsingtao beer is produced in **Qingdao**$_{tok7}$.

Boldface here is not recommended in actual tagging.

b) The end of each extent is marked with a unique ID in subscript.

EXAMPLE 2 Tsingtao beer is produced in Qingdao$_{tok7}$.

c) If an extent consists of more than one token, then it is enclosed by a pair of square brackets and an ID is placed outside of the closing bracket.

EXAMPLE 3 John hopped$_{m}$ [out of the room]$_{p}$.

d) If an extent is a non-contiguous sequence of more than one token, then each non-contiguous token is bracketed and marked with an identical ID.

EXAMPLE 4 Mia [looked]$_{e1}$ me [up]$_{e1}$.

8.3 Basic entity tags

8.3.1 <place>

The ISOspace <place> tag is inherited from Reference[40] with some additions and modifications. This tag is used to annotate geographic entities like lakes and mountains, as well as administrative entities like towns and counties. With the exception of implicit, non-consuming tags, a <place> tag in ISOspace should be directly linked to an explicit span of text.

The syntax and definition for the <place> tag are set out below.

List 1 — List of attributes for the <place> tag

```
<!ELEMENT place ( #PCDATA ) >
<!ATTLIST place id ID prefix="pl" #REQUIRED >
<!ATTLIST place markable (IDRef | CDATA) #REQUIRED >
<!ATTLIST place type (water|celestial|civil|country|grid|latLong|mtn|mts
|postalCode|postBox|ppl|ppla|pplc|rgn|state|UTM) #IMPLIED >
<!ATTLIST place dimensionality (point|line|area|volume) #IMPLIED >
<!ATTLIST place form ( nam | nom ) #IMPLIED >
<!ATTLIST place continent (AF|AN|AI|AU|GO|LA|NA|PA|SA) #IMPLIED >
<!ATTLIST place country CDATA #IMPLIED >
<!ATTLIST place state CDATA #IMPLIED >
<!ATTLIST place county CDATA #IMPLIED >
<!ATTLIST place ctv ( city | town | village ) #IMPLIED >
<!ATTLIST place gazref CDATA #IMPLIED >
<!ATTLIST place latLong CDATA #IMPLIED >
<!ATTLIST place elevation CDATA #IMPLIED >
<!ATTLIST place mod CDATA #IMPLIED >
<!ATTLIST place dcl ( true | false ) #IMPLIED "false" >
<!ATTLIST place comment CDATA #IMPLIED >
```

The ATTLIST can specify that an attribute can be any of the following (this list is not exhaustive):

a) ID should start with an alphabetic character and may not contain spaces. An ID value should be unique within the document. The name of the attribute @id may take a prefix "xml:" for XML documents.

b) IDRef should be a value that is used as an ID somewhere in the document or in the annotation.

c) CDATA is any parsed character data.

d) "#REQUIRED" is for required attributes, whereas "#IMPLIED" is for optional ones, allowing no value to be specified.

NOTE 1 A value for the attribute @latLong attribute will be provided automatically and it is therefore, not usual for it to be manually specified.

The attributes for the <place> tag are largely inherited from Reference[40]. For example:

— the value "mtn" stands for mountain;

— the value "mts" for mountain range;

— the value "ppl" stands for populated place;

— the value "ppla" stands for a capital of a sub-country (populated area), such as a state or a province;

— the value "pplc" stands for a capital of a country (populated place);

— the value "rgn" stands for a (non-political or non-administrative) region, such as a desert.

For places that have known latitude and longitude values, the @latLong attribute can be used to allow for mapping to other resources such as Google Maps[3)].

NOTE 2 For further details, see Reference[40] Table 1, ISO 3166-1:1999, Table 2 and Table 4, as well as other parts of the manual as a whole.

Adopting standoff annotation, ISOspace requires an attribute @markable to refer to a markable in a tokenized text or an extent in the given text. It also includes a Document Creation Location or @dcl attribute, which is a special location that serves as the "narrative location". If the document includes a @dcl, it is generally specified at the beginning of the text, in rather the same way that a Document Creation Time is specified in ISO-TimeML. If a place is the DCL, the special @dcl attribute is annotated as "true" and all other location tags have the default @dcl value of "false". The current set of <place> attributes is shown in List A.1 in A.3.1.2.

NOTE 3 The default value for the attribute @dcl is "false". This means that a document creation location is not specified.

NOTE 4 It is worth remembering that, by convention, the tag names such as <place> and the value of each attribute are no longer represented in uppercase, but in lowercase (unless they are acronyms), while the name of each attributes such as **latLong** is followed by the prefix @, thus being represented as @latLong. This convention is adopted throughout the whole document.

The values for the @type attribute are identical to those for the SpatialML <place> tag, although there are exceptions, such as "vehicle", which is a <spatialEntity> (spatial entity) in ISOspace and "road", which is a <path> in ISOspace. The tag <place> can be in the form of proper names (*New York*) or nominals (*town*); these are marked with the @form attribute as "nam" or "nom" respectively. For applications to countries other than the U.S., ISOspace also adds "province" both as a value for the attribute @type and as an attribute for the element <place>.

EXAMPLE Text: Tsingtao beer is produced in Qingdao$_{tok7}$.

```
<place xml:id="pl01" markable="#tok7" form="nam" type="ppl" ctv="city"
province="Shandong" country="CN"/>
```

NOTE 5 For its value, the attribute @target can refer to a token in a tokenized text. However, in ISOspace, it has been replaced with the attribute @markable, which takes a) an extent directly out of the text as its value in order to make examples more readable and b) a token ID. It follows that, in the above example, the value "$_{tok7}$" of the @markable can be replaced with "Qingdao" or use them interchangeably.

NOTE 6 Although this part of ISO 24617 describes the full ISOspace language, many of the example annotations provided show the result of human annotation but do not include elements (e.g. attributes and/or attribute values) that can be introduced by later processing components (e.g. the closure tool).

The @mod attribute is intended to capture cases like *tall building*, *long trail*, and *the higher observation deck* where *tall*, *long*, and *higher* do not constrain the location of the entity but do add spatial information. The @mod attribute is substantially different from its counterpart in SpatialML, where it was used for modifiers like *bottom of the well*, *Burmese border*, *near Harvard*, *northern India*, and *the right side of the building*. In many cases, these modifiers are deemed necessary in SpatialML because SpatialML focuses on annotating gazetteer entries. In ISOspace, these cases are analyzed in one of two ways

a) the SpatialML modifier is a <spatialSignal> for a spatial relation, or

b) the entire phrase is a <place>.

NOTE 7 Given this discrepancy with SpatialML, it is likely that the ISOspace annotator will have to perform some "clean-up" of the <place> elements that are inherited from a SpatialML annotation. However, as this matter is not relevant to this International Standard, it will be addressed in the annotation guidelines.

3) Google Maps is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of these products.

Sometimes, it is necessary to capture location information of places without explicit extents in the text. In such cases, ISOspace allows for creation of non-consuming <place> tags. For example, a non-consuming <place> tag would be necessary in the case of *John climbed to 9 000 feet*, where the elevation *9 000 feet* indirectly references a location that is not associated with any extent in the text. Once a non-consuming <place> tag is created, the identifier of a <measure> can be supplied to the @elevation attribute for the <place>; either the <place> tag's identifier can be supplied to attributes of other tags, or else the <place> can be related to other entities via links.

The attribute @comment introduces any relevant remarks on the content of the tag itself.

8.3.2 <path>

The spatial entity <path> is a location where the focus is on the potential for traversal or else it functions as a boundary. This spatial entity includes common nouns like *road*, *coastline*, and *river* and proper names like *Route 66* and *Kangamangus Highway*.

The <path> tag typically has @begin points and @end points, although these points might not be referred to explicitly in the text. Although traversals of <path>s are inherently directional, <path>s themselves are not, and the choice between what is the @begin point and what is the @end point is therefore, arbitrary.

The attributes of the <path> tag are a subset of the attributes of the <place> tag, but with the additional @beginID, @endID, and @midIDs attributes.

List 2 — List of attributes for the <path> tag

```
<!ELEMENT path ( #PCDATA ) >
<!ATTLIST path id ID prefix="p" #REQUIRED >
<!ATTLIST path markable ( IDRef | CDATA) #REQUIRED >
<!ATTLIST path beginID IDRef #IMPLIED >
<!ATTLIST path endID IDRef #IMPLIED >
<!ATTLIST path midID IDRefs #IMPLIED >
<!ATTLIST path dimensionality (line | area | volume ) #IMPLIED >
<!ATTLIST path form ( nam | nom ) #IMPLIED >
<!ATTLIST path gazref CDATA #IMPLIED >
<!ATTLIST path latLong CDATA #IMPLIED >
<!ATTLIST path elevation CDATA #IMPLIED >
<!ATTLIST path mod CDATA #IMPLIED >
<!ATTLIST place dcl ( true | false ) #IMPLIED "false" >
<!ATTLIST path comment CDATA #IMPLIED >3
```

EXAMPLE 1 The railroad$_{token2}$ between Boston$_{pl1}$ and New York$_{pl2}$

```
<path xml:id="p1" markable="railroad" beginID="#pl1" endID="#pl2" form="nom"/>
```

EXAMPLE 2 We descended into a long valley$_{token6}$.

```
<path xml:id="p2" markable="valley" form="nom" mod="long"/>
```

NOTE 1 A "point" is not listed here as a possible value for the attribute @dimensionality of <path> because a path is understood to be a location of more than one dimensionality.

NOTE 2 Here, the noun *valley* is annotated as a path. In a different context, such as in *John lives in a valley*, it can be annotated as a place.

8.3.3 <spatialEntity>

An entity that is tagged as <spatilEntity> in ISOspace is generally anything that is spatially relevant, but which does not fit into either the <place> or the <path> category. In order to be considered spatially relevant, the entity should both be located in real-space and participate in an ISOspace link tag. In practice, moving objects and objects that have the potential to move are most commonly tagged as

<spatialEntity>s. For example, vehicles are designed potentially to move but they are not considered to be inherently places or paths and are therefore marked up as <spatialEntity>s.

List 3 — List of attributes for the <spatialEntity> tag

```
<!ELEMENT spatialEntity ( #PCDATA ) >
<!ATTLIST spatialEntity id ID prefix="se" #REQUIRED >
<!ATTLIST spatialEntity markable (IDRef | CDATA) #REQUIRED >
<!ATTLIST spatialEntity type ( facility | vehicle | person | dynamicEvent | artifact )
#IMPLIED > DISCUSS
<!ATTLIST spatialEntity dimensionality ( point | line | area | volume ) #IMPLIED >
<!ATTLIST spatialEntity form ( nam | nom ) #IMPLIED >
<!ATTLIST spatialEntity latLong CDATA #IMPLIED >
<!ATTLIST spatialEntity elevation CDATA #IMPLIED >
<!ATTLIST spatialEntity mod CDATA #IMPLIED >
<!ATTLIST spatialEntity comment CDATA #IMPLIED >
```

EXAMPLE Two [**cars**$_{token2}$] are parked on the street.

```
<spatialEntity xml:id="se1" markable="#token2" form="nom"/>
```

8.3.4 <motion>

A <motion> is an ISO-TimeML event that involves a change of location of some entity. Since <motion> events are inherently spatial, they play a special role in ISOspace. When an ISO-TimeML event has been identified as a <motion>, it is re-annotated with the <motion> tag that has additional attributes.

List 4 — List of attributes for the <motion> tag

```
<!ELEMENT motion ( #PCDATA ) >
<!ATTLIST motion id ID prefix="m" #REQUIRED >
<!ATTLIST motion markable (IDRef | CDATA) #REQUIRED >
<!ATTLIST motion motionType ( manner | path | comopound ) #IMPLIED >
<!ATTLIST motion motionClass ( move | moveExternal | moveInternal | leave | reach | cross
| detach | hit | follow | deviate | stay ) #IMPLIED >
<!ATTLIST motion motionSense ( literal | fictive | intrinsicChange ) #IMPLIED>
<!ATTLIST motion mod CDATA #IMPLIED >
<!ATTLIST motion comment CDATA #IMPLIED >
```

The @motionType attribute refers to the two distinct strategies for expressing concepts of motion in language: *path constructions* and *manner of motion constructions*.[61] This is illustrated in the sentences in the following example, where *m* indicates a manner verb and *p* indicates a path. In the first sentence, the motion verb specifies a path, whereas in the second one, the motion verb specifies the manner of motion. The motions in these sentences are of the @motionType COMPOUND since they supply both path and manner information.

EXAMPLE a. John arrived$_p$ [by foot]$_m$.

b. John hopped$_m$ [out of the room]$_p$.

NOTE 1 The prepositional phrases *by foot* and *out of the room* above are manner and path adjuncts. They are tagged as <motionSignal>s and influence the value of the respective @motionType attributes.

Motion classes are taken from Reference[51] which was in turn based on the motion classes in Reference[44]. These classes are associated with a spatial event structure that specifies the spatial relations between the arguments of the motion verb at different phases of the event.

The @motionSense attribute distinguishes between the following different kinds of interpretation of motion-events:

— the "literal" sense covers motion-events where the mover participant's location changes over time;

— the "fictive" sense covers cases where the event involves an atemporal, experiential change in an extrinsic, spatial property (e.g. elevation or location);

— the “intrinsicChange” sense covers motion verbs that describe change in some intrinsic, spatial characteristic (e.g. height, width, length, or shape). This attribute disambiguates motion examples such as *the balloon rose above the building* from *the river rose above the levee*; in the latter case, a “literal” interpretation (i.e. the river’s elevation increased) is inappropriate;

— the @motionSense attribute also captures “fictive” motion interpretations such as *the mountain rises above the valley*, where there is no temporal interpretation (the mountain’s elevation increasing over time) but rather a purely spatial, atemporal interpretation predicating spatial characteristics of the mountain over some region.

NOTE 2 See A.4.2 for both detailed information on the element <motion> and for examples.

8.3.5 <event> for non-motion event

An <event> for a non-motion event is an ISO-TimeML <event> that does not involve a change of location, but is directly related to another ISOspace element by way of a link. Events are inherited directly from an ISO-TimeML annotation and require no further specification in ISOspace, except that the tag <event> is changed to <nonMotionEvent> and its idPrefix “e” is changed to “nme”. But note that there are additional attributes for this <event> in ISOspace to be specified, as shown below.

List 5 — List of attributes for the <event> tag

```
<!ELEMENT event ( #PCDATA ) >
<!ATTLIST event id ID prefix=”e” #REQUIRED >
<!ATTLIST event markable (IDRef | CDATA) #REQUIRED >
<!ATTLIST event latLong CDATA #IMPLIED >
<!ATTLIST event elevation CDATA #IMPLIED >
<!ATTLIST event mod CDATA #IMPLIED >
<!ATTLIST event comment CDATA #IMPLIED >
```

EXAMPLE John $\text{grew}_{\text{token2}}$ $\text{up}_{\text{token3}}$ in Boston.

```
<event xml:id=”e1” markable=”#token2 #token3” />
```

NOTE 1 In ISO-TimeML, the element <event> has no attributes such as @latLong, @elevation or @mod. These are added to associate <event>s for non-motion events in ISOspace with other spatial entities in general.

NOTE 2 The attributes @pos, @tense, and @aspect were removed from the element <event> in ISO-TimeML.

8.3.6 <motionSignal>

The <motionSignal> tag is introduced in ISOspace to capture either manner or path type information on motions.

List 6 — List of attributes for the <motionSignal> tag

```
<!ELEMENT motionSignal ( #PCDATA ) >
<!ATTLIST motionSignal id ID prefix=”ms” #REQUIRED >
<!ATTLIST motionSignal markable (IDRef | CDATA) #REQUIRED >
<!ATTLIST motionSignal motionSignalType ( manner | path | compound) #REQUIRED >
<!ATTLIST motionSignal mod CDATA #IMPLIED >
<!ATTLIST motionSignal comment CDATA #IMPLIED >
```

EXAMPLE 1 John walked to_{ms1} the store.

```
<motionSignal xml:id=”ms1” motionSignalType=”path”/>
```

EXAMPLE 2 John left the garage $[\text{by car}]_{\text{ms2}}$.

```
<motionSignal xml:id=”ms2” motionSignalType=”manner”/>)
```

EXAMPLE 3 John arrived in$_{ms3}$ Boston.

```
<motionSignal xml:id="ms3" motionSignalType="path"/>
```

NOTE See 8.4.3 for how <motionSignal> is used in conjunction with <moveLink>, and A.4.3 for detailed information on <motionSignal>s.

8.3.7 <spatialSignal>

<spatialSignal>s trigger topological or qualitative spatial relations <qsLinK>, orientational relations <oLink>, or both topological and orientational relations. The attribute @semanticType is required for the element <spatialSignal>. The attribute @semanticType should be specified for the <spatialSignal> element by one of the three possible values: topological, directional, and dirTop, as listed below:

— if its @semanticType, attribute is topological, <spatialSignal> triggers <qsLink>;

— if it is directional, <spatialSignal> triggers <oLink>;

— if the attribute is specified as 'dirTop', both of the <qsLinK and <oLink> links are triggered.

Its 'topological' value triggers <qsLink>, the value 'directional' <oLink> and the value 'dirTop', and both <oLink> and <qsLink>.

List 7 — List of attributes for the <spatialSignal> tag

```
<!ELEMENT spatialSignal ( #PCDATA ) >
<!ATTLIST spatialSignal id ID prefix="ss" #REQUIRED >
<!ATTLIST spatialSignal markable (IDRef | CDATA) #REQUIRED >
<!ATTLIST spatialSignal cluster CDATA #IMPLIED >
<!ATTLIST spatialSignal semanticType ( topological | directional | dirTop ) #REQUIRED >
<!ATTLIST spatialSignal mod CDATA #IMPLIED >
<!ATTLIST spatialSignal comment CDATA #IMPLIED >
```

EXAMPLE 1 Danielle was headed [**west-northwest**$_{ss3}$] at near 17 mph (28 kmph).

```
<spatialSignal xml:id="ss3" semanticType="directional"/>
```

EXAMPLE 2 The cup is [**on**$_{ss1}$] the table.

```
<spatialSignal xml:id="ss1" cluster="on-1" semanticType="dirTop"/>
```

NOTE See A.5.1 for a more detailed information on spatial signals and measurements.

8.3.8 <measure>

The <measure> tag plays its role in measurement relations, providing quantitative information on the dimensions (e.g. length and height) of spatial entities or their relations (e.g. distances). The attributes @value and @unit are two attributes required for the element <measure>, as shown below.

List 8 — List of attributes for the <measure> tag

```
<!ELEMENT measure ( #PCDATA ) >
<!ATTLIST measure id ID prefix="mes" #REQUIRED >
<!ATTLIST measure markable (IDRef | CDATA) #REQUIRED >
<!ATTLIST measure value CDATA #REQUIRED >
<!ATTLIST measure unit CDATA #REQUIRED >
<!ATTLIST measure mod CDATA #IMPLIED >
<!ATTLIST measure comment CDATA #IMPLIED >
```

EXAMPLE John walked for [5 miles]$_{me1}$.

```
<measure xml:id="mes1" markable="5 miles" value="5" unit="miles">
```

NOTE See A.5.1.2 for a more detailed information on measurements.

8.4 Link tags

8.4.1 <qsLink>

The tag <qsLink>s is used in ISOspace to annotate topological relationships between two or three targeted elements in the annotation.

List 9 — List of attributes for the <qsLink> tag

```
<!ELEMENT qsLink EMPTY >
<!ATTLIST qsLink id ID prefix="qsl" #REQUIRED >
<!ATTLIST qsLink relType ( IN | DC | EC | PO | TPP | ITPP | NTPP | INTPP | EQ ) #IMPLIED >
<!ATTLIST qsLink figure IDRef #IMPLIED >
<!ATTLIST qsLink ground IDRef #IMPLIED >
<!ATTLIST qsLink trigger IDRef #IMPLIED >
<!ATTLIST qsLink comment CDATA #IMPLIED >
```

The @relType attribute values come from an extension to the RCC8 set of relations that was first used by SpatialML (see Table A.1). The possible RCC8+ values include the RCC8 values in addition to "in", which is a disjunction of "TPP" and "NTPP".

It is worth noting that while the <qsLink> tag is used exclusively for capturing topological relationships (they are only possible between two regions), the @figure and @ground attributes can accept IDs for both <place>s and <path>s (these are more traditional regions), as well as for <spatialEntity> tags, <event> tags, and <motion> tags. In the case of the last three types of tag, it is the region of space associated with the location of the entity or event that participates in the <qsLink> tag; in other words, the entity or event is coerced to a region for the purposes of interpreting this link.

In practice, a <qsLink> is triggered by a <spatialSignal> with a @semanticType of "topological" or "dirTop". This is shown in the following examples.

EXAMPLE 1 $[\text{The book}]_{se1}$ is on_{ss1} $[\text{the table}]_{se2}$.

```
 <spatialSignal xml:id="ss1" markable="on" cluster="on-1" semanticType="dirTop"/>
<qsLink xml:id="qsl1" figure="#se1" ground="#se2" trigger="#ss1" relType="EC"/>
```

EXAMPLE 2 $[\text{The light switch}]_{se3}$ is on_{ss2} $[\text{the wall}]_{se4}$.

```
<spatialSignal xml:id="ss2" markable="on" cluster="on-2" semanticType="dirTop"/>
<qsLink xml:id="qsl2" figure="#se3" ground="#se4" trigger="#ss2" relType="PO"/>
```

NOTE It is assumed here that all of the four spatial entities have been annotated with their IDs as shown with the subscripts, so that they can be referred to.

8.4.2 <oLink>

Orientation links describe non-topological relationships between ISOspace elements. A <spatialSignal> with a directional @semanticType triggers such a link. In contrast to qualitative spatial relations, <oLink> relations are built around a specific frame of reference type and a reference point. The attributes for <oLink> are as follows:

List 10 — List of attributes for the <oLink> tag

```
<!ELEMENT oLink EMPTY >
<!ATTLIST oLink id ID prefix="ol" #REQUIRED >
<!ATTLIST oLink relType CDATA #IMPLIED >
```

```
<!ATTLIST oLink figure IDRef #IMPLIED >
<!ATTLIST oLink ground IDRef #IMPLIED >
<!ATTLIST oLink trigger IDRef #IMPLIED >
<!ATTLIST oLink frameType ( absolute | intrinsic | relative | unspecified ) #IMPLIED >
<!ATTLIST oLink referencePt CDATA #IMPLIED >
<!ATTLIST oLink projective ( true | false ) #IMPLIED >
<!ATTLIST oLink comment CDATA #IMPLIED >
```

The @referencePt value depends on the @frameType of the link. The "absolute" frame type stipulates that the @referencePt is a cardinal direction. For "intrinsic" <oLink>s, the @referencePt is the same identifier that is given in the @ground attribute. For "relative" <oLinK>s, the identifier for the viewer should be provided relative to the @referencePt. For "unspecified" <oLink>s or where the viewer is not explicit in the text, the special value "viewer" should be used for the attribute @referencePt. The @projective attribute is a Boolean that determines whether the <oLink> should have a projective interpretation. This information generally depends on which spatial signal triggered the <oLink>. Projective interpretations add an additional spatial dimension, against which the oLink value is evaluated (e.g., going from a 1-D to a 2-D reading for a preposition).

EXAMPLE 1 . Boston_{pl1} $[\text{north of}]_{ss1}$ $[\text{New York City}]_{pl2}$.

```
      <oLink xml:id='ol1" figure="#pl1" ground="#pl2" trigger="#ss1" relType="north"
frameType="absolute"
      referencePt="north" projective="true"/>
```

<oLink> tags also capture projective information. Consider the sentences in the following examples:

EXAMPLE 2 a) The helicopter_{e1} is above_{ss1} the town_{pl1}.

b) The hill_{pl2} is above_{ss2} the town_{pl3}.

c) The $[\text{city of Boston}]_{pl4}$ is $[\text{north of}]_{ss3}$ $[\text{Stoughton, MA}]_{pl5}$.

d) The $[\text{city of Boston}]_{pl6}$ is $[\text{north of}]_{ss4}$ $[\text{New York City}]_{pl7}$.

Both examples a) and b) in example 2 above use the same <spatialSignal> word, *above*. However, in example 2a), the likely interpretation is that the *helicopter* is located directly above the *town*. This is not the most salient interpretation for example 2b); hills usually do not fly or hover above towns. To distinguish between these two interpretations, the <oLink> in example 2b) has a projective interpretation in which it is imagined that the region associated with the town projects outwards beyond its normal limits. It is this projected region, which is associated with the town that the hill is located above. It follows that both of these sentences should have nearly identical <oLink> tags created for them, except that the @projective attribute value for the link for example 2b) will be flagged as "true" and it is "false" for example 2a).

The issue of projectivity might also arise for <oLink> tags involving any of the four cardinal directions. In example 2c), the relation between Boston and Stoughton would not be projective because Boston is directly north of Stoughton, but the relation in example 2d) would be projective because Boston is indirectly north of New York City. The actual relationship in example 2d) could be described with a @relType of "northeast", although this information is not directly accessible from the language; that kind of world-knowledge would have to be looked up from a gazetteer entry. The above examples include annotations that illustrate this distinction in further detail.

8.4.3 <moveLink>

The <moveLink> tag connects @motion events with @mover participants. The other attributes of the <moveLink> tag are then used to specify any evident information about components of the event-path and any motion signals. <moveLink> tags are always introduced by a triggering <motion> tag, so whenever annotators tag an extent with the <motion> tag, they are also committing themselves to creating a corresponding <moveLink>. The annotation for the <moveLink> depends on the **@**motionType of the <motion> (i.e. "manner", "path", or "compound"). A bare-manner motion verb (e.g. *David cycles seriously*) still triggers a <moveLink>, although most of the attributes will be underspecified since there

is no evident event-path information. At the other extreme, it is possible for “path” or “compound” type motions to make use of the full range of <moveLink> attributes.

List 11 — List of attributes for the <moveLink> tag

```
<!ELEMENT moveLink EMPTY >
<!ATTLIST moveLink id ID prefix=”mvl” #REQUIRED >
<!ATTLIST moveLink trigger IDRef #IMPLIED >
<!ATTLIST moveLink source IDRef #IMPLIED >
<!ATTLIST moveLink goal IDRef #IMPLIED >
<!ATTLIST moveLink midPoint IDRefs #IMPLIED >
<!ATTLIST moveLink mover IDRef #IMPLIED >
<!ATTLIST moveLink ground IDRef #IMPLIED >
<!ATTLIST moveLink goalReached ( yes | no | uncertain ) #IMPLIED >
<!ATTLIST moveLink pathID IDRef #IMPLIED >
<!ATTLIST moveLink motionSignalID IDRef #IMPLIED >
<!ATTLIST moveLink comment CDATA #IMPLIED
```

The @trigger value of a <moveLink> is filled by the <motion> tag ID of the motion that is being linked to the @mover participant.

The @source, @goal, @midPoint, and @ground attributes are used when the @trigger is a “path” or “compound” type <motion>. Motions of these types always include some information about the path traversed by the @mover (i.e. the event-path). This information is stored in the <movelink>’s @source, @goal, @midPoint, and @ground attributes.

NOTE There can be more than one value (IDRef) for the attribute @midPoint.

The values for these attributes may be filled by any ISOspace location tag, or any tag which can be coerced to act as a location including <place>, <path>, <spatialEntity>, <event>, and <motion> tags, although they will usually be filled with IDs of <place> or <path> tags. When creating <movelink> tags, it is important not to look across sentence boundaries to find @source, @goal, @ground, or other event-path information, but rather to allow post-processing to fill in that kind of information.

The @mover attribute specifies the tag element that participates in the <motion> event by changing location. The @mover attribute usually takes an ID of a <spatialEntity>, although it may also be filled by a location tag or event tag coerced to a location.

The @ground attribute identifies another ISOspace element whose location acts as a ground within a figure-ground relation where the figure corresponds to the ISOspace element identified in the @mover attribute for the <moveLink>. Not all classes of motion-events require a @ground to be specified, but <movelink> tags triggered by “moveExternal” and “moveInternal” class motion-events demand specific @ground to be identified.

The @goalReached attribute, which can have a value of “true”, “false” or “uncertain”, is used for those cases where it is not clear from the text whether the identified @goal location was reached. If there is no @goal location associated with the event, this attribute will be left unspecified. For instance, in *John arrived in Boston*, the @goalReached attribute would be set to “true”. To take another example, in *John left for Boston*, *Boston* appears to be the @goal of the <motion>, but the reader does not know if *John* ever really got there. In such a case, the @goalReached attribute should be set to “uncertain”. Marking @goalReached as “uncertain” stipulates that the annotator is unsure of *John*’s location within the narrative after the *left* <motion> event has occurred. Note that it does not fall within the purview of ISOspace to capture negation or modality. In the case of *John* ***did not*** *arrive in Boston*, the negation does not affect the @goalReached attribute value, which should be set to “true”. Although it is true, within the spatial narrative, that *John*’s location would not be *Boston* after the motion-event had been completed, the @goal location of *Boston* would have been reached if the verb phrase headed by *arrive* was not negated. Contrastively, in *John approached Boston*, @goalReached would be filled as “false” because, on completion of the approach motion-event, *John* would still not have reached *Boston*.

The @motionSignalD attribute takes the IDs of any <motionSignal> tags contributing to the manner of motion or the event-path of the triggering <motion>. @motionSignalD is an optional attribute because

not all motion verbs are accompanied by motion signals. For example, in *John traveled by car*, the phrase *by car* is a <motionSignal> but for *John traveled for three days*, there is no <motionSignal>.

EXAMPLE The past week has been a long ride$_{m1}$ through$_{ms1}$ northern Baja$_{pl1}$... $\emptyset_{se1}$.

```
<motion xml:id="m1" markable="ride" motionType="compound"
motionClass="moveInternal" motionSense="literal"/>
<place xml:id="pl1" markable="Baja" form="nom"/>
<motionSignal xml:id="ms1" markable="through"/>
<spatialEntity xml:id="se1" markable="" form="nom" countable="true"/>
<moveLink xml:id="mvl1" trigger="#m1" mover="#se1# ground="#pl1"
goalReached="uncertain" motionSignalID="#ms1"/>
```

8.4.4 <mLink>

Measurement relationships are captured with the <mLink> tag. This tag can describe either the relationship between two spatial objects or the dimensions of a single object.

List 12 — List of attributes for the <mLink> tag

```
<!ELEMENT mLink EMPTY >
<!ATTLIST mLink id ID prefix="ml" #REQUIRED >
<!ATTLIST mLink figure IDRef #IMPLIED >
<!ATTLIST mLink ground IDRef #IMPLIED >
<!ATTLIST mLink trigger IDRef #IMPLIED >
<!ATTLIST mLink relType ( distance | length | width | height | generalDimension ) #REQUIRED >
<!ATTLIST mLink val IDRef #REQUIRED >
<!ATTLIST mLink endPoint1 IDRef #IMPLIED >
<!ATTLIST mLink endPoint2 IDRef #IMPLIED >
<!ATTLIST mLink comment CDATA #IMPLIED >
```

NOTE The value of @trigger is the same as that of the attribute @val, that is to say, the ID of the tag <measure>. It follows that the attribute @val is redundant.

Where there is a measure of a distance between two spatial objects in a figure-ground configuration, the @figure attribute is used to identify the spatial object acting as the @figure and the @ground attribute specifies the object acting as the ground. Where there is a measure of an intrinsic spatial dimension of a single spatial object, the @figure specifies the ID of that ISOspace element and the @ground attribute is unspecified.

In cases where a dimension of a spatial object is described with explicit bounding points, the attributes @endPoint1 and @endPoint2 are used to specify ISOspace elements whose locations mark the bounds of a stative-path that corresponds to the dimension. These attributes are not used in cases where there are measures of distances between different spatial objects.

EXAMPLE We camped [three miles]$_{mes2}$ from the river$_{p1}$ $\emptyset_{pl2}$

```
<path xml:id="p1" markable="river"/>
<place xml:id="pl2" markable=""/>
<measure xml:id="mes2" markable="three miles" value="3" unit="miles"/>
<mlink xml:id="ml1" figure="#pl2" ground=#"p1" trigger="#mes2" relType="distance"
val="#mes2"/>
```

8.5 Root tag: <isoSpace>

NOTE ISO Space refers both to this part of ISO 24617 and to the specification language defined in that document for spatial annotation, whereas <isoSpace> is the root node for an XML-based annotation of a text that follows ISOspace. These two uses should not be confused.

All well-formed XML documents should have a single root node: in ISO 24617, it is <isoSpace>; for example, a sample, partially-annotated ISOspace document might look like this:

```
<?xml version="1.0" encoding="UTF-8" ?>
<text><![CDATA[
Sleeping alligator in the jungle
An alligator in the water between leaves; Puerto Maldonado, Peru
```

```
images/02/2007.jpg
]]></text>
<isoSpace xml:id="is1">
<place xml:id="pl0" markable="water" dimensionality="volume" form="noun" dcl="false"/>
<place xml:id="pl1" markable="Puerto Maldonado" dimensionality="area" form="nam" dcl="true"/>
<place xml:id="pl2" markable="Peru" dimensionality="area" form="nam" dcl="false"/>
<spatialEntity xml:id="se0" markable="alligator" dimensionality="volume" form="nom"/>
<spatialEntity xml:id="se1" markable="leaves" dimensionality="volume" form="nom"/>
<spatialSignal xml:id="ss0" markable="in" semanticType="topological"/>
<spatialSignal xml:id="ss1" markable="between" semanticType="dirTop" comment="right?"/>
<qsLink xml:id="qsl1" figure="#se0" ground="#pl0" trigger="#ss0" relType="IN"/>
<qsLink xml:id="qsl2" figure="#se0" ground="#se1 "trigger="#ss1" relType="between"/>
<qsLink xml:id="qsl3" figure="#pl1" ground="#pl2" relType="IN"/>
</isoSpace>
```

8.6 Summary

8.6.1 Identifier

Every element embedded in <isoSpace> has a unique identifier with an idPrefix followed by one or more integers. The following list shows how each element is assigned a unique identifier.

```
<isoSpace xml:id="is2"/>
<place xml:id="pl3"/>
<path xml:id="p5"/>
<spatialEntity xml:id="se7"/>
<motion xml:id="m8"/>
<event xml:id="e3"/>
<spatialSignal xml:id="ss3"/>
<motionSignal xml:id="ms3"/>
<measure xml:id="mes2"/>
<qsLink xml:id="qsl5"/>
<oLink xml:id="ol5"/>
<moveLink xml:id="mvl5"/>
<mLink xml:id="ml5">
```

Every idPrefix should be a sequence of one or more non-numeric characters.

NOTE 1 Note again that <place> and <path> are sub-elements of the element "location", but ISOspace has no valid <location> tag.

NOTE 2 ISOspace borrows the tag <event> from ISO-TimeML to annotate non-motion events, thus inheriting all of the attribute-value specifications from their corresponding ISO-TimeML <event> element. Both <motion> and <event> are valid tags in ISOspace.

Figure 2 also shows how a unique identifier is assigned to each of the ISOspace elements.

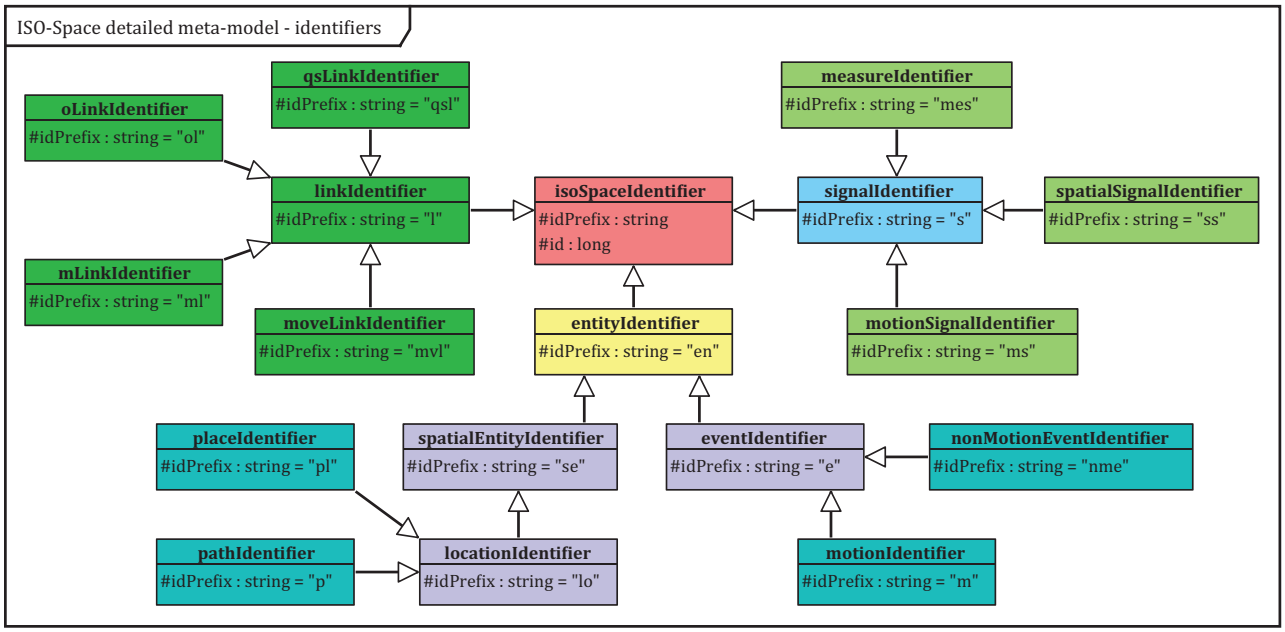

Figure 2 — Construction of identifiers in ISOspace

8.6.2 Shared attributes

Every element of ISOspace has, in addition to its required unique identifier, an optional attribute @comment that can have a string of any character data as its value.

Every extent tag (i.e. the element name that refers to a basic entity in ISOspace) has the required attribute @markable with its value IDRef (i.e. the token or word ID) or with its value CDATA (i.e. an extent in a given text). This attribute refers to a markable in a text to be annotated for spatial information. Additionally, every extent tag may have a list of attributes: @mod and @comment. The last three attributes are introduced to treat quantification of spatial objects.

Unlike the extent tags, the link tags, especially <moveLink> and <mLink>, have a somewhat heterogeneous list of attributes. Although some, such as @figure, @ground, @trigger and @relType, are shared to some extent.

Figure 3 below shows the ISOspace metamodel extended with the corresponding attributes. The subclasses inherit the attributes specified in each of the classes to which they belong.

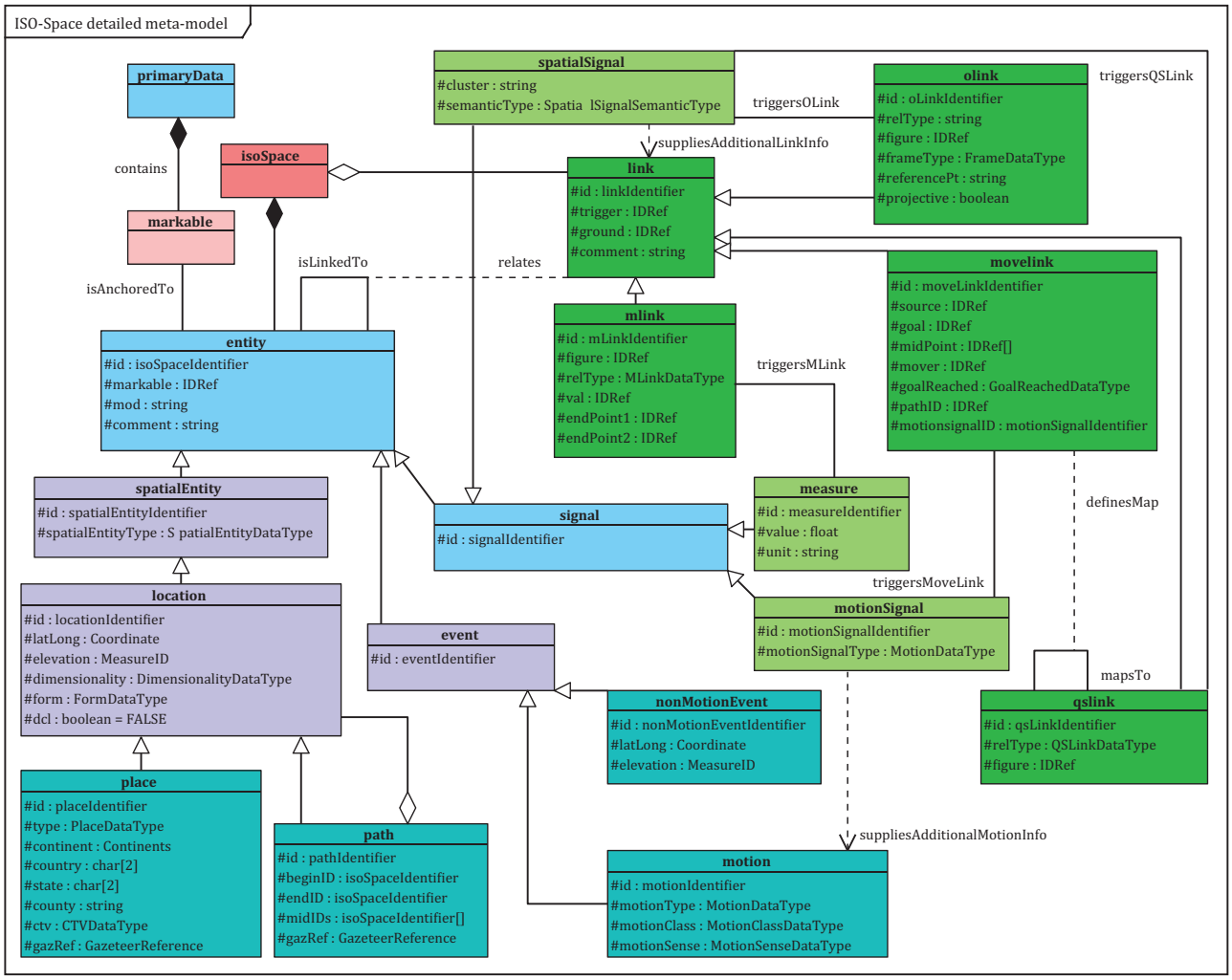

Figure 3 — The ISOspace metamodel extended with the corresponding attributes

8.6.3 IDRef as value

Many of the attributes have IDRef as their value. Except for the attribute @markable, which refers to a token ID of the extent or to the extent itself in a tokenized text outside the scope of <isoSpace>, each attribute, as listed below, has, as its value, an IDRef that refers to some other elements embedded within its scope.

List of tags that have IDs as their values

```
<path>: @beginID, @endID, @midIDs;
<qsLink> and <oLink>: @figure, @ground, @trigger;
<moveLink>: @trigger, @source, @goal, @midPoint, @mover, @ground, @pathID, @
motionSignalID;
<mLink>: @figure, @ground, @val, @endPoint1, @endPoint2;
<metaLink>: @objectID1, @objectID2.
```

This list demonstrates that every attribute ending with ID has IDRef as its value and that the attributes referring to locations or motions also have IDRef as their value. It can also be possible to name these attributes in such a way that their IDRef type value can be easily recognized.

Annex A
(normative)

Core annotation guidelines

A.1 General

This Annex describes the annotation guidelines for marking up text according to the ISOspace language. A.2 explains what the ISOspace tags (XML elements) are and how to use them. It also specifies each tag and what its attributes are and provides an extended BNF definition for the tag and its attributes, as specified in ISO/IEC 14977.

While this exposition contains many examples illustrating what and how to tag, the examples focus, for clarity's sake, on the tag under discussion at any given point.

NOTE This Annex is a revised version of *ISOspace Annotation Guidelines,* Version 1.7.0, (April 2013), written by James Pustejovsky, Jessica Moszkowicz, and Zachary Yocum at the ISOspace Working Group, Brandeis University. For this Annex, several important modifications have been made to the Brandeis Guidelines by ISO/TC 37/SC 4/WG 2 to ensure that they conform to the main part of this International Standard.

A.2 ISOspace tags and their attributes

The tags and attributes in the guidelines are organized as follows: A.3 to A.5 are divided into sub-clauses covering the different extent tags. In each sub-clause, what should be captured by each tag (the extent) is described and explained what additional information should be supplied (the attributes for that tag). A.6 explains how to annotate spatial relationships by constructing links between tagged extents.

When examples are given, they are shown using a predicate argument structure for readability. That is to say, the tagged extent is marked in the example text as $\text{extent}_{\text{id\#}}$ if the extent consists of a single token or $[\text{extent}]_{\text{id\#}}$ if the extent consists of more than one token, and the attributes assigned for that tag are listed separately in a format such as tagType(id=id#, markable="#token1", attribute1=value and attribute2= value, ...).

Each of the extent tags that mark-up location-type entities, event-type entities, and signals should be anchored to a (tokenized) text. This is done with the attribute @markable, which refers to a (possibly null or non-contiguous) sequence of tokens. To make this anchoring explicit in a text, extents are marked up with token IDs.

NOTE 1 The attribute @target was introduced into ISO-TimeML to refer to an extent ID in a tokenized source text. In ISOspace, however, this attribute name is replaced by the attribute @markable, which can refer either to the token ID of an extent or to an extent itself. For example, given a text *John left*, it can have either markable="#token2" or markable="left". This makes it easier to read annotations.

NOTE 2 When an attribute does not receive a value or the default value is assigned, it might not be included in the briefer examples in A.3 to A.6.

A.3 Places, paths, and spatial entities

A.3.1 Places

A.3.1.1 General

The <place> tag is used in ISOspace to annotate geographical entities and regions like *lakes* or *mountains* and administrative entities like *towns* or *countries*.

A.3.1.2 Place extents

In general, places are referred to explicitly in language such that there is a text extent to capture (i.e. consume) with a <place> tag. A place is generally a noun phrase (NP) and only the head nouns of NPs should be marked. The examples below show some <place> extents that should be captured with this tag.

NOTE In example c) below, the extent includes both and *MA*. This could be annotated with two <place> tags but, since it is really describing only one location, it is preferable to keep this as a single <place> extent.

EXAMPLE a) Boston$_{pl1}$ is north of [New York]$_{pl2}$.

b) John entered the store$_{pl3}$.

c) [Boston, MA]$_{pl4}$ -- It was reported today that...

d) [Back Bay]$_{pl5}$ is also served by Amtrak...

e) My father flew to Managua$_{pl6}$ with a silly-looking bicycle.

A.3.1.3 Place attributes

The majority of attributes for the <place> tag (shown in List A.1) are inherited directly from SpatialML. For the most part, the annotator does not need to fill in values for these attributes except that, as stated in the introduction, the extended BNF, specified in ISO/IEC 14977 is used to list attributes and their possible values for each of the ISOspace tags.

NOTE The extended BNF has simplified various notations that used to be employed, for instance, for TimeML. The defining symbol ::= is simply replaced by the equals sign '=', and the comma (,) is used as the concatenate symbol instead of a white space.

List A.1— Attributes for the <place> tag

```
attributes = identifier, markable, [type], [dimensionality], [form], [continent],
[country], [state], [province],[county], [ctv], [gazref], [latLong], [elevation], [mod],
[dcl], [comment];
      {* Attributes in square brackets are optional. The attribute @state may be replaced
by the attribute @province, depending on the country. *}
identifier = pl, decimal digit, {decimal digit}";
      {* The identifier is tagged "xml:id" for XML documents, otherwise "id". Examples are:
"pl3", "pl20". *}
markable = IDRef | CDATA;
      {* As its value, the attribute @markable has an extent ID in a tokenized source text
or the extent itself. It can be a (possibly null or non-contiguous) sequence of tokens or
their IDs. *}
type = "bodywater" | "celestial" | "civil" | "country" | "grid" | "latLong" | "mtn"
| "mts"| "postalCode" | "postBox" | "ppl" | "ppla" | "pplc" | "rgn" | "state" |
"province" | "UTM"; dimensionality = "point" | "line" | "area" | "volume"; form = "nam" |
"nom";continent = " AF" | "AN" | "AI" | "AU" | "GO" | "LA" | "NA" | "PA" | "SA";
country = CDATA;
    {* For code names for each country, state or province, See ISO 3166-1:1999 and its series. *}
state = CDATA; {* a principal subdivision of U.S.A. *}
county = CDATA; {* a principal subdivision of states *}
ctv = "city" | "town" | "village";
gazref = CDATA; {* A gazetteer name plus a colon plus an identifier: e.g. IGDB:2104656. *}
latLong = CDATA; {* a coordinate from the gazetteer.}
elevation = CDATA;
mod = CDATA;
dcl = "true" | "false"; {* Default is "false". *}
comment = CDATA;
```

NOTE 1 ISO 3166-1:1999 refers to the first part of a series of the ISO International Standards on 2-letter and 3-letter country codes developed by ISO/TC 37.

Annotators should first mark whether the extent of a <place> is a nominal form (as in *the mountain*) or a named location (as in *Mount Everest*). This is done using the @form attribute with the values '"nom" and "nam" respectively.

The second attribute that annotators should fill is the @elevation attribute. This attribute takes a <measure> ID if a location's elevation is established as in *The city of Zacatecas, at 8 000 feet* ... (See A.5.2 for more details regarding the <measure> tag). This is an optional attribute, so if no explicit elevation is set out in the text, the annotator should leave this attribute unspecified.

The @mod attribute is used to capture cases like *tall mountain*, *upper observation deck*, and *longest lake*, where *tall*, *upper*, and *longest* do not constrain the location of the location, but do contribute spatial information. The following is a list of scalar adjectival terms in English that may act as spatial modifiers, but it is not intended to be an exhaustive list of modifiers, and these terms do not always act as modifiers: *long*, *short*, *tall*, *low*, *high*, *deep*, *shallow*, *thin*, *narrow*, *wide*, *upper*, *lower*, *inner*, *outer*, *inland*, *near*, *far*, and *northern*. Remember that it is only the head of an NP that gets tagged as a <place> extent in ISOspace but the modifier should also be noted in the @mod attribute as shown in example a) below. Like the @ elevation attribute, if no spatially relevant modifier is referred to, this attribute should be left unspecified.

The @dcl attribute is used to specify the Document Creation Location (DCL). The @dcl is a special location that the author should declare as the location where the text was written. Such a location is often used in newswire text. Any given text can have no more than one @dcl and the default value for this attribute is set to "false". If the annotator can determine that a location tag is the DCL, the value of the @dcl attribute for the first instance of that location should be set to "true" and, from that point on, no other location tag in the text can be declared the DCL, even if the same location is referenced later in the text. In example b) below, it would be appropriate to mark a <place> tag as the dcl. Note that the second reference to *Boston* in this example is not the DCL.

Sometimes, it is necessary to create non-consuming <place> tags for locations when they are referred to indirectly in the text.

NOTE For further details regarding non-consuming tags, see A.3.4.

EXAMPLE a) John visited the tall building$_{pl1}$.

```
place(id=pl1, markable=building, form=name, mod=tall)
```

b) [Boston, MA]$_{pl2}$ – It was reported today in Boston$_{pl3}$ that ...

```
place(id=pl2, markable=Boston, MA, form=nam, dcl=true)
place(id=pl3, markble=Boston, form=nam, dcl=false)
```

c) It$_{pl4}$ contains 1,2 million square feet (111 484 square meters) of commercial and retail [space$_{pl5}$]

```
place(id=pl4, markable=it, form=nom)
place(id=pl5, markable=space, form=nom)
```

d) The skyscraper$_{pl6}$ at [111 Huntington Avenue]$_{pl7}$ was completed in 2002...

```
place(id=pl6, markable=skyscraper, form=nom)
place(id=pl7, markable=111 Huntington Avenue, form=nam)
```

e) [The Plaza de Armas]$_{pl8}$ is one of the most visited places in Cochabamba$_{pl9}$.

```
place(id=pl8, markable=range(token1,token4), form=nam)
place(id=pl9, markable=token13, form=nam)
```

f) There are two [Dunkin' Donuts]$_{pl10}$ in the area$_{pl11}$.

```
place(id=pl10, markable=range(token4,token6), form=nam)
place(id=pl11, markable=token9, form=nom)
```

A.3.2 Paths

A.3.2.1 General

The <path> tag captures locations where the focus is on the potential for traversal or where the location functions as a boundary. This includes common nouns like *road*, *river*, and *border*, as well as proper names like *Route 66* and *Kangamangus Highway*. The distinction between places and paths is not always clear-cut. For example, take the case of *river* in *follow the river* and *cross the river*: in the former, it is clearly is a path, but one could argue that, in the latter, the traversal functionality is not accessed and therefore, *river* could be annotated as a <place>.

While the inferences that can be made with both places and paths are actually identical, it is important for inter-annotator agreement to try to apply a diagnostic test in order to determine if a location should be tagged as a <place> or a <path>.

One useful heuristic is the "*be-at/take*" test (i.e. while you can *be at* a place or path location, you can only *take* or *follow* a path). In general, it should be consistent, such that when an annotator comes across something like a road that typically has the potential to be traversed or followed, he/she does not need to consider whether that particular road is functioning more like a place in that particular context. Locations such as *roads*, *rivers*, *alleys*, *walls*, *stairways*, *shorelines*, *ridgelines*, and *mountain ranges* should be consistently marked with the <path> tag for this round of annotation.

A.3.2.2 Path extents

Paths occur within noun phrases and, consistent with the <place> tag, only the head of the NP should be captured as the extent for the <path> tag. Note that the <path> tag in ISOspace is only used to capture static, non-stative paths. Dynamic event-paths are captured using the <motion> tag (see A.4.2).

EXAMPLE *Trip* in the *trip from Los Angeles to Hollywood* would not be tagged as a <path> but *road* in the *road from Los Angeles to Hollywood* would.

A.3.2.3 Path attributes

<path> tags have some attributes that overlap with the <place> tag. The <path> attributes are shown in List A.2.

List A.2 — Attributes for the <path> tag

```
attributes = identifier, markable, [type], [beginID], [endID], [midIDs], [dimensionality],
[form], [gazref], [latLong], [elevation], [mod], [dcl], [comment];
identifier = p, decimal digit, {decimal digit}";
            {* The identifier is tagged "xml:id" for XML documents, otherwise "id".
Examples are: "p3", "p20". *}
markable = IDRef | CDATA;
type = "bodyofwater" | "mts" | "road";
beginID = IDRef; {* ID of a location/entity/event tag whose location is a bounding point
of the path *}
endID = IDRef; {* ID of a location/entity/event tag whose location is a bounding point
of the path *}
midIDs = IDRef; {* IDs list of mid-points *}
dimensionality = "line" | "area" | "volume"; {* The value "point" is deleted. *}
form = "nam" | "nom"; {* name or nominal *}
gazref = CDATA; {* A gazetteer name plus a colon plus an identifier: e.g., IGDB:2104656. *}
latLong = CDATA; {* a coordinate from the gazetteer.}
elevation = CDATA; {* a <measure> ID *}
mod = CDATA; {* spatially relevant modifer *}
dcl = "true" | "false"; {* Default is "false". *}
comment = CDATA;
```

Although it is possible for paths to be continuous loops, they typically have endpoints; however, these endpoint locations might not be explicit in the text. Example 1 a) illustrates a <path> tag for which the endpoints happen to be explicit; example 1 b) shows a case where the endpoints are unspecified.

EXAMPLE 1 a) The railroad$_{p1}$ between Boston$_{pl1}$ and [New York]$_{pl2}$

```
path(id=p1, markable=railroad, beginID=pl1, endID=pl2, form=nom)
```

b) We descended into a long valley$_{p2}$.

```
path(id=p2, markable=valley, form=nom, mod="long")
```

NOTE 1 The noun *valley* can be a place, as in *We stayed at a hotel in the [**valley**$_{pl2}$]*.

In a case like example 1 a), the annotator should include the IDs for the relevant end point locations as values for the appropriate attributes in the <path> tag. Some paths might even have an explicit midpoint, as shown in example 2 a) below. <path> tags also have the optional @mod attribute, as in example 2 b) and example 2 c).

EXAMPLE 2 a) John took the road$_{p1}$ through Boston$_{pl1}$.

```
path(id=p1, markable=road, midIDs=pl1, form=nom)
```

b) The car took the upper ramp$_{p1}$.

```
path(id=p2, markable=ramp, form=nom, mod="upper")
```

c) The police assured me that the road$_{p3}$ ahead was safe during the day, but that is also what we had heard of the road$_{p4}$ behind.

```
path(id=p3, markable=token7, type=road, form=nom, mod="ahead")
path(id=p4, markable=token25, type=road, form=nom, mod="behind")
```

NOTE 2 Here, it is necessary to assign, not the extent "road", but a token ID to @markable as its value.

The @form attribute indicates whether the <path> is a nominal form as in *road* or a named path as in *Massachusetts Avenue*. Given that <path> tags are a special kind of <place>, the remaining attributes are the same as those for the <place> tag.

NOTE 3 See A.3.1.3 for a detailed explanation of the @elevation and @mod.

As with <place> tags, it is possible to have non-consuming <path> tags (i.e. tags that do not have an extent in the text associated with them).

NOTE 4 See A.3.4 for more details regarding non-consuming tags.

A.3.3 Spatial entities

A.3.3.1 General

A spatial entity in ISOspace is, generally, anything that is spatially relevant but which does not fit into either the <place> or <path> categories. In order to be considered spatially relevant, the entity should be both located in real-space and participate in an ISOspace link tag. In practice, moving objects and objects that have the potential to move are most commonly tagged as a <spatialEntity>. For example, *car* in example a) and example b) below should be marked as <spatialEntity>s. In the first case, *car* is the mover and, in the second case, it behaves like a <place>. However, note that it should still be annotated as a <spatialEntity> and not annotated as a <place>, since cars still have the potential for movement.

EXAMPLE a) The car$_{se1}$ drove down the street.

b) John$_{se1}$ arrived at the car$_{se2}$.

c) My father$_{se1}$ and I$_{se2}$ biked for two days.

d) Two men$_{se1}$ with machetes and masks jumped out of the forest.

NOTE Spatial entities such as *John, father, I* and *men* and moving objects such as *cars* may **only potentially** involve motions or locations. They are not understood as **inherently** involving locations or motions.

A.3.3.2 Spatial entity extents

The same extent rules apply for <spatialEntity> extents as they do for <place> and <path>; only the head of the NP should be captured as the extent.

A.3.3.3 Spatial entity attributes

Because tagging something as a <spatialEntity> is akin to treating it as a location, the <spatialEntity> tag shares some attributes with <place> and <path>. The list of <spatialEntity> attributes is shown in List A.3 below.

List A.3 — Attributes for the <spatialEntity> tag

```
attributes = identifier, markable, [type], [dimensionality], [form], [latLong],
[elevation], [mod], [comment];
identifier = se, decimal digit, {decimal digit}";
         {* The identifier is tagged "xml:id" for XML documents, otherwise "id". Examples
are: "se3", "se20". *}
markable = IDRef | CDATA;
type = "facility" | "vehicle" | "person" | "dynamicEvent" | "artifact";
dimensionality = "point" | "line" | "area" | "volume";
form = "nam" | "nom"; {* name or nominal *}
latLong = CDATA; {* a coordinate from the gazetteer.}
elevation = CDATA; {* a <measure> ID *}
mod = CDATA; {* spatially relevant modifer *}
comment = CDATA;
```

Annotators do not need to fill in the @latLong attribute but the remaining attributes will require annotation. The @form attribute should be used to specify whether the spatialEntity is a proper name or a nominal. If a spatially relevant modifier is present, it should be entered as the value for the @mod attribute.

EXAMPLE 1 a) John$_{se1}$ visited Boston.

```
spatialEntity(id=se1, markable=John, type=person, form=nam)
```

b) Two cars$_{se2}$ are parked on the street.

```
spatialEntity(id=se2, markable=cars, type=vehicle, form=nom)
```

c) Two men$_{se3}$ with machetes and masks jumped out of the forest.

```
spatialEntity(id=se3, markable=men, type=person, form=nom)
```

d) The dogs$_{se4}$ in Costa Rica are more likely to chase [cyclists$_{se5}$].

```
spatialEntity(id=se4, markable=dogs, form=nom, countable=true)
spatialEntity(id=se5, markable=cyclists, type=person, form=nom)
```

e) So much oil$_{se6}$ had been extracted from the ground....

```
spatialEntity(id=se6, markable=oil, form=nom)
```

A.3.4 Special section: Non-consuming tags

Annotators might encounter situations where a spatially relevant location or entity is referenced indirectly. In such situations, it is possible to create so-called "non-consuming" tags in order to

generate tag IDs that can then either be filled in as attributes for other tags or participate in links, where appropriate. For the time being, the only non-consuming tags which are allowed by the ISOspace specification are <place> and <path> tags.

Normally, for "consuming" tags, there is a word or string in the text that is associated with the tag (called the tag's extent). Non-consuming tags are so-called because, in the text, they have no associated extent that is "consumed". In other words, the extent of a non-consuming tag is a "null" string.

Generally, non-consuming tags are not necessary to capture relevant spatial objects and relations. For this reason, the non-consuming tags will be a tag of last resort, and thus, should be used sparingly. If an annotator is considering using a non-consuming tag, it might be worth reconsidering if there is anything spatially relevant being described at all or whether there is an extent that was missed. That said, the situations where the use of non-consuming tags is necessary are as follows:

a) **Locations referenced by a <measure>**. When a relevant location is referenced indirectly by an elevation that will be captured as a <measure> tag, a non-consuming <place> tag can be used so that its <place> ID can fill an attribute for other tags or links. In cases such as Example 1 b) below, where the <measure> is not clearly an elevation, an <mLink> that links the non-consuming <place> to some other object will be necessary.

NOTE 1 See A.5.2 for more details regarding the <measure> tag and A.6.5 for more details regarding <mLink> tags.

EXAMPLE 1 a) John climbed to [9 000 feet]$_{mes1}$. $\emptyset_{pl1}$

```
place(id=pl1, markable=_, elevation=me1)
```

b) We camped [three miles]$_{mes2}$ from the river$_{p1}$ $\emptyset_{pl2}$

```
place(id=pl1, markable=river)
place(id=pl2, target=)
measure(id=mes2, value=3, unit=miles)
mLink(id=ml1, figure=pl2, ground=p1, relType=distance, trigger=mes2,
            val=mes2)
```

NOTE 2 Two different null strings, that is to say those strings that occur in different (offset) character positions, can be represented by the use of the string range scheme, **string-range(fragmentIdentifier, offset [,length])**", as defined in *TEI P5*. This definition is based on character-offset positions. If two strings with their null length have two different offsets, then they are two different null strings.

b) **Locations implied by "cross" and "across"**. When the path traversed by an object "crosses" a region, but there is no explicit <path> in the text, the use of non-consuming <place> tags might be appropriate. This might occur in cases of "cross" class <motion> events. It also might be necessary in instances where some location is "across" from another relative to some reference location. In Example a) below, the event-path (i.e. the path traversed by *John*) is interpreted as entirely within the *town*, so the @source and @goal for the <moveLink> that would be triggered by the motion event *walked* should be created by the annotator.

NOTE 3 See A.6.3 for further details regarding <moveLink> tags.

The IDs of these non-consuming <place> tags – pl2 and pl3 – in example 2 a) can then participate in links with the <place> tag for twon$_{pl1}$. The <qsLink> tag IDs – qsl1 and qsl2 – illustrate this.

NOTE 4 See A.6.1 for further details regarding <qsLink> tags.

Additionally, the non-consuming <place> tag IDs are linked to the tag for *town* and to each other via an <oLink> to establish a three-way relation such that, relative to the *town,* pl3 is *across* from pl2.

EXAMPLE 2 a) John walked across town$_{pl1}$ $\emptyset_{pl2}$ $\emptyset_{pl3}$

```
place(id=pl1, markable=town)
place(id=pl2, markable=)
place(id=pl3, markable=)
```

```
qsLink(id=qsl1, figure=pl2, ground=p1, relType=IN)
qsLink(id=qsl2, figure=pl3, ground=p1, relType=IN)
oLink(id=ol1, figure=pl3, ground=p1, relType="across", frameType=relative,
      referencePt=pl2)
```

b) The $\text{forest}_{\text{pl4}}$ sits across the $\text{border}_{\text{p1}}$. $\emptyset_{\text{pl5}}$

```
place(id=pl4, markable=forest)
place(id=pl5, markable=)
oLink(id=ol2, figure=pl4, ground=p1, relType="across", frameType=relative,
      referencePt=pl5)
```

c) **Sets whose members are named**. When sets of ISOspace objects are referenced in the text, it will sometimes be necessary to create non-consuming tags to reify them so that they may participate within links. For instance, if an anaphor corefers to a split antecedent, a non-consuming tag should be created to reify the antecedent set.

d) **Mover entities of nominalized <motion>**. When a <motion> occurs in a nominalized form, there is often no explicit entity to fill as a @mover for the triggered <moveLink>. In such cases, it is appropriate to create a non-consuming <spatialEntity> tag that will later be filled as the @entity. The example below illustrates a non-consuming <spatialEntity> annotation.

EXAMPLE 3 The past week has been a long ride_{m1} $\text{through}_{\text{a1}}$ northern Baja_{pl1}. . . $\emptyset_{\text{se1}}$.

```
motion(id=m1, markable=ride, motionType=compound, motionClass=moveInternal,
       motionSense=literal)
place(id=pl1, markable=Baja, form=nam)
motionSignal(id=ms1, markable=through)
spatialEntity(id=se1, markable=)
moveLink(id=mvl1, trigger=m1, mover=se1, ground=pl1, goalReached=uncertain,
motionSignalID=ms1)
```

A.4 Motions, non-motion events, and motion signals

A.4.1 Motions

A.4.1.1 General

A <motion> is a special kind of <event> that involves a change of location. Note that every <motion> tag will participate in a relation with whatever participates in the motion event. That is to say, in creating a <motion> tag, annotators are also committing themselves to creating at least one <moveLink> for that <motion>. <motion>s receive special attention in ISOspace since they are inherently spatial. They come in three varieties.

EXAMPLE a) Bare manner of motion: e.g. *John walked*.

b) Path motion: e.g. *John left home*.

c) Compound motion: e.g. *John left home running*.

John walked home.

These different types of motion are reflected in the attributes as described in A.4.1.3.

A.4.1.2 Motion extents

When identifying motion events, follow the same extent rules for any ISO-TimeML event. Annotate an <event> as a <motion> only if it passes the <event> tests and involves a change of location in "real space"; for example, *followed* in *David followed the map* would not be annotated as a <motion>, but in *David followed the road* it would be.

A.4.1.3 Motion attributes

List A.5 shows the attributes for the <motion> tag. As usual, the @id attribute is automatically generated, but the annotator should fill in values for the remaining attributes.

List A.5 — Attributes for the <motion> tag

```
attributes = identifier, markable, [motionType], [motionClass], [motionSense], [comment];
identifier = m, decimal digit, {decimal digit}";
      {* The identifier is tagged "xml:id" for XML documents, otherwise "id". Examples are:
"m3", "m20". *}
markable = IDRef | CDATA;
motionType = "manner" | "path" | "compound";
motionClass = "move" | "moveExternal" | "moveInternal" | "leave" | "reach" | "cross" |
"detach" | "hit" | "follow" | "deviate" | "stay";
motionSense = "literal" | "fictive" | "intrinsicChange" | "simulated";
comment = CDATA;
```

The @motionType attribute refers to the distinction mentioned earlier in this Clause. Bare manner of motion events (those with the "manner" value) are quite rare in the corpus. In order to receive this value, there can be no indication of the source (starting location) or goal (ending location) of the movement. Motions of "path" and "compound" types are far more likely to appear in the corpus.

<motion> tags of the "path" motion type are those that have an explicit component of the path of motion evident in the text, but which have no indication of the manner in which the change of location takes place. The examples in EXAMPLE 1 are all "path" motion events.

EXAMPLE 1 a) John left_{m1} the room.

b) John arrived_{m2} at the party.

c) John left_{m3}.

d) John arrived_{m4}.

e) Danielle was headed_{m5} west-northwest at near 17 mph (28 kph).

f) Projections show Danielle nearing_{m6} the Bermuda area by Sunday morning.

Notice that examples 1 c) and d) are considered "path" motions although there are no explicit locations given as the source or the goal. This is because certain predicates are always interpreted as "path" motion events even if the "path" information is implicit (e.g. "leave" class motion events require a @source which is "path" information). When the @source, @goal, @midPoints, or @ground locations are not made explicit, one can figure out what it should be using context. The same can be said for example 1 b) with the @goal location. You can tell when you are dealing with such a predicate if you find yourself looking for missing information. To put it in another way, if you read the sentence *John left*, it is natural to wonder *left where? Leave* and *arrive* will be common "path" motion events in the corpus, so you should consistently tag them as such, even when pieces of information like @source and @goal are not explicit.

<motion> tags of the "manner" @motionType capture what are known as "bare-manner" motion events and they are a rarer type of motion event, at least in English. These are motion events where no explicit path of motion is evident but the manner of motion is indicated. The following examples in example 2 illustrate <motion> tags of the "manner" motion type.

EXAMPLE 2 a) John ran_{m1} five miles yesterday.

b) John bikes_{m2} seriously.

c) The arrow flew_{m3} straight and true.

d) John took_{m4} the bus.

Note the light verb construction in example 2 d). Light verbs can act as motions and, in this case, *took* expresses no manner information by itself. Here, the presence of the motion signal or adjunct *the bus* provides the manner component of motion (see A.4.3 for further details regarding <motionSignal> tags.).

The most common value for the @motionType attribute is "compound". A "compound" motion event has characteristics of both "path" and "manner" motions. Sometimes the "manner" of motion will be encoded

in the verb itself while path information will appear as a <motionSignal>. However, some motion verbs conflate path and manner without any <motionSignal>. Bare-manner motion verbs can also coincide with a <moitonSignal> that encodes path information. In another case, multiple <motionSignal>s may provide both "path" and "manner" information. The sentences in example 3 provide examples of <motion> tags with the "compound" @motionType.

EXAMPLE 3 a) John biked$_{m1}$ from Virginia to Oregon.

b) John left$_{m2}$ the concert on foot.

c) John went$_{m3}$ through the tunnel on his bike.

d) John caught$_{m4}$ a taxi home.

Each of the values for the @motionClass attribute is associated with a spatial event structure that specifies the spatial relations between the arguments of the motion at different phases of the event. For example, a "reach" motion such as *arrive* involves a pre-state in which the mover is not at the @goal location and a post-state in which the mover is at the @goal location.

If a <motion>'s @motionClass is "move", the path of motion is underspecified. The "move" class, as such, is a base-case; the event structures of all other classes are more specific. Annotating a <motion> tag with "moveExternal" @motionClass stipulates that at every phase of the event, the @mover and @ground are disconnected [i.e. in terms of qualitative spatial relations (QSRs)] (see Table A.1 for further details regarding QSRs.). It holds that dc (mover, ground). The @motion"moveInternal" stipulates that at every phase of the event, it holds that IN (mover, ground).

— The @motionClass attribute value "leave" stipulates that at the beginning of the event, it holds that "IN(mover, source)" and at the end of the event, it holds that "DC(mover, source)".

— The "reach" value stipulates that at the beginning of the event, it holds that "DC(mover, goal)" and at the end of the event, it holds that "IN(mover, goal)".

— The "detach" value stipulates that at the beginning of the event, it holds that "EC(mover, source)" and at the end of the event, it holds that "DC(mover, source)".

— The "hit" value stipulates that at the beginning of the event, it holds that "DC(mover, goal)" and at the end of the event, it holds that "EC(mover, goal)".

— The "follow" value requires that the identifier of the "path" traversed by the @mover participant is filled for the @pathID attribute. This is a shortcut for specifying that the event-path for the <motion> is essentially identical or else, is a part of the <path> whose ID is filled in the @pathID attribute.

— The "cross" value stipulates that at the beginning of the event, it holds that "IN(mover, source)", after the beginning of the event, it holds that "IN(mover, midPoints)" and at the end of the event, it holds that "IN(mover, goal)". For all classes, it holds during the middle of the event that "IN (mover, midIDs)".

The @motionSense attribute distinguishes between the following different kinds of interpretations of motion events:

— the "literal" sense covers motion verbs that describe temporal or dynamic translocation;

— the "fictive" sense covers motion verbs that describe atemporal or static paths;

— the "intrinsicChange" sense attribute covers motion verbs that describe a temporal or dynamic transformation of an intrinsic, spatial property of an object.

List A.6 lists some examples of each of the senses of motion.

List A.6 — Examples for values for the attribute @motionSense

```
literal = "John bikes" | "the ball rolls" | "the balloon rises";
fictive = "the river runs" | "the road climbs" | "the mountains rise";
intrinsicChange = "the glacier melts"| "the river rises" | "the balloon expand";
```

A.4.2 Non-motion events

The tag <event> for non-motion events in ISOspace annotates events that do not involve a change of location. The term "event" here is borrowed directly from TimeML, the original version of ISO-TimeML (ISO 24617-1). The tag <event> in ISOspace thus inherits all the attributes and their values from the ISO-TimeML annotation.

A.4.3 Motion signals

A.4.3.1 General

In ISOspace, a <motionSignal> is either a prepositional word or phrase or other satellite that supplies additional path or manner information about a motion event. It is often called an adjunct or a motion adjunct. Even a noun phrase, such as *the bus* in *John took the bus* can be tagged <motionSignal> [see example 2 (d) in A.4.1.3].

NOTE The specification originally treated <motionAdjunct> as a type of <spatialSignal>. For more information about <spatialSignal> tags, see A.5.1.

The <motionSignal> tag captures these motion adjuncts by specifying path or manner of motion information. Motion adjuncts of "path" type contribute information about the path of motion and include prepositions like *to* and *from*. The tag <motionSignal> of type "manner" supply manner of motion information (e.g. *by car*). The IDs of <motionSignal> tags are eventually used to fill the @motionSignalID attribute for <moveLink> tags. Note that prepositions which function as spatial signals in some contexts may act as motion signals in others (e.g. *in* acts as a "path" type <motionSignal> - not a <spatialSignal> - in the example in A.4.3.3).

A.4.3.2 Motion signal extents

When a <motionSignal> supplies "path" information, the extent of the tag should be limited to the preposition or the satellite itself. In the sentence in example 1, the entire extent of the prepositional phrase *to the store* is not tagged, only *to*.

EXAMPLE 1 John walked to_{ms1} the store.

When a "compound" type <motion> appears, as in example 2 where the <motionSignal> supplies "manner" information, the entire extent of the prepositional phrase is tagged as the <motionSignal>.

EXAMPLE 2 John left the garage $[by\ car]_{ms2}$.

A.4.3.3 Motion signal attributes

<motionSignal>s have only three relevant attributes including the attribute @markable:

List A.7 — Attributes for the <motionSignal> tag

```
attributes = identifier, markable, motionSignalType [comment];
identifier = ms, decimal digit, {decimal digit};
  {* The identifier is tagged "xml:id" for XML documents, otherwise "id". Examples
are: ms3, ms20 *}
markable = IDRef | CDATA;
motionSignalType = "manner" | "path";
comment = CDATA
```

Annotators shall choose whether the @motionSignlType is "path" or "manner".

a) "manner": Used when the <motionSignal> supplies information about the "manner" of the <motion> it is associated with.

b) "path": Used when the <motionSignal> supplies information about the "path" of the <motion> it is associated with.

The following example shows the attribute values for example 1 and example 2 in the previous Clause.

EXAMPLE a) John walked to$_{ms1}$ the store.

```
motionSignal(id=ms1, markable=to, motionSignalType=path)
```

b) John left the garage [by car]$_{ms2}$.

```
motionSignal(id=ms2, markable=by car, motionSignalType=manner)
```

c) John arrived in$_{ms3}$ Boston.

```
motionSignal(id=ms3, markable=in, motionSignalType=path).
```

It might not always be obvious when a preposition is acting as a <motionSignal> or a <spatialSignal>. Annotators should consider what semantic information the preposition is contributing. Note in the above example c) that *in* is acting as a motion signal in this context. Although the preposition *in* may act as a <spatialSignal> in other contexts, in this instance, it is supplying path of motion information about a motion event: namely *arrived*. In this example c), *in* identifies the @goal location: namely *Boston*. Motion signals never contribute qualitative or quantitative relational information: this is the job of the <spatialSignal> tag.

A.5 Spatial signals and measurements

A.5.1 Spatial signals

A.5.1.1 General

A <spatialSignal> is a word that supplies information to spatial links, <qsLink> and <oLink>. For example, the spatial signals are highlighted in each of the sentences in the following examples:

EXAMPLE a) The cup is on$_{ss1}$ the table.

b) Boston is [north of]$_{ss2}$ New York.

c) Danielle was headed west-northwest$_{ss3}$ at near 17 mph (28 kph).

d) The new skyscraper at$_{ss4}$ 111 Huntington Avenue was completed in 2002, [directly across$_{ss5}$] the street from The Colonnade Hotel.

In general, spatial signals are prepositions or prepositional phrases that reveal the particular relationship between two ISOspace elements, thereby helping the annotator decide what kinds of link should be used and what the values for attributes in those links should be. Remember that <motionSignal> tags and <spatialSignal> tags have different functions in ISOspace. <spatialSignal> tags always supply information about topological or qualitative spatial relations between other ISOspace elements. <motionSignal> tags capture information specifically about the path or manner of a motion event.

A.5.1.2 Spatial signal extents

The extents for spatial signals are usually one-word prepositions and are generally easy to spot. For more examples, see examples in A.5.1.1.

A.5.1.3 Spatial signal attributes

Spatial signals have three attributes associated with them; they are shown in List A.8.

List A.8 — Attributes for the <spatialSignal> tag

```
attributes = identifier, markable, motionSignalType [comment];
```

```
identifier = ss, decimal digit, {decimal digit};
{* The identifier is tagged "xml:id" for XML documents, otherwise "id". Examples are: ss3,
ss20 *}
markable = IDRef | CDATA;
cluster = CDATA; {* identifies the sense of the preposition *}
semanticType = "directional" | "topological" | "dirTop";
comment = CDATA
```

Of these attributes, only @semanticType should be filled in by the annotator. The @semanticType refers to what kinds of ISOspace link are introduced by the spatial signal. This attribute has the following three possible values:

— "directional" value introduces an <oLink> (see A.6.2);

— "topological" value introduces a <qsLink> (see A.6.1);

— "dirTop" value introduces both a <qsLink> and an <oLink>.

Note that <motionSignal> supplies information to a <moveLink> (see A.6.3).

The following examples show the attribute values for the examples in A.5.1.1.

EXAMPLE a) The cup is on$_{s1}$ the table.

```
spatialSignal(id=ss1, target=token4, semanticType=dirTop)
```

b) Boston is [north of]$_{ss2}$ New York.

```
spatialSignal(id=ss2, markabel=north of, semanticType=directional)
```

c) Danielle was headed west-northwest$_{ss3}$ at near 17 mph (28 kph).

```
spatialSignal(id=ss3, markable=west-northwest, semanticType=directional)
```

d) The new skyscraper at$_{ss4}$ 111 Huntington Avenue was completed in 2002, [directly across$_{ss5}$] the street from The Colonnade Hotel.

```
spatialSignal(id=ss4, markable=at, semanticType=dirTop)
spatialSignal(id=ss5, markable=directly across, semanticType=dirTop)
```

This attribute refers to the sense of the spatial signal as it appears in a sense inventory. It is expected that the signal's sense will indicate what ISOspace links are introduced by the signal. It follows that the annotator will no longer have to fill in the @semanticType attribute if he or she knows the sense number for the signal but, for the time being, this attribute should be ignored.

A.5.2 Measures

A.5.2.1 General

A <measure> is a special kind of spatial signal that both captures distances and dimensions and introduces a metric link (i.e. an <mLink>). (See A.6.5 for more details regarding <mLink> tags.) <measure> tags consist of a numerical component and a unit component, as shown in the examples below in A.5.2.2

A.5.2.2 Measure extents

The extent for the <measure> tag includes the numerical component and the unit component. The sentences in the following example each contain a <measure> tag.

EXAMPLE a) John walked for [5 miles]$_{mes1}$.

b) The field is [100 yards]$_{mes2}$ long.

c) Danielle's center was about [710 miles]$_{mes3}$ ([1,145 kilometers$_{me4}$]) east of the northern Leeward Islands.

d) At a mere [25 stories]$_{mes5}$, it is overshadowed by the other two.

e) Arriving in the town of Juanjui, near$_{mes6}$ the park, I learned....

A.5.2.3 Measure attributes

The attributes for the <measure> tag are fairly straightforward (see List A.9). The @value attribute should have a numerical value for the numerical component of the <measure> tag; the unit of measurement should be stored in the @unit attribute, as shown in the examples below.

List A.9 — Attributes for the <measure> tag

```
attributes = identifier, markable, value, [unit], [comment];
  {* The @unit value may remain unspecified, for instance, for cases like 'near' that
have no unit. *}
identifier = mes, decimal digit, {decimal digit};
{* The identifier is tagged "xml:id" for XML documents, otherwise "id". Examples are:
mes3, mes20 *}
markable = IDRef | CDATA;
value = real; {* real number *};
unit = CDATA;
comment = CDATA
```

NOTE There are exceptional cases where the distance between locations is described in relative terms. In example e), for instance, *near* would be tagged as a <measure> although its @unit attribute would remain unspecified. Other deictic spatial terms, such as *near*, *far*, *close*, and *distant*, can also act in this fashion although they are also capable of acting as qualifying spatial modifiers that would fill a @mod attribute for a location tag (e.g. *the near* side *of the lake* or *the distant mountains*).

EXAMPLE a) John walked for [5 miles]$_{mes1}$.

```
measure(id=mes1, markable=5 miles, value="5", unit="miles")
```

b) The field is [100 yards]$_{mes2}$ long.

```
measure(id=me2, markable=100 yards, value="100", unit="yards")
```

c) Danielle's center was about [710 miles]$_{mes3}$ ([1,145 kilometers$_{mes4}$) east of the northern Leeward Islands.

```
measure(id=mes3, markable=710 miles, value="710", unit="miles")
measure(id=mes4, markable=1,145 kilometers, value="1145",
                                unit="kilometers")
```

d) At a mere [25 stories]$_{mes5}$, it is overshadowed by the other.

```
measure(id=mes5, markable=25 stories, value="25", unit="stories")
```

e) Arriving in the town of Juanjui, near$_{mes6}$ the park, I learned....

```
measure(id=mes6, markable=near, value="near", unit=" ")
```

f) The city has sunk [6 meters]$_{mes6}$ over the past decade.

```
measure(id=mes7, target=token5 token6, value="6", unit="meters")
```

Note in example f) above that the <measure> tag @value attribute is not negative. In such cases, the directionality is contributed by the motion verb *sunk*, not the <measure> tag. The value of the <measure> tag measures a dimension of the event-path of the sinking event, which cannot be negative. Note, however, that the @value attribute for <measure> tags might take a negative value when identifying elevations, if they are specified as an offset on some scale (e.g. *500 ft below sea level* would necessitate a @value of "-500"). Annotators should not fill separating commas (or other extraneous notation) in attributes that hold numerical values (e.g. in example c) above, the @value for @me4 is "1145" not "1 145". For non-integer numerical values, use decimal notation, not fractions (e.g., "0.5" not "1/2").

A.6 Spatial relationships

A.6.1 General

Thus far, all of the tags that have been discussed (with the exception of <metaLink> tags), have involved tagging some spatially relevant span of text. The remainder of the ISOspace tags capture information about spatial relationships between those tagged elements. The following are four ISOspace link tags (not counting <metaLink>), which is not spatial in nature:

a) <qsLink> — qualitative spatial links;

b) <oLink> — orientation links;

c) <moveLink> — movement links;

d) <mLink> — measurement links.

Each of these links captures unique information about the relationships shared between spatial objects. Note that ISOspace links have no extents themselves. Links typically hold the IDs of two ISOspace tag elements that are spatially related, in addition to attributes that describe the nature of the relationship. In a way, the tags discussed in previous clauses in this International Standard can be thought of as "ingredients" for creating these links. The remainder of this Annex describes each of the four ISOspace links in detail.

A.6.2 Qualitative spatial links

A.6.2.1 General

A qualitative spatial link captures the topological relationship between two spatial objects. For this reason, they are triggered by <spatialSignal> tags with a @semanticType of either "topological" or "dirTop". Topological information primarily refers to containment and connection relations between two regions. The possible relationships come from a field of research called Qualitative Spatial Reasoning (QSR), which primarily deals with how abstract objects relate. However, since most of the spatial objects that are mentioned in natural language text are not abstract, QSR is generally insufficient for fully capturing the intended relationship between the objects. For that reason, both <qsLink> and <oLink> tags might be required to fully capture spatial relationships.

For example, consider the sentence: *The cup is on the table*. The <spatialSignal> *on* in this sentence tells us that the cup is in direct contact with the table. This is **topological** information. However, a simple "direct contact" relationship does not say whether the cup is sitting on top of the table (the likely intended relationship) or if it is somehow clinging to the side of or hanging from beneath the table (not likely, but possible). To capture this aspect of the relationship, an <oLink> is required. This is discussed in A.6.3. For now, though, let us focus on QSR-based relationships.

ISOspace uses the Region Connection Calculus (RCC) as the basis for its qualitative spatial relationships. RCC is concerned with how regions (spatial objects) are *connected* to each other. RCC8, a variant of RCC that consists of eight basic relations, is used as a basis for the possible relationships between ISOspace

objects. RCC8 along with the "IN" value will be referred to as RCC8+. Table A.1 defines the different relationships that RCC8+ captures and Figure A.1 provides an abstract example of the RCC8 relations.

Table A.1 — RCC8+ relations

Value	Description
DC	disconnected
EC	externally connected
PO	partial overlap
EQ	equal
TPP	tangential proper part
TPPi	tangential proper part inverse
NTPP	non-tangential proper part
NTPPi	non-tangential proper part inverse
IN	disjunction of TTP and NTTP

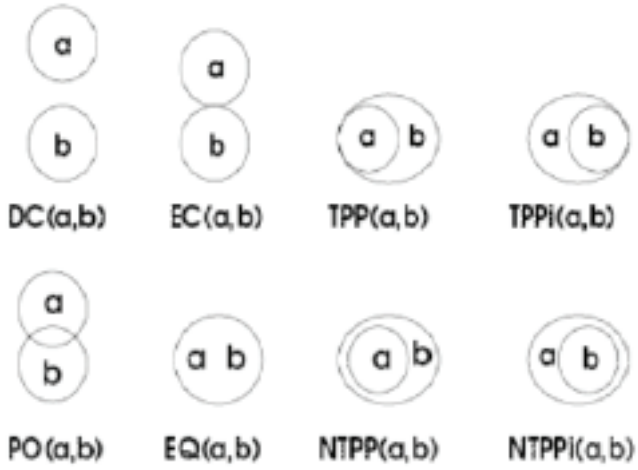

Figure A.1 — RCC8+ figures

The objects participating in a spatial relation with one another are typically referred to as either the @figure or @ground. The @figure is the object *being related* to the @ground while the @ground is what the @figure is *being related to*. It is not a universal rule, but the @figure is often a movable object while the @ground tends to be more static. In the cup and table example above, the cup is the @figure while the table is the ground. The next clause includes several examples that should help clarify this distinction.

A.6.2.2 Qualitative spatial link attributes

List A.10 shows the attributes for the tag. As usual, the @id attribute is assigned automatically, but the annotator should fill in the @figure, @ground, @trigger and @relType values.

List A.10 — Attributes for the <qsLink> tag

```
attributes = identifier, relType, [figure], [ground], [trigger];
  {* The @unit value may remain unspecified, for instance, for cases like "near" which
has no unit. *}
identifier = qsl, decimal digit, {decimal digit};
{* The identifier is tagged "xml:id" for XML documents, otherwise "id". Examples are:
qsl3, qsl20 *}
markable = IDRef | CDATA;
```

```
relType = DC | EC | PO | EQ | TPP | TPPi | NTPP | NTPPi | IN;
figure = IDRef; {* ID of a location/entity/event tag that is being related *}
ground = IDRef; {* ID of a location/entity/event tag that is being related to *}
trigger = IDRef; {* ID of the spatial signal that triggered the link *}
```

Both @figure and @ground can hold the ID of an ISOspace <place>, <path>, <spatialEntity>, motion, or <nonMotionEvent> tag. When an entity that is not a location tag participates in a <qsLink>, it is actually being coerced into behaving like a location. That is to say, instead of saying that a spatial entity is in some relationship to another ISOspace object in a <qsLink>, you are really saying that the location that the spatial entity occupies is in relation to the location of the other ISOspace object. Remember that the @figure is the object *being related* and the @ground is the object that the figure is *being related to*.

The @trigger value takes the ID of <spatialSignal> with a @semanticType of "topological" or "dirTop". Keep in mind that signals of this type always introduce a <qsLink>, but the @trigger attribute is optional because it is possible to have a <qsLink> that is not associated with any particular <spatialSignal> in the text.

The @relType attribute is used to specify the type of qualitative spatial relationship that exists between the @figure and the @ground. The @relType attribute takes as its value any of the RCC8 relations as well as the additional IN value, which is the disjunction of TPP and NTPP. A @relType of IN should be used when it is not clear whether TPP or NTPP is the correct @relType, but one of those two values should apply. The EQ value is special in that it is used to say that two spatial objects occupy the same space or, in other words, that they have the same location. Table A.2 displays the possible @relType values with some natural language examples with @figure objects marked as $figure_f$ and ground objects as $ground_g$.

NOTE 1 The EQ @relType is not used to indicate that two spatial objects are actually identical; it simply indicates that those two occupy the same location.

NOTE 2 The <metaLink> tag is used to indicate that two spatial objects referred to in the text are identical.

Table A.2 — Examples for <qsLink> @relType values

Value	Example
DC	the [$grill_f$] outside of the [$house_g$]
EC	the [cup_f] on the [$table_g$]
PO	[$Russia_{f/g}$] and [$Asia_{f/g}$]
EQ	[*The White House*$_{f/g}$] and [*1600 Pennsylvania Avenue*$_{f/g}$]
TPP	the [$coast_f$] of [$Delaware_g$]
TPPi	
NTPP	the [$island_f$] in the [$lake_g$]
NTPPi	
IN	the [$bookcase_f$] in the [$room_g$]

The sentences in the following example provide some examples of <qsLink> tags.

EXAMPLE a) The $book_{se1}$ is on_{ss1} the $table_{se2}$.

```
spatialSignal(id=ss1, target=token4, cluster=on-1, semanticType=dirTop)
qsLink(id=qsl1, figure=se1, ground=se2, trigger=ss1, relType=EC)
```

b) The [light switch]$_{se3}$ is on_{ss2} the $wall_{se4}$.

```
spatialSignal(id=ss2, target=token5, cluster=on-2, semanticType=dirTop)
qsLink(id=qsl2, figure=se3, ground=se4, trigger=ss2, relType=PO)
```

c) A thick green $rainforest_{pl2}$ grew up $around_{ss3}$ the $road_{p1}$.

```
spatialSignal(id=ss3, target=token7, cluster=on-?,
                                semanticType=topological)
qsLink(id=qsl3, figure=p1, ground=pl2, trigger=ss3, relType=IN)
```

Note that while the same spatial signal is used in both of these examples, the @relType value for each differs. This is because the signal *on* (or *around*) is being used in a slightly different sense in each of the examples. It is also worth noting here that the @semanticType for these examples dictates that an <oLink> be supplied in addition to these <qsLink>s. <oLink> tags are described in A.6.3.

A.6.3 Orientation links

A.6.3.1 General

The <oLink> tag covers those relationships that occur between two locations that are non-topological in nature. Orientation links essentially fill in the spatial relations that <qsLink> tags cannot capture. This includes three different types of information based on the four frames of reference as follows:

a) "absolute" frame of reference can be considered the "bird's eye" view;

b) "intrinsic" frame of reference is used when some part of a spatial object has an intrinsic orientation (e.g. a television set), which has an intrinsic front;

c) "relative" frame of reference is used when the relationship being described depends on a particular entity's point of view;

d) "unspecified" frame of reference is used when it only depends on the viewer's point of view or is totally unknown.

Once the frame of reference for the <oLink> has been identified, the annotator should also supply a reference point. For "absolute" <oLink> tags, the @referencePt attribute value should also match the @relType value, which in turn should be a cardinal direction. For "intrinsic" <oLink> tags, the @referencePt takes the ID filled for the @ground attribute. For "relative" <oLink> tags, the @referencePt is either the ID of a spatial entity from whose viewpoint the relation is described or the special "viewer" value, which is used to indicate that the author did not explicitly declare who is viewing the relationship; however, it is still a relative frame of reference (e.g. *the table on David's left* vs. *the table on the left*).

<oLink> tags also capture projective information. Consider the sentences in the following examples.

EXAMPLE a) The helicopter$_{e1}$ is above$_{ss1}$ the town$_{pl1}$.

b) The hill$_{pl2}$ is above$_{ss2}$ the town$_{pl3}$.

c) The [city of Boston]$_{pl4}$ is [north of]$_{ss3}$ [Stoughton, MA]$_{pl5}$.

d) The [city of Boston]$_{pl6}$ is [north of]$_{ss4}$ [New York City]$_{pl7}$.

Both example a) and example b) use the same <spatialSignal> word, *above*. However, in example a), the likely interpretation is that the *helicopter* is located directly above the *town*. This is not the most salient interpretation for example b); hills usually do not fly or hover above towns in the same way that the helicopters do. To distinguish between these two interpretations, it can be said that the <oLink> in example b) has a projective interpretation in which it can be imagined that the region associated with the town projects outwards beyond its normal limits. It is above this projected region, which is associated with the town, that the hill is located. So both of these sentences should have nearly identical <oLink> tags created for them, except that the @projective attribute value for the link for example b) would be flagged as "true" and it is "false" for example a).

The issue of projectivity might also arise for <oLink> tags involving any of the four cardinal directions. In example c), the relation between *Boston* and *Stoughton* would not be projective because *Boston* is directly north of *Stoughton*, but the relation in example d) would be projective because *Boston* is indirectly north of *New York City*. The actual relationship in example d) could be described with a @relType of "northeast", although this information is not directly accessible from the language: that

kind of world-knowledge would have to be drawn from a gazetteer entry. The above examples include annotations that illustrate this distinction in further detail.

A.6.3.2 Orientation link attributes

List A.11 — Attributes for the <oLink> tag

```
attributes = identifier, relType, [figure], [ground], [trigger], [frameType], [referentPt],
[projective];
  {* The @unit value may remain unspecified, for instance, for cases like "near" which
has no unit. *}
identifier = ol, decimal digit, {decimal digit};
{* The identifier is tagged "xml:id" for XML documents, otherwise "id". Examples are: ol3,
ol20 *}
markable = IDRef | CDATA;
relType = "above" | "behind" | "nextTo" | "northOf" | CDATA; {* may have CDATA for
other values *}
figure = IDRef; {* ID of a location/entity/event tag that is being related *}
ground = IDRef; {* ID of a location/entity/event tag that is being related to *}
trigger = IDRef; {* ID of the spatial signal that triggered the link *}
frameType = "absolute" | "intrinsic" | "relative";
referentPt = CDATA | IDRef | "viewer"; {* CDATA for cardinal direction; IDRef for
ground entity *}
projective = "true" | "false";
```

As with <qsLink>, the @figure and @ground attributes can hold the ID of any location/entity/event tag. The @trigger, which is optional, should be a <spatialSignal> with a @semanticType of either "directional" or "dirTop". The @projective attribute can have a value of either "true" for projective interpretations or "false" for non-projective cases. The @relType attribute currently has an open set of values, some of which are set out in List A.11. Annotators should try to stick to this set of values, but may annotate additional values if none of those are appropriate.

Perhaps more so than any other ISOspace element, the attributes of the <oLink> tag are dependent on each other. The value for the @frameType attribute determines what the @referencePt value should be and the @frameType should therefore be filled first. Table A.3 shows the consequences for each @frameType value.

Table A.3 — Impact of @frameType values on @referencePt

@frameType value	Effect
absolute	referencePt = value of @relType
intrinsic	referencePt = value of @ground
relative	referencePt = viewer or tag ID specifying the viewpoint

The following example shows several different kinds of <oLink> tag. Once again, only the tag in question is shown in these annotations, although many of them also have accompanying <qsLink> tags.

EXAMPLE a) Boston_{pl1} $[\text{north of}]_{ss1}$ $[\text{New York City}]_{pl2}$.

```
oLink(id=ol1, figure=pl1, ground=pl2, trigger=s1, relType="north",
      frameType=absolute, referencePt=north, projective=true)
```

b) The dog_{se1} is $[\text{in front of}]_{ss2}$ the couch_{se2}.

```
oLink(id=ol2, figure=se1, ground=se2, trigger=ss2, relType="front",
    frameType=intrinsic, referencePt=se2, projective=false)
```

c) The dog_{se3} is $[\text{next to}]_{ss3}$ the tree_{se4}.

```
oLink(id=ol3, figure=se3, ground=se4, trigger=ss3, relType="nextTo",
```

```
      frameType=relative, referencePt=viewer, projective=false)
```

d) The $hill_{pl3}$ is $above_{ss4}$ the $town_{pl4}$.

```
oLink(id=ol14, figure=pl3, ground=pl4, trigger=ss4, relType="above",
      frameType=intrinsic, referencePt=pl4, projective=true)
```

e) The $helicopter_{se5}$ is $above_{ss5}$ the $town_{pl6}$.

```
oLink(id=ol15, figure=se5, ground=pl6, trigger=ss5, relType="above",
      frameType=intrinsic, referencePt=pl6, projective=false)
```

f) The $book_{se5}$ is on_{ss6} the $table_{se6}$.

```
oLink(id=ol16, figure=se5, ground=se6, trigger=s6, relType="above",
      frameType=INTRINSIC, referencePt=se6, projective=false)
```

g) The gum_{se7} is on_{ss7} the $table_{se8}$.

```
oLink(id=ol17, figure=se7, ground=se8, trigger=s7, relType="below",
      frameType=intrinsice, referencePt=se8, projective=false)
```

h) The new tropical $depression_{se9}$ was about 430 miles (690 kilometers) $west_{ss8}$ of the southernmost $[Cape\ VerdeIslands]_{pl8}$.

```
oLink(id=ol18, figure=se9, ground=pl8, trigger=s8, relType="west",
frameType=absolute, referencePt="west", projective=true)
```

A.6.4 Movement links

A.6.4.1 General

The <moveLink> tag connects motion-events with mover-participants. The other attributes of the <moveLink> tag are then used to specify any obvious information about components of the event-path as well as any motion-adjuncts. <moveLink> tags are always introduced by a triggering <motion> tag. Therefore, whenever annotators tag an extent with the <motion> tag, they are committing to creating a corresponding <moveLink> as well. The annotation for the <moveLink> depends on the @motionType of the <motion> (i.e. "manner", "path", or "compound"). A bare-manner motion verb (e.g. *David cycles seriously*) still triggers a <moveLink>, but most of the attributes will be underspecified since there is no evident event-path information. At the other extreme, it is possible for "path" or "compound" type motions to make use of the full range of <moveLink> attributes.

A.6.4.2 Movement link attributes

List A.12 — Attributes for the <moveLink> tag

```
attributes = identifier, [trigger], [source], [goal], [midPoint], [mover], [ground],
[goalReached], [pathID], [motionSignalID], [comment];
  {* The @unit value may remain unspecified, for instance, for cases like "near" which
has no unit. *}
identifier = mvl, decimal digit, {decimal digit};
{* The identifier is tagged "xml:id" for XML documents, otherwise "id". Examples are:
mvl3, mvl20 *}
markable = IDRef | CDATA;
trigger = IDRef; {* ID of a <motion> that triggered the link *}
source = IDRef; {* ID of a location/entity/event tag at the beginning of the event-path *}
goal = IDRef; {* ID of a location/entity/event tag at the end of the event-path *}
midPoint = IDRef; {* ID(s) of event-path midpoint location/entity/event tags *}
mover = IDRef; {* ID of the location/entity/event tag whose location changes *}
ground = IDRef; {* ID of a location/entity/event tag that the @mover participant's motion
is relative to *}
```

```
goalReached = "yes" | "no" | "uncertain";
pathID = IDRef; {* ID of a <path> tag that is identical to the event-path of the @
trigger <motion> *}
motionSignalID = IDRef;
  {*ID(s) of <motionSignal> tag(s) that contributes path or manner information that the @
trigger <motion> *}
comment = CDATA;
```

The @trigger value of a <moveLink> is filled by the <motion> tag ID of the motion which is being linked to the @mover participant. The @source, @goal, @midPoint and @ground attributes are used when the @trigger is a "path" or "compound" type <motion>. Motions of these types always include some information about the path traversed by the @mover (i.e. the event-path). This information is stored in the <moveLink>'s @source, @goal, @midPoint, and @ground attributes. The values for these attributes may be filled by any ISOspace location tag or any tag which can be coerced to act as a location including <place>, <path>, <spatialEntity>, <motion>, and <Event> (for non-motion events) tags, although they will usually be filled with IDs of <place> or <path> tags. When creating <moveLink> tags, annotators should not look across sentence boundaries to find @source, @goal, @ground, or any other event-path information, but allow post-processing to fill in that kind of information.

The @mover attribute specifies the tag element that participates in the <motion> event by changing location. The @mover attribute usually takes an ID of a <spatialEntity>, although it may also be filled by a location tag or event tag coerced to a location.

The @goalReached attribute, which can have a value of "true", "false", or "uncertain", is used for those cases where it is not clear from the text whether the identified @goal location was reached. If there is no @goal location associated with the event, this attribute will be left unspecified. For instance, in *John arrived in Boston*, the @goalReached attribute would be set to "true". To take another example, in *John left for Boston*, *Boston* appears to be the @goal of the <motion>, but the reader does not know if *John* ever really got there. In a case like this, the @goalReached attribute should be set to "uncertain". Marking @goalReached as "uncertain" stipulates that the annotator is unsure of *John*'s location within the narrative after the *left* <motion> event has occurred.

It does not fall within the purview of ISOspace to capture negation or modality. In the case of *John* ***did not*** *arrive in Boston*, the negation does not affect the @goalReached attribute value, which should be set to "true". Even though, within the spatial narrative, it is true that *John*'s location would not be *Boston* after the motion-event had completed, if the verb phrase headed by *arrive* were not negated, the goal location of *Boston* would have been reached. Contrastively, in *John approached Boston*, @goalReached would be filled as "false" because upon completing of the approach motion-event, *John* would still not have reached *Boston*.

The @motionSignalID attribute takes the IDs of any <motionSignal> tags contributing to the manner of motion or the event-path of the triggering <motion>. @motionSignalID is an optional attribute because not all motion verbs are accompanied by motion adjuncts. For example, in *John traveled by car*, the phrase *by car* is a motion signal, but for *John traveled for three days*, there is no motion signal.

Depending on the @motionClass of the trigger <motion>, certain attributes of the <moveLink> tag, which define the event-path, will be required. E.g., in the following example e), below, the @motionClass for the <motion> *jump* is "moveExternal". This @motionClass requires that the @ground attribute is filled by the identifier of the <path> tag for *fence* to capture the fact that the location of the *fence* is what *John jumped* over. The only @motionClass that can remain totally underspecified is the "move" class, although it is not obligated to be underspecified (i.e., a "move" class motion may have a @source, @goal, @midPoint or other attributes specified, but only if the motion event structure does not fit any of the more specific classes). Table A.4 lists which <moveLink> attributes are requisite for each of the different classes of <motion>.

Table A.4 — <moveLink> attributes required by classes of <motion>

Motion class	Required attributes
move	NONE

Table A.4 *(continued)*

Motion class	Required attributes
moveExternal	ground
moveInternal	ground
leave	source
reach	goal
detach	source
hit	goal
follow	pathID
deviate	source
cross	source, midPoint, goal

<moveLink> tags triggered by "follow" class <motion> tags require the @pathID attribute to be filled, such as in example c). In such a case, the @pathID attribute for <moveLink> is used to link the <path> that is traversed by the @mover to the <motion> to specify an explicit event-path. Essentially, this specifies that the <path> Massachusetts Turnpike is identical to the event-path for the drove <motion>. Note, however, that there might also be information about the event-path supplied by way of the @source, @midPoint, and @goal or @ground attributes (in this instance, the @goal happens to Worcester).

The following examples illustrate how to annotate <moveLink> tags. Since the <motion> tag that triggers a movement link informs the <moveLink> tag's attributes, the <motion> tags are also included in the example annotations.

EXAMPLE a) John_{se1} walked_{m1} from_{ms1} Boston_{pl1} to_{ms2} Cambridge_{pl2}.

```
motion(id=m1, target=token2, motionType=compound, motionClass=move,
        motionSense=literal)
moveLink(id=mvl1, trigger=m1, mover=se1, source=pl1, goal=pl2,
         goaReached=true, motionSignalID={ms1,ms2})
```

b) John_{se2} traveled_{m2} $[\text{by car}]_{ms3}$.

```
motion(id=m2, target=token2, motionType=manner, motionClass=move,
       motionSense=literal)
moveLink(id=mvl2, trigger=m2, motionSignalID=ms3)
```

c) John_{se3} drove_{m3} to_{ms4} Worecester_{pl3} on_{ss1} $[\text{Massachusetts Turnpike}]_{p1}$.

```
motion(id=m3, target=token2, motionType=compound, motionClass=follow,
       motionSense=literal)
moveLink(id=mvl3, trigger=m3, mover=se3, goal=pl3, goaReached=true,
       motionSignalID=ms4, pathID=p1)
```

d) John_{se4} left_{m4} for_{ms5} Boston_{pl3}.

```
motion(id=m4, target=token2, motionType=path, motionClass=leave,
       motionSense=literal)
moveLink(id=mvl4, trigger=m4, mover=se4, goal=pl3,
        goaReached=uncertain, motionSignalID=ms5)
```

e) John_{se5} jumped_{m5} over_{ms6} the fence_{p2}.

```
motion(id=m5, target=token2, motionType=compound,
motionClass=moveExternal, motionSense=literal)
moveLink(id=mvl5, trigger=m5, mover=se5, ground=p2, motionSignalID=ms6)
```

f) John$_{se6}$ walked$_{m6}$ off$_{ms7}$ the path$_{p3}$.

```
motion(id=m6, target=token2, motionType=compound, motionClass=deviate,
motionSense=literal)
moveLink(id=mvl6, trigger=m6, mover=se6, source=p3, motionSignalID=ms7)
```

g) The brook$_{p4}$ runs$_{m7}$ along$_{ms8}$ the road$_{p5}$.

```
motion(id=m7, target=token3, motionType=path, motionClass=follow,
motionSense=fictive)
moveLink(id=mvl7, trigger=m7, mover=p4, ground=p5, motionSignalID=ms8)
```

h) The glacier$_{p6}$ melted$_{m8}$ down$_{ms9}$ the valley$_{p7}$.

```
motion(id=m8, target=token3, motionType=manner, motionClass=follow,
motionSense=intrinsicChange)
moveLink(id=mvl8, trigger=m8, mover=p6, motionSignalID=ms9, pathID=p7)
```

i) The clouds$_{se7}$ spread$_{m9}$ over$_{s2}$ the [Peruvian coast]$_{p8}$.

```
motion(id=m9, target=token3, motionType=manner, motionClass=move,
motionSense=intrinsicChange)
       moveLink(id=mvl9, trigger=m9, mover=se7, goal=p8, goaReached=true)
```

Pay special attention to example h) and example i). “IntrinsicChange” <motion> tags will always have a @motionType of “manner”. This is due to the fact that the location of an entity is an extrinsic property. The location of the @mover entities participating in “intrinsicChange” motion events are not undergoing any change, but rather there is some dynamic change in an intrinsic characteristic (e.g. size or shape) of the @mover participant.

A.6.4.3 Special section: Ergative motion verbs

Annotators should take particular care when annotating <moveLink> tags triggered by ergative motion verbs. Ergative verbs act differently depending on whether they are used transitively or intransitively. Note the sentences in the examples below where the @mover entities have been marked in **boldface**: when *flew* is used ditransitively, as in example c), it is the object “being flown” that fulfills the role of the @mover, but when it is used intransitively, as in example a), it is the “flyer” that is the @mover. In other words, in example c), it is not the case that ***John*** *flew over the harbor*. Depending on the context, it can be entailed that both the subject and direct object of a ditransitive, ergative motion verb happen to undergo the same change of location; this is the case in example f). In those cases, it is appropriate to create a separate <moveLink> for each @mover participant.

EXAMPLE a) **John** flew over the harbor.

b) The remote-controlled **plane** flew over the harbor.

c) John flew the remote-controlled **plane** over the harbor.

d) **John** drove to the airport.

e) The **taxi** drove to the airport.

f) The **taxi** drove **John** to the airport.

A.6.4.4 Special section: Underspecified mover participants

When creating <moveLink> tags, it is necessary to link a <motion> tag to some other @mover element. In some cases, there might not be an explicit @mover participant to link to. Two situations where this problem arises are nominalized motion events and motion events that fall under certain grammatical or narrative moods (e.g. imperative and simulated). In cases where the @mover is not evident or

underspecified, it is acceptable to link the <motion> tag to itself since the @mover will not be associated with any extent tag that would normally be linked to. When performing a link from a <motion> tag to itself, the @mover attribute should be left unspecified (i.e. blank). The annotator should then write a short comment describing the @mover participant. The following examples demonstrate how to create <moveLink> tags for underspecfied @mover participants and what helpful comments might look like.

EXAMPLE:

a) There was some incredible night biking$_{m1}$ in$_{ms1}$ the [Atacama Desert]$_{pl1}$.

```
motion(id=m1, target=token6, motionType=compound, motionClass=moveInternal,
motionSense=literal)
moveLink(id=mvl1, trigger=m1, mover= ground=pl1, motionSignalID=ms1,
comment="The author is describing biking which they themselves (possibly among
others) participated in as a mover.")
```

b) Take$_{m1}$ the stairs$_{p1}$ to$_{md1}$ the roof$_{pl1}$.

```
motion(id=m1, target=token1, motionType=path, motionClass=follow,
motionSense=literal)
moveLink(id=mvl1, trigger=m1, mover=, ground=pl1, pathID=p1, motionSignalID=ms1,
comment="This is an imperative construction where the mover participant would be
anyone that follows the direction.")
```

A.6.5 Measure links

A.6.5.1 Introduction

The <mLink> tag serves two purposes in ISOspace. First, it can be used to capture the distance between two locations, as in *The bone is two feet from the dog*. Such relationships are commonly accompanied by a <measure> extent, but this is not a requirement. For example, the phrase *the hot dog stand near Macy's* also introduces an <mLink>, since *near* is interpreted on a scale.

Second, and in addition to relating two spatial objects, <measure> links can be used to describe the dimensions of a single object. Locations, spatial entities, and even events possess spatial dimensions that may be captured by an <mLink> tag. A typical case where the <mLink> tag is used is when the length dimension of a location is described, as in *The football field is 100 yards long*. Note, however, that the <mLink> tag can also capture dimensions of motion events, as in *I rode 30 miles* [See examples b) and c)] in A.6.5.2). In such a case, the <mLink> is specifying a dimension of the event-path associated with the motion.

A.6.5.2 Measure link attributes

The attributes for the MLINK tag are presented in List A.13.

List A.13 — Attributes for the <mLink> tag

```
attributes = identifier, markable, [trigger], [figure], [ground], relType, val, [endPoint1],
[endPoint2], [comment];
            {* The @unit value may remain unspecified, for instance, for cases like "near"
which has no unit. *}
identifier = ml, decimal digit, {decimal digit};
            {* The identifier is tagged "xml:id" for XML documents, otherwise "id".
Examples are: ml3, ml20 *}
markable = IDRef | CDATA;
trigger = IDRef; {* ID of a <measure> that triggered the link *}
figure = IDRef; {* ID of a location/entity/event tag *}
ground = IDRef; {* ID of the related location/entity/event tag *}
relType = "distance" | " length" | " width" | "height" | "generalDimension";
val = IDRef | CDATA; {* "near", "far", "taller", "shorter", or ID of a <measure> tag *}
endPoint1 = IDRef ; {* ID of a location/entity/event tag at one end of a stative-path *}
endPoint2 = IDRef; {* ID of a location/entity/event tag at one end of a stative-path *}
comment = CDATA;
```

When the <mLink> tag is used to describe the relationship between two spatial objects, their IDs are filled in the @figure and @ground attributes. In the other <mLink> usage, in which only one spatial object is described, that object's ID should be filled in the @figure attribute and either repeated as the @ground or else the @ground attribute should be left unspecified.

The @relType attribute describes what dimension is being measured with the <mLink>. The possible values are "distance", "length", "width", "height" and "generalDimension". Table A.5 describes how to choose the appropriate @relType value depending on the dimension being measured.

Table A.5 — @relType values for the <mLink> tag

relType Value	Description
distance	distance between two spatial objects
length	intrinsic length of a single spatial object
width	intrinsic width of a single spatial object
height	intrinsic height of a single spatial object
generalDimension	the dimension being measured is not clear

The @val attribute describes the actual measurement. Its value can be the ID for a <measure> tag or one of "near", "far", "taller", and "shorter". If the annotator believes an <mLink> is appropriate but is not satisfied with the possible values for the link attributes, he or she should comment on this in the <mLink>'s annotation.

When a static path is used to describe the dimensions of an object, any endpoints that bound the object should appear in the @endPoint and @endPoint2 attributes. As usual, the values for these attributes can be the ID of any ISOspace object (e.g. places, paths, and motions). The following examples provide the annotations for several <mLink> tags.

EXAMPLE a) The new tropical depression$_{se1}$ was about [430 miles]$_{mes1}$ (690 kilometers$_{mes2}$) west of the southernmost [Cape Verde Island$_{pl1}$], forecasters said.

```
mLink(id=ml1, relType=distance, figure=se1, ground=pl1, val=mes1)
mLink(id=ml2, relType=distance, figure=se1, ground=pl1, val=mes2)
```

b) The football field$_{se2}$ is [100 yards]$_{mse3}$ long.

```
mLink(id=ml3, relType=length, figure=se2, ground=se2, val=mes3)
```

c) I rode$_{m1}$ [30 miles]$_{mes4}$ yesterday.

```
mLink(id=ml4, relType=generalDimension, figure=m1, ground=m1, val=mes4)
```

d) [The width of the office]$_{pl3}$ is [25 feet]$_{mes5}$ from the bookcase$_{se3}$ to the [white board]$_{se4}$.

```
mLink(id=ml5, relType=distance, figure=pl3, ground=pl3, val=mes5,
              endPoint1=se3, endPoint2=se4)
```

e) The hot dog stand$_{se5}$ near$_{mes6}$ Macy's$_{se6}$.

```
mLink(id=ml6, relType=distance, figure=se5, ground=se6, val=mes6)
```

A.7 Special Clause: Quantification

NOTE This Clause is informative. It is included here to show what should be one of the items to be discussed in PWI 24617-9 Spatial semantics.

This Clause aims to cover a number of attributes that handle quantification over spatial elements in ISOspace. These attributes, namely @quant, @countable, and @scopes, are common to many different tag types and they have therefore, been consolidated here. The tag types which share these attributes include location tags (i.e. <place> and <path> tags) as well as any tags that may be coerced to act like a location including <spatialEntity>, <motion> and <event> tags. Table A.6 reiterates the attributes for capturing quantification.

Table A.6 — Quantification attributes

Attribute	Value
countable	true or false
quant	a generalized quantifier
scopes	an ID of a location/entity/event tag that the *scopee* in a *scopes(socper,socpee)* relation

A value of "true" is usually filled for the @countable attribute for nouns that are individually countable such as *trees*, *lakes*, *roads*, and *trips*. A value of "false" might be used for mass terms such as *water* and *countryside*. It is important to bear in mind that languages like English possess mechanisms for coercing mass-terms to act like count-terms (e.g. *There are three waters in the fridge*) and vice versa (e.g. *As a group, the trees surround the building*).

The @quant attribute takes a quantifier as its value. Generalized quantifiers are most commonly introduced by determiner phrases, although they can also be implicit, as is often the case for generic references (e.g. *snow* is taken to be universally quantified in *Snow is white*). Determiners can indicate universal or existential quantification depending on context; for example, the English indefinite article *a(n)* can introduce universal or existential quantification depending on the context. The same is true for the grammatically plural articles *some* and *any*. There are also many determiners in English that indicate a vaguely specified quantity (e.g. *some*, *several*, *many*, *few*, and *most*). Numerals (e.g. *half*, *one*, *two*, and *a hundred*, etc.) and other numerical terms (e.g. *both* and *a dozen*) can indicate a specific quantity. Other expressions can introduce a constraint on the quantity (e.g. *more than a few*, *nearly every*, and *most*).

The @scopes attribute specifies a scoping relation between the *scoper*, which is the tag element whose @scopes attribute is being filled, and the *scopee*, which is the tag element whose ID is filled as the value. In other words, if the @scopes attribute for a <spatialEntity> tag with its ID being *X* were filled with the value *Y*, this relation can be represented in terms of a *scopes(scoper, scopee)* function such that *scopes(X,Y)* means that the quantifier for *X* has scope over the quantifier for Y.

The following examples are designed to help illustrate how to capture scoping relations with the @scopes attribute.

EXAMPLE a) A computer$_{se1}$ on$_{ss1}$ every desk$_{se2}$.

```
spatialEntity(id=se1, markable="computer", form=nom, countable=true,
quant="1", scopes=)
spatialEntity(id=se2, markable="desk", form=nom, countable=true, quant="every",
scopes=se1)
spatialSignal(id=ss1, markable="on", semanticType=dirTop)
qsLink(id=qsl1, relType=EC, figure=se1, ground=se2, trigger=ss1)
oLink(id=0l1, relType="above", figure=se1, ground=se2, trigger=ss1,
frameType=intrinsic,
referencePt=se2, projective=false)
```

$$\forall se2 \exists se1 \left[\left[se2 \in DESKS \wedge se1 \in COMPUTERS \right] \rightarrow \left[EC\left(se2, se1\right) \wedge ABOVE\left(se2, se1\right) \right] \right]$$

NOTE The symbol ∅ is used here to indicate an unspecified attribute value.

b) I$_{se1}$ rode$_{m1}$ along$_{ms1}$ some steep roads$_{p1}$

```
spatialEntity(id=se1, target="I", form=nom, countable=true, quant="1'', scopes=p1)
path(id=p1, markable="roads", form=nom, countable=true, quant="some'', scopes=m1))
motion(id=m1, markable="rode", motionType=compound, motionClass=follow,
```

```
motionSense=literal, countable=true, quant="exists'', scopes=)
motionSignal(id=ms1, markable="along", motionSignalType=path)
moveLink(id=mvl1, trigger=m1, mover=se1, pathID=p1, motionSignalID=ms1)
```

$$\exists_1 se1 \exists_{some} p1 \exists m1 \left[\begin{array}{l} se1 \in INDIVIDUALS \wedge p1 \in \left\{ STEEP \cap ROADS \right\} \wedge m1 \\ \in RIDINGS \wedge follows\left(m1, p1\right) \wedge mover\left(m1, se1\right) \end{array} \right]$$

c) ... every car_{se2} that $passed_{m1}$ me_{se1} had at least three or more $people_{se3}$ $inside_{ss1}$.

```
spatialEntity(id=se2, markable="car'', form=nom, countable=true, quant="every'',
scopes=m1)
spatialEntity(id=se1, markable="me'', form=nom, countable=true, quant="1'',
scopes=se2)
spatialEntity(id=se3, markable="people'', form=nom, countable=true, quant=gte3,
scopes=))
spatialEntity(id=s1, markable="inside'', semanticType=topological)
motion(id=m1, markable="passed", motionType=path, motionClass=moveExternal,
motionSense=literal, countable=true, quant="exists'', scopes=se3)
moveLink(id=mvl1, trigger=m1, mover=se2, ground=se1)
qsLink(id=qsl1, relType=IN, figure=se3, ground=se2)
```

$$\exists_1 se1 \forall se2 \exists m1 \exists_{\geq 3} se3 \left[\left[\begin{array}{l} se1 \in INDIVIDUALS \wedge se2 \in CARS \wedge m1 \in PASSINGS \wedge se3 \\ \in PEOPLE \wedge movesEternal\left(m1, se1\right) \wedge mover\left(m1, se2\right) \end{array} \right] \rightarrow \left[in\left(se2, se3\right) \right] \right]$$

NOTE The existential quantifier $\exists_1$ means 'there is exactly one' and the existential quantifier $\exists_{\geq 3}$ means 'there are at least 3'. The existential quantifier $\exists$ without a subscripted modifier, on the other hand, means 'there are at least one' and the universal quantifier means 'for all', as defined in Predicate Logic.

Partial logical translation has been provided after each annotation in the examples above to make them easier to interpret. Note that whenever multiple quantified variables are introduced, there exists a possibility for scoping ambiguities. Like any lexical or syntactic ambiguity, not all quantificational scoping ambiguities will necessarily resolve to a single plausible interpretation. Part of the annotator's responsibility is to assume the interpretation that he or she finds most appropriate and ensure that the annotation is consistent with that interpretation.

The interpretation assumed for the annotation in example a) above is one under which for every se_2, there exists some se_1 such that if se_2 is a d*esk* and se_1 is a *computer*, se_1 is *on* se_2. The other possible interpretation is the one under which it holds that there exists some *computer* for every *desk* such that that particular *computer* is *on* every *desk*. This second interpretation was discarded here since it seems unlikely, at least pragmatically, that one particular computer would be on every desk. However, in an appropriate context, that interpretation might be plausible; for example, given a domain of discourse where the set of desks is small, say 2, and those desks are arranged in such a way that their surfaces are contiguous, a particular computer could be on every desk. However, under this "particular computer" interpretation, the @scopes attribute values for the <spatialEntity> tags for *computer* and *desk* would need to reflect that scoping relation such that *scopes* (se_1,se_2). The "particular computer" interpretation is not reflected in the annotation provided where the scoping relation is such that *scopes* (se_2, se_1).

The annotation in example b) corresponds to an individual interpretation in which there is a distinct *riding* motion event for each *steep road*. This is contrastive with a collective interpretation, which would require the @countable attribute for the <path> tag for *roads* (p1) to be set to "false". Such a collective interpretation would be one for which a single *riding* event occurred in which the *steep roads* were traversed as a group. Pragmatically, for this to be plausible, one would have to imagine the roads to be configured in a parallel series. Under the individual interpretation, which corresponds to the annotation example, it holds that

— there exists an entity se_1 for some paths p_1, and

— for p_1, there exists a motion event m_1 such that the se_1 is an individual (referenced by *I*) and m_1 is a *riding* and p_1 are *steep roads* and those m_1 traverse p_1 and the mover participant in m_1 is the individual se_1.

The interpretation that has been annotated in example c) is another individual interpretation where the @countable attributes for each entity have been annotated as "true". The @quant attribute for se_2 takes the "every" value due to the determiner *every*; se_1 and se_3 are quantified existentially. For se_3, there is

an explicit, definite determiner (*3 or more*) which is captured with the @quant value of "geq3" (greater than or equal to 3), and for se_1 the @quant attribute takes a value of "1" as *me* is a grammatically singular pronoun. Under this interpretation, it holds that there exists an individual entity se_1 for every entity se_2 and for every se_2, there exists a motion event m_1 and for m_1, there exist *3 or more* entities se_3, such that if se_1 is an individual (referenced by *me*), se_2 is a *car*, m_1 is a *passing*, se_3 are *people*, m_1 is a *passing by* of se_1, and the mover participant of m_1 is se_2, then se_3 are *inside* se_2.

It is important to give special attention to the @scopes attributes in the above examples. If there are *n* quantified variables, there might be as many as *n-1* scoping relations. In example a), there is one scoping relation that can be represented in terms of a *scopes*(*scoper*,*scopee*) function where *scopes*(se_2,se_1). In example b), there are two scoping relations: *scopes*(se_1,p_1) and *scopes*(p_1,m_1). In example c), there are three scoping relations: [*scopes*(se_1,se_2), $\wedge$*scopes*(se_2,m_1), and $\wedge$*scopes*(m_1,se_3)]. Note how, after applying quantifier raising (QR), the ordering of the quantifiers in the logical formulae reflect these scoping relations in the annotations.

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