

Language resource management — Semantic annotation framework — Discourse structures

Gestion des ressources linguistiques — Cadre d'annotation sémantique — Partie 5: Structures de discours

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Foreword

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Introduction

Discourse structures play an essential role in formulating the syntactic, semantic and pragmatic content of linguistic and other types of documents. This standard is to be a basis for annotation, production, translation, etc. of such various types of documents. Note that there are discourse structures not only in linguistic content but also in non-linguistic content such as (possibly silent) video. The standard also deals with documents without predefined total temporal ordering of presentation, such as hypertexts and games.

The standard scheme provided here specifies the organization of discourse structures consisting of eventualities (or what represent them, such as sentences, clauses, phrases, video scenes, and so on) and discourse relations among them. Discourse relations have traditionally been assumed to carry both semantic and presentational (syntactic and pragmatic) information, but this standard simplifies discourse relation and thus minimizes the set of discourse relations by attributing presentational information to other parts of discourse structures.

This scheme will provide a common, language-neutral pivot for the interoperation among diverse formats of discourse structures of various types of documents, linguistic or not. For example, if the discourse structures of speech and other linguistic data contained in motion pictures were fitted to this scheme, then multilingual subtitles to these pictures could be composed for a reduced cost by means of some standardized tool for multilingual translation. By the same token, the interoperability among various discourse corpora would facilitate researches using them.

Language resource management – Semantic annotation framework – Part 5: Discourse structure

1 Scope

This standard is to describe how sentences (or eventualities) are combined through discourse connectives (or discourse relations) to constitute a discourse (or its semantic and pragmatic content).

2 Normative references

- ISO 12620-1 Data Categories
- ISO 24612 Linguistic Annotation Framework

3 Terms and definitions

3.1. eventuality

event (possibly dialogue act) or state or process or their abstraction (type).

NOTE Same as event in TimeML.

3.2. discourse relation

semantic relation among eventualities.

3.3. discourse graph

graph representing discourse semantics in which nodes represent eventualities and links among them represent discourse relations.

3.4. discourse tree

annotated tree structure of discourse representing presentational structures of the discourse besides its semantic content.

4 Overview

As for sentences, logical forms represent their semantic content and parse trees describe their presentation. As for discourses, however, their meanings and presentations have been discussed in a more intertwined manner. For instance, most literature has regarded discourse relations as carrying both semantic and presentational (syntactic and pragmatic) information. This is inappropriate when one wants to focus on the semantic aspects of discourses, for instance, which may be the case when dealing with hypertexts, games, and so on, which lack prefixed temporal order of presentation, and when discussing multiple (e.g., multilingual) presentations of the same semantic content.

This standard specifies two ways to describe discourse structures: discourse graphs and discourse trees. Discourse graphs represent the semantic content of discourses. Discourse trees describe the presentational structures of discourses, besides their semantic content.

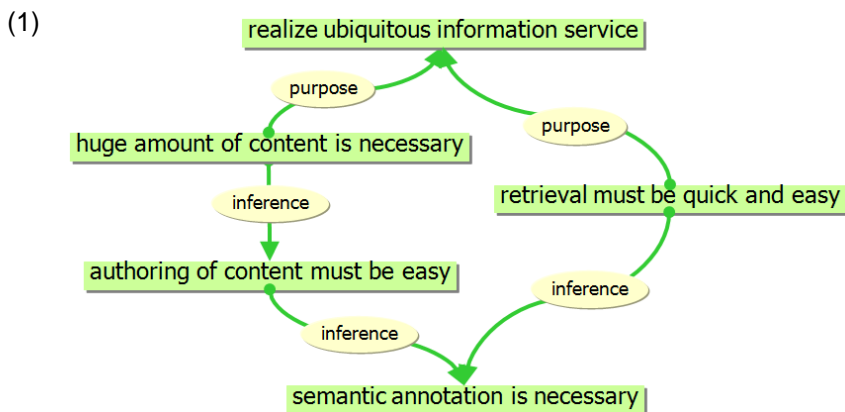
Nodes in a discourse graph represent eventualities and links among them represent discourse relations. This standard regards discourse relations as purely semantic as possible, by abstracting presentational aspects (such as surface ordering and nucleus/satellite distinction) away from those relations. The standard also maximally accommodates polymorphism, which encompasses metonymy, projection, and so on. This minimizes the set of discourse relations and raises the versatility of discourse relations and discourse graphs while preserving semantic distinctions. An annex to this document also provides a language-neutral set of common discourse relations.

A discourse tree describes the presentational structures of a discourse by specifying its hierarchical organization. Nodes in the tree are parts of the discourse, such as sentences, paragraphs, clauses, and phrases. A child of each node is one of its subconstituents. In addition, annotations to the discourse tree indirectly represent the semantic structures of the discourse.

It is straightforward to encode discourse graphs and discourse trees by LAF.

5 Discourse Graphs and Discourse Trees

Discourse graphs represent semantic content of discourses. Each node in a discourse graph represents an eventuality, and each link therein represents a discourse relation between two such eventualities. Below is a sample discourse graph.



Each link in a discourse graph is directed from the first argument to the second argument of the discourse relation. For instance, 'realize ubiquitous information service' is a purpose of 'huge amount of content is necessary' and 'authoring of content must be easy' is inferred from 'huge amount of content is necessary.'

Discourse trees encode presentational structures of discourses. The following discourse, followed by its discourse tree, presents the semantic content represented by discourse graph (1).

- (2) Semantic annotation is necessary because retrieval must be quick and easy and authoring of content must be easy. Retrieval must be quick and easy in order to realize ubiquitous information access. Authoring of content must be easy because huge amount of content is necessary in order to realize ubiquitous information access.

```
[
  [Semantic annotation is necessary
    {-inference
      because
        {conjunction
          [2 retrieval must be quick and easy]
          and
          [3 authoring of content must be easy]
        }
      }
    ]
  ]
  [2 Retrieval must be quick and easy
```



```

    {purpose
      in order to
      [0 realize ubiquitous information access]
    }
  .]
[3 Authoring of content must be easy
  {-inference
    because
    [1 huge amount of content is necessary
      {purpose
        in order to
        [0 realize ubiquitous information access]
      }
    ]
  }
.]
]

```

In a discourse tree, each pair of brackets encloses an expression representing an eventuality; to be more precise, the semantic head of the expression enclosed in a pair of brackets represents an eventuality. For instance, `[realize ubiquitous information access]` represents an eventuality.

Similarly, each pair of curly braces encloses an expression whose semantic head is a representation of a discourse relation and its complement is the second argument of the discourse relation; when the discourse relation is symmetric, there may be multiple complements, which are all the arguments of the discourse relation. Words with gray background specify types of discourse relations. The minus sign means the inversion of the subsequent discourse relation. For instance, `{purpose in order to [0 realize ubiquitous information access]}` represents a relation of type `purpose` plus its second argument `[0 realize ubiquitous information service]`. That is, `realize ubiquitous information service` is a purpose of `huge amount of content is necessary.` For another example, `[3 Authoring of content must be easy {-inference because [1 huge amount of content is necessary ...]}]` means that `huge amount of content is necessary` and `authoring of content must be easy` are the first and the second argument of an `inference` relation, respectively.

The expression enclosed in a pair of curly braces minus the embedded expressions enclosed in pairs of brackets is the discourse connective representing the discourse relation heading the whole expression. In (2), for example, `in order to` is the discourse connective representing the `purpose` relation.

The expression on which the discourse connective syntactically depends represents the first argument of the discourse relation. If the discourse connective is a subordinate conjunction or a similar expression, the complement (mandatory syntactic dependent) of the discourse connective represents the second argument of the discourse relation. If the discourse connective is an adverb, then the second argument of the discourse relation is implicitly referred to as shown in an example later. If the discourse connective is a coordinate conjunction, then its complements are its arguments of the (symmetric) discourse relation.

The subscript numbers specify coreferences. For the sake of simplicity, the referent of an expression is regarded as the referent of its semantic head. So `[2 retrieval must be quick and easy]` and `[2 Retrieval must be quick and easy {purpose ...}]` are coreferent.

The semantic content represented by discourse graph (1) may be presented by another discourse as below, followed by its discourse tree.

- (3) In order to realize ubiquitous information access, huge amount of content is necessary, so that authoring of content must be easy. Also in order to realize ubiquitous information access, retrieval must be quick and easy. So semantic annotation is necessary.

```

[
  [1
    {purpose
      In order to
      [0 realize ubiquitous information access]
    },
    huge amount of content is necessary,
    {causes
      so that

```

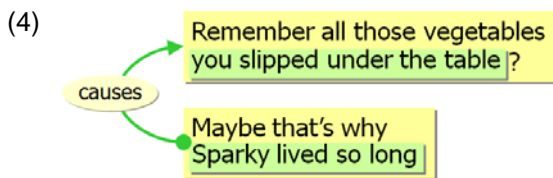
```

    [3 authoring of content must be easy]
  }
.]
[
  {purpose
    Also in order to
    [0 realize ubiquitous information access]
  },
  [2 retrieval must be quick and easy]
.]
[
  {-causes So2+3}
  semantic annotation is necessary
.]
]

```

The subscripts to adverbial discourse connectives specify their second arguments. For instance, ‘{-causes So₂₊₃}’ means that ‘[₂ retrieval must be quick and easy]’ and ‘[₃ authoring of content must be easy]’ together form the second argument of the ‘-causes’ relation or the first argument of the ‘causes’ relation.

In previous annotation practices, discourse relation may concern not the whole apparent argument but its core wrapped in an attitude report, a modal operator, etc., as below.



This standard instead recommends more precise descriptions in terms of both discourse graphs and discourse trees.

recommended descriptions

6 Discourse Relations

Discourse relations hold among eventualities and thus play an indispensable role in describing semantic content of (linguistic or non-linguistic) documents. This standard distinguishes between the semantic content and the presentation of discourse by abstracting presentational aspects (such as surface ordering and nucleus/satellite distinction) away from discourse relations, together with the distinction between discourse graphs as pure semantic content representation and discourse trees as representations encompassing the presentational features of discourses as well. The standard also maximally accommodates polymorphism of discourse relations, which includes metonymy, projection, and so on.

The following discourse tree provides a case where an instance event (I worked hard) and an event type (pass the exam) are combined by a ‘purpose’ relation.

(5) [I worked hard {purpose to [pass the exam]}].]

The two arguments of a conditional relation are both event types, as in the following example.

(6) [Tom will come {-conditional if [Mary comes]}].]

Discourse relations are factual and/or inferential.

(7) [Tom came {-inference because [Mary came]}].]
 = [I guess [Tom came] {-inference because [Mary came]}].]

Some discourse relations inevitably entail some presentational aspects. For instance, the ‘restatement’ relation is the same as equivalence in the pure semantic terms, but it has an obvious function of providing different presentations to the same semantic content. Nonetheless, this standard attempts to restrict discourse relations to semantic aspects as much as possible.

In each of the following pairs of inverse relations, we shall adopt the latter, using the parenthesized names, if any.

- means vs. purpose
- cause vs. result (causes)
- reason vs. conclusion (inference)
- attribution vs. content
- general vs. specific
- whole vs. part

For instance, instead of `reason' and `conclusion' the `inference' relation will be used, whose first argument is the reason and whose second argument is the conclusion. The `inference' relation does not specify which argument is more important than the other, since that is up to particular presentations described by discourse trees.

any criterion under which to choose names and directions of these relations?

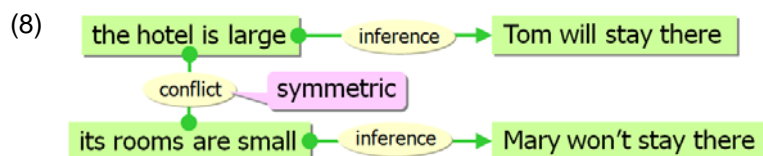
correspondence among different namespaces

hypernode (node containing a graph)

6.1 Headedness

Since the headedness (importance or nucleus/satellite distinction) and the linear order of presentation are encoded not in discourse graphs but in discourse trees, we can abstract these presentational features away from discourse relations.

Let us consider the following discourse graph in order to discuss the headedness issue.



The following two discourses, each followed by its discourse tree, present different parts of this graph.

(9) Although its rooms are small, the hotel is large. So Tom will stay there.

```

[
  [1
    {conflict
      Although
      [its rooms are small]
    },
    the hotel is large
  .]
  [
    {-inference So1}
    Tom will stay there
  .]
.]
  
```

(10) The hotel is large, but its rooms are small. So Mary won't stay there.

```

[
  [conjunction
    [The hotel is large],
    But
    [1its rooms are small]
  .]
  [
    {-inference So1}
    Mary won't stay there
  .]
.]
  
```

Since it is not necessary to address the headedness of the `concession` relation, this standard adopts the `conflict` relation (a symmetric version of `concession`) so that the above discourse graph (8) is versatile over many different discourses with different importance assignments such as the above two.

6.2 Polymorphism, Metonymy, and Projection

Some discourse relations are polymorphic due to metonymy, projection, and other reasons. We do not pose multiple discourse relations for different cases in a polymorphic variation, but unify them in a single discourse relation to address the semantic uniformity across the relevant cases in the variation.

6.3 Object/Eventuality Polymorphism

Discourse relations such as below hold both between eventualities and between other objects.

- similar
- dissimilar
- general-specific
- set-member
- whole-part
- example
- restatement
- means-purpose
- comparison?
- attribution-content?

6.4 Temporal Projection

`time` (semantic role or temporal relation) and `circumstance` (discourse relation) may be unified, if an eventuality is regarded as its temporal projection. In the following examples, `8 o'clock` and `Mary came` may be regarded as equivalent modulo temporal projection, and so are `time` and `circumstance`.

(11) [Tom came {time at [8 o'clock].}]

(12) [Tom came {circumstance when [Mary came].}]

The following relations share the same property.

- circumstance
- before-after
- until
- simultaneous

6.5 Instance/Type Polymorphism

Some discourse relations take both instances and types for either or both of their first and second arguments.

- purpose

(13) [I used this sword {purpose to [cut it]}]

- conditional

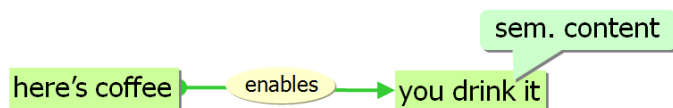
(14) [{-conditional} If [you're going to school]], it's eight o'clock].

- unconditional

6.6 Semantic/Dialogue Polymorphism

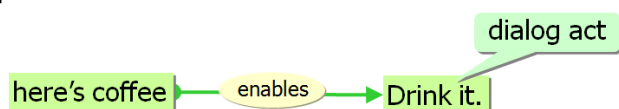
Discourse relations such as 'enables' connect dialogue acts.

```
(15) {inference
      Since
      (here's coffee),
      it's possible that
      [you drink it].
      }
```



A pair of parentheses encloses the expression representing the first argument of the discourse relation. In (15), 'here's coffee' represents the first argument of the 'inference' relation. The semantic head of (15) is a discontinuous discourse connective 'Since ... it's possible that.'

```
(16) [
      [_1 Here's coffee.]
      [{-enables So1} [drink it].]
      ]
```



Here the fact that here's coffee supports the precondition for the imperative.

Annex A Enumeration of Discourse Relations

Two binary semantic distinctions are used to sort discourse relations into the four types below.

additive

- positive
 - Elaboration: specific, part, step, object, member, example, extraction, minimum, detail, restatement, definition
 - Attribution: content
 - Background: background, circumstance
 - Comparison: similarity, proportion
 - Complement: supplement
 - Additive: coordination, addition
 - Manner: manner
- negative
 - Contrast: contrast, dissimilarity, disjunction, substitution
 - Complement: constraint
 - Comparison: comparison, preference

causal

- positive
 - Causality: causes, motivates, triggers
 - Enablement: purpose, enables
 - Inference: inference, explanation
 - Evaluation: evaluation, interpretation, comment
 - Condition: conditional
- negative
 - Concession: conflict
 - Condition: otherwise, unconditional, compromise

Positive additive relations

relation	inverse	definition	connective	example
conjunction	conjunction	Both 1 and 2 hold or take place.	and also furthermore inAddition besides too	[1 The weather was fine], and [2 the wind was cool].
addition			and also furthermore in addition besides too	[1 Tom was tired]. Also [2 he was feverish].
proportion	proportionOf	The degree of 1 is in accordance with that of 2.	-theThe	[2 the sooner], [1 the better].
similar	similar	1 and 2 are similar to each other.	similarly	[1 dance] like [2 a butterfly]
manner		1 in a manner similar to that of 2.	as aslf	[1 She cooks a turkey] as [2 her mother did]. [1 Do it] exactly as [2 I said].
suppliment	suplimentOf	2 provides information relevant to 1. (Same as Elaboration-Additional of RST.)	InThisConnection	[1 The first meeting shall be held on the 16th.] [2 The next one shall be in next month].
background	backgroundOf	2 provides background information of 1.	when -null	
restatement	restatement	1 and 2 paraphrase each other with similar degrees of minuteness.	that is namely	
elaboration	summary	2 elaborates 1.	-in summary null	
specific	general	1 is a general description and 2 is a specific aspect of it.	null	
part	whole	2 is part or constituent of 1		
member	set	2 is a member of set 1.	null	
example	exampleOf	2 is an example of 1.	forInstance forExample	
extraction	extractionOf	2 is a particular example of 1.	inParticular	
minimum	minimumOf	2 is the minimal possibility of 1.	atLeast	
step	process	2 is a step of a process 1.	null	[1 Water is circulating.] [2 It falls on the earth as rain or show, and evaporates back to the sty.]
content	attribution	1 is an utterance, a thought, or the like, and 2 is its content.	that	[1 I think] that [2 she is wrong]. the [1 idea] that [2 the earth revolves around the sun] a [1 desire] to [2 get married]
definition	definitionOf		be	[1 To lie] is [2 to tell a false].

Negative additive relations

relation	inverse	definition	connective	example
contrast	contrast	1 and 2 are in contrast to each other.	but	[1 His hair is white]

relation	inverse	definition	connective	example
		Their cooccurrence is neither unlikely nor undesirable, so that they cannot be connected with 'despite'.	however while whereas although though onTheOtherHand	but [2 his eyes are black].
disjunction	disjunction	Either 1 or 2 holds or take place.	or either or alternatively	[1 Publish] or [2 perish].
comparison		The degree of 1 is more than that of 2.	than	[1 Tom swims faster] than [2 Sue walks].
letAlone		2 is more natural than 1.	let alone	[1 He can't read], let alone [2 write].
dissimilar	dissimilar	1 and 2 are dissimilar to each other.	unlike	[1 Tom is rich] unlike [2 Sue].
substitution	substitutes		rather	[1 I hate bananas.] Rather [I'd like ananas].
constraint	constraintOn	2 constrains 1.	though	[1 I can come with you] though [2 I must go home by eight].

Positive causal relations

relation	inverse	definition	connective	example
causes	cause	1 is a cause of a result 2.	-because -since -as so soThat	[2 Tom passed the exam] because [1 he studied hard]. [1 Tom studied hard]. So [2 he passed the exam].
Inference??	evidence	1 is an evidence and 2 is a conclusion of it.	-because -since -as so soThat null	[2 It's raining] because [1 people are putting up umbrellas]. [2 Tom must have studied hard] because [1 he passed the exam].
triggers	triggeredBy	2 occurs with 1 as a trigger, or 2 is an output of 1. 1 contains no concrete information of the cause of 2.	-as a result of then null	[1 I was walking along the avenue]. Then [2 a man approached me]. [2 The density doubled] as a result of [1 the experient].
purpose	means	1 is a means for the purpose of 2. Unlike in RST, 2 may have been achieved.	inOrderTo forTheSakeOf -by soThat	[1 Tom studied hard] in order to [pass the exam]. [2 Tom passed the exam] by [1 studying hard].
enables	enablement	1 makes 2 possible.	-because -since -as so so that null	[1 Here is a glass of wine]. [2 Drink it]. [2 Let's have a break] because [1 we have half an hour].
conditional	condition	If 1 then 2.	-if	If [1 Tom comes here], [2 he'll be surprized].
explanation	explains	2 is a possible explanation of 1.	null	[1 Most of the dinosaurs died about 65,000,000 years ago.] [2 Maybe the impact of a big meteorite caused this.]

relation	inverse	definition	connective	example
evaluation	evaluates	2 is an evaluation of 1.	null	

Negative causal relations

relation	inverse	definition	connective	example
conflict	conflict	The cooccurrence of 1 and 2 is regarded as unlikely or undesirable.	but however while whereas although though despite	[1 Tom studied hard] but [2 he failed in the exam]. [1 Tom failed in the exam] despite [2 his hard work].
unconditional	noncondition	2 whether or not 1.	-whetherOrNot	[2 I'll go] whether or not [1 it rains].
compromise		2 even if 1.	-evenIf	[2 I'll go] even if [1 it rains].