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RRSet - Taxonomy of rhetorical relations in SemDok

Harald Längen

Institut für Germanistik
Angewandte Sprachwissenschaft und Computerlinguistik

Justus-Liebig-Universität Gießen

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1 Introduction

This report serves as a documentation of the taxonomy of rhetorical relations that was designed in the SemDok project, its formalisation in OWL, and the implementation of several Prolog predicates that can be applied to the OWL formalisation.

In the project SemDok, a text parser deriving discourse structures according to RST (Rhetorical Structure Theory) has been developed with special consideration of the text type of scientific journal articles (Lüngen et al., 2006). A taxonomy of rhetorical relations has been defined to be used within SemDok for a.) manual annotations of rhetorical analysis of scientific articles from the SemDok corpus, and b.) the RST annotations output by the SemDok Parser.

This SemDok taxonomy of rhetorical relations is called RRSET and has been designed taking the following dimensions into account:

1. Previous discourse relation taxonomies proposed by Mann and Thompson (1988), Hovy and Maier (1995), and Carlson and Marcu (2001).
2. Certain features of the text type of scientific articles
3. The application scenario for the SemDok parser, namely an explorative reading environment for students studying the argumentative structure of scientific texts (Lüngen et al., 2008, cf.).

This document does not contain definitions of rhetorical relations for use in manual annotation projects. For the relation definitions as employed in the SemDok project, see Bärenfänger (2008).

2 Taxonomies of rhetorical relations

Already in the original conception of Rhetorical Structure Theory by Mann and Thompson (1988), (see also Mann and Taboada, 2005), rhetorical relations were grouped into classes. On a top level, there were the two groups of *multinuclear* vs. *mononuclear* relations according to the structural criterion of nuclearity. The mononuclear relations were further subdivided into *presentational* vs. *subject-matter relations* (cf. Mann and Taboada,

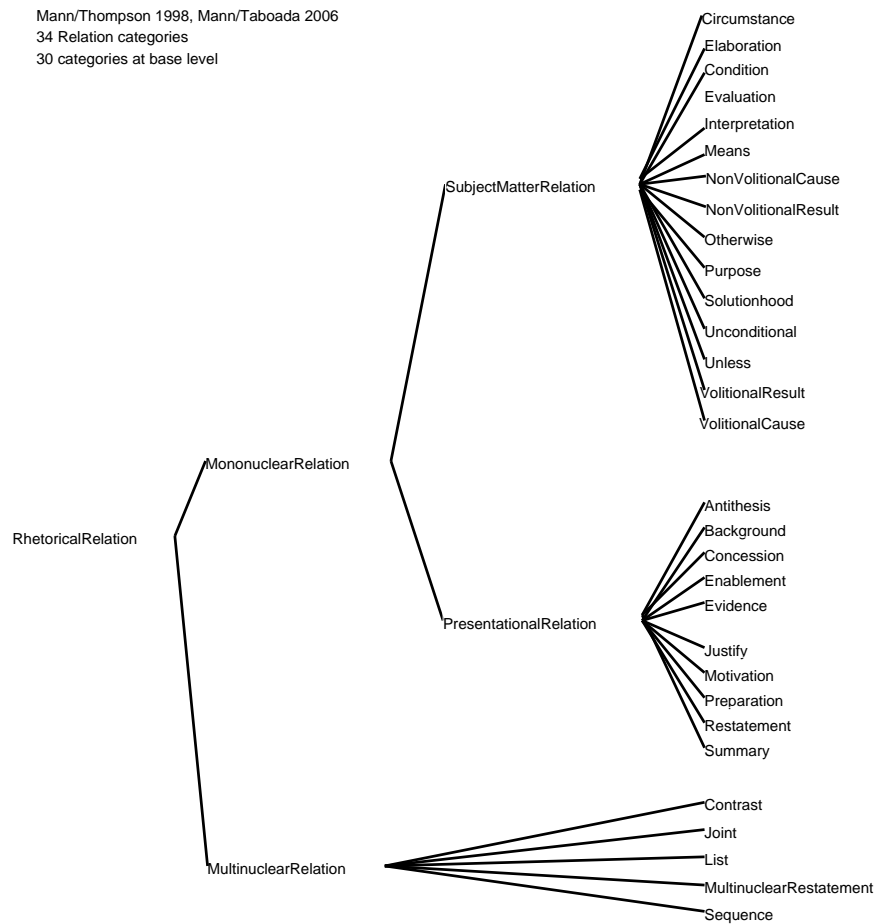


Figure 1: Hierarchy of rhetorical relations according to Mann and Thompson (1988)

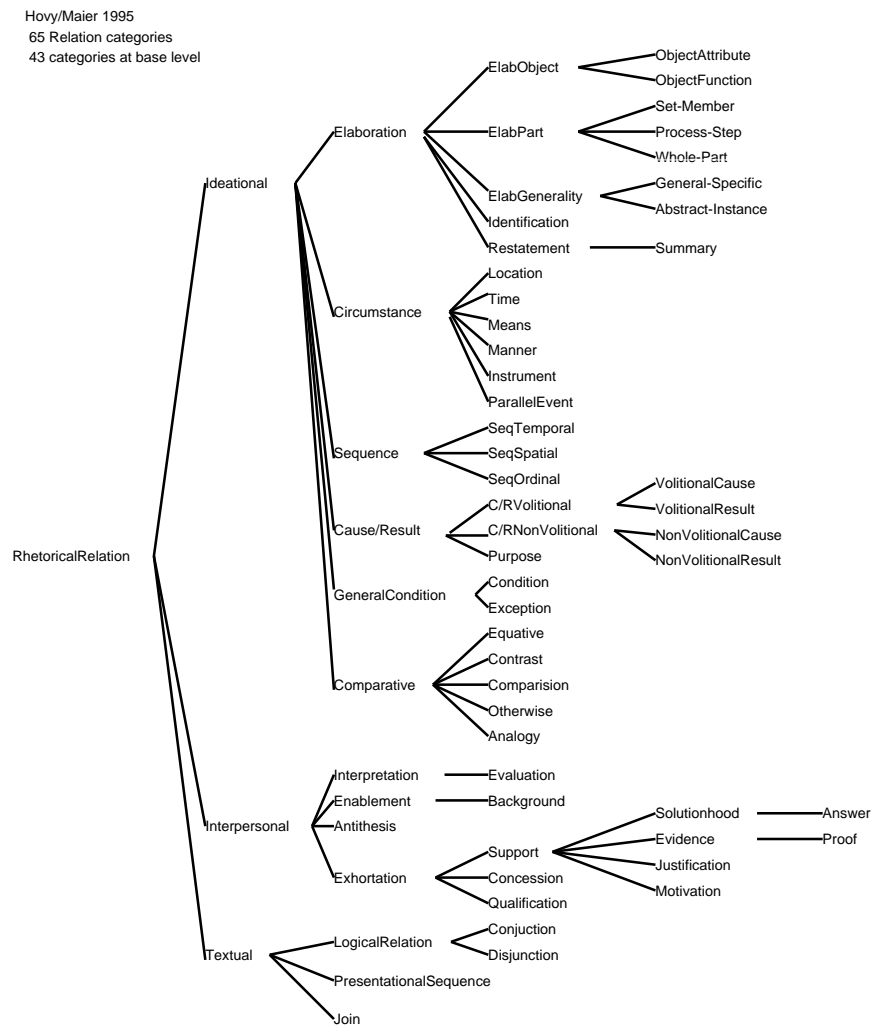


Figure 2: Hierarchy of discourse relations according to Hovy and Maier (1995)

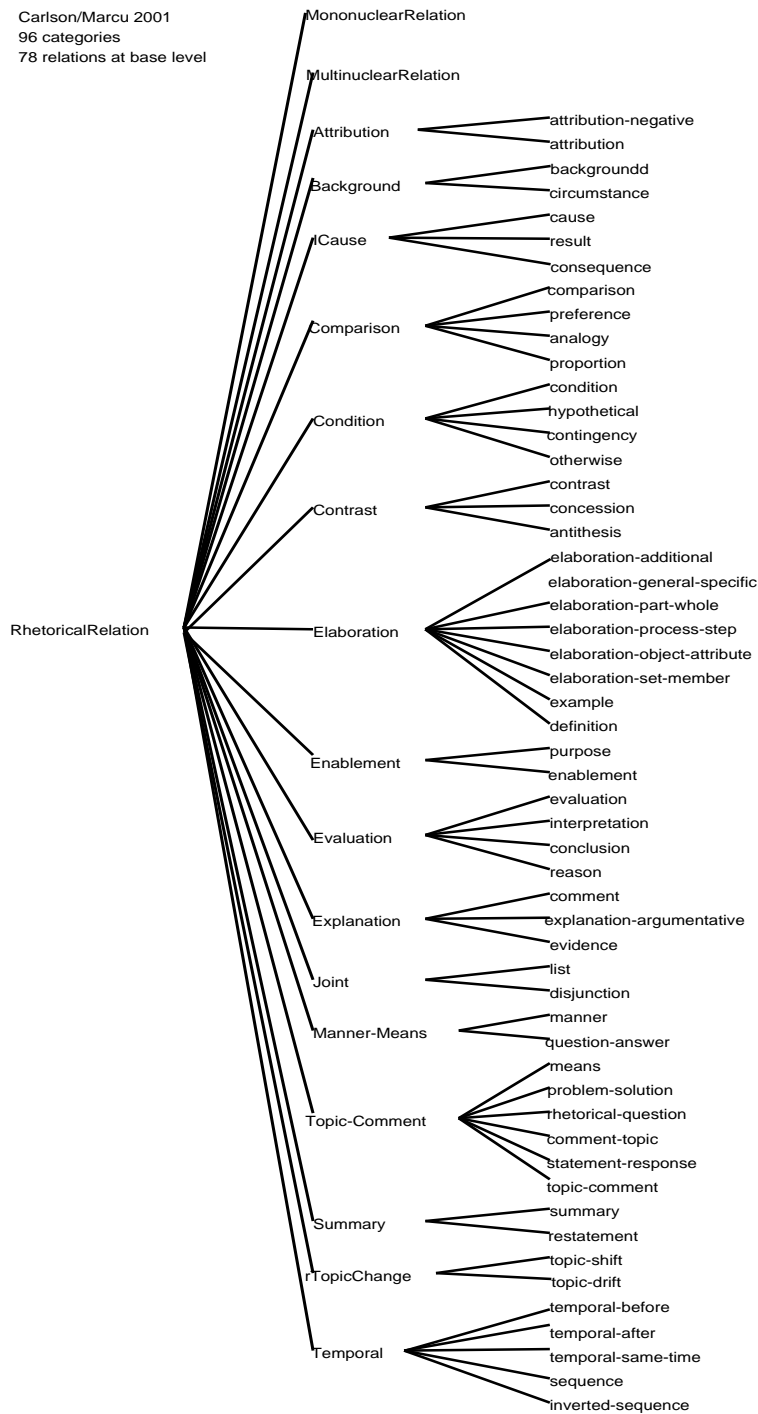


Figure 3: Hierarchy of discourse relations according to Carlson and Marcu (2001)

2005). Lower-level subgroups such as *Evidence-and-Justify* were introduced as well. The complete hierarchy is shown in Figure 1.

Hovy and Maier (1995) suggested a merger of existing hierarchies of discourse relations (without special reference to RST) into one comprehensive hierarchy consisting of 65 relation categories, 43 of which were relations at the base level. Their prediction was that application-specific extensions to this merged relation set would always consist of the refinement of a relation category that was already in the hierarchy, i.e. the number of higher-level relation types would always stay the same. One purpose of developing a hierarchy of discourse relations is thus to point out compatibility of different relation sets by showing how they can be mapped on each other or even merged, ultimately supporting the view that a universal set of relation types exists. This hierarchy can be seen in Figure 2.

Carlson and Marcu (2001) used a taxonomy of RST relations with 96 categories used in the annotation of articles in a corpus of Wall Street Journal articles. In their hierarchy, there is a base level with 78 categories that were used in the annotation project, and an intermediate level consisting of 18 relation classes. (The tree representation in Figure 3 was reconstructed according to the information given in the table overview in Carlson and Marcu (2001)).

3 The SemDok RRSet

The SemDok RRSET of rhetorical relations suitable for analysing scientific articles in an explorative reading scenario (cf. Lungen et al. (2008)) was developed according to the following strategy: We took the extended classical MT relation set (Mann and Taboada, 2005), cf. Figure 1 and additionally reviewed the taxonomies by Hovy and Maier (1995) and Carlson and Marcu (2001) and chose candidates for extending the MT relation set. We also evaluated the RST annotations that were available from an earlier project phase (cf. Lungen et al., 2008) for determining the relevance of the candidate relations in our corpus. Subsequently, we designed the RRSET along the following criteria:

- we introduced subrelations when we found strong associations with certain discourse markers that seemed highly scenario-relevant; for instance we wanted to distinguish between LIST-COORDINATION re-

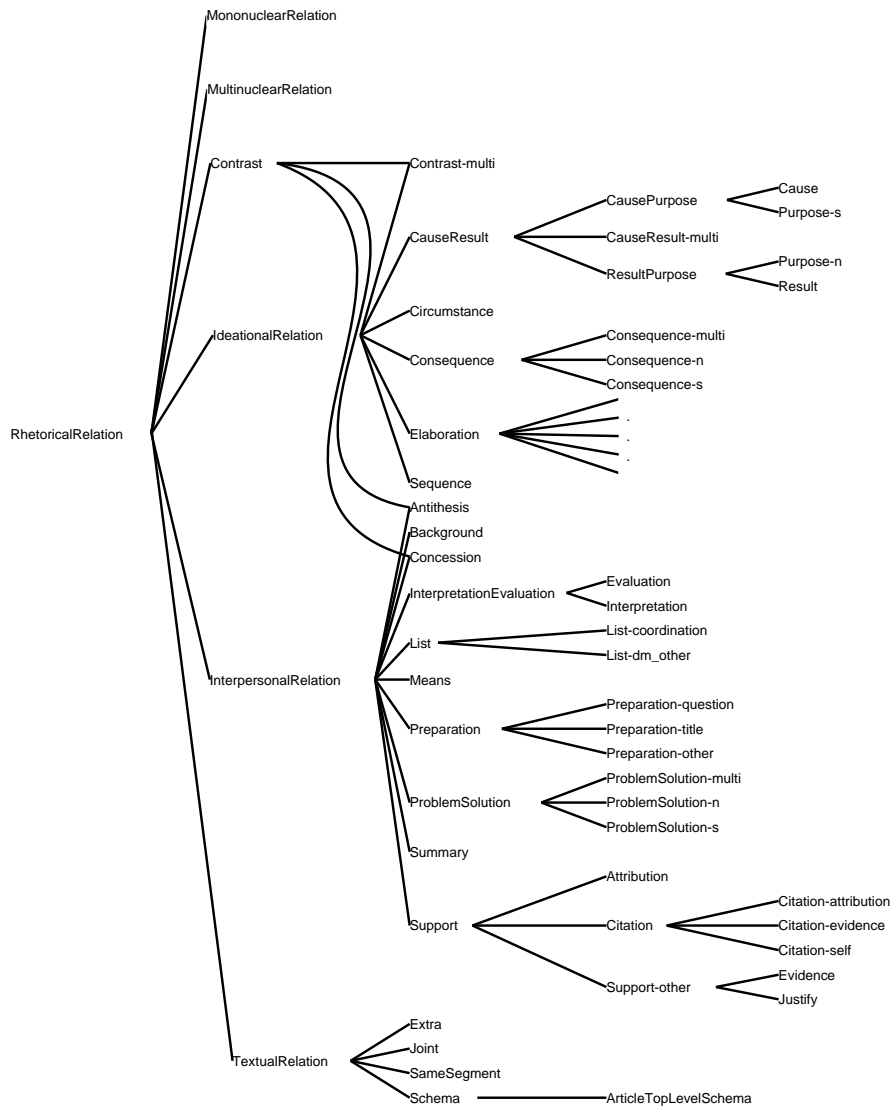


Figure 4: SemDok RRSET ontology (save the subclasses of ELABORATION)

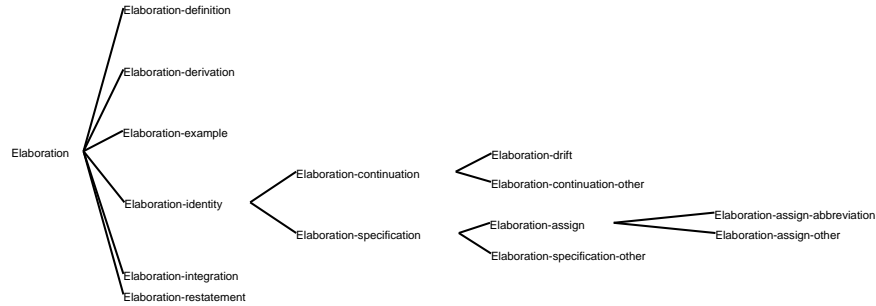


Figure 5: SemDok hierarchy of ELABORATION relations)

lations that are indicated by syntactic coordination vs. LIST-DM-OTHER relations that are indicated by discourse markers on the logical document structure level such as `<listitem>` elements. Similarly, we introduced PREPARATION-TITLE, PREPARATION-QUESTION, PREPARATION-OTHER, CITATION-EVIDENCE, and CITATION-ATtribution;

- we introduced the comprehensive sub-taxonomy of ELABORATION relations described in Bärenfänger (2008);
- we omitted two relations from Mann and Thompson (1988), which had proved to be irrelevant in our text type (MOTIVATION, ENABLEMENT);
- we introduced new superordinate relation classes for relations that were hardly distinguished by discourse markers and that were also often confused by human annotators when trying to apply semantically oriented definitions (SUPPORT-OTHER, CONTRAST, LISTSEQUENCE, and INTERPRETATIONEVALUATION);
- we introduced relation types that denote heavily underspecified relations (MONONUCLEARRELATION, MULTINUCLEARRELATION, IDEATIONALRELATION, INTERPERSONALRELATION, and TEXTUALRELATION).
- we introduced certain subrelations based on alternative nuclearity assignments as in Carlson and Marcu (2001) (CONSEQUENCE-MULTI, CONSEQUENCE-MULTI-N, CAUSERESULT-MULTI, PROBLEMSOLUTION-MULTI), and PROBLEMSOLUTION-N);

The RRSET thus consists of 70 relation types, 44 of which are base categories in the hierarchy (Figures 4 and 5. For reasons of decipherability,

the links from MONONUCLEARRELATION and MULTINUCLEARRELATION are not shown).

The RRSET was used in the corpus annotations of the SemDok project in documents encoded according to the XML application RST-HP (Hilbert and Längen, 2008), as well as for the RST-HP documents that are output by the SemDok parser.

4 OWL representation

A formalisation of taxonomies of linguistic category systems in a standardised ontology formalism helps making different category systems for the same domain *interoperable* and is thus a contribution to the overall goal of *sustainability* of linguistic resources (Goecke et al., 2005, Stührenberg et al., 2008). We formalised the RRSET taxonomy in the Semantic Web ontology language OWL (Bechhofer et al., 2004), and since most OWL reasoning and inference tools are based on description logic, we chose only constructs from the OWL DL dialect.

Though it seems natural to model rhetorical *relations* as OWL *properties* (`<owl:ObjectProperty>`) as we proposed in an earlier publication (Goecke et al., 2005), we finally refrained from doing so, because we also wanted to declare disjointness between certain rhetorical relation types and to encode properties of rhetorical relations that would be inherited by their subrelations. This is only possible for classes. Within OWL DL, properties can be arranged in a hierarchy but cannot be declared classes at the same time (Smith et al., 2004). Thus in the RRSET ontology we modelled the rhetorical relations as OWL classes. Subrelation-hood is marked by the `<rdfs:subclassOf>` construct.

The OWL representation of the RRSET is saved in the file `semdok-relations.owl`; it was developed using the ontology editor Protégé 3.1.1¹ in connection with the reasoner/classifier software RacerPro 1.9.1².

4.1 Top level of the class hierarchy

On the top level of the class hierarchy in `semdok-relations.owl`, the following classes can be found:

¹ <http://protege.stanford.edu>

² <http://www.racer-systems.com>

```

DiscourseRelation
  BridgingRelation
  RhetoricalRelation
DiscourseRole
  DiscourseEntity
  DiscourseMarker
  DiscourseSegment
RelationDefinition

```

The top-level class *DiscourseRelation* has the immediate subclasses *BridgingRelation* and *RhetoricalRelation*. Bridging relations are a different type of discourse relations, which is induced by anaphora, see Goecke et al. (2005). The RRSET hierarchy proper as shown in Figures 4 and 5 is found under the class *RhetoricalRelation*.

Using the `<rdfs:subclassOf>` construct, all rhetorical relations are cross-classified along the two dimensions *nuclearity* and *metafunction*, resulting in a hierarchy with multiple inheritance as sketched in Figure 4. SUPPORT, for example, is a subclass of both INTERPERSONALRELATION and MONONUCLEARRELATION.

Linguistic expressions such as noun phrases or adverbs can function as discourse entities or discourse markers on the semantic level. This is reflected in the top-level class *DiscourseRole*. It has the three subclasses *DiscourseEntity*, *DiscourseMarker*, and *DiscourseSegment* according to Goecke et al. (2005). The latter two are also relevant in the taxonomy of rhetorical relations. The instances of the *DiscourseMarker* are intended to be the entries of a discourse marker lexicon.

Finally, *RelationDefinition* is a class specifying the features of a rhetorical relation definition according to Mann and Taboada (2005).

4.2 Object Properties

Three object properties have been defined in the RRSET OWL ontology, namely *markedBy*, *hasNucleus*, and *hasSatellite*. Their respective domains and ranges are shown in Table 1.

Property	Domain	Range
markedBy	RhetoricalRelation	DiscourseMarker
hasNucleus	RhetoricalRelation	DiscourseSegment
hasSatellite	MononuclearRelation	DiscourseSegment

Table 1: Domain and range of RRSET object properties

Property	Domain	Range
directionSatellite	MononuclearRelation	“left” “right”
intention-A	RelationDefinition	xs:string
constraint-on-N	RelationDefinition	xs:string
constraint-on-S	RelationDefinition	xs:string
constraint-on-combination	RelationDefinition	xs:string
source	RelationDefinition	xs:string

Table 2: Domain and range of RRSET datatype properties

4.3 Datatype properties

Six datatype properties have been defined in the RRSET OWL ontology. The first one, *directionSatellite* is appropriate for the class of *MononuclearRelation* (i.e. has *MononuclearRelation* as its domain), and has the strings “left” or “right” as its two possible values. The remaining five properties are also string-valued and represent the elements of a rhetorical relation definition according to Mann and Taboada (2005), such as the speaker’s intention (*intention-A*) or a constraint on the meaning of a satellite (*constraint-on-S*).

4.4 Annotation properties and `rdf:comment`

Two properties, *rrset* and *noAnnotate* were supposed to be modelled as annotation properties in the RRSET OWL ontology. *Rrset* was supposed to have the two possible values “full” or “reduce-01”, indicating whether the rhetorical relation represented by the class belongs to the full RRSET (i.e. the one shown in Figure 4) or to the so-called reduced RRSET. Nevertheless, they were modelled neither as annotation properties nor as datatype properties for the following reasons:

- In OWL DL one cannot define domain and range constraints for

annotation properties (cf. Bechhofer et al., 2004).

- Annotation properties are not available when editing a class in Protégé.
- Modelling *rrset* and *noAnnotate* as ordinary datatype properties and using `<owl:hasValue>` specifications at each class is not feasible because property specifications are inherited by the subclasses. E.g. the specification `reduce-01="yes"` at the *Contrast* class would be inherited by its subclasses, which is not part of the intended meaning of the *reduce-01* property.

As a workaround, two types of specification have been annotated to classes as string values of the `<rdf:comment>` property:

“rrset=reduce-01”: All classes that are specified with this annotation are part of the reduced RRSET.

“rrset=noAnnotate”: All classes that are specified with this annotation shall not be used in the corpus annotations.

5 Prolog predicates for processing the RRSet

Several Prolog predicates for queries to the RRSET ontology have been implemented and are collected in the file “rrset-predicates.pl”. The queries serve tasks such as printing a list of classes where each subclass is indented in relation to its superclass, or generating a `.rels` file to be loaded in the RSTTool by O’Donnell (2000). The implemented Prolog predicates make use of the Thea OWL Library for Prolog (Vassiliadis, 2006), which in turn uses the SWI Prolog Semantic Web Library (cf. <http://www.swi-prolog.org/>). They were developed and tested using Thea 0.5.5 and SWI-Prolog 5.6.14.1 under Suse Linux 9.3.

In the following instructions, it is assumed that the file “rrset-predicates.pl” and the files of the Thea library, such as “owl_parser.pl” reside in the working directory. If that is not the case, please include your local directory paths in the respective Prolog atoms.

When starting the Prolog interpreter, first consult the files `rrset-predicates.pl` and `owl_parser.pl` (the Thea OWL parser), and then parse the ontology by calling `owl_parse('semdok-relations.owl', complete, complete, _)`.

You can do all this from the command line, including calling one of the predicates below by using the parameter `-g` with the SWI prolog interpreter. If you also call `'halt'` in the parameter string for `-g`, the result will be printed to `stdout`. For example, for generating a `.rels` file for the RSTTool (cf. Section 5.2), type:

```
pl -f rrset-predicates.pl -g "consult('owl_parser.pl'),
␣␣owl_parse('semdok-relations.owl',␣complete,␣complete,␣_),
␣␣print_rels(['http://www.text-technology.de/semdok-relations.owl#
    RhetoricalRelation'], 'full'),
␣␣halt."
```

5.1 Print as a list with indentations

The classes of the ontology can be printed out as list where indentations indicate the subclass relationship (modelled after Protégé's class browser view, e.g. for documentation purposes. For this purpose, the predicate `print_class_hierarchies/2` is available.

```
print_class_hierarchies(+L,+E)

L : a list of classes on the same level
E: indentations per level, e.g. 3

example:
print_class_hierarchies(['http://www.text-technology.de/semdok-
    relations.owl#Contrast',
    'http://www.text-technology.de/semdok-relations.owl#ListSequence',
    'http://www.text-technology.de/semdok-relations.owl#IdeationalRelation',
    'http://www.text-technology.de/semdok-relations.owl#
        InterpersonalRelation'],3).
```

The two arguments that need to be specified are:

L: a list of classes on the same level for which subclasses should be contained in the list. Presently, the namespace of the ontology (presently

'http://www.text-technology.de/sem dok-relations.owl') has to be specified in front of each class, followed by a '#'.

E: an integer specifying how many bytes should be used for indentation of each subclass level. Processing of this parameter does not work correctly, please use 3 for E until further notice.

As an example, the output of the call

```
print_class_hierarchies(['http://www.text-technology.de/sem dok-
relations.owl#RhetoricalRelation'],3).
```

is shown in Appendix 6.1.

5.2 Generate a .rels file for the RSTTool

The predicate `print_rels` will print a list of rhetorical relations that can be saved in a .rels file as needed for annotation projects using the RSTTool (O'Donnell, 2000).

```
print_rels(+L, +R)

L = list of classes for which subclasses should be printed
R = rhetorical relation subset identifier ('reduce-01', or 'full')

example: print_rels(['http://www.text-technology.de/sem dok-relations.
owl#RhetoricalRelation'], 'full').
example: print_rels(['http://www.text-technology.de/sem dok-relations.
owl#RhetoricalRelation'], 'reduce-01').
example: print_rels(['http://www.text-technology.de/sem dok-relations.
owl#Contrast', 'http://www.text-technology.de/sem dok-relations.owl#
ListSequence', 'http://www.text-technology.de/sem dok-relations.owl#
IdeationalRelation', 'http://www.text-technology.de/sem dok-
relations.owl#InterpersonalRelation', 'http://www.text-technology.
de/sem dok-relations.owl#TextualRelation'], 'full').
```

The two arguments that need to be specified are:

L: a list of classes for which subclasses should be contained in the list.

Presently, the namespace of the ontology (presently 'http://www.text-technology.de/se has to be given in front of each class, followed by a '#').

R: a valid rhetorical relation subset identifier (presently 'reduce-01' or 'full').

As an example, the output of the call

```
print_rels(['http://www.text-technology.de/sem dok-relations.owl\#
    Contrast',
'http://www.text-technology.de/sem dok-relations.owl\#ListSequence',
'http://www.text-technology.de/sem dok-relations.owl\#
    IdeationalRelation',
'http://www.text-technology.de/sem dok-relations.owl\#
    InterpersonalRelation',
'http://www.text-technology.de/sem dok-relations.owl\#TextualRelation'],
    'full').
```

is shown in Appendix 6.2.

5.3 Find the lowest common superclass for a pair of classes

The predicate `get_lcs/5` calculates the lowest common superclass for a pair of classes in the ontology. It was implemented as an interface predicate to be called by the SemDok parser to combine competing hypothesis in the parsing process (Lüngen and Hilbert, 2008) .

```
get_lcs(+C1, +C2, +R, +MaxD, -L)

top-level predicate to get the lowest common superclass(es)

C1: a relation, e.g. 'Elaboration'
C2: another relation, e.g. 'Circumstance'
R: rhetorical relation subset identifier, e.g. 'reduce-01'
MaxD: maximum allowed distance of the superclasses
L: result list

example: get_lcs('Elaboration', 'Circumstance', 'reduce-01', 10, L).
```

The fifth argument, `L`, is the list that will contain the solutions. The four arguments that need to be specified are:

C1, C2: two classes representing rhetorical relations, e.g. `Elaboration` and `Circumstance`

R: a rhetorical relation subset identifier, either 'full' or 'reduce-01'

MaxD: maximum allowed distance of the superclasses. i.e. when a common superclass can only be found higher in the hierarchy than the distance specified, L will be empty.

The result list L contains n lists of the form [Superclass, Nuclearity, DegreeC1, DegreeC2], where Superclass is a lowest common superclass, Nuclearity is the nuclearity of that lowest common superclass, i.e. one of mono, multi, or unspec_nucl, DegreeC1 is the distance between C1 and the superclass in terms of the number of direct subClassOf links, and DegreeC2 is the distance between C2 and the superclass.

Several example calls of `get_lcs` and their solutions can be found in Appendix 6.3.

5.4 Print a mapping table for processing output of the RSTTool

The RSTTool (O'Donnell, 2000) changes the orthography of relation names such that all capital letters are changed into small letters in annotated documents. In order to reconvert the relation names in annotated documents into the original spelling, a mapping table of original vs. changed relation names is required. The predicates `print_rsttool_mapping_table/2` and `print_rsttool_mapping_table_xml/2` generate mapping tables, the former as a prolog fact base, the latter in an XML format.

```
print_rsttool_mapping_table(+L,+R)
print_rsttool_mapping_table_xml(+L,+R)

L = List of Classes for which mapping table for all subclasses should
    be printed
R = rhetorical relation subset identifier ('reduce_01' or 'full')

example: print_rsttool_mapping_table(['http://www.text-technology.de/
    semdok-relations.owl#RhetoricalRelation'],'full').
example: print_rsttool_mapping_table_xml(['http://www.text-technology.
    de/semdok-relations.owl#RhetoricalRelation'],'full').
```

The two arguments that need to be specified are:

- L:** a list of classes for which subclasses should be contained in the mapping table. Presently, the namespace of the ontology (presently 'http://www.text-technology.de/sem dok-relations.owl') has to be given in front of each class, followed by a '#'.
R: a valid rhetorical relation subset identifier (presently 'reduce-01' or 'full').

As an example, the output of the calls

```
print_rsttool_mapping_table(['http://www.text-technology.de/sem dok-  
relations.owl\#RhetoricalRelation'], 'full').}  
  
print_rsttool_mapping_table_xml(['http://www.text-technology.de/sem dok-  
relations.owl\#RhetoricalRelation'], 'full').}
```

are shown in Appendix 6.4.

6 Appendix

6.1 Output for print_class_hierarchies/2

```
?- print_class_hierarchies(['http://www.text-technology.de/sem dok-relations.owl#
  RhetoricalRelation'],3).

RhetoricalRelation [unspec_nucl]
  MononuclearRelation [mono]
    Concession [mono]
    CausePurpose [mono]
      Cause [mono]
      Purpose-s [mono]
    ResultPurpose [mono]
      Result [mono]
      Purpose-n [mono]
    Antithesis [mono]
    Circumstance [mono]
    InterpretationEvaluation [mono]
      Evaluation [mono]
      Interpretation [mono]
    ProblemSolution-s [mono]
    Preparation [mono]
      Preparation-title [mono]
      Preparation-question [mono]
      Preparation-other [mono]
    Background [mono]
    ProblemSolution-n [mono]
    Means [mono]
    Elaboration [mono]
      Elaboration-restatement [mono]
      Elaboration-identity [mono]
      Elaboration-continuation [mono]
      Elaboration-drift [mono]
      Elaboration-continuation-other [mono]
        *Elaboration-theme-rheme* [mono]
        *Elaboration-theme-theme* [mono]
      Elaboration-specification [mono]
      Elaboration-specification-other [mono]
      Elaboration-assign [mono]
      Elaboration-assign-abbreviation [mono]
      Elaboration-assign-other [mono]
    Elaboration-integration [mono]
    Elaboration-example [mono]
    Elaboration-derivation [mono]
      *Elaboration-process-step* [mono]
      *Elaboration-class-subclass* [mono]
      *Elaboration-set-member* [mono]
      *Elaboration-whole-part* [mono]
      *Elaboration-class-instance* [mono]
    Elaboration-definition [mono]
    Summary [mono]
    Extra [mono]
    Consequence-s [mono]
```

```

Consequence-n [mono]
Support [mono]
  Attribution [mono]
  Citation [mono]
    Citation-self [mono]
    Citation-attribution [mono]
    Citation-evidence [mono]
  Support-other [mono]
    *Justify* [mono]
    *Evidence* [mono]
IdeationalRelation [unspec_nucl]
  CauseResult [unspec_nucl]
    CauseResult-multi [multi]
  Sequence [multi]
  Consequence [unspec_nucl]
    Consequence-multi [multi]
TextualRelation [unspec_nucl]
  SameSegment [multi]
  Schema [unspec_nucl]
    ArticleTopLevelSchema [unspec_nucl]
  Joint [multi]
InterpersonalRelation [unspec_nucl]
  List [multi]
    List-dm_other [multi]
    List-coordination [multi]
  ProblemSolution [unspec_nucl]
    ProblemSolution-multi [multi]
Contrast [unspec_nucl]
  Contrast-multi [multi]
MultinuclearRelation [multi]
  ListSequence [multi]

```

6.2 Output for print_rels/2

```
?- print_rels(['http://www.text-technology.de/semdok-relations.owl#RhetoricalRelation'], 'full').

MononuclearRelation rst
Concession rst
CausePurpose rst
Cause rst
Purpose-s rst
ResultPurpose rst
Result rst
Purpose-n rst
Antithesis rst
Circumstance rst
InterpretationEvaluation rst
Evaluation rst
Interpretation rst
ProblemSolution-s rst
Preparation rst
Preparation-title rst
Preparation-question rst
Preparation-other rst
Background rst
ProblemSolution-n rst
Means rst
Elaboration rst
Elaboration-restatement rst
Elaboration-identity rst
Elaboration-continuation rst
Elaboration-drift rst
Elaboration-continuation-other rst
Elaboration-specification rst
Elaboration-specification-other rst
Elaboration-assign rst
Elaboration-assign-abbreviation rst
Elaboration-assign-other rst
Elaboration-integration rst
Elaboration-example rst
Elaboration-derivation rst
Elaboration-definition rst
Summary rst
Extra rst
Consequence-s rst
Consequence-n rst
Support rst
Attribution rst
Citation rst
Citation-self rst
Citation-attribution rst
Citation-evidence rst
Support-other rst
CauseResult-multi multinuc
Sequence multinuc
Consequence-multi multinuc
```

```
SameSegment multinuc  
Joint multinuc  
List multinuc  
List-dm_other multinuc  
List-coordination multinuc  
ProblemSolution-multi multinuc  
Contrast-multi multinuc  
MultinuclearRelation multinuc  
ListSequence multinuc
```

6.3 Sample queries for get_lcs/5

```
?- get_lcs('Elaboration-specification-other', 'Elaboration-definition', 'reduce-01', 10,
L).
L = [['Elaboration', 'mono'], 3, 1]] ;
fail.

?- get_lcs('Elaboration-specification-other', 'Elaboration-assign-other', 'reduce-01', 10,
L).
L = [['Elaboration-specification', 'mono'], 1, 2]] ;
fail.

?- get_lcs('Elaboration-specification-other', 'Antithesis', 'reduce-01', 10, L).
L = [['MononuclearRelation', 'mono'], 4, 1]] ;
fail.

?- get_lcs('Elaboration-specification-other', 'Contrast', 'reduce-01', 10, L).
L = [['RhetoricalRelation', 'unspec_nucl'], 5, 1]] ;
fail.

?- get_lcs('Elaboration-specification-other', 'Elaboration-specification-other', 'reduce
-01', 10, L).
L = [['Elaboration-specification-other', 'mono'], 0, 0]] ;
fail.

?- get_lcs('Elaboration-specification-other', 'Background', 'reduce-01', 10, L).
L = [['MononuclearRelation', 'mono'], 4, 1]] ;
fail.

?- get_lcs('Elaboration-specification-other', 'Cause', 'reduce-01', 10, L).
L = [['MononuclearRelation', 'mono'], 4, 2]] ;
fail.

?- get_lcs('Elaboration-specification-other', 'Circumstance', 'reduce-01', 10, L).
L = [['IdeationalRelation', 'unspec_nucl'], 4, 1], ['MononuclearRelation', 'mono'], 4,
1]] ;
fail.

?- get_lcs('Background', 'Cause', 'reduce-01', 10, L).
L = [['MononuclearRelation', 'mono'], 1, 2]] ;
fail.

?- get_lcs('Background', 'Concession', 'reduce-01', 10, L).
L = [['InterpersonalRelation', 'unspec_nucl'], 1, 1], ['MononuclearRelation', 'mono'],
1, 1]] ;
fail.

?- get_lcs('Antithesis', 'Concession', 'reduce-01', 10, L).
L = [['Contrast', 'unspec_nucl'], 1, 1], ['InterpersonalRelation', 'unspec_nucl'], 1,
1], ['MononuclearRelation', 'mono'], 1, 1]] ;
fail.
```

6.4 Outputs for print_rsttool_mapping_table/2 and print_rsttool_mapping_table_xml/2

```
?- print_rsttool_mapping_table(['http://www.text-technology.de/semdok-relations.owl#  
RhetoricalRelation'], 'reduce-01').
```

```
map('RhetoricalRelation', 'rhetoricalrelation').  
map('MononuclearRelation', 'mononuclearrelation').  
map('Concession', 'concession').  
map('Circumstance', 'circumstance').  
map('InterpretationEvaluation', 'interpretationevaluation').  
map('Preparation', 'preparation').  
map('Background', 'background').  
map('Means', 'means').  
map('Elaboration', 'elaboration').  
map('Summary', 'summary').  
map('Extra', 'extra').  
map('Support', 'support').  
map('IdeationalRelation', 'ideationalrelation').  
map('CauseResult', 'causeresult').  
map('Consequence', 'consequence').  
map('SameSegment', 'samesegment').  
map('Joint', 'joint').  
map('InterpersonalRelation', 'interpersonalrelation').  
map('ProblemSolution', 'problemsolution').  
map('Contrast', 'contrast').  
map('MultinuclearRelation', 'multinuclearrelation').  
map('ListSequence', 'listsequence').
```

```
?- print_rsttool_mapping_table_xml(['http://www.text-technology.de/semdok-relations.owl#  
RhetoricalRelation'], 'reduce-01').
```

```
<?xml version="1.0" encoding="ISO-8859-1"?>  
<mappings>  
<map><uppercase>RhetoricalRelation</uppercase><downcase>rhetoricalrelation</downcase></  
map>  
<map><uppercase>MononuclearRelation</uppercase><downcase>mononuclearrelation</downcase></  
map>  
<map><uppercase>Concession</uppercase><downcase>concession</downcase></map>  
<map><uppercase>Circumstance</uppercase><downcase>circumstance</downcase></map>  
<map><uppercase>InterpretationEvaluation</uppercase><downcase>interpretationevaluation</  
downcase></map>  
<map><uppercase>Preparation</uppercase><downcase>preparation</downcase></map>  
<map><uppercase>Background</uppercase><downcase>background</downcase></map>  
<map><uppercase>Means</uppercase><downcase>means</downcase></map>  
<map><uppercase>Elaboration</uppercase><downcase>elaboration</downcase></map>  
<map><uppercase>Summary</uppercase><downcase>summary</downcase></map>  
<map><uppercase>Extra</uppercase><downcase>extra</downcase></map>  
<map><uppercase>Support</uppercase><downcase>support</downcase></map>  
<map><uppercase>IdeationalRelation</uppercase><downcase>ideationalrelation</downcase></  
map>  
<map><uppercase>CauseResult</uppercase><downcase>causeresult</downcase></map>  
<map><uppercase>Consequence</uppercase><downcase>consequence</downcase></map>
```

```
<map><uppercase>SameSegment</uppercase><downcase>samesegment</downcase></map>
<map><uppercase>Joint</uppercase><downcase>joint</downcase></map>
<map><uppercase>InterpersonalRelation</uppercase><downcase>interpersonalrelation</
downcase></map>
<map><uppercase>ProblemSolution</uppercase><downcase>problemsolution</downcase></map>
<map><uppercase>Contrast</uppercase><downcase>contrast</downcase></map>
<map><uppercase>MultinuclearRelation</uppercase><downcase>multinuclearrelation</downcase>
</map>
<map><uppercase>ListSequence</uppercase><downcase>listsequence</downcase></map>
</mappings>
```


6.5 Source code of semdoc-relations.owl

```
<?xml version="1.0"?>
<rdf:RDF
  xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
  xmlns:owl="http://www.w3.org/2002/07/owl#"
  xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
  xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
  xmlns="http://www.text-technology.de/sem dok-relations.owl#"
  xml:base="http://www.text-technology.de/sem dok-relations.owl">
  <owl:Ontology rdf:about=""/>
  <owl:Class rdf:ID="MononuclearRelation">
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
      >rrset=reduce-01</rdfs:comment>
    <owl:disjointWith>
      <owl:Class rdf:ID="MultinuclearRelation"/>
    </owl:disjointWith>
    <rdfs:subClassOf>
      <owl:Class rdf:ID="RhetoricalRelation"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="Elaboration-process-step">
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
      >rrset=noAnnotate</rdfs:comment>
    <rdfs:subClassOf>
      <owl:Class rdf:ID="Elaboration-derivation"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="Concession">
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
      >rrset=reduce-01</rdfs:comment>
    <rdfs:subClassOf>
      <owl:Class rdf:ID="Contrast"/>
    </rdfs:subClassOf>
    <rdfs:subClassOf>
      <owl:Class rdf:ID="InterpersonalRelation"/>
    </rdfs:subClassOf>
    <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
  </owl:Class>
  <owl:Class rdf:ID="Elaboration-restatement">
    <rdfs:subClassOf>
      <owl:Class rdf:ID="Elaboration"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="Elaboration-drift">
    <rdfs:subClassOf>
      <owl:Class rdf:ID="Elaboration-continuation"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="CauseResult-multi">
    <rdfs:subClassOf>
      <owl:Class rdf:about="#MultinuclearRelation"/>
    </rdfs:subClassOf>
    <rdfs:subClassOf>
      <owl:Class rdf:ID="CauseResult"/>
    </rdfs:subClassOf>
  </owl:Class>
```

```

    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="ListSequence">
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >rrset=reduce-01</rdfs:comment>
    <rdfs:subClassOf>
      <owl:Class rdf:about="#MultinuclearRelation"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="BridgingRelation">
    <rdfs:subClassOf>
      <owl:Class rdf:ID="DiscourseRelation"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="Citation-self">
    <rdfs:subClassOf>
      <owl:Class rdf:ID="Citation"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="CausePurpose">
    <rdfs:subClassOf>
      <owl:Class rdf:about="#CauseResult"/>
    </rdfs:subClassOf>
    <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
  </owl:Class>
  <owl:Class rdf:ID="Attribution">
    <rdfs:subClassOf>
      <owl:Class rdf:ID="Support"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="Evaluation">
    <rdfs:subClassOf>
      <owl:Class rdf:ID="InterpretationEvaluation"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="ResultPurpose">
    <rdfs:subClassOf>
      <owl:Class rdf:about="#CauseResult"/>
    </rdfs:subClassOf>
    <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
  </owl:Class>
  <owl:Class rdf:ID="SententialDiscourseSegment">
    <rdfs:subClassOf>
      <owl:Class rdf:ID="DiscourseSegment"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="CDS-block">
    <rdfs:subClassOf>
      <owl:Class rdf:ID="ComplexDiscourseSegment"/>
    </rdfs:subClassOf>
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >aka sds+</rdfs:comment>
  </owl:Class>
  <owl:Class rdf:ID="Citation-attribution">
    <rdfs:subClassOf>
      <owl:Class rdf:about="#Citation"/>

```

```

    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="Citation-evidence">
    <rdfs:subClassOf>
      <owl:Class rdf:about="#Citation"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="ProblemSolution-multi">
    <rdfs:subClassOf>
      <owl:Class rdf:about="#MultinuclearRelation"/>
    </rdfs:subClassOf>
    <rdfs:subClassOf>
      <owl:Class rdf:ID="ProblemSolution"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="Consequence-multi">
    <rdfs:subClassOf>
      <owl:Class rdf:about="#MultinuclearRelation"/>
    </rdfs:subClassOf>
    <rdfs:subClassOf>
      <owl:Class rdf:ID="Consequence"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="ElementaryDiscourseSegment">
    <rdfs:subClassOf>
      <owl:Class rdf:about="#DiscourseSegment"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:about="#RhetoricalRelation">
    <rdfs:subClassOf rdf:resource="#DiscourseRelation"/>
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
      >rrset=reduce-01</rdfs:comment>
  </owl:Class>
  <owl:Class rdf:ID="Antithesis">
    <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
    <rdfs:subClassOf>
      <owl:Class rdf:about="#InterpersonalRelation"/>
    </rdfs:subClassOf>
    <rdfs:subClassOf>
      <owl:Class rdf:about="#Contrast"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="Circumstance">
    <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
    <rdfs:subClassOf>
      <owl:Class rdf:ID="IdeationalRelation"/>
    </rdfs:subClassOf>
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string">
      >rrset=reduce-01</rdfs:comment>
  </owl:Class>
  <owl:Class rdf:about="#DiscourseSegment">
    <rdfs:subClassOf>
      <owl:Class rdf:ID="DiscourseRole"/>
    </rdfs:subClassOf>
  </owl:Class>
  <owl:Class rdf:ID="SameSegment">

```

```

<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>rrset=reduce-01</rdfs:comment>
<rdfs:subClassOf>
  <owl:Class rdf:about="#MultinuclearRelation"/>
</rdfs:subClassOf>
<rdfs:subClassOf>
  <owl:Class rdf:ID="TextualRelation"/>
</rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:about="#InterpretationEvaluation">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>rrset=reduce-01</rdfs:comment>
  <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
  <rdfs:subClassOf>
    <owl:Class rdf:about="#InterpersonalRelation"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:ID="Preparation-title">
  <rdfs:subClassOf>
    <owl:Class rdf:ID="Preparation"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:about="#ComplexDiscourseSegment">
  <rdfs:subClassOf rdf:resource="#DiscourseSegment"/>
</owl:Class>
<owl:Class rdf:about="#Elaboration-continuation">
  <rdfs:subClassOf>
    <owl:Class rdf:ID="Elaboration-identity"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:ID="ProblemSolution-s">
  <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
  <rdfs:subClassOf>
    <owl:Class rdf:about="#ProblemSolution"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:ID="CDS-doc">
  <rdfs:subClassOf rdf:resource="#ComplexDiscourseSegment"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>aka section+</rdfs:comment>
</owl:Class>
<owl:Class rdf:ID="List-dm_other">
  <rdfs:subClassOf>
    <owl:Class rdf:ID="List"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:ID="DiscourseMarker">
  <rdfs:subClassOf rdf:resource="#DiscourseRole"/>
</owl:Class>
<owl:Class rdf:ID="Schema">
  <rdfs:subClassOf>
    <owl:Class rdf:about="#TextualRelation"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:ID="Result">
  <rdfs:subClassOf rdf:resource="#ResultPurpose"/>

```

```

</owl:Class>
<owl:Class rdf:ID="Cause">
  <rdfs:subClassOf rdf:resource="#CausePurpose"/>
</owl:Class>
<owl:Class rdf:about="#Elaboration-identity">
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Elaboration"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:about="#IdeationalRelation">
  <rdfs:subClassOf rdf:resource="#RhetoricalRelation"/>
  <owl:disjointWith>
    <owl:Class rdf:about="#InterpersonalRelation"/>
  </owl:disjointWith>
  <owl:disjointWith>
    <owl:Class rdf:about="#TextualRelation"/>
  </owl:disjointWith>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
  >rrset=reduce-01</rdfs:comment>
</owl:Class>
<owl:Class rdf:ID="Elaboration-specification">
  <rdfs:subClassOf rdf:resource="#Elaboration-identity"/>
</owl:Class>
<owl:Class rdf:about="#List">
  <rdfs:subClassOf>
    <owl:Class rdf:about="#InterpersonalRelation"/>
  </rdfs:subClassOf>
  <rdfs:subClassOf rdf:resource="#ListSequence"/>
</owl:Class>
<owl:Class rdf:ID="Elaboration-theme-rheme">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
  >rrset=noAnnotate</rdfs:comment>
  <rdfs:subClassOf>
    <owl:Class rdf:ID="Elaboration-continuation-other"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:about="#Preparation">
  <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
  <rdfs:subClassOf>
    <owl:Class rdf:about="#InterpersonalRelation"/>
  </rdfs:subClassOf>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
  >rrset=reduce-01</rdfs:comment>
</owl:Class>
<owl:Class rdf:about="#TextualRelation">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
  >rrset="reduce-01"</rdfs:comment>
  <rdfs:subClassOf rdf:resource="#RhetoricalRelation"/>
  <owl:disjointWith>
    <owl:Class rdf:about="#InterpersonalRelation"/>
  </owl:disjointWith>
  <owl:disjointWith rdf:resource="#IdeationalRelation"/>
</owl:Class>
<owl:Class rdf:ID="Purpose-s">
  <rdfs:subClassOf rdf:resource="#CausePurpose"/>
</owl:Class>

```

```

<owl:Class rdf:ID="Background">
  <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
  <rdfs:subClassOf>
    <owl:Class rdf:about="#InterpersonalRelation"/>
  </rdfs:subClassOf>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >rrset=reduce-01</rdfs:comment>
</owl:Class>
<owl:Class rdf:ID="Elaboration-integration">
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Elaboration"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:ID="Joint">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >rrset=reduce-01</rdfs:comment>
  <rdfs:subClassOf>
    <owl:Class rdf:about="#MultinuclearRelation"/>
  </rdfs:subClassOf>
  <rdfs:subClassOf rdf:resource="#TextualRelation"/>
</owl:Class>
<owl:Class rdf:ID="Elaboration-class-subclass">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >rrset=noAnnotate</rdfs:comment>
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Elaboration-derivation"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:about="#InterpersonalRelation">
  <owl:disjointWith rdf:resource="#IdeationalRelation"/>
  <owl:disjointWith rdf:resource="#TextualRelation"/>
  <rdfs:subClassOf rdf:resource="#RhetoricalRelation"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >rrset=reduce-01</rdfs:comment>
</owl:Class>
<owl:Class rdf:ID="DiscourseAdverbial">
  <rdfs:subClassOf rdf:resource="#DiscourseMarker"/>
</owl:Class>
<owl:Class rdf:ID="ProblemSolution-n">
  <rdfs:subClassOf>
    <owl:Class rdf:about="#ProblemSolution"/>
  </rdfs:subClassOf>
  <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
</owl:Class>
<owl:Class rdf:ID="Justify">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >rrset=noAnnotate</rdfs:comment>
  <rdfs:subClassOf>
    <owl:Class rdf:ID="Support-other"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:ID="Elaboration-assign-abbreviation">
  <rdfs:subClassOf>
    <owl:Class rdf:ID="Elaboration-assign"/>
  </rdfs:subClassOf>
</owl:Class>

```

```

<owl:Class rdf:about="#CauseResult">
  <rdfs:subClassOf rdf:resource="#IdeationalRelation"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>rrset=reduce-01</rdfs:comment>
</owl:Class>
<owl:Class rdf:ID="Means">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>rrset=reduce-01</rdfs:comment>
  <rdfs:subClassOf rdf:resource="#InterpersonalRelation"/>
  <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
</owl:Class>
<owl:Class rdf:ID="StructuralConnective">
  <rdfs:subClassOf rdf:resource="#DiscourseMarker"/>
</owl:Class>
<owl:Class rdf:ID="List-coordination">
  <rdfs:subClassOf rdf:resource="#List"/>
</owl:Class>
<owl:Class rdf:ID="Elaboration-set-member">
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Elaboration-derivation"/>
  </rdfs:subClassOf>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>rrset=noAnnotate</rdfs:comment>
</owl:Class>
<owl:Class rdf:about="#Citation">
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Support"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:ID="Elaboration-example">
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Elaboration"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:about="#Elaboration-continuation-other">
  <rdfs:subClassOf rdf:resource="#Elaboration-continuation"/>
</owl:Class>
<owl:Class rdf:ID="ArticleTopLevelSchema">
  <rdfs:subClassOf rdf:resource="#Schema"/>
</owl:Class>
<owl:Class rdf:about="#ProblemSolution">
  <rdfs:subClassOf rdf:resource="#InterpersonalRelation"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>rrset=reduce-01</rdfs:comment>
</owl:Class>
<owl:Class rdf:about="#Contrast">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>rrset=reduce-01</rdfs:comment>
  <rdfs:subClassOf rdf:resource="#RhetoricalRelation"/>
</owl:Class>
<owl:Class rdf:ID="Preparation-question">
  <rdfs:subClassOf rdf:resource="#Preparation"/>
</owl:Class>
<owl:Class rdf:about="#MultinuclearRelation">
  <owl:disjointWith rdf:resource="#MononuclearRelation"/>
  <rdfs:subClassOf rdf:resource="#RhetoricalRelation"/>

```

```

    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >rrset=reduce-01</rdfs:comment>
</owl:Class>
<owl:Class rdf:ID="Elaboration-whole-part">
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >rrset=noAnnotate</rdfs:comment>
    <rdfs:subClassOf>
        <owl:Class rdf:about="#Elaboration-derivation"/>
    </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:ID="Purpose-n">
    <rdfs:subClassOf rdf:resource="#ResultPurpose"/>
</owl:Class>
<owl:Class rdf:ID="Elaboration-specification-other">
    <rdfs:subClassOf rdf:resource="#Elaboration-specification"/>
</owl:Class>
<owl:Class rdf:ID="Preparation-other">
    <rdfs:subClassOf rdf:resource="#Preparation"/>
</owl:Class>
<owl:Class rdf:ID="Interpretation">
    <rdfs:subClassOf rdf:resource="#InterpretationEvaluation"/>
</owl:Class>
<owl:Class rdf:ID="RelationDefinition">
<owl:Class rdf:about="#Elaboration">
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >rrset=reduce-01</rdfs:comment>
    <rdfs:subClassOf rdf:resource="#IdeationalRelation"/>
    <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
    <rdfs:subClassOf>
        <owl:Restriction>
            <owl:onProperty>
                <owl:DatatypeProperty rdf:ID="directionSatellite"/>
            </owl:onProperty>
            <owl:hasValue rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
            >left</owl:hasValue>
        </owl:Restriction>
    </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:ID="Summary">
    <rdfs:subClassOf rdf:resource="#InterpersonalRelation"/>
    <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >rrset=reduce-01</rdfs:comment>
</owl:Class>
<owl:Class rdf:ID="Contrast-multi">
    <rdfs:subClassOf rdf:resource="#Contrast"/>
    <rdfs:subClassOf rdf:resource="#MultinuclearRelation"/>
</owl:Class>
<owl:Class rdf:ID="Extra">
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
    >rrset=reduce-01</rdfs:comment>
    <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
    <rdfs:subClassOf rdf:resource="#TextualRelation"/>
</owl:Class>
<owl:Class rdf:ID="Consequence-s">
    <rdfs:subClassOf>

```



```

    <owl:Class rdf:about="#Consequence"/>
  </rdfs:subClassOf>
  <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
</owl:Class>
<owl:Class rdf:ID="Sequence">
  <rdfs:subClassOf rdf:resource="#IdeationalRelation"/>
  <rdfs:subClassOf rdf:resource="#ListSequence"/>
</owl:Class>
<owl:Class rdf:ID="Elaboration-class-instance">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
  >rrset=noAnnotate</rdfs:comment>
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Elaboration-derivation"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:ID="DiscourseEntity">
  <rdfs:subClassOf rdf:resource="#DiscourseRole"/>
</owl:Class>
<owl:Class rdf:ID="Consequence-n">
  <rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Consequence"/>
  </rdfs:subClassOf>
</owl:Class>
<owl:Class rdf:about="#Consequence">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
  >rrset=reduce-01</rdfs:comment>
  <rdfs:subClassOf rdf:resource="#IdeationalRelation"/>
</owl:Class>
<owl:Class rdf:about="#Elaboration-assign">
  <rdfs:subClassOf rdf:resource="#Elaboration-specification"/>
</owl:Class>
<owl:Class rdf:ID="Elaboration-assign-other">
  <rdfs:subClassOf rdf:resource="#Elaboration-assign"/>
</owl:Class>
<owl:Class rdf:ID="CDS-div">
  <rdfs:subClassOf rdf:resource="#ComplexDiscourseSegment"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
  >aka para+</rdfs:comment>
</owl:Class>
<owl:Class rdf:ID="Evidence">
  <rdfs:subClassOf>
    <owl:Class rdf:about="#Support-other"/>
  </rdfs:subClassOf>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
  >rrset=noAnnotate</rdfs:comment>
</owl:Class>
<owl:Class rdf:ID="Elaboration-theme-theme">
  <rdfs:subClassOf rdf:resource="#Elaboration-continuation-other"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
  >rrset=noAnnotate</rdfs:comment>
</owl:Class>
<owl:Class rdf:about="#Elaboration-derivation">
  <rdfs:subClassOf rdf:resource="#Elaboration"/>
</owl:Class>
<owl:Class rdf:about="#Support">

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<rdfs:subClassOf rdf:resource="#InterpersonalRelation"/>
<rdfs:subClassOf rdf:resource="#MononuclearRelation"/>
<rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>rrset=reduce-01</rdfs:comment>
</owl:Class>
<owl:Class rdf:ID="Elaboration-definition">
  <rdfs:subClassOf rdf:resource="#Elaboration"/>
</owl:Class>
<owl:Class rdf:about="#Support-other">
  <rdfs:subClassOf rdf:resource="#Support"/>
</owl:Class>
<owl:ObjectProperty rdf:ID="markedBy">
  <rdfs:domain rdf:resource="#RhetoricalRelation"/>
  <rdfs:range rdf:resource="#DiscourseMarker"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>relating a rhetorical relation to a discourse marker</rdfs:comment>
</owl:ObjectProperty>
<owl:ObjectProperty rdf:ID="hasSatellite">
  <rdfs:range rdf:resource="#DiscourseSegment"/>
  <rdfs:domain rdf:resource="#MononuclearRelation"/>
</owl:ObjectProperty>
<owl:ObjectProperty rdf:ID="hasNucleus">
  <rdfs:domain rdf:resource="#RhetoricalRelation"/>
  <rdfs:range rdf:resource="#DiscourseSegment"/>
</owl:ObjectProperty>
<owl:DatatypeProperty rdf:ID="constraint-on-S">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>Constraint on the satellite</rdfs:comment>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#string"/>
  <rdfs:domain rdf:resource="#RelationDefinition"/>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="constraint-on-N">
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>Constraint on the nucleus</rdfs:comment>
  <rdfs:domain rdf:resource="#RelationDefinition"/>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#string"/>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:ID="intention-A">
  <rdfs:domain rdf:resource="#RelationDefinition"/>
  <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#string"/>
  <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>Intention of the Writer</rdfs:comment>
</owl:DatatypeProperty>
<owl:DatatypeProperty rdf:about="#directionSatellite">
  <rdfs:range>
    <owl:DataRange>
      <owl:oneOf rdf:parseType="Resource">
        <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>left</rdf:first>
        <rdf:rest rdf:parseType="Resource">
          <rdf:rest rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-ns#nil"/>
          <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
>right</rdf:first>
        </rdf:rest>
      </owl:oneOf>
    </owl:DataRange>
  </rdfs:range>

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    </rdfs:range>
    <rdfs:domain rdf:resource="#MononuclearRelation"/>
  </owl:DatatypeProperty>
  <owl:DatatypeProperty rdf:ID="constraint-on-N-S-combination">
    <rdfs:domain rdf:resource="#RelationDefinition"/>
    <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#string"/>
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
      >Constraint on the combination of nucleus and satellite. After the format used by Mann
      /Thompson/Taboada.</rdfs:comment>
  </owl:DatatypeProperty>
  <owl:DatatypeProperty rdf:ID="source">
    <rdfs:range rdf:resource="http://www.w3.org/2001/XMLSchema#string"/>
    <rdfs:domain rdf:resource="#RelationDefinition"/>
    <rdfs:comment rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
      >Source e.g. of a relation or of a definition, e.g. which author introduced it</
      rdfs:comment>
  </owl:DatatypeProperty>
  <owl:DataRange>
    <owl:oneOf rdf:parseType="Resource">
      <rdf:rest rdf:parseType="Resource">
        <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
          >reduced-01</rdf:first>
        <rdf:rest rdf:resource="http://www.w3.org/1999/02/22-rdf-syntax-ns#nil"/>
      </rdf:rest>
      <rdf:first rdf:datatype="http://www.w3.org/2001/XMLSchema#string"
        >full</rdf:first>
    </owl:oneOf>
  </owl:DataRange>
  <RelationDefinition rdf:ID="Def_IdeationalRelation"/>
</rdf:RDF>

<!-- Created with Protege (with OWL Plugin 3.4, Build 120) http://protege.stanford.edu --
>

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