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Language resource management — Comprehensive Annotation Framework (ComAF) —

Part 3: Diagrammatic semantic authoring (DSA)

Gestion des ressources linguistiques — Cadre global d'annotation (ComAF) —

Partie 3: Création sémantique diagrammatique (DSA)

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Foreword

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This document was prepared by Technical Committee ISO/TC 37, *Language and terminology*, Subcommittee SC 4, *Language resource management*.

A list of all parts in the ISO 24627 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Graphs (diagrams consisting of nodes and links) have been used for decades to represent and visualize both documents (instance data) and data schemas. This document concerns graph-based representation (not visualization) of documents (not data schemas).

Graph-based representation and visualization of documents are addressed by concept maps,[15] mind maps, argument maps, and so on. Theoretical linguistics and artificial intelligence have also used graph-based content visualization associated with semantic network, mental space,[10] discourse representation structure,[13] and so forth.

Graph-based visualization of data schemas (or ontologies, terminologies, metamodels, etc.) is a more usual practice. Ontologies are often visualized as graphs in which nodes are classes (and datatypes) and links are properties (relations). ISO 24156-1 specifies a UML-based visualization of concept modelling. Other metamodels are usually represented as similar diagrams, too.

This document gives a data schema of graph documents to facilitate composition and comprehension by making logical document structure explicit. It neither covers visualizations or manipulations of graphs nor does it define annotations to existing documents, but rather it addresses graphical/diagrammatic representation of documents for the sake of semantic authoring: i.e., for people to directly view and manipulate syntactic/semantic structures on computer displays or their future alternatives. The linearity of traditional text documents is due to the linearity of speech languages, which constrains the interaction between people and documents, making it hard for people to read and write. DSA defines graphical/diagrammatic documents with more explicit structures than in text in order to make it easier for people to read and write. Documents based on DSA, together with some user interfaces involving appropriate visualizations and easy operations, can enhance collaborations among people and between people and machines.

DSA mainly deals with syntactic or document structures. It addresses some fragmentary semantic structures as well, but more systematic semantics (formal mapping between documents and their meanings or logical forms) can be provided by another specification so that machines better 'understand' DSA-based documents and thereby better assist information sharing and consensus building among people.

Figure 1 shows a workflow involving DSA and other types of documents. The DSA-based documents in the upper half can be automatically converted (while preserving propositional content) to and from machine-understandable documents based on appropriate standards on semantic representations and annotations. It is possible to automatically generate traditional text documents from these machine-understandable documents (while preserving the propositional content, too), though the inverse conversion cannot generally be automated. Since DSA-based documents (together with some appropriate user interfaces) are easier for people to compose and interpret than text documents, people can usually touch and see DSA-based documents whereas traditional documents could be used for legacy procedures (such as patent applications) and oral presentations.

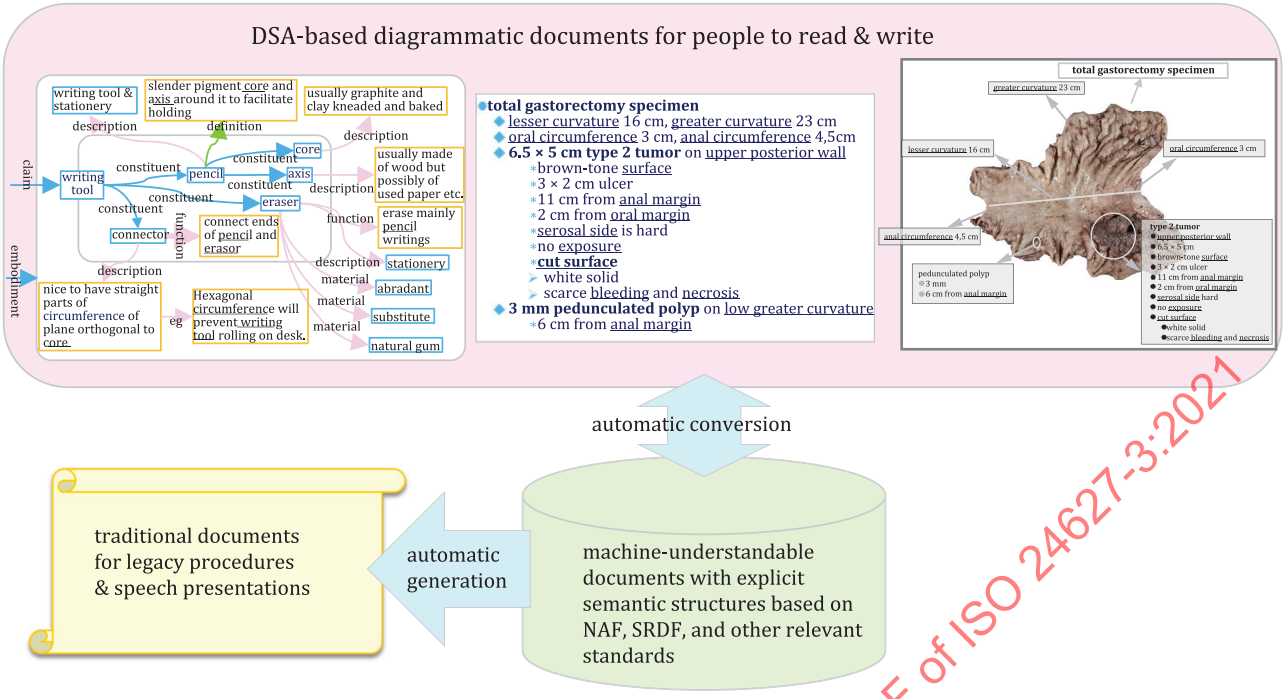

Figure 1 — Document workflow involving DSA

DSA is a minimal metamodel for ISO TS 24617-5 (SemAF-DS), which in turn is based on ISO/IEC 15938.5/Amd.1 (MPEG-7 MDS AMD1 — Linguistic description scheme). The machine-understandable documents in Figure 1 are assumed to use other standards including ISO 24615 (SynAF), ISO 24612 (LAF) and ISO 24617 (SemAF) while also incorporating insights from other relevant literature[1][8][9][10][11][12][13][14][15][16][17][18].

Language resource management — Comprehensive Annotation Framework (ComAF) —

Part 3: Diagrammatic semantic authoring (DSA)

1 Scope

This document specifies how to represent (not visualize) documents (instance data, not data schemas) as graphs. It does not specify how to visualize or operate on document data, but it aims at making documents easier for people to compose and comprehend by allowing for various graph-based flexible user interfaces, possibly incorporating document-visualization practices (see Introduction). In this connection, this document does not specify annotations to existing documents either, but rather it specifies a schema of documents with explicit logical structures.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
hypernode
node which is a graph segment

3.2
segment
referenceable part of a DSA-based document, which is either a graph segment or a data segment (text, image, audio, video, etc.)

3.3
semantic authoring
composition of documents while making their logical structures explicit

4 Specification

Figure 2 illustrates DSA, which is a metamodel (ontology) of graph documents. Each markable (referenceable) part of a DSA-based document is called a segment. Each DSA-based document itself is a segment, too.

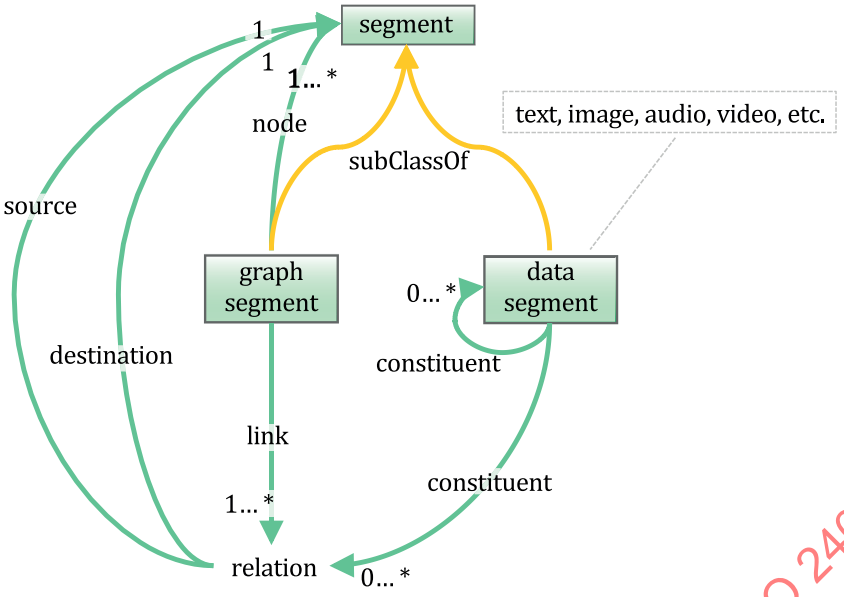

Figure 2 — DSA metamodel (ontology)

A graph segment shall be a labelled directed graph comprising nodes and links. A node shall be a segment and a link shall be a relation between two endnodes (source and destination segments).

A node in a graph segment can be another graph segment. A node which is a graph segment is called a hypernode. So a graph segment can embed other graph segments as hypernodes, which are rarely used in concept maps. Arbitrarily large DSA-based documents can hence be made of small graph segments which are hypernodes of each other.

A data segment can embed smaller data segments as constituents. For instance, a discourse can be a text/audio/video segment embedding sentence utterances as smaller text/audio/video segments, which can further embed still smaller text/audio/video segments such as phrases, and so forth.

DSA is exactly the metamodel in Figure 2, which formally specifies multimodal graph documents involving hypernodes, but does not specify how to visualize or operate on them. The diagrammatic visualizations in Annex A are not part of DSA, they are informative examples. DSA users can adopt any sorts of diagrammatic visualization as far as the logical document structures are made explicit enough to meet their purposes.

Annex A
(informative)

Examples

A.1 Graph segments

In Figure A.1, graph segments are visualized as rounded boxes. The smaller graph segment is a hypernode in the larger one. Most nodes in Figure A.1 are text segments, but nodes can be other types of segments as well. Links in this example represent discourse relations and thematic roles. For instance, a 'core' and an 'axis' are constituents of a 'pencil' and a function of an 'eraser' is to erase mainly pencil writings.'

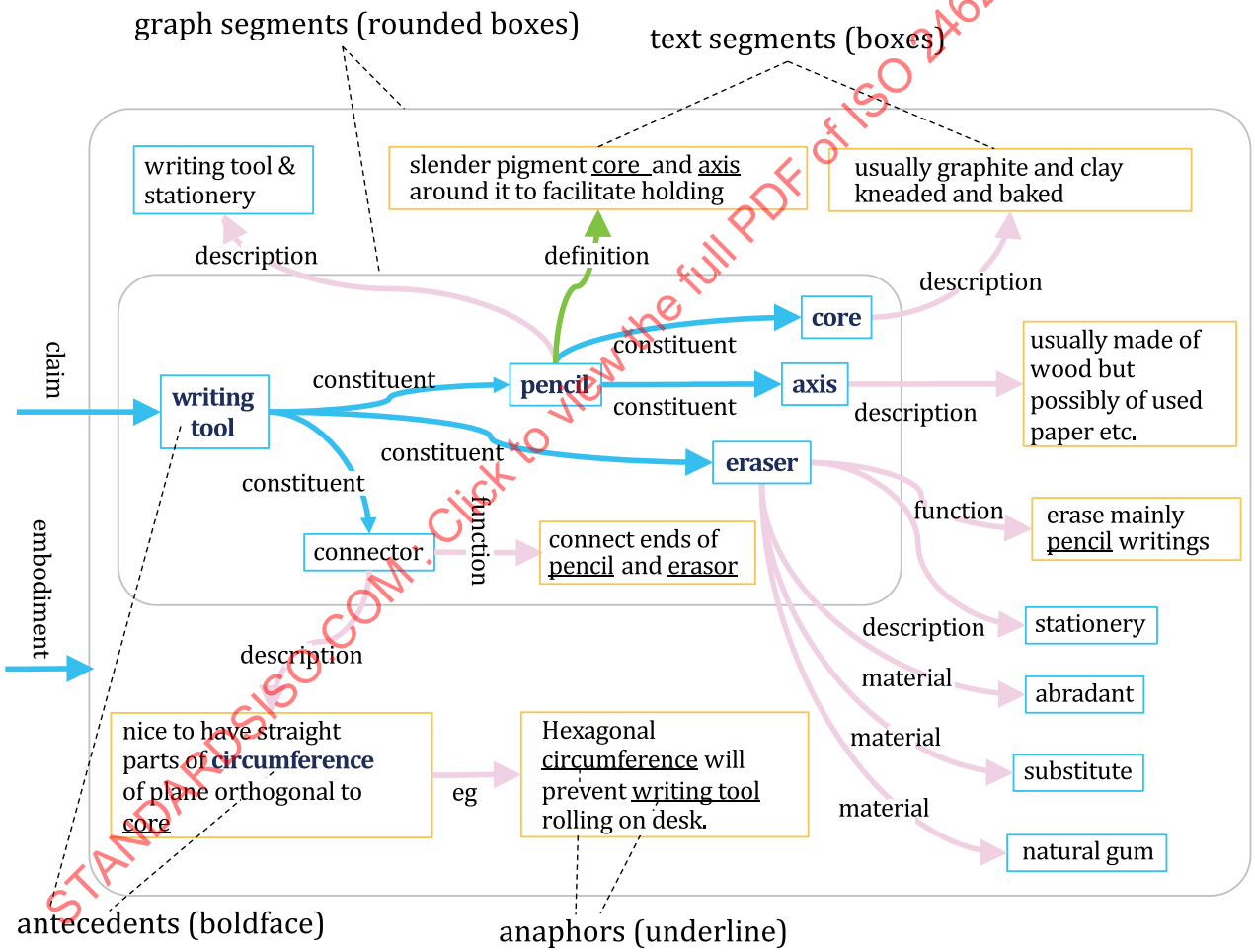

Figure A.1 — Graph segment representing part of a patent document

Throughout this document, anaphors are underlined and their antecedents are in boldface characters. Anaphoric relations can be explicitly visualized as links as shown in Figure A.2. Some endnodes of these anaphoric links are text segments embedded in larger graph/text segments and thus those endnodes do not belong to the graphs to which the anaphoric relations belong. A problem is that a graph visualizing too many such anaphoric relations is hard for people to understand and compose. This problem is partially addressed by visualizing graphs as trees.

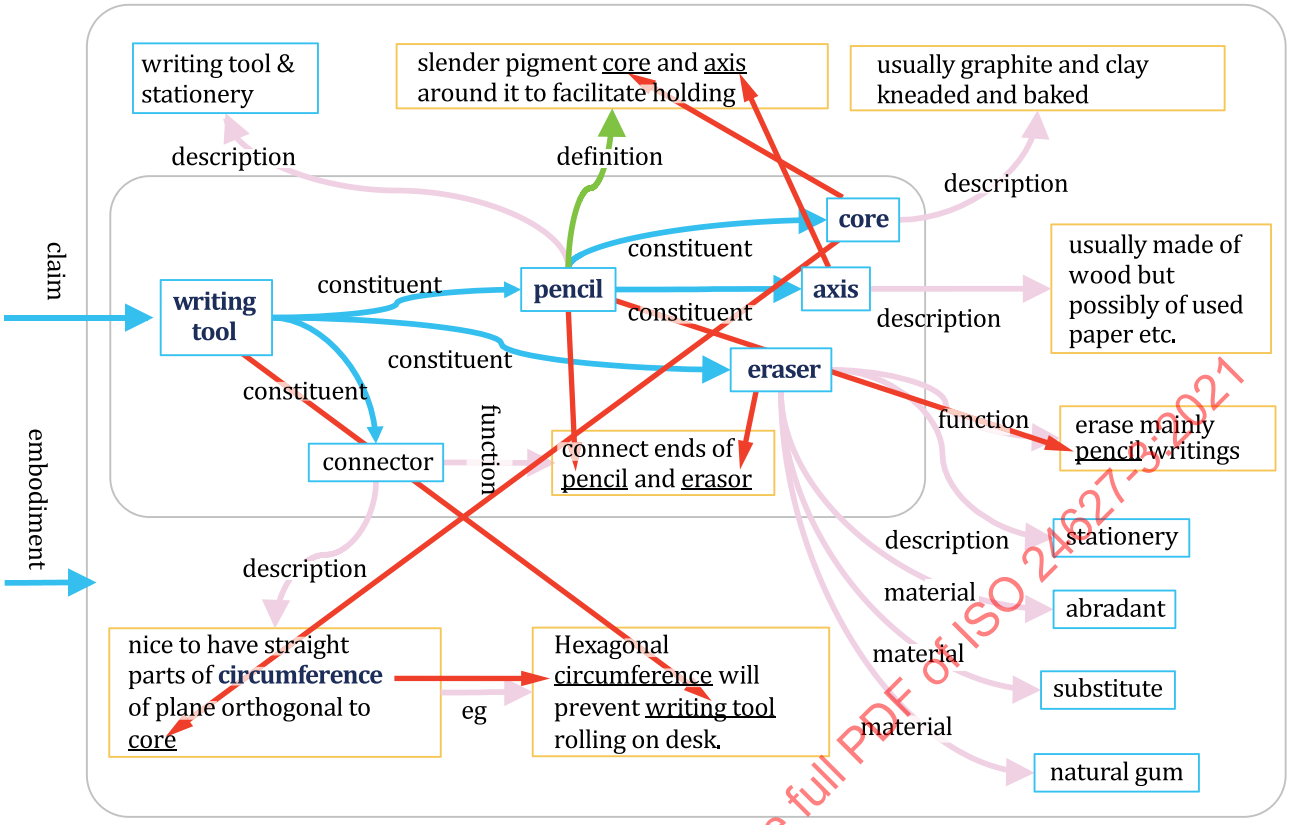

Figure A.2 — Anaphoric links in graph segment

Some graph segments can be visually presented as trees. In this document, such a tree is enclosed in a box and contains tree nodes headed by bullets, except that the root node lacks a bullet. In the tree shown in Figure A.3, all the bullets represent some sort of elaboration; i.e., the child node elaborates the parent node by describing details (such as parts) of the parent node's referent. One needs to choose the right root node of the tree to enjoy such a uniform interpretation of the bullets. A more specific relation label should be used instead of a simple bullet if a node does not elaborate its parent. In this document, text segments are enclosed in boxes, such as in Figure A.2, but such boxes are omitted when the text segments are nodes of trees, such as in Figure A.3.

- **total gastorectomy specimen**
  - lesser curvature 16 cm
  - greater curvature 23 cm
  - oral circumference 3 cm
  - anal circumference 4,5 cm
  - **6,5 × 5 cm type 2 tumor** on upper posterior wall
    - brown-tone surface
    - 3 ×2 cm ulcer
    - 11 cm from anal margin
    - 2 cm from oral margin
    - serosal side is hard
    - no exposure
    - **cut surface**
      - white solid
      - scarce bleeding and necrosis
  - **3 mm pedunculated polyp** on low greater curvature
    - 6 cm from anal margin

Figure A.3 — A tree representing a pathology report

Trees can simplify visual presentations of documents also because anaphora resolution is often easy when antecedents c-command (constituent-command) anaphors. Phrase A c-commands another phrase B if and only if the tree node containing A as a direct syntactic constituent dominates the node containing B. For instance, '6,5 x 5 cm type 2 tumor' c-commands (and is the antecedent of) the missing subject of 'exposure' in Figure A.3. If all such anaphoric relations are made visually explicit by links in this figure, the result is as shown in Figure A.4.

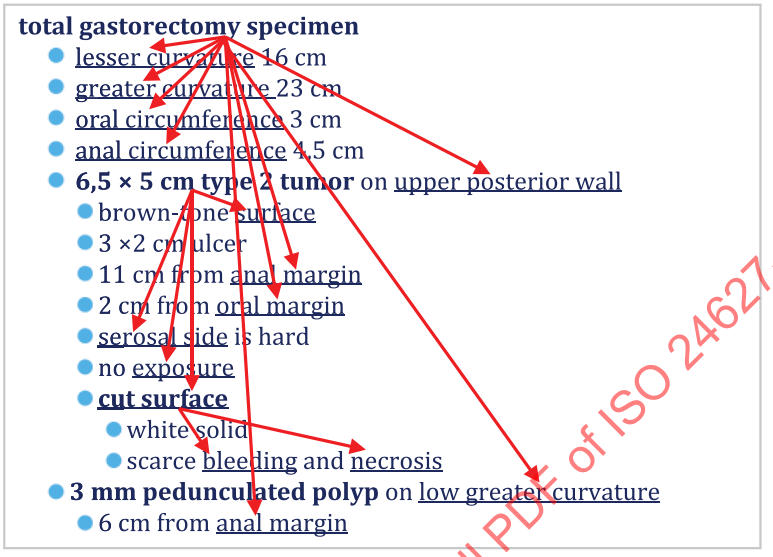

Figure A.4 — Anaphors easy to resolve using c-command relations

The simpler visualization in Figure A.3 is probably better for the user interface than the one in Figure A.4, because all the anaphoric relations marked by the arrows in Figure A.3 are easy to resolve under the condition that they satisfy c-command relations. To identify the antecedent of the missing subject of 'exposure', the c-command condition narrows down the candidates to '6,5 x 5 cm type 2 tumor' and 'whole gastorectomy specimen' while excluding 'serosal side', 'oral margin', '3 x 2 cm ulcer', 'anal circumference', and so forth. The antecedent is '6,5 x 5 cm type 2 tumor' because a tumor can expose but a whole specimen cannot, which is a piece of pathology domain knowledge rather easy to incorporate in the knowledge base for a natural-language processing system assisting the composition or comprehension of such DSA-based documents. However, visually explicit anaphoric links are necessary when the antecedents do not c-command the anaphors.

A.2 Data segments

The DSA metamodel can be extended so that a data segment (text/audio segment in particular) can accompany a syntactic annotation. So a data segment can be diagrammatically visualized as a possibly two-part box shown in Figure A.5.

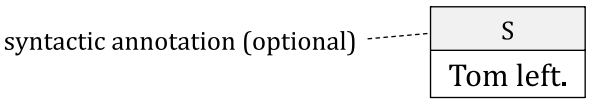

Figure A.5 — Terminal text segment

The upper gray half of the box in Figure A.5 contains a syntactic annotation to the segment. The lower half is the segment data itself in a terminal data segment. This lower part of a data segment can recursively embed smaller data segments and, together with the syntactic-annotation part, partially specify the syntactic structure of the whole data segment, as shown in Figure A.6, where the left-to-right order among the embedded text segments reflects the temporal order among them.

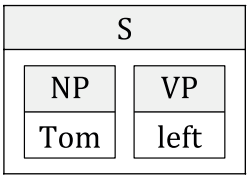

Figure A.6 — Text segment 'Tom left' containing two smaller text segments

A data segment can contain relations between smaller data segments, which can be dependencies as in Figure A.7.

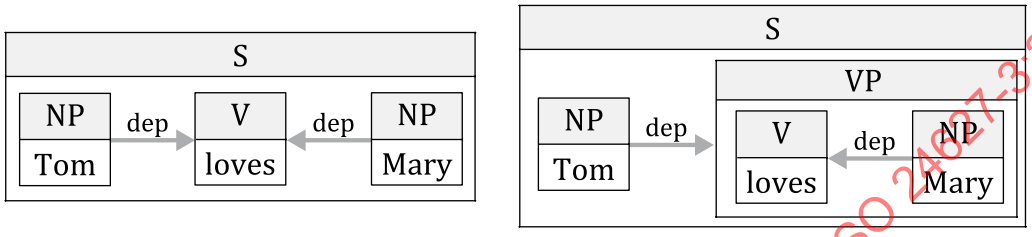

Figure A.7 — Dependency and constituent structures visualized in text segments

These visualizations can be simplified by introducing a convention to mark the head syntactic constituents with thick borders, as in Figure A.8.

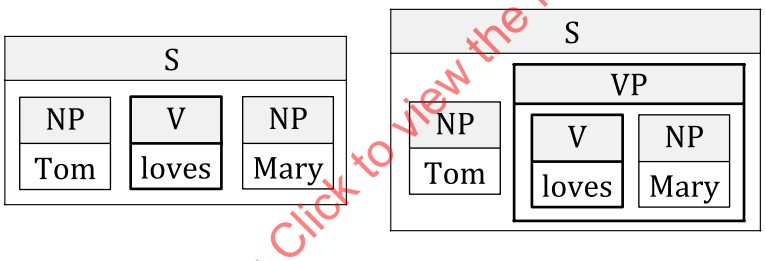

Figure A.8 — Simplified visualization of complement-head relations

A data segment can be elaborated by other DSA segments, which is often the case typically with non-text data segments, as in Figure A.9, where the arrows represent elaboration relations. The entire image segment is elaborated by a text segment 'whole gastorectomy specimen' and the embedded image segments are elaborated by other text segments and graph segments (visualized as trees), too.