Use of Hypertext in Information Science
Concepts, Systems, Models and Applications

Ph.D. dissertation

Károly I. Boda

University of Debrecen

Debrecen, 2000

CONTENTS

Introduction

The dissertation consists of four chapters which are closely related to each other. In the *first chapter* of the dissertation a general and abstract model of information systems is introduced and discussed in detail. The Multi-Layer Architecture of Information Systems (MLAIS) model, invented by the author, describes information systems as complex structures built on four main layers and two additional layers. The layers are connected to each other by interfaces that carry out communications procedures to exchange information ("messages") between the layers. Each of the following three chapters of the dissertation discusses an important aspect of one of the layers of the MLAIS model (i.e. the T, LC, and H layers, respectively), which therefore serves as a *general framework* of the issues discussed in the dissertation. In addition, the chapters add some new approaches to the corresponding layers of the MLAIS model:

- the *second chapter* of the dissertation examines the inner structure and coherence of natural language texts using co-reference analysis (the complex notation and terminology of which have been developed by János S. Petőfi [PETŐ97], [PETŐ98]). The second chapter applies, and completes the notation of co-reference analysis with some new elements in order that it can serve as a *metalanguage* in further, and mainly computer-based, text linguistic or textological studies;
- the *third chapter* of the dissertation explores a promising way of describing natural language texts in an artificial language (i.e. in PROLOG) placing great emphasis on the coding and interpretation of (conceptual) metaphors and other figures of speech;
- the *fourth chapter* of the dissertation demonstrates the universality and applicability of the above considerations in the semantic interpretation of poetic texts using the "iceberg" representation of the MLAIS model as a cognitive framework. The "iceberg" model and its cognitive aspects has been developed and applied in the interpretation of literary texts together with Judit Porkoláb (see the publications [15], [17], [30], [32], [34], [35], [45], [51], [55], [67], [69], [71] in the 'Publications and presentations of the author' section).

As regards methodological issues, each chapter follows a constructive way to elaborate its subject that is, the methods, considerations and conclusions applied are always demonstrated through *examples from selected literary works*. Note that each chapter (including the first chapter as well) contains original, and new, results based on the following presentations and publications:

1. Károly I. Boda: Complex Data Structures and their Role in the Organisation of Information Systems. - Presentation in "Conference of PhD Students in Computer Science" (Institute of Informatics of József Attila University, Szeged, 18 July 1998.) **(Chapter 1)**
2. Boda I. Károly - B. Porkoláb Judit: Koreferenciális kifejezések és koreferenciarelációk. Példaszöveg: Szent János Apostol Jelenéseinek könyve. 21:9-23. Az új Jeruzsálem. (Részlet) = Officina Textologica 1998 évf. 2 szám, 32-56. l. **(Chapter 2)**
3. Boda I. Károly - Porkoláb Judit: A koreferencia kérdései a számítógépes szövegfeldolgozás szempontjából. = Officina Textologica 4 szám. Koreferáló elemek – koreferenciarelációk. Magyar nyelvű szövegek elemzése. Diszkusszió. – (szerk. Dobi Edit, Petőfi S. János) – Kossuth Egyetemi Kiadó, Debrecen, 2000. **(Chapter 2)**
4. Károly I. Boda – Judit Porkoláb: The Role of Conceptual Metaphors in the Hypertext Structure of Poetic Texts. = Annales Universitatis Scientiarum Budapestinensis de Rolando Eötvös Nominatae. Sectio Linguistica. Tomus XXIV. (Redigit I. Szathmári.) - Univ. Budapestinensis de Eötvös Nom. Facult. Philosophiae, Budapest. (in publication) **(Chapter 3)**

5. Boda I. Károly - Porkoláb Judit: A nyelvi tudat fejlesztésének néhány eszköze. - Előadás a II. Pszicholingvisztikai Nyári Egyetemen (Balatonalmádi, 1999. június 8.) **(Chapter 4)**
6. Károly I. Boda – Judit Porkoláb: The hypertext approach to the question of the interpretation of poems (Miklós Radnóti: Neither Memory Nor Magic). = Annales Universitatis Scientiarum Budapestinensis de Rolando Eötvös Nominatae. Sectio Linguistica. Tomus XXIV. (Redigit I. Szathmári.) - Univ. Budapestinensis de Eötvös Nom. Facult. Philosophiae, Budapest. (in publication) **(Chapter 4)**

The dissertation has been supported by the Soros Foundation.

Overview of Chapter 1
Complex Data Structures and their Role in the Organisation of Information Systems

It is widely known that the accumulated knowledge of mankind rapidly grows, at a rate that often seems to be very hard to handle. Those who use the Internet, and especially the World Wide Web with its hypermedia capabilities, have to cope day by day with more or less difficulties in finding the relevant, or at least the adequate information they need. As a consequence, the various ways of *organising the accumulated knowledge* stored in different computers and networks are, with no doubt, of great importance. The ultimate aim of these efforts is to increase the effectiveness and efficiency of *information retrieval*: its relevance, completeness (or recall), etc.

Setting out from the experiences and basic principles of some well-tried information systems, in the first chapter a general and abstract model of information systems is introduced and discussed in detail. In the development of the MLAIS model, some information systems as well as other means and methods of organising knowledge in traditional or modern way (i.e. by the use of computers) have been taken into consideration. Those information systems and their equals (e.g. traditional, "linear" texts (e.g. books) and selected methods for analysing and processing them, bibliographies, encyclopaedias, monolingual and bilingual dictionaries, thesauruses, lexicons, classifications schemes, library systems, keyword indexing systems, relational and object-oriented database models, expert systems, hypertext and hypermedia systems such as the WWW, multimedia CD-ROMs, etc), their organisation levels or layer structure, as well as the basic functions and relationships of the layers explored, can serve as examples that illustrate certain points of the MLAIS model. In order to describe hypertext-based information systems, ‘there have been several attempts to create a unified data model but, up to now, without resounding success’. ([SÜTH99], p. 28) As can be seen later, the MLAIS model implements the terminology and various parts of other models (e.g. Dexter Hypertext Reference Model ([HAL94]), object-oriented database (OODB) model ([ULLM88], [ULLM98], [BUS93]), etc – for a good overview of the different models see [SÜTH99], [BAL94], [ALB90]). Where it is possible, we refer to points of contact with different models.

Before we discuss the data structure and basic functions of the layers, we should make some restrictions. Our main concern is to explore the data structure of the layers or, generally, the organisation levels of information systems; so we will not deal with operational issues of information systems (e.g. functionality, user friendliness, data safety and security, physical structure and implementation, etc). Also, the questions relating to interfaces between layers as

well as their communications functions are only slightly discussed, mainly to the extent that they are relating to our main concern.

Architecture of the MLAIS model

The four main layers of the MLAIS model are as follows:

- textual layer (designated as T layer)
- index layer (designated as I layer)
- logical / conceptual layer (designated as LC layer)
- hypertextual layer (designated as H layer)

Moreover, two additional layers belong to the MLAIS model:

- supplementary layer (designated as S layer)
- component layer (designated as C layer).

We should not forget two additional components which are of vital importance: the *users* themselves who use the information system (normally via the H layer), and the *entities of the real world* (the representations or images of which are normally stored in the T layer as parts or components of a complex hypertext system).

The function of the main layers can be outlined as follows:

- the index layer identifies the attributes, or characteristics of the abstract objects of the LC layer and the components of the T layer;
- the logical / conceptual layer identifies the abstract objects, and their high-level structures, which are abstract representations of the components of the T layer;
- the textual layer contains components, or segments, that are abstract representations of the entities described by the information system, and concrete representations of the abstract objects and their structures;
- the hypertextual layer implements various links between segments of the textual layer, *organising its content on high level*. Beside this, the hypertextual layer presents links or sequence of links (coming from the result of a search query, keyword index, list of subject categories, etc) which enable us to access the segments of the textual layer indirectly, i.e. via the index layer or logical / conceptual layer which generate the links to be presented.

Textual Layer (T layer) and Component Layer (C layer)

The primary information supplied by an information system are stored basically in the textual layer or T layer in the MLAIS model. In the MLAIS model the T layer is composed of components interconnected by relational or hypertext links. The components, which make up the so-called *macrostructure* of the T layer, can be

- atomic or base components, or atoms which are considered "primitive" or "black boxes" in the T layer i.e. their structure is not studied on this level (e.g. a linear text such as an electronic mail, an image, etc),
- (hypertext or static) links which contain references to other components (e.g. a chapter name in a 'Table of Contents', a keyword in an 'Index', etc), and

- composite components, composites or segments that consist of other components (e.g. an HTML document such as a Web-page, a chapter of a book that contains text, illustrations, tables, etc).

The terminology *node* can be used for atoms or composites. The *hypertext architecture* can be considered roughly (i.e. apart from functional issues such as navigation which will be discussed later, in the section dealing with the H layer) as a network of nodes and links. There can be several approaches to study the macrostructure of the T layer. Note that the great majority of the composites have a kind of textual format and are written in one of the natural languages. Although multimedia is, with no doubt, essential with respect to the efficient communication between the information system and the user, but the typical multimedia formats belong nowadays chiefly to atoms, and not composites. So the basic question concerning the inner organisation of the T layer is the way *how natural language texts are organised*. Some basic issues of the organisation of natural language texts are discussed in detail in **Chapter 2**. It is interesting, however, that the interaction between natural language texts and hypertext is mutual. Based on various hypertext link structure models, hypertext can also be used in creative writing. ([TRAE])

Now let us deal briefly with some other issues, mainly about the *microstructure* and *functions* of the T layer. The segments or composites of the T layer can contain atoms, links and (other) composites to form a complex structure which play a major role in particular applications. As has been established before, the inner structure of atoms as well as the way segments are composed of other components is of no concern to the T layer. In particular applications, however, these issues can be very important. So we should introduce another layer, the *component layer* or C layer by which the inner structure of components, that is, the microstructure of the T layer, can be interpreted. The C layer is more or less equivalent to the 'within-component' layer of the Dexter model ([HAL94]).

There is a huge variety of different physical and logical realisation of components. For example, any component can be described or identified by its

- media (e.g. text, image, sound, video, etc);
- organisation (logical structure) (e.g. list, table, tree (hierarchy), etc or any combination of these, predefined as hypertext or hypermedia, (Word) document, (Excel) spreadsheet, etc);
- (physical) format (e.g. TXT, HTM(L), GIF, WAV, AVI, DOC, XLS, PS, PDF, CGI, etc).

Because of the great number of different kinds of components, the C layer should be divided into *different sub-layers* each of which is familiar with the specification of a particular component realisation which in turn is based on a sensible and/or existing variation of the aspects mentioned above (that is, the various realisations may differ in media, organisation and format).

Logical / Conceptual Layer (LC layer)

The logical / conceptual layer or LC layer consists of abstract objects that identify or describe components of the T layer. Considering the T layer as "cyberspace", the LC layer might be referred to as a "mirror" that reflects the data stored in the T layer by mapping the objects of the LC layer into the T layer. In other words, the objects of the LC layer can be considered as abstractions or "images" of the components of the T layer, while the components of the T layer can be considered as concrete representations of the objects of the LC layer.

The LC layer performs a *database function* in the MLAIS model. In order to describe most of the different applications, the object-oriented database model (OODBM) appears to be the most appropriate data model for the LC layer. 'Hypermedia in general, but more so the WEB, are founded on the object oriented paradigm.' ([GUAY95]) The object-oriented paradigm has definite advantages over other paradigms. For example, considering a library application that uses the tables 'READER', 'OPAC', and 'TRANSACTIONS', the table 'CIRCULATION' can be obtained on the relational database paradigm by joining the tables with each other (or using the appropriate 'select' or 'create view' statement in SQL). Besides, the problem of multiple authors are frequently solved using another paradigm, e.g. in keyword indexing systems by using a repeatable field for authors. In OODBM either the joining of different tables or the use of repeatable fields can be easily accomplished (see e.g. in [ABIT96]). For example, assuming that, in a new object class containing several object classes, the fields occurring in more than one object classes with the same name will occur only once, we can create the following classes (as regards the notation we used see [BUS93]):

```
class READER
        τ(READER) = [cardno:integer,rname:string,address:string,...]

class AUTHOR
        τ(AUTHOR) = [names:{[#:integer,aname:string]}]

class OPAC
        τ(OPAC) = [locmark:longint,auth:AUTHOR,titl:string,...]

class TRANSACTION
        τ(TRANSACTION) = [cardno:integer,locmark:longint,date:DATE,...]
```

There are some ways to create the object 'CIRCULATION', e.g. simply by using object types:

```
class CIRCULATION                                                    (1)
        τ(CIRCULATION) = [book:OPAC,user:READER,date:DATE,cardno:integer,...]
```

We might use another notation henceforth referred to as *P-notation* in describing the data structure outlined above. Assuming that we have a database of facts, the following PROLOG-like (or DATALOG-like) rules are equivalent with the object classes described above:

```
reader(R,X,....) :-
        cardno(R,X),
        rname(R,X1),
        address(R,X2),
        ...

author(A,Y,...) :-
        aname(A,Y,Y1), /* the second variable (Y) corresponds to the field # */
        ...

etc
```

Now, with these rules we can create the rule for *circulation*:

```
circulation(X,Z,...) :-                                          (2)
        reader(R,X,...),
        transaction(T,X,Z,...),
        opac(O,Z,...).
```

Note that in the rule for *circulation* the variables *X* and *Z* occur in more than one predicate and so link them together.

Let us study now briefly the problem of semantic interpretation. We can describe the situation which is expressed by the concept *circulation* with the following *pattern in natural language*:

sy (a user) borrows sth (a book) in (MM-DD-YYYY) (e.g. in June 16, 2000) **(3)**

Let us try to describe this pattern in P-notation:

```
circulation(C,X,Z,...) :-                                        (4)
        _subject(C,R),
                reader(R,X,...),
        _predicate(C,T),
                _object(T,O),
                        opac(O,Z,...),
                _in(T,D),
                        date(D,...).
```

Let us call this notation *P*-notation*. Although we should have made some modifications, but the result is semantically equivalent with what appears in definitions (1) and (2). The main difference is that definition (4) reflects the grammatical structure of pattern (3) which describes the situation in *natural language*. Therefore the *semantic interpretation* of definition (4) (i.e. the rule for *circulation* written in P*-notation) is as clear as any description when using natural language in describing a situation. This suggests that natural language texts and object-oriented databases are semantically very close to each other. It is not surprising that the complex data structure of an OODB can be equivalently described in natural language (as we normally think and communicate in this way). But we will demonstrate in **Chapter 3** that a natural language text, including such complex language elements as *metaphors*, can be fully described in P*-notation.

The main function of the LC layer in the MLAIS model is, together with the I layer discussed below, to provide *interactive access* to the components of the T layer. Beside this, the LC layer can support the retrieval of the components by itself (i.e. without queries), accomplishing the idea of 'classification' by creating, *according to some predefined aspects*, classes from certain groups of components, higher classes from these classes and other groups of components, etc. The hierarchy obtained as a result of this is called a 'classification scheme'. We will demonstrate in Chapter 1 that *classification schemes can be represented by class hierarchies in OODBM.*

Index Layer (I layer)

The index layer or I layer identifies the attributes, or characteristics of the abstract objects of the LC layer and the components of the T layer, in order to retrieve the objects or components stored in the information system according to those attributes. The I layer is often represented by computer-generated concordances (see e.g. [PAPP75]) or keyword lists which can either be used in preparing the objects of the LC layer (e.g. when represented in dictionary form, see

[PAPP68]), or in the retrieval of the objects or components of the corresponding T or LC layers. The objects or components can be retrieved either interactively by *search queries* which identify a *set of objects* called search results, or by means of *navigation* through selected lists of attributes (such as keyword or concordance lists) which contain *links* to various objects or components.

The information retrieval is usually based on the attributes and attribute values of objects. In the simplest case, values are of elementary type that is, the domain of attribute values can be mapped into the power-set of objects directly (e.g. by indexes). In case of values that are of complex type however, we should at first determine those fragments or extracts from each attribute value that characterise relevantly the objects containing the attribute value in question (i.e. fragments or extracts that have semantic content). Then the domain of extracted values called *keywords* or terms can be mapped into the power-set of objects (e.g. by inverted files). The elementary attribute values and keywords are called object characteristics. In case of components containing text written in natural language we can consider certain parts of the text (e.g. text sentences, paragraph, etc) as attributes having values of complex type.

As for an appropriate data structure of the I layer, frames appear to be one of the most flexible choices. Almost every aspect of a *descriptor-based* search language can be described with the use of frames. (In our case we need two types of frames, namely *generic* and *reference frames*.) The use of frames, often applied in expert systems as well as in early linguistic investigations ([KIEF00a]), emphasises that the I layer can be considered as *the knowledge representation of the LC layer* (and through that of the T layer as well). We should remark here, however, that in some cases (e.g. in relational database systems) the function of the I layer is restricted to the support of the information retrieval function of the LC layer. By contrast, the effective implementation of the I layer is extremely important when searching full-text databases, e.g. in keyword indexing systems. 'Indexing and other common database techniques are complicated in full-text, since every word is, by default, equal in importance to every other. The structure of the data cannot be as easily used to optimize indexing. Semantic processing is often necessary to produce useful navigation aids and search techniques.' ([ELAB95])

Hypertextual Layer (H layer) and Supplementary Layer (S layer)

The hypertextual layer or H layer provides an integrated "user interface" for the information system (and its users). The H layer enables the users to access the primary information stored in the T (or LC) layers in the information system according to different approaches. Some publications use the terminology *hypertext management system (HTMS)* which is very close to the concept of the H layer ([SÜTH99]). Moreover, the H layer corresponds more or less to the *'run-time layer'* of the Dexter model [HAL94].

The H layer has three basic functions which allow users to have access to the information stored in the information system. They are as follows:

- The H layer provides two basic *control methods* through which the users can express their special needs or requests for information;
- The H layer (together with the S layer, see later) has special *presentation capabilities* through which the information content of the segments or objects having different organisation and format can be satisfactorily presented (i.e. displayed, printed, etc);

- The H layer allows users to *navigate* between the various links of the information system. It is a step-by-step interactive process wherein the users can gradually refine the results the information system provides.

Let us examine first the *navigation function* of the H layer. The navigation capabilities of the information system are of vital importance because they make the information content stored and organised in the system work. In other words, while navigating between the various links of the information system the individual knowledge of the user and the stored and organised knowledge of the information system *becomes one unit or entity* and immensely extends the information accessing and processing capabilities of the user. Note that communication between the user and the information system is (usually) not for its own sake. The user should have a starting point, in most cases a text to be interpreted or processed, which will serve as the *initial paradigm of the communication process* through which the information content of the text becomes understood, completed, and linked to the knowledge activated by the paradigm (that is, with the knowledge covered by the appropriate cognitive schema of the user and with the appropriate portion of the "third world" represented by the information system). The cognitive paradigm described here is illustrated in Fig 1.

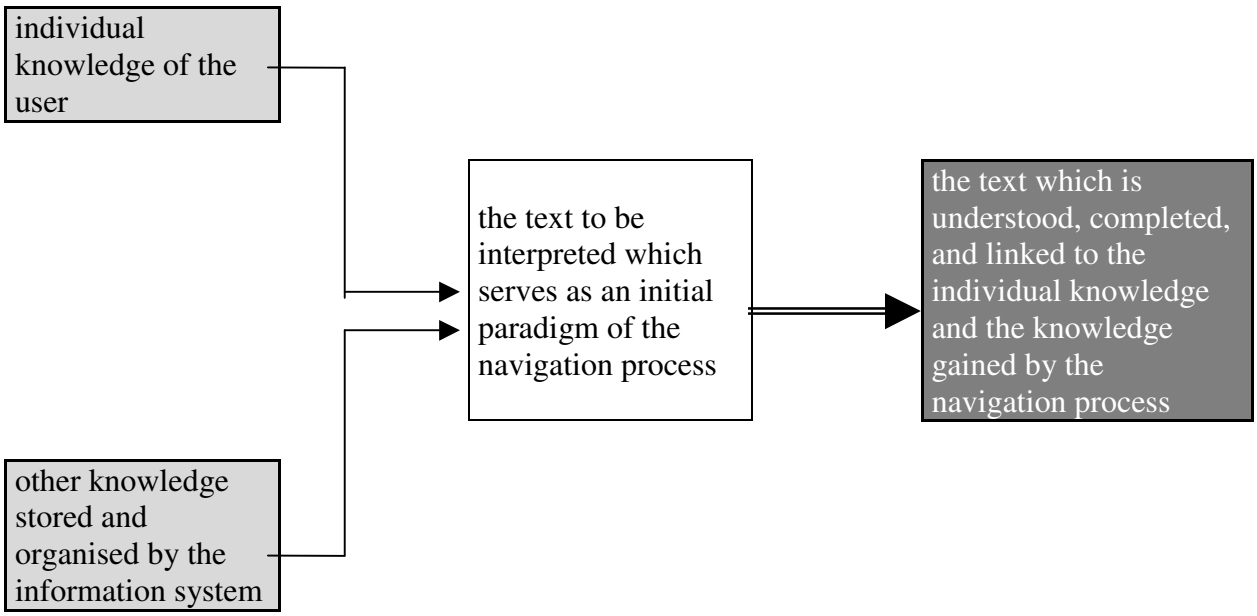


Figure 1: cognitive paradigm for the interpretation process

It is clear that the organisation of the T layer in macro level influences greatly the effectiveness of navigation. It has proved to be very fruitful in our examinations to compare metaphorically the organisation structure of the T layer to an "iceberg" which we will henceforth consider as a *cognitive framework* for the various applications of the MLAIS model. The different levels of the iceberg correspond to the different kinds of knowledge. The levels of the iceberg are cross-linked with each other, the overall corpus of various texts and these links form together a *complex hypertext structure* which is the core of our further considerations. These issues will be discussed in detail in **Chapter 4**.

Overview of Chapter 2
Co-reference analysis and the structure of natural language texts

In this chapter we will analyse a selected text from the Bible using the methods and notation of *co-reference analysis*. The complex notation and terminology of co-reference analysis have been developed by János S. Petőfi ([PETŐ97], [PETŐ98]). In this chapter we will complete (and slightly modify) this notation in order that it can serve as a *metalanguage* in further, and mainly computer-based, text linguistic or textological investigations. The new elements added to the original form of co-reference analysis are as follows:

- using communication units instead of text sentences as the basic elements for the analysis
- the relationship between text sentences and communication units is completely formalised
- the coding of communication units is completely formalised
- the introduction of relation indices
- using verb patterns in the coding of the communication units
- the introduction of new operators and symbols such as B, N, G, C, !, !!, /, +, decl, imp, t0, t1, ...
- adding "dimensions" (such as time, mood, etc) to the coding of the relation indices
- using traditional operators (such as =) in new, broadened sense
- using prepositional or adverbial phrases in the coding of the communication units (e.g. to, in order that, etc)
- the formal introduction and coding of comments as part of the metalanguage developed
- the introduction of basic co-reference indices and definitive attributes
- the introduction of group indices
- the introduction of the net of co-reference indices (as well as its table representation)
- the introduction of the graph representations of the associative structure of text

Our aim is to demonstrate the effectiveness of co-reference analysis in describing natural language texts in a way which may be independent of any natural language. This makes possible, among others, that the prepared text could be the input for a text processing computer program. We will lay great stress on specific methodological issues, e.g. how natural language texts can be transformed or coded adequately i.e., without loss of information; how we can describe and *complete* the syntactic and semantic structure of the text analysed without modifying its content; how we can present the results of co-reference analysis in a friendly, clearly way; etc. After we performed the co-reference analysis of the selected text, we will discuss the interpretation possibilities of the results.

Overview of Chapter 3
The Role of Conceptual Metaphors in the Hypertext Structure of Poetic Texts

'One of the most important subjective factors of any language is *metaphor* which is the part of language creativity.' ([KIEF00b]) In Chapter 3 we will examine the role of *conceptual metaphors* ([LAK92], [KÖV98]) in the hypertext structure of poetic texts. We will describe and apply a simplified language model using the so-called P*-notation (see **Chapter 1**) which will serve as a *constructive linguistic tool* in our further examinations. In other words, our

experiences coming from the application of the P*-notation in practice will help us expressing some ideas, as well as checking our considerations,

- about the role of conceptual metaphors in poetic texts, and
- about the explicit form of metaphorical (and other) relationships within the hypertext structure we use as a cognitive paradigm in the interpretation of poetic texts.

The coding of natural language texts in P*-notation is partially based on the notation of co-reference analysis described in **Chapter 2**.

We tried to lay great stress upon the simplicity and easy-to-use feature of the model. Thus it is not at all intended to be a "perfect language" ([ECO98]); rather, it *is* intended to be a useful linguistic tool which makes it possible for us to examine directly, *constructively* some linguistic phenomena including metaphors, other figures of speech, etc. Nevertheless, it is essential for the model to have enough complexity to meet some *minimal* criteria:

minimal syntactic criteria for the model:

- the model should properly describe the inner structure of syntagmas (phrases, clauses, sentences, etc), and
- the model should convey the original syntactic structure of sentences or *communication units* and the co-referential structure of texts.

minimal semantic criteria for the model:

- any question that can be formulated in a natural language should be expressed (that is, *coded*) in the model of that language, and
- the model should give meaningful (coded) answers to meaningful (coded) questions on the basis of, and faithfully to, the original text described in the model.

Here we would like to emphasise again that our approach is basically constructive which is also expressed in the way we expound our ideas *by the interpretation process of a selected poem*. Consequently, we do not intend to build a theoretic construction that can solve every problem (from the simpliest to the most sophisticated one), but do intend to *describe and apply* a simple language model which can be used as a useful tool in our further examinations. Thus the appropriateness of the model can be measured by its usefulness or usability, some examples to which will be shown in the following parts of this chapter. The usability of the model in practice can be well ensured by using computer assistance. For that purpose, we will apply the syntactic rules of the Turbo Prolog 2.0 language.

Because the model has not been intended to be exhaustive, it is possible that some linguistic phenomena cannot be represented adequately in it. But we looked for *a logically well-founded model* that meets the minimal syntactic and semantic criteria prescribed above. Thus those things that can actually be represented in the model can be considered as a firm basis of our further considerations which can therefore be expected to correspond to the facts.

The description of the model can be found in the following sections of the chapter as part of the interpretation process of the poem Poppy by Miklós Radnóti.

Overview of Chapter 4
The Hypertext Approach to the Question of the Interpretation of Poems

The concept *'understanding'* is used, as in everyday language, in more than one sense in the psychology of discourse. In the narrower sense, it can be interpreted as a process in which, from the input signals coming from spoken or written sources, we recognise the basic statements lying behind the acts of discourse ([BÜKY84]). Although the understanding of poetic texts is a more complex process, it should be similar, in one way or another, to the recognition process of everyday statements. In this chapter, we try to establish some basic elements of the understanding process of those people who want to understand the way the poet thinks, or, in an advanced stage, who can enter into the spirit of the poem, i.e. the emotions, ideas, attitudes, or behaviour patterns expressed by the text of the poem.

During their elementary, secondary, or higher education literary studies in Hungary, pupils and students get to know a lot of poems and several excellent, and mainly heuristical, methods for interpreting them. However, it seems to be a very promising way with respect to the better understanding of literary texts, to add *psycholinguistic methods* and ideas to the usual interpretation methods pupils and students use day by day during their literary studies. We are convinced, that the effectiveness of such methods can greatly contribute, among other things, to the development of the overall knowledge and skills pupils and students have in language use, from the recognition of words and concepts to the complete understanding of them.

There are several models for the *representation of knowledge* or memory described in the specialist literature of psycholinguistics (see e.g. [DENH88], [GÓSY99]). In the following, we attempt to select some basic elements of those models, as well as adding some new elements to them, without strictly sticking to one of the models having been described so far. As our aim is to study the understanding process of poetic texts as well as our approach is constructive instead of being purely theoretical, the applicability of the interpretation procedure we describe later, with its effectiveness and efficiency in practice, can justify the consistence of the selection of elements.

The *cognitive framework* of our further considerations is as follows. The interpretation of texts - in this case, poetic texts - requires, first of all, the precise knowledge of the meaning of words. Here, together with the accepted definition of the words that is valid in the given context, we should take into consideration certain knowledge about the world (see [PETŐ97]) which is necessary to understand fully the message of the text of the poem (note that the context itself is also part of such knowledge at “the tip of an iceberg” or below, as can be seen later). This knowledge can well be represented as a *hypertext structure* rather than a hierarchical one. The structure can be considered metaphorically as an "iceberg" where the text of the poem is only at the tip of the iceberg which contains several additional levels. Note that these levels are almost as important with respect to the meaning of the text as the text itself.

The levels of the "iceberg" might be as follows:

- the selected poem or text to be interpreted
- other poems or texts from the poet of the text analysed;
- poems or texts from other poets who had or could have had certain effects on the poem;

- the background context of the text of the poem, e.g. its historical background, events that were of vital importance for the poet, similar events or experiences (i.e. the appropriate *schemas* of the receiver of the poetic message) that might influence, in one way or other, the understanding or interpretation process of the poem, etc.

The levels of the iceberg are cross-linked with each other, the overall corpus and these links forming together a hypertext structure which is the core of our further considerations.

Note that the 'dictionary' or 'lexical' knowledge (about the different types of knowledge see [ANDO98]), and the knowledge about the "world" (of the poem, of other literary texts, of the poet etc. - that is, the knowledge about the corresponding portions of the real and *third world*, see [POPP98]) represented above as an "iceberg" are equally important with respect to the whole interpretation process. Therefore, they can be represented as two separate, but cross-linked, layers of a complex, multi-layer hypertext structure (see Fig 2). Note that they correspond to the LC and T layers of the MLAIS model, respectively.

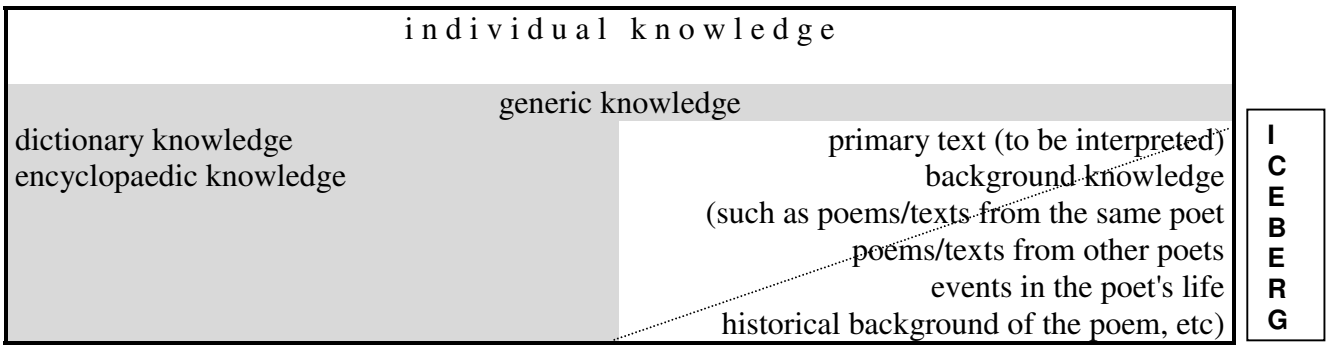


Figure 2: certain types of knowledge as layers of a complex hypertext framework

As can be clearly seen in the construction of the "iceberg" structure, the layers of the multi-layer hypertext structure have their own, inner or "fine" structure which fits the multi-level hypertext representation excellently. For example, dictionary knowledge can be *represented* as a certain network of the meaning of words, a so-called semantic network of concepts (see e.g. [BOR95], [ECK95], [GÓSY99], [PRÓ99]). Note that this *representation* corresponds to the I layer of the MAIS model. The semantic network of concepts is organised on the basis of certain (binary) relationships between the concepts including paradigmatic and syntagmatic relations coming from substitution, addition, comparison and distinction of concepts, etc. Most of such relations are implicitly or explicitly indicated in the dictionary items of the corresponding words. In addition to the words and their relationships that can be found in dictionaries, other concepts and relations may as well be necessary e.g. from specialist books, essays, articles, encyclopaedias, etc. Thus if we take this "encyclopaedic" knowledge into consideration, it will form a new level beside (or under) the "dictionary" level of the corresponding layer. Because the relationships of concepts can easily be represented as hypertext links between the nodes of the semantic network, a hypertext paradigm can be applied to the layer containing those nodes as well as to the whole cognitive framework, too.

Although forming a corpus as a hypertext structure as well as having enough dictionary (and encyclopaedic) knowledge is fundamental to understand the meaning of the elements of the text of the poem, there are obviously other levels in the organization of knowledge which are also responsible for the effectiveness of the whole, rather complex, cognitive process of understanding the poem.

One example of those levels is as follows. Based on the complex hypertext structure outlined above, the concepts of the text of the poem can be (simultaneously) grouped *or classified* into several schemas where each schema forms, after all, a consistent system of concepts and relationships. In other words, ‘concepts may be *organized* into schemas ... which are mental frameworks for representing knowledge, encompassing an array of interrelated concepts in a meaningful organization.’ ([STER96], pp. 198-199) These schemas, especially in case of reading or hearing the text for the first time, are supposed to be organised around certain keywords (see [GUID53]), and can be clearly separated on the basis of certain dimensions (e.g. time, space, etc.). Note that the construction of schemas is a kind of abstraction (or generalisation) and therefore the schemas belong to a particularly high level of a vertically organised "generic" knowledge which corresponds to the LC layer of the complex hypertext framework. In addition, generic knowledge is an inherent part of the hypertext structure *which is expressed through the activity of the users* who

- formulate a query,
- activate the corresponding links of the overall structure,
- access to the corresponding nodes of the structure , and
- *organise dynamically* the obtained information in their own mental knowledge base.

As can be seen, this activity is a representation of the H layer of the MAIS model. Note that its effectiveness depends on the users who try to get the best of the navigation features of the H layer of the system. This approach might as well explain some problems with respect to the use of hypertext, for example cognitive overload.

Note that the abstract schemas, their content and organisation, and especially the paradigm on the basis of which the concrete, or text-based representation of those schemas (referred to simply as 'schemas' above) can be interpreted, depend on and are greatly influenced by his or her own "individual" knowledge of the receiver of the message of the poem, concerning all types of knowledge mentioned so far. This fact itself can provide a huge number of different interpretations, and therefore it is responsible for the 'openness' of poetic texts which is probably one of the most important features of the interpretation process (see [ECO98]).

In what follows, we try to demonstrate the applicability and efficiency of the MAIS model as a cognitive framework in the interpretation process of poems.

References

[ABIT96] Abiteboul, S. – Cluet, S. – Christophides, V. – Milo, T. – Moerkotte, G. – Siméon, J.: Querying Documents in Object Databases. – Journal of Digital Libraries Manuscript, December 5, 1996.
[ALB90] Alberico, R. - Micco, M.: Expert systems for reference and information retrieval. - Meckler, 1990.
[ANDO98] Andor J.: A komplex lexikálisjegy-analízis és a mormota esete. In: Pléh Cs. - Győri M. (szerk): A kognitív szemlélet és a nyelv kutatása. - Pólya K. 1998. 83-100.
[BAL94] Balasubramanian, V.: State of the Art Review on Hypermedia Issues And Applications. (http://www.isg.sfu.ca/~duchier/misc/hypertext_review/index.html)
[BOR95] Borgulya I.: Szakértõi rendszerek, technikák és alkalmazások. - ComputerBooks, 1995.
[BUS93] Van den Bussche, J. - Heuer, A.: Using SQL with Object-Oriented Databases. In: Information Systems 18 (1993) 7: 461-487.
[BÜKY84]: Büky B. - Egyed A. - Pléh Cs.: Nyelvi képességek - fogalomkincs - megértés. - Tankönyvk. Budapest, 1984.
[DENH88] Denhière, G.Y.: Szemantikai, fogalmi, vagy lexikai emlékezet? (Mémoire sémantique, conceptuelle ou lexicale?) In: Pléh Cs. (szerk.): Szöveggyűjtemény a pszicholingvisztika tanulmányozásához. - Tankönyvk. Budapest, 1988.
[ECK95] Von Eckardt, B.: What is cognitive science? – A Bradford Book, 1995.
[ECO98] Eco, Umberto: Nyitott mű. (Opera aperta. Forma e indeterminazione nelle poetiche contemporanee.) - Európa K. Budapest, 1998.
[ELAB95] The Electronic Labyrinth. (http://jefferson.village.virginia.edu/elab/elab.html)
[GÓSY99] Gósy M.: Pszicholingvisztika. – Corvina K. 1999.
[GUAY95] Guay, T.: WEB Publishing Paradigms. - Simon Fraser University, April 1995. (http://hoshi.cic.sfu.ca/~guay/Paradigm/Paradigm.html)
[GUID53] Guiraud, P.: Langage et versification d'apres l'oeuvre de Paul Valery. - Paris, 1953.
[HAL94] Halasz, F. - Schwartz, M.: The Dexter Hypertext Reference Model. In: Commun. ACM 37 (February 1994) 2: 30-39.
[KIEF00a] Kiefer F.: A nyelvészet és a számítástudomány. In: Természet Világa 2000/II. Különszám 37-41.
[KIEF00b] Kiefer F.: A kognitív nyelvészet: új paradigma? In: A megismeréskutatás útjai. – szerk. Pléh Cs., Kampis Gy., Csányi V. – Akad K. 2000. – 120-144. (Pszichológiai Műhely 12.)
[KÖV98] Kövecses Z.: A metafora a kognitív nyelvészetben. In: A kognitív szemlélet és a nyelv kutatása. (szerk. Pléh Cs. és Győri M.) - Budapest, Pólya K. 1998. pp. 50-82.
[LAK92] Lakoff, G.: The Contemporary Theory of Metaphor. - To Appear in Ortony, Andrew (ed.) Metaphor and Thought (2nd edition), Cambridge University Press. – 1992.
[PAPP68] Papp F.: Amíg a gépi listából olvasható tanulmány lesz. – Magyar Nyelvőr 92 (1968) 321-333.
[PAPP75] Papp F.: Konkordancia: Írói szótár előkészítése számítógépen. – Magyar Nyelvőr 3 (1975) 351-356.
[PETŐ97]: Petőfi S. János: Egy poliglott szövegnyelvészeti-szövegtani kutatóprogram. In: Officina Textologica, 1. szám. – Kossuth Egyetemi K. Debrecen, 1997.
[PETŐ98] Petőfi S. János: Koreferenciális elemek és koreferenciarelációk. Példaszöveg: Mt. 9,9 -13. Máté meghívása. 15. - Officina Textologica 2 (1998) 15-31.
[POPP98] Popper, K.: Test és elme. Az interakció védelmében. - Typotex K. 1998.
[PRÓ99] Prószéky G.: Természetes nyelvek. In: Mesterséges intelligencia. – szerk. Futó I. – Aula K. 1999. pp. 756-814.
[STER96] Sternberg, R.J.: Cognitive Psychology. – Harcourt Brace College Publishers, 1996.
[SÜTH99] Sütheő P.: Hypertext. Természetes intelligencia az információtudományban. – OSZK, Budapest, 1999.
[TRAE] Traenker, N.: Hypertext Link Structure Models. (http://www.contract.kent.edu/people/nick/models/index.html)
[ULLM88] Principles of Database and Knowledge-Base Systems. Vol 1. – Computer Science Press, 1988.
[ULLM98] Ullman, J. D. – Widom, J.: Adatbázisrendszerek. Alapvetés. – Panem – Prentice-Hall, 1998.

Chapter 1

Complex Data Structures and their Role in the Organisation of Information Systems

1.1 Introduction

In this chapter a general and abstract model of information systems is introduced and discussed in detail. The *Multi-Layer Architecture of Information Systems (MLAIS) model*,[1] invented by the author, describes information systems as complex structures built on four main layers and two additional layers. The layers are connected to each other by interfaces that carry out communications procedures to exchange information ("messages") between the layers.

Before we discuss the data structure and basic functions of the layers, we should make some restrictions. Our main concern is to explore the data structure of the layers or, generally, the organisation levels of information systems; so we will not deal with operational issues of information systems (e.g. functionality, user friendliness, data safety and security, physical structure and implementation, etc). Also, the questions relating to interfaces between layers as well as their communications functions are only slightly discussed, mainly to the extent that they are relating to our main concern.

In the development of the MLAIS model, some information systems as well as other means and methods of organising knowledge in traditional or modern way (i.e. by the use of computers) have been taken into consideration. Those information systems and their equals (e.g. traditional, "linear" texts (e.g. books) and selected methods for analysing and processing them, bibliographies, encyclopaedias, monolingual and bilingual dictionaries, thesauruses, lexicons, classifications schemes, library systems, keyword indexing systems, relational and object-oriented database models, expert systems, hypertext and hypermedia systems such as the WWW, multimedia CD-ROMs, etc – as for the main sources our considerations are based see Bibliography), their organisation levels or layer structure, as well as the basic functions and relationships of the layers explored, can serve as examples which illustrate certain points of the MLAIS model. In order to describe hypertext-based information systems, ‘there have been several attempts to create a unified data model but, up to now, without resounding success’. ([SÜTH99], p. 28) As can be seen later, the MLAIS model implements the terminology and various parts of other models (e.g. Dexter Hypertext Reference Model ([HAL94]), object-oriented database (OODB) model ([ULLM98], [BUS93]), etc – for a good overview of the different models see [SÜTH99], [BAL94], [ALB90]). Where it is possible, we refer to points of contact with different models.

[1] In Hungarian publications we used the acronym *IRAM (Információs Rendszerek Architekturális Modellje)* for the model we are discussing here, which is the Hungarian equivalent of the acronym *MLAIS*.

1.2 Architecture of the MLAIS model

The layers of the MLAIS model and their relationships are as follows:

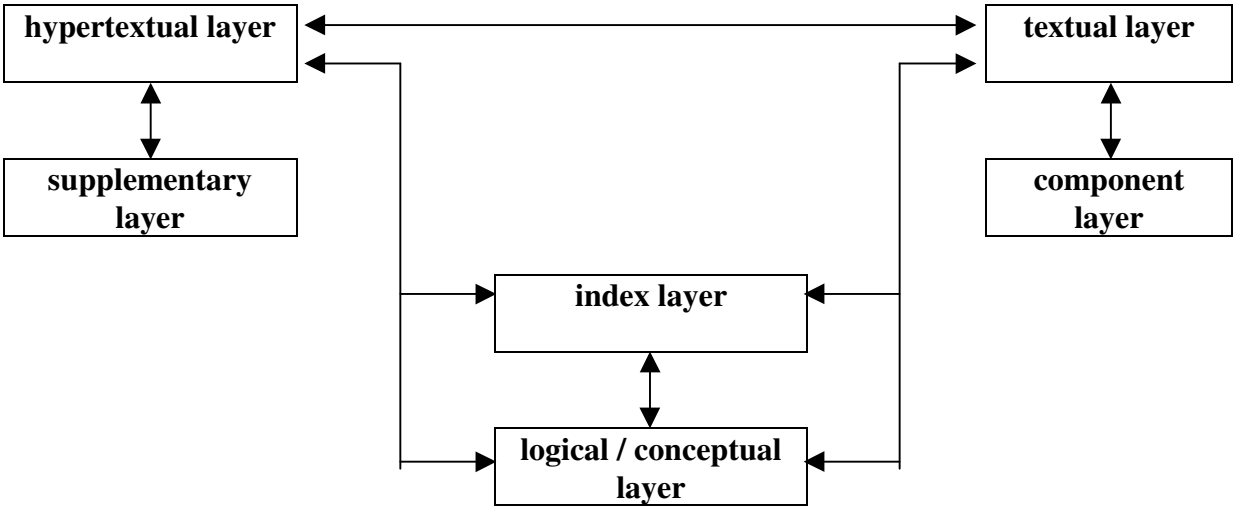


Figure 1

As can be seen in Fig 1, the four main layers of the MLAIS model are as follows:

- textual layer (designated as T layer)
- index layer (designated as I layer)
- logical / conceptual layer (designated as LC layer)
- hypertextual layer (designated as H layer)

Moreover, two additional layers are shown in Fig 1:

- supplementary layer (designated as S layer)
- component layer (designated as C layer).

We should not forget two additional components which are of vital importance: the *users* themself who use the information system (normally via the H layer), and the *entities of the real world* (the representations or images of which are normally stored in the T layer as parts or components of a complex hypertext system).

The function of the main layers can be outlined as follows:

- the index layer identifies the attributes, or characteristics of the abstract objects of the LC layer and the components of the T layer;
- the logical / conceptual layer identifies the abstract objects, and their high-level structures, which are abstract representations of the components of the T layer;
- the textual layer contains components, or segments, that are abstract representations of the entities described by the information system, and concrete representations of the abstract objects and their structures;

- the hypertextual layer implements various links between segments of the textual layer, *organising its content on high level*. Beside this, the hypertextual layer presents links or sequence of links (coming from the result of a search query, keyword index, list of subject categories, etc) which enable us to access the segments of the textual layer indirectly, i.e. via the index layer or logical / conceptual layer which generate the links to be presented.

1.3 Textual Layer (T layer) and Component Layer (C layer)

The primary information supplied by an information system is stored basically in the textual layer or T layer in the MLAIS model. As the T layer contains primary information in the first place, it might as well be referred to as 'document collection' ([PÁL98]). Some publications use the terminology *hypertext base (HTB)* which is also very close to the concept of the T layer ([SÜTH99]). Moreover, the T layer is more or less equivalent to the *'storage layer'* of the Dexter model as regards its components and functions ([HAL94]). Based on the Dexter model, the so-called relational hypertext model summarises as well as formalises the basic elements of the two models as follows: 'In the Dexter model, *components* (i.e. documents) of a hypertext consist of a *base component* (the unit of information in the component, e.g. a text or a picture), two sets of *source anchors* and *destination anchors* located on this base component, and some additional information. In the relational hypertext model, this has been formalized by defining a component c as a triple $c=(b,S_c,D_c)$ where b denotes a base component and S_c and D_c denote subsets of source and destination anchors respectively. A link l is then defined as a pair of pairs $l=((c,s_c),(c',d_{c'}))$ where c and c' denote components and s_c and $d_{c'}$ denote a source and a destination anchor located on c and c' respectively. Such a construct formalizes a link from the source anchor s_c on component c to the destination anchor $d_{c'}$ on the component c'.' ([ALB97; RATH])

In the MLAIS model the T layer is composed of components interconnected by relational or hypertext links. The components, which make up the so-called *macrostructure* of the T layer, can be

- atomic or base components, or atoms which are considered "primitive" or "black boxes" in the T layer i.e. their structure is not studied on this level (e.g. a linear text such as an electronic mail, an image, etc),
- (hypertext or static) links which contain references to other components (e.g. a chapter name in a 'Table of Contents', a keyword in an 'Index', etc), and
- composite components, composites or segments that consist of other components (e.g. an HTML document such as a Web-page, a chapter of a book that contains text, illustrations, tables, etc).

The terminology *node* can be used for atoms or composites. The *hypertext architecture* can be considered roughly (i.e. apart from functional issues such as navigation which will be discussed later, in the section dealing with the H layer) as a network of nodes and links. There can be several approaches to study the macrostructure of the T layer. Note that the great majority of the composites have a kind of textual format and are written in one of the natural languages. Although multimedia is, with no doubt, essential with respect to the efficient communication between the information system and the user, but the typical multimedia

formats belong nowadays chiefly to atoms, and not composites. So the basic question concerning the inner organisation of the T layer is the way *how natural language texts are organised*. Some basic issues of the organisation of natural language texts are discussed in detail in **Chapter 2**. It is interesting, however, that the interaction between natural language texts and hypertext is mutual. Based on various hypertext link structure models, hypertext can also be used in creative writing. ([TRAE])

Now, let us outline briefly some other issues, mainly about the *microstructure* and *functions* of the T layer. The segments or composites of the T layer can contain atoms, links and (other) composites to form a complex structure which play a major role in particular applications. As for some restrictions concerning the inner construction of segments, we might as well refer to the Dexter model (segments may not be part of themselves, they can be represented as a directed-acyclic graph, etc – see [HAL94]), but the issue is of no concern to the T layer. We should remark that although we can consider links as individual entities, in practice links are, almost exclusively, embedded in various segments. Therefore, from now on, when we speak simply about *components*, we usually think of atoms or composites (i.e. nodes).

The T layer has two major functions: the *accessor and resolver function*. To access a node (e.g. by a link) we need first of all a component specification (e.g. URL, access path, file name, etc) which, being more or less symbolic, should then be resolved in a so-called Unique Identifier (UID) of a component. The UID identifies uniquely a specific component in "cyberspace" that is, in the T layer. In other words, *the T layer provides access to components via their UIDs.* The component specifications are derived from static or dynamic links to a specific component in the T layer. Note that static links are embedded in the segments of the T layer, while dynamic links are generated by the I or LC layers (or rather by their interfaces).

In a particular application, the resolver function can be achieved "physically" (i.e. at internal level) by the T layer itself. However, in complex or network applications the mapping of component specifications into UIDs is usually performed using certain *databases* (e.g. name servers) the 'natural' location of which is in the logical / conceptual layer according to the MLAIS model. So, in certain cases, the resolver function of the T layer requires the co-operation between the T layer and LC layer across their interface. This means that the information about the components of the T layer and their UIDs should be validated from time to time. (Unfortunately the applications in practice occassionally seem to forget it.) The database solution might be of great importance when studying such questions as flexibility, compatibility, portability, etc of different information systems forming an integrated network. The accessor and resolver functions are illustrated in Fig 2.

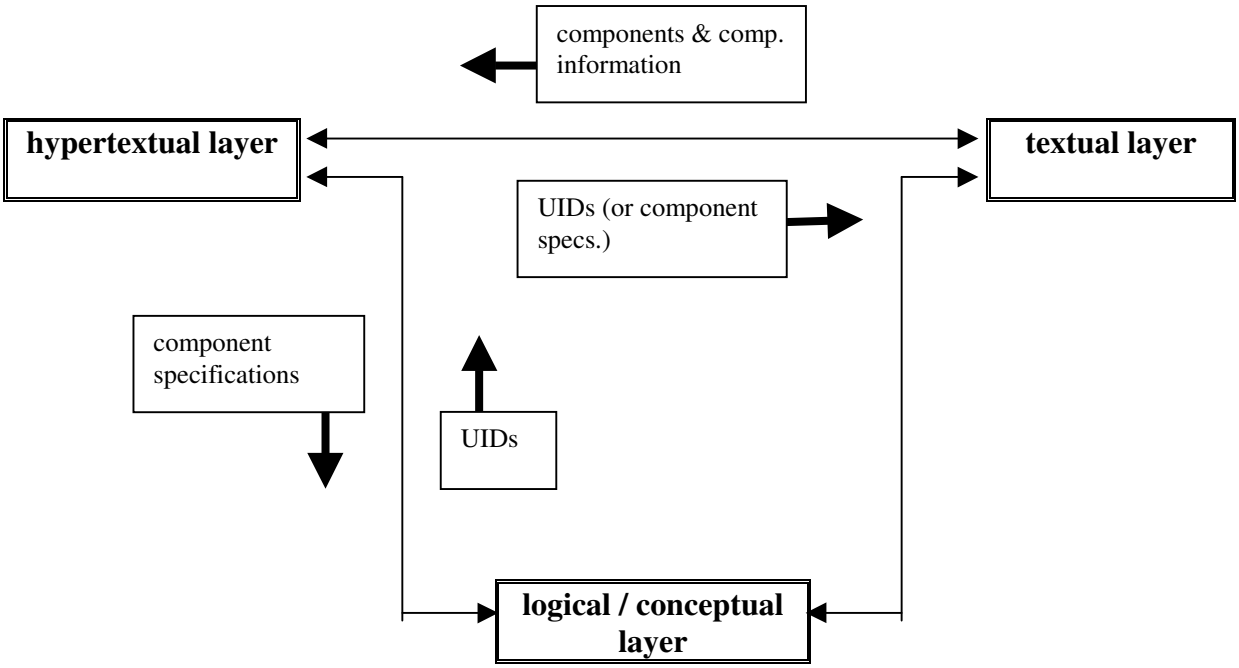


Figure 2

As has been established before, the inner structure of atoms as well as the way segments are composed of other components is of no concern to the T layer. In particular applications, however, these issues can be very important. So we should introduce another layer, the *component layer* or C layer by which the inner structure of components, that is, the microstructure of the T layer, can be interpreted. The C layer is more or less equivalent to the 'within-component' layer of the Dexter model ([HAL94]).

There is a huge variety of different physical and logical realisation of components. For example, any component can be described or identified by its

- media (e.g. text, image, sound, video, etc);
- organisation (logical structure) (e.g. list, table, tree (hierarchy), etc or any combination of these, predefined as hypertext or hypermedia, (Word) document, (Excel) spreadsheet, etc);
- (physical) format (e.g. TXT, HTM(L), GIF, WAV, AVI, DOC, XLS, PS, PDF, CGI, etc).

These aspects describe the individual components at different abstraction levels, and therefore they (or the combinations of them) correspond to different layers including the "main" layer, i.e. the user(s) themselves:

- the media, or multimedia, by which the information is presented (or manipulated in some cases) are essential for the end users of the information system to perceive the information effectively;
- the organisation of components as well as their format should be precisely known for accomplishing certain *functions*: note that these are the major functions of the C layer. They can be as follows:
  — preparing the components for use (by decoding or decompressing them, if necessary, or by generating them e.g. from other components),

— supplying the components with additional information called *component information* (which is stored "somewhere" within the components but can only be accessed with full knowledge of the inner data structure of the components), and
— passing the components, together with their component information, to the T layer;

- the media, organisation, and format of components is necessary for presenting (displaying, printing, conveying, etc) the information content of the individual components to the user, so they are used by the H or S layers.

Because of the great number of different kinds of components, the C layer should be divided into *different sub-layers* each of which is familiar with the specification of a particular component realisation which in turn is based on a sensible and/or existing variation of the aspects mentioned above (that is, the various realisations may differ in media, organisation and format).

To illustrate the necessity of *component information*, at this point we should briefly discuss the question of contact or co-operation between layers. The interfaces, carrying out certain communications procedures, need some information about the components to be able to accomplish their function properly. For example, displaying the information content of a selected segment may consist of the following steps:

(1) selecting a segment to be displayed by activating one of the links actually present in the hypertextual layer. There is a *list of anchors* (as part of a hierarchy of objects representing a particular segment that are being presented) in the H layer that assigns component specification (as well as additional information) to each of the segments to which the anchors are attached. Using these specifications the segments can be retrieved by activating the corresponding links;
(2) retrieving the selected segment from the T layer by its component specification;
(3) retrieving those embedded atomic components that are addressed directly (by the segment retrieved) or indirectly (through other composites addressed). That is why a segment may not contain itself i.e. this step of the procedure could otherwise become an endless recurring procedure;
(4) building the list of anchors (and other parts of the object hierarchy in H layer that represent the segment being presented) from the information that has been provided by or with the segment retrieved;
(5) searching for a certain point in the segment retrieved from which the content of the segment should be displayed. Normally it is the beginning of the segment; nevertheless in case of *span-to-span linking,* the anchor is identified so that it can refer to a certain point inside the segment to be retrieved;
(6) displaying the information content of the segment (as well as presenting the links and atoms embedded in the segment, etc). It needs information about the media, organisation, and format of the components to be presented called *presentation specifications*.

It is clear from the example that each segment, in addition to its information content, should contain supplementary information referred to above as *component information*. This information consists of, among others,

- a sequence of *(source) anchors* or “outer links”. Each anchor contains a component specification as well as additional information (e.g. an anchor identifier referring to the corresponding *destination anchor* within the component specified which enables span-to-

span linking between components, command-line arguments or parameters for programs, etc);
- information about the components embedded in the segment. This includes information about the hierarchy of components, component specifications or “inner links” (by which they can be retrieved), etc;
- presentation specifications (e.g. identified starting points that is, *destination anchors* of the segment in question; channel name, duration, synchronisation information, etc [HAR94]; component-specific presentation information that is, how, where, and in which order the atoms, links, etc are to be displayed, etc).

There are two ways in which component information can be located. On the one hand, component information can be stored within a special part of each segment (e.g. in a header) which is separated clearly from the part that contains the information content of the segment. In this case the information can be accessed directly from the T layer. On the other hand, component information can be encoded within the description of the segments and thus can be provided by an indirect procedure in which the content of the segments are analysed by the C layer according to the specification of the actual realisation of the segments concerned.

1.4 Logical / Conceptual Layer (LC layer)

The logical / conceptual layer or LC layer consists of abstract objects that identify or describe components of the T layer. Considering the T layer as "cyberspace", the LC layer might be referred to as a "mirror" that reflects the data stored in the T layer by mapping the objects of the LC layer into the T layer. In other words, the objects of the LC layer can be considered as abstractions or "images" of the components of the T layer, while the components of the T layer can be considered as concrete representations of the objects of the LC layer. As the LC layer contains *secondary information* in the first place, it might as well be referred to as ‘information collection’ ([PÁL98]).

The LC layer performs a *database function* in the MLAIS model. In order to describe most of the different applications, the object-oriented database model (OODBM) appears to be the most appropriate data model for the LC layer. ‘Hypermedia in general, but more so the WEB, are founded on the object oriented paradigm.’ ([GUAY95]) The object-oriented paradigm has definite advantages over other paradigms. For example, considering a library application that uses the tables 'READER', 'OPAC', and 'TRANSACTIONS', the table 'CIRCULATION' can be obtained on the relational database paradigm by joining the tables with each other (or using the appropriate 'select' or 'create view' statement in SQL). Besides, the problem of multiple authors are frequently solved using another paradigm, e.g. in keyword indexing systems by using a repeatable field for authors. In OODBM either the joining of different tables or the use of repeatable fields can be easily accomplished (see e.g. in [ABIT96]). For example, assuming that, in a new object class containing several object classes, the fields occurring in more than one object classes with the same name will occur only once, we can create the following classes (as regards the notation we used see [BUS93]):

```
class READER
        τ(READER) = [cardno:integer,rname:string,address:string,...]

class AUTHOR
        τ(AUTHOR) = [names:{[#:integer,aname:string]}]

class OPAC
        τ(OPAC) = [locmark:longint,auth:AUTHOR,titl:string,...]

class TRANSACTION
        τ(TRANSACTION) = [cardno:integer,locmark:longint,date:DATE,...]
```

There are some ways to create the object 'CIRCULATION', e.g.

(a) simply by using object types,

```
class CIRCULATION                                                    (1)
        τ(CIRCULATION) = [book:OPAC,user:READER,date:DATE,cardno:integer,...]
```

(b) or with inheritance,

```
class CIRCULATION isa TRANSACTION
        τ(CIRCULATION) = [user:READER,book:OPAC],
```

(c) or with multiple inheritance,

```
class CIRCULATION isa READER,BOOK,TRANSACTION.
```

We might use another notation henceforth referred to as *P-notation* in describing the data structure outlined above. Assuming that we have a database of facts, the following PROLOG-like (or DATALOG-like) rules are equivalent with the object classes described above:

```
reader(R,X,....) :-
        cardno(R,X),
        rname(R,X1),
        address(R,X2),
        ...

author(A,Y,...) :-
        aname(A,Y,Y1), /* the second variable (Y) corresponds to the field # */
        ...

opac(O,Z,...) :-
        locmark(O,Z),
        _author(O,A),
                author(A,Z11,Z12,...),
        titl(O,Z2),
        ...
```

```
transaction(T,V,V1,...) :-
        cardno(T,V)
        locmark(T,V1),
        _date(T,D),
                date(D,V21,V22,...), /* this corresponds to the object class DATE */
        ...
```

Now, with these definitions we can create the rule for *circulation*:

```
circulation(X,Z,...) :-                                                    (2)
        reader(R,X,...),
        transaction(T,X,Z,...),
        opac(O,Z,...).
```

Note that in (2) the variables *X* and *Z* occur in more than one predicate and so link them together.

Let us see now how we can apply these definitions for data handling. For example, the data structure for multiple authors using set type attribute in the class 'AUTHOR' can be illustrated as follows:

AUTHOR	**#**	**aname**
a1	1	Kiss
	2	Nagy
	3	Tóth
a2	1	Kovács
a3	1	Kepes
	2	Szabó

OPAC	**locmark**	**auth**	**titl**
o1	11111	a1	The Summer
o2	11112	a2	The Autumn
o3	11113	a3	The Spring

Figure 3

The data in the corresponding tables in Fig 3 can be represented by the following facts:

```
aname(a1,1,'Kiss').
aname(a1,2,'Nagy').
aname(a1,3,'Tóth').
aname(a2,1,'Kovács').
aname(a3,1,'Kepes').
aname(a3,2,'Szabó').

locmark(o1,11111).
locmark(o2,11112).
locmark(o3,11113).

auth(o1,a1).
auth(o2,a2).
auth(o3,a3).
```

```
titl(o1,'The Summer').
titl(o2,'The Autumn').
titl(o3,'The Spring').
```

Let us study now briefly the problem of the semantic interpretation. We can describe the situation which is expressed in the definition with the following *pattern in natural language*:

sy (a user) borrows sth (a book) in (MM-DD-YYYY) (e.g. in June 16, 2000) **(3)**

Let us try to describe this pattern in P-notation:

```
circulation(C,X,Z,...) :-                                    (4)
        _subject(C,R),
                reader(R,X,...),
        _predicate(C,T),
                _object(T,O),
                        opac(O,Z,...),
                _in(T,D),
                        date(D,...).
```

Let us call this notation *P*-notation*. Although we should have made some modifications, but the result is semantically equivalent with what appears in definition (1) and (2). The main difference is that definition (4) reflects the grammatical structure of pattern (3) which describes the situation in *natural language*. Therefore the *semantic interpretation* of definition (4) (i.e. the rule for *circulation* written in P*-notation) is as clear as any description when using natural language in describing a situation. This suggests that natural language texts and object-oriented databases are semantically very close to each other. It is not surprising that the complex data structure of an OODB can be equivalently described in natural language (as we normally think and communicate in this way). But we will demonstrate in **Chapter 3** that a natural language text, including such complex language elements as *metaphors*, can be fully described in P*-notation.

The main function of the LC layer in the MLAIS model is, together with the I layer discussed below, to provide *interactive access* to the components of the T layer. Beside this, the LC layer can support the retrieval of the components by itself (i.e. without queries), accomplishing the idea of 'classification' by creating, *according to some predefined aspects*, classes from certain groups of components, higher classes from these classes and other groups of components, etc. The hierarchy obtained as a result of this is called a 'classification scheme'.

Classification schemes are frequently used in libraries. They contain a hierarchy of categories or subjects, e.g. in UDC (Universal Decimal Classification scheme) the main classes are as follows ([CHA81]):

0 Generalities of knowledge
1 Philosophy. Metaphysics. Psychology. Logic. Ethics
2 Religions. Theology
3 Social sciences

4 Currently vacant; it is for "further development"
5 Mathematics. Natural sciences
6 Applied sciences. Medicine. Technology
7 The Arts. Recreation. Entertainment. Sport
8 Linguistics. Philology. Literature. Belles-lettres
9 Geography. Biography. History

As can be seen, the main classes consist of ten groups, indicated by the decimal digits 0,1,...,9. When the main classes are subdivided into further groups, other digits are concatenated after the preceding digits and so on. (A full stop is used in UDC after every three digits.) The resulted sequence of digits, called a notation, identifies a certain subject category under which books, articles, *components of the T layer*, etc can be classified. They can be retrieved simply by a sequence of decisions, selecting the appropriate class, subclass, etc on each level.

So that the classification scheme should be more flexible, certain operators or symbols (facet indicators, common auxiliaries, etc) can be used for creating new concepts. For example in UDC

+ is used for combining two separate numbers, e.g. 975.5 + 976.9 means the History of Virginia and Kentucky (975.5 is the History of Virginia; 976.9 is the History of Kentucky)

: is used for indicating relationships between two subjects, and the (0 ...) brackets, as a typical example of the so-called common auxiliaries, are used for indicating different forms of documents, e.g. 026:61 (058.7) means the Dictionary of medical libraries (026 is Libraries, 61 is Medicine, 058.7 is Directory)

Classification schemes can be represented by class hierarchies in OODBM. First, at the top of a class hierarchy there should be a 'main' class looking like this,

Class main_class
τ(main_class)=[comp_spec:T1, ...]

base-level object	**component specification**	**attr1**	**attr2**	**...**	**obj1**	**obj2**	**...**
OID_1	<comp. spec. for OID_1>						
OID_2	<comp. spec. for OID_2>						
...							

Figure 4

where OID refers to a unique Object IDentifier, which *represents a component in the T layer* that is identified by the component specification given as a value of the first attribute of the class (which is in the second column in Fig 4). The other attributes of any type, including object type, depend on specific applications.

The other classes can be derived from the 'main' class, preferably by way of inheritance, where every derived class corresponds to a specific notation of the classification scheme. For example, the class 'subdiv_975' that corresponds to notation '975' can be obtained like this,

Class subdiv_9 isa main_class

τ(subdiv_9)=[attrx:Typ,...]
Class subdiv_97 isa subdiv_9
τ(subdiv_97)=[attry:Typ,...]
Class subdiv_975 isa subdiv_97
τ(subdiv_975)=[attrz:Typ,...]

where the other attributes that complete the set of attributes given explicitly or inherited from parent classes are either arbitrary attributes of any type that depend on a specific application, or can be omitted.

Let us see now how we can describe the above object classes in P-notation. First, we need a database of facts, which might contain e.g. the following facts:

component_specification(oid1,<component specification for OID_1>).
attr1(oid1,<...>).
attr2(oid1,<...>).
attr3(oid1,<...>).
...

component_specification(oid2,<component specification for OID_2>).
attr1(oid2,<...>).
attr2(oid2,<...>).
attr3(oid2,<...>).
...

Then we can represent the object classes described above with corresponding rules. (We might as well add more variables to the heads of the rules, it makes no difference.) The rules might be something like this:

```
main_class(X,Y) :-
        component_specification(X,Y),
        attr1(X,Y1),
        attr2(X,Y2),
        attr3(X,Y3),
        ...

subdiv_9(X,Y) :-
        main_class(X,Y),
        attrx(X,Z),
        ...

subdiv_97(X,Y) :-
        subdiv_9(X,Y),
        attry(X,T),
        ...

subdiv_975(X,Y) :-
        subdiv_97(X,Y),
        attrz(X,V),
        ...
```

Note that search queries can be formulated in the same form, e.g.

```
query(X,Y) :-
        component_specification(X,Y),
        attr_a(X,Y1),
        attr_b(X,Y2),
        attr_c(X,Y3),
        ...
```

The functions of the LC layer that correspond to the above considerations are illustrated in Fig 5.

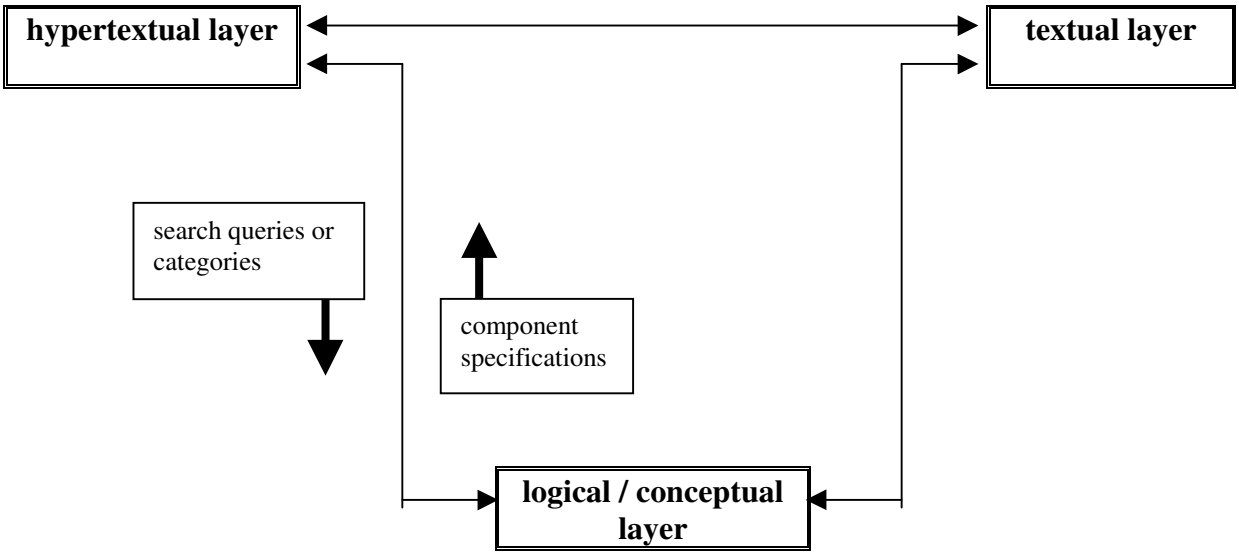


Figure 5

The implementation of operators, e.g. facet indicators in UDC, is based on the idea of creating new object classes permanently when classifying new objects, or dynamically (that is, in running time) when retrieving stored objects. For example, the class that corresponds to the notation '975.5 + 976.9' can be derived from class 'subdiv_97' and can be the parent class of the classes that correspond to the notations '975.5' and '976.9', respectively. Let us see another example: the class that corresponds to the notation '026:61 (058.7)' can be derived, by way of multiple inheritance, from classes 'subdiv_026', 'subdiv_61', and 'subdiv_(058.7)', respectively. Note that the common auxiliary '(058.7)' can be a value of an appropriate attribute but in such case apparently without the advantage of grouping the corresponding subjects. This latter approach leads us to the idea of creating groups of objects according to attribute values which corresponds more or less to the function of the index layer, which will be discussed below.

The LC layer can be searched for relevant information (e.g. for corresponding component specifications the attributes of which match a given search query), therefore *the presentation of objects* is as important as that of the components of the T layer. As for the presentation of objects, or a particular set of objects retrieved e.g. interactively by a search query, the most convenient method is to adopt the methods that are used when presenting the components of the T layer. *Considering a set of objects as a "virtual" component to be presented*, it should contain the same component information as the components themselves, such as

- a sequence of anchors including component specifications (as well as additional information),
- information about the components (e.g. objects, links) embedded in the set of objects, and
- presentation specifications.

1.5 Index Layer (I layer)

The index layer or I layer identifies the attributes, or characteristics of the abstract objects of the LC layer and the components of the T layer, in order to retrieve the objects or components stored in the information system according to those attributes. The I layer is often represented by computer-generated concordances (see e.g. [PAPP75]) or keyword lists which can either be used in preparing the objects of the LC layer (e.g. when represented in dictionary form, see [PAPP68]), or in the retrieval of the objects or components of the corresponding T or LC layers. The objects or components can be retrieved either interactively by *search queries* which identify a *set of objects* called search results, or by means of *navigation* through selected lists of attributes (such as keyword or concordance lists) which contain *links* to various objects or components.

The information retrieval is usually based on the attributes and attribute values of objects. In the simplest case, values are of elementary type that is, the domain of attribute values can be mapped into the power-set of objects directly (e.g. by indexes). In case of values that are of complex type, however, we should at first determine those fragments or extracts from each attribute value that characterise the objects containing the attribute value in question (i.e. fragments or extracts that have semantic content). Then the domain of extracted values called *keywords* or terms can be mapped into the power-set of objects (e.g. by inverted files). The elementary attribute values and keywords are called object characteristics. In case of components containing text written in natural language we can consider certain parts of the text (e.g. text sentences, paragraph, etc) as attributes having values of complex type.

Inverted files are used widely in *keyword indexing systems* and interactive library systems for retrieving objects by their characteristics (usually, but not necessarily, by keywords). Inverted files can be created for each attribute or *field* of the objects. These files are called additional indexes, and are often integrated in a full "basic" index. Inverted files usually contain

- the keywords of objects (called items),
- object specifications (or identifiers), and
- supplementary information about the location and relationships of items (e.g. the name of the field where the particular items occur, the position number of the item within the field, etc).

Search queries contain object characteristics which can be connected by certain *operators*. The way characteristics and operators are used to form a query called the syntax of a query. The syntax and semantics of operators depend greatly on the search languages in which they have been implemented. Therefore operators vary in different systems. Some typical examples of them are as follows:

- Boolean operators, based on the corresponding set operations (e.g. intersection, union, and complementation) which can be applied on the *sets of objects* retrieved (e.g. AND, OR, and (AND) NOT);
- proximity operators (e.g. A (w) B means that keyword A and B should occur in the same field of an object following directly each other, A (a) B means either A (w) B or B (w) A, etc);
- other operators (e.g. operators for creating phrases, field names used as prefixes or suffixes, operators for specifying a domain of objects to restrict the search, truncation, etc).

As can be seen, the result of a search query is a set of objects which is considered as the semantics or semantic content ("meaning") of the query. As queries can consist of one single keyword, the semantic content of a keyword can be defined in the same way.

In turn, search results (or the queries generating them) can be considered as temporarily or dynamically defined "virtual" keywords which can be treated in the same way as keywords. In other words, queries are useful means to broaden the "vocabulary" of keywords. To preserve queries (as well as the corresponding "virtual" keywords), they can be saved and then recalled later in many of the existing keyword indexing system implementations (e.g. in DIALOG [DIAL91]).

Perhaps the most important issue of information systems is the effectiveness and efficiency of information retrieval. It can be measured for example by its relevance, accuracy or precision and its completeness or recall. The basic problem of users who perform searches is that they are not quite familiar with the exact meaning of keywords they should use in formulating search queries. Here we assume that those librarians who assign keywords to objects possess the full knowledge of the meaning of the keywords they use (or in any event theirs is superior to what users can conjure up).

One promising way to obtain better understanding of keywords is to determine the relations between keywords. In this respect, the two basic relation types are as follows:

- syntagmatic relations (‘the relationship that linguistic units ... have with other units because they may occur together in a sequence. For example, a word may be said to have syntagmatic relations with the other words which occur in the sequence in which it appears, but **paradigmatic relations** with words that could be substituted for it in the sentence.’ [LONG93]. For example, *A 'R' B* means that keyword A and keyword B may occur in the same field ("context"). An example for the importance of context is provided by the paradigmatic relations 'use' or 'used for' which mean that a particular form of a keyword should or should not be used in a special meaning, i.e. context);
- paradigmatic relations (For example, *A 'N' B* means that keyword A has *narrower* meaning than keyword B; the symbol 'B' refers to *broader* terms in the same way. Other relations such as syn, ant, rel, cont, etc might refer to synonyms, antonyms, related and contrasted terms, respectively [WEBS76[).

As can be seen, syntagmatic and paradigmatic relations are closely related to the syntax and semantics of keywords. In a generic tree or hierarchy of possible relationships, syntagmatic and paradigmatic relations can be classified under the so-called *referential* and *typified relations*, respectively [KUH91; SÜTH99].

Paradigmatic relations can mainly be used for extending queries, improving the completeness of information retrieval, while syntagmatic relations can for example be used for validating queries, improving the relevance of information retrieval. Syntagmatic relations can be replaced by the full context or *concordances of keywords* referred to in some cases as the "properties" of keywords (e.g. in frames or semantic nets, etc). Concordances are frequently used in linguistic investigations (see e.g. [PAPP75]) or in vocabulary databases (e.g. in the COBUILD database which is called "the Bank of English", see [COL97]). In addition, the context of keywords plays a major role in dictionaries designed to explore the full vocabulary of a poet or writer (see e.g. [BENK79], [JAK93]).

Instead of the strict 'use' or 'used for' relations, in practice it often proves to be useful to list the number of occurrences, or give the frequency, for each keyword either alone, *or coupled with other keywords* (i.e. in a given context). For example, 'COBUILD gives information about the frequency of the headwords. Five frequency bands have been established. ... Starting with the very common words, we move through a basic vocabulary to an intermediate one, and on until we have covered the core vocabulary of the language.' ([COL97]) In addition, we can select those words that are frequently used in a special context or field. They can be considered as keywords. For example the list of all the words that are used ten times or more in the *dictionary explanations* can be found in [COL90].

There is a need for search languages which comprise the vocabulary of keywords (sometimes called *descriptors*), their relations, search operators, and grammatical rules by which queries can be formulated. These languages are often supported by *(library) thesauruses* containing descriptors with unique meaning and some of their relations.

As for an appropriate data structure of the I layer, frames appear to be one of the most flexible choices. 'A frame is a knowledge representation proposed specifically for work in AI ... A frame is a data structure for representing a stereotyped situation. Attached to each frame are several types of information, including information on how to use the frame. This information «attached to each frame» is in a slot, which is an extension of a field in a record or file in that it goes beyond merely holding a value.' ([PAR95], p. 202) Using frames as data structures for keywords, we should distinguish between generic and reference frames. In an FRL-like language (see [BOR95]) they can be of the form like

generic frames:

frame: <keyword>
AKO(=A Kind Of)$value: <generic keyword>

slot: No. of occurrences
$value: <No. of occurrences>

slot: <relation type>
$value: <related keyword>

...

reference frames:

frame: <FID (Unique Frame IDentifier)>
AKO$value: <the keyword that is a characteristic of the object or component specified>

slot: specification
$value: <object or component specification>

slot: attribute/field name
$value: <attribute/field name>

slot: location
$value: <inner location of the keyword in the field>

slot: concordance
$value: <concordance of the keyword>

...

Note that almost every aspect of a *descriptor-based* search language outlined above can be described with the use of the two types of frames. As frames make up a hierarchy according to paradigmatic relations, the number of occurrences of a generic frame can be accumulated from derived generic and reference frames (each of the latter adding one occurrence to the total sum). The use of frames, often applied in expert systems as well as in early linguistic investigations ([KIEF00a]), emphasises that the I layer can be considered as *the knowledge representation of the LC layer* (as well as that of the T layer). We should remark here, however, that in some cases (e.g. in relational database systems) the function of the I layer is restricted to the support of the information retrieval function of the LC layer. By contrast, the effective implementation of the I layer is extremely important when searching full-text databases, e.g. in keyword indexing systems. 'Indexing and other common database techniques are complicated in full-text, since every word is, by default, equal in importance to every other. The structure of the data cannot be as easily used to optimize indexing. Semantic processing is often necessary to produce useful navigation aids and search techniques.' ([ELAB95])

As for the presentation of frames or, preferably, sets of frames, it is highly recommended to use the presentation capabilities developed for the components of the T layer. Considering a set of frames as a "virtual" component to be presented, it should contain the same component information as the components themselves, such as

- a sequence of anchors including object or component specifications (as well as additional information),
- information about the components (e.g. frames, links) embedded in the set of frames, and
- presentation specifications.

1.6 Hypertextual Layer (H layer) and Supplementary Layer (S layer)

The hypertextual layer or H layer provides an integrated "user interface" for the information system (and its users). The H layer enables the users to access the primary information stored in the T (or LC) layers in the information system according to different approaches. Some publications use the terminology *hypertext management system (HTMS)* which is very close to the concept of the H layer ([SÜTH99]). Moreover, the H layer corresponds more or less to the *'run-time layer'* of the Dexter model [HAL94]. But as our main concern here is to explore the data structure of a complex information system, we will not deal with the functional or operational aspects of the H layer in detail. Instead, we try to give a brief overview of the main functions of the layer and its relationships with the other layers of the MLAIS model.

The H layer has three basic functions which allow users to have access to the information stored in the information system. They are as follows:

- The H layer provides two basic *control methods* through which the users can express their special needs or requests for information;
- The H layer (together with the S layer, see later) has special *presentation capabilities* through which the information content of the segments or objects having different organisation and format can be satisfactorily presented (i.e. displayed, printed, etc);
- The H layer allows users to *navigate* between the various links of the information system. It is a step-by-step interactive process wherein the users can gradually refine the results the information system provides.

Let us examine first the *navigation function* of the H layer. The navigation capabilities of the information system are of vital importance because they make the information content stored and organised in the system work. In other words, while navigating between the various links of the information system the individual knowledge of the user and the stored and organised knowledge of the information system *becomes one unit or entity* and immensely extends the information accessing and processing capabilities of the user. Note that communication between the user and the information system is (usually) not for its own sake. The user should have a starting point, in most cases a text to be interpreted or processed, which will serve as the *initial paradigm of the communication process* through which the information content of the text becomes understood, completed, and linked to the knowledge activated by the paradigm (that is, with the knowledge covered by the appropriate cognitive schema of the user and with the appropriate portion of the “third world” represented by the information system). The cognitive paradigm described here is illustrated in Fig 6.

It is clear that the organisation of the T layer in macro level influences greatly the effectiveness of navigation. It has proved to be very fruitful in our examinations to compare metaphorically the organisation structure of the T layer to an “iceberg” which we will henceforth consider as a *cognitive framework* for the various applications of the MLAIS model. The different levels of the iceberg correspond to the different kinds of knowledge. The levels of the iceberg are cross-linked with each other, the overall corpus of various texts and these links form together a *complex hypertext structure* which is the core of our further considerations. These issues will be discussed in detail in **Chapter 4**.

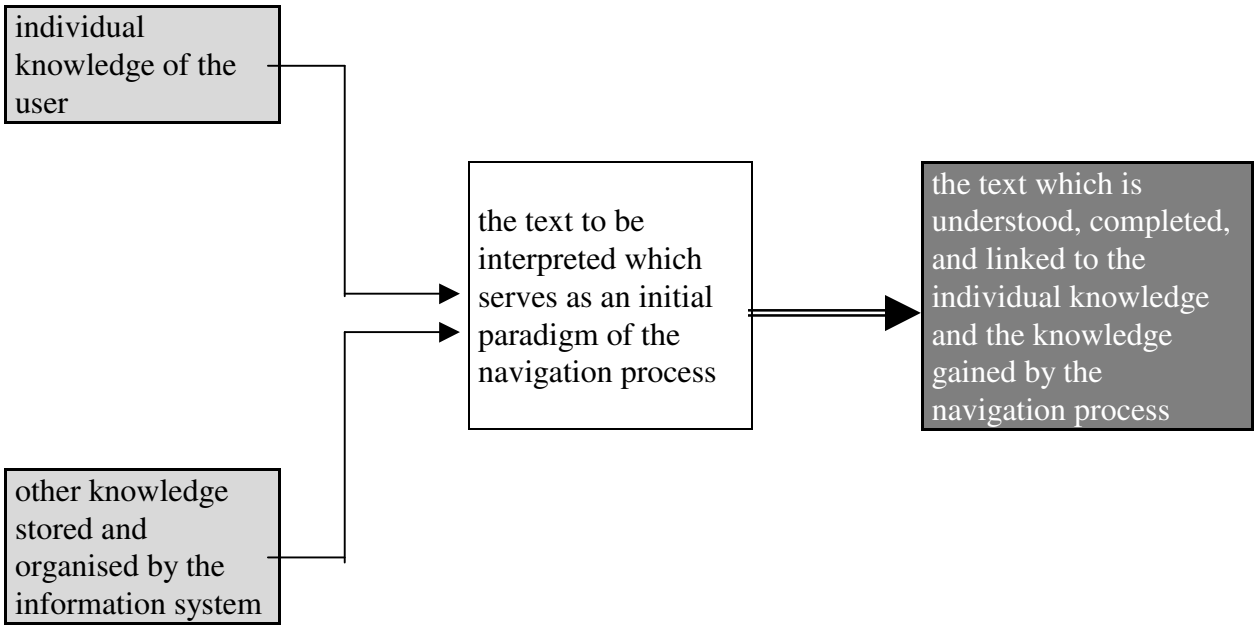


Figure 6

As we mentioned before, the H layer provides for us two basic *control methods*, which are as follows:

- menu-driven or link-based access to *components of the T layer* where the links can be derived from "static" components stored in the T layer or "virtual" components generated dynamically from the I or LC layer. The "virtual" components can be composed of listed concepts or *concordances* from the I layer, or retrieved sets of objects from the LC layer;
- interactive or command-line driven search performed by *search queries* (and some other *commands* which complete and/or extend the search capabilities of the information system) through the I or LC layers for particular sets of objects from the LC layer, or components from the T layer.

The basic control methods of the H layer determine how the information stored in the layers can be accessed, and therefore direct the co-operation between layers. They correspond to two different paradigms which are usually referred to as *browsing-based* or *matching-based* search paradigms, respectively. Because in a complex hypertext information retrieval system (HIR) the data is stored in different abstraction levels and media which in turn might require different search paradigms, it is necessary to implement both technologies and make contact between them [AGOS96; SÜTH99]. In other words, the efficient use of both control methods in an information system implies certain relationships between them. Although there is a trend to use, wherever possible, the first control method considered as more “user friendly”, the second one is, with no doubt, more flexible and provides much more possibilities for the users to retrieve the information they want. Therefore the interactive access to the information stored (method 2) is often the first step in the information retrieval process which is followed by the presentation of search results as “virtual” components that enables the users to choose between the links presented (method 1) instead of using further commands.

Let us outline now the *presentation function* of the H layer. Presentation refers here to a dynamic, and sometimes parallel process controlled by the user who opens (and closes)

sessions for information retrieval. At a certain time a session contains special arrangements, "snapshots" of particular objects, called *session objects* (for example, they might be as follows: Anchor, Button, Checkbox, Date, Document, Form, History, Link, Location, Math, Password, Radio, Reset, Selection, String, Submit, Text, Textarea, Window [MAN96]) which present information to the user as well as enable him or her to control the information retrieval process. What regards presentation, we can say that *a session corresponds to dynamically assigned components from time to time*. Because of the dynamic character of session objects, they should contain attributes of the type relating to time (e.g. history).

As a consequence, the presentation capabilities of the H layer are determined by the available classes of session objects. They form a hierarchy, an example of that can be seen in Fig 7. ([BOCZ98])

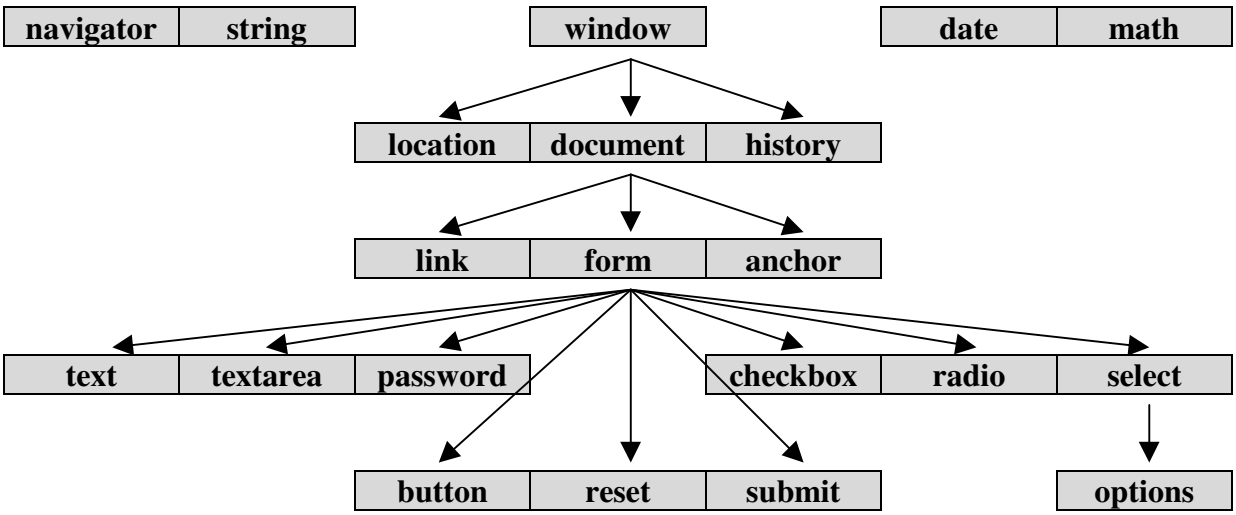


Figure 7

In a session the current "snapshot" or instances of objects represents a specific component to be presented, or more precisely, an *instantiation* of that component (i.e. a run-time instance of a component, which is usually cached). It is based on the component information supplied by the appropriate layer the component in question comes from. In addition to component-specific information, the objects contain session-specific information as well (e.g. opened windows, history of actions, current settings, etc).

The object hierarchy of the H layer can represent certain "standard" component types but, as we have seen before, there is a huge variety of different component realisation. In addition, new forms and types emerge from time to time which it can be very difficult to keep abreast with. Therefore a new layer, called *supplementary layer* or *S layer* should be introduced to supplement the basic presentation capabilities of the H layer. To be more precise, the S layer consists of sub-layers each of which corresponds to a certain component type or realisation (e.g. audio or video clips, postscript files, etc). In the presentation of a component of non-standard type, the H layer co-operates with the S layer, or with one of its corresponding sub-layers, which performs certain operations:

- suggests an action to the user (e.g. save to disk or pick up an application);
- converts the component to be presented to a standard type (e.g. to a different format);

- inserts the component into the object hierarchy (e.g. displaying or running it in a window);
- simply presents the component independently from the H layer, opening a new session (e.g. running an assigned application).

1.7 Organisation levels of the WWW

Finally, as a summary of the above considerations, let us briefly overview some possible representations of the layers of the MLAIS model in the case of World Wide Web:

- textual layer: Web pages; other files which contain primary information (with different formats such as txt, doc, zip, gif, jpg, etc);
- index layer: search engines or indexes (e.g. Altavista);
- logical / conceptual layer: library databases which contain records that refer to certain Web pages; "virtual libraries" which enable the users to search the Web by subject categories (e.g. Yahoo);
- hypertextual layer: Web browsers (such as Netscape Communicator or Internet Explorer);
- supplementary layer: various plugins or application programs (which extend the capabilities of the browsers);
- component layer: programs which provide access to various components of the textual layer which cannot be accessed or interpreted otherwise, e.g. converting or generating them (such as CGI programs).

Bibliography

[ABIT96] Abiteboul, S. – Cluet, S. – Christophides, V. – Milo, T. – Moerkotte, G. – Siméon, J.: Querying Documents in Object Databases. – Journal of Digital Libraries Manuscript, December 5, 1996.

[AGOS96] Agosti, M. – Smeaton, A.F.: Information Retrieval and Hypertext. – Kluwer Academic Publishers, 1996.

[ALB90] Alberico, R. - Micco, M.: Expert systems for reference and information retrieval. - Meckler, 1990.

[ALB97] Albert, D. - Hockemeyer, C. - Held, T. A relational model for hypertext structures. - Manuscript. 1997.

[AND95] Classic Library. Over 2,000 Great Works of World Literature (CD-ROM). - Andromeda Interactive, 1995.

[ARC97a] Verstár. A magyar líra klasszikusai (CD-ROM). – Arcanum Databases, Budapest 1997.

[ARC97b] Biblia 5.0 (CD-ROM). Kilenc bibliafordítás teljes szövegű Folio Views adatbázisa. - Arcanum DataBases Kft. 1997.

[ARE92] Arents, H.C. – Bogaerts, W.F.L.: Hypermedia and the User: Defining Hypermedia by Its Application Areas and Its Utilization Characteristics. – Microcomputers for Information Management 9 (1992) 1, 17-34.

[BAL94] Balasubramanian, V.: State of the Art Review on Hypermedia Issues And Applications. (http://www.isg.sfu.ca/~duchier/misc/hypertext_review/index.html)

[BENK79] Benkő L.: Az írói szótár. A szépirodalmi nyelv és stílus lexikográfiai feldolgozása. – Akadémiai K. 1979.

[BOCZ98] Bócz P. – Szász P.: A világháló lehetőségei. Interaktív Weblapok készítése. – ComputerBooks, 1998.

[BOR95] Borgulya I.: Szakértõi rendszerek, technikák és alkalmazások. - ComputerBooks, 1995.

[BORN93] Bornman, H. – von Solms, S.H.: Hypermedia, Multimedia and Hypertext: Definitions and Overview. – The Electronic Library 11 (1993) 4/5 259-267.

[BRA] De Bra, P.M.E.: Hypermedia structures and systems (http://wwwis.win.tue.nl/~debra/cursus/static/index.html)

[BRO92] Brown, P.J.: Hypertext in Action: Some Results from an Application. – Information Services & Use 12 (1992) 41-54.

[BUS93] Van den Bussche, J. - Heuer, A.: Using SQL with Object-Oriented Databases. = Information Systems 18 (1993) 7: 461-487.

[CHA81] Chan, L.M.: Cataloging and Classification. - McGraw-Hill 1981.

[COL90] Collins COBUILD Student's Dictionary. – HarperCollinsPublishers, 1990.

[COL93] Collins COBUILD English Language Dictionary. – HarperCollinsPublishers, 1993.

[COL97] Collins COBUILD English Dictionary. – HarperCollinsPublishers, 1997.

[CON87] Conklin, J.: Hypertext: An Introduction and Survey. – IEEE Computer, Survey and Tutorial Series, September 1987. – pp. 17-41.

[COS92] Cosgrove, S.J. – Weimann, J.M.: Expert System Technology Applied to Item Classification. In: 10 (1992) 1-2, 33-40

[DIAL91] Searching DIALOG. The Complete Guide. – DIALOG Information Services, 1991.

[ECO98] Eco, U.: A tökéletes nyelv keresése. – Atlantisz K. 1998.

[ELAB95] The Electronic Labyrinth.
(http://jefferson.village.virginia.edu/elab/elab.html)

[EYS97] Eysenck, M. W.—Keane, M.T.: Kognitív pszichológia. Hallgatói kézikönyv. - Nemzeti Tankönyvkiadó, 1997.

[GRA87] Grant, J.: Logical introduction to databases. - Harcourt Brace Jovanovich, 1987.

[GUAY95] Guay, T.: WEB Publishing Paradigms. - Simon Fraser University, April 1995.
(http://hoshi.cic.sfu.ca/~guay/Paradigm/Paradigm.html)

[HAL94] Halasz, F. - Schwartz, M.: The Dexter Hypertext Reference Model. = Commun. ACM 37 (February 1994) 2: 30-39.

[HAR94] Hardman, L. – Bulterman, D.C.A. – van Rossum, G.: The Amsterdam Hypermedia Model: Adding Time and Context to the Dexter Model. In: Commun. ACM 37 (February 1994) 2: 50-62.

[HORN80] Hornby, A.S. - Cowie, A.P.: Oxford Advanced Learner's Dictionary of Current English. 3rd ed. - Oxford University Press, 1980.

[JAK93] Jakab L. – Bölcskei A.: Csokonai-szókincstár I. Csokonai színművei szókincsének szövegszótára és adattára. – KLTE Debrecen, 1993.

[JOHN96] Johnson, S.: Electronic Publishing Construction Kit. Creating Multimedia for Disk, CD-ROM, and the Internet. – John Wiley & Sons, 1996.

[KIEF00a] Kiefer F.: A nyelvészet és a számítástudomány. = Természet Világa 2000/II. Különszám 37-41.

[KIEF00b] Kiefer F.: A kognitív nyelvészet: új paradigma? = A megismeréskutatás útjai. – szerk. Pléh Cs., Kampis Gy., Csányi V. – Akad K. 2000. – 120-144. (Pszichológiai Műhely 12.)

[KUH91] Kuhlen, R.: Hypertext. Ein nicht-lineares Medium zwischen Buch und Wissensbank. – Springer, 1991.

[LONG93] Richards, J.C. – Platt, J. – Platt, H.: Longman Dictionary of Language Teaching and Applied Linguistics. – Longman, 1993.

[MAN96] Manger, J.J.: A Java programozási nyelv. – Panem – McGraw-Hill, 1996.

[NIEL95] Nielsen, J.: Multimedia and Hypertext. The Internet and Beyond. – Academic Press, 1995.

[PÁL98] Pálvölgyi Mihály: Információfeldolgozás, információkereső nyelvek. – BGYTF, Szombathely, 1998.

[PAPP68] Papp F.: Amíg a gépi listából olvasható tanulmány lesz. – Magyar Nyelvőr 92 (1968) 321-333.

[PAPP69] Papp F.: Gépi eredményeink felhasználása szótárírásunkban. – Magyar Nyelvőr 93 (1969) 376-381.

[PAPP75] Papp F.: Konkordancia: Írói szótár előkészítése számítógépen. – Magyar Nyelvőr 3 (1975) 351-356.

[PAR95] Partridge, D. – Hussain, K.M.: Knowledge-Based Information Systems. – McGraw-Hill, 1995.

[PRÓ99] Prószéky G.: Természetes nyelvek. In: Mesterséges intelligencia. – szerk. Futó I. – Aula K. 1999. pp. 756-814.

[RATH] Hockemeyer, C. - Held, T. – Albert, D.: RATH. A Relational Adaptive Tutoring Hypertext WWW-Environment Based on Knowledge Space Theory.
(http://wundt.kfunigraz.ac.at/rath/publications/calisce/calisce.html)

[SÜTH99] Sütheő P.: Hypertext. Természetes intelligencia az információtudományban. – OSZK, Budapest, 1999.

[TRAE] Traenker, N.: Hypertext Link Structure Models.
(http://www.contract.kent.edu/people/nick/models/index.html)

[ULLM88] Principles of Database and Knowledge-Base Systems. Vol 1. – Computer Science Press, 1988.

[ULLM98] Ullman, J. D. – Widom, J.: Adatbázisrendszerek. Alapvetés. – Panem – Prentice-Hall, 1998.

[WEBS76] Webster's Collegiate Thesaurus. – G. & C. Merriam Company, 1976.

[WIL93] Wilson, E.: Link into Hypertext. In: Vine 91 (June 1993) 3-11.

Chapter 2

Co-reference analysis and the structure of natural language texts

Introduction

In this chapter we will analyse a selected text from the Bible using the methods and notation of *co-reference analysis*. The complex notation and terminology of co-reference analysis have been developed by János S. Petőfi ([PETŐ97], [PETŐ98]). In this chapter we will complete (and slightly modify) this notation in order that it can serve as a *metalanguage* in further, and mainly computer-based, text linguistic or textological investigations. The new elements added to the original form of co-reference analysis are as follows:

- using communication units instead of text sentences as the basic elements for the analysis
- the relationship between text sentences and communication units is completely formalised
- the coding of communication units is completely formalised
- the introduction of relation indices
- using verb patterns in the coding of the communication units
- the introduction of new operators and symbols such as B, N, G, C, !, !!, /, +, decl, imp, t0, t1, ...
- adding "dimensions" (such as time, mood, etc) to the coding of the relation indices
- using traditional operators (such as =) in new, broadened sense
- using prepositional or adverbial phrases in the coding of the communication units (e.g. to, in order that, etc)
- the formal introduction and coding of comments as part of the metalanguage developed
- the introduction of basic co-reference indices and definitive attributes
- the introduction of group indices
- the introduction of the net of co-reference indices (as well as its table representation)
- the introduction of the graph representations of the associative structure of text

Our aim is to demonstrate the effectiveness of co-reference analysis in describing natural language texts in a way which may be independent of any natural language. This makes possible, among others, that the prepared text could be the input for a text processing computer program. We will lay great stress on specific methodological issues, e.g. how natural language texts can be transformed or coded adequately i.e., without loss of information; how we can describe and *complete* the syntactic and semantic structure of the text analysed without modifying its content; how we can present the results of co-reference analysis in a friendly, clearly way; etc. After we performed the co-reference analysis of the selected text (**see Section 2.1**) we will discuss the interpretation possibilities of the results (**see Section 2.2 and 2.3**).

2.1 Co-reference analysis

The selected text (denoted by[1] the symbol *Ve*) is as follows:

Ve: Revelation. 1:1-3. Prologue. (extract).

[1]The revelation of Jesus Christ, which God gave him to show his servants what must soon take place. He made it known by sending his angel to his servant John, [2]who testifies to everything he saw - that is, the word of God and the testimony of Jesus Christ. [3]Blessed is the one who reads the words of this prophecy, and blessed are those who hear it and take to heart what is written in it, because the time is near.

(Revelation. = The Bible. New International Version. - Hodder & Stoughton, 1989. - p. 1503.)

2.1.1 Co-reference analysis of the first text sentence

During co-reference analysis it is worth dividing *text sentences* from the text analysed into smaller units or clauses, hereafter referred to as communication units. Consequently, let us divide the first text sentence into three communication units:

[K01] = [k01]&[k02]&[k03]

Here, the index *[K01]* and the indices *[k01], [k02],* and *[k03]* denote the first text sentence and its three communication units, respectively:

[K01] =
[k01] (the book *Revelation* by John is) [1]The revelation of Jesus Christ, &
[k02] which (=the revelation) God gave him (=Jesus Christ) to [k03] &
[k03] (let Jesus Christ) show his (=Jesus Christ's) servants what (=the events that) must soon take place.

It can be seen that there are three communication units, linked with the operator *&*, within the first text sentence. The inserted texts in brackets complete the contents of the communication units in order that each communication unit should contain all information explicitly and independently from the others. The sign = has been used when additional information has been placed in the brackets to complete (or specify) the meaning of the word that precedes the brackets. Note that the index *k03* also occurs as a part of the second communication unit because it refers directly to the third communication unit as the objective of the action described in the second communication unit.

The co-reference analysis of the first communication unit of the first text sentence (denoted by the symbol *[k01/&vb/&ind]*) is as follows:

(the book Revelation by John is) [1]The revelation of Jesus Christ,

[k01] = (=i03)[=!i01] [B] (=i05)[=i02]

[1] The complex notation of co-reference analysis has been developed by János S. Petőfi. As regards the meaning of some elements of it see [PETŐ98].

[k01/&vb/&ind]:
the^book^*Revelation*(i03)[=i01]^
by^John[=i03]
is[i01][=r01⇔B]
the^revelation(i05)[=i02]^
of^Jesus^Christ[=i05],

[i01] the book *Revelation* by John
[i02] the revelation of Jesus Christ
[i03] John
[i05][2] Jesus Christ
[r01] sth (S) is (P) sth (SC)[3] – in this case, this corresponds to the relation symbol *B* (see later)

The explanation of the notation applied above is as follows:

- The sign ^ (caret) denotes syntactically related words in expressions or phrases (e.g. possessive cases, etc) within the communication unit analysed.
- Every individual concept has its own co-reference index in the form *[ixx]* where *xx* is the ordinal number of the index (e.g. *01*). The relationship between *syntagmatically related* concepts is expressed explicitly right in front of the index of the „base" concept by the co-reference index of the „attribute" concept in round brackets (e.g. (i05)[=i02] corresponds to *the Revelation of Jesus Christ*). Note that the term which describes the „basic" concept contains the term which describes the „attribute" concept. The typical example is the possessive case where the possessive is considered as the „attribute" concept and the possession as the „base".
- The sign = (equal sign) denotes the first occurrence of a co-reference index.
- The sign ! (exclamation mark) denotes a so-called basic co-reference index. By definition, it is in the first meaningful position of the communication unit from which the basic co-reference index should be assigned. (We can, however, force another index to be the basic co-reference index in special cases, e.g. for definitive purposes, see later.) In the net of co-reference indices, every communication unit (or comment, see later) will be considered as an attribute to its basic co-reference index.
- The symbol *[B]* denotes, in the form *narrower_term [B] broader_term*, hyponym relationship which is expressed typically by the corresponding use of the verb *to be* (e.g. as in the pattern *X is Y*). In the first communication unit, the superordinate or broader term is *the revelation of Jesus Christ*, and the hyponym or narrower term is *the book Revelation by John*.[4]

[2] We try to stick to the same ordinal numbers in co-reference indices as those used in the interpretation of the Hungarian version of the text ([BOD00]). This is why we omitted the co-reference index *[i04]* which did occur in the Hungarian version but not in the English version of the text analysed.

[3] [VP1]

[4] The place of the operands in a specific relation (or operation) carries semantic meaning, and therefore the operands cannot be replaced by each other (without further consequences). But introducing the relation *N* (for *narrower* terms), we can arrive at an index-representation based on the relation *N* which is equivalent with that based on the relation *B*, e.g. [k01] = (=i05)[=i02] N (=i03)[=!i01].

- Every relationship between concepts expressed by the corresponding verb of the analysed communication unit has its own relation index in the form *[rxx]* where *xx* is the ordinal number of the index (e.g. *01*). The *verb pattern* (see [HORN80]) is described for every relation index.
- The (sentence) pattern *[k01] = (=i03)[=!i01] B (=i05)[=i02]* represents fully the first communication unit using only those symbols introduced above. This is referred to as the index-representation of the communication unit (denoted by the symbol *Ko/&ind*) which will be the basis of the computer processing algorithm.

Beside the relation symbol *B*, we use two additional relation symbols during the analysis, which both express paradigmatic relationship. The relation symbol *U* (*use*) describes synonym relationship between words, and the relation symbol *B** links those words which differ only in their number (e.g. *Jesus Christ's servant B* Jesus Christ's servants*).

In addition, we introduce two relation symbols which both express syntagmatic relationship. The relation symbol *G (generate)* expresses the syntagmatic relationship *(ia)[ib]* explicitly in the form *[ia] G [ib]*. In turn, the relation symbol *C (cut)* expresses the same relationship in the form *[ib] C [ia]*. Because the computer program generates those relationships automatically, if once a relationship is described in the form *(ia)[ib]* during the co-reference analysis, then it will not be necessary to repeat it again and again, at every occurrence of the index *[ib]*. Those relations will play an essential role in exploring the associative relationships of the text analysed.

The co-reference analysis of the second communication unit of the first text sentence can be performed in two equivalent ways:

which (=the revelation) God gave him (=Jesus Christ) to [k03]

[k02] = [=i06] [=r02]/t0,decl [i05], [!i02] + to [r03]*
[k02] = [=i06] [=r02]/t0,decl [!i02] + to [i05], in order that [k03]

While the first coded form of the communication unit *k02* fits exactly the grammatical structure of the original sentence, the second one, which expresses the same meaning as the first, reflects the relationship between the communication units *k02* and *k03* more explicitly. The first form follows the verb pattern [VP12A] where „the verb is followed by an indirect object (IO) and a direct object (DO). The indirect object is equivalent to a prepositional object with to, as in [VP13A]." ([HORN80], p. xxiv) The second form folllows the verb pattern [VP13A] where „the verb is followed by a direct object, the preposotion *to*, and the preposotional object. It is convertible to [VP12A]." (op. cit. [HORN80], pp. xxiv) We will always give the corresponding verb pattern after the definition of a relational index.

In what follows, the first of the alternatives given will be preferred and marked with an asterisk (*).

[k02/&vb/&ind]:
which (=the revelation)[i02]
God[=i06]
gave[i06][=r02]
him (=Jesus Christ)[i05]
to [r03]

[i02] the revelation of Jesus Christ
[i05] Jesus Christ
[i06] God
[r02] sb (S) give (P) sb (IO=PO) sth (DO)[5], or sb (S) give (P) sth (DO) to sb (PO)[6], {to (R) or in order that (K)}[7]
[r03] sy (S) show (P) sy (IO=PO) sth (DO), or sy (S) show (P) sth (DO) to sy (PO)
t0: the time when God gave the revelation to Jesus Christ

The coded form of the second communication unit contains the relation index (*[r01]*). It describes the predicate of the communication unit as well as expresses a corresponding verb pattern which determines, together with the necessary prepositions (e.g. *to*) and phrases (e.g. *in order that*), the grammatical function of the additional parts of the communication unit described by the corresponding co-reference indices (e.g. *[i06]* is the subject, *[i02]* is the (direct) object, etc). The operators + (plus sign) and , (comma) have only separating function. In addition, if the direct object is missing, we will use the . (dot) operator in place of the direct object in the pattern. It is worth noting that the pattern should contain at least one relation index and one co-reference index. (To emphasize the bijective or one-to-one relationship, we might as well use the same ordinal number *xx* in the index *[kxx]* of the communication unit and in the relation index *[rxx]* of the predicate of the unit.) As can be seen in the pattern above, it can contain communication indices (e.g. *[k03]*) as well. When there is a set of indices in the pattern with the same grammatical function, we will use the & (ampersand) operator to connect them. The = operator before a relation index denotes its first occurrence during the analysis.

Because the definition of relation indices contains only the dictionary form of the corresponding verb, it is necessary to add two more „dimensions" to each index. The index and the dimensions are separated by the / (slash) and the , (comma) operators. The symbol *t0* denotes the (relative) time of the action (there will be other symbols, like *t1*, *t2*, etc, with increasing numbers as time passes). The *decl* symbol expresses the declarative mood of the verb, as opposed to the imperative (denoted by the symbol *imp*), etc.

The time dimensions which occur even in the short text analysed here well characterise the extension of the Revelation in time. They are as follows:

t0: the time when God gave the revelation to Jesus Christ

[5] [VP12A]

[6] [VP13A]

[7] The tags in angle brackets are additional parts of the pattern which describes the syntactical structure of the sentence.

t1: the time when Jesus Christ sent an angel to John
t2: the time when Jesus Christ's angel showed the events to John
t3: the time when John wrote the book *Revelation*
t4: the time when his servants get to know the revelation of Jesus Christ
t5: the time when the events written in the book *Revelation* take place

The co-reference analysis of the third communication unit of the first text sentence can also be coded in two ways, just like in the case of the analysis of the previous communication unit:

(let Jesus Christ) show his (=Jesus Christ's) servants what (=the events that) must soon take place.

[k03] = [!i05] [=r03]/t2,imp (i05)[=i08], [=i07]*
[k03] = [!i05] [=r03]/t2,imp [=i07] + to (i05)[=i08]

[k03/&vb/&ind]:
(Jesus Christ)[i05]
show[i05][=r03]
his^(=Jesus Christ[i05]'s)^
servants(i05)[=i08]
what^(=the events that)^must^soon^take^place.[=i07]

[i05] Jesus Christ
[i07] the events that must soon take place
[i08] Jesus Christ's servants
[r03] sy (S) show (P) sy (IO=PO) sth (DO)[8], or sy (S) show (P) sth (DO) to sy (PO)[9]
t2: the time when Jesus Christ's angel showed the events to John

1st comment:

The events identified by the co-reference index [i07] must soon take place.

[c01] = [!i07] [=!q01]/t0,must . + in [=i18]

[i07] the events that must soon take place
[i18] the time when the events written in the book *Revelation* take place
[q01] sth (S) take place (P)[10] {in some time (TA)}
t0: the time when God gave the revelation to Jesus Christ

Here we should make clear distinction between the time of the comment *[c01]* (i.e. when it states that the events must soon take place) and the time which is suggested by the meaning of the comment (i.e. when they will actually take place). Looking up the dictionary entries of the word *take place, happen,* etc we can find that the monolingual dictionaries cannot help; for

[8] [VP12A]

[9] [VP13A]

[10] [VP2A]

example according to ([HORN80]), *take place* means *happen* (p 635), *happen* means *take place* or *come about* (p. 390), and *come about* means *happen* (p. 165). But it is evident that every word is related to the time when a particular event takes place (or happens, etc). Note that in the text analysed the time when the events identified by the co-reference index *[i07]* take place is explicitly mentioned (in the communication unit *[k11]*, see below). That is why we present the co-reference index *[i18]* in the coded form of the first comment explicitly.

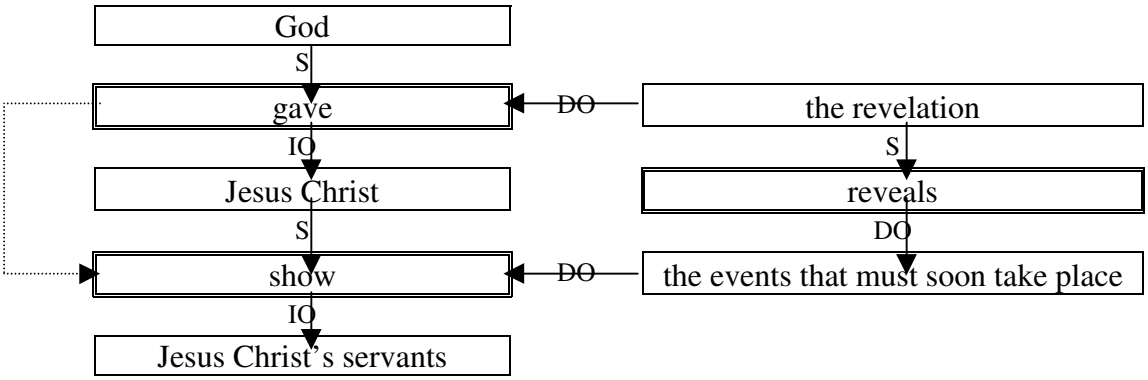
2nd comment:

The revelation of Jesus Christ reveals the events that must soon take place.

[c02] = [!i02] [=q02]/t4,decl [i07]

[i02] the revelation of Jesus Christ
[i07] the events that must soon take place
[q02] sth (S) reveal (P) sth (DO)[11]
t4: the time when his servants get to know the revelation of Jesus Christ

Actually, the co-reference analysis of the comment *[c01]* does not contain any new element (except for the use of the relation index of the *comment* in the form *[qxx]* which is only a formal notation, and the use of the ! (exclamation mark) operator in a relation index, see later). But new is the *comment* itself and its role in co-reference analysis. On the one hand, let us note that the first comment is based on a *clause* of the communication unit *[k03], the syntactic as well as the semantic structure of which has remained „hidden" in the co-reference analysis of the communication unit [k03]*. In such cases, the ! (exclamation mark) operator will be used before the corresponding relation index (e.g. *[=!q01]*). On the other hand, let us examine the cognitive function of the second comment. It is well known that the interpretation of texts needs both text linguistic, and textological tools ([PETŐ98]). Using the latter, we can add knowledge about the world to the semantic content of the text gained by using only text linguistic tools. This is why we use comments in co-reference analysis. For example, let us illustrate by a figure how we can arrive at the second comment:



It is quite clear that the information expressed by the second comment is not included explicitly or directly in the original text, but it *does* comprise that information implicitly on the basis of

[11] [VP6A]

(a) the meaning of the word *revelation*,
(b) the relationship between the words *gave* and *show* which also involves the relationship of the word *revelation* with the word *show* (and consequently with its direct object *the events that must soon take place*), and
(c) the similar function, or symmetric position, of the direct objects in the two sentences or clauses (i.e. *the revelation* and *the events that must soon take place*) which suggests paradigmatic relationship between them.
Of course, the points (a), (b), and (c) do not explain the secont comment by themselves, they do need the knowledge of a corresponding *cognitive schema* about the situation they describe which is considered here as a collection of patterns closely related to each other. For example in this case the corresponding schema might contain the following patterns:

- sy (A) gives information to sy (B);
- the information is about sth (C);
- sy (B) has enough knowledge about sth (C);
- sy (B) makes sth (C) known to others (D).

Note that a cognitive schema defined that way is an essential (and probably inexhaustible) source of additional information or knowledge about the world in a given context (or paradigm).

So the comments inserted among the communication units carry additional information (i.e. information „about the world"), and thus they help us exploring the full semantic content of the text currently analysed. In order to build comments smoothly into the framework of co-reference analysis, they are represented in the same way as communication units (*Co/&ind* representation). In fact, comments and communication units differ only in the source of information they are derived from. While a communication unit belongs strictly to the text analysed, as a certain part of it, comments are based on the individual (dictionary or encyclopaedical, background, etc) knowledge the interpreter of the text has about the world. That knowledge might include common everyday (cognitive) schemas, linguistic and literary knowledge, the full text that comprises the selected text analysed, facts about the author of the text and his life, studies and essays about the topic covered by the text, etc. Note that, in most cases, comments do not add *new* co-reference indices to the analysis, but include new relation indices to express additional relationships between the co-refernce indices introduced by the original text.

We have seen before that the ! (exclamation mark) operator is used in two meanings:

- in basic co-reference indices (as in *[=!i01]*), and
- in relation indices which occur in comments (or communication units) that have revealing or definitive function (as in *[=!q01]*).

In the latter case communication units or comments containing the ! operator in their relation indices are considered as *definitive attributes* of the basic co-reference index in the net of co-reference indices. The definitive attributes are, *by definition*, required to be always true in the context in which they occur, as opposed to the alternative attributes which can either be true or not in different situations (described, of course, by different texts). In other words, the information content of a definitive attribute for a given basic co-reference index is coded in the semantic meaning of the index.

Because the assignment rules of a basic co-reference index are different from those of a definitive attribute, the latter is either supposed to have the basic co-reference index in the

first meaningful position of its syntactic structure (e.g. in the case of the first comment) or we should force another co-reference index to be the basic index (e.g. the case of the fourth comment). In such cases we will use the !! (double exclamation mark) operator before the relation index.

Now, we have not only finished the co-reference analysis of the first text sentence of the text analysed, but outlined the main concepts and notation of co-reference analysis which are essential for the complete understanding what follows.

2.1.2 co-reference analysis of the second text sentence

The second text sentence can be divided into four communication units:

[K02] = [k04]&[k05]&[k06]&[k07]

[K02] =
[k04] He (=Jesus Christ) made it (=the revelation) known (to John) by [k05] &
[k05] (Jesus Christ) sending his (=Jesus Christ's) angel to his (=Jesus Christ's) servant (=John) &
[k06] his (=Jesus Christ's) servant John (=John is Jesus Christ's servant), &
[k07] [2]who (=John) testifies (to Jesus Christ's servants) to (=on) everything he (=John) saw - that is, the word of God and the testimony of Jesus Christ.

The co-reference analysis of the first communication unit of the second text sentence is as follows:

He (=Jesus Christ) made it (=the revelation) known (to John) by [k05]

[k04] = [!i05] [=r04]/t1,decl [i02] + to [i03], by [r05]

[k04/&vb/&ind]:
He (=Jesus Christ)[i05]
made^... ^known[i05][=r04]
it (=the revelation)[i02]
(to John[i03])
by [r05]

[i02] the revelation of Jesus Christ
[i03] John
[i05] Jesus Christ
[r04] sy (S) make known (P) sth (DO) to sy (PO)[12] {by doing sth (R)}
[r05] sy (S) send (P) sy (DO) to sy (PO)
t1: the time when Jesus Christ sent an angel to John

The co-reference analysis of the second communication unit of the second text sentence is as follows:

[12] [VP13A]

(Jesus Christ) sending his (=Jesus Christ's) angel to his (=Jesus Christ's) servant (=John)

[k05] = [!i05] [=r05]/t1,decl (i05)[=i09] + to [i03]

[k05/&vb/&ind]: (Jesus Christ)[i05] sending[i05][=r05] his^(=Jesus Christ[i05]'s)^ angel(i05)[=i09]) to his (=Jesus Christ's) servant (=John)[i03]

[i03] John
[i05] Jesus Christ
[i09] Jesus Christ's angel
[r05] sy (S) send (P) sy (DO) to sy (PO)[13]
t1: the time when Jesus Christ sent an angel to John

The co-reference analysis of the third communication unit of the second text sentence is as follows:

his (=Jesus Christ's) servant John (=John is Jesus Christ's servant),

[k06] = [!i03] [B] (i05)[=i11]

[k06/&vb/&ind]: John[i03] is[=r06⇔B] Jesus Christ[i05]'s^ servant(i05)[i11]

[i03] John
[i05] Jesus Christ
[i11] Jesus Christ's servant
[r06] sy (S) is (P) sy (SC)[14] – this corresponds to the relation symbol *B*

3rd comment:

Jesus Christ's servant is one of Jesus Christ's servants.

[c03] = [!i11] [B*] [i08]

[i08] Jesus Christ's servants
[i11] Jesus Christ's servant

[13] [VP13A]

[14] [VP1]

[q03] sy (S) is (P) one of sy (SC)[15] – this corresponds to the relation symbol *B**

The co-reference analysis of the fourth communication unit of the second text sentence is as follows:

[2]*who (=John) testifies (to Jesus Christ's servants) to (=on) everything he (=John) saw - that is, the word of God and the testimony of Jesus Christ.*

[k07] = [!i03] [=r07]/t3,decl . + to [i08], on [=i14]&(i06)[=i12]&(i05)[=i13]

[k07/&vb/&ind]:
[2]who (=John)[i03]
testifies[i03][=r07]
to^Jesus^Christ[i05]'s^
servants[i08]
to (=on)^everything[=i14]^
he^(=John[i03])^saw&
- that is, the^word(i06)[=i12]^
of^God[i06]&
and the^testimony(i05)[=i13]^
of^Jesus^Christ[i05].

[i03] John
[i05] Jesus Christ
[i06] God
[i08] Jesus Christ's servants
[i14] everything John saw
[i12] the word of God
[i13] the testimony of Jesus Christ
[r07] sy (S) testify (P) to sth (PO)[16]
t3: the time when John wrote the book *Revelation*

4th comment:

John saw the things identified by the co-reference index [i14].

[c04] = [i03] [=!!q04]/t2,decl [!i14]

[i03] John
[i14] everything John saw
[q04] sy (S) see(s) (P) sth (DO)[17]
t2: the time when Jesus Christ's angel showed the events to John

[15] [VP1]

[16] originally [VP3A]; „Verbs in this pattern are followed by a preposition and its object (...). The verb and preposition function as a unit." (Hornby, 1980. p. xxx) We used the pattern sy (S) testify (P) to sy (IO) on sth (PO) instead.
[17] [VP6A]

5th comment:

Jesus Christ's angel showed John the events that must soon take place.

[c05] = [!i09] [=q05]/t2,decl [i03], [i07]*
[c05] = [!i09] [=q05]/t2,decl [i07] + to [i03]

[i03] John
[i07] the events that must soon take place
[i09] Jesus Christ's angel
[q05] sy (S) show (P) sy (IO=PO) sth (DO)[18], or sy (S) show (P) sth (DO) to sy (PO)[19]
t2: the time when Jesus Christ's angel showed the events to John

6th comment:

The things that John saw are the events that must soon take place.

[c06] = [!i14] [B] [i07]

[i07] the events that must soon take place
[i14] everything John saw
[q06] sth (S) is/are (P) sth (SC)[20] – this corresponds to the relation symbol *B*

7th comment:

John wrote the things that he saw in the book Revelation.

[c07] = [!i03] [=q07]/t3,decl [i14] + in [i01]

[i01] the book *Revelation* by John
[i03] John
[i14] everything John saw
[q07] sy (S) write (P) sth (DO)[21] {in (AP)[22]}
t3: the time when John wrote the book *Revelation*

2.1.3 co-reference analysis of the third text sentence

The third text sentence can be divided into three communication units:

[18] [VP12A]

[19] [VP13A]

[20] [VP1]

[21] [VP6A]

[22] *AP* refers here to the *adverb of place* (Országh L.: Magyar-angol szótár. – Akadémiai K. 1992. - p. 835)

[K03] = [k08]&[k09]&[k10]&[k11]

[K03] =
[k08] [3]Blessed is (by God) the one who reads the words of this prophecy (=the book *Revelation*), (because [k11]) &
[k09] (the book *Revelation* is a prophecy) &
[k10] and blessed are (by God) those who hear it (=the words of the book *Revelation*) and take to heart what (=the things that) is written in it (=the book *Revelation*), because [k11] &
[k11] the time (when the events written in the book *Revelation* take place) is near.

The co-reference analysis of the first communication unit of the third text sentence is as follows:

[3]Blessed is (by God) the one who reads the words of this prophecy (=the book Revelation), (because [k11])

[k08] = [=i19] [=r08]/t4,decl . + by [!i06], because [k11]

[k08/&vb/&ind]:
[3]Blessed^is[i19][=r08]
(by^God[i06])
the^one[=i19]^who^reads^the^words^of^this^prophecy (=the book *Revelation*),
(because [k11])

[i06] God
[i19] the one who reads the words of the book *Revelation*
[r08] sy (S) is blessed (P+SC)[23] {by sy (A[24]), because (K)}
t4: the time when his servants get to know the revelation of Jesus Christ

8th comment:

Those people who are identified by the co-reference index [i19] read the words of the book Revelation.

[c08] = [!i19] [=!q08]/t4,decl (i01)[=i16]

[i01] the book *Revelation* by John
[i16] the words of the book *Revelation*
[i19] the one who reads the words of the book *Revelation*
[q08] sy (S) read (P) sth (DO)[25]
t4: the time when his servants get to know the revelation of Jesus Christ

[23] [VP1]

[24] *A* refers here to the *agent*, or doer of the action (see Thomson, A.J. – Martinet, A.V.: A Practical English Grammar. – Oxford Univ. Press, 1982. - p.255).

[25] [VP6A]

The co-reference analysis of the second communication unit of the third text sentence is as follows:

(the book Revelation is a prophecy)

[k09] = [!i01] [B] [=i21]

[k09/&vb/&ind]: the^book^*Revelation*[i01] is[=r09⇔B] a prophecy[=i21]^

[i01] the book *Revelation* by John
[i21] a prophecy
[r09] sth (S) is (P) sth (SC)[26] – this corresponds to the relation symbol *B*

The co-reference analysis of the third communication unit of the third text sentence is as follows:

and blessed are (by God) those who hear it (=the words of the book Revelation) and take to heart what is written in it (=the book Revelation), because [k11]

[k10] = [=i20] [=r10]/t4,decl . + by [!i06], because [k11]

[k10/&vb/&ind]: and^blessed^are[i20][=r10] (by^God[i06]) those[=i20]^ who^hear^it (=the words of the book *Revelation*)^ and^take^to^heart^what (=the things that)^is^written^in^it (=the book *Revelation*), because [k11]

[i06] God
[i20] those who hear the words of the book *Revelation* and take to heart the things that are written in the book *Revelation*
[r10] sy (S) is blessed (P+SC)[27] {by (A), because (K)}
t4: the time when his servants get to know the revelation of Jesus Christ

9th comment

Those people who are identified by the co-reference index [i20] hear the words of the book Revelation.

[c09] = [!i20] [=!q09]/t4,decl [i16]

[26] [VP1]

[27] [VP1]

[i16] the words of the book *Revelation*
[i20] those who hear the words of the book *Revelation* and take to heart the things that are written in the book *Revelation*
[q09] sy (S) hear (P) sth (DO)[28]
t4: the time when his servants get to know the revelation of Jesus Christ

10th comment

Those people who are identified by the co-reference index [i20] take to heart the things that are written in the book Revelation.

[c10] = [!i20] [=!q10]/t4,decl [=i17]

[i20] those who hear the words of the book *Revelation* and take to heart what is written in the book *Revelation*
[i17] the things that are written in the book *Revelation*
[q09] sy (S) take to heart (P) sth (DO)[29]
t4: the time when his servants get to know the revelation of Jesus Christ

11th comment:

John wrote the things identified by the co-reference index [i17] in the book Revelation.

[c11] = [i03] [=!!q11]/t3,decl [!i17] + in [i01]

[i01] the book *Revelation* by John
[i03] John
[i17] the things that are written in the book *Revelation*
[q11] sy (S) write (P) sth (DO)[30] {in (AP)}
t3: the time when John wrote the book *Revelation*

12th comment:

The things that are written in the book Revelation are the things that John saw.

[c12] = [!i17] [B] [i14]

[i14] everything John saw
[i17] the things that are written in the book *Revelation*
[q12] sth (S) is/are (P) sth (SC)[31] – this corresponds to the relation symbol *B*

[28] [VP6A]

[29] [VP6A]

[30] [VP6A]

[31] [VP1]

The co-reference analysis of the fourth communication unit of the third text sentence is as follows:

[k11] = [!i18] [=r11]/t3,decl .

[k11/&vb/&ind]: the^time[i18]^(when the events written in the book *Revelation* take place) is^near[i18][=r11].

[i18] the time when the events written in the book *Revelation* take place
[r11] sth (S) is near (in time) (P+SC)[32]
t3: the time when John wrote the book *Revelation*

Now we have enough information to draw some conclusions. Because

- [c06] = [!i14] [B] [i07] *(The things that John saw are the events that must soon take place.)* and
- [c12] = [!i17] [B] [i14] *(The things that are written in the book Revelation are the things that John saw.),*

the following relationship should be necessarily true:

The things that are written in the book Revelation are the events that must soon take place.

Thus the *things* that are written in the book *Revelation* are, actually, *events* which might take place at a certain time. Therefore, we can complete the definition of the corresponding co-reference index as follows:

[i17] the things (=events) that are written in the book *Revelation*

We might as well specify the exact time of those events by another comment:

13th comment:

The events written in the book Revelation take place at the time that is identified by the co-reference index [i18].

[c13] = [i17] [=!!q13]/t5,decl . + in [!i18]

[i17] the things (=events) that are written in the book *Revelation*
[i18] the time when the events written in the book *Revelation* take place
[q12] sth (S) take place (P)[33] {in (TA[34])}
t5: the time when the events written in the book *Revelation* take place

[32] [VP1]

[33] [VP2A]

[34] *TA* refers here to the *time adverb*, or adverbial modifier of time (Országh L.: Magyar-angol szótár. – Akadémiai K. 1992. - p. 894).

2.2 Summary

Before we go on, it is worth collecting and reviewing the results of the co-reference analysis. First, let us see the co-reference indices introduced so far:

[i01] the book *Revelation* by John
[i02] the revelation of Jesus Christ
[i03] John
[i05] Jesus Christ
[i06] God
[i07] the events that must soon take place
[i08] Jesus Christ's servants
[i09] Jesus Christ's angel
[i11] Jesus Christ's servant
[i12] the word of God
[i13] the testimony of Jesus Christ
[i14] everything John saw
[i16] the words of the book *Revelation*
[i17] the things (=events) that are written in the book *Revelation*
[i18] the time when the events written in the book *Revelation* take place
[i19] the one who reads the words of the book *Revelation*
[i20] those who hear the words of the book *Revelation* and take to heart the things that are written in the book *Revelation*
[i21] a prophecy

It is also worth listing the coded communication units and comments with their definitions:

[K01] =
[k01] (the book *Revelation* by John[35] is) [1]The revelation of Jesus Christ, &
[k02] which (=the revelation) God gave him (=Jesus Christ) to [k03] &
[k03] (let Jesus Christ) show his (=Jesus Christ's) servants what (=the events that) must soon take place.
[c01] The events identified by the co-reference index [i07] must soon take place.
[c02] The revelation of Jesus Christ reveals the events that must soon take place.
[K02] =
[k04] He (=Jesus Christ) made it (=the revelation) known (to John) by [k05] &
[k05] (Jesus Christ) sending his (=Jesus Christ's) angel to his (=Jesus Christ's) servant (=John) &
[k06] his (=Jesus Christ's) servant John (=John is Jesus Christ's servant), &
[k07] [2]who (=John) testifies (to Jesus Christ's servants) to (=on) everything he (=John) saw - that is, the word of God and the testimony of Jesus Christ.
[c03] Jesus Christ's servant is one of Jesus Christ's servants.
[c04] John saw the things identified by the co-reference index [i14].

[35] The underlined word denotes the basic co-reference index of the communication unit or comment.

[c05] Jesus Christ's angel showed John the events that must soon take place.
[c06] The things that John saw are the events that must soon take place.
[c07] John wrote the things that he saw in the book Revelation.
[K03] =
[k08] [3]Blessed is (by God) the one who reads the words of this prophecy (=the book *Revelation*), (because [k11]) &
[k09] (the book *Revelation* is a prophecy) &
[k10] and blessed are (by God) those who hear it (=the words of the book *Revelation*) and take to heart what (=the things that) is written in it (=the book *Revelation*), because [k11] &
[k11] the time (when the events written in the book *Revelation* take place) is near.
[c08] Those people who are identified by the co-reference index [i19] read the words of the book Revelation.
[c09] Those people who are identified by the co-reference index [i20] hear the words of the book Revelation.
[c10] Those people who are identified by the co-reference index [i20] take to heart the things that are written in the book Revelation.
[c11] John wrote the things identified by the co-reference index [i17] in the book Revelation.
[c12] The things that are written in the book Revelation are the things that John saw.
[c13] The events written in the book Revelation take place at the time that is identified by the co-reference index [i18].

The coded form of the communication units and comments are as follows:

[K01] = [k01]&[k02]&[k03]
[k01] = (=i03)[=!i01] [B] (=i05)[=i02]
[k02] = [=i06] [=r02]/t0,decl [i05], [!i02] + to [r03]
[k03] = [!i05] [=r03]/t2,imp (i05)[=i08], [=i07]*
[c01] = [!i07] [=!q01]/t0,must . + in [=i18]
[c02] = [!i02] [=q02]/t4,decl [i07]
[K02] = [k04]&[k05]&[k06]&[k07]
[k04] = [!i05] [=r04]/t1,decl [i02] + to [i03], by [r05]
[k05] = [!i05] [=r05]/t1,decl (i05)[=i09] + to [i03]
[k06] = [!i03] [B] (i05)[=i11]
[k07] = [!i03] [=r07]/t3,decl [=i14]&(i06)[=i12]&(i05)[=i13] + on [i08]
[c03] = [!i11] [B*] [i08]
[c04] = [i03] [=!!q04]/t2,decl [!i14]
[c05] = [!i09] [=q05]/t2,decl [i03], [i07]*
[c06] = [!i14] [B] [i07]
[c07] = [!i03] [=q07]/t3,decl [i14] + in [i01]
[K03] = [k08]&[k09]&[k10]&[k11]
[k08] = [=i19] [=r08]/t4,decl . + by [!i06], because [k11]
[k09] = [!i01] [B] [=i21]
[k10] = [=i20] [=r10]/t4,decl . + by [!i06], because [k11]
[k11] = [=!i18] [=r11]/t3,decl .
[c08] = [!i19] [=!q08]/t4,decl (i01)[=i16]
[c09] = [!i20] [=!q09]/t4,decl [i16]
[c10] = [!i20] [=!q10]/t4,decl [=i17]

[c11] = [i03] [=!!q11]/t3,decl [!i17] + in [i01]
[c12] = [!i17] [B] [i14]
[c13] = [i17] [=!!q13]/t5,decl . + in [!i18]

The list of syntagmatic relationships between the co-reference indices is as follows:

[i01] C [i03][36] (the book *Revelation* by John);
[i02] C [i05] (the revelation of Jesus Christ)
[i08] C [i05] (Jesus Christ's servants)
[i09] C [i05] (Jesus Christ's angel)
[i11] C [i05] (Jesus Christ's servant)
[i12] C [i06] (the word of God)
[i13] C [i05] (the testimony of Jesus Christ)
[i16] C [i01] (the words of the book *Revelation*)

Now we illustrate in a table the relationships between co-reference indices, relation indices,[37] communication units and comments (see Table 1). In addition to the grammatical function of the indices (denoted by S, DO, PO, etc. according to the corresponding verb patterns), we also present the syntagmatical relationships between co-reference indices (denoted by the Italic-typed symbol *C* below the first occurrence of the relationship). Note that, on the one hand, the table is a kind of representation for a (specific part of a) semantic net. On the other hand, we can easily construct the graphic or semantic net-form of the table (see below).

We can observe in the table, among others, a very important characteristic of the text analysed. The basic co-reference indices, being chiefly (by definition) in the first meaningful position of the communication units or comments, play an essential role in the „real time" processing, and therefore the understanding, of the text. For example, in the understanding process we can first select, from every communication unit or comment, a corresponding pattern for the basic co-reference index of the unit analysed *according to the active paradigm* (e.g. from a dictionary when something is not quite clear), and then we can try to unify the selected pattern and the corresponding unit. Note that in the unification process we need, at every step, the list of the active co-reference indices the first occurrence of which is denoted by the operator = in cells with dark background in the table. Now let us notice that – apart from the first communication unit – the basic co-reference indices of the communication units and comments (denoted by the operator !) always follow their first occurrence in the table that is, they appear only in the second, third, etc occurrence of the index. In other words, according to the text analysed a co-reference index cannot be a basic co-reference index in its first occurrence. (This appears to be true only with one obvious restriction: in the first communication unit this experimental rule cannot be realised.) This shows the second cognitive function of the basic co-reference index: a communication unit or comment that is being processed can be linked to the text which have been previously processed by the basic co-reference index of the unit to be linked. That is, during the process the basic co-reference index from the new unit and one of the „active" indices from the processed text are to be unified.

[36] The form *[ixx] C [iyy]* denotes the relationship *(iyy)[ixx]*.

[37] Unfortunately, we have been compelled to omit relation indices from comments (denoted by *[qxx]*) in order to avoid to further increase the complexity of the table.

On the basis of this observation we can study the associative structure of the text analysed as follows:

In case the rule we have established applies in a text analysed, the text can be considered as coherent, but otherwise it may consist of two or more parts that are not linked associatively.

We can establish that the text analysed here has proved to be coherent according to the rule discussed above.

In the table there are some co-reference indices expressed by *abstract concepts* which do not exist in the strict sense of the word – that is, there are no real objects (persons, things, etc), relationships between such concepts,[38] or dimensions (place, time, etc) which belong to those concepts. The function of such concepts is to classify or *characterise* the corresponding „real" (i.e. concrete or definite) co-reference indices with which they have paradigmatic relationship. For example, let us see the sixth communication unit:

[k06] = [!i03] [B] (i05)[=i11] *(John is Jesus Christ's servant)*

In this unit the co-reference index *[i03] (John)* expresses a concrete person, and the co-reference index *[i11] (Jesus Christ's servant)* expresses an abstract category of persons to which John belongs. The latter contributes to the character of John a new attribute not mentioned so far in the text.

Moreover, some concrete co-reference indices having paradigmatic relationships with each other belong to the same real object (e.g. *[i01] the book Revelation by John* and *[i02] the revelation of Jesus Christ*). In such cases, the information content of the different forms of the indices can be shared between them – that is, both indices could add further information to the semantic meaning of the other.

The concepts which have paradigmatic relationship with each other (denoted by the symbol *B*, see the list of the coded forms of the communication units and comments above for further details) can be grouped together. This results in so-called *group concepts* denoted by the form *[gxx]*. In the text analysed, the following group concepts occur:

[g01] = {[i01], [i02], [i21]}
[i01] the book *Revelation* by John
[i02] the revelation of Jesus Christ
[i21] a prophecy

[g03] = {[i03], [i11]}
[i03] John
[i11] Jesus Christ's servant

[38] Certain concepts express or refer to *relationships* (that is actions, events, existence, etc), and not objects or dimensions (e.g. *[i13] the testimony of Jesus Christ*).

[g07] = {[i07], [i14], [i17]}
[i07] the events that must soon take place
[i14] everything John saw
[i17] the things (=events) that are written in the book *Revelation*

Using these group indices, we arrive at a new table that can be seen in Table 2. As the order of rows has not carried semantic meaning so far, we might group those rows together that correspond to a given group concept. When interpreting the table, we can consider the rows that belong to a particular group concept as a single one. As both tables represent the *abstract structure* of the text analysed,[39] any simplification of the tables might lead to the occurrence of the resulted patterns in different tables. Grouping rows together might result in another simplification of the structure because those columns which represent relationships between concepts *from the same group* can be omitted (e.g. *[c06], [k09], [c12]*).

It can be seen from the above considerations that with the help of the complex notation and syntactic rules of co-reference analysis we have in fact applied a kind of *meta-language* to the syntactic coding of the English language text selected for the analysis. We have already referred to the fact that, in another article ([BOD00]), we performed co-reference analysis for the same text in Hungarian language. *Both analyses have been accomplished without major difficulties.* Consequently, the co-reference analysis can be considered as a constructive linguistic tool which provides a coded text form that is independent of any natural language. Although this is a one-way method for the time being (that is, we have not dealt so far with the issue of how the coded text can be converted back to its original form) it might as well provide, among others, an excellent possibility for us to check or validate the semantic equivalence of natural language texts translated from different languages.

[39] Strictly speaking, it is only a selected part of the structure of the text analysed. Although we tried to cover all important elements during the analytical process, it seems to be absolutely impossible to exhaust every aspect, or association, which emerges recursively again and again from the already processed parts of the text. Comparing two texts with each other, therefore, should necessarily be an *iterative* process.

	k01	k02	k03	c01	c02	k04	k05	k06	c03	k07	c04	c05	c06	c07	k08	c08	k09	k10	c09	c10	c11	c12	k11	c13
i01	=!S													AP		*C*	!S				AP			
i02	=SC	!DO			!S	DO																		
i03	=*C*					PO	PO	!S		!S	S	IO		!S							S			
i05	=*C*	IO	!S *C*			!S	!S *C*	*C*		*C*														
i06		=S								*C*					!A			!A						
i07			=DO	!S	DO							DO	SC											
i08			=IO						SC	IO														
i09							=DO					!S												
i11								=SC	!S															
i12										=PO														
i13										=PO														
i14										=PO	!DO		!S	DO								SC		
i16																=DO			DO					
i17																				=DO	!DO	!S		S
i18				=TA																			!S	!TA
i19															=S	!S								
i20																		=S	!S	!S				
i21																	=SC							
r01	=B																							
r02		=P																						
r03		R	=P																					
r04						=P																		
r05						R	=P																	
r06								=B																
r07										=P														
r08															=P									
r09																	=B							
r10																		=P						
r11															K			K					=P	
	k01	k02	k03	c01	c02	k04	k05	k06	c03	k07	c04	c05	c06	c07	k08	c08	k09	k10	c09	c10	c11	c12	k11	c13

Table 1

	k01	k02	k03	c01	c02	k04	k05	k06	c03	k07	c04	c05	c06	c07	k08	c08	k09	k10	c09	c10	c11	c12	k11	c13
i01	=!S													AP		*C*	!S				AP			
i02	=SC	!DO			!S	DO											=SC							
i21																								
i03	*=C*					PO	PO	!S		!S	S	IO		!S							S			
i11								=SC	!S															
i05	*=C*	IO	!S *C*			!S	!S *C*	*C*		*C*														
i06		=S								*C*					!A			!A						
i07			=DO	!S	DO							DO	SC !S	DO								SC !S		S
i14										=PO	!DO													
i17																				=DO	!DO			
i08			=IO						SC	IO														
i09							=DO					!S												
i12										=PO														
i13										=PO														
i16																=DO			DO					
i18				=TA																			!S	!TA
i19															=S	!S								
i20																		=S	!S	!S				
r01	=B																							
r02		=P																						
r03		R	=P																					
r04						=P																		
r05						R	=P																	
r06								=B																
r07										=P														
r08															=P									
r09																	=B							
r10																		=P						
r11															K			K					=P	
	k01	k02	k03	c01	c02	k04	k05	k06	c03	k07	c04	c05	c06	c07	k08	c08	k09	k10	c09	c10	c11	c12	k11	c13

Table 2

2.3. Further Considerations

Now that we have succesfully described the selected text on meta-level, we can make further examinations about the structure of the text analysed. First, let us arrange the communication units, comments, and relationships between the co-reference indices in a so-called *net of co-reference indices*. The net consists of items or entries which contain the units and relationships of the text analysed. There is one item for each basic co-reference index. Every item has four fields referred to as *Classes, Relationships, Definitions,* and *Attributes*.

The definition of the fields is as follows:[40]

CLASSES: the paradigmatic relationships of the basic co-reference index (e.g. those denoted by the symbols *B* and *B**)
RELATIONSHIPS: the syntagmatic relationships of the basic co-reference index (e.g. those denoted by the symbol *C*)
DEFINITIONS: the communication units or comments assigned as *definitive attributes* where the given basic co-reference index occurs (e.g. *[c01]* is classified under the basic co-reference index *[!i07]*. Note that both the co-reference index *[!i07]* and the relation index *[=!q01]* of the first comment contain the ! (exclamation mark) operator .)
ATTRIBUTES: the communication units or comments *not* assigned as *definitive attributes* where the given basic co-reference index occurs (e.g. *[c02]* is classified under the basic co-reference index *[!i02]*. Note that whereas the co-reference index *[!i02]* does, but the relation index *[=q02]* of the second comment does *not* contain the ! (exclamation mark) operator.)

The items of the net of co-reference indices (ordered by their index number) are as follows:

[i01] the book *Revelation* by John
CLASSES
[k01] (the book *Revelation* by John is) [1]The revelation of Jesus Christ,
[k09] (the book *Revelation* is a prophecy)
RELATIONSHIPS
[i03] John

[i02] the revelation of Jesus Christ
RELATIONSHIPS
[i05] Jesus Christ
ATTRIBUTES
[k02] which (=the revelation) God gave him (=Jesus Christ) to [k03]
[c02] The revelation of Jesus Christ reveals the events that must soon take place.

[40] Let us notice that the entry structure of the net of co-reference indices is very similar to that of a monolingual dictionary.

[i03] John
CLASSES
[k06] his (=Jesus Christ's) servant John (=John is Jesus Christ's servant),
ATTRIBUTES
[k07] [2]who (=John) testifies (to Jesus Christ's servants) to (=on) everything he (=John) saw - that is, the word of God and the testimony of Jesus Christ.
[c07] John wrote the things that he saw in the book Revelation.

[i05] Jesus Christ
ATTRIBUTES
[k03] (let Jesus Christ) show his (=Jesus Christ's) servants what (=the events that) must soon take place.
[k04] He (=Jesus Christ) made it (=the revelation) known (to John) by [k05]
[k05] (Jesus Christ) sending his (=Jesus Christ's) angel to his (=Jesus Christ's) servant (=John)

[i06] God
ATTRIBUTES
[k08] [3]Blessed is (by God) the one who reads the words of this prophecy (=the book *Revelation*), (because [k11])
[k10] and blessed are (by God) those who hear it (=the words of the book *Revelation*) and take to heart what (=the things that) is written in it (=the book *Revelation*), because [k11]

[i07] the events that must soon take place
DEFINITIONS
[c01] The events identified by the co-reference index [i07] must soon take place.

[i08] Jesus Christ's servants
RELATIONSHIPS
[i05] Jesus Christ

[i09] Jesus Christ's angel
RELATIONSHIPS
[i05] Jesus Christ
ATTRIBUTES
[c05] Jesus Christ's angel showed John the events that must soon take place.

[i11] Jesus Christ's servant
CLASSES
[c03] Jesus Christ's servant is one of Jesus Christ's servants.
RELATIONSHIPS
[i05] Jesus Christ

[i12] the word of God
RELATIONSHIPS
[i06] God

[i13] the testimony of Jesus Christ
RELATIONSHIPS
[i05] Jesus Christ

[i14] everything John saw
CLASSES
[c06] The things that John saw are the events that must soon take place.
DEFINITIONS
[c04] John saw the things identified by the co-reference index [i14].

[i16] the words of the book *Revelation*
RELATIONSHIPS
[i01] the book *Revelation* by John

[i17] the things (=events) that are written in the book *Revelation*
CLASSES
[c12] The things that are written in the book Revelation are the things that John saw.
DEFINITIONS
[c11] John wrote the things identified by the co-reference index [i17] in the book Revelation.

[i18] the time when the events written in the book *Revelation* take place
DEFINITIONS
[c13] The events written in the book Revelation take place at the time that is identified by the co-reference index [i18].
ATTRIBUTES
[k11] the time (when the events written in the book *Revelation* take place) is near.

[i19] the one who reads the words of the book *Revelation*
DEFINITIONS
[c08] Those people who are identified by the co-reference index [i19] read the words of the book Revelation.

[i20] those who hear the words of the book *Revelation* and take to heart the things that are written in the book *Revelation*
DEFINITIONS
[c09] Those people who are identified by the co-reference index [i20] hear the words of the book Revelation.
[c10] Those people who are identified by the co-reference index [i20] take to heart the things that are written in the book Revelation.

[i21] a prophecy

Now let us illustrate the various relationships between the co-reference indices, the so-called *associative structure* of the text analysed, on the basis of the items of the net of co-reference indices. We divided the full associative structure into three figures (see them at the end of the chapter):

- Figure 1: communication units as CLASSES and ATTRIBUTES
- Figure 2: comments as CLASSES and ATTRIBUTES
- Figure 3: comments as DEFINITIONS, and RELATIONSHIPS

Studying the *class and attribute structure* of the communication units in Fig 1 we can observe that (1) it is a diagram scheme or graph, and (2) the directed edges of the graph are very close to form a (maximal) tree of the graph. It is completed by the edges or links that appear in the *class and attribute structure* of the comments in Fig 2. Note that these edges contribute to the associative structure of the text but do not link other indices to the tree structure outlined in Fig 1. In general, on the basis of the class and attribute structure we can examine the conciseness of the text because
(1) the minimal requirement for a *cohesive* text is having a maximal tree of links between the co-reference indices in its class and attribute structure, and
(2) the maximum number of links are limited by that of the corresponding schema to which the text analysed belongs.
In the first case the receiver of the communication should complete the text on the basis of a selected cognitive schema which serves as a paradigm in the understanding process. In the second, rather theoretical, case, however, the text contains all the information that is necessary for its complete understanding. In practice we almost always need supplemental information, that is, knowledge about the situation or „the world" in which the text analysed is placed to understand the meaning of the message the text conveys. In our case, the supplemental information needed has been inserted into the text by comments. *In this respect, the comments we have added to the analysed text demonstrate, among others, the way how the complex understanding process works.*

The indices that are separate from the others in Fig 1 and Fig 2 are linked to the other, already linked, indices by the edges that appear in the *definition and relationship structure* of the comments in Fig 3. But the latter structure has its own special characteristics that distinguish it from the other schemes. First, let us notice that the structure in Fig 3 does not form a connected graph, that is, there are separate parts or sub-graphs in the structure which have their own inner structure.

(1) There are two sub-graphs that form *star topology*.

[i05] Jesus Christ
  [i02] the revelation of Jesus Christ
  [i08] Jesus Christ's servants
  [i09] Jesus Christ's angel
  [i11] Jesus Christ's servant
  [i13] the testimony of Jesus Christ

[i06] God
  [i12] the word of God

(2) There is a rather complex sub-graph that is very close to form a *lattice*. There is only one close directed-edge train or circuit in the graph. But the direct link between the co-reference index *[i17]* and *[i03]* can be omitted because the links *[i17]⇒[i01]* and *[i01]⇒[i03]* include it indirectly or *transitively*. (Note that the relationships presented in Fig 3 are very similar to the inclusion or part-whole relation which is transitive.) Doing so, there will not be directed circuits in the structure any more. The resulted structure is as follows:

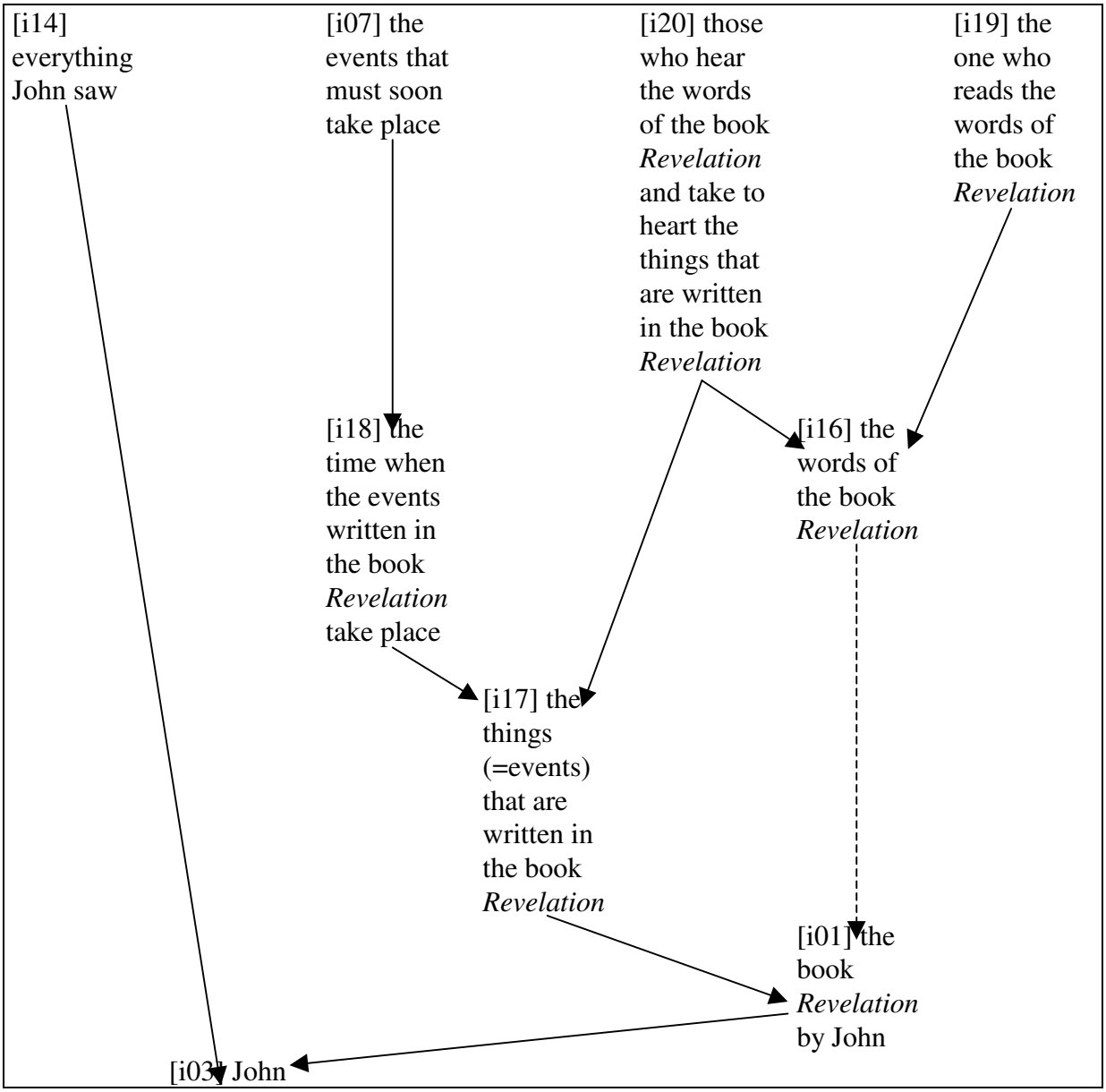


Figure 4

Only one index has been omitted as it is not connected to any of the indices of the structure ([i21] a prophecy). It is probably the analyser's fault: we should have added another comment(s) to the text that might cover the rich information content of the word *prophecy* as well.

Second, note that there are certain nodes in the graph to which several edges join. These nodes play an essential, *central* role in the text as they hold together particular sets of co-reference indices of the structure. For example the nodes to which more than three edges join are as follows:

[i01] the book *Revelation* by John (2 edges in, 1 edge out)
[i03] John (3 edges in)
[i05] Jesus Christ (5 edges in)
[i16] the words of the book *Revelation* (2 edges in, 1 edge out)
[i17] the things (=events) that are written in the book *Revelation* (2 edges in, 1 edge out)

These indices can, with no doubt, be considered as the *keywords* of the text.

Bibliography

[BNC] British National Corpus (BNC) - Oxford University Computing Services.
(http://info.ox.ac.uk/bnc/)

[BOD98] Boda I. K. – B. Porkoláb J.: Koreferenciális kifejezések és koreferenciarelációk. Példaszöveg: Szent János Apostol Jelenéseinek Könyve. 21:9-23. Az új Jeruzsálem. (Részlet). = Officina Textologica, 2. szám. – Kossuth Egyetemi K. Debrecen, 1998. – pp. 32-56.

[BOD99] Boda I. K. - Porkoláb J.: Nyelvi megformálások értelmezése számítógépes programmal (A Jelenések könyve néhány részlete alapján). = Szemiotikai szövegtan 12. Szövegtani kutatás: témák, eredmények, feladatok (II). - Szerk. Petőfi S. János, Békési Imre, Vass László. - JGYTF Kiadó, Szeged, 1999. - 295-302 l. - Acta Academiae Pedagogicae Szegediensis. Series Linguistica, Literaria et Aesthetica.

[BOD00] Boda I. K. - Porkoláb J.: A koreferencia kérdései a számítógépes szövegfeldolgozás szempontjából = Officina Textologica, 4. szám. – Kossuth Egyetemi K. Debrecen, 2000. – pp. 150-180.

[HORN80] Hornby, A. S.—Cowie, A. P. ed.: Oxford Advanced Learner's Dictionary of Current English. - Oxford University Press, 1980.

[LING] Linguistic Glossary. - compiled by the International Linguistics Department of the Summer Institute of Linguistics - Dallas, TX, 1997. (published on CD-ROM as a component of the LinguaLinks® product)
(http://www.sil.org/linguistics/glossary/index.html)

[PETŐ97] Petőfi S. János: Egy poliglott szövegnyelvészeti-szövegtani kutatóprogram. = Officina Textologica 1 (1997).

[PETŐ98] PETŐFI S. JÁNOS: Koreferenciális elemek és koreferenciarelációk. Példaszöveg: Mt. 9,9 -13. Máté meghívása. 15. - Officina Textologica 2 (1998) 15-31.

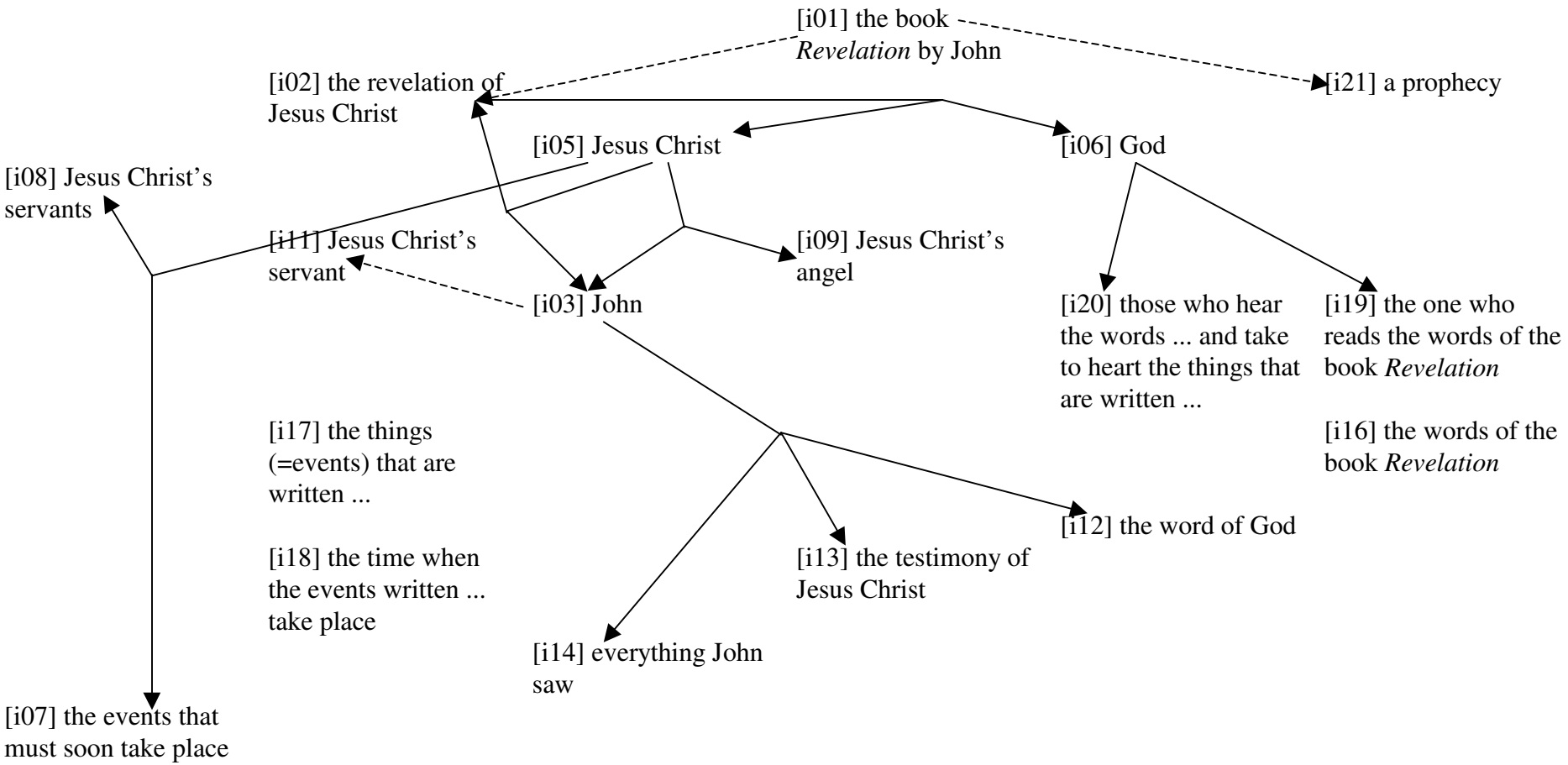

[i01] the book *Revelation* by John
[i02] the revelation of Jesus Christ
[i21] a prophecy
[i05] Jesus Christ
[i06] God
[i08] Jesus Christ's servants
[i11] Jesus Christ's servant
[i09] Jesus Christ's angel
[i03] John
[i20] those who hear the words ... and take to heart the things that are written ...
[i19] the one who reads the words of the book *Revelation*
[i16] the words of the book *Revelation*
[i17] the things (=events) that are written ...
[i12] the word of God
[i18] the time when the events written ... take place
[i13] the testimony of Jesus Christ
[i14] everything John saw
[i07] the events that must soon take place

Figure 1

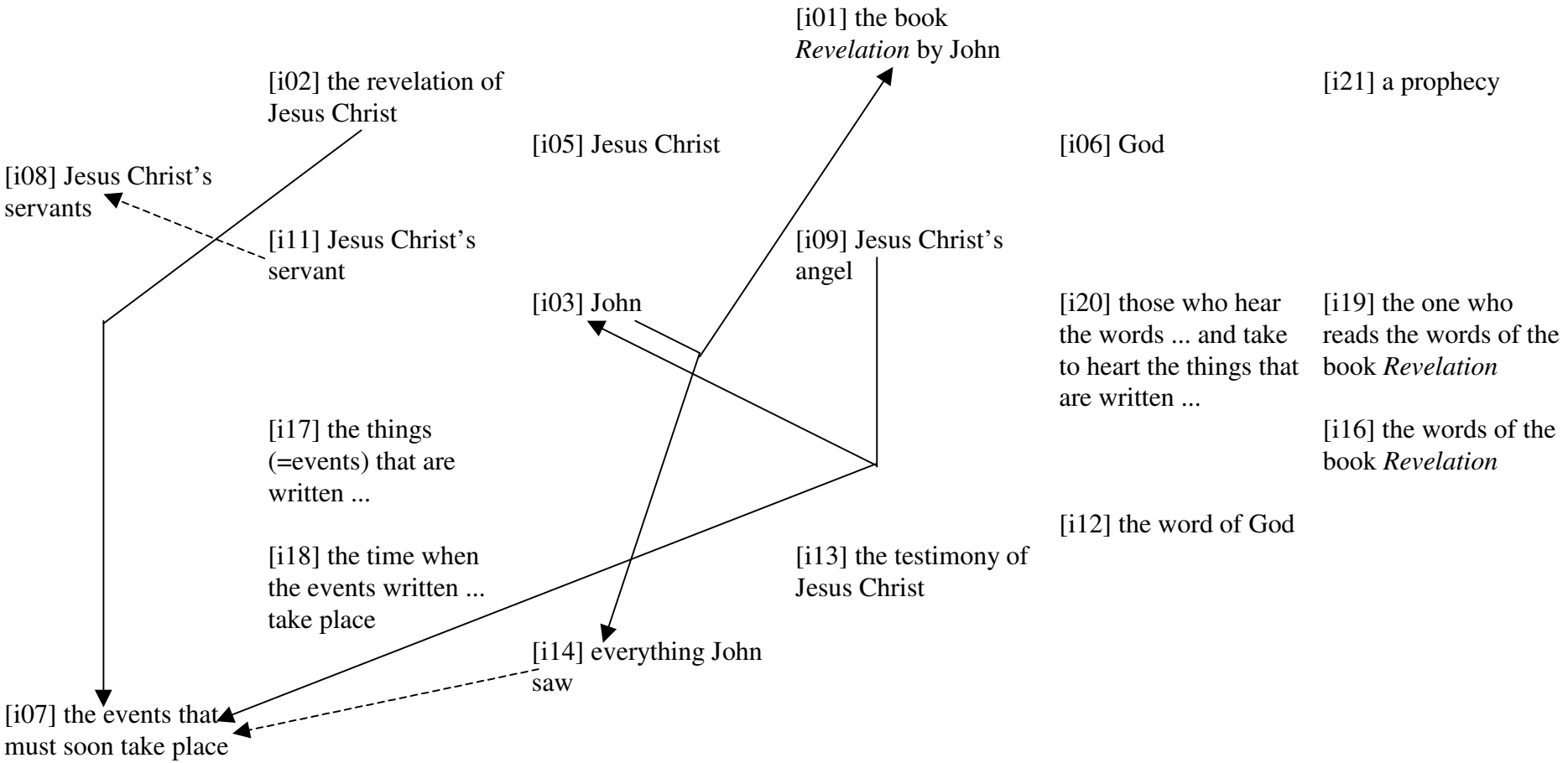

[i01] the book *Revelation* by John
[i02] the revelation of Jesus Christ
[i21] a prophecy
[i05] Jesus Christ
[i06] God
[i08] Jesus Christ's servants
[i11] Jesus Christ's servant
[i09] Jesus Christ's angel
[i03] John
[i20] those who hear the words ... and take to heart the things that are written ...
[i19] the one who reads the words of the book *Revelation*
[i17] the things (=events) that are written ...
[i16] the words of the book *Revelation*
[i12] the word of God
[i18] the time when the events written ... take place
[i13] the testimony of Jesus Christ
[i14] everything John saw
[i07] the events that must soon take place

Figure 2

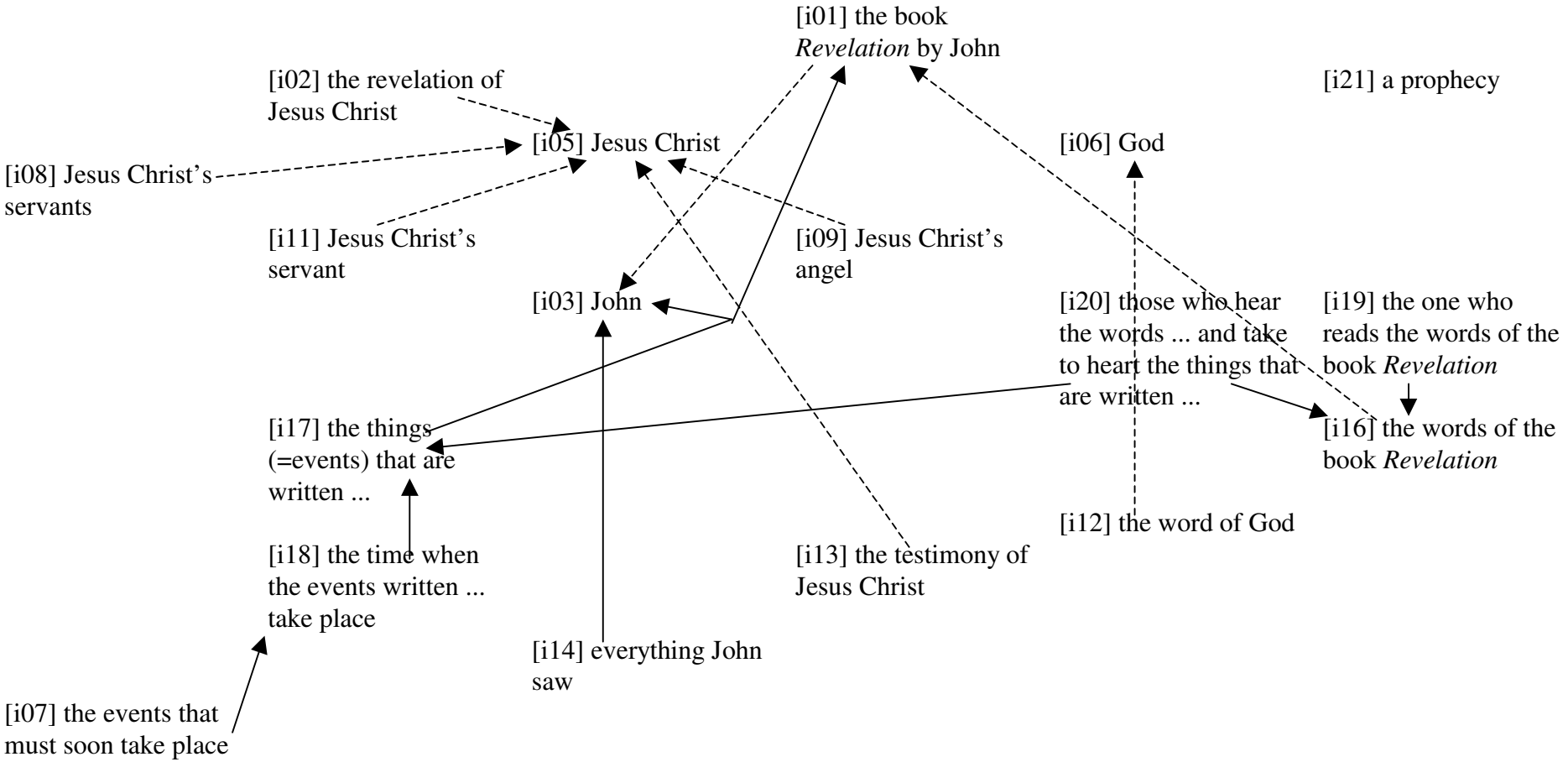

[i01] the book *Revelation* by John
[i02] the revelation of Jesus Christ
[i21] a prophecy
[i05] Jesus Christ
[i06] God
[i08] Jesus Christ's servants
[i11] Jesus Christ's servant
[i09] Jesus Christ's angel
[i03] John
[i20] those who hear the words ... and take to heart the things that are written ...
[i19] the one who reads the words of the book *Revelation*
[i16] the words of the book *Revelation*
[i17] the things (=events) that are written ...
[i12] the word of God
[i18] the time when the events written ... take place
[i13] the testimony of Jesus Christ
[i14] everything John saw
[i07] the events that must soon take place

Figure 3

Chapter 3

The Role of Conceptual Metaphors in the Hypertext Structure of Poetic Texts

Introduction

One of the most important subjective factors of any language is *metaphor* which is the part of language creativity. ([KIEF00b]) In this chapter we will examine the role of *conceptual metaphors* ([LAK92], [KÖV98]) in the hypertext structure of poetic texts. We will describe and apply *a simplified language model* using the so-called P*-notation (see **Chapter 1**) which will serve as a *constructive linguistic tool* in our further examinations. In other words, our experiences coming from the application of the P*-notation in the interpretation of a selected poem will help us expressing some ideas, as well as checking our considerations,

- about the (cognitive) role of conceptual metaphors, especially in poetic texts, and
- about the explicit form of metaphorical (and other) relationships within the hypertext structure we use as a cognitive paradigm in the interpretation of poetic texts.

The coding of natural language texts in P*-notation is partially based on the notation of co-reference analysis described in **Chapter 2**.

We tried to lay great stress upon the simplicity and easy-to-use feature of the model. Thus it is not at all intended to be a "perfect language" ([ECO98]); rather, it *is* intended to be a useful linguistic tool which makes it possible for us to examine directly, *constructively* some linguistic phenomena including metaphors, other figures of speech, etc. Nevertheless, it is essential for the model to have enough complexity to meet some *minimal* criteria:

minimal syntactic criteria for the model:
- the model should properly describe the inner structure of syntagmas (phrases, clauses, sentences, etc), and
- the model should convey the original syntactic structure of sentences or *communication units* and the co-referential structure of texts.

minimal semantic criteria for the model:
- any question that can be formulated in a natural language should be expressed (that is, *coded*) in the model of that language, and
- the model should give meaningful (coded) answers to meaningful (coded) questions on the basis of, and faithfully to, the original text described in the model.

Here we would like to emphasise again that our approach is basically constructive which is also expressed in the way we expound our ideas *by the interpretation process of a selected poem*. Consequently, we do not intend to build a theoretic construction that can solve every problem (from the simpliest to the most sophisticated one), but do intend to *describe and apply* a simple language model which can be used as a useful tool in our further examinations. Thus the appropriateness of the model can be measured by its usefulness or usability, some examples to which will be shown in the following parts of this chapter. The usability of the model in practice can be well ensured by using computer assistance. For that purpose, we will apply the syntactic rules of the Turbo Prolog 2.0 language.

Because the model has not been intended to be exhaustive, it is possible that some linguistic phenomena cannot be represented adequately in it. But we looked for *a logically well-founded model* that meets the minimal syntactic and semantic criteria prescribed above. Thus those things that can actually be represented in the model can be considered as a firm basis of our further considerations which can therefore be expected to correspond to the facts.

In what follows, we will describe the model as well as analyse and interpret the poem 'Poppy' by Miklós Radnóti. In **Section 3.1** we will code the text to be interpreted. In **Section 3.2** we will outline how we can use the model, placing great emphasis on its information retrieval features. In **Section 3.3** and **3.4** we will discuss the question of coding metaphors and other figures of speech. Then we will draw some conclusions in **Section 3.4**.

3.1 Coding the text

First of all, let us see the poem to be interpreted:

Radnóti Miklós: Pipacs

Az asszonyom pipacsot lát
és füttyent nekem az úton át
s hogy visszafüttyentek, lehajol.

Két ujja végigcsúszik a szár
szőrén s a fű közt megáll. És már
kezében lángol a lenge virág.

Ujra füttyentek; füttyömbe boldog
madár füttye vág s ő mosolyog:
Pipacspirossal zendüljön a világ!

(1933. június 13.)

Miklós Radnóti: Poppy

My beloved sees a poppy
and whistles to me across the road,
and as I whistle back, she bends.

Her two fingers glide up the stem's
hair, and stop in the grass. And already
the light flower flames in her hand.

I whistle again; into my whistle a
happy bird note cuts and she smiles:
Let the world rebel on poppy-red!

13 June 1933 ([RADN80])

As we have seen in **Chapter 2**, it appears to be very useful to code *communication units* (that is, least meaningful units of text sentences that preserve the structure of a sentence) instead of the direct coding of text sentences. Thus we do not lose information, and the structures we get will be much easier to survey and handle. For example, the first verse of the poem is a text sentence which can be divided into four communication units as follows:

[K01]
My beloved sees a poppy
and whistles to me across the road,
and as I whistle back, she bends.

[k01] My beloved sees a poppy
[k02] and [my beloved] whistles to me across the road,
[k03] and as I whistle back [to my beloved],
[k04] she [=my beloved] bends.

Using the notation of co-reference analysis described in **Chapter 2** this can be expressed as follows:

[K01] = [k01]&[k02]&[k03]&[k04]

Note that the missing or coded information within the text sentences is explicitly shown in square brackets [and] during the construction of the communication units.

In order to code communication units in P*-notation, let us use the predicate *_sentence,* the first and second argument of which is the index of the communication unit to be coded in the form of *kxx,* and the verbal description or form of the communication unit in the given (natural) language. In other words, the type of the second argument is *text*. Using arguments of such type, their values, written in natural language, will make the program more user-friendly because of their rich information content. Although this way the computer can provide "natural language" answers for us, these arguments are not supposed to be used to link two predicates to each other (which is usually reserved for the codes, i.e. the "indices").

For example, the coding of the first communication unit is as follows:

_sentence(k01,"My beloved sees a poppy").

We assign predicates beginning with underline sign _ to syntactic units in order to distinguish them from the words or concepts (like *_sentence*). For example we can describe the subject, predicate, and (direct) object of the sentence as follows:

_subject(k01,i01).
_predicate(k01,r01).
_object(r01,i04[1]).

The indices i01 and i04 denote the corresponding co-reference indices, and r01 denotes the relation index of the first communication unit. These indices can be expressed as follows:

my_beloved(i01).
poppy(i04).
see(r01).

Let us point out that the predicates we introduced correspond to the [k01] = [i01] [r01] [i04] sentence pattern. We can easily represent the hierarchical structure (or tree diagram) of the communication unit on the basis of the *occurrence* of the indices k01 and r01 in more than one predicates (see Fig 1).

[1] We follow the order of symbols in the Prolog program that can be found in the Appendix. (Of course, there is no objection to using the next index i02 for the *poppy* object instead of the index i04).

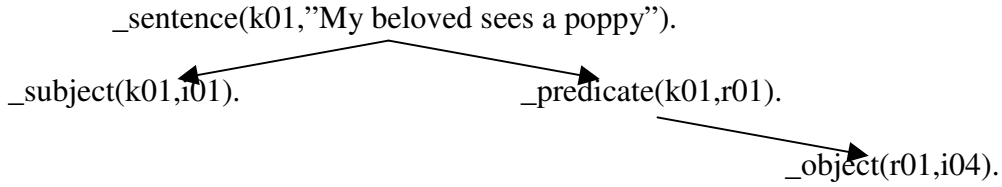


Figure 1

Before we go on, we should add some new elements to the coding of the first sentence. On the one hand, it is necessary to add the description of *time* to the model. This can be achieved by using the *relative time* of the event (statement, etc) expressed by the communication unit, as can be seen in the following sentence pattern:

[k01] = [i01] [r01]/t1 [i04]

It seems to be practical to use numerals instead of symbols when referring to relative time in the model. The use of integers to give the relative time (e.g. 1, 2, 3, ... instead of the symbols t1, t2, t3, ...) has considerable advantages when making a computer realisation of the model. For example, the description of the relationships between communication units with respect to time (e.g. simultaneity, being the preceding / succeeding, etc) is very simple – we need not use recurring definitions, that is, rules expressing symmetry, transitivity, etc.

On the other hand, the possessor of the predicate 'my beloved' is the predicate 'I' (=the poet) which also occurs in the text sentence analysed (*and [my beloved] whistles to me across the road,*) which requires the coding of possessive case in the model. Thus the predicates which correspond to the first communication unit are completed with three additional predicates:

_time(r01,1).
_of(i01,i02).
i[2](i02).

With these predicates the structure of the first communication unit can be represented as follows:

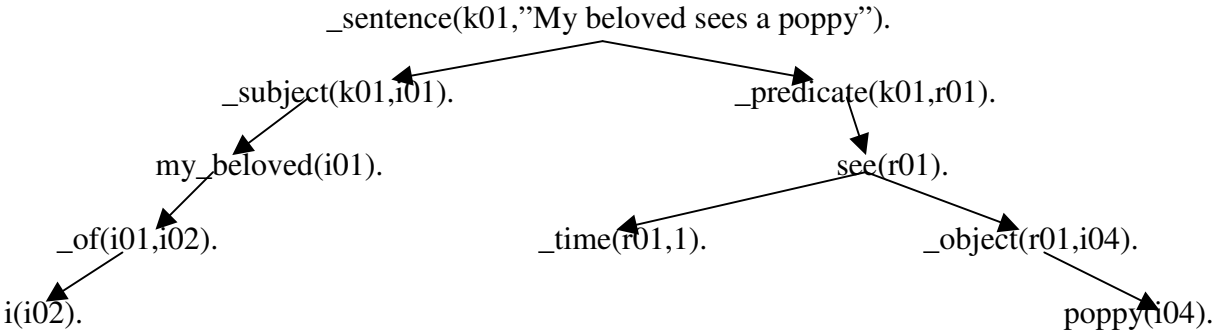


Figure 2

[2] We should apply lower-case letters to comply with the syntactic rules of the Prolog language (to distinguish the name of predicates from variables, see later).

Let us deal now with the coding of the rest of the communication units. The coding of the second communication unit is as follows (henceforth we will use tab characters for illustrating the relationships between predicates instead of giving the graphic representation of the structure of the communication units):

```
_sentence(k02,"and [my beloved] whistles to me across the road,").
        _subject(k02,i01).
                my_beloved(i01).
                        _of(i01,i02).
                                i(i02).
        _predicate(k02,r02).
                whistle(r02).
                        _to(r02,i02).
                                me(i02).
                        _across(r02,i08).
                                road(i08).
                        _time(r02,2).
```

This corresponds to the following sentence pattern:

[k02] = [i01] [r02]/t2 . + to [i02], across [i08]

The full stop after the relation index and the relative time symbol *[r01]/t2* denotes the absence of the direct object. As can be seen, for the proper identification of the grammatical function of the adverbial complements *i02* and *i08* in the pattern, we used the prepositions *to* and *across* from the communication unit *([my beloved] whistles to me across the road,)* as additional predicates in the model.

The coding of the 3rd, 4th, ..., 10th communication units is similar to that of the first and second one discussed above. For the exact form used including the predicates, the relation and co-reference indices, etc, see the attached Prolog language program in the Appendix. There can be only one difficulty, i.e. the predicates that belong to a specific communication unit are fairly scattered and therefore cannot be gathered easily in the list of the program. This is because the Turbo Prolog compiler requires that the clauses (i.e. the facts and rules) for the same predicate – and not for the same communication unit - should be grouped.

Now let us examine the 11th communication unit. It is as follows:

[my beloved says that]

Note that this is not a direct part of the original text of the poem but is naturally included in the description of the situation. In other words, such *hidden parts* of the text, which are obvious for a human but non-existing for the machine, make the computer-based interpretation process very difficult. To solve this problem, we have chosen the simple but hopefully effective way of adding to the text the information which is essential to understand it completely.

The coding of the 11th communication unit is as follows:

```
_sentence(k11,"[my beloved says that]").
        _subject(k11,i01).
                my_beloved(i01).
                        _of(i01,i02).
                                i(i02).
        _predicate(k11,r11).
                say(r11).
                        _object(r11,k12).
                                _sentence(k12,"Let the world rebel on poppy-red!")[3].
                        _time(r11,8).
```

This corresponds to the following sentence pattern:

[k11] = [i01] [r11]/t8 [k12]

The new element in this pattern is the index *k12* of the 12th communication unit *(Let the world rebel on poppy-red!)* in the place of the direct object. This way the model allows us to code the quotations without difficulty.

Finally, let us examine the coding of the next, 12th communication unit. Temporarily sticking to the English translation of the poem, this may be as follows:

```
_sentence(k12,"Let the world rebel on poppy-red!").
        _subject(k12,i06).
                world(i06).
        _imperative(k12,r12).
                rebel(r12).
                        _on(r12,i13).
                                poppy_red(i13).
                        _time(r12,8).
```

This corresponds to the following pattern:

[k12] = [i06] [r12]/t8,imp . + on [i13]

The new element in the coding of the communication unit is the predicate *_imperative* which stands for the predicate *_predicate* (which occurs only in declarative sentences) and denotes the imperative mood of the verb in the model.

Unfortunately, there is a serious difference here between the original Hungarian version and the translated English language version of the poem which force us to make some modifications to the coding of the 12th communication unit. Note that this is a purely semantic question which does not concern the coding procedure we have followed so far (as well as the artistic value of the translation of the poem). The modified form of the 12th communication unit is as follows:

[3] We will add some modifications to the coding of the 12th communication unit, see later.

_sentence(k12,"Let the world resound with poppy-red!").
    _subject(k12,i06).
        world(i06).
    _imperative(k12,r12).
        resound(r12).
            _with(r12,i13).
                poppy_red(i13).
            _time(r12,8).

Let us explain the underlined modifications. The English translation *(Let the world rebel on poppy-red!)* of the last sentence of the poem *(Pipacspirossal zendüljön a világ!)* expresses only the figurative sense of the sentence. It is based on the two different meanings of the corresponding Hungarian verb *zendül* as well as on a very powerful synaesthesia (that is, *pipacspirossal zendüljön / resound with poppy-red*):

zendül *v*
1. *(zene)* (re)s*ou*nd, ring* out
2. *(lázad)* rise* (in rebellion), reb*e*l, r*i*ot[4]

The figurative sense is, with no doubt, of vital importance but to completely miss the primary sense of the sentence is a rather raw mapping of Radnóti's subtle and refined poetic tools. For in the primary, literal sense of the sentence the poet's beloved says that "Let music resound in the world" in harmony with all the music of the situation described in the poem where the poet, his beloved and the birds whistle merrily to each other. There are altogether five occurrences of the word 'whistle' in a poem of nine lines! (whistles / *füttyent*, whistle back / *visszafüttyentek*, whistle again / *ujra füttyentek*, into my whistle / *füttyömbe*, a happy bird note - originally 'the whistle of a happy bird' - / *boldog madár füttye*) In addition, the poet's beloved wishes that "Let poppies bloom (or flame / shine, etc) in the world" like there and then, in that happy situation.

Therefore it seems most adequate to use

- the predicate *resound* instead of *rebel*, and
- the predicate *_with* instead of *_on*

in the coding of the communication unit. We refer here to the 2nd item of the entry *resound*:

resound ... **2** when a place **resounds** with noise, it is filled with a loud, long song. ([COL93], p. 1233)

Note that the definition of the entry compared with the recommended translation of the poem (*Let the world resound with poppy-red!*) suggests a strange but powerful *synaesthetic* metaphor: POPPY-RED IS A SONG (which resounds through the world, etc).

Of course, there could be other variations for the translation, e.g. (1) Let the world resound with red poppies! which is more concrete and is based on the metonymy POPPY-RED MEANS RED POPPIES, or (2) Let whistles and poppy-red / red poppies resound through the

[4] Magay T. – Országh L.: Magyar – angol kéziszótár. – Akadémiai K. 1990.

world! which is more explicit[5]. Fortunately, as can be seen later, there are other, explicit ways of coding appropriately the information content expressed in complex figures of speech by the poet. Although we chose the translation *Let the world resound with poppy-red!*, but adopted both the metonymy of variation (1) and the explicitness of variation (2) in the final coding of the 12th communication unit.

3.2 Using the model

After coding the communication units of the text analysed we can ask some questions. One of the great advantages of the model we selected that we will receive answers to them. First, let us outline briefly the information retrieval procedure which results in the necessary answers.

The Turbo Prolog language program [TURB88] which our considerations are based on can be found in the Appendix. We have taken most of our examples directly from the program list and from the messages the computer sent while the program was running. We can type in the questions into the computer after the *Goal:* prompt, and after that the computer can generate answers on the basis of the stored fact and rules (i.e. the knowledge base) of the Prolog program.

It is important, that in case there are more than one correct answer to our question, and there is at least one free variable (beginning with a capital letter) in the question, the computer gives us all the answers. In fact, the computer *retrieve from the knowledge base* the correct values for the free variables of the question we have typed in. In most cases, a question consists of predicates and variables, and the facts are described in the knowledge base in a form that is similar to the coding of the communication units (where we have used predicates and indices as their arguments). So when a set of values for all variables that occur in the question can be found *in a way that* every predicate in the question (with properly substituted values in its arguments) occurs in the knowledge base *as a fact*, then an answer has been found; and the computer provides us with the values of those variables that appear explicitly in the "head" of the question.

Using *rules* in the knowledge base the situation is a bit more difficult. A rule for a predicate allows that the predicate might be substituted by other predicates (which are given in the "body" of the rule). Note that a rule is similar to, and therefore can be considered as a "built-in" question in the knowledge base. So when there are rules in the knowledge base, the information retrieval procedure looks for *each occurrence of each predicate included in the question* (1) as a fact and (2) as a rule. In the latter case the rules are treated as further questions for which the information retrieval procedure is to be performed the same way (looking for *each occurrence of each predicate included in the rule*, etc). This algorithm is finished when each occurrence of the predicates included in the question has been retrieved and each rule for them has been also processed (which itself, of course, includes further predicates to be retrieved and rules to be processed).

Now, as an example, let us ask the following question: *What did the poet's beloved see?*

[5] Another version to emphasise the figurative sense of the sentence could be something like this: Let the world be haunted by whistles / melodies / music and / with red poppies / poppy-red! (In accordance with the opening words of The Communist Manifesto: *A spectre is haunting Europe – The spectre of Communism*.)

The coding of this question is as follows:

```
_question(Comm_unit,What) :-
        _sentence(X,Comm_unit),
        _subject(X,I),
        my_beloved(I),
        _predicate(X,R),
        see(R),
        _object(R,What).
```

The computer will produce the following answer:

```
Goal: _question(Comm_unit,What)

Comm_unit=My beloved sees a poppy, What=i04
1 Solution
```

The answer to the question is represented by the value *i04* of the variable *What*. Because the co-reference index *i04* means *poppy*, the answer is correct (see the fact *poppy(i04).* in the coding of the first communication unit). Additional information has been retrieved using the variable *Comm_unit*; its value *My beloved sees a poppy* is the communication unit itself that comprises the answer to the question.

As can be seen *the answer we received has been coded*. Although we can easily check whether *poppy(i04)* is true or false (by means of typing it as a question to the computer which will give the brief answer *Yes*), there is fortunately a more user-friendly way to get the answer from the computer directly. All we have to do is introduce the predicate *_keyword* which will "resolve", i.e. decode the co-reference and relational indices by assigning their names to them. For example in the case of the co-reference index *i04* we should place another fact in the knowledge base as follows:

```
_keyword(i04,poppy).
```

Using the predicate *_keyword*, the coded form of the first communication unit is as follows:

```
_sentence(k01,"My beloved sees a poppy").
        _subject(k01,i01).
                my_beloved(i01).
                        _keyword(i01,"my beloved").
                        _of(i01,i02).
                                i(i02).
                                        _keyword(i02,"I").
        _predicate(k01,r01).
                see(r01).
                        _keyword(r01,see).
                        _object(r01,i04).
                                poppy(i04).
                                        _keyword(i04,poppy).
                        _time(r01,1).
```

Similarly, the coded form of the second communication unit is as follows:

```
_sentence(k02,"and [my beloved] whistles to me across the road,").
        _subject(k02,i01).
                my_beloved(i01).
                        _keyword(i01,"my beloved").
                        _of(i01,i02).
                                i(i02).
                                        _keyword(i02,"I").
        _predicate(k02,r02).
                whistle(r02).
                        _keyword(r02,whistle).
                        _to(r02,i02).
                                me(i02).
                                        _keyword(i02,"I").
                        _across(r02,i08).
                                road(i08).
                                        _keyword(i08,road).
                        _time(r02,2).
```

Note that because the type of the second argument in the predicate *_keyword* is *text*, we can use capital letters, expressions, special characters, etc (between quotation marks, of course) to increase the *user-friendliness* of the program. Let us check it by using the predicate *_keyword* in the previous question:

```
_question(Comm_unit,What,Keyword):-
        _sentence(X,Comm_unit),
        _subject(X,I),
        my_beloved(I),
        _predicate(X,R),
        see(R),
        _object(R,What),
        _keyword(What,Keyword).
```

```
Goal: _question(Comm_unit,What,Keyword)

Comm_unit=My beloved sees a poppy, What=i04, Keyword=light flower
Comm_unit=My beloved sees a poppy, What=i04, Keyword=poppy
2 Solutions
```

The reason for the *two* solutions (instead of only one) is that there are two predicates (*poppy* and *light_flower*) which contain the co-reference index *i04* as facts in the knowledge base. They correspond to two synonyms in the given context of the poem *(poppy* and *light flower)* and therefore each synonym appears in the corresponding *_keyword* predicate as well. Both of them have been retrieved as can be seen in the answer to the question above.

Although *poppy* and *light flower* are not synonyms in the strict sense of the word (e.g. there might be a poppy with thick stem and big, heavy bloom which can hardly be considered as "light"; and a light flower, of course, may be tulip, rose, violet, etc) but in the poem the poet obviously used the two words for the same thing. Therefore we also used the same co-

reference index (*i04*) as the argument of the predicates corresponding to the words *poppy* and *light flower*. (We can say that an index which, as a single argument, occurs in more than one fact is *overloaded*.) Note that this is a so-called low-level or fact-level coding of synonyms, or hyponyms, as compared to the use of rules for expressing such relationships (e.g. light_flower(X) :- light_poppy(X).[6]) which in turn may be referred to as a so-called high-level or language-level coding of such relationships.

Note that we are speaking now of predicates with only one argument i.e. those predicates which express in the model the notion of concepts. (Predicates with two or more arguments are used for expressing grammatical or syntagmatic relationships as well as relationships of communication units or sentences.) The different levels in coding mean *different abstraction levels*. The relationship of two predicates can be expressed with two (or more) facts for the predicates with the same (single) index in their argument. (e.g. *poppy(i04)* and *light_flower(i04)*) This is low-level coding expressed by *the corresponding indices*. But the relationship of two predicates can also be expressed with rules. (e.g. *flower(X) :- poppy(X).*) In this case the predicate in the "head" of the rule is always true for those indices for which the predicate in the "body" of the rule is true (that is, when there is a fact in the knowledge base for the predicate that occurs in the "body" of the rule). This is high-level coding expressed by *every index* that occurs in the corresponding argument of a fact in the knowledge base for the predicate with narrower meaning which occurs in the "body" of the rule.

3.3 Coding metaphors

Now we have enough knowledge to attempt the coding of conceptual metaphors in the model outlined before. Let us see the 7th communication unit of the poem:

And already the light flower flames in her [=my beloved's] hand.

The use of the verb *flame* can be interpreted by the conceptual metaphor A POPPY IS FIRE where POPPY is the so-called target domain, and FIRE is the source domain ([LAK92], [KÖV98]). Let us see the following train of thought: the fire can flame, a poppy is (a kind of) fire, therefore a poppy can flame. Of course, a poppy is not flaming here in the strict sense of the word, only metaphorically: the flaming fire gives us light, that is, it shines, and this attribute of fire is conveyed to, or inherited by, the semantic field of poppy (which results in that the light flower *shines* in the hand of the poet's beloved).

But it needs some explanation why the following consideration is rejected intuitively right away: the flaming fire gives us warmth, a poppy is (a kind of) fire, so a poppy heats up, gives us warmth, too. This is just the case where we should apply the *invariance principle* ([LAK92], [KÖV98]). Anybody could imagine a field where the red poppies emerge from the green background just like they were flaming. Consequently, the fact that poppies are shining, is quite acceptable on the basis of our previous experiences. In turn, probably nobody could remember a poppy that heats up (without fire...). Therefore there is a contradiction between the 'heating' attribute of poppy and our previous experiences, so we reject the former.

[6] cf. light_poppy(X) :- light_flower(X), poppy(X). which is a more complex type of rule. Here we are focusing our attention on rules of the more simple form *predicate1(X) :- predicate2(X).*

Finally, it is worth mentioning the role, or the importance, of the colour *red* in the conceptual metaphor A POPPY IS FIRE. It seems quite evident that it increases the connection between the two semantic fields as the colour of the flaming fire as well as the poppy is usually red (but not always: *The gasfire began to flame blue and gold*, [COL93], p. 546.). However, here are some quotations which might suggest that the red colour is not absolutely necessary for that metaphor: distant *flaming plain* (Miklós Radnóti: Hymn To The Nile); *fiery lake* of burning sulphur ([BIBLE89]) or the *lake which burneth with fire* and brimstone ([BIBLE82], Revelation 21:8).

The inheritance of the attribute 'shining' can be expressed in the model with two rules:

```
fire(X):-
        _metaphor(X),
        poppy(X).

shine(X):-
        _subject(K,Y),
        _predicate(K,X),
        flame(X),
        fire(Y).
```

Only the predicate *_metaphor* needs some explanation. We have mentioned before that rules of the form *predicate1(X) :- predicate2(X).* express the hyponym relationships of concepts corresponding to *predicate1* and *predicate2,* respectively. In order to be more precise, we need a definition of hyponymy:

(**hyponymy** is) 'a relationship between two words, in which the meaning of one of the words includes the meaning of the other word ... The specific term ... is called a **hyponym**, and the general term ... is called a **superordinate**. A superordinate term can have many hyponyms.' ([RICH93])

In the hyponym relationship expressed by the rule *predicate1(X) :- predicate2(X)., predicate1* corresponds to the superordinate term, and *predicate2* corresponds to the hyponym. Therefore a rule that expresses the conceptual metaphor A POPPY IS FIRE, if it were realised by the simple form *fire(X) :- poppy(X).,* would be a generalisation of the form expressing hyponym relation. But we have to distinguish between the two cases clearly (i.e. when a rule is used figuratively or literally), because if a poppy were considered *literally* a kind of fire, it would inherit all attributes of fire (including shining, *heating,* etc). To avoid this, we should use the predicate *_metaphor* which, among others, enables "metaphorical poppies" to inherit only specific attributes.

However, we do not deal now with the actual realisation of the invariance principle in the model. We might as well introduce predicates, *for each predicate and for each metaphor*, to allow inheritance or not, but to define those predicates we would need a „complete" knowledge base which we can use to decide whether a specific predicate for a metaphorical concept (e.g. *_shine* for *poppy*) occurs *at least once* or not. In the first case we might allow inheritance, and in the second case we might not.

As can be seen, the language-level coding of conceptual metaphors can be achieved without particular difficulties. We do not deal here with the question of the low-level coding of

conceptual metaphors, although they might be handled in such way, e.g. in the case discussed above by simply adding the fact *_shine(r07).* to the coding of the seventh communication unit. Note that *with the facts _shine(r07). and _flame(r07).,* two predicates would have the same relational index which would necessarily be overloaded in such way. We can avoid this by adding another communication unit (with a new unit index *k07a* as well as with a new relation index *r08*) to the set of communication units which describes the literal meaning of the sentence.

3.4 Coding other figures of speech

Beside metaphors, there are usually *other figures of speech* in poetic texts. An example of that can be found in the last line of the poem analysed, for which we will demonstrate two alternative ways of coding. Let us see the 12th communication unit of the poem:

Let the world rebel on poppy-red!

We have already discussed the interpretation possibilities of the sentence (in the first section). Let us summarise what we have established there: because the translation *Let the world rebel on poppy-red!* emphasises only the figurative meaning of the original sentence of the poem, *in coding* it is worth using an alternative to that, e.g. *Let the world resound with poppy-red!* In the foregoing, we will use the latter as our "starting point", so the model should be able to provide us with the primary as well as the figurative meaning of the corresponding sentence of the poem from the alternative we have chosen. The primary, literal meaning of the sentence could be expressed as follows:

Let music resound in the world, and let poppies bloom in the world!

But, as we have mentioned it before, there is another, figurative meaning of the sentence the literal meaning of which could be expressed by something like this:

Let proletarians of the world rebel with communists!

The coding of the latter, metaphorical sense of the sentence can be achieved more or less in the same way like that of the 7th communication unit. (We remark, though, that we should be very cautious with the interpretation of the sentences of this kind so as not to read a fanciful meaning into it.) The only new element here is the coding of the metonymy THE WORLD MEANS THE PROLETARIANS OF THE WORLD. But there is no difficulty at all in doing this:

```
proletarians_of_the_world(X) :-
        _metaphor(X),
        world(X).
```

We need two additional rules to coding the *metonymy* discussed here:

```
communists(X) :-
        _metaphor(X),
        poppies(X). /* POPPIES ARE COMMUNISTS */
```

```
rebel(X) :-
        _subject(K,Y),
        _imperative(K,X),
        resound(X),
        proletarians_of_the_world(Y).
```

With all these, the coding of the figurative meaning of the 12th communication unit is complete.

It is interesting, however, that the coding of the primary, literal meaning is much more difficult than that of the secondary, figurative meaning. To do this, we should divide the sentence to be coded (i.e. the 12th communication unit) into two communication units.

The coding of the original sentence, supplied with the corresponding predicates, is as follows:

```
_sentence(k12,"Let the world resound with poppy-red!").
        _subject(k12,i06).
                world(i06).
                        _keyword(i06,world).
        _imperative(k12,r12).
                resound(r12).
                        _keyword(r12,resound).
                        _with(r12,i13).
                                poppy_red(i13).
                                        _keyword(i13,"poppy-red").
                        _time(r12,8).
```

The coding of the two additional communication units is as follows[7]:

```
_sentence(k12a,"Let music resound in the world!").
        _subject(k12a,i14).
                music(i14).
                        _keyword(i14,music).
        _imperative(k12a,r13).
                resound(r13).
                        _keyword(r13,resound).
                        _in(r13,i06).
                                world(i06).
                                        _keyword(i06,world).
                        _time(r13,8).
```

[7] Both communication units (with the indices *k12a* and *k12b*, respectively) fit the same sentence pattern:
[k12a] = [i14] [r13]/t8,imp . + in [i06]
[k12b] = [i13] [r14]/t8,imp . + in [i06]

_sentence(k12b,"Let poppies bloom in the world!").
    _subject(k12b,i13).
        poppies(i13).
            _keyword(i13,poppies).
    _imperative(k12b,r14).
        bloom(r14).
            _keyword(r14,bloom).
            _in(r14,i06).
                world(i06).
                    _keyword(i06,world).
            _time(r14,8).

The basic questions about the low-level coding of such figures of speech are as follows:

- How can we establish the links between the coded communication units (e.g. *k12a* and *k12b*) and the original, and also coded, communication unit (e.g. *k12*) which contains the figure(s) of speech to be coded?
- How can we transform (or translate) the literal and figurative meaning of the original communication unit, *without loss of information,* into other communication unit(s)?

As far as the first question is concerned, let us note that the links are based upon the verbal predicates having the same name (e.g. *resound*) as well as the same co-reference indices (e.g. *i06*). The various links between the communication units are illustrated in Fig 3.

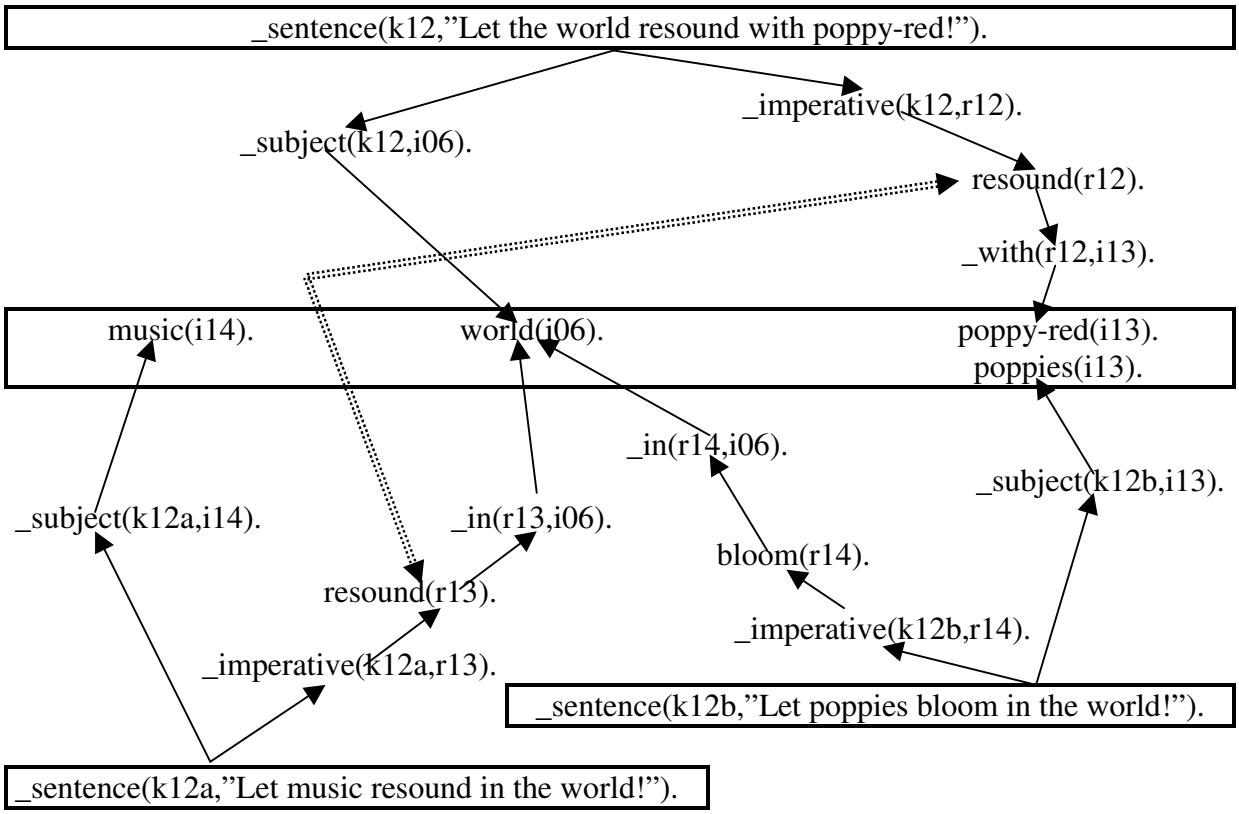


Figure 3

Although we might assume that the links are realised by the same relation and co-reference indices, or the predicates with the same name that have only one argument (which correspond to the nouns and verbs), that is not necessarily true. First, we usually must not overload relation indices because the connecting language elements can easily be mixed up in different communication units, resulting in confused meaning. Thus in most cases only the semantic relationships of the verbal predicates can have linking function, e.g. the rules concerning those predicates, accomplishing language-level links between the communication units. In turn, noun predicates with the same name that have different co-reference indices *identify different objects* (through their co-reference indices), and therefore do not necessarily accomplish linking function between the communication units. Consequenly, in such cases the links are normally realised by the same co-reference indices which accomplish low-level links between the communication units.

As regards the second question, we can declare the rules for the proper transformation of a selected communication unit into other communication unit(s) as follows:

We are looking for the communication unit(s)

(1) that contain all information of the original communication unit, that is, "cover" it without loss of information,

(2) that are minimal in a sense that they contain the least additional information to the original communication unit,

(3) that are parts of the knowledge base that is, they are acceptable on the basis of the valid syntactic and semantic rules.

Let us now turn our attention to the question of language-level coding of the figures of speech not discussed before. For example, let us try to construct the rules that produce the communication unit *k12a (Let music resound in the world!),* which has only a temporary function here, from the original, 12th communication unit *(Let the world resound with poppy-red!).*

First of all, let us notice that *the resounding world means the resounding music in the world*[8]. We will henceforth refer to the relationships of this kind as *associative relationships*. Because this relationship may include almost any kind of relationship between concepts, its coding in the model is a bit more complex than the coding techniques we have discussed so far. In what follows we will deal with the coding of associative relationships using language-level coding techniques.

Let us return to the coding of the expression *Let the world resound*. This is the original "target" (from *k12*) which we would like to retrieve using the expression *Let music resound in the world*. (from *k12a*) as a kind of search expression or "source". Altogether, we should describe formally the following relation of predicates with syntactically valid rules in the model:

[8] „All the world's a stage" (Shakespeare: As You Like It, Act II. Scene VII.) In our case, all the world is music.

```
music(X),
_subject(K,X),
resound(Y),
_imperative(K,Y),
_in(Y,Z),
world(Z):-
        world(X),
        _subject(L,X),
        _imperative(L,W),
        resound(W).
```

Let us note that the right side of the relation that is, the predicates on the right side of the *:-* sign, occur in the knowledge base as part of the coding of the 12th communication unit. Because *there can be only one predicate* on the left side of the *:-* sign, we should divide the relation above into a few separate but syntactically valid rules. The first rule is as follows:

```
music(X):-
        _association(X),
        world(X),
        _subject(K,X),
        _imperative(K,Z),
        resound(Z).
```

As *music* is, formally, a superordinate of *the (resounding) world* we need a predicate with which we can separate "real" hyponyms (that is, hyponyms used in their literal sense, e.g. *classical music*) from "associative" hyponyms (that is, hyponyms used in their figurative sense, e.g. *the resounding world* in our case). We introduce the predicate *_association* for that purpose. Note that it has to occur as a fact in the knowledge base as well, in our case together with the predicate *world* (i.e. in the form *_association(i06).* and *world(i06).*)

The second rule is as follows:

```
_in(Y,A):-
        world(A),
        _subject(L,A),
        _imperative(L,Y),
        resound(Y).
```

As this rule does not represent a hyponym relationship, there is no need to use the predicate *_association*. This is a rather formal, but effective, rule which could hardly be interpreted separately i.e., without the full sequence of rules coming from the division of the previously described relation of predicates. In fact, the first and second rule are all we need in our case because, as we can see below, it is not necessary to add any more rules to the adequate coding of the communication unit *k12a*.

Let us verify our statement by asking a question about the communication unit *k12a*: (Does the poet's beloved suggest that) music should resound in the world?

```
_question(Comm_unit) :-
        music(X),
        _subject(Comm_unit,X),
        _imperative(Comm_unit,Y),
        resound(Y),
        _in(Y,A),
        world(A).
```

Let us note that in the „body" of the question there are exactly the same predicates which occur on the left side of the previously described relation of predicates. Consequently, if we get positive answer(s) to the question, then the coding process of the communication unit *k12a* is complete.

The result is as follows:

```
Goal: _question(Comm_unit)
Comm_unit=k12a
Comm_unit=k12

2 Solutions
```

It is rather easy to check upon the process that leads to the solution *k12* (which corresponds to the high-level coding of the communication unit *k12a* discussed above). First, let us replace the predicate *music(X)* in the body of the question with the right side of the rule of the same predicate. Second, let us replace the predicate *_in(Y,A)* in the body of the question with the right side of the rule of the same predicate. Then let us perform the following substitutions of the variables: C:=K, Y:=Z, L=K, A:=X and L:=K (we are allowed to do that because the information retrieval algorithm searches all the occurrences of the variables anyway). We will find that all predicates in question occur in the knowledge base with the arguments K=k12, X=i06, Z=r12, respectively.

Because we have found two solutions which correspond to the indices of the communication units *k12a* and *k12*, respectively, both the low-level and high-level (or language-level) coding techniques we used have proved to be correct. We carried out the same procedure in the language-level coding of the communication unit *k12b*. The corresponding predicates can easily be found in the Prolog language program in the Appendix, so we will not go into further details here.

3.5 Conclusions

Finally, let us summarise and generalise our experiences acquired during the application of the model that has been selected for our constructive linguistic examinations. First, we need a brief overview of an appropriate cognitive framework for our further considerations. Note that a more elaborated one will be introduced and discussed in detail in **Chapter 4**.

In the interpretation process a selected poetic text can be considered as a *hypertext structure* to be explored in every detail. To be more precise, our task is to determine the full information content which is segmented in the various nodes of the hypertext structure, and

connected by the links between the nodes. Metaphorically, the hypertext structure is like a pyramid which has several *levels*:

- the selected poetic text(s) to be interpreted,
- other texts from the same author,
- various literary texts from other authors which could have had some effect on the author of the selected text(s), either directly or indirectly,
- additional (background) knowledge which can help the interpretation process in one way or another (e.g. biographical data, historical background, etc).

Moreover, in the interpretation process we obviously use dictionary, and encyclopaedic knowledge as well which does not come directly from the corpus or pyramid outlined above but form an inherent part of our mental knowledge base. (Here we remark that the individual component of such knowledge naturally varies horizontally and vertically in different persons.) Thus we arrive at two different layers of a complex hypertext structure (see Table 1).

dictionary knowledge encyclopaedic knowledge	primary text to be interpreted texts by the same author texts by other authors other (background) knowledge

Table 1

The various types of knowledge represented in the table are closely related to the corresponding layers of the MLAIS model as follows:

- the knowledge represented in the second column of the table corresponds to the T layer of the MLAIS model;
- using the P*-notation, the information coded as facts in the knowledge base comes primarily from the knowledge represented in the second column, that is, from the T layer. Note that, however, that the facts belong to the LC layer, see below;
- the information coded as rules in the knowledge base comes primarily from, or will be part of dictionary and encyclopaedic knowledge;
- the dictionary and encyclopaedic knowledge, represented in the first column of the table, corresponds to the LC, and I layers of the MLAIS model;
- using the P*-notation, the information coded as facts and rules in the knowledge base belongs to the LC layer of the MLAIS model. In other words, the P*-notation describes the *fine structure* of the LC layer.

Now turn our attention to the question of metaphors, and their cognitive role. The main conclusion of our former examinations can be formulated as follows:

In general, metaphors belong to the LC layer, and not to the T layer, so we usually need not apply low-level coding (using language-level coding instead).

In the model, we coded the conceptual metaphors, as well as other figures of speech, on two separate levels. We used

- low-level or fact-level coding which resulted in facts in the knowledge base;
- high-level or language-level coding which resulted rules in the knowledge base.

Let us restrict our consideration to metaphors now as the train of thought provided here can be easily generalised and conveyed from metaphors to other figures of speech. It seems to be clear, that only those metaphors that have been coded on language-level or high-level could belong to dictionary (or encyclopaedic) knowledge. Metaphors coded on fact-level or low-level can be considered as individual or unique language components the domain of which covers only the semantic environment of the text in which they occur. (In this sense they belong to the knowledge represented by the T layer of the MLAIS model.)

Let us examine now, how the fact that conceptual metaphors are mappings between domains of concepts ([LAK92], [KÖV98]) can be expressed explicitly in the model by the use of rules. We have seen before that conceptual metaphors appear in the model as the generalisation of *hyponym relationships* of concepts which can be easily represented in the form of rules. Consequently, on the one hand, the source domain of a conceptual metaphor (*from which* we select certain attributes) corresponds to the superordinate concept of a hyponym relationship. On the other hand, the target domain of the conceptual metaphor (*which* is to be conceptualised with the selected attributes) corresponds to the metaphorical hyponym of the superordinate concept so that the hyponym inherites those attributes from the source domain which are in harmony with its literal sense. It also suggests that *conceptual metaphors use the same conceptualisation mechanism as hyponym relationships*. The only exception is that metaphorical hyponyms belong to two superordinate concepts at the same time: one is for their figurative sense, and the other is for their literal sense. For example, the conceptual metaphor A POPPY IS FIRE can be illustrated as follows:

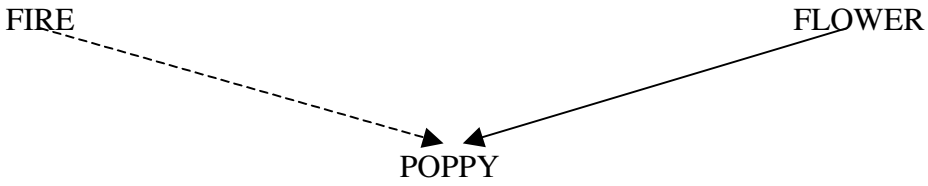


Figure 4

(Here the broken line shows “metaphorical”, and the continuous one shows “real” hyponym relationship between the concepts.)

So it is not surprising, that only those attributes are inherited from the metaphorical side which do not contradict the attributes inherited from the literal side. The definite advantage of this conceptualisation mechanism is that there can be *more than one* attribute which can restrict the meaning of, or characterise, the metaphorical concept. In case of simultaneous mappings of related concepts which lead to a *coherent system of conceptual metaphors* this effect can be further increased. Note that while the inherited attributes should be *definitive* in the source domain with respect to the meaning of the superordinate concept, the attributes which *validate* their inheritance on the basis of the invariance principle, are only *alternative* or basic-level, and not at all definitive attributes in the literal sense, or target domain of the hyponym concept.

Let us examine now the consequences we can draw about the explicit form of metaphorical (and other) relationships within the hypertext structure we consider as a cognitive paradigm in the interpretation of poetic texts. On the basis of the language model we used we can establish two types of relationships within the hypertext structure:

- low-level or fact-level relationship which is related to the facts in the knowledge base. Is is based on the occurrence of the same co-reference index in two or more facts, which in turn links those facts (as well as the units or nodes which contain them) together;
- high-level or language-level relationship which is related to the rules in the knowledge base. It can be represented by a two-step information retrieval procedure (which resembles the procedure described in [DENH88], pp. 271-272). This procedure is the base of the *hypertext-based or associative interpretation of literary texts* (see [BOD96], [PORK96]), which performs the following steps several times in a recurring process (see Fig 5):
  1. selecting a concept or *keyword* ([GUID53]), especially which implies a suppositional, e.g. hyponym or metaphorical relationship, from the primary text (e.g. which is to be interpreted), and retrieving a rule containing the keyword in its "body" from the actual representation of a knowledge base;
  2. selecting those (secondary) texts which can be retrieved using the rule selected in the previous step.

As can be seen, rules play an essential role in the hypertext structure as links. These links are illustrated in Fig 5.

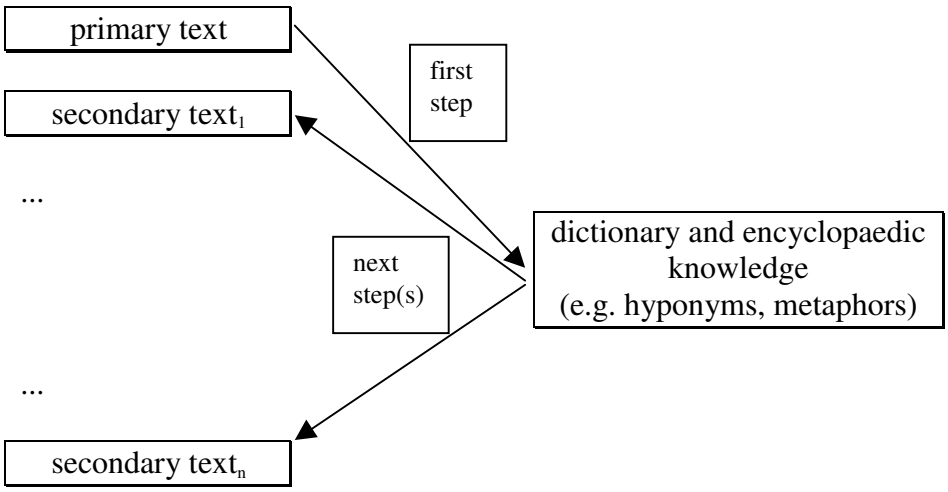


Figure 5

Note that low-level relationships have syntagmatic character, and high-level relationships have paradigmatic character.

Let us deal now briefly with the concrete representation of the hypertext structure. The main components of the hypertext structure which corresponds to our considerations can be implemented as follows:

- the corpus which contains the primary and secondary texts. Note that, in a given corpus, it depends on our decision which text is to be considered as a primary text that is, the text to be interpreted (TEXTUAL LAYER; in the model we have used this corresponds to the main *source* of facts);
- an interactive concordance index or dictionary which is usually generated directly from the texts of the corpus. This makes it possible to browse or navigate, through the concepts *as well as their context* coming from the textual layer, between (1) the texts of the corpus and (2) the objects or items of the logical / conceptual layer (INDEX LAYER; note that it is the only layer which does not appear directly in the model we have used because it is related to the syntagmatic relationship of concepts);
- a language database or, to be more precise, knowledge base. It can be represented, for example, as a
  1. monolingual dictionary which processes, among others, the language used by selected poets or novelists (see e.g. [COL93]),
  2. thesaurus (see e.g. [ROG78]),
  3. dictionary of synonyms and related words (see e.g. [MGUI71]),
  4. lexicon (see e.g. [MCAR84]),
  5. dictionary of a poet's vocabulary (see e.g. [JAK93]), or
  6. bilingual dictionary which also has a similar function (offering different words or phrases as synonyms under a specific heading, etc).

  In this layer selected groups of concordances can be classified or grouped into items or entries under specific keywords. It facilitates the navigation across different places of the index layer which belong to the same semantic category (LOGICAL / CONCEPTUAL LAYER; in the model we have used this corresponds to the knowledge base of rules *and* facts);
- the user interface which promotes the interaction between the computer and the user, and controls the navigation across the different components of the complex hypertext structure (HYPERTEXTUAL LAYER; note that making a selection from the various links offered at a certain stage of navigation means taking the next step in a kind of manual information retrieval or „unification" algorithm).

Bibliography

[ALB90] Alberico, R. - Micco, M.: Expert systems for reference and information retrieval. - Meckler, 1990.

[AND98] Andor J.: A komplex lexikálisjegy-analízis és a mormota esete. In: Pléh Cs. - Győri M. (szerk): A kognitív szemlélet és a nyelv kutatása. - Pólya K. 1998. pp. 83-100.

[BIBLE82] The Bible. Authorized Version. – The Bible Societies, Oxford, 1982.

[BIBLE89] The Bible. New International Version. – Hodder&Stoughton, 1989.

[BOD96] Boda I. Károly - Porkoláb Judit: Költői szókészletvizsgálat számítógépes programmal. = Iskolakultúra 6 (1996) 1. 51-61.

[BOD98] Károly I. Boda: Complex Data Structures and their Role in the Organization of Information Systems. - Presentation in "Conference of PhD Students in Computer Science" (Institute of Informatics of the József Attila University, Szeged, 18 July 1998.)

[BOD00] Boda I. Károly - Porkoláb Judit: A koreferencia kérdései a számítógépes szövegfeldolgozás szempontjából. = Officina Textologica 4 szám. Koreferáló elemek – koreferenciarelációk. Magyar nyelvű szövegek elemzése. Diszkusszió. – (szerk. Dobi Edit, Petőfi S. János) – Kossuth Egyetemi Kiadó, Debrecen, 2000.

[BOR95] Borgulya I.: Szakértői rendszerek, technikák és alkalmazások. – ComputerBooks, 1995.

[BÜKY84] Büky B. - Egyed A. - Pléh Cs.: Nyelvi képességek - fogalomkincs - megértés. - Tankönyvk. Budapest, 1984.

[COL93] Collins Cobuild English Language Dictionary. – HarperCollins Publishers, 1993.

[COL97] Collins Cobuild English Dictionary. – HarperCollins Publishers, 1997.

[DENH88] Denhière, G.Y.: Szemantikai, fogalmi, vagy lexikai emlékezet? (Mémoire sémantique, conceptuelle ou lexicale?) In: Pléh Cs. (szerk.): Szöveggyűjtemény a pszicholingvisztika tanulmányozásához. - Tankönyvk. Budapest, 1988.

[OXF91] The Concise Oxford Dictionary of Quotations. 2nd ed. - Oxford University Press, 1991.

[ECO98] Eco, U.: A tökéletes nyelv keresése. – Atlantisz K. 1998.

[GUID53] Guiraud, P.: Langage et versification d'apres l'oeuvre de Paul Valery. - Paris, 1953.

[HORN80] Hornby, A.S. - Cowie, A.P.: Oxford Advanced Learner's Dictionary of Current English. 3rd ed. - Oxford University Press, 1980.

[JAK93] Jakab L. – Bölcskei A.: Csokonai-szókincstár I. Csokonai színművei szókincsének szövegszótára és adattára. – KLTE Debrecen, 1993.

[KIEF00b] Kiefer F.: A kognitív nyelvészet: új paradigma? = A megismeréskutatás útjai. – szerk. Pléh Cs., Kampis Gy., Csányi V. – Akad K. 2000. – 120-144. (Pszichológiai Műhely 12.)

[KÖV98] Kövecses Z.: A metafora a kognitív nyelvészetben. In: A kognitív szemlélet és a nyelv kutatása. (szerk. Pléh Cs. és Győri M.) - Budapest, Pólya K. 1998. pp. 50-82.

[LAK92] Lakoff, G.: The Contemporary Theory of Metaphor. - To Appear in Ortony, Andrew (ed.) Metaphor and Thought (2nd edition), Cambridge University Press. – 1992.

[MCAR84] McArthur, T.: Longman Lexicon of Contemporary English. – Longman, 1984.

[MGUI71] Modern Guide to Synonyms and Related Words. – ed. by Hayakawa, S.I. – Penguin Books, 1971.

[PETŐ97] Petőfi S. J.: Egy poliglott szövegnyelvészeti-szövegtani kutatóprogram. = Officina Textologica, 1. szám. – Kossuth Egyetemi K. Debrecen, 1997.

[PETŐ99] Petőfi S. J.: Adalékok a szó- és gondolatalakzatok szemiotikai textológiai keretű általános elméletéhez, különös tekintettel a metaforakutatásra. – Szemiotikai szövegtan 12. szám. Szövegtani kutatás: témák, eredmények, feladatok (II). – JGYF Kiadó, Szeged, 1999. pp. 110-135.

[PORK96] B. Porkoláb Judit - *Boda I. Károly*: Helyzet és válasz Radnóti Miklós: Ó fény, ragyogás, napszemű reggel! c. versében. = Anyanyelv és iskola az ezredfordulón. XII. Anyanyelv-oktatási napok Eger, 1996. július 8-11. - A Magyar Nyelvtudományi Társaság Kiadványai 207 (1996) 260-267.

[PRÓ89] Prószéky G.: Számítógépes nyelvészet. Természetes nyelvek használata számítógépes rendszerekben. – SZÁMALK, 1989.

[RADN76] Radnóti Miklós művei. - Szépirodalmi K. 1976.

[RADN80] Miklós Radnóti: The Complete Poetry. - edited and translated by E. George. - Ardis, 1980.

[RICH93] Richards, J.C. - Platt, J. - Platt, H.: Longman Dictionary of Language Teaching and Applied Linguistics. - Longman, 1993.

[ROG78] Roget's Thesaurus of English Words and Phrases. – rev. and abr. by Dutch, R.A. - Penguin Books, 1978.

[RUSS00] Russell, S. J. – Norvig, P.: Mesterséges intelligencia modern megközelítésben. – Panem – Prentice Hall, 2000.

[SAD81] Sadock, J.M.: Figurative Speech and Linguistics. In: Metaphor and Thought. – ed. by Ortony, A. - Cambridge University Press, 1981.

[SHAK99] The Complete Works of William Shakespeare. - As You Like It. - June, 1999 [Etext #1786]. - The Library of the Future Complete Works of William Shakespeare. – World Library, Inc. - Project Gutenberg, 1999.

[TURB88] Turbo Prolog User's Guide. Version 2.0. – Borland International, 1988.

[WAL95] Wales, K.: A Dictionary of Stylistics. – Longman, 1995.

Appendix for Chapter 3

A sample PROLOG program for the processing of the poem *Poppy* by Miklós Radnóti

```
Domains

    oid = symbol /* indexes of the form kxx, ixx or rxx */
    txt = symbol /* texts */

/* ------------------------------------------------------------------- */

Predicates

/* structural (binary) predicates */

    _sentence(oid,txt) /* communication unit */
    _subject(oid,oid) /* subject of a sentence */
    _predicate(oid,oid) /* predicate of a declarative sentence */
    _imperative(oid,oid) /* predicate of an imperative sentence */
    _object(oid,oid) /* direct object of a sentence */
    _across(oid,oid)
    _in(oid,oid)
    _into(oid,oid)
    _to(oid,oid)
    _up(oid,oid)
    _with(oid,oid)
    _time(oid,integer) /* relative time within a text */
    _atst(oid,oid) /* at the same time */
    _then(oid,oid) /* next to */
    _related(oid,oid) /* occurrence in the same situation */
    _of(oid,oid)
    _keyword(oid,txt)

/* figures of speech */

    _metaphor(oid)
    _association(oid)

/* vocabulary */

bend(oid)
bloom(oid)
communists(oid)
cut(oid)
fire(oid)
flame(oid)
flower(oid)
glide_up(oid)
grass(oid)
happy_bird_note(oid)
i(oid)
light_flower(oid)
music(oid)
my_beloved(oid)
my_beloved_s_hand(oid)
my_beloved_s_two_fingers(oid)
my_whistle(oid)
poppies(oid)
poppy(oid)
```

```
poppy_red(oid)
proletarians_of_the_world(oid)
rebel(oid)
resound(oid)
road(oid)
say(oid)
see(oid)
shine(oid)
smile(oid)
stop(oid)
the_poppy_s_stem_s_hair(oid)
whistle(oid)
whistle_back(oid)
world(oid)

/* questions */

_q1(txt,oid,txt)
_q1a(txt,oid,txt)
_q2
_q3
_q4(oid,txt)
_q5(oid,txt)
_q6(oid)
_q7(oid,txt)
_q8(oid)
_q9(txt)
_q10(txt)
_q11(oid,txt)

/* ------------------------------------------------------------------- */

Clauses

_sentence(k01,"My beloved sees a poppy").
_sentence(k02,"and [my beloved] whistles to me across the road").
_sentence(k03,"and as I whistle back [to my beloved],").
_sentence(k04,"she [=my beloved] bends.").
_sentence(k05,"Her [=my beloved's] two fingers glide up the [poppy's]
stem's hair,").
_sentence(k06," and [=my beloved's two fingers] stop in the grass.").
_sentence(k07,"And already the light flower flames in her [=my beloved's]
hand.").
_sentence(k08,"I whistle again;").
_sentence(k09," into my whistle a happy bird note cuts ").
_sentence(k10,"and she [=my beloved] smiles:").
_sentence(k11,"[my beloved says that]").
_sentence(k12,"Let the world resound with poppy-red!").
    _sentence(k12a,"Let music resound in the world!").
    _sentence(k12b,"Let poppies bloom in the world!").

/* the coding of sentences */

_subject(k01,i01).
_subject(k02,i01).
_subject(k03,i02).
_subject(k04,i01).
_subject(k05,i03).
_subject(k06,i03).
_subject(k07,i04).
_subject(k08,i02).
```

```
_subject(k09,i05).
_subject(k10,i01).
_subject(k11,i01).
_subject(k12,i06).
_subject(k12a,i14).
_subject(k12b,i13).

_predicate(k01,r01). /* [k01] = [i01] [r01]/t1 [i04] */
_predicate(k02,r02). /* [k02] = [i01] [r02]/t2 . + to [i02], across [i08]
*/
_predicate(k03,r03). /* [k03] = [i02] [r03]/t3 . + to [i01] */
_predicate(k04,r04). /* [k04] = [i01] [r04]/t3 . */
_predicate(k05,r05). /* [k05] = [i03] [r05]/t4 . + up [i09] */
_predicate(k06,r06). /* [k06] = [i03] [r06]/t5 . + in [i10] */
_predicate(k07,r07). /* [k07] = [i04] [r07]/t6 . + in [i11] */
_predicate(k08,r08). /* [k08] = [i02] [r08]/t7 . */
_predicate(k09,r09). /* [k09] = [i05] [r09]/t7 . + into [i12] */
_predicate(k10,r10). /* [k10] = [i01] [r10]/t8 . */
_predicate(k11,r11). /* [k11] = [i01] [r11]/t8 [k12] (!) */
_imperative(k12,r12). /* [k12] = [i06] [r12]/t8,imp . + with [i13] */
_imperative(k12a,r13). /* [k12a] = [i14] [r13]/t8,imp . + in [i06] */
_imperative(k12b,r14). /* [k12b] = [i13] [r14]/t8,imp . + in [i06] */

_object(r01,i04).
_object(r11,k12).

_time(r01,1).
_time(r02,2).
_time(r03,3).
_time(r04,3).
_time(r05,4).
_time(r06,5).
_time(r07,6).
_time(r08,7).
_time(r09,7).
_time(r10,8).
_time(r11,8).
_time(r12,8).
_time(r13,8).
_time(r14,8).

_atst(X,Y):-
    _time(X,N),
    _time(Y,M),
    N=M.

_then(X,Y):-
    _time(X,N),
    _time(Y,M),
    N<M.

_related(X,Y):-
    _atst(X,Y).
_related(X,Y):-
    _then(X,Y).
_related(X,Y):-
    _then(Y,X).

_across(r02,i08).
_in(r06,i10).
_in(r07,i11).
```

```
_in(r13,i06).
_in(r14,i06).
_in(Y,A):-
    world(A), /* 'resounding world' means various things that resound
                 in the world.) */
    _subject(K,A),
    _imperative(K,Y),
    resound(Y).
_into(r09,i12).
_with(r12,i13).
_to(r02,i02).
_up(r05,i09).

_of(i01,i02).
_of(i03,i01).
_of(i09,i04). /* this is not quite correct but it does not seem necessary
                 to enter the poppy's stem in the list of predicates
                 because it has only one occurrence (see i09) */
_of(i11,i01).
_of(i12,i02).

communists(X):-
    _metaphor(X),
    poppies(X). /* POPPIES ARE COMMUNISTS */
fire(X):-
    _metaphor(X),
    poppy(X). /* A POPPY IS FIRE */
flower(X):-
    light_flower(X).
flower(X):-
    poppy(X).
grass(i10).
happy_bird_note(i05).
i(i02).
light_flower(i04).
music(i14).
music(X):-
    _association(X),
    world(X),
    _subject(K,X),
    _imperative(K,Y),
    resound(Y).
my_beloved(i01).
my_beloved_s_two_fingers(i03).
my_beloved_s_hand(i11).
my_whistle(i12).
poppies(i13).
poppies(X):-
    _association(X),
    world(X),
    _subject(K,X),
    _imperative(K,Y),
    resound(Y),
    _with(Y,A),
    poppy_red(A).
poppy(i04).
poppy(X):-
    poppies(X).
poppy_red(i13).
proletarians_of_the_world(X):-
    _metaphor(X),
```

```
    world(X). /* THE WORLD MEANS THE PROLETARIANS OF THE WORLD */
road(i08).
the_poppy_s_stem_s_hair(i09).
world(i06).

bend(r04).
bloom(r14).
bloom(X):-
    _association(X),
    resound(X),
    _with(X,A),
    poppy_red(A).
cut(r09).
flame(r07).
glide_up(r05).
rebel(X):-
    _subject(K,Y),
    _imperative(K,X),
    resound(X),
    proletarians_of_the_world(Y).
resound(r12).
resound(r13).
say(r11).
see(r01).
shine(X):-
    _subject(K,Y),
    _predicate(K,X),
    flame(X),
    fire(Y).
smile(r10).
stop(r06).
whistle(r02).
whistle(r08).
whistle(X):-
    whistle_back(X).
whistle_back(r03).

_metaphor(i04).
_metaphor(i06).
_metaphor(i13).
_association(i06).
_association(r12).

/* index of keywords */

_keyword(i01,"my beloved").
_keyword(i02,"I").
_keyword(i03,"my beloved's two fingers").
_keyword(i04,"light flower").
_keyword(i04,poppy).
_keyword(i05,"happy bird note").
_keyword(i06,"world").
_keyword(i08,"road").
_keyword(i09,"the poppy's stem's hair").
_keyword(i10,"grass").
_keyword(i11,"my beloved's hand").
_keyword(i12,"my whistle").
_keyword(i13,"poppy-red").
_keyword(i13,poppies).
_keyword(i14,music).
```

```
_keyword(r01,see).
_keyword(r02,whistle).
_keyword(r03,"whistle back").
_keyword(r04,bend).
_keyword(r05,"glide up").
_keyword(r06,stop).
_keyword(r07,flame).
_keyword(r08,whistle).
_keyword(r09,cut).
_keyword(r10,smile).
_keyword(r11,say).
_keyword(r12,resound).
_keyword(r13,resound).
_keyword(r14,bloom).

/* ---------------------------------------------------------------- */

/* questions */

/*****************************/
/* What does my beloved see? */
/*****************************/

_q1(Comm_unit,What,Keyword):-
    _sentence(X,Comm_unit),
    _subject(X,I),
    my_beloved(I),
    _predicate(X,R),
    see(R),
    _object(R,What),
    _keyword(What,Keyword).

/*
Goal: _q1(Comm_unit,What,Keyword)
Comm_unit=My beloved sees a poppy, What=i04, Keyword=light flower
Comm_unit=My beloved sees a poppy, What=i04, Keyword=poppy
2 Solutions
*/

/**********************/
/* Who sees a flower? */
/**********************/

_q1a(Comm_unit,Who,Keyword):-
    _sentence(X,Comm_unit),
    _subject(X,Who),
    _keyword(Who,Keyword),
    _predicate(X,R),
    see(R),
    _object(R,Y),
    flower(Y).

/*
Goal: _q1a(Comm_unit,Who,Keyword)
Comm_unit=My beloved sees a poppy, Who=i01, Keyword=my beloved
Comm_unit=My beloved sees a poppy, Who=i01, Keyword=my beloved
2 Solutions
*/

/************************/
/* Does the poppy shine? */
```

```
/************************/

_q2:-
    _subject(K,I),
    poppy(I),
    _predicate(K,R),
    shine(R).

/*
Goal: _q2
Yes
*/

/*********************************************************************/
/* Does the poet's beloved call upon the proletarians of the world to
rebel? */
/*********************************************************************/

_q3:-
    _subject(K,I),
    proletarians_of_the_world(I),
    _imperative(K,R),
    rebel(R),
    _with(R,A),
    communists(A).

/*
Goal: _q3
Yes
*/

/*************************************************************/
/* What does the poet' beloved want to resound with poppy-red? */
/*************************************************************/

_q4(What,Keyword):-
    _keyword(What,Keyword),
    _subject(K,What),
    _imperative(K,Y),
    resound(Y),
    _with(Y,A),
    poppy_red(A).

/*
Goal: _q4(What,Keyword)
What=i06, Keyword=world
1 Solution
*/

/*************************************************************/
/* What does the poet' beloved want to resound in the world? */
/*************************************************************/

_q5(What,Keyword):-
    _keyword(What,Keyword),
    _subject(K,What),
    _imperative(K,Y),
    resound(Y),
    _in(Y,A),
    world(A).
```

```
/*
Goal: _q5(What,Keyword)
What=i06, Keyword=world
What=i14, Keyword=music
2 Solutions
*/

/*****************************************************************/
/* Does the poet' beloved want the music to resound in the world? */
/*****************************************************************/

_q6(K):-
    music(X),
    _subject(K,X),
    _imperative(K,Y),
    resound(Y),
    _in(Y,A),
    world(A).

/*
Goal: _q6(K)
K=k12a
K=k12
2 Solutions
*/

/*********************************************************/
/* What does the poet' beloved want to bloom in the world? */
/*********************************************************/

_q7(What,Keyword):-
    _keyword(What,Keyword),
    _subject(K,What),
    _imperative(K,Y),
    bloom(Y),
    _in(Y,A),
    world(A).

/*
Goal: _q7(What,Keyword)
What=i06, Keyword=world
What=i13, Keyword=poppy-red
What=i13, Keyword=poppies
3 Solutions
*/

/* Does the poet' beloved want the poppies to bloom in the world? */

_q8(K):-
    poppies(X),
    _subject(K,X),
    _imperative(K,Y),
    bloom(Y),
    _in(Y,A),
    world(A).

/*
Goal: _q8(K)
K=k12b
K=k12
2 Solutions
```

```
*/

/* What does the poet’s beloved say? */

_q9(Text):-
    _subject(K,S),
    my_beloved(S),
    _predicate(K,R),
    say(R),
    _object(R,K1),
    _sentence(K1,Text).

/*
Goal: _q9(Text)
Text=Let the world resound with poppy-red!
1 Solution
Goal:
*/

/* What does the poet’s beloved want? */

_q10(Text):-
    _subject(K,S),
    my_beloved(S),
    _predicate(K,R),
    say(R),
    _object(R,K1),
    _imperative(K1,_),
    _sentence(K1,Text).

/*
Goal: _q10(Text)
Text=Let the world resound with poppy-red!
1 Solution
Goal:
*/

/* What follows the event when the poet’s beloved sees a poppy? */

_q11(K1,Text):-
    _subject(K,S),
    my_beloved(S),
    _predicate(K,R),
    see(R),
    _object(R,X),
    poppy(X),
    _then(R,R1),
    _predicate(K1,R1),
    _sentence(K1,Text).
/* the solution includes only declarative sentences */

/*
Goal: _q11(K1,Text)
K1=k02, Text=and [my beloved] whistles to me across the road
K1=k03, Text=and as I whistle back [to my beloved],
K1=k04, Text=she [=my beloved] bends.
K1=k05, Text=Her [=my beloved's] two fingers glide up the [poppy's] stem's
hair,
K1=k06, Text= and [=my beloved's two fingers] stop in the grass.
K1=k07, Text=And already the light flower flames in her [=my beloved's]
hand.
```

```
K1=k08, Text=I whistle again;
K1=k09, Text= into my whistle a happy bird note cuts
K1=k10, Text=and she [=my beloved] smiles:
K1=k11, Text=[my beloved says that]
10 Solutions
*/
```

Chapter 4

The Hypertext Approach to the Question of the Interpretation of Poems

Introduction

The concept *'understanding'* is used, as in everyday language, in more than one sense in the psychology of discourse. In the narrower sense, it can be interpreted as a process in which, from the input signals coming from spoken or written sources, we recognise the basic statements lying behind the acts of discourse ([BÜKY84]). Although the understanding of poetic texts is a more complex process, it should be similar, in one way or another, to the recognition process of everyday statements. In this chapter, we try to establish some basic elements of the understanding process of those people (e.g. elementary or secondary school pupils, university or college students, etc.) who want to understand the way the poet thinks, or, in an advanced stage, who can enter into the spirit of the poem, i.e. the emotions, ideas, attitudes, or behaviour patterns expressed by the text of the poem.

During their elementary, secondary, or higher education literary studies in Hungary, pupils and students get to know a lot of poems and several excellent, and mainly heuristical, methods for interpreting them. However, it seems to be a very promising way with respect to the better understanding of literary texts, to add *psycholinguistic methods* and ideas to the usual interpretation methods pupils and students use day by day during their literary studies. We are convinced, that the effectiveness of such methods can greatly contribute, among other things, to the development of the overall knowledge and skills pupils and students have in language use, from the recognition of words and concepts to the complete understanding of them.

There are several models for the *representation of knowledge* or memory described in the specialist literature of psycholinguistics (see e.g. [DENH88], [GÓSY99]). In the following, we attempt to select some basic elements of those models, as well as adding some new elements to them, without strictly sticking to one of the models having been described so far. As our aim is to study the understanding process of poetic texts as well as our approach is constructive instead of being purely theoretical, the applicability of the interpretation procedure we describe later, with its effectiveness and efficiency in practice, can justify the consistence of the selection of elements.

In this chapter, we first describe a hypertext-based cognitive framework in **Section 4.1** which has been developed by the author together with Judit Porkoláb for the interpretation of natural language texts, especially poetic texts (see e.g. [BOD96], [PORK96]). This framework is based on the MLAIS model described in **Chapter 1,** and it has been outlined briefly in **Chapter 3**. Because the usability of this framework can be presented only in action, we apply this approach to the *hypertext-based or associative interpretation* of the poem 'Nor Memory Nor Magic' by Miklós Radnóti in **Sections 4.2 and 4.3**. Finally, we summarise our experiences in **Section 4.4**.

4.1 Description of a hypertext-based cognitive framework

The *cognitive framework* of our further considerations is as follows. The interpretation of texts - in this case, poetic texts - requires, first of all, the precise knowledge of the meaning of words. Here, together with the accepted definition of the words that is valid in the given context, we should take into consideration certain knowledge about the world (see [PETŐ97]) which is necessary to understand fully the message of the text of the poem (note that the context itself is also part of such knowledge at “the tip of an iceberg” or below, as can be seen later). This knowledge can well be represented as a *hypertext structure* rather than a hierarchical one. The structure can be considered metaphorically as an "iceberg" where the text of the poem is only at the tip of the iceberg which contains several additional levels. Note that those levels are almost as important with respect to the meaning of the text as the text itself.

The levels of the "iceberg" might be as follows:

- the selected poem or text to be interpreted
- other poems or texts from the poet of the text analysed;
- poems or texts from other poets who had or could have had certain effects on the poem;
- the background context of the text of the poem, e.g. its historical background, events that were of vital importance for the poet, similar events or experiences (i.e. the appropriate *schemas* of the receiver of the poetic message) that might influence, in one way or other, the understanding or interpretation process of the poem, etc.

The levels of the iceberg are cross-linked with each other, the overall corpus and these links forming together a hypertext structure which is the core of our further considerations.

Note that the 'dictionary' or 'lexical' knowledge (about the different types of knowledge see [ANDO98]), and the knowledge about the "world" (of the poem, of other literary texts, of the poet etc. - that is, the knowledge about the corresponding portions of the real and *third world*, see [POPP98]) represented above as an "iceberg" are equally important with respect to the whole interpretation process. Therefore, they can be represented as two separate, but cross-linked, layers of a complex, multi-layer hypertext structure (see Fig 1). Note that they correspond to the LC and T layers of the MLAIS model, respectively.

As can be clearly seen in the construction of the "iceberg" structure, the layers of the multi-layer hypertext structure have their own, inner or "fine" structure which fits the multi-level hypertext representation excellently. For example, dictionary knowledge can be *represented* as a certain network of the meaning of words, a so-called semantic network of concepts (see e.g. [BOR95], [ECK95], [GÓSY99], [PRÓ99]). Note that this *representation* corresponds to the I layer of the MAIS model. The semantic network of concepts is organised on the basis of certain (binary) relationships between the concepts including paradigmatic and syntagmatic relations coming from substitution, addition, comparison and distinction of concepts, etc. Most of such relations are implicitly or explicitly indicated in the dictionary items of the corresponding words. In addition to the words and their relationships that can be found in dictionaries, other concepts and relations may as well be necessary e.g. from specialist books, essays, articles, encyclopaedias, etc. Thus if we take this "encyclopaedic" knowledge into consideration, it will form a new level beside (or under) the "dictionary" level of the corresponding layer. Because the relationships of concepts can easily be represented as hypertext links between the nodes of the semantic network, a hypertext paradigm can be applied to the layer containing those nodes as well as to the whole cognitive framework, too.

Although forming a corpus as a hypertext structure as well as having enough dictionary (and encyclopaedic) knowledge is fundamental to understand the meaning of the elements of the text of the poem, there are obviously other levels in the organization of knowledge which are also responsible for the effectiveness of the whole, rather complex, cognitive process of understanding the poem.

One example of those levels is as follows. Based on the complex hypertext structure outlined above, the concepts of the text of the poem can be (simultaneously) grouped *or classified* into several schemas where each schema forms, after all, a consistent system of concepts and relationships. In other words, 'concepts may be *organized* into schemas ... which are mental frameworks for representing knowledge, encompassing an array of interrelated concepts in a meaningful organization.' ([STER96], pp. 198-199) These schemas, especially in case of reading or hearing the text for the first time, are supposed to be organised around certain keywords ([GUID53]), and can be clearly separated on the basis of certain dimensions (e.g. time, space, etc.). Note that the construction of schemas is a kind of abstraction (or generalisation) and therefore the schemas belong to a particularly high level of a vertically organised "generic" knowledge which corresponds to the LC layer of the complex hypertext framework.

In addition, generic knowledge is an inherent part of the hypertext structure *which is expressed through the activity of the users* who

- formulate a query,
- activate the corresponding links of the overall structure,
- access to the corresponding nodes of the structure , and
- *organise dynamically* the obtained information in their own mental knowledge base.

As can be seen, this activity is a representation of the H layer of the MAIS model. Note that its effectiveness depends on the users who try to get the best of the navigation features of the H layer of the system. This approach might as well explain some problems with respect to the use of hypertext, for example cognitive overload.

Note that the abstract schemas, their content and organisation, and especially the paradigm on the basis of which the concrete, or text-based representation of those schemas (referred to simply as 'schemas' above) can be interpreted, depend on and are greatly influenced by his or her own "individual" knowledge of the receiver of the message of the poem, concerning all types of knowledge mentioned so far. This fact itself can provide a huge number of different interpretations, and therefore it is responsible for the 'openness' of poetic texts which is probably one of the most important features of the interpretation process (see [ECO98]).

The types of knowledge mentioned so far as layers of a complex hypertext-based framework are illustrated in Figure 1.

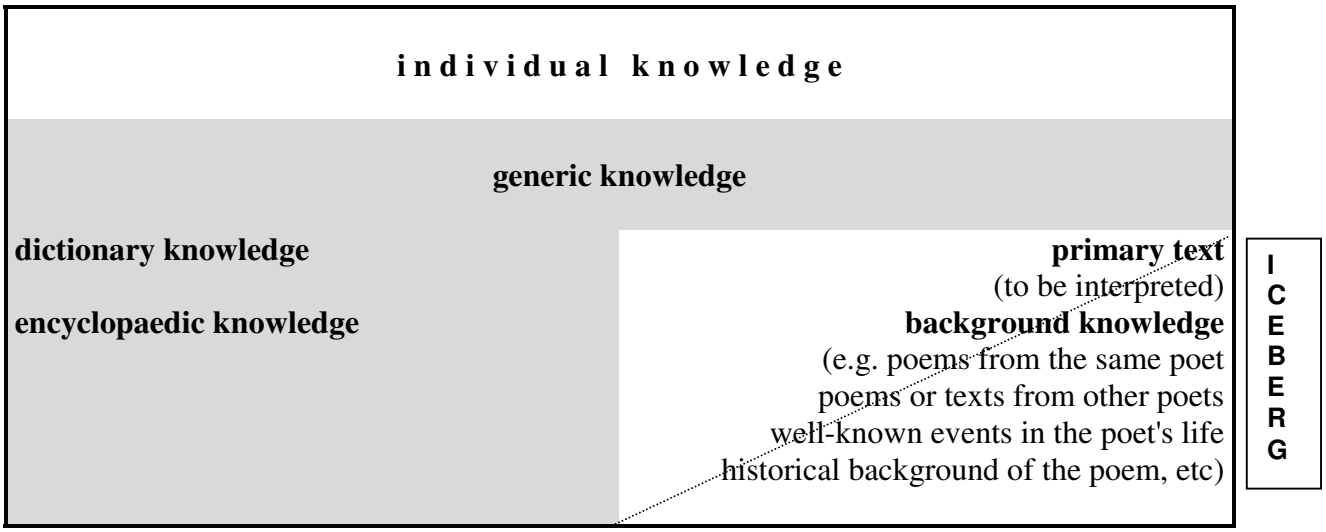


Figure 1: certain types of knowledge as layers of a complex hypertext framework

4.2 Interpretation of the poem *Neither Memory Nor Magic* by *Miklós Radnóti*

After such rather abstract considerations, let us be constructive. We consider the framework outlined above as the basis of the hypertext-based interpretation process of poetic texts. Note that during this process *we will build up a complete hypertext or associative structure* (see **Section 4.3**) which is, by its nature, nonlinear like the associative structure of the human brain. Therefore a lot of associations will arise at almost every point of the structure which will be placed in footnotes. Hopefully, the content of the hypertext structure does not become completely unrecognisable in its linearised form.

Now, we attempt to follow and illustrate the hypertext-based interpretation process step-by-step by interpreting a selected poem of the great Hungarian poet, Miklós Radnóti. The poem to be interpreted is as follows (in Hungarian and in English, respectively):

Radnóti Miklós: Sem emlék, sem varázslat

1. Eddig úgy ült szívemben a sok, rejtett harag,
2. mint alma magházában a négerbarna mag,
3. és tudtam, hogy egy angyal kisér, kezében kard van,
4. mögöttem jár, vigyáz rám s megvéd, ha kell a bajban.
5. De aki egyszer egy vad hajnalon arra ébred,
6. hogy minden összeomlott s elindul mint kisértet,
7. kis holmiját elhagyja s jóformán meztelen,
8. annak szép, könnyűléptű szívében megterem
9. az érett és tűnődő kevéssavú alázat,
10. az másról szól, ha lázad, nem önnön érdekéről,
11. az már egy messzefénylő, szabad jövő felé tör.

12. Semmim se volt s nem is lesz immár nekem,
13. merengj el hát egy percre e gazdag életen;
14. szívemben nincs harag már, bosszú nem érdekel,
15. a világ újraépül, — s bár tiltják énekem,
16. az új falak tövében felhangzik majd szavam;
17. magamban élem át már mindazt, mi hátravan,
18. nem nézek vissza többé s tudom, nem véd meg engem
19. sem emlék, sem varázslat, – baljós a menny felettem;
20. ha megpillantsz, barátom, fordulj el és legyints.
21. Hol azelőtt az angyal állt a karddal, —
22. talán most senki sincs.

Miklós Radnóti: Neither Memory Nor Magic

1. Till now, the many hidden angers dwelt so in my soul
2. as negro-brownish kernels in the apple's heart.
3. I knew I was escorted by an angel, in his hand a sword,
4. walking behind to watch and **< |~shield>**[1] me when my troubles start.
5. But when one morning, someone wakes to see
6. that everything is crushed, and ghostlike he must flee
7. leaving all his earthly goods behind,
8. then his handsome, easy-going heart will grow
9. a musing, ripe and meager-worded woe;
10. when he rebels, he does not talk about his selfish interest -
11. a free and distant future shines toward which he starts his quest.

12. I had no fortune. I shall have nothing more but strife;
13. let me, once more, daydream about this wealthy life.
14. No anger in my heart, no vengeance makes me care -
15. The world becomes renewed, although my being is forsaken there;
16. below the new-built walls, my words will then resound,
17. and in my heart I shall consume all that which lies around.
18. I shall not look back anymore - I know that neither memory
19. nor magic can **< |~protect>** me: evil-omened heavens cover me -
20. And if you see me, turn away, wink lightly with your hands:
21. where the sworded angel stood before -
22. perhaps there, no one stands.

(April 30, 1944.)

(translated by J. Grosz and W. A. Boggs) ([GRO63], [PORK87])

The first reading of the text needs, broadly speaking, only dictionary knowledge as well as the text itself. It provides a 'first version' paradigm which should be extended, and deepened, by further readings.

[1] The words typed with bold-face fonts will be the starting points of the interpretation process, see below.

This paradigm can be, more or less, as follows:

There were a lot of angers inside me (i.e. in my soul). I knew that an angel would protect (i.e. shield) me against my troubles.
When everything is crushed, someone must flee and so he leaves all his fortune (i.e. all his earthly goods) behind. From that time on, he does not talk about his selfish interests, he is interested only in the future.
Now there is no anger in my heart. Sometimes, the world will be renewed. My words will be well-known (i.e. resound) then. But in the meantime nothing (i.e. nor memory, nor magic) and no-one (i.e. the angel, or maybe you) can protect me.

There are obviously a lot of information which have been lost or omitted. And some questions are, certainly, still to be asked (and answered). For example one of the most important questions is that in addition to purely broadening this précis, are there any other approaches which can, partly or completely, alter this paradigm?

At first, we should choose a 'starting point' to begin interpreting the text. Probably, in harmony with that the poet expressed by the title of the poem, the last sentence of the précis will do:

nothing and no-one can protect me

Thus, let the first of our keywords be the word 'protect' as well as the word 'shield' and other synonyms or related words which mean more or less the same in the given context of the poem. Note that one of the key concepts of the construction of the hypertext representation of the poem is to use synonyms groups instead of using individual keywords. Here we can make good use of monolingual dictionaries (e.g. [COL93], [HORN80]) and especially of thesauruses (e.g. [SPO91], [WEBS76]). For example, the dictionary item for the words 'protect' and 'shield' contains the following words in [SPO91]:

protect 1 ... 2 ... to defend, to escort, to guard, to harbour, to keep safe. 3 ... to safeguard, to screen, to shield.

shield 1 ... 2 ... to defend, to guard, to keep safe, to protect, to safeguard, to shelter. 3 ...

Quite interesting, however, and shows the importance of relationships in any of the knowledge representation models, that during the construction of the hypertext structure, we found in the dictionary item in ([COL93]) for the word 'trouble' the following example:

trouble 1 … 2 … 3 If you refer to your troubles, you mean the problems in your life. EG ... She thought that all her troubles were over now she had the insurance money.

Here comes the word 'insure' which has its own dictionary item in ([COL93]) as follows:

insure 1 If you insure someone or something, you protect them by having an agreement with an insurance company to pay them money regularly so that, if there is an accident or if someone is ill, the company will pay the amount of money necessary for repairs, medical treatment, etc. ...

So that the word 'insure' is, semantically, closely related to the word 'protect'; to be more precise, they have paradigmatic relation ([RICH93]) where 'insure' is the narrower and 'protect' is the broader term.

The word 'insure' does not occur in [SPO91]; but in [WEBS76] it does, and has the following dictionary item:

insure vb syn ENSURE, assure, cinch, secure rel guard, protect, safeguard, shield

which backs up our train of thought completely. (Note that the word 'insure' occurs neither with 'protect' nor 'shield' in the thesauruses we used, so this heuristic way was the only one of finding it.)

Now, let us see the 'node' of the words 'protect', 'shield', etc. from the hypertext structure. We got the information that is stored in the node from the text as well as from dictionaries and from our corpus including quotations from Miklós Radnóti and other poets/authors, the Bible, and so on. Looking for the best way of organising the information within the nodes seemed to be the second key issue of the construction of the hypertext structure. At last we organised the information around certain questions which could imply a lot of possible answers. The question-answer construction or organisation of nodes seemed to be very useful to formally unify the information coming from several different types of sources and abstraction levels, as well as to make those information consistent. In addition, the questions and answers were very important with respect to the construction of the hypertext structure because selected keywords from the answers to the questions could be assigned as hypertext links to other nodes. In other words, each assigned keyword of an answer in a given node links the node to the corresponding node of the keyword from the hypertext structure (note that the nodes are organised around certain keywords or, more precisely, around groups of synonymous or paradigmatically related keywords). The nodes and their relationships with other nodes represent (and can be obtained primarily from) the abstract schemas of generic knowledge the reconstruction of which, as far as we can see, forms the basis of the interpretation or understanding process.

Within a node additional information is stored which can imply the possible questions and answers about the basic, synonymous or closely (paradigmatically) related, keywords of the node. The information can be grouped into a maximum of four different types of entries:

definitions: contain some definitive entries of monolingual dictionaries in selected senses of the keywords and closely related terms (*dictionary knowledge*). (see [COL93], [HORN80]);

alternatives: contain definitive entries of other keywords which contain at least one of the main keywords within, as well as examples of the main keywords from monolingual dictionaries (*dictionary knowledge*). Note that the definitive entries in the 'alternatives' group serve also as kinds of examples of the main keywords (see [COL93], [HORN80]);

quotations: contain quotations from our corpus including quotations from Miklós Radnóti and other poets/authors, the Bible, and so on (*background knowledge*) (see [AND95], [ARC97], [BIBLE97], [GEOR80], [OXF91], [PORK87], [RADN76], [SHAK88])

concordances: contain concordances from Miklós Radnóti: Neither Memory, Nor Magic (primary text from [GRO63]), generated by a computer program created by Károly I. Boda ([BODA96]). Those concordances seemed to be more powerful than using "traditional" quotations from the text of the poem analysed because the concordance dictionary of the text makes it possible to select

each word of the poem individually. Note that if an interactive concordance dictionary, with links from all words of the corpus to the concordances as well as to the text itself, were generated from a sort of "full" corpus covering *all the knowledge* our considerations have been based on, that dictionary could be considered as a "raw", not edited version of the hypertext structure described below.

The role of *encyclopaedic knowledge* (from philosophy, psychology, etc.) in the construction of the hypertext structure appears partly in the proper selection of the questions and answers (and the keywords within), and partly in the arrangement of the information within the nodes. In other words, encyclopaedic knowledge is responsible, in certain respect, for the completeness or recall of the information stored in the nodes. Here, we should be a little bit cautious using direct encyclopaedic knowledge to avoid misinterpretation and the use of purely "technical", scientific terms that can easily repress the emotional content of the poem. However, taking into consideration that the result of any interpretation process belongs to (a kind of) encyclopaedic knowledge, the results of the interpretation can greatly contribute to the development of the interpreter's own encyclopaedic knowledge about the subject. This is one reason why the interpretation of literary text is extremely important.

Of course, the availability and use of all the different types of knowledge mentioned so far is affected (that is, limited, extended, altered(!), etc) by *individual knowledge*. Thus, individual knowledge determines the way how effectively the interpreter of the poem (e.g. a certain student) can build the hypertext structure outlined above for himself or herself.

Now let us see the first node of the hypertext structure that we have generated from Miklós Radnóti's poem 'Neither Memory, Nor Magic' as well as from the various kind of information sources we could have had access to.

~protect; ~shield; defend; guard; insure

Questions

Who was / is to be shielded / protected?
  < |~the poet> (“me”)
Who else / What was / were to be protected?
  his life, his earthly **< |~goods>**
  his world
  his young wife
  his selfish **< |~interest>**, his self-esteem
  his spirit
Who was to shield the poet?
  a (guardian) **< |~angel> /** archangel
When did the angel shield the poet?
  when his **< |~trouble>**s started
What else can protect the poet?
  neither memory
  nor **< |~magic>**

From what should the poet be protected / shielded?
< |~danger>
< |~damage>; < |~injury>
< |~loss>

Definitions

To protect someone or something means to keep them safe from injury, damage, loss, or other unpleasant effects or events.
(Collins, 1993)

If someone or something shields a person or thing from particular danger or damage, they protect them from it, especially by putting a barrier between them.
(Collins, 1993)

...

Alternatives

A guardian angel is a spirit who is believed to protect and to guide a particular person.
(Collins, 1993)

An archangel is an angel of the highest rank.
(Collins, 1993)

If you have an interest in something being done, you want it to be done because it will benefit you, for example because it will protect your money, power, or position.
(Collins, 1993)

…

Quotations

... careful! it would be a pity about your life,
for your world, which you yourself have grubbed
with ten hard fingernails around your life, while
around you death hovered circling, round and round,
and see, it hovers again!
(M. Radnóti: Before A Storm; 1934)

Earth whirls into new war; up in its sky
the gentle blue is food for a hungry cloud,
and as it darkens, fearfully your young wife hugs you
and weeps aloud.

(M. Radnóti: War diary. 1. Monday Evening. 1935-36.)

... we shall have peace in the end.
Till then, spirit, don't cease - hold out, defend!
(M. Radnóti: Peace: A Hymn. 1938)

… defend yourself,
winter's law won't protect you, either,
nor will archangels come and help you,
pearl-colored light shivers on the sky,
and your close ones slowly die.
(M. Radnóti: Woods In October; 1937)

…

Concordances

```
s heart. I knew I was escorted by an angel, in his hand a sword, walking
ore - I know that neither memory nor magic can protect me: evil-omened he
neither memory nor magic can protect me: evil-omened heavens cover me - A
, walking behind to watch and shield me when my troubles start.
k back anymore - I know that neither memory nor magic can protect me: evi
ow that neither memory nor magic can protect me: evil-omened heavens cove
a sword, walking behind to watch and shield me when my troubles start.
ehind to watch and shield me when my troubles start.
```

Note that each keyword and hypertext link is denoted by the sign '~' and the signs '~', '<' and '>', respectively. The node above contains explanations and related examples of the keywords 'protect', 'shield', etc. (here from [COL93]), appropriate quotations (here from [GEOR80]) and some rows of the concordance dictionary of the poem generated by a computer program of the authors (see [BOD96]). The selection of the concordances is based on the verb pattern (for the words 'shield' and 'protect', this pattern is coded as VP15A and VP14, respectively; see [HORN80]):

An angel	can shield	me	against	my troubles
Neither memory	can protect		from	
Nor magic				

Note that every part of the corresponding sentences of the poem can be found in the 'Concordances' field of the node. This fact results some redundancies but ensures that every possible link should occur in the selection. In addition, concordances give us an easy way of formally assessing the covered or processed amount of the text analysed.

Now let us see an abridged (and obviously linearised) version of the hypertext structure omitting some of the concordances (the full concordance dictionary can be found in the Appendix), and placing the definitions, alternatives and quotations as 'footnotes'. This will not lead to a great loss of information as the essential parts of the omitted or "hidden" fields are embedded into the main, "visible" part (i.e. the 'Questions' field) of the nodes. It is worth noting that, among the possible

ways of navigating the non-linear hypertext structure through the various links, we can choose a way that we think it is the most significant one.

4.3 The associative structure of the poem

****

~protect; ~shield; defend; guard; insure

Who was / is to be shielded / protected?
  < |~the poet> ("me")
Who else / What was / were to be protected?
  his life[2], his earthly **< |~goods>**
  his world[3]
  his young wife[4]
  his selfish **< |~interest>**[5], his self-esteem[6]
  his spirit[7]
Who was to shield the poet?
  a (guardian)[8] **< |~angel> /** archangel[9]
When did the angel shield the poet?
  when his **< |~trouble>**s started

[2] „... careful! it would be a pity about *your life*, // for your world, which you yourself have grubbed / with ten hard fingernails around your *life*, while / around you death hovered circling, round and round, // and see, it hovers again!" (M. Radnóti: Before A Storm; 1934)

[3] „... careful! it would be a pity about your life, // for *your world*, which you yourself have grubbed / with ten hard fingernails around your life, while / around you death hovered circling, round and round, // and see, it hovers again!" (M. Radnóti: Before A Storm; 1934)

[4] „Earth whirls into new war; up in its sky / the gentle blue is food for a hungry cloud, / and as it darkens, fearfully *your young wife* hugs you / and weeps aloud." (M. Radnóti: War diary. 1. Monday Evening. 1935-36.)

[5] If you have an *interest* in something being done, you want it to be done because it will benefit you, for example because it will *protect* your money, power, or position. (Collins, 1993)

[6] This is all about one's success or failure and the state of mind produced by them. The state of mind produced by failure is a mixture of anxiety, anger caused by helplessness, shame and humiliation (see Ranschburg, 1998). As "humiliation is the feeling of embarrassment caused by having lost your pride and so appearing to be helpless or stupid" (Collins, 1993), the humiliating action and/or situation destroy one's pride and self-esteem and therefore evoke anger ("an anger born of frustration and humiliation", Collins, 1993). Because "most people *protect* themselves from injury to their self-esteem" (Collins, 1993), so anger should be essential in survival. Radnóti, as a great poet, knew the nature of human emotions perfectly well; he used the word 'anger' and related words as a keyword in his poetry, e.g. "Velvety darkness comforts me no longer, / *nor will thorny anger give release*; keeping vigil, hopeless, I wait / for morning's light to dawn on the walls." (M. Radnóti: Is This It, Then? …; 1937).

[7] „... we shall have peace in the end. // Till then, *spirit*, don't cease - hold out, defend!" (M. Radnóti: Peace: A Hymn. 1938)

[8] A guardian angel is a spirit who is believed to *protect* and to guide a particular person. (Collins, 1993)

[9] An archangel is an angel of the highest rank. (Collins, 1993) "… defend yourself, / winter's law won't *protect* you, either, / nor will *archangels* come and *help* you, / pearl-colored light shivers on the sky, / and your close ones slowly die." (M. Radnóti: Woods In October; 1937)

What else can protect the poet?
  neither memory
  nor **< |~magic>**
From what should the poet be protected[10] / shielded[11]?
  < |~danger>
  < |~damage>; < |~injury>
  < |~loss>

```
ow that neither memory nor magic can protect me: evil-omened heavens cove
a sword, walking behind to watch and shield me when my troubles start.
```

****

~the poet; I; me; he; someone

What is the poet daydreaming / thinking about?
  his wealthy life
What shall the poet do?
  not look back anymore
  (in his heart) consume all that which lies around
What does he not talk about when he rebels?
  his selfish **< |~interest>**
What makes the poet care?
  no vengeance
What is / was in the poet's heart / soul?
    What was in the poet's soul?
      many hidden **< |~anger>**s
    What is there now in the poet's heart?
      no **< |~anger>**
      humility[12]
      no trace of vanity[13]
    What kind of woe will his handsome, easy-going heart grow?
      musing
      ripe
      meager-worded

[10] To protect someone or something means to keep them safe from *injury, damage, loss,* or other unpleasant effects or events. (Collins, 1993)

[11] If someone or something shields a person or thing from particular *danger or damage*, they protect them from it, especially by putting a barrier between them. (Collins, 1993)

[12] The 8-9th lines of the poem are as follows: "then his handsome, easy-going heart will grow / a musing, ripe and meager-worded woe" in English, and „annak szép, könnyűléptű szívében megterem / az érett és tűnődő, kevésszavú alázat" in Hungarian, respectively. The last word, 'alázat' means 'humility' in English. Humility is the quality that someone has of being modest and not too proud, because they know that there are things about them which are not perfect. (Collins, 1993). Note that humility is closely related to one's self-esteem.

[13] „And, leaning on his pen, he thinks of all the children, / and in his heavy heart no trace of vanity, / it is for them he works …" (M. Radnóti: As, imperceptibly, 1943) 'No trace of vanity' here is a synonym of 'humility' (vanity is a very great feeling of pride about your appearance, cleverness, etc; used showing disapproval; Collins, 1993). Interesting, however, that according to (Webster, 1976) 'vanity' is a synonym of 'self-esteem'.

Who does the poet think of / work for while leaning on his pen?
  all the children[14]
What is the poet questing[15] for?
  a free and distant **< |~future>**

```
d meager-worded woe; when he rebels, he does not talk about his selfish i
everything is crushed, and ghostlike he must flee leaving all his earthly
ng, ripe and meager-worded woe; when he rebels, he does not talk about hi
d distant future shines toward which he starts his quest.
d ghostlike he must flee leaving all his earthly goods behind, then his h
g all his earthly goods behind, then his handsome, easy-going heart will
future shines toward which he starts his quest.
en he rebels, he does not talk about his selfish interest - a free and di
                                    I had no fortune. I shall have nothi
ownish kernels in the apple's heart. I knew I was escorted by an angel, i
und. I shall not look back anymore - I know that neither memory nor magic
s will then resound, and in my heart I shall consume all that which lies
                   I had no fortune. I shall have nothing more but strife
 consume all that which lies around. I shall not look back anymore - I kn
kernels in the apple's heart. I knew I was escorted by an angel, in his h
rotect me: evil-omened heavens cover me - And if you see me, turn away, w
nger in my heart, no vengeance makes me care - The world becomes renewed,
neither memory nor magic can protect me: evil-omened heavens cover me - A
ll have nothing more but strife; let me, once more, daydream about this w
ed heavens cover me - And if you see me, turn away, wink lightly with you
, walking behind to watch and shield me when my troubles start.
 The world becomes renewed, although my being is forsaken there; below th
, my words will then resound, and in my heart I shall consume all that wh
about this wealthy life. No anger in my heart, no vengeance makes me care
, the many hidden angers dwelt so in my soul as negro-brownish kernels in
g behind to watch and shield me when my troubles start.
en there; below the new-built walls, my words will then resound, and in m
               But when one morning, someone wakes to see that everything
```

****

~interest; benefit

```
, he does not talk about his selfish interest - a free and distant future
```

****

~anger

```
daydream about this wealthy life. No anger in my heart, no vengeance make
           Till now, the many hidden angers dwelt so in my soul as negro-
```

[14] „And, leaning on his pen, he thinks of all the children, / and in his heavy heart no trace of vanity, / it is for them he works …" (M. Radnóti: As, imperceptibly, 1943)

[15] A quest is a long and difficult search for something, especially something that you *value*. To quest means to search or seek for something, especially something which you *value*. (Collins, 1993)

****

~future; end

What indicates the future to the poet?
  evil-omened[16] **< |~heavens>**
  the **< |~sky>**[17]
What is to be expected in the near future?
  evil things
What is to be expected in the distant future?
  peace[18]
  the **< |~world>** becomes renewed

```
elfish interest - a free and distant future shines toward which he starts
mory nor magic can protect me: evil- omened heavens cover me - And if you
will then resound, and in my heart I shall consume all that which lies ar
                 I had no fortune. I shall have nothing more but strife;
onsume all that which lies around. I shall not look back anymore - I know
 then his handsome, easy-going heart will grow a musing, ripe and meager-
 below the new-built walls, my words will then resound, and in my heart I
```

****

~heavens; sky

```
or magic can protect me: evil-omened heavens cover me - And if you see me
```

****

the ~world; ~everything; the earth

What happened to the world?
  everything was crushed
What happens to the world / the earth?
  whirls into new war[19]
What will happen to the world?
  becomes renewed
  its walls become rebuilt

```
ostlike he must flee leaving all his earthly goods behind, then his hands
e morning, someone wakes to see that everything is crushed, and ghostlike
 forsaken there; below the new-built walls, my words will then resound, a
rt, no vengeance makes me care - The world becomes renewed, although my b
```

[16] An omen is something that you think indicates *what is going to happen in the future* and whether it will be good or bad. (Collins, 1993)

[17] "Earth whirls into new war; *up in its sky* // the gentle blue is food for a hungry cloud, // and as it darkens, fearfully your young wife hugs you // and weeps aloud." (M. Radnóti: War diary. 1. Monday Evening. 1935-36.) "… defend yourself, / winter's law won't protect you, either, / nor will archangels come and help you, / *pearl-colored light shivers on the sky*, / and your close ones slowly die." (M. Radnóti: Woods In October; 1937)

[18] „... we shall have peace *in the end*. // Till then, spirit, don't cease - hold out, defend!" (M. Radnóti: Peace: A Hymn. 1938)

[19] "*Earth whirls into new war*; up in its sky // the gentle blue is food for a hungry cloud, // and as it darkens, fearfully your young wife hugs you // and weeps aloud." (M. Radnóti: War diary. 1. Monday Evening. 1935-36.)

****

~fortune; earthly ~goods; money; possessions; property; treasure; wealth;

```
                              I had no fortune. I shall have nothing more b
                                     I had no fortune. I shall have nothing
           I had no fortune. I shall have nothing more but strife; let me
he must flee leaving all his earthly goods behind, then his handsome, eas
t me, once more, daydream about this wealthy life. No anger in my heart,
```

****

~angel; guardian angel; archangel

```
s heart. I knew I was escorted by an angel, in his hand a sword, walking
y with your hands: where the sworded angel stood before - perhaps there,
 knew I was escorted by an angel, in his hand a sword, walking behind to
```

****

~danger; ~trouble; strife

Who is in trouble?
  someone, like **< |~the poet>**
Who will help you in trouble?
  a guardian **< |~angel> /** archangel[20]
  the Lord God[21]
  Jesus[22]
Who / What else can help in trouble?
  a **< |~fortune>**[23]
  < |~friends>[24]

[20] An archangel is an angel of the highest rank. An angel is one of the spiritual beings that some people believe live with *God* in heaven and act as *God's servants* and messengers. (Collins, 1993) "… defend yourself, / winter's law won't protect you, either, / nor will *archangels* come and *help* you, / pearl-colored light shivers on the sky, / and your close ones slowly die." (M. Radnóti: Woods In October; 1937)

[21] According to the Holy Bible: "But the salvation of the righteous is of the LORD: he is their strength in the time of *trouble*. And the LORD shall *help* them, and *deliver* them: he shall *deliver* them from the wicked, and *save* them, because they trust in him." (Psa 37:39-40) But: "Give us help from trouble: *for vain is the help of man*." (Psa 60:11; 108:12) and "Better is little with the fear of the LORD *than great treasure and trouble therewith*." (Pro 15:16)

[22] "Let not your heart be troubled: ye believe in God, believe also in me." (St. John 14:1) „I know your new poems. Fury sustains you. / Anger of prophets, of poets: they're closely related, and peoples / find them their food and drink. Those who'll live, could live on it, till that / kingdom arrived, which *a certain youthful disciple had promised: / rabbi, who came and fulfilled our law and the word of the prophets*. / Come, proclaim with me that the hour is close, very close – that / kingdom is being born – wait! What God's plan and what is his purpose? / I once asked, and see: it's that kingdom. We'll take to the road. Let's / gather the tribe, bring your wife, and start cutting sticks for the journey." (M. Radnóti: Eighth Eclogue; 1944)

[23] "Better is little with the fear of the LORD *than great treasure and trouble therewith*." (Pro 15:16)

[24] "Give us help from trouble: *for vain is the help of man*." (Psa 60:11; 108:12)

What can you do in the time of trouble / in danger[25]?
< |~flee>
suffer the slings and arrows of outrageous fortune[26]
take arms against the sea of troubles[27]
→ to **< |~rebel>**[28]
→ → to protest; to **< |~say>** (against something)
→ to die, to sleep[29]

```
rtune. I shall have nothing more but strife; let me, once more, daydream
ehind to watch and shield me when my troubles start.
```

****

~friends; you; the poet's wife[30]; other poets; their wives

Where are the poets's friends now?
in his **< |~memory>**[31]
How can a friend help?
shout when it is needed[32]

```
vil-omened heavens cover me - And if you see me, turn away, wink lightly
see me, turn away, wink lightly with your hands: where the sworded angel
```

[25] Danger is the possibility that someone may be harmed or *killed*. (Collins, 1993)

[26] „To be or not to be - that is the question. / Whether 'tis nobler in the mind to suffer / *The slings and arrows of outrageous fortune*, / Or to take arms against the sea of troubles, / And by opposing end them? - To die - to sleep - / No more; and by a sleep to say we end / The heart-ache, and the thousand natural shocks / That flesh is heir to; 'tis a consummation / Devoutly to be wished." (Shakespeare: Hamlet, III.i.56)

[27] „To be or not to be - that is the question. / Whether 'tis nobler in the mind to suffer / The slings and arrows of outrageous fortune, / Or to take arms against *the sea of troubles*, / And by opposing end them? - To die - to sleep - / No more; and by a sleep to say we end / The heart-ache, and the thousand natural shocks / That flesh is heir to; 'tis a consummation / Devoutly to be wished." (Shakespeare: Hamlet, III.i.56)

[28] rebel (against): "*take up arms* to fight (against the government)" or "show resistance; *protest* strongly" (OALD, 1980). protest (against): "raise an objection, *say sth (against)*" (OALD, 1980).

[29] „To be or not to be - that is the question. / Whether 'tis nobler in the mind to suffer / The slings and arrows of outrageous fortune, / Or to take arms against the sea of troubles, / And by opposing end them? - *To die - to sleep* - / No more; and *by a sleep* to say we end / The heart-ache, and the thousand natural shocks / That flesh is heir to; 'tis a consummation / Devoutly to be wished." (Shakespeare: Hamlet, III.i.56)

[30] „My wife, my friend and peer" (M. Radnóti: Letter to my wife; 1944)

[31] "Bygone and gentle nights, you, too, are knighted to a *memory*! / Dazzling tables, wreathed with *youthful wives and poets*, / where do you grovel on the mire of bygone days? // Where is the night when *nimble friends* joyously drank // herb wine out of a handsome-eyed and slender glass?" (M. Radnóti: À La Recherche …; 1944)

[32] "Don't go past me, *my friend* - shout! and I'll rise again." (M. Radnóti: Forced march, 1944)

```
****************************************
```

~memory; past[33]

```
             Miklós Radnóti: Neither Memory Nor Magic
k back anymore - I know that neither memory nor magic can protect me: evi

****************************************
```

~flee

Why should you flee[34]?
  because of danger
  because of fear
What do you leave behind when you flee?
  all your earthly **< |~goods>**

```
ng is crushed, and ghostlike he must flee leaving all his earthly goods b

****************************************
```

~rebel

```
 ripe and meager-worded woe; when he rebels, he does not talk about his s

****************************************
```

~say; ~talk; sing; express one's thoughts

How does the poet express his thoughts?
  with **< |~poems>**
  using **< |~magic>**[35]
What does the poet (not) talk about?
  his selfish **< |~interest>**

```
ded woe; when he rebels, he does not talk about his selfish interest - a

****************************************
```

~poems; songs; the poet's words

How are the poet's songs accepted?
  his songs are forbidden[36]

---

[33] „As, imperceptibly, we fall into a dream / it's so he falls from youth over to grownup men, / he has a *past* …" (M. Radnóti: As, imperceptibly, …; 1943)

[34] To flee from something or someone, or to flee a person or place means to run quickly away from the person, place, or thing mentioned, especially *because of danger or fear.* (Collins, 1993)

[35] "A költő - ajkán csörömpöl a szó, / de ő, (az adott világ / varázsainak mérnöke), / tudatos jövőbe lát / s megszerkeszti magában, mint ti / majd kint, a harmóniát." [The words jingle on the poet's lips / but he (*who is the engineer / of all the magic of the given world*) / foresees the conscious future / and constructs in his heart, like you will do / in the outside world, the harmony. (translated by B.I.K.)] (József Attila: A város peremén [At The Edge of The City])

[36] This occurs only in the original poem (and not in its English translation): „s bár *tiltják énekem*" (instead of "my being is forsaken there", in the 15th line).

When / Where will the poet's words resound?
  in the free and distant **< |~future>**
  in the renewed **< |~world>**
  → below the new-built walls

```
 new-built walls, my words will then resound, and in my heart I shall con
will grow a musing, ripe and meager- worded woe; when he rebels, he does
there; below the new-built walls, my words will then resound, and in my h
```

****

~magic; charm; spell

How can a poet use magic?
  conjure things[37]
  foresee the conscious future[38]
  construct the harmony of the world[39]
How can the poets' magic protect you?
  heal the wounds of your heart[40]

```
  Miklós Radnóti: Neither Memory Nor Magic
ore - I know that neither memory nor magic can protect me: evil-omened he
```

[37] ""You could be a sailor," he said, "a windblown, clear heart, / and could live there /between the sunsets and the blue of the sea!" / I am that too, I laughed - oh, of all the things / a poet can be! / And all that you're declaiming for me / I'll here conjure - flash! you won't even guess / where the sun rises, which way is east!" (M. Radnóti: I sat with Tristan, 1939)

[38] "A költő - ajkán csörömpöl a szó, / de ő, (az adott világ / varázsainak mérnöke), / tudatos jövőbe lát / s megszerkeszti magában, mint ti / majd kint, a harmóniát." [The words jingle on the poet's lips / but he (who is the engineer / of all the magic of the given world) / *foresees the conscious future* / and constructs in his heart, like you will do / in the outside world, the harmony. (translated by B.I.K.)] (József Attila: A város peremén [At The Edge of The City])

[39] "A költő - ajkán csörömpöl a szó, / de ő, (az adott világ / varázsainak mérnöke), / tudatos jövőbe lát / s megszerkeszti magában, mint ti / majd kint, a harmóniát." [The words jingle on the poet's lips / but he (who is the engineer / of all the magic of the given world) / foresees the conscious future / and *constructs in his heart, like you will do / in the outside world, the harmony*. (translated by B.I.K.)] (József Attila: A város peremén [At The Edge of The City])

[40] Legyetek üdvöz egy nemes varázsló, / Egy tiszta költő arany szigetén. / Igen, míg künn a bús kor rossz viharja / Vak hullámokkal zúzni fenyeget, / S a vén világot jajgatni kavarja, / Hajókat sújtva és reményeket, / Ó, jertek, megpihenni, felpihegni / A parton, ahol megtörik az ár, / Ahol a vad vész verve búj lihegni, / Mert Prospero varázsvesszője vár. [Welcome in the golden island / of a righteous poet, a noble magician. / Oh yes, while in the outside world the evil tempest of this woeful age / threatens to crush the old world in blind waves / and stirs it smashing ships and hopes / until it begins to wail. / Oh come here to rest and climb up / the beach where the tide breaks / and where the wild trouble hides away to gasp for breath defeated / because there Prospero's magic staff waits.] (...) Ó, jertek, jertek e tündérszigetre, / Vad tengerek bús száműzöttjei! / Itt balzsam vár a sebbel vert szivekre, / A jó varázsló kebelére hí; / Nincs rossz dagály, amelynek nincs apálya, / A bomlott hab ma zúg, holnap siket, / De áll a költő-megszentelte pálya, / A dús, vigasztaló, örök sziget. [Oh come, come to this fairy island / sad refugees of all the wild seas! / *There is balm here that heals the wounds of your hearts* / and the good magician calleth you with open arms; / there is no evil tide which is always high, / and the roaring waves are mad today and calm tomorrow, / but the way to this rich, comforting, everlasting island / is sanctified by the poet to be always open to you. (translated by B.I.K.)] (Tóth Árpád: Prospero szigetén. [In Prospero's Island])

****

~damage; ~injury; harm

What causes damage / harm?
  war[41]
How can war cause damage / harm?
  < |~destroy> the **< |~world>**
   → **< |~crush> < |~everything>**
  plunder people[42]
   → cause people to lose their **< |~property>**
  kill people
   → cause a lot of people to die

****

~destroy; ~crush; defeat; ruin

```
eone wakes to see that everything is crushed, and ghostlike he must flee
```

****

~loss

What did the poet lose?
  all his earthly **< |~goods>**
What else can he lose?
  his **< |~liberty>**, **< |~freedom>**
  his **< |~life>**

****

~liberty; ~freedom

```
 talk about his selfish interest - a free and distant future shines towar
```

****

~life; being

```
e world becomes renewed, although my being is forsaken there; below the n
ce more, daydream about this wealthy life. No anger in my heart, no venge
```

****

[41] „Earth whirls into new *war*; up in its sky / the gentle blue is food for a hungry cloud, / and as it darkens, fearfully your young wife hugs you / and weeps aloud." (M. Radnóti: War diary. 1. Monday Evening. 1935-36.)

[42] If someone plunders someone or something, they *steal property* from them, using force and often *causing damage*. (Collins, 1993)

4.4 Conclusions

Now, as we finished our short tour in Radnóti Miklós's – and eventually other poet's – world, we should summarise our experiences. Using the hypertext methodology and, first of all, hypertext links to explore this world, we came to such semantic depths of the poem that – we firmly believe – we can hardly obtain from other approaches. But the pure amount of such links obviously makes it difficult to simply understand the poem. Therefore we should draw the conclusion that

(a) converting the information content of the poem into hypertext form (e.g. linking it to other parts or levels of the "knowledge pyramid" or "iceberg", etc) is an extremely efficient way to analyse the poem but
(b) we need new, additional methods, *paradigms* to understand all the tiny details and, at the same time, overview the whole of the knowledge base we built up.

We suggest two such methods. Note that each method we outline below has *more than one dimension* to represent the inner structure of the knowledge base.

1. Firstly, using a special *map* of the hypertext structure the various links of the structure can be clearly represented. In addition, "surfing" the structure the history of the links we visited can be easily marked.

2. Secondly, we can arrange the main points of the poem in a *two-dimensional table* which can serve as a starting point of our further considerations. The table looks like this (see Table 1):

(TABLE 1)

(endnotes for Table 1)

In the table we tried to show some inner links between the cells using arrows as references (as well as italic font style). For example, note the joint occurrence of the word 'hand' in both the *protect/past* cell and the *friends/near future* cell. We use the up arrow in the second cell indicating a reference to the first cell.

Although the table summarises the main points of our previous considerations, we would like to close our considerations with two final remarks.

1. On the one hand, there is a point which is not covered by the paradigm represented in Table 1. It is the metaphor of the first two lines of the poem:

Till now, the many hidden angers dwelt so in my soul
as negro-brownish kernels in the apple's heart.

The metaphor continues in the 6-9th lines of the poem:

… ghostlike he must flee
leaving all his earthly goods behind,
then his handsome, easy-going heart will grow
a musing, ripe and meager-worded woe;

Compare it with another quotation from the Fourth Eclogue:

the fruit swings and will fall, once it is ripe,
earth, deep with memory, will lay you to rest[43]

This, with the adjective 'ghostlike', suggests the coming of death – Radnóti was able to condense the essence of the poem into one forceful poetic image. As though we heard the words of the prophet:

Man that is born of a woman is of few days, and full of trouble. He cometh forth like a flower, and is cut down; he fleeth also as a shadow, and continueth not. (Job 14:1) ([ARC97b])

2. On the other hand, the rows of our table correspond more or less with the various levels of Maslow's Hierarchy Of Needs (see [MASL97]):

Table 1	***Maslow's Hierarchy Of Needs***
earthly goods; fortune	Physiological needs (including salary, etc)
protect; shield	Safety and Security
friends; help	Social needs
work; interest	Esteem
songs; magic	Self-actualization

As the needs listed in Maslow's Hierarchy are the main sources of *motivation* we might interpret our table in such a way. It is worth noticing that in the cell containing

"I shall not look back anymore - I know that neither memory (←) nor magic (↓) can protect me"

[43] (M. Radnóti: Fourth Eclogue; 1943)

the first column ("past; memories") and the last row ("songs; magic") are refused *by the poet himself* as a motivation factor. What else remained? Let us see the rows one by one:

- First row ("earthly goods; fortune"): "I had no fortune" (first cell); "I shall have nothing …" (fourth cell)
- Second row ("protect; shield"): "where the sworded angel stood before – perhaps there, no one stands *[who can shield me…]*" (third cell)
- Third row ("friends; help"): "if you see me, turn away … *[do not help]*" (fourth cell)
- Fourth row ("work; interest"): "he does not talk about his selfish interest" (second cell).

Thus no motivation remained. As if Radnóti Miklós wanted to select the second of Hamlet's choices… In fact, there is only one hope left in Pandora's box: though literally refused, the end of the last row outlines the picture of a free and distant future where everybody – and especially those who still have the innocent child in their heart - respect and like the poet of that woeful age. It is really the meaning of life – perhaps not motivation it its strict sense, but, actually, more than that.

Bibliography

[ANDO98] Andor J.: A komplex lexikálisjegy-analízis és a mormota esete. In: Pléh Cs. - Győri M. (szerk): A kognitív szemlélet és a nyelv kutatása. - Pólya K. 1998. 83-100.

[AND95] Classic Library. Over 2,000 Great Works of World Literature (CD-ROM). - Andromeda Interactive, 1995.

[ARC97a] Verstár. A magyar líra klasszikusai (CD-ROM). – Arcanum Databases, Budapest 1997.

[ARC97b] Biblia 5.0 (CD-ROM). Kilenc bibliafordítás teljes szövegű Folio Views adatbázisa. - Arcanum DataBases Kft. 1997.

[BODA96] Boda I.K. - Porkoláb J.: Költői szókészletvizsgálat számítógépes programmal. In: Iskolakultúra 6 (1996) 1, 51-61.

[BODA99] Boda I.K. - Porkoláb J.: Nyelvi megformálások értelmezése számítógépes programmal (a Jelenések könyve néhány részlete alapján). = Szemiotikai Szövegtan 12. szám. Szövegtani kutatás: témák, eredmények, feladatok (II). – JGYF Kiadó, Szeged, 1999. – 295-302 l.

[BODA00] Boda I.K. - Porkoláb J.: A koreferencia kérdései a számítógépes szövegfeldolgozás szempontjából = Officina Textologica, 4. szám. – Kossuth Egyetemi K. Debrecen, 2000. – 150-180 l.

[BORI65] Bori I.: Radnóti. - Fórum K. Novi Szad, 1965.

[[BÜKY84]: Büky B. - Egyed A. - Pléh Cs.: Nyelvi képességek - fogalomkincs - megértés. - Tankönyvk. Budapest, 1984.

[COL93] Collins COBUILD English Language Dictionary. - HarperCollins Publishers, 1993.

[DENH88] Denhière, G.Y.: Szemantikai, fogalmi, vagy lexikai emlékezet? (Mémoire sémantique, conceptuelle ou lexicale?) In: Pléh Cs. (szerk.): Szöveggyűjtemény a pszicholingvisztika tanulmányozásához. - Tankönyvk. Budapest, 1988. – 268-310.

[ECK95] Von Eckardt, B.: What is cognitive science? – A Bradford Book, 1995.

[ECO98] Eco, Umberto: Nyitott mű. (Opera aperta. Forma e indeterminazione nelle poetiche contemporanee.) - Európa K. Budapest, 1998.

[GEOR80] Miklós Radnóti: The Complete Poetry. - edited and translated by E. George. - Ardis, 1980.

[GÓSY99] Gósy M.: Pszicholingvisztika. – Corvina K. 1999.

[GRO63] Hungarian Anthology. A Collection of Poems. - translated by J. Grosz and W. A. Boggs. - Griff, Munich, 1963.

[GUID53] Guiraud, P.: Langage et versification d'apres l'oeuvre de Paul Valery. - Paris, 1953.

[HORN80] Hornby, A.S. - Cowie, A.P.: Oxford Advanced Learner's Dictionary of Current English. 3rd ed. - Oxford University Press, 1980.

[MASL97] Maslow, A.H.: Elmélet az emberi motivációról. = Szöveggyűjtemény az általános és a személyiségpszichológiához pedagógia és tanárszakos hallgatók részére. – (szerk. Oláh A., Pléh Cs.) - Nemzeti Tankönyvkiadó, 1997. -

[MILL88] Miller, G.A.: Pszichológiai kutatások a nyelvtanról. (Some psychological studies of grammar.) In: Pléh Cs. (szerk.): Szöveggyűjtemény a pszicholingvisztika tanulmányozásához. - Tankönyvk. Budapest, 1988. – 110-135.

[OSG88a] Osgood, C.E.: Mi a nyelv? (What is language?) In: Pléh Cs. (szerk.): Szöveggyűjtemény a pszicholingvisztika tanulmányozásához. - Tankönyvk. Budapest, 1988. – 13-56.

[OSG88b] Osgood, C.E.: Mondatok megértése és létrehozása. (On understanding and creating sentences.) In: Pléh Cs. (szerk.): Szöveggyűjtemény a pszicholingvisztika tanulmányozásához. - Tankönyvk. Budapest, 1988. – 136-167.

[OXF91] The Concise Oxford Dictionary of Quotations. 2nd ed. - Oxford University Press, 1991.

[PETŐ97]: Petőfi S. János: Egy poliglott szövegnyelvészeti-szövegtani kutatóprogram. = Officina Textologica, 1. szám. – Kossuth Egyetemi K. Debrecen, 1997.

[POPP98] Popper, K.: Test és elme. Az interakció védelmében. - Typotex K. 1998.

[PORK87] A csönd virága. Válogatás a magyar költészet remekeiből. Versek magyar, angol, francia, német és orosz nyelven. - TIT, 1987.

[PORK96] Porkoláb J. - Boda I.K.: Helyzet és válasz Radnóti Miklós Ó fény, ragyogás, napszemü reggel! c. versében. In: A Magyar Nyelvtudományi Társaság Kiadványai 207 (1996) 260-267.

[PRÓ99] Prószéky G.: Természetes nyelvek. In: Mesterséges intelligencia. – szerk. Futó I. – Aula K. 1999. pp. 756-814.

[RADN76] Radnóti Miklós művei. - Szépirodalmi K. 1976.

[RANS98] Ranschburg J.: Félelem, harag, agresszió. 9th ed. – Nemzeti Tankönyvkiadó, 1998.

[RICH93] Richards, J.C. - Platt, J. - Platt, H.: Longman Dictionary of Language Teaching and Applied Linguistics. - Longman, 1993.

[SHAK88] William Shakespeare: Hamlet. - ed. by B. Lott. - Longman, 1988. (New Swan Shakespeare. Advanced Series.)

[SPO91] The Oxford Children's Thesaurus. - compiled by Spooner, A. - Oxford University Press, 1991.

[STER96] Sternberg, R.J.: Cognitive Psychology. – Harcourt Brace College Publishers, 1996.

[TOLN81] Tolnai: Nőnek az árnyak. - Szépirodalmi K. Budapest, 1981.

[WEBS76] Webster's Collegiate Thesaurus. - G. & C. Merriam Co. 1976.

Appendix for Chapter 4

Concordance Dictionary of Miklós Radnóti: Neither Memory Nor Magic

ot talk about his selfish interest - **a** free and distant future shines tow
handsome, easy-going heart will grow **a** musing, ripe and meager-worded woe
as escorted by an angel, in his hand **a** sword, walking behind to watch and
oe; when he rebels, he does not talk **a**bout his selfish interest - a free
 strife; let me, once more, daydream **a**bout this wealthy life. No anger in
, and ghostlike he must flee leaving **a**ll his earthly goods behind, then h
und, and in my heart I shall consume **a**ll that which lies around. I shall
me care - The world becomes renewed, **a**lthough my being is forsaken there;
le's heart. I knew I was escorted by **a**n angel, in his hand a sword, walki
 about his selfish interest - a free **a**nd distant future shines toward whi
s to see that everything is crushed, **a**nd ghostlike he must flee leaving a
t me: evil-omened heavens cover me - **A**nd if you see me, turn away, wink l
t walls, my words will then resound, **a**nd in my heart I shall consume all
going heart will grow a musing, ripe **a**nd meager-worded woe; when he rebel
and a sword, walking behind to watch **a**nd shield me when my troubles start
s heart. I knew I was escorted by an **a**ngel, in his hand a sword, walking
y with your hands: where the sworded **a**ngel stood before - perhaps there,
daydream about this wealthy life. No **a**nger in my heart, no vengeance make
           Till now, the many hidden **a**ngers dwelt so in my soul as negro-
h lies around. I shall not look back **a**nymore - I know that neither memory
oul as negro-brownish kernels in the **a**pple's heart. I knew I was escorted
 I shall consume all that which lies **a**round. I shall not look back anymor
ny hidden angers dwelt so in my soul **a**s negro-brownish kernels in the app
s cover me - And if you see me, turn **a**way, wink lightly with your hands:
 which lies around. I shall not look **b**ack anymore - I know that neither m
 vengeance makes me care - The world **b**ecomes renewed, although my being i
hands: where the sworded angel stood **b**efore - perhaps there, no one stand
t flee leaving all his earthly goods **b**ehind, then his handsome, easy-goin
 angel, in his hand a sword, walking **b**ehind to watch and shield me when m
e world becomes renewed, although my **b**eing is forsaken there; below the n
although my being is forsaken there; **b**elow the new-built walls, my words
angers dwelt so in my soul as negro- **b**rownish kernels in the apple's hear
ng is forsaken there; below the new- **b**uilt walls, my words will then reso
o fortune. I shall have nothing more **b**ut strife; let me, once more, daydr
                                   But when one morning, someone wakes
apple's heart. I knew I was escorted **b**y an angel, in his hand a sword, wa
I know that neither memory nor magic **c**an protect me: evil-omened heavens
r in my heart, no vengeance makes me **c**are - The world becomes renewed, al
hen resound, and in my heart I shall **c**onsume all that which lies around.
 can protect me: evil-omened heavens **c**over me - And if you see me, turn a
eone wakes to see that everything is **c**rushed, and ghostlike he must flee
 more but strife; let me, once more, **d**aydream about this wealthy life. No
ut his selfish interest - a free and **d**istant future shines toward which h
eager-worded woe; when he rebels, he **d**oes not talk about his selfish inte
    Till now, the many hidden angers **d**welt so in my soul as negro-brownis
ostlike he must flee leaving all his **e**arthly goods behind, then his hands
hly goods behind, then his handsome, **e**asy-going heart will grow a musing,
s in the apple's heart. I knew I was **e**scorted by an angel, in his hand a
e morning, someone wakes to see that **e**verything is crushed, and ghostlike
her memory nor magic can protect me: **e**vil-omened heavens cover me - And i
ng is crushed, and ghostlike he must **f**lee leaving all his earthly goods b
ecomes renewed, although my being is **f**orsaken there; below the new-built
                                I had no **f**ortune. I shall have nothing more b
 talk about his selfish interest - a **f**ree and distant future shines towar
elfish interest - a free and distant **f**uture shines toward which he starts
 see that everything is crushed, and **g**hostlike he must flee leaving all h

ods behind, then his handsome, easy- **g**oing heart will grow a musing, ripe
he must flee leaving all his earthly **g**oods behind, then his handsome, eas
his handsome, easy-going heart will **g**row a musing, ripe and meager-worde
I **h**ad no fortune. I shall have nothing
w I was escorted by an angel, in his **h**and a sword, walking behind to watc
e, turn away, wink lightly with your **h**ands: where the sworded angel stood
l his earthly goods behind, then his **h**andsome, easy-going heart will grow
I had no fortune. I shall **h**ave nothing more but strife; let me
d meager-worded woe; when he rebels, **h**e does not talk about his selfish i
everything is crushed, and ghostlike **h**e must flee leaving all his earthly
ng, ripe and meager-worded woe; when **h**e rebels, he does not talk about hi
d distant future shines toward which **h**e starts his quest.
egro-brownish kernels in the apple's **h**eart. I knew I was escorted by an a
y words will then resound, and in my **h**eart I shall consume all that which
ut this wealthy life. No anger in my **h**eart, no vengeance makes me care -
ehind, then his handsome, easy-going **h**eart will grow a musing, ripe and m
or magic can protect me: evil-omened **h**eavens cover me - And if you see me
Till now, the many **h**idden angers dwelt so in my soul as
d ghostlike he must flee leaving all **h**is earthly goods behind, then his h
knew I was escorted by an angel, in **h**is hand a sword, walking behind to
g all his earthly goods behind, then **h**is handsome, easy-going heart will
future shines toward which he starts **h**is quest.
en he rebels, he does not talk about **h**is selfish interest - a free and di
I had no fortune. I shall have nothi
ownish kernels in the apple's heart. **I** knew I was escorted by an angel, i
und. I shall not look back anymore - **I** know that neither memory nor magic
s will then resound, and in my heart **I** shall consume all that which lies
I had no fortune. **I** shall have nothing more but strife
consume all that which lies around. **I** shall not look back anymore - I kn
kernels in the apple's heart. I knew **I** was escorted by an angel, in his h
: evil-omened heavens cover me - And **i**f you see me, turn away, wink light
. I knew I was escorted by an angel, **i**n his hand a sword, walking behind
lls, my words will then resound, and **i**n my heart I shall consume all that
am about this wealthy life. No anger **i**n my heart, no vengeance makes me c
now, the many hidden angers dwelt so **i**n my soul as negro-brownish kernels
in my soul as negro-brownish kernels **i**n the apple's heart. I knew I was e
, he does not talk about his selfish **i**nterest - a free and distant future
someone wakes to see that everything **i**s crushed, and ghostlike he must fl
d becomes renewed, although my being **i**s forsaken there; below the new-bui
welt so in my soul as negro-brownish **k**ernels in the apple's heart. I knew
nish kernels in the apple's heart. I **k**new I was escorted by an angel, in
d. I shall not look back anymore - I **k**now that neither memory nor magic c
crushed, and ghostlike he must flee **l**eaving all his earthly goods behind
shall have nothing more but strife; **l**et me, once more, daydream about th
heart I shall consume all that which **l**ies around. I shall not look back a
ce more, daydream about this wealthy **l**ife. No anger in my heart, no venge
- And if you see me, turn away, wink **l**ightly with your hands: where the s
that which lies around. I shall not **l**ook back anymore - I know that neit
Miklós Radnóti: Neither Memory Nor **M**agic
ore - I know that neither memory nor **m**agic can protect me: evil-omened he
. No anger in my heart, no vengeance **m**akes me care - The world becomes re
Till now, the **m**any hidden angers dwelt so in my so
rotect me: evil-omened heavens cover **m**e - And if you see me, turn away, w
nger in my heart, no vengeance makes **m**e care - The world becomes renewed,
neither memory nor magic can protect **m**e: evil-omened heavens cover me - A
ll have nothing more but strife; let **m**e, once more, daydream about this w
ed heavens cover me - And if you see **m**e, turn away, wink lightly with you
, walking behind to watch and shield **m**e when my troubles start.
g heart will grow a musing, ripe and **m**eager-worded woe; when he rebels, h
Miklós Radnóti: Neither **M**emory Nor Magic
k back anymore - I know that neither **m**emory nor magic can protect me: evi

Miklós Radnóti: Neither Memory Nor M
had no fortune. I shall have nothing **m**ore but strife; let me, once more,
othing more but strife; let me, once **m**ore, daydream about this wealthy li
But when one **m**orning, someone wakes to see that e
ndsome, easy-going heart will grow a **m**using, ripe and meager-worded woe;
rything is crushed, and ghostlike he **m**ust flee leaving all his earthly go
The world becomes renewed, although **m**y being is forsaken there; below th
, my words will then resound, and in **m**y heart I shall consume all that wh
about this wealthy life. No anger in **m**y heart, no vengeance makes me care
, the many hidden angers dwelt so in **m**y soul as negro-brownish kernels in
g behind to watch and shield me when **m**y troubles start.
en there; below the new-built walls, **m**y words will then resound, and in m
hidden angers dwelt so in my soul as **n**egro-brownish kernels in the apple'
Miklós Radnóti: **N**either Memory Nor Magic
not look back anymore - I know that **n**either memory nor magic can protect
y being is forsaken there; below the **n**ew-built walls, my words will then
e, daydream about this wealthy life. **N**o anger in my heart, no vengeance m
I had **n**o fortune. I shall have nothing mor
angel stood before - perhaps there, **n**o one stands.
wealthy life. No anger in my heart, **n**o vengeance makes me care - The wor
Miklós Radnóti: Neither Memory **N**or Magic
anymore - I know that neither memory **n**or magic can protect me: evil-omene
all that which lies around. I shall **n**ot look back anymore - I know that
-worded woe; when he rebels, he does **n**ot talk about his selfish interest
I had no fortune. I shall have **n**othing more but strife; let me, onc
Till **n**ow, the many hidden angers dwelt so
mory nor magic can protect me: evil- **o**mened heavens cover me - And if you
ave nothing more but strife; let me, **o**nce more, daydream about this wealt
But when **o**ne morning, someone wakes to see th
gel stood before - perhaps there, no **o**ne stands.
ere the sworded angel stood before - **p**erhaps there, no one stands.
ow that neither memory nor magic can **p**rotect me: evil-omened heavens cove
re shines toward which he starts his **q**uest.
Miklós **R**adnóti: Neither Memory Nor Magic
ripe and meager-worded woe; when he **r**ebels, he does not talk about his s
ce makes me care - The world becomes **r**enewed, although my being is forsak
new-built walls, my words will then **r**esound, and in my heart I shall con
easy-going heart will grow a musing, **r**ipe and meager-worded woe; when he
negro-brownish kernels in the apple' **s** heart. I knew I was escorted by an
omened heavens cover me - And if you **s**ee me, turn away, wink lightly with
t when one morning, someone wakes to **s**ee that everything is crushed, and
e rebels, he does not talk about his **s**elfish interest - a free and distan
will then resound, and in my heart I **s**hall consume all that which lies ar
I had no fortune. I **s**hall have nothing more but strife;
onsume all that which lies around. I **s**hall not look back anymore - I know
a sword, walking behind to watch and **s**hield me when my troubles start.
interest - a free and distant future **s**hines toward which he starts his qu
ll now, the many hidden angers dwelt **s**o in my soul as negro-brownish kern
But when one morning, **s**omeone wakes to see that everything
he many hidden angers dwelt so in my **s**oul as negro-brownish kernels in th
stood before - perhaps there, no one **s**tands.
watch and shield me when my troubles **s**tart.
istant future shines toward which he **s**tarts his quest.
your hands: where the sworded angel **s**tood before - perhaps there, no one
rtune. I shall have nothing more but **s**trife; let me, once more, daydream
escorted by an angel, in his hand a **s**word, walking behind to watch and s
k lightly with your hands: where the **s**worded angel stood before - perhaps
ded woe; when he rebels, he does not **t**alk about his selfish interest - a
en one morning, someone wakes to see **t**hat everything is crushed, and ghos
shall not look back anymore - I know **t**hat neither memory nor magic can pr
and in my heart I shall consume all **t**hat which lies around. I shall not

my soul as negro-brownish kernels in the apple's heart. I knew I was esco
Till now, the many hidden angers dwelt so in m
gh my being is forsaken there; below the new-built walls, my words will t
wink lightly with your hands: where the sworded angel stood before - per
heart, no vengeance makes me care - The world becomes renewed, although
eaving all his earthly goods behind, then his handsome, easy-going heart
w the new-built walls, my words will then resound, and in my heart I shal
newed, although my being is forsaken there; below the new-built walls, my
sworded angel stood before - perhaps there, no one stands.
e; let me, once more, daydream about this wealthy life. No anger in my he
Till now, the many hidden angers dwe
But when one morning, someone wakes to see that everything is crushed, a
in his hand a sword, walking behind to watch and shield me when my troub
t - a free and distant future shines toward which he starts his quest.
ehind to watch and shield me when my troubles start.
eavens cover me - And if you see me, turn away, wink lightly with your ha
althy life. No anger in my heart, no vengeance makes me care - The world
But when one morning, someone wakes to see that everything is crus
ed by an angel, in his hand a sword, walking behind to watch and shield m
forsaken there; below the new-built walls, my words will then resound, a
rnels in the apple's heart. I knew I was escorted by an angel, in his han
his hand a sword, walking behind to watch and shield me when my troubles
t me, once more, daydream about this wealthy life. No anger in my heart,
musing, ripe and meager-worded woe; when he rebels, he does not talk abo
alking behind to watch and shield me when my troubles start.
But when one morning, someone wakes to s
away, wink lightly with your hands: where the sworded angel stood before
ree and distant future shines toward which he starts his quest.
in my heart I shall consume all that which lies around. I shall not look
then his handsome, easy-going heart will grow a musing, ripe and meager-
below the new-built walls, my words will then resound, and in my heart I
r me - And if you see me, turn away, wink lightly with your hands: where
you see me, turn away, wink lightly with your hands: where the sworded a
row a musing, ripe and meager-worded woe; when he rebels, he does not tal
will grow a musing, ripe and meager- worded woe; when he rebels, he does
there; below the new-built walls, my words will then resound, and in my h
rt, no vengeance makes me care - The world becomes renewed, although my b
vil-omened heavens cover me - And if you see me, turn away, wink lightly
see me, turn away, wink lightly with your hands: where the sworded angel

	past; memories	one morning	present	Near future	distant future
Earthly goods; fortune	I had no fortune	leaving all his earthly goods behind; *[he is almost naked[i]]*	let me, once more, daydream about this wealthy life	I shall have nothing more than strife	
protect; shield	I knew I was escorted by an angel, in his *hand* a sword, / walking behind to watch and shield me		where the sworded angel stood before – perhaps there, no one stands	I shall not look back anymore - I know that neither *memory* (←) nor *magic* (↓) can protect me	
world; trouble	when my troubles start	one morning someone wakes to see / that everything is crushed	evil-omened heavens cover me		the world becomes *renewed* (↓)
friends; help	*[his wife ,his friends, other poets[ii]]*		in my heart I shall consume all that which lies around[iii]	if you see me, *[my friend[iv],]* turn away, wink lightly with your *hands* (↑)	my being is forsaken there
work; interest		when he rebels, he does not *talk* (↓) about his selfish interest			
heart, soul	many hidden angers dwelt so in my soul / as negro-brownish kernels in the *apple's* (→) heart	his handsome, easy-going heart will grow a musing, *ripe* (→) and meager-*worded* (↑) woe *[or humility[v]]*	no anger in my heart, no vengeance makes me care	ghostlike he must flee; *[the fruit (←) swings and will fall, once it is ripe (←)[vi]]*	*[earth, deep with memory (←), will lay you to rest[vii]]*
Songs; magic			*[my songs are forbidden there[viii]]*	a free and *distant future* (→) shines toward which he starts his quest	*[he works for all the children[ix]];* below the *new-built* (↑) walls, my words will then resound

Table 1

[i] This occurs only in the original poem (and not in its English translation): „kis holmiját elhagyja s *jóformán meztelen*" (after "leaving all his earthly goods behind", in the 7th line).

[ii] „Bygone and gentle nights, you, too, are knighted to a *memory*! / Dazzling tables, wreathed with *youthful wives and poets*, / where do you grovel on the mire of bygone days? / Where is the night when *nimble friends* joyously drank / herb wine out of a handsome-eyed and slender glass?" (M. Radnóti: À La Recherche …; 1944)

[iii] Here, 'in my heart' could possibly mean 'all alone', as expressed explicitly in the original poem („*magamban* élem át").

[iv] This occurs only in the original poem (and not in its English translation): „ha megpillantsz, *barátom*, fordulj el és legyints" (20th line).

[v] The 8-9th lines of the original poem are as follows: „annak szép, könnyűléptű szívében megterem / az érett és tűnődő, kevésszavú alázat", where 'alázat' means 'humility' in English.

[vi] (M. Radnóti: Fourth Eclogue; 1943)

[vii] (M. Radnóti: Fourth Eclogue; 1943)

[viii] This occurs only in the original poem (and not in its English translation): „s bár *tiltják énekem*" (instead of "my being is forsaken there", in the 15th line).

[ix] „And, leaning on his pen, he thinks of all the children, / and in his heavy heart no trace of vanity, / it is for them he works …" (M. Radnóti: As, imperceptibly, 1943)

Publications and presentations of the author

1. publications

[1] S. Nagy, S. Daróczy, P. Raics, *I. Boda*, and I. Matajsz.: Semiempirical Description of the Mass Distribution for the 238U(n,f) Process in the 1.5- to 15-MeV Energy Inerval. = Nuclear Science and Engineering 88 (1984) 154-163.

[2] Gomba Szabolcsné dr. - *Boda István*: Gondolatok a számítógépes hálózatszervezésről. = Könyvtári Figyelő 36 (1986) 4, 405-407.

[9] Porkoláb Judit - *Boda I. Károly*: Füst Milán: "Ha csontjaimat meg kelletik adni". Versértelmezés interaktív számítógépes program segítségével. = Anyanyelvi nevelés - embernevelés. Országos Anyanyelv-Oktatási Napok, Eger, 1994. július 4-7. - Szerk. Szende Aladár. - A Magyar Nyelvtudományi Társaság Kiadványai, 198. szám. - Kiad. a Magyar Nyelvtudományi Társaság, Budapest, 1995.

[10] Judit Porkoláb - *Károly I. Boda*: Das Vorkommen und die Bedeutungsebenen des Wortes "Zeit" in der Dichtung von Milán Füst. (Die Benutzung der interaktiven Konkordanz zur Analyse des dichterischen Wortschatzes). = Annales Universitatis Scientiarum Budapestinensis de Rolando Eötvös Nominatae. Sectio Linguistica. Tomus XXIII. (Redigit I. Szathmári.) - Univ. Budapestinensis de Eötvös Nom. Facult. Philosophiae, Budapest. 1992-98. - 45-65 p.

[15] Porkoláb Judit - *Boda I. Károly*: Versértelmezés interaktív számítógépes program segítségével. = Magyartanítás 36 (1995) 5. 13-16.

[17] Boda I. Károly - Porkoláb Judit: Költői szókészletvizsgálat számítógépes programmal. = Iskolakultúra 6 (1996) 1. 51-61.

[29] Boda István Károly: Könyvtárak gépesítésének támogatása a könyvtárosképzés felől. = Könyv és Könyvtár 18. - KLTE Könyvtára, Debrecen, 1997. - 203-217 l.

[30] B. Porkoláb Judit - *Boda I. Károly*: Helyzet és válasz Radnóti Miklós: Ó fény, ragyogás, napszemű reggel! c. versében. = Anyanyelv és iskola az ezredfordulón. XII. Anyanyelv-oktatási napok Eger, 1996. július 8-11. - A Magyar Nyelvtudományi Társaság Kiadványai 207. Szerk. V. Raisz Rózsa. - Budapest, 1996. - 260-267 l.

[31] B. Judit Porkoláb - *Károly I. Boda*: "Korol' Genrih Csetvertüj" (1931) piszat'elja Milana Fjusta. (Füst Milán: Negyedik Henrik király 1931.) = Annales Universitatis Scientiarum Budapestinensis de Rolando Eötvös Nominatae. Sectio Linguistica. Tomus XXIII. (Redigit I. Szathmári.) - Univ. Budapestinensis de Eötvös Nom. Facult. Philosophiae, Budapest 1992-98. - 67-75 p.

[32] Boda I. Károly - Porkoláb Judit: A mitológiai nevek szerepe a költői önkifejezésben (költői szókészletvizsgálat számítógépes program segítségével). = Az V. Magyar Névtudományi Konferencia előadásai (Miskolc, 1995. augusztus 28-30.). II. köt. - Szerk. B. Gergely Piroska és Hajdú Mihály. - Kiad. a Magyar Nyelvtudományi Társaság és a Miskolci Egyetem Bölcsészettudományi Intézete, Budapest - Miskolc, 1997. 524-529 l. - A Magyar Nyelvtudományi Társaság Kiadványai 209. szám.

[33] Boda István - Juhász István: Könyvtár-informatikai képzés a Kossuth Lajos Tudományegyetemen. = Könyvtári Figyelő, 7 (43) évf. 1997. 1. szám - 33-39. l.

[34] B. Porkoláb Judit - *Boda I. Károly*: Helyzet és válasz Radnóti Miklós Ó fény, ragyogás, napszemű reggel! című versében. Egy interaktív számítógépes elemzés eredményei. = Szemiotikai szövegtan 9. A szemiotikai szövegtani kutatás diszciplináris környezetéhez (I). - Szerk. Petőfi S. János, Békési Imre, Vass László. - JGYTF Kiadó, Szeged, 1996. - 145-155. l. - Acta Academiae Pedagogicae Szegediensis Series Linguistica, Literaria et Aesthetica.

[35] Porkoláb Judit - *Boda I. Károly*: Füst Milán: A magyarokhoz című versének értelmezése számítógépes konkordanciák segítségével. = Magyartanítás 38 (1997) 4, 16-23 l.

[43] Boda I. Károly - B. Porkoláb Judit: Koreferenciális kifejezések és koreferenciarelációk. Példaszöveg: Szent János Apostol Jelenéseinek könyve. 21:9-23. Az új Jeruzsálem. (Részlet) = Officina Textologica 1998 évf. 2 szám, 32-56. l.

[45] Boda I. Károly - Porkoláb Judit: Kísérletek, módszerek az irodalmi szövegek számítógépes elemzésében. A Pogány köszöntő c. verseskötet (1930) számítógépes vizsgálata nyelvi, stilisztikai szempontból. = Debreceni Szemle, 1999. (megjelenés alatt).

[47] Boda István Károly: A nyitott oktatási formák perspektívái a 90-es években. = A magyar felnőttoktatás története konferencia dokumentumai. Debrecen, 1997. október 6-8. = Felnőttoktatás, továbbképzés és élethosszig tartó tanulás 18. - Magyar Művelődési Intézet, Budapest, 1998.

[51] Boda I. Károly - Porkoláb Judit: Nyelvi megformálások értelmezése számítógépes programmal (A Jelenések könyve néhány részlete alapján). = Szemiotikai szövegtan 12. Szövegtani kutatás: témák, eredmények, feladatok (II). - Szerk. Petőfi S. János, Békési Imre, Vass László. - JGYTF Kiadó, Szeged, 1999. - 295-302 l. - Acta Academiae Pedagogicae Szegediensis. Series Linguistica, Literaria et Aesthetica.

[52] Boda I. Károly - Porkoláb Judit: A koreferencia kérdései a számítógépes szövegfeldolgozás szempontjából. = Officina Textologica 4 szám. Koreferáló elemek – koreferenciarelációk. Magyar nyelvű szövegek elemzése. Diszkusszió. – (szerk. Dobi Edit, Petőfi S. János) – Kossuth Egyetemi Kiadó, Debrecen, 2000.

[55] Boda I. Károly - Porkoláb Judit: Füst Milán: Feleségem története (1942). (A mű megközelítése néhány szempont alapján.) = Stilisztika és gyakorlat. – szerk. Szathmári István. – Nemzeti Tankönyvkiadó, 1998. – 233-41 l.

[64] Porkoláb Judit - *Boda I. Károly*: Milyen stilisztikai töltése lehet egy adott korpuszban a névutóknak? = Magyar Nyelvjárások. A KLTE Magyar Nyelvtudományi Tanszékének Évkönyve. 37. kötet. - Köszöntő könyv Sebestyén Árpád 70. születésnapjára. - szerk. Hoffmann I., Mező A., Nyirkos I. - Debrecen, 1999. 365-374 l. *(megjelent könyvformában, díszkötésben is).*

[65] Boda I. Károly - Porkoláb Judit: Radnóti-szinesztéziák. Szinesztézia és szinesztetikus képek Radnóti Miklós Pogány köszöntő című kötetében. = Nyelvi és kommunikációs kultúra az iskolában. XIII. Anyanyelv-oktatási Napok. Eger, 1998. július 7-10. 1. kötet. - szerk. V. Raisz R., H. Varga Gy. - Magyar Nyelvtudományi Társaság, Budapest, 1999. 93-100 l. - A Magyar Nyelvtudományi Társaság Kiadványai, 212. szám

[66] Boda István - Gomba Szabolcsné: Gondolatok a könyvtári menedzsment és a minőség-menedzsment oktatásáról. = Könyvtári Figyelő 9(45) (1999) 3, 527-540 l.

[67] Károly I. Boda – Judit Porkoláb: The hypertext approach to the question of the interpretation of poems (Miklós Radnóti: Neither Memory Nor Magic). = Annales Universitatis Scientiarum Budapestinensis de Rolando Eötvös Nominatae. Sectio Linguistica. Tomus XXIV. (Redigit I. Szathmári.) - Univ. Budapestinensis de Eötvös Nom. Facult. Philosophiae, Budapest. (in publication)

[68] Porkoláb Judit - *Boda I. Károly*: Milyen jellegű kérdő mondatokat találunk Füst Milán Összes verseinek Újak ciklusában? = A stilisztikai kérdés. Az ELTE Magyar Nyelvi Tanszéke mellett működő Stíluskutató Csoport füzetei. (megjelenés alatt)

[69] Boda I. Károly - Porkoláb Judit: A speciális szövegrészek közötti kapcsolat mint a hipertext rendszer egyik információs forrása. (A hipertext kiterjesztése a tulajdonnevek használatában.) = Köszöntő könyv Jakab László 70. születésnapjára. Magyar Nyelvjárások XXXVIII. - szerk. Hoffmann I. Kiss T. és Nyirkos I. - Debrecen, 2000. *(megjelent könyvformában, bőrkötésben)*

[71] Boda I. Károly - Porkoláb Judit: A szövegmegértés lehetőségei egy versben. Fejleszthető-e a nyelvi tudat versszövegek vizsgálatával? = Alkalmazott nyelvészeti tanulmányok. Közép-Európa. 4. köt. - (szerk. Lengyel Zs., Navracsics J., Nádasi E.) - Alkamazott Nyelvészeti Tanszék, Veszprémi Egyetem, 2000. - 39-48 l.

[74] B. Porkoláb Judit - Boda István Károly: Barla tanár úr katedrája. = Emlékezés Barla Gyulára. - Hajdú-Bihar Megyei Neveléstörténeti Egyesület, Debrecen, 2000. - 31-37 l.

2. essays published in conference proceedings

[18] Boda I. Károly - Porkoláb Judit: Az elbeszélő múlt tanítása számítógépes program segítségével. = Ötödik Magyar Alkalmazott Nyelvészeti Konferencia. - Veszprém, 1995. - 199-201 l.

[24] Boda István - Juhász István: Könyvtár-informatikai képzés a KLTE-n. = Informatika a felsőoktatásban '96 és Networkshop '96. Konferencia kiadvány. Debrecen, 1996. augusztus 27-30. (Megjelent CD-n is.)

[27] Boda I. Károly - B. Porkoláb Judit: A Pogány köszöntő c. verseskötet (1930) számítógépes vizsgálata nyelvi, stilisztikai szempontból. = VI. Országos Alkalmazott Nyelvészeti Konferencia. Nyelvek és nyelvoktatás a Kárpát-medencében. II. kötet. - Bessenyei György Könyvkiadó, Nyíregyháza, 1996.

[38] Boda István Károly - Porkoláb Judit: Konkordanciák szerepe a szövegek befogadásában. = Hetedik Országos Alkalmazott Nyelvészeti Konferencia Budapest, 1997. április 3-5. I. kötet. - Szerk. Polyák Ildikó. - Külkereskedelmi Főiskola, Bp. 1997. - 237-241 l.

[58] Boda I. Károly - Porkoláb Judit: Nyelvi megformálások értelmezése számítógépes programmal. (A Jelenések könyve néhány részlete alapján.) = A nyelv, mint szellemi és gazdasági tőke II. A VIII. Magyar Alkalmazott Nyelvészeti Konferencia előadásainak gyűjteményes kiadása. 1998. április 16-18. Szombathely. - MANYE, 1999.

[70] Boda I. Károly - Porkoláb Judit: Radnóti-versek kognitív értelmezése. = Nyelvi kihívások a harmadik évezredben. IX. Magyar Alkalmazott Nyelvészeti Kongresszus. - (szerk. Lengyel Zs., Navracsics J., Nádasi E.) - Alkalmazott Nyelvészeti Tanszék, Veszprémi Egyetem, 1999. - 228 l.

3. other essays, reviews, etc

[3] Boda István: Költői világkép-vizsgálat számítógépes program segítségével. (Szakdolgozat.) - KLTE Debrecen, 1992.

[4] Boda I. Károly: Füst Milán Negyedik Henrik király című drámájának konkordanciája. 1-2. kötet. (Kézirat.) - Debrecen, 1994. - 415 l.

[40] Mikulás Gábor: Menedzsment. Bevezetés 7 vezetői teszttel, 222 információs és könyvtári példával. - *Lektorálta Boda István*, Papp István, Pataki Béla. - "Szabolcs-Szatmár-Bereg Megyei Könyvtárak" Egyesülés, Nyíregyháza, 1999.

[41] Boda István: Mihály Sári: Town and Culture. The Historicocultural and Sociological Background of Politico-Cultural Decisions and Local Actions in a Middle-Sized Town of the Great Hungarian Plain. c. értekezésének ismertetése. = Művelődéstudományi Tanulmányok 1998 évf. 17 szám, 155-156 l.

4. presentations in conferences

[5] Boda I. Károly - Porkoláb Judit: Füst Milán: "Ha csontjaimat meg kelletik adni ...". Versértelmezés interaktív számítógépes program segítségével. - Előadás a XI. Anyanyelv-Oktatási Napokon (Anyanyelvi nevelés - embernevelés, Eger, 1994. július 4-7.)

[7] B. Porkoláb Judit - *Boda I. Károly*: Füst Milán költői szókészletének számítógépes feldolgozása - a program leírása, működése. - Előadás a Magyar Nyelvészek VI. Nemzetközi Kongresszusán (A lexikológia és a lexikográfia elmélete és módszertana, Eger, 1994. augusztus 23-26.)

[8] Boda I. Károly - B. Porkoláb Judit: Az elbeszélő múlt tanítása számítógépes programmal. - Előadás az V. Alkalmazott Nyelvészeti Konferencián (Európai és hazai dimenziók, Veszprém, 1995. április 21-22.)

[13] B. Porkoláb Judit - *Boda I. Károly*: A mitológiai nevek szerepe a költői önkifejezésben. = Előadás az V. Magyar Névtudományi Konferencián. (Miskolc, 1995. augusztus 29-31.)

[19] Boda I. Károly - B. Porkoláb Judit: Radnóti Miklós: Pogány köszöntő c. verseskötetének (1930) számítógépes vizsgálata nyelvi, stilisztikai szempontból. - Előadás a VI. Országos Alkalmazott Nyelvészeti Konferencián (Nyíregyháza, 1996. április 3.)

[20] Boda I. Károly - B. Porkoláb Judit: Egy példa az interaktív számítógépes verselemzésre. - Előadás az Országos anyanyelv-oktatási napokon. (Anyanyelv és iskola az ezredfordulón. Eger, 1996. július 9.)

[23] Boda István - Juhász István: Könyvtár-informatikai képzés a KLTE-n. - Előadás az Informatika a felsőoktatásban '96 konferencián. (Debrecen, 1996. augusztus 29.)

[25] Boda István: Könyvtárak gépesítésének támogatása a könyvtárosképzés felől. - Előadás a Kovács Máté Emlékülésen (Debrecen, 1996. október 29.)

[26] István Boda - István Juhász: The teaching of library- and information science in Kossuth Lajos University of Debrecen. = Presentation in the 5th International BOBCATSSS Symposium. (New Book Economy, Budapest, January 27-30, 1997.)

[28] Boda István Károly - Porkoláb Judit: Konkordanciák szerepe a szövegek befogadásában. - Előadás a VII. Alkalmazott Nyelvészeti Konferencián. (Budapest, 1997. április 3-5.)

[36] Boda István Károly: A nyitott oktatási formák perspektívái a 90-es években. - Előadás a Magyarországi Felnőttoktatás Története konferencián (Debrecen, 1997. október 6-8.)

[37] Boda István Károly - Porkoláb Judit: Füst Milán: Feleségem története c. művének stílussajátságai. - Előadás a Stilisztika és Gyakorlat Konferencián (ELTE Budapest, 1997. október 15.)

[39] Boda István: Informatikus könyvtáros képzés a KLTE-n. - Előadás az Informatika és Oktatás Konferencián (Békéscsaba, 1997. november 21.)

[48] Boda István Károly - Porkoláb Judit: Nyelvi megformálások értelmezése számítógépes programmal (A Jelenések könyve néhány részlete alapján). - Előadás a VIII. Magyar Alkalmazott Nyelvészeti Konferencián (A nyelv mint szellemi és gazdasági tőke.) - Berzsenyi Dániel Tanárképző Főiskola, Szombathely, 1998. április 17.

[50] Kocsány Piroska - B. Porkoláb Judit - *Boda I. Károly*: Radnóti-szinesztéziák. - Előadás a XIII. Anyanyelv-oktatási Napokon (Nyelvi és kommunikációs kultúra az iskolában). - Eger, 1998. július 9.

[53] Petőfi Sándor János - *Boda István Károly* - Vass László: A CD alkalmazásának lehetőségei. - Előadás "A tanár és a tankönyvi szöveg" c. konferencián (Juhász Gyula Tanárképző Főiskola, Szeged, 1998. július 15.)

[54] Károly I. Boda: Complex Data Structures and their Role in the Organization of Information Systems. - Presentation in "Conference of PhD Students in Computer Science" (Institute of Informatics of the József Attila University, Szeged, 18 July 1998.)

[56] Boda I. Károly - Porkoláb Judit: Radnóti-versek kognitív értelmezése. - Előadás a IX. Magyar Alkalmazott Nyelvészeti Kongresszuson (Nyelvi kihívások a harmadik évezredben). - Veszprémi Egyetem, Veszprém, 1999. április 9.

[57] Boda I. Károly - Porkoláb Judit: A nyelvi tudat fejlesztésének néhány eszköze. - Előadás a II. Pszicholingvisztikai Nyári Egyetemen (Balatonalmádi, 1999. június 8.)

[60] Boda István Károly: Rendszerfejlesztés integrált megközelítésben. - Előadás "A Közgyűjtemények és a Tudomány" c. konferencián. (Országos Széchenyi Könyvtár Budapest, 1999. július 2.)

[62] Boda I. Károly - Porkoláb Judit: Metaforák a kognitív nyelvészetben. Informatikai szaknyelvi metaforák vizsgálata. - Előadás "A metafora grammatikája és stilisztikája" c. konferencián. (Miskolc, 1999. október 12.)

[63] Boda I. Károly: Könyvtár-informatika képzés a Kossuth Lajos Tudományegyetemen. - Előadás a "Könyvtárosképzés, továbbképzés" c. szakmai konferencián (Szeged, 1999. november 18.)

[72] Boda I. Károly - Porkoláb Judit: A hipertext és a költői mű. - Előadás a X. Magyar Alkalmazott Nyelvészeti Kongresszuson. A nyelv szerepe az információs társadalomban. - Kodolányi János Főiskola, Székesfehérvár, 2000. április 18-20.

[73] Boda István - Porkoláb Judit: Költői szövegek értelmezése pszicholingvisztikai módszerekkel. - Előadás a III. Pszicholingvisztikai Nyári Egyetemen (Balatonalmádi, 2000. május 31.)

[76] Porkoláb Judit - Boda István Károly: Hipertextuális vonatkozások virágokkal kapcsolatos metaforákban. - Előadás a Magyar Tudományos Akadémia Szabolcs-Szatmár-Bereg Megyei Tudományos Testülete 2000. évi tudományos ülésén. - Nyíregyháza, 2000. szeptember 30.

5. other presentations, lectures, contributions, etc

[6] Porkoláb Judit - *Boda I. Károly*: Versértelmezések számítógépes programmal. - Előadás a Debreceni Nyári Egyetemen (Debrecen, 1994. július 17-augusztus 13.)

[11] Boda I. Károly - Porkoláb Judit: Mitológiai képek Radnóti Miklós verseiben (Hagyományos és számítógépes szövegvizsgálat). - Előadás a Debreceni Nyári Egyetemen (Debrecen, 1995. július 16-augusztus 12.)

[12] Boda I. Károly - Porkoláb Judit: Füst Milán: IV. Henrik (szövegelemzés). - Előadás a Debreceni Nyári Egyetemen (Debrecen, 1995. július 16-augusztus 12.)

[14] B. Porkoláb Judit - *Boda I. Károly*: Hagyományos és modern módszerek a stilisztikában. = A Magyar Nyelvtudományi Társaság Magyar nyelvi Szakosztályának felolvasó ülése, Budapest, 1995. november 7.

[16] B. Porkoláb Judit - *Boda I. Károly*: Számítógépes közelítésmódok a stilisztikai elemzésben. = A Magyar Nyelvtudományi Társaság debreceni csoportjának ülése, Budapest, 1995. november 30.

[21] Boda I. Károly - Porkoláb Judit: Helyzet és Válasz Radnóti Miklós verseiben. - Előadás a Debreceni Nyári Egyetemen (Debrecen, 1996. július 22.)

[22] Boda I. Károly - Porkoláb Judit: Életmotívumok Ady Endre verseiben. - Előadás a Debreceni Nyári Egyetemen (Debrecen, 1996. július 24.)

[42] Részvétel és hozzászólás a helyi könyvtárosképzés átalakítását célzó szakmai megbeszélésen. - *Meghívottak: Boda István*, Kokas Károly, Koltay Tibor, Nagy László. (Jászberényi Tanítóképző Főiskola, 1997. november 25.)

[44] Boda I. Károly - Porkoláb Judit: A Jelenések könyvének számítógépes elemzése. - A Magyar Nyelvtudományi Társaság debreceni csoportjának felolvasó ülése. - Debrecen, 1998. október 16.

[46] Boda István: Nyitott oktatási formák. - Előadás a Bessenyei György Tanárképző Főiskolán. - Nyíregyháza, 1998. október 26.

[49] Boda I. Károly - Porkoláb Judit: "... és lát az Isten égő mennyeket". Pilinszky János (Nyelvi látomások). - Előadás a debreceni Nyári Egyetemen. - Debrecen, 1998. július 23.

[59] Boda István: A multimédia alkalmazása. - Előadás a Hatvani István szakkollégium keretében. - Debrecen, 1999. április 7.

[61] Boda I. Károly - Porkoláb Judit: Értékvilág Radnóti verseiben. - Előadás a debreceni Nyári Egyetemen. - Debrecen, 1999. július 20.

[75] Boda I. Károly - Porkoláb Judit: "Sem emlék, sem varázslat" (Hipertextuális elemek Radnóti Miklós költészetében). - Előadás a Debreceni Nyári Egyetemen (Debrecen, 2000. július 19.)