

# Universal Terminology

## CHAPTER 1: INTRODUCTION AND SCOPE

This chapter introduces the concept of terminology on top of an ontology. The terminology is the language part of an ontology that is supposed to be independent of the representation of its content. However, it will be shown that the terminology must preferably be language independent to insure its universality regarding different languages.

Ontology is a formal science in the domain of philosophy. Numerous publications on this science are available and give the background for any implementation. A terminology cannot be reduced to a list of terms and must be minimally concordant with the underlying ontology.

A definition of what is a terminology is presented on a formal basis. Multiple authors develop lists of terms and other classifications, often without formal background. Indeed, the scientific community is in need of a more formal approach of this domain.

This document is the chapter 1 of the book Universal Terminology which presents a global documentation on the  $\mathbf{T}_{logy}$ .

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## 1.1 What is a terminology?

At first and intuitively, the answer is: a collection of terms related to some domain of knowledge. This is not a bad answer and it is essentially true. But it lacks the necessary precision to distinguish artifacts from a true terminology. Any casual person can write a list of terms and publish them, but that's not enough to call it a terminology, despite it corresponds to our introductory definition.

From there on, when we use the word terminology for speaking about the implementation of our anatomical terminology, it will be labelled as  $\mathbf{T}_{logy}$ .

The first attempt to structure  $\mathbf{T}_{logy}$  is to order the terms according to some hierarchical criteria. There are two main common hierarchies available for this task: the taxonomy and the partonomy. A taxonomy is easy to use (but hard to build), because it is built with a single relation: the ISA link, figuring the Aristotle principle of genus et differentia. A partonomy (also known as a meronomy) is a complicated hierarchy subject to approximate representations and to numerous errors, but it is the preferred hierarchy by anatomists! Other hierarchy may be envisaged, but they are of less importance.

From the above comments, the easy solution would be to take an existing taxonomy of the domain, to build a partonomy of the domain, taking care of the pitfalls of the partonomy. But, does such a taxonomy exist? Hopefully, there is a valuable taxonomy of anatomy named the Foundational Model of Anatomy (thereafter the FMA).

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[Rosse and Mejino, 2003]

*The Foundational Model of Anatomy is a major development for the ontology of human anatomy, where it is largely recognized. The coverage is close to 100 percent regarding the  $\mathbf{T}_{logy}$ . The FMA is in the public domain. However, there are a few missing entities especially related to the latest development of the TNA, where we had to create new entities.*

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Up to this point, everything is mostly language independent, because we can consider the English names of the FMA as labels or identifiers. We can in fact ignore their naming conventions, despite the overall quality of the FMA to this respect is real. On top of that, we can build the  $\mathbf{T}_{logy}$ , with the essential property of being language independent, as it will be shown below. Our recipe is simple: take the FMA and build  $\mathbf{T}_{logy}$  on top of it.

The basis of  $\mathbf{T}_{logy}$  is the underlying ontology. The formalism to which we adhere is BFO, standing for Basic Formal Ontology.

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[Smith and al., 2007]

*OBO is a standard recommended for biomedical ontologies and largely adopted for the life sciences. It is managed by a consortium of experts in this domain (see the list of authors in the reference). The main goal is to facilitate interchanges between different ontologies by adoption of common rules of representation, facilitating the machine-readable inter-activities. A website is available.*

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Now we can reopen the question: what is  $\mathbf{T}_{logy}$ ? The complete answer

is given by this book and the full related bibliography. That's a domain in permanent evolution.

But in an introductory way, we can say the following. Because our main goal is the communication of anatomical knowledge between people speaking several languages, we first create a terminology based on an abstract representation that is essentially language independent. Second, we provide an automatic translation tool able to generate the  $\mathbf{T}_{logy}$  in any language, including Latin. This two step process is the foundational process of the  $\mathbf{T}_{logy}$ , which is call the Universal Terminology in order to promote the language independancy.

In order to be correct and specific, the  $\mathbf{T}_{logy}$  is limited to the domain of human anatomy.

Our introductory definition is now the following:

A terminology is a structured collection of entities based on a taxonomy and a partonomy of the domain, plus an abstract language independent representation of the terms associated to these entities, plus an automatic generation tool to translate the terms in any language.

What else, that's a nice starting point!

## 1.2 History of creation of $\mathbf{T}_{logy}$

### 1.2.1 Up to TA98

The history of early publications in the twentieth century of anatomical terminologies up to Terminologia Anatomica released in 1998, was somewhat controversial [DiDio, 1998].

### 1.2.2 TA98

The direct events preceding the official publication of the TA98 have been summarized by Ian Whitmore, who was the president of FCAT and as such the leader of this publication [Whitmore, 1999].

### 1.2.3 FMA

Once upon the time, Professor Cornelius Rosse and his collaborators have invented the Foundational Model of Anatomy [Rosse and Mejino, 2003]. It was at the very beginning of the 21st century. They have been able to create an full taxonomy of the human anatomy, up to a good degree of details, corresponding to the advancement of medicine at this time.

### 1.2.4 BFO

A couple of years later, Professor Barry Smith, provided advises to the FMA team and published the Basic Formal Ontology [Smith and al., 2007]. This modern concept was applied to the FMA.

### 1.2.5 TNA

In 2017, FIPAT decided to revise a part of Terminologia Anatomica (TA) published in 1998, under the new name Terminologia NeuroAnatomica (TNA). This important task was supervised by Professor Hans ten Donkelaar and a supporting committee [tenDonkelaar et al., 2016].

### 1.2.6 The Fribourg website

The database implementation and the language developments of TNA were done by Robert Baud, PhD, the author of this book. The first official release was done at end of 2021.

The website is hosted by the University of Fribourg in Switzerland. Thanks to Professor Pierre Sprumont and Professor Luis Filgueira for their support to this enterprise.

## 1.3 The book Universal Terminology

This section presents a short introduction to all chapters of this book. The number of the subsections below correspond to the chapter numbers.

### 1.3.1 Chapter 1: Introduction and scope

Direct access to [chapter 01](#).

This chapter introduce the anatomical  $\mathbf{T}_{logy}$ : the main subject of the book. It defines what is  $\mathbf{T}_{logy}$  built on top of an ontology, itself formally defined.

This is also the place where all conventions applied in the book are introduced and explained.

Another section is about the size of  $\mathbf{T}_{logy}$ . It is demonstrated how the limit of one million terms could be reached and that automatic generating tools are necessary for a safe implementation of  $\mathbf{T}_{logy}$ .

### 1.3.2 Chapter 2: Basic objects

Direct access to [chapter 02](#).

An entity is the central subject of  $\mathbf{T}_{logy}$ : it is named by an **anatomical term** accompanied by all its variants, synonyms and related terms.

### 1.3.3 Chapter 3: Identifiers

Direct access to [chapter 03](#).

Identifiers are at the core of the  $\mathbf{T}_{logy}$ : amongst the time, they are the permanent items of the entities and other atoms forming the terminology.

The principal characteristics of identifiers are presented in this chapter, as well as some comments on their implementation.

### 1.3.4 Chapter 4: Atoms of the $\mathbf{T}_{logy}$

Direct access to [chapter 04](#).

The principal objects manipulated by the  $\mathbf{T}_{logy}$  are called atoms: they are the entities, the units, the lexemes of the vocabulary and the lists. There is a trend from the low level vocabulary to the high level lists in the sense that each next level is made of the former level. This means that the terms of entities are made of words (vocabulary level), the units are made of entities, and the lists are made of units.

These different levels are important and active for the structuring of the  $\mathbf{T}_{logy}$ . They are also deeply present in the implementation of the  $\mathbf{T}_{logy}$ .

### 1.3.5 Chapter 5: Units

Direct access to [chapter 05](#).

This chapter shows how the entities are grouped into units of different types.

At implementation level, only the units are specifically defined, not the entities. Each unit contains one generic entities that holds the terms of the unit.

### 1.3.6 Chapter 6: Vocabulary

Direct access to [chapter 06](#).

This chapter introduces the vocabulary of  $\mathbf{T}_{logy}$ . It is structured in a language-independent way, and it is instantiated in all languages that are candidate to automatic translation.

Because in any language there are words with different meanings, a special care is given to word definition. In  $\mathbf{T}_{logy}$  we have one word - one meaning.

### 1.3.7 Chapter 7: Hierarchical list

Direct access to [chapter 07](#).

These lists have their own personality: a dimension, a collection of entities and a hierarchical structure. All these features are language independent, making these lists unique for all languages.

In order to preserve the personality of the lists in the presence of maintenance tasks or updates of the terminology, it has been created a **signature of list**, which is a blind integer value computed by a permanent dedicated algorithm. The signature is dependent on the content of the list, but not dependent of the language.

We have several active hierarchies in the database of the terminology. They are the taxonomy, the partonomy, the TA98 hierarchy and the hierarchy of partonomic lists. These hierarchies share the same content of the database, but they are in fact independent one of the others.

### 1.3.8 Chapter 8: Anatomy of a term

Direct access to [chapter 08](#).

This chapter examines the nature of anatomical terms, how much they are similar or different in their structure.

### 1.3.9 Chapter 9: Grammar of terms

Direct access to [chapter 09](#).

This chapter defines a formal grammar of an anatomical term. The resulting rules constrains any regular term to a predefined form which can be analyzed and translated. This is the basis for the multilingual  $\mathbf{T}_{logy}$ . It is thought that this formalism does not limit the expressiveness of the authors of the terminology and that  $\mathbf{T}_{logy}$  gains in coherence and shows less ambiguities than traditional approaches.

### 1.3.10 Chapter 10: Universal terminology

Direct access to [chapter 10](#).

This chapter introduces the core of the universal  $\mathbf{T}_{logy}$ . In addition, it describes the process of automatic translation from the universal formula to an anatomical term in any language.

### 1.3.11 Chapter 11: Uneven terms

Direct access to [chapter 11](#).

This chapter is about irregular terms, because they do exist and they are the source of numerous problems. It shows by examples and comments why the irregular terms are a problem and what can be done to find an acceptable solution.

### 1.3.12 Chapter 12: Taxonomy

Direct access to [chapter 12](#).

This chapter is about the taxonomy used in  $\mathbf{T}_{logy}$ . The source of the taxonomy is the FMA: Fundamental Model of Anatomy, that has been corrected and augmented when needed.

### 1.3.13 Chapter 13: Partonomy

Direct access to [chapter 13](#).

The partonomic hierarchy is the preferred hierarchy of most anatomists, because it mimics the so-call atlas of anatomy with their annotated drawings corresponding to a partonomic list.

The partonomy is a complicated hierarchy, not as natural or simple than the taxonomy with a unique relation. On the contrary, the partof relation is subdivided in numerous sublinks, which must be formally defined and applied. This chapter will enumerate all these links.

### 1.3.14 Chapter 14: Definitions

Direct access to [chapter 14](#).

A basic duty of  $\mathbf{T}_{logy}$  is to define its atoms, here the anatomical entities, but very few existing terminologies do the work, considering that the general knowledge of anatomy is sufficient. Indeed, the failure to define entities is a source of ambiguities and errors.

By experience, when there is confusion about the subdivisions of a given entity, we are generally facing a problem of identification of what we are speaking of. Diverging interpretations do exist between different authors. The only solution is to precisely define each entity of interest, using a non ambiguous definition. The goal of this chapter is to demonstrate the feasibility of this approach.

This chapter considers the **taxonomic definitions** and shows how they are applied.

### **1.3.15 Chapter 15: Links to past terminology**

Direct access to [chapter 15](#).

This chapter shows how to move from TA98 to the new TA and vice-versa.

### **1.3.16 Chapter 16: Navigation**

Direct access to [chapter 16](#).

This chapter describes what kind of navigation is feasible in the terminology. Most navigation strategies are implemented on the website of the terminology.

### **1.3.17 Chapter 17: Help system**

Direct access to [chapter 17](#).

This chapter describes what is the help system underlying the implementation of the  $\mathbf{T}_{loggy}$  with its several degrees of details and how to best use it.

### **1.3.18 Chapter 18: Management of terms**

Direct access to [chapter 18](#).

### **1.3.19 Chapter 19: Management of pages**

Direct access to [chapter 19](#).

### **1.3.20 Chapter 20: Management of lists**

Direct access to [chapter 20](#).

### **1.3.21 Chapter 21: Database**

Direct access to [chapter 21](#).

### **1.3.22 Chapter 22: Website**

Direct access to [chapter 22](#).

### **1.3.23 Chapter 23: Single language implementation**

Direct access to [chapter 23](#).



### 1.3.24 Chapter 24: Tex documentation system

Direct access to [chapter 24](#).

### 1.3.25 Chapter 50: Bibliography

Direct access to [chapter 50](#).

Complete bibliography of all relevant publications related to the present book. Most publications are cited elsewhere in the chapters of the book.

When possible, the scientific papers mentioned in the bibliography are accompanied with a hyperlink to a PDF copy available elsewhere. This would give direct access to the casual user.

## 1.4 Conventions

This book is using several conventions in its presentation.

### 1.4.1 Chapters

The book is organized in chapters, each one being the seat of a well define topic about the  $\mathbf{T}_{logy}$ . All chapters are briefly introduced in the chapter 1. The Universal Terminology is documented by the sum of all chapters, the website and its content, and the corpus of software, the generating programs, the Tex documentation system and the database.

Each chapter is defined as an independant document having its own files. Any chapter, as well as help files used on the website, is created as a Tex document (file .tex) that is entirely described elsewhere. Each chapter can be generated as a PDF file and is made visible in this way.

A general format is enforced for all chapters. It include several which are reviewed now:

- **Abstract box**

The first visible item of any chapter is a box displaying a summary of the content under the form of several paragraphs. The last paragraph positions the chapter into the book on Universal Terminology. The abstract box must necessarily fit on the first page.

- **Table of content**

The table of content, under the heading Contents, is automatically generated by the documentation system. It is made of a list of sections, each one possibly having a number of subsections. The table of content starts immediately after the abstract box, on the first page if left a sufficient space. It may be extended on more than one page. Each entry in the table of content is an hyperlink to the position of this entry in the document.

- **Page header**

A header is present on top of each page except the first one.

- **Page footer**

A footer is present at bottom of each page. It is simply made of the page number in the chapter, centered. The page number is restarted to 1 in each new chapter.

- **Log of updates**

This section presents all successive updates to this chapter, the most recent on top.

- **Credentials**

This is a paragraph positioning this document in the context of the Universal Terminology. An invitation to comment the content is proposed. A link to the official source file of this chapter, with the most recent available updates is given, allowing to check for the last valid version.

## 1.4.2 Defined items

The Tex documentation system allows the definition of preprogrammed actions capable of dedicated performances in the corpus of any text. On this basis, it has been developed a number of features which can be exercised anywhere in the documentation of the  $\mathbf{T}_{logy}$ .

These defined items are formally defined below. The list is limited to the specific items created for the  $\mathbf{T}_{logy}$ , not including the numerous items of the Tex environments, documented elsewhere with this system, see *chapter 24*.

### **tlogy**

The command `tlogy` (definition) displays a dedicated logo representing the current terminology.

It is recommended to call this command as often as necessary, in order to facilitate any update of the logo. The current result is  $\mathbf{T}_{logy}$ .

### **cite{Author}**

The command `cite` (definition) gives access to any bibliography entry by the argument `Author`.

See the subsection on the bibliography below for more information. An example of this command is [\[Smith and al., 2007\]](#).

### **reference{Citation}{Size}{Explain}**

The command `reference` (definition) documents a reference specified by `Citation` with a text `Explain` and with `Size` is as its width;

The true goal of this command is the display of a short information on a citation of the bibliograpy. Examples of references are present in the first section of this document.

### **chap{NoChap}**

The command `chap` (definition) opens the chapter specified by the argument `NoChap`, with an hyperlink on its valid url.

The hyperlink is active when the document is within the field of an active internet browser. For example, the *chapter 14* is accessed by the attached hyperlink.

**LA{LatinTerm}{UID}**

The command LA (definition) displays the first argument LatinTerm and uses the second argument UID to build a link to the corresponding Unit page, which is open in presence of an active internet connection.

This command is commonly used to illustrate by example the arguments of the book of the Universal Terminology. It exists also for the other languages EN, FR, ES or RU.

**La{LatinTerm}**

The command La (definition) displays the first argument LatinTerm, without hyperlink.

This command also exists also for the other languages En, Fr, Es or Ru.

**defw{Object}**

The command defw (definition) emphasises the text given as the argument Object, when this text is about an object of the  $T_{logy}$  which is defined elsewhere in the book on Universal Terminology.

However the command defw does not provide any link to such a definition. For example, the defined item **defw** is defined in the present subsection.

**defin{Object}{DefText}**

The command defin (definition) prepares a title on a first line from the first argument Object. Then in a new paragraph, it displays the text DefText of the second argument, which acts as the corpus of the definition of the object.

### 1.4.3 Bibliography

The bibliography of the entire book is documented in *chapter 50*.

The defined item cite{...} allows the insertion of a citation of a document of the bibliography. This item has been defined above.

Each chapter may have any number of citation. These citations and only them will be displayed at the end of the chapter in a similar presentation of the entire bibliography.

## 1.5 Size of the terminology

This section aims at delivering a pragmatic information on the size of the  $T_{logy}$ . Of course, such a corpus of information is continuously evolving and the quantitative information is not stable by definition. In addition, what is large and what is small is quite relative when considering the processing of the terminology by computer programs. In such a framework, we will only evoke the major quantitative problems and limits in the current implementation of the  $T_{logy}$ , taking care to mention the time where each measurement has been performed.

### 1.5.1 Number of entity and units

### 1.5.2 Number of words

### 1.5.3 Number of languages

The number of languages in the  $\mathbf{T}_{logy}$  is 4 plus 1 in **May 2023**. The four active languages are Latin, English, French and Spanish: these languages are normally developed in parallel with a priority for Latin. Russian is the fifth language and has been entirely implemented, but later frozen for temporary reasons and ready to become again an active language.

Other languages are candidate for an implementation, waiting for a decision. Implementation of a new language is an expense of two to four men-months for programming by a person not necessarily knowing the target language, but some background knowledge of the linguistic domain. It necessitates three to six men months for validation by an anatomist who is a native speaker of the target language. These figures must be probably augmented for non Western languages.

### 1.5.4 Number of lines of programs

### 1.5.5 Number of database objects

### 1.5.6 Number of pages on the website

# Bibliography

- [DiDio, 1998] DiDio, L. (1998). History of international anatomical terminology. *Terminologia Anatomica, Thieme, 1998*. [PDF](#).
- [Rosse and Mejino, 2003] Rosse, C. and Mejino, J. (2003). A reference ontology for biomedical informatics: the foundational model of anatomy. *Journal of Biomedical Informatics 36 (2003) 478–500*. [PDF](#).
- [Smith and al., 2007] Smith, B. and al. (2007). The obo foundry: coordinated evolution of ontologies to support biomedical data integration. *Nat Biotechnol. 2007 November ; 25(11): 1251*. [PDF](#).
- [tenDonkelaar et al., 2016] tenDonkelaar, H., Broman, J., Neumann, P., Puellas, L., Riva, A., Tubbs, S., and Kachlik, D. (2016). Towards a terminologia neuroanatomica. *in Clinical Anatomy · November 2016*. [PDF](#).
- [Whitmore, 1999] Whitmore, I. (1999). Terminologia anatomica: New terminology for the new anatomist. *THE ANATOMICAL RECORD (NEW ANAT.) 257:50–53*. [PDF](#).

## 1.6 Log of updates

**22 May 2023** First appearance of the section on conventions.

**30 Mar 2022** Standardization of the file as a chapter.

**30 Oct 2021** Creation of the file.

## 1.7 Credentials

This document is part of the book "Universal Terminology" accompanying the website on Terminologia Anatomica, sponsored by the University of Fribourg, Switzerland. It expresses the vision of the authors of the  $\mathbf{T}_{logy}$  about the foundations of the science of ontology, supporting the here presented terminology. Despite it is as exact as possible, close to the reality of the database of the terminology and the surrounding software, approximations, errors and ambiguities are possible and should be considered as independent of their willingness and intents.

Identified comments about the content of this document and the website and its presentation are welcome. An appropriate answer will be given when pertinent.

Authentic URL of this file: <https://ifaa.unifr.ch/Public/TNAEntryPage/help/Chap01.pdf>. It gives access to the last update of the present document.