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Extending the adverbial coverage of a French morphological lexicon

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Abstract

We present an extension of the adverbial entries of the French morphological lexicon DELA (Dictionnaires Electroniques du LADL / LADL electronic dictionaries). Adverbs were extracted from LGLex, a NLP-oriented syntactic resource for French, which in its turn contains all adverbs extracted from the Lexicon-Grammar tables of both simple adverbs ending in *ment* (i.e., *'-ly'*) (Molinier and Levrier, 2000) and compound adverbs (Gross, 1986b; Gross, 1986a). This work exploits fine-grained linguistic information provided in existing resources. The resulting resource is reviewed in order to delete duplicates and is freely available under the LGPL-LR license.

Keywords: morphological lexicon, adverb, paraphrase

1. Introduction

Recognising adverbs such as extrêmement ‘extremely’ and à long terme ‘in the long run’ in texts is likely to be useful for information retrieval and extraction because of the information that some of these adverbs convey. Adverbs, or more generally circumstantial complements, have often been overlooked in the compilation of lexical resources (Nölke, 1990) (p. 3). Several reasons explain this lack of interest. Firstly, adverbs are usually felt as less useful than nouns for information retrieval and extraction. Secondly, compound adverbs in particular are difficult to distinguish from prepositional phrases assuming other syntactic functions, such as arguments or noun modifiers: the distinction is hardly correlated to any material markers in texts and lies in complex linguistic notions (Villavicencio, 2002; Merlo, 2003).

The availability of large-coverage lexicons providing lexical, syntactic and semantic information is essential in order to gain insight on the recognition and analysis of adverbs, including the dual problems of variability and ambiguity (Laporte and Voyatzi, 2008). In addition, it is likely to help solving prepositional phrase attachment during shallow or deep parsing (Agirre et al., 2008).

In this paper, we propose a method for extending the coverage of the French morphological lexicon DELA (Dictionnaires Electroniques du LADL / LADL electronic dictionaries) with respect to adverbial entries. These adverbs were extracted from LGLex, a NLP-oriented syntactic resource for French, which in its turn contains all adverbs extracted from the Lexicon-Grammar tables (hereafter LG tables) of both simple adverbs ending in *ment* *'-ly'* (Molinier and Levrier, 2000) and compound adverbs (Gross, 1986b; Gross, 1986a).

The paper is organized as follows. Section 2. provides an overview of the resources used in our work. Section 3. describes the method used to enhance DELA thanks to the integration of the new entries of LGLex, which are extracted from LG tables. Section 4. is focused on the generation of complex adverbial entries with variables. In section 5., we report and discuss the obtained results. Finally, in section 6. we point out several possible extensions and avenues for future research.

2. Resources

2.1. The LG tables of adverbs

LG tables are currently one of the major sources of lexical and syntactic information for the French language¹. Their development was initiated as early as the 1970s by Maurice Gross, at the LADL (Gross, 1975), and then at the LIGM, University Paris-Est (Boons et al., 1976; Guillet and Leclère, 1992).

Lexical information is represented as tables. Each table puts together elements of a given lexical-grammatical category (for a given language) that share a certain number of defining features, which usually concern subcategorization information. These elements form a class. Tables are represented as matrices: each row corresponds to a lexical item of the corresponding class; each column lists a feature that may be valid or not for the different members of the class; at the intersection of a row and a column, the symbol + (resp. −) indicates that the feature corresponding to the column is valid (resp. not valid) for the lexical entry corresponding to the row.

The resources described in this paper correspond to the LG tables of both simple and compound adverbs, in which previously implicit features have been made explicit² for more convenient use in NLP. All tables are fully available³ under

¹LG tables are available in several languages. With regard to adverbs, LG tables exist in English (Gross, 1986b), German (Seelbach, 1990), Spanish (Blanco and Catalá, 1998), Italian (Gioia, 2001), Portuguese (Baptista, 2003), Korean (Jung, 2005) and Modern Greek (Voyatzi, 2006).

²In order to make previous implicit features explicit, a table of classes has been created (Tolone, 2009; Tolone, 2011). Its role is to assign features when their value is constant over a class, e.g. class definition features. Each row stands for a class and each column stands for a feature. Each cell corresponds to the validity of a feature in a class. In particular, the table of French adverb classes is composed of 32 different classes and 164 features.

a free license (LGPL-LR).

In French, there are two resources of adverbs that follow different principles both in classification and in representation within the Lexicon-Grammar framework (Tolone et al., 2010). That is, first, tables of simple adverbs ending in -ment “-ly” (Moliner, 1984; Moliner and Levrier, 2000), which are mainly derived from adjectives and, secondly, tables of compound adverbs\(^4\) (Gross, 1986b; Gross, 1986a). In both tables, there are encoded 3,203 simple and 7,284 compound entries assuming an adverbial function in discourse.

Figure 1 displays a sample of the table PCA which is defined by the morphosyntactic structure Preposition, Determiner, Constrained noun, Pre-adjectival Modifier, Adjective.

In this table, each row corresponds to a lexical item with adverbial function, and each column corresponds to:

- one of the components in the morphosyntactic structure of the items, i.e. features with identifiers Prép, Det, C, Modif pré-adj, and Adj;
- a syntactic feature holding binary values, for example: Prép Det Modif pré-adj Adj C describes the possible permutation (without loss of information) of the adjectival phrase represented in this table as Modif pré-adj Adj; moreover, Neg obl encodes the constraint that the adverbial occurs obligatorily in a negative clause;
- a semantic feature holding binary values, for instance, Conjonction points out whether the compound adverb has a connector function in discourse, i.e. it links the clause in which it occurs with the previous clause as, for example, dans le cas contraire ‘otherwise’;
- an item of information provided as an aid to help human readers find examples of sentences containing the compound adverb: features with identifiers Ppv and Prédicat type give an example of a verbal predicate that combines commonly with the adverb.

Some entries in the table are flexible, like à échéance :Adj, which contains the variable :Adj (adjective) in order to recognize adverbs like à échéance courte ‘short-term’, à échéance longue ‘long-term’, etc.

2.2. The syntactic lexicon LGLex

The current version of French LG tables enables the use of their lexical data in NLP tools (Tolone, 2009). To this end, the tables have been converted into an interchange format, based on the same linguistic concepts as those handled in the tables. This conversion is based on LGExtract:

\[^{4}\]According to (Laporte and Voyatzis, 2008) (p. 31) “a phrase composed of several words is considered to be a multiword expression if some or all of its components are tied together, that is, if their combination does not obey productive rules of syntactic and semantic compositionality”. This criterion ensures a complementarity between lexicon and grammar. In other words, it tends to ensure that any combination of linguistic elements which is correct in the language, but is not represented in common syntactic-semantic grammars, should be stored in lexicons.
In order to enrich the French DELA, we first extended
LGLex with respect to adverbial entries by using various
types of features that are encoded in the tables of both sim-
ple and compound adverbs (Tolone and Voyatzis, 2011). We
added 11,351 entries (+108%), so the lexicon is now com-
posed of 21,843 adverbial entries in total.

2.3. The morphological lexicon DELA
The French morphological lexicon DELA (Dictionnaires
Électroniques du LADL / LADL electronic dictionaries) describes the simple and compound lexical units of French and provides the corresponding grammatical, semantic and inflectional information. It is freely available7, and is currently composed of 683,824 simple entries and 108,436
compound entries.

Each entry is represented in its canonical form and contains an inflectional code which allows to automatically generate all inflected forms of the entry using a graph. When we process a corpus with the Unitex software8 we can apply directly the DELA lexicon. Unitex generates the lexicon of all inflected forms (called DELAF) present in texts; then, it tags them.

An entry of a DELAF is a line of text that ends in a newline and conforms to the following syntax:

```
paresseux, paresseux. A+d+z1: fs
'lazy'
```

The different elements of this line are:

- **paresseux** is the inflected form of the entry; it is mandatory; *paresseux* is the canonical form (lemma) of the entry. For nouns and adjectives (in French), it is usually the masculine singular form; for verbs, it is the infinitive. This information may be left out as in the following example:

```
paresseux, A+d+z1:ms
```

This means that the canonical form is the same as the inflected form. The canonical form is separated from the inflected form by a comma.

- **A+d+z1** is the sequence of grammatical and semantic information. In our example, *A* designates an adjective and *D* indicates that the adjective occurs after the noun.

The codes +z1, +z2 and +z3 indicate the language register (this information is optional): +z1 is used for general language (for example, *blague* 'joke'), +z2 for specialized language (for example, *disquette* 'floppy disk') and +z3 for very specialized (or technical) language (for example, *sérialisation* 'serialization').

Each entry must have at least one grammatical or semantic code, separated from the canonical form by a period. If there are more codes, these are separated by the + character.

- :fs is an inflectional code which indicates that the noun is feminine singular. Inflectional codes are used to describe gender, number, declination, and conjugation. This information is optional. An inflectional code is made up of one or more characters that represent one information each. Inflectional codes have to be separated by the : character, for instance in an entry like the following:

```
adv, adverse. A+d+z1:mp:fs
'opposite'
```

The : character is interpreted as a logical OR. Thus, :mp:fs means "masculine plural" or "feminine plural".

3. Extending DELA
We completed DELA with the new adverbial entries added in LGLex in order to evaluate their accuracy by means of both a corpus-annotation practice and a detailed compar-
ison with related work by (Laporte et al., 2008). Using this method, we managed to increase the number of the adver-
bial entries in the morphological lexicon.

3.1. Adverbial variants in LGLex
The first step of our method consisted of representing vari-
ous types of features, already encoded in LG tables, as vari-
ants of the adverbial entries present in LGLex.

These features describe paraphrases (à *Adv* parler, P or *N0 V W de* *(façon+maniè re) Adj*), substructures (Prép1 Det1 C1 derived from the basic structure Prép1 Det1 C1 Prép2 C2), or intensified structures (plus *Adv*)9.

---

8http://igm.univ-mlv.fr/~unitex/
9Entries with intensification are included in the lexicon when their combination does not seem to obey regular rules of syntac-
ic and semantic compositionality. For instance, particulièrement ‘particularly’ is a quantifier in the following example and, thus, refuses intensification: *Elle est (*très+*plus) particulièrement grande pour son âge* ‘She is (*very*+*more*) particularly tall for her age’. On the contrary, it can be intensified when it is used as a focus adverb: *Les adolescents, (tout+plus) particulièrement les filles, sont grands pour leur âge* ‘Teens, (more) particularly girls, are tall for their age’. However, this is not the case of the focus adverbs essentiellement ‘essentially’, principalement ‘basically’, notamment ‘notably’. Thus, plus particulièrement ‘more particularly’ is considered as an idiomatic compound, as opposed to an open series of identical forms with a different syntax. It is represented in LGLex as a variant of the focus adverbial entry particulièrement ‘particularly’.
The following example is taken from the lexicon LGLeX and concerns the adverbial entry *paresseusement* 'lazily', which is encoded in table ADVMS of subject oriented manner adverbs. Four new adverbs were added in section lexical-info and are represented as *paraphrases*, followed by their internal morphosyntactic structure in structureAdv of section all-constructions:

```
ID=P_advms_643;status=completed
lexical-info=[cat="adv",
  exprF=[adv=[notperm=[complete=
    "paresseusement"]]],
  paraphrases=[adv="de facon <paresseux>",
    adv="d’une facon <paresseux>",
    adv="de maniere <paresseux>",
    adv="d’une maniere <paresseux>",
    autres-ID=(),
    autres-structures=()]
  all-constructions=[
    structureAdv=(construction="base::Adv",
      construction="o::de facon Adj",
      construction="o::d’une facon Adj",
      construction="o::de maniere Adj",
      construction="o::d’une maniere Adj"),
    absolute=(construction="true::N0 V Adv W",
      construction="true::Adv, N0 V W",
      construction="o::N0 hum V W de (E+une) (facon+maniere) Adj"),
    relative=()]
```

In LGLeX, adverbial variants do not form new entries, but are only considered and represented as variants. If one wants to find in texts the various forms of an adverb using DELA, they cannot do so unless these forms are added in the lexicon and are associated to a canonical (or standard) form.

### 3.2. Conversion into DELA format

In order to produce adverbial entries in DELA format from the adverbial variants that have been added in LGLeX, we followed the following steps:

1. **First**, a few specific treatments had to be performed only once. For example, the paraphrasal feature du point de vue de Ddef Ndomaine ‘from the point of view of Ndomain’, present in table ADVPM of viewpoint adverbs, requires to encode explicitly the definite determiner (Ddef) associated to the domain noun (Ndomaine), which is encoded in the table. To do so, we added and encoded a new column for Ddef;

2. **Second**, we retrieve the forms of the lexical-grammatical categories that are described inside angle brackets in various constructions from DELAF. For instance, all verbal manner adverbs ending in -ment ‘-ly’ (e.g. *paresseusement* ‘lazily’) have the paraphrase de (E+une) (façon+manière) Adj ‘in a Adjective way’. In order to reconstruct the adverbial entry, it is necessary to associate to each simple verbal manner adverb the correspondent adjective (Adj) in the feminine singular form (here, *paresseuse*, cf. 2.3);

3. **Third**, we extract the list of adverbial variants from the three following fields present in LGLeX: paraphrases, other-structures and other-ID;

4. **Then**, we must do a few language-dependent substitutions which are of common use in French. For instance, in jusqu’à la fin des temps ‘until the end of time’, the preposition de ‘of’ and the definite determiner les have to be merged into a single form, and so de les becomes des;

5. **Finally**, we convert this list into DELA format, linking all variants of a given adverb to its canonical (or standard) form (complete), and specifying the grammatical category ADV, followed by the name of the morphosyntactic or syntactico-semantic class (found in ID) in which it is encoded. All this information is provided in LGLeX (cf. 3.1.).

For instance, the four variants associated in LGLeX to the adverbial entry *paresseusement* ‘lazily’ (see 3.1.), produce in DELA format:

```
de façon paresseuse, paresseusement ADV+advms
d’une façon paresseuse, paresseusement ADV+advms
de manière paresseuse, paresseusement ADV+advms
d’une manière paresseuse, paresseusement ADV+advms
```

‘in a lazy way’

Moreover, we added the 24 missing adjectives in DELA followed by their inflectional code. This allowed us to construct the corresponding variants with the feminine form of the adjectives, such as:

```
abrégé, affaireux, amiteux, amitieux, aucun, bijournalier, compontueux, considéré, drôlatique, exaspéré, flâneux, gent, goujat, indévot, intra-utérin, irrévérent, marniteux, maupiteux, médiatIF, pêneux, plaignard, recta, révérent, salaud.
```

---

10 This is an extract of the version 3.4 that takes into account the paraphrases which are encoded in LG tables, notably, the associated lexical features.

11 Another possibility is to construct graphs used in Unitex to generate these variants in DELA format. But graphs must be constructed manually. So, it is better to generate new entries with these paraphrases and other structures that have been already added in LGLeX rather than create graphs to generate them.

12 These adjectives are: abrégé, affaireux, amiteux, amitieux, aucun, bijournalier, compontueux, considéré, drôlatique, exaspéré, flâneux, gent, goujat, indévot, intra-utérin, irrévérent, marniteux, maupiteux, médiatIF, pêneux, plaignard, recta, révérent, salaud.
Then, we filtered the entries in order to remove duplicates. In fact, some entries are exactly the same. For example, *ces temps derniers* 'recently', defined by the morphosyntactic structure Prép Det C Modif pré-adj Adj and encoded in table PCA, can also take the form *ces derniers temps* due to the permutation of the adjective *derniers* 'recent'. This latter is already encoded in table PAC:

`ces temps derniers,.ADV+pca
ces derniers temps,.ADV+pca`

We can also evoke the case of the deleting relation that associates different adverbs of table PCDC. For example, the adverbs *dans l’état actuel des choses* 'in the current state of things' and *dans l’état actuel des connaissances* 'in the current state of knowledge' are both encoded in table PCDC. They both accept the substructure *dans l’état actuel* 'in the current state', which is obtained after deletion of the prepositional noun phrase modifiers *des choses* 'of things' and *des connaissances* 'of knowledge', and without loss of information:

`dans l’état actuel des choses,.ADV+pcdc
dans l’état actuel,.ADV+pcdc`

In fact, each substructure provides information about the corresponding entry in LGLex, and so the generated substructures in DELA format are filtered automatically in order to delete duplicates. We obtained 21,587 new entries (22,850 new entries before removing duplicates) in DELA format.

Last, some errors in the new entries are due to the way initial adverbial entries are encoded in tables. Considering the adverb *à cette heure-ci* 'at the present time' represented in table PCA: the noun component *heure* 'time' is encoded together with the hyphen, and thus form an amalgam that is automatically reproduced in the substructure *à cette heure-\*ci* 'at this time'. So, we deleted hyphens:

`à cette heure-\*ci,.ADV+pca`

In addition, some spaces had to be deleted. We mention the previous example, written *à cette heure-\*ci*, or the entry *y compris* 'including' ending by a space:

`y compris,.ADV+pcpn`

These corrections are necessary for two reasons: to improve the quality of entries and to compare with the current version of DELA.

Some entries contain variables like *:Adj* (adjective) or *:DNUM* (numerical determiner) (see 2.1):

`par temps,:Adj,ADV+pc`
`à,:Adj échéance,:Adj,ADV+pc`
`à,:DNUM franc près,:ADV+pc`

We have 20,757 entries without variables and 830 entries with variables. The first step consists in integrating all entries without variables in the existing DELA. See the section 4. for the treatment of entries with variables.

### 3.3. Integration in the existing DELA

All these variants need to be added to the existing DELA, which currently contains 9,036 entries, after merging the two lists and verifying that no variant is already present in DELA. In order to produce the new DELA of adverbs, we followed the following steps:

- First, we removed from the existing DELA the adverbial entries of the morpho-syntactic class PECO as they describe idiomatic adjectival phrases rather than adverbs:

  `lent comme une tortue,.ADV+PECO+z1`

  'slow as a turtle'

- Then, we lowercased the LG table names in existing DELA in order to homogenize the notation. In addition, we deleted the quotes around the LG table name 'P ADV':

  `à altitude moyenne,.ADV+pc`
  `à altitude moyenne,.ADV+PCA+z1`

  'at medium altitude'

  `abondamment,.ADV+‘PADV‘+z1`
  `abondamment,.ADV+pdy`

  'amply'

We can see in these examples the code +z1 (cf. 2.3.), which is used in existing DELA but not in LGLex. We sorted and compared all pairs of entries in order to detect any differences between them with respect to the language register:

- Finally, we merged the entries encoded in the 16 LG tables of simple adverbs with the relevant entries present in the existing DELA in order to add the information about the language register. For instance, *abominablement* 'abominably' already exists in current DELA but is followed only by the language register code +z1; after merging the two entries, we obtained a complete new entry:

  `abominablement,.ADV+advmqi+*z1`

  (LG table)

  `abominablement,.ADV+z1`

  (existing DELA)

  `abominablement,.ADV+advmqi+z1` (new entry)
Except entries with variables, we obtained 22,564 final entries (29,793 final entries before removing duplicates) merging 9,036 initial entries and 20,757 new entries in DELA format.

4. Graph dictionary

There are 830 entries with variables\(^{13}\) (cf. 3.2.) which are represented in the 16 LG tables of compound adverbs. In order to produce dictionary entries from these data we used what we call a graph dictionary. This is a sort of transducer which calls upon subgraphs and so it is capable to dynamically produce new dictionary entries in a format similar to that of DELA.

Variables present in adverbial entries can be expressed, according to their type, in two different ways:

- Variables such as $\text{Adj}$ (adjective), $\text{N}$ (noun) and $\text{N-hum}$ (non human noun) are represented in the form of lexical masks, respectively $<\text{A}>$, $<\text{N}>$ and $<\text{N-hum}>$. They use lexical items previously recognized by other resources (such as dictionaries or graph dictionaries);

- All other variables are transformed into a call to a subgraph of the same name. So, we created 171 subgraphs (they are empty by default but some subgraphs already exist). For example, variable :$\text{DNUM}$ is transformed into a call to the subgraph $\text{DNUM}$ that recognizes numerical determiners whether they are expressed in numbers or letters.

For instance, the entries described in the end of section 3.2. are represented as follows:

\[
\text{par temps} <\text{A}> \text{.ADV+pca} \\
\text{à} <\text{A}> \text{échéance} \text{.ADV+pca} \\
\text{à} :\text{DNUM franc près, ADV+pca}
\]

The graph dictionary corresponding to these entries is given in the Figure 2.

![Figure 2: Example of a graph dictionary](image)

\[\text{par temps} <\text{A}> \text{.ADV+pca} \]
\[\text{à} <\text{A}> \text{échéance} \text{.ADV+pca} \]
\[\text{à} :\text{DNUM franc près, ADV+pca}\]

The compact notation ",, " (cf. 2.3.) indicates that the inflected form and the canonical form are identical. The notation $<\text{franc}>$ refers to all inflected forms of the noun. The boxes "$\text{A}"$ and "$\text{A}"$ allow to capture the value of the adjective in order to reproduce it inside the canonical form given in output by "$\text{AS}"$. The grey box represents a call to a subgraph.

During a corpus processing, the analysis of the sequences

\[
\text{par temps sec 'in dry weather', par temps pluvieux 'in rainy weather', à brève échéance 'in the short term' and à cinq francs près 'to the very last penny'}
\]

produce the four following entries in DELA format:

\[
\text{par temps sec,ADV+pca} \\
\text{par temps pluvieux,ADV+pca} \\
\text{à brève échéance, à échéance brève,ADV+pca} \\
\text{à cinq francs près,ADV+pca}
\]

In order to generate dictionary entries in DELA format from the $\text{LGLex}$ adverbial entries with variables we need to create manually all 171 subgraphs. Some subgraphs already exist: $\text{DNUM}$, $\text{Ntps}$, $\text{POSS}$.

5. Results

Table 1 shows the number of the initial adverbial entries in DELA and the new entries extracted from $\text{LGLex}$:

<table>
<thead>
<tr>
<th></th>
<th>without variables</th>
<th>with variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial entries in DELA</td>
<td>9,036</td>
<td>/</td>
</tr>
<tr>
<td>New entries from $\text{LGLex}$</td>
<td>21,898</td>
<td>952</td>
</tr>
<tr>
<td>New entries from $\text{LGLex}$ (without duplicates entries)</td>
<td>20,757</td>
<td>830</td>
</tr>
<tr>
<td>All entries</td>
<td>29,793</td>
<td>/</td>
</tr>
<tr>
<td>All entries (without duplicates entries)</td>
<td>22,564</td>
<td>/</td>
</tr>
</tbody>
</table>

Table 1: Number of entries in DELA

We enhanced the DELA with 13,528 entries, and we have 830 entries with variables which enable the generation of more entries by using the graph dictionary method. The results are quite satisfactory as we obtain 150% new entries in the lexicon only by exploiting precise linguistic information of high coverage, which is freely available in existing resources.

6. Conclusion and future work

At a time when the lack of large-scale lexical syntactic resources for French impedes on NLP research, we have shown the interest of using fine-grained linguistic information, which is provided in existing resources, in order to enrich or diversify their content. This work led to an increase of 150% of the adverbial entries in DELA, and this method is being tested in other languages such as Modern Greek (Voyatzis, 2006). These encouraging results confirm it is worthwhile exploiting features such as paraphrases. Therefore, we plan to complete the LG tables in that direction, starting, for example, with the table of verbal manner adverbs:

\[
\text{Adj-ment = en tout Nabstrait =: amicalement = en toute amitié 'friendly' 'in all friendship'}
\]
Furthermore, we plan to convert the new adverbial entries into the Leff format (Sagot, 2010), in order to integrate them into a parser, following similar work by (Tolone and Sagot, 2011) and (Tolone, 2011). Finally, we can also consider enhancing the French WordNet with respect to adverbial entries (Sagot et al., 2009).

7. References


