Semantic Annotation of Reported Information in Arabic

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Abstract

In this article, we are presenting a semantic annotation tool for Arabic texts with a strategy adapted to the automatic location of reported information. The method used is that of Contextual Exploration, which consists of using purely linguistic knowledge to identify semantic-discursive textual representations.
This work has been carried out in the framework of a thesis at the LaLICC Laboratory at the University ParisIV-Sorbonne.
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Introduction

The automatic identification of Reported Information (RI) is a particularly important problem in the domain of automatic summarization, technological or economic watches etc. This consists of carrying out a semantic annotation of the *information searched* in a text, by specifying the author of this information, his position in relation to his remarks, and where or when he said them.
However, the automatic location of RI, like other semantic-discursive mechanisms in a text, is a task that is even more delicate because the concerned linguistic procedures implicated in its formation differs according to the language. This idiosyncrasy is particularly clear in Arabic where work on the automatic treatment of texts regularly comes up against difficulties related to the morphology of the language and to its syntactic system [Aloulou et al. 03, Gaubert 01, Jaccarini 97, etc.]. We especially mention the phenomenon of agglutination [Debili 01], the absence of vocalisation or the mixed order of words in the sentence [el-Kassas 04].
The method of Contextual Exploration (CE) offers the advantage of getting past certain difficulties of traditional automatic treatment of texts, for example the difficulties met with in morpho-syntactic analysis. Initialized by J.-P. Desclés [Declés 91, 97], CE process is set up in a system of declarative rules and it is principally based on a surface analysis of the context by finding linguistic indicators independent of a particular domain. These markers are the direct traces of the enunciative intention of the author of the text and the instruments he uses to guide the reader in his cognitive process of comprehension. Then we need to confirm or to declare null the pertinence of the location using complementary indicators that are present or not in the context. This approach has been the occasion for different computer applications, such as automatic summarization [Berri 96, Minel 02], extraction of causal relationships [Jackiewicz 98] and relationships between concepts [Cartier 04], segmentation [Mourad 01] etc.
The following is an example of automatic annotation of a conclusive remark (Al-Jazeera Corpus):

وأخيراً **اختتم** الطبيب حديثه **قائلاً** : اعتقد بحسب تحاليلي أن عملية السيد الرئيس يجب أن تجرى خلال الأيام القادمة.

*Finally, the doctor **concluded** his speech **by saying**: I think according to my diagnostics that the president's operation will take place in the next few days.*

This sentence is annotated by a CE rule thanks to the principal indicator (اختتم / *concluded*) and the secondary clue (قائلاً / *by saying*).
We will now explain the different steps for constructing the necessary linguistic resources relevant to the automatic identification of reported information. Next, we will evoke the implementation of this data. We will finish with a presentation of tests and perspectives for the future.

1. Management of Linguistic Resources

The methodology used in the construction of a Context Exploration (CE) system follows a sequence of ordered steps.

1.1 Specification of the framework: Reported Information

Reported Information is any part of the text which allows the enunciator to report on the words or actions of someone else. Reported speech is thus part of this notion. It is therefore appropriate to distinguish between several levels: that of the primary enunciator, that of the speaker and, according to the verb, that of the interlocutor. We can of course have nested reported information.

The enunciator or the speaker can more or less take responsibility for his speech [Desclés et al. 97]. The responsibility taken indicates the degree of the enunciator's commitment regarding his remarks.
For example, the verb *to affirm* does not have the same meaning as the verb *to doubt* though both are RI indicators.
In this article, we only treat certain aspects of this act of language that is Reported Information (RI); the research about the remaining problems is still going on. As a result, we do not treat the principal enunciator or the nested reported information; we do no not treat the taking of responsibility of the enunciator or the speaker regarding his remarks. We will thus explain today, in an operational perspective of NLP, how to identify the speaker, *«the last enunciator who takes directly responsibility for the predicative relationship.* »[Desclés et al. 97] and his remarks in the text: *Who Says What?* Consequently we will show the phases of conception of this point of view.

1.2 Definition of the Corpus

Our experiences are based on a corpus of Arabic language texts made up of more than a thousand press articles from two sources:

- The complete corpus from the newspaper *Le Monde Diplomatique* (LMD) in Arabic.
- A corpus of articles and press releases from the Arabic channel Al-Jazeera.

1.3 Linguistic Analysis of the Corpus

To start with, this part allows us to unravel the textual representations linked to reported information and to isolate the relevant linguistic markers [Alrahabi et al. 04]. These markers are the triggers of the CE process. The RI can be introduced by linguistic markers, typographical markers [Mourad et al. 01] or a combination of both. Linguistic markers are often verbs of communication such as *to announce,* nouns such as *response* or adverbs such as *according to*. We have about 280 verbs and about a hundred nouns and locutions acting as triggers of the RI task. There is indeed a quite tight correlation between the morpho-syntactic property and the semantic property of nearly four hundred verbs involved in reported speech as well as in RI, as has been showed for French by Maurice Gross [Gross 1975] and for Arabic by Amr H. Ibrahim [Ibrahim 1979]. But since the methodology of CE doesn't rely, for many reasons that will not be discussed here, on morpho-syntactic analysis, we will not explore this path here.
Secondly, we need to resolve the discursive ambiguity of the trigger indicator by exploring its context in search of other complementary clues. These can be linguistic, as in the case of named entities or coordinating particles. The clues can also be typographical (quotation marks, colons, footnotes towards bibliographical references) or positional (place of the complementary *that* in the context that follows the verb). We point out at this stage the impact of the presence or absence of a complement like *that* (Inna class) with the verb. In reality, it becomes rather difficult (especially in Arabic) to locate the speaking subject and his remarks in the absence of this clue (mainly when the quotation marks and the colons are also absent). Example (Al-Jezeera Corpus):

أعلنت السلطات الاسرائيلية مساء يوم الجمعة 1996/3/8 **فرض** طوق عسكري على طول ساحل قطاع غزة...

*The Israeli authorities **declared** on Friday night 08/03/1996 **the set up** of a military circle all along the coast of the Gaza Strip…*

1.4 Organization and Mode of Access of Linguistic Markers

The indicators and the linguistic clues are organized in separate groups according to grammatical and enunciative criteria. Thus, the lexical category makes the first important distinction: the verbs are separated from the nouns or the particles. Next, concerning the verbs, we started classifying them in empirical and provisional groups. Other more detailed criteria for classification will be applied later to all the verbs, especially concerning the modality and the responsibility that the enunciators take for their remarks.

1.4.1 Verb classes: Here is a non-exhaustive list of some classes of RI verb indicators:

Declaration class: *أعلن/to declare,* صرح/to announce, أكد/to affirm,* قال/to say,* أشار/to note,* أخبر/to inform, etc.*

Observation class*:* لاحظ/to remark, وجد/to find, أدرك/to observe, فهم/ to understand, أحس/ to feel, etc.*

Explanation class*:* شرح/to explain, بين/to show, وصف/to describe, برهن/ to prove, حلل/ to analyse, etc.*

Negotiation class*:* تباحث/to discuss, راسل/to correspond, تبادل/to exchange, تفاوض/to negotiate, تناقش/ to discuss, etc.*

Continuation class*:* أضاف/to add, أكمل/ to continue, تابع/to follow up, etc.*

Summarization class*:* اختتم/to sum up, لخص/to synthesize, اختصر/to reduce, etc.*

The lists only contain the simple forms of the markers, meaning the masculine singular form of the accomplished verb and the masculine singular form of nouns.
In order to get around a morpho-syntactic analysis of the texts, we will carry out an automatic generation of certain inflected and agglutinated forms of linguistic markers. Then we will proceed with their recognition in the texts.

1.4.2 Generation of the Glossary: We have set up an automatic glossary generator for Arabic, adapted to the semantic annotation of the reported information. Only the

part we consider the most important and which concerns the verbs has been carried out so far. As a reminder, the Arabic glossary is composed of roots, a root corresponds to a notion (example: رقص /*to dance*). Based on a single root, all the other concepts linked to a notion are derived according to some schemes. A graphic word in Arabic is formed [Cohen 70] from:

proclitic + prefix + base + suffix + enclitic

Certain particles in Arabic are linked to simple forms to constitute a single graphic block, where the ambiguity can be potentially difficult to resolve.

The verb generator is based on an algorithm of detection of morphological variations between the two forms of the accomplished and unaccomplished of the verb.

It is necessary to specify the kind of suffix particles that can be agglutinated to verbs. Thus we naturally distinguish three kinds of verbs in Arabic:

• Those that accept the agglutination of particles referring to remarks, like *to say* (قال الشيء لفلان: قاله لفلان);

• Those that accept the agglutination of particles referring to the interlocutor, like *to speak* (كلم فلان عن الشيء: كلمه عن الشيء);

• And finally those that don't accept this kind of agglutination (عبر عن الشيء لفلان: عبر عنه لفلان).

The generator is then able to give the complete conjugation of the verb according to the parameters that we have chosen. Thus each verb will be conjugated according to the following grammatical traits:

• Gender: masculine or feminine;

• Number: singular, dual and plural;

• The third person, which corresponds to the speaker.

• Aspect: accomplished or unaccomplished;

• Agglutination concerning the particles attached to the generated forms, the particles of coordination (ex. و, ف) and, according to the entered verb, the suffixes (ها, هـ) or (هم, ها, نا, هـ).

Example: For the verb أكد /*to affirm* we will have the following generated forms:

أكد, وأكد, فأكد, أكده, وأكده, فأكده, يؤكد, ويؤكد, فيؤكد, يؤكده, ويؤكده, فيؤكده, الخ.

He affirmed, and he affirmed, so he affirmed, he affirmed it, and he affirmed it, so he affirmed it, he affirms, and he affirms, so he affirms, he affirms it, and he affirms it, so he affirms it, etc.

The linguist can also provide other information at the time of verb generation, mainly the nature of Inna type particle. In fact, not all the verbs of a list are followed by the same type of complementary clue, so we have found it more reliable to directly attach each verb entry to its own conjunction (Inna class). Example:

قال إن /*say that*
عبر عن /*to express oneself on*
شرح أن, شرح كيف /*explain that, explain how*

1.5 Conception of the CE rules

The role of a CE rule is to offer a semantic filtering strategy adapted to the automatic annotation. Once the trigger indicator is located in the text, the next step is to resolve any ambiguity concerning this indicator by exploring its context through the search of secondary clues. Hence the capital importance is the definition of the indicator's context.

1.5.1 The search field: The notion of search field is strictly linked to the task treated. As an example, the search field for the location of enumerations is not the same as that for thematic announcements or defining expressions. Concerning the identification of RI, the smallest unit we can work with is a textual passage containing one (or more than one) verbal or nominal predication. In practice, this corresponds to a textual fragment containing one or more trigger indicators. Then the fragment is cut into several segments each containing one single indicator with other elements coexisting in the context. Taking a simple search field, containing a single indicator verb, we can then study all the possibilities of positioning of the elements we are looking for in this field, according to the nature of the verb and its Inna type particle. To do this, we must establish a certain organization of the sentence in Arabic in the case of reported information. So that the RI has informative value, we exclude imperative, interrogative and negative sentences. Consequently, in the case of an active elementary structure we can have several syntactic constructions such as:

1- قال إن الربيع قادم
1 - (he) said that spring is coming
2- قال زيد إن الربيع قادم
2 - said Zaïd that spring is coming
3- قال اليوم إن الربيع قادم
3 - (he) said today that spring is coming
4- اليوم قال إن الربيع قادم
4 - today (he) said that spring is coming
5- زيد قال إن الربيع قادم
5 - Zaïd said that spring is coming
6- زيد قال اليوم إن الربيع قادم
6 - Zaïd said today that spring is coming
7- اليوم قال زيد إن الربيع قادم
7 - today said Zaïd that spring is coming

If we consider that the introductory verb and its Inna always exist, we can then describe all the attested cases by the language according to the following structure:

Right_Context			**Indicator**	**Left_Context** (from the indicator's point of view)
After_Inna	**Inna**	Before_Inna		

Reading Direction

This offers us three search fields that the CE rules will exploit. We must also find the other models for the cases where, for example, the Inna particle does not exist or

when the RI introducer is a noun or a term. So it already allows us to specify the placement of the sought after elements. Next, we must find the sought after elements more precisely, with the help of other heuristics and a secondary group of clues like "named entities" or others. If the results of these searches are positive, the semantic annotations are attributed to the sentence in question, to the speaker, and to his remarks.

1.5.2 Declaration of the Rules: A CE rule is formalized by heuristics in a declarative form, made up of conditions and actions concerning the attribution of semantic labels. Example of a basic rule:

```
CE rule # 3:
Given a sentence P
If (indicator exists in P)
If (Inna exists in right_context)
If (left_context is empty)
If (before_Inna is not empty)
Then :
   If (before_Inna contains a speaker of the class
                                        Named_Entities)
   If (remark is in the field (after_Inna to the end of the
     sentence)or in the field (after_Inna to next_Indicator))
   Then:
      Give a semantic annotation to the sentence
      Give a semantic annotation to the speaker
      Give a semantic annotation to the remark
```

This rule allows us to pick up a sentence like the one in example 2.

In the premises of the CE rules we can use several means to take away the ambiguity. For example, the verification of the morphology of the marker (the linking suffixes and prefixes), the presence or absence of certain words in the context, the distribution of words in the sentence, the placement of a word in the sentence, etc. We also use lists of secondary clues, like lists of named entities (names of places, time expressions, titles and functions, etc.), lists of thematic terms, lists of certain grammar particles etc.

2. Computer Implementation of Linguistic Resources

The goal behind the conception of this tool is to have a coherent and complete environment adapted to our needs in which we can build and exploit linguistic knowledge. Three essential points have thus been respected: firstly, the separation of linguistic data from the computer implementation; secondly, the ease of use (the linguist doesn't need to have advanced knowledge of computers); and thirdly, the use of standard formats of exchange (XML) in order to facilitate the exchange of data and the mobility of the tool. This tool offers several functions for the preprocessing and processing of the data:

2.1 Preprocessing of the Data

2.1.1 Cleaning: In order to treat a text in our system, it must first be converted into raw text format to delete any layout, and to encode it in UTF-8.

2.1.2 Devocalisation: The collection of texts is generally partially vocalized. Our choice is to eliminate all of the vocalizations that exist in the texts, meaning the ten signs [Zaghibi 02] that mark the Arabic pronunciation. This is because in most arab countries, today's Arabic texts are only partially vocalized, especially in the newspapers. So the system can function for all kinds of texts without worrying about the problem of vocalisation. For example: the devocalisation of a word like صرّحَ */to declare* would give صرح.

2.1.3 Segmentation: Unlike Latin languages, the segmentation of Arabic texts cannot be simply done using typographical signs [Mourad 02]. Added to this are other difficulties like the absence of capitals letters in Arabic or the ambiguity of the agglutinated conjunction to the words that follow (و / *and,* ف*so*) [Baccour et al. 03]. The technique that we have adopted allows us to cut the text into paragraphs and sentences. Each sentence ends with a period or starts back on a new line. Several rules to clarify the period have been encoded in the program in the form of regular expressions. The output is in XML format. We feel that the results of this technique go perfectly with the principle of CE. A first "general" segmentation gives whole sentences ending with periods; and according to the annotation profile (the RI in our case) the first step of filtering will offer a finer segmentation of the sentence, based on semantic criteria that we have seen above.

2.2 Treatment of Data: Semantic Annotation

Three rounds of filtering are necessary for this strategy of contextual exploration, and only the first two have been carried out so far.

During the *first round* of filtering we locate the verb indicators and their Inna type clues as well as typographical markers : or "". This allows us to construct the search field in which the CE rules will function.

The presence of trigger indicators will start the *second round* of filtering, and rules will test their conditions in the search fields that are already outlined based on adequate heuristics and secondary groups of clues.

The premises of the CE rules are encoded in the tag of the XML files. As a rule is being read, the tags are looked through: the conditions are verified and the actions are executed. Finally, the *third round* of filtering is dedicated to resolving the conflicts between the results of several rules on the same passage of the text, to assigning degrees of pertinence to the locations and to choosing the modes of visualization and textual navigation.

3. Tests and partial evaluation

The tests carried out on the generation, segmentation, first and second round of filtering seem satisfactory. But we cannot provide any reliable figures at this point until the final result can be obtained and evaluated, as the other tasks to be completed aren't yet fully studied and implemented.

3.1 Example of processing

Let's take an example to show the functioning of the different steps of execution, with one type of rule (described below). Starting with the generator, we will first generate the necessary forms of a RI introductory verb, for example قال / *to say*:

The list of generated forms is coded in XML files in which each child corresponds to a form of indicator. The Inna type secondary clue is added as the attribute of each indicator tag. Here is an extract from the XML generated file:

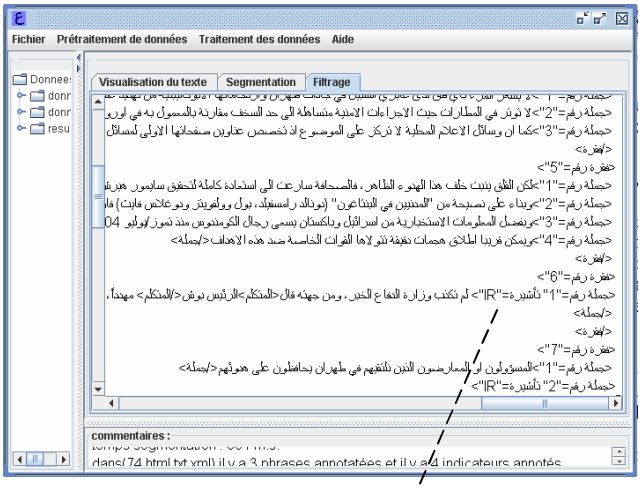
```
<?xml version="1.0" encoding="UTF-8" ?>
<liste nomFichier="indicateursVerbes.xml">
  <indicateur particule="إن">قال</indicateur>
  <indicateur particule="إن">قالت</indicateur>
  <indicateur particule="إن">قالوا</indicateur>
  <indicateur particule="إن">وقال</indicateur>
  <indicateur particule="إن">وقالت</indicateur>
  <indicateur particule="إن">وقالوا</indicateur>
  <indicateur particule="إن">فقال</indicateur>
```

Now let's consider for instance a corpus like that of Al-Jazeera. We can choose a text (or several texts) and we carry out the semantic annotation. In this way we first convert the text in raw text format, then we devocalize and segment it.

Now we will launch the filtering process with some CE rule, we search the text for indicators and Inna clues. Here is an extract showing different possible options after going through the *first round*. We can see that three sentences are kept and each one has several search fields: sentences 1 and 2 of the paragraph 6 and sentence 2 of the paragraph 7:

```
<"6"=فقرة رقم>
< "1"=جملة رقم>
<يسار>لم تكذب وزارة الدفاع الخبر، ومن جهته</يسار><دليل>قال</دليل>
<يمين><قبل>الرئيس بوش مهدداً، ردا على سؤال من محطة "أن بي سي"
التلفزيونية حول احتمال الاقدام على عمل عسكري ضد ايران</قبل>
<مؤشر>:</مؤشر><بعد> "آمل التوصل الى حل دبيلوماسي لكني لا استبعد
أياً من الخيارات"</يمين></جملة>
<جملة رقم="2" >
<يسار>هذه التصريحات لا تقل خطورة عن مزاودات وزير الدفاع علي
شمخاني الذي كان اكثر صلابة, ويرى المراقبون أن ما </يسار>
<دليل>قاله</دليل><يمين> في مؤتمره الصحفي يوم أمس لا يخلو من
الاستفزاز المباشر لواشنطن</يمين></جملة>
</فقرة>
<فقرة رقم="7">
<جملة رقم="1">المسؤولون او المعارضون الذين نلتقيهم في طهران
يحافظون على هدوئهم</جملة>
<جملة رقم="2"><يسار></يسار><دليل></دليل><يمين><قبل>لنا الاستاذ
محمود كاشاني مثلا، وهو معارض معتدل ومرشح سابق لرئاسة الجمهورية
</قبل> <مؤشر>أنه</مؤشر><بعد> "منذ 25 عاما تضع الولايات المتحدة
ايران في خط نارها، ومنذ العام 1995 اعلنت واشنطن حصارا اقتصاديا على
طهران ضاعفته بقانون اماتو [2]. ثم قام السيد بوش بتصنيفنا في محور الشر
وها هي وزيرة الخارجية الجديدة كوندوليزا رايس تعرّف ايران "كموقع متقدم
للطغيان" في العالم. اعتدنا العدائية هذه والبرنامج النووي ليس سوى ذريعة
جديدة"</بعد>
```

In the *second round*, each time an indicator is found in the text, the CE rules are triggered and executed one after another. Here is an extract of the result:




```
<"6"=فقرة رقم>
<جملة رقم="1" تأشيرة="IR"> لم تكذب وزارة الدفاع الخبر، ومن جهته
قال</المتكلم>الرئيس بوش</المتكلم> مهدداً، ردا على سؤال من محطة "أن بي
سي" التلفزيونية حول احتمال الاقدام على عمل عسكري ضد ايران: <الكلام>
"آمل التوصل الى حل دبيلوماسي لكني لا استبعد أياً من الخيارات" </الكلام>
</جملة>
```

Traduction:

```
<paragraph no="6">
<sentence no="1" annotation="RI">The minister of Defence
did not refute the information, on the other hand<speaker>
president Bush</speaker>said, with menace, answering the
question of the television channel NBC, about the
eventuality of a military action against Iran :<remark>"I
hope that we will arrive at a political solution but I don't
exclude other solutions"</remark> </sentence>
```

Only two sentences will be kept by our rule. The second one (sentence number 2, paragraph number 6) will not be kept because its indicator is not surrounded with any

secondary IR clue. The two sentences that are kept will have a semantic annotation for the speaker and his remark.
We have to notice that in the right context of the sentence chosen from the extract above, we resorted to a list of named entities that helped the localisation of the clue (الرئيس بوش /*the president Bush*).

3.2 Difficulties and Solutions

The Arabic language presents several difficulties for automatic treatment due mainly to the absence of a complete vocalisation, the absence of capital letters, the agglutination and the relatively free order of words in a sentence. The contextual analysis done by the CE allows us to clear up different kinds of ambiguity, and to provide a semantic annotation of the textual passages containing reported information.
Nevertheless, certain difficulties demand a pertinent linguistic analysis and the writing of efficient CE rules. For example, in the case of anaphora or the precise location of the subject, a problem closely linked to the recognition of the named entities.

4. Conclusion and Perspectives

In this paper we have presented a method of semantic annotation and automatic identification of RI in Arabic texts. The method used, CE, has allowed us for the most part to get rid of the difficulties of the automatic treatment of Arabic and to attribute the semantic annotation to the involved textual passages. The CE methodology adopted offers us the advantage of avoiding self implication as it happened with the classic procedures of NLP, mainly concerning morpho-syntactic analysis or statistical methods.
We have three short-term objectives: First, to formalize the structures corresponding to the other cases of RI seen above, for example, those that do not contain an Inna clue or those introduced by a noun. Secondly, to study the responsibility taken by the enunciators for their remarks. And finally, to technically carry out the third round of filtering. This will allow us to make an evaluation.
Subsequently, it is possible to integrate this tool, from a technical and conceptual point of view, in a more important setting, where other tasks can be carried out.

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