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Maghrebi Arabic dialect processing: an overview

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Natural Language Processing for Arabic dialects has grown widely these last years. Indeed, several works were proposed dealing with all aspects of Natural Language Processing. However, some AD varieties have received more attention and have a growing collection of resources. Others varieties, such as Maghrebi, still lag behind in that respect. Maghrebi Arabic is the family of Arabic dialects spoken in the Maghreb region (principally Algeria, Tunisia and Morocco). In this work we are interested in these three languages. This paper presents a review of natural language processing for Maghrebi Arabic dialects.

1. INTRODUCTION

The Arabic language is characterized by its plurality. It consists of a wide variety of languages, which includes the Modern Standard Arabic (MSA), and a set of various dialects differing according to regions and countries. The varieties of Arabic dialects (AD) are distributed over the 22 countries in the Arab World. Geographically, Arabic dialects are classified in two main blocs, namely Middle East (Mashriq) and North Africa (Maghreb) dialects. Maghrebian dialects are the languages that are spoken in this geographical area (Maghreb). They are characterized by the coexistence of several languages: MSA, dialectal Arabic, Berber and French. The Berber dialects constitute the oldest linguistic substratum of this region and are, therefore, the mother tongue of a part of the population. Since the Islamic conquest of the Maghreb, several Arab tribes have intermingled, especially in pastoral areas, because of the similarity of their way of life. This coexistence reinforced the Arabization of the Berber tribes. The influence of the Arabic language on the Berber world spread fairly rapidly, and this practically all over the Maghreb [1]. The French language was introduced by the colonial occupation. First, as the language of the colonial administration, this language has spread to a large part of the population through education and administration. This language spread in its written and oral uses, it influenced the spoken languages (Berber and AD) by the borrowings that these made to it [2].

The Maghreb is composed, in its central part, of Algeria, Tunisia and Morocco. In this paper, we are interested in the Arabic spoken in these three countries. This interest is justified by the fact that these countries have in common a lot of socio-historical similarities and an identical linguistic situation. We therefore present in this work an overview of these dialects, first on several levels of linguistic representation (section 2) and then in terms of research work dealing with these languages (section 3). We believe that such a study is very useful for the scientific community working in the field of Natural Language Processing (NLP) in general and more specifically those working on NLP of Maghrebi Arabic dialects.
2. LINGUISTIC OVERVIEW

Maghrebi Arabic dialects include principally Algerian Arabic, Moroccan Arabic and Tunisian Arabic. In this section, we give an overview of these three languages regarding phonological, lexical, morphological and syntactic level.

A. At phonological level

The three Maghrebi Arabic dialects share the most features of standard Arabic. Besides the 28 Arabic consonants phonemes /$g$/ /$p$/ and /$v$/ which are mainly used in words borrowed from foreign languages as French. Also, the (ظ) is uttered as /d/ (ض), whereas (ژ) and (ث) are mostly pronounced as /d/ (ذ) and /t/ (د) for both Algerian and Moroccan dialects and not for Tunisian where the utterance of these two consonants is the same as in MSA. Furthermore, the letter (ق) is particular in the way that it has different pronunciations. For the three dialects it is uttered as /q/ and /g/. It should be noted that the use of /g/ is observed not only in rural places but also in urban cities. In addition, the (ق) is uttered as the glottal stop /ʔ/ as in Tlemcen (west of Algeria) and Fes (Morocco), just like in Egyptian dialect. In some eastern cities of Algeria a particular pronunciation of the (ژ) is /k/ (this phenomenon does not exist in Tunisian and Moroccan). Also, the consonant (رح) has different pronunciations /d/ /j/ or /z/ (for Tunisian dialect and the dialect of Tlemcen and other cities in the east of Algeria). Other notable features of Maghrebi dialects are the collapse of short vowels both in nouns and verbs and the glottal stop (Hamza) omission particularly in the middle and the end of words.

B. At Lexical level

Maghrebi dialects’ vocabulary is mostly inspired from Arabic but it is phonologically altered, with significant Berber substrates, and many loanwords from French, Italian, Turkish and Spanish. Like for Arabic vocabulary, these dialects’ vocabularies include verbs, nouns, pronouns and particles.

C. At Morphological level

The morphology of Arabic dialectal words shares a lot of features with MSA morphology. Furthermore, dialect inflection system is simpler in some aspects than MSA, whereas affixation system seems to be more complicated than MSA. Indeed inflection system is simplified by the elimination of a wide range of rules. In fact, as in all Arabic dialects, Algerian, Moroccan and Tunisian do not accept the singular word declension which corresponds to the nominative, the genitive, and the accusative cases which take the short vowels ء، ـ and ة respectively in the end of the word. Similarly, the three doubled case endings expressing nominal indefiniteness are also dropped. It should be noted that for the three dialects, the singular nouns declension to the plural (feminine/masculine regular plural and broken plural) follows MSA rules but with the difference that the three cases enumerated above are not distinguished.\(^2\) In addition, the three dialects do not have the nominal dual which is a distinctive feature of standard Arabic. The verb conjugation of the three dialects uses a set of affixes slightly different with MSA ones besides a variation in vocalization. We mention that the dual and feminine plural of MSA are lost in the dialects. Moreover, the negation in the three dialects seems to be more complex than in MSA, the circumfix negation ( Muslim) could be مسلمان (nominative case) or مسلم (accusative or genitive). In contrast, for the dialect word مسلم (Muslim) always takes the plural makes for the regular plural whatever its grammatical category.

\(^2\)Example: Depending on its function in the sentence, the masculine regular plural of MSA word مسلم (Muslim) could be مسلمان (nominative case) or مسلم (accusative or genitive).
For Algerian dialect, in [13], the authors crawled an Algerian newspaper to extract comments that they used to build a romanized code-switched Algerian Arabic-French corpus. In this study, the authors highlighted the particular Algerian linguistic situation by discussing its main features. It should be noted that the corpus is annotated by language identification at word-level.

KALAM’DZ, An Arabic Spoken corpus dedicated to Algerian dialectal varieties was built in [14] by exploiting Web resources such as Youtube and other Social Media, Online Radio and TV. The dataset covers a large number of Algerian dialects with 4881 native speakers and more than 104 hours.

An another Speech corpus dedicated to Algerian dialect, AMCASC (Algerian Modern Colloquial Arabic Speech Corpus) was presented in [15]. Authors used this corpus for the purpose of evaluating their automatic regional accent recognition approaches based on GMM-UBM and i-vectors frameworks.

In the same vain, authors of [16] presented their methodology to build an Arabic Speech Corpus for Algerian dialects. The authors proceeded by recording speeches uttered by 109 native speakers from 17 different regions in Algeria.

In [17], CALYOU, a Comparable Corpus of the spoken Algerian was built from Youtube comments. It consists of 853K comments including a total of 12.7M words. This work deals with the issue of comparability of comments extracted from Youtube. It presents a Word2Vec based method of alignment which achieves the best comparability results among the other methods that the authors experimented.

B. Identification
Several efforts dealing with Maghrebi Arabic dialects are those dedicated to the identification and recognition. In fact, Arabic dialects differ from one country to another and even in the same Arab country there is a lot of dialect variaties. In this context, authors of [18] addressed the problem of spoken Algerian dialect identification by using prosodic speech information (intonation and rhythm). They performed an experiment of their approach on six dialects from different Algerian departments. Another study [19] showed that Algiers and Oran dialects can be identified by prosodic cues.

In [20], for the classification of Tunisian and Moroccan dialects, two methods were used namely the feed forward back propagation neural network (FFBPNN) and the support vector machine (SVM). The former (FFBPNN) performs better than the later in terms of recognition rates.

In the context of dialect identification within social media (Facebook comments), authors of [21] used an Algiers dialect lexicon and perform different ways of identification: total (word matching), partial (prefix and suffix matching) and by applying improved Levenshtein distance.

The work cited in [22] presents DATOOL a graphical tool for annotating tweets. A native speaker of Moroccan dialect annotated an average of 250 (mixed-language and mixed-script) tweets per hour. The obtained corpus has been used for the purpose of dialect identification.

C. Orthography
A particular attention is devoted to dialect orthography because of their spoken nature and thus a total absence of standard writing rules. Some efforts were made to resolve this issue. The authors of [23] presented orthography guidelines for transcribing Tunisian speech corpora based on the standard Arabic transcription conventions. Later, the CODA map (Conventional Orthography for Dialectal Arabic) described in [24] was adapted to Tunisian dialect [25], Algerian dialect [26] and finally in general for Maghrebi dialects [25].

D. Morphological analysis
In [27], a morphological analyzer for the Tunisian dialect based on a MSA analyzer was proposed. Furthermore, as an expansion of a MSA lexicon, a lexicon for the Tunisian dialect was built. This last lexicon has been used in [28] to convert a standard Arabic corpus for creating a large Tunisian dialect corpus, in order to train a POS tagger. A similar approach was adopted in [29] where the authors exploited also the closeness between standard Arabic and Tunisian dialect. They developed a POS tagger by converting a Tunisian sentence to MSA lattice, after a disambiguation step, a MSA target sentence is then produced and tagged simply with a MSA tagger.

For Moroccan dialect, in [30] a morphological analyzer has been developed in addition of an annotated corpus that has been created within this work. It should be noted that specific CODA guidelines for Moroccan dialect has been also created (inspired from [24] cited above).

For Algerian dialect, a morphological analyzer was developed in [31]. Authors adapted the well-known morphological analyzer BAMA dedicated for MSA.

E. Sentiment analysis
Sentiment analysis is a promising and challenging direction research in the area of dialect NLP. Indeed, Arab people use their dialects on social media and discussion forums to express their opinions. Sentiment analysis for Maghrebi dialects is still in an earlier stage. Most of the work are recent compared to contributions related to MSA or a relatively more-resourced dialect such as Egyptian dialect.

In [32], the authors proposed a lexicon-based approach for sentiment analysis of Algerian dialect. They used a manually annotated dataset and three Algerian Arabic lexicons.

Authors of [33] presented an approach for emotion analysis of Tunisian Facebook pages. They introduced a new method to create emotion dictionaries by using emotion symbols as sentiment polarity indicators. Recently, in [34] the focus was also made on Tunisian dialect sentiment analysis. Their approach is based on machine learning techniques for determining comments polarity. Within this research, a corpus of 17K Facebook comments has been created and annotated.

F. Machine translation
Machine translation is another issue related to Arabic dialects and Maghrebi ones particularly. In fact, Machine translation requires specific resources like parallel corpora in the context of data-based approach and strong linguistic studies in the case of rule-based approach, while this dialects suffer from a lack of resources especially parallel corpora. Few efforts have been deployed to deal with machine translation of Maghrebi dialects,
We focused in this paper on Maghrebi Arabic dialects particularly Algerian, Moroccan and Tunisian Arabic. After a linguistic overview, we provided a survey of the research work dealing with these languages. Several comments can be made based on this work. In view of the various published works, we can see that the research efforts dealing with Maghrebi Arabic dialects are at an early stage. Most of the research work dealing with these dialects has been devoted to the construction of corpora and lexicon. This is mainly due to the fact that these languages are under-resourced. The identification task has also been researched. While the morphology of the Maghrebi Arabic dialects has been addressed in few papers, the syntactic analysis remains totally ignored. It is also worth noting the small number of works devoted to machine translation of these dialects. In addition, these few existing contributions are dedicated to the translation between dialects and MSA, no work has considered the French language.

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