QurAna: Corpus of the Quran annotated with Pronominal Anaphora

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Abstract

This paper presents QurAna: a large corpus created from the original Quranic text, where personal pronouns are tagged with their antecedence. These antecedents are maintained as an ontological list of concepts, which has proved helpful for information retrieval tasks. QurAna is characterized by: (a) comparatively large number of pronouns tagged with antecedent information (over 24,500 pronouns), and (b) maintenance of an ontological concept list out of these antecedents. We have shown useful applications of this corpus. This corpus is the first of its kind covering Classical Arabic text, and could be used for interesting applications for Modern Standard Arabic as well. This corpus will enable researchers to obtain empirical patterns and rules to build new anaphora resolution approaches. Also, this corpus can be used to train, optimize and evaluate existing approaches.

Keywords: Anaphora, Quran, Corpus

1. Introduction

In this paper, we report the release of QurAna: a corpus of the Quran annotated with antecedent references of pronouns. We describe in detail the annotation scheme, annotation process, and intended use of this language resource. We believe this annotation work on Classical Arabic is the first of its kind and will be a valuable language resource for the corpus linguistics community. This corpus will benefit researchers in extracting empirical patterns and rules for building new anaphora resolution approaches. Also, this corpus can be used to train, optimize and evaluate existing approaches.

The ability to identify the antecedents of a pronominal anaphor has many applications in NLP. For example, correct antecedence assignment is vital for efficient machine translation. Similarly, information extraction and question answering systems can work efficiently when pronouns are resolved correctly. Also, automatic summarization systems rely on producing cohesive meaning through proper anaphor chaining. The importance of this task was recognized through the Message Understanding Conference (MUC) community (Hirschman & Chinchor, 1997) with a separate task for developing automatic coreference resolution systems.

Despite increasing work on corpus building in recent years and recognition of the importance of annotated corpus data for various tasks, annotation of anaphoric links is still lagging behind (Mitkov et al. 2000).

1.1 Why this text?

The Quran is a scripture which is according to Muslims the verbatim words of Allah containing over 77,000 words revealed through Archangel Gabriel to Prophet Muhammad over 23 years beginning in 610 CE. It is divided into 114 chapters of varying sizes, where each chapter is divided into verses, adding up to a total of 6,243 verses.

The Quran was chosen for creation of this annotated corpus for a number of reasons:

1. The original Arabic Quran is characterized by very frequent use of anaphors. The majority of anaphoric devices in the Quran appear around pronominal anaphora. Hence, the ability to resolve pronoun antecedence is vital to understanding the Quran. We will demonstrate pronominal anaphora in the Quran further through examples from Quranic verses in the next sub-section.

2. The Quranic scripture is a widely used and cited document that guides the lives of over 1.5 Muslim adherents today. Increasingly non-Arabic speaking Muslims –and many non-Muslims- learn Classical Arabic with the objective to understand the Quran. For Arabic speakers, the Quran is considered to be the finest piece of literature in the Arabic Language. Producing language evaluation resources for computational analysis of pronominal anaphora of such an important text should be well justified.

3. Classical Arabic (CA) text is the form of Arabic language used in literary texts authored by early Arabic scholars mainly in the 6th through 10th century. The Quran is considered to be the highest form of Classical Arabic text and has been extensively cited in linguistic scholarly works since the 7th century. In contrast to most languages, the total body of Arabic texts published during this classical period large, compared to modern corpora of Modern Standard Arabic (MSA) - the form used in contemporary scholarly published works as well as in the media. MSA does not differ from Classical Arabic in morphology or syntax, but richness of stylistic and lexis usage is apparent in Classical works. This makes Classical Arabic subsume MSA making computational and linguistic research work on CA benefit both. However, most recent work on Arabic corpus annotation has concentrated on MSA, and the computational corpus linguistic community has largely ignored study of the large body of language resources available in Classical Arabic.

4. Being a central text in Arabic, over the past 14 centuries a large body of scholarly commentary volumes has been compiled elaborating on linguistic, stylistic, semantic and other aspects of the Quran. This makes the task of compiling evaluation datasets and annotated corpora on the Quran simpler; as it is very likely we can find scholarly comments on any difficult annotation question. In our QurAna corpus, we relied on assigning correct antecedence of pronouns in ambiguous cases on scholarly commentary of Ibn Kathir -a well-known Quranic scholar who died in 1373 CE.

5. The Quran is widely translated into almost all live languages of the world, and in many cases multiple translations within one language are available. Among these translations a number of them are also available in machine readable electronic format in the web[1]. All translations maintain chapter and verse numbers as available in the original text, allowing alignment between these translations at sentence or verse level. Moreover, as the Quran is believed to be the words of God, all translations are made very carefully. Given this fact, any language evaluation resource in the source language of the Quran could be used to evaluate computational tasks on the target language translation as well. Having the source language properly annotated with pronoun antecedents enables evaluation of other language translations as well as evaluation of rival translations in one language. Moreover, there has been analogous research to produce a corpus of the Bible aligned in many translations (Resnik et. al, 1999).

6. The size of the Quran is manageable for manual or semi-automatic annotation tasks. Given that the Arabic language still lacks many NLP resources available for a language like English (e.g., taggers, parsers, Wordnet, frameNet, etc.), developing manually annotated language resource on a smaller scale like the Quran text could be a good starting point. A case in point is the Quranic Arabic Corpus (QAC)[2] project (Dukes, et al 2010), where every word of the Quran is tagged with morphological, part-of-speech and syntactic information, and is publicly available for research purposes. Another available resource is QurSim, a corpus of the Quran annotated with related verses (Sharaf & Atwell, 2012)[3]. Our QurAna corpus, along with these other available resources on the Quran, will enable interesting computational linguistic applications on the Quran which in turn will eventually create motivation for wider applications and resource development for Classical and Modern Standard Arabic.

7. With the wide spread of knowledge in machine readable formats (e.g., ontologies, wikis, corpora, digitized libraries, etc.), and the availability of large bodies of Arabic texts from both the classical as well as modern period, we find increasing interest in incorporating world knowledge in information and knowledge extraction tasks (Gabrilovich & Markovitch, 2007). As the Quran frequently uses pronouns that require such domain knowledge to resolve their antecedents, we think this resource would be very valuable for researchers in this new direction.

1.2 Pronominal Anaphora in the Quran

The Quran is characterized by frequent and varied use of pronouns, at least in part because the morphology of Arabic in general requires a pronoun with each verb, which is not the case in many languages including English. This is evident in the following example from verse (24:31). Note that the English translation[4] retains only 16 pronouns from the original Arabic's 27 pronouns. Also, note that the underlined Arabic pronouns are affixed to the word rather than standing alone.

وَقُل لِّلْمُؤْمِنَاتِ يَغْضُضْنَ مِنْ أَبْصَارِهِنَّ وَيَحْفَظْنَ فُرُوجَهُنَّ وَلَا يُبْدِينَ زِينَتَهُنَّ
إِلَّا مَا ظَهَرَ مِنْهَاۖ وَلْيَضْرِبْنَ بِخُمُرِهِنَّ عَلَىٰ جُيُوبِهِنَّۖ وَلَا يُبْدِينَ زِينَتَهُنَّ إِلَّا
لِبُعُولَتِهِنَّ أَوْ آبَائِهِنَّ أَوْ آبَاءِ بُعُولَتِهِنَّ أَوْ أَبْنَائِهِنَّ أَوْ أَبْنَاءِ بُعُولَتِهِنَّ أَوْ إِخْوَانِهِنَّ أَوْ
بَنِي إِخْوَانِهِنَّ أَوْ بَنِي أَخَوَاتِهِنَّ أَوْ نِسَائِهِنَّ أَوْ مَا مَلَكَتْ أَيْمَانُهُنَّ أَوِ التَّابِعِينَ غَيْرِ
أُولِي الْإِرْبَةِ مِنَ الرِّجَالِ أَوِ الطِّفْلِ الَّذِينَ لَمْ يَظْهَرُوا عَلَىٰ عَوْرَاتِ النِّسَاءِۖ وَلَا
يَضْرِبْنَ بِأَرْجُلِهِنَّ لِيُعْلَمَ مَا يُخْفِينَ مِن زِينَتِهِنَّ

And say / to the believing women / (that) they should lower / [of] / their gaze / and they should guard / their chastity, / and not / they (to) display / their adornment / except / what / is apparent / of it. / And let them / their head covers / over / their bosoms, / and not /they (to) display / their adornment / except / to their husbands, / or / their fathers / or / fathers / (of) their husbands / or / their sons / or / sons / (of) their husbands / or / their brothers / or / sons / (of) their brothers / or / sons / (of) their sisters, / or / their women / or / what / possess / their right hands / or / the attendants / having no physical desire / among / [the] men / or / [the] children / who /they (are) not / aware / of / private aspects / (of) the women. / And not / let them / their feet / to make known / what / they conceal / of / their adornment.

And tell the believing women to lower their gaze and be modest, and to display of their adornment only that which is apparent, and to draw their veils over their bosoms, and not to reveal their adornment save to their own husbands or fathers or husbands' fathers, or their sons or their husbands' sons, or their brothers or their brothers' sons or sisters' sons, or their women, or their slaves, or male attendants who lack vigour, or children who know naught of women's nakedness. And let them not stamp their feet so as to reveal what they hide of their adornment ..

Also, the following verse shows intensive reliance on pronouns.

وَإِنَّهُمْ لَيَصُدُّونَهُمْ عَنِ السَّبِيلِ وَيَحْسَبُونَ أَنَّهُم مُّهْتَدُونَ

And indeed, they / surely, turn them / from / the Path / and they think / that they /they (are) guided

And lo! they surely turn them from the way of Allah, and yet they deem that they are rightly guided [43:37]

[1] See for example: http://quran.com and http://qurandatabase.org

[2] http://corpus.quran.com

[3] http://textminingthequran.com/wiki

[4] We follow the Arabic text with English word-by-word translation available at http://corpus.quran.com, followed by Pickthall translation available at http://quran.com - a subset of pronouns are underlined to illustrate the point in the text

Resolving pronoun reference is vital to understanding the meaning of the Quran. Consider the following two verses, the underlined pronouns refer to "children of Israel" which has been tagged as such, although the actual mention of the antecedent was made very earlier in the text.

وَإِذْ أَخَذْنَا مِيثَاقَكُمْ وَرَفَعْنَا فَوْقَكُمُ الطُّورَ
And when / We took / your covenant / and We raised / over you / the mount,
And when We made a covenant with you and caused the mount to tower above you [2:63]

وَإِذْ نَتَقْنَا الْجَبَلَ فَوْقَهُمْ
And when / We raised / the mountain / above them
And when We shook the Mount above them [7:171]

The Quran relies on the reader's world knowledge and intuition when using pronouns without explicitly including any antecedent information. For example a good number of second person pronouns in the Quran refer to Prophet Muhammad with no prior mention of his name, as in verse 2:4 below.

وَالَّذِينَ يُؤْمِنُونَ بِمَا أُنزِلَ إِلَيْكَ وَمَا أُنزِلَ مِن قَبْلِكَ
And those who / believe / in what / (is) sent down / to you / and what / was sent down / from / before you
And who believe in that which is revealed unto thee and that which was revealed before thee [2:4]

In terms of counting pronouns in the Quran, we relied on the Quranic Arabic Corpus (QAC) to produce the statistics presented in table 1 below.

	Total count	**%**
Person		
1st person	3,903	13.3%
2nd person	6,881	23.3%
3rd person	13,933	47.2%
None/other	4,777	16.2%
Gender		
Masculine	22,284	75.6%
Feminine	1,822	6.2%
None/other	5,388	18.3%
Number		
Singular	9,141	31%
Dual	381	1%
Plural	17,671	60%
None/other	2,301	8%

Table 1. Distribution of pronouns in the Quran

2. Quranic Pronoun Reference Annotation

2.1 Related Annotation Schema

The first anaphora annotation scheme is the Lancaster IBM project at UCREL (Garside et al. 1997). Under this scheme the antecedent (whether anaphor or cataphor) is enclosed in brackets and given an index number and the proform (i.e, the pronoun) is preceded by the 'REF' symbol with the index number along with either '<' or '>' symbol indicating the direction: either anaphora or cataphora. For example:

```
(6 the married couple 6) said that <REF=6
they were happy with <REF=6 their lot.
```

This scheme was used to annotate part of the AP corpus consisting around 100,000 words.

Another tagging schema is MUC-7 SGML schema (Hirschman and Chinchor 1997) which accompanied the task definition of the MUC-7 on coreference annotation. The following is a sample annotation from this corpus:

```
<COREF ID=”100”>Lawson Mardon Group
Ltd.</COREF> said <COREF ID=”101”
TYPE=”IDENT” REF=”100”>it</COREF>…
```

The GNOME project relies on an earlier general purpose annotation scheme called MATE. This scheme was designed keeping in mind a 'discourse model' and thus aimed at annotating 'discourse entities' and any co-reference to them. Under this scheme `<de>` is the main discourse element, and `<link>` is used to mark information about anaphoric relations using `<anchor>` elements. Here is an example (Poesio 2004).

```
<de ID="de_01">we</de>'re gonna take
<de ID="de_07"> the engine E3 </de>
and shove <de ID="de_08"> it </de> over
to <de ID="de_02">Corning</de>,
hook <de ID="de_09"> it </de> up to
<de ID="de_03">the tanker car</de>...
<link href="coref.xml#id(de_07)"
type="ident">
<anchor href="coref.xml#id(de_08)"/>
</link>
<link href="coref.xml#id(de_08)"
type="ident">
<anchor href="coref.xml#id(de_09)"/>
</link>
```

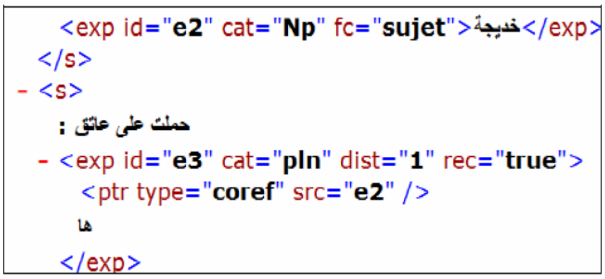
AQA (Boldrini et al. 2009) is a multilingual anaphora annotation scheme that can be applied in machine learning for the improvement of Question Answering systems. This scheme has been used to annotate the CLEF 2008 corpus in Spanish. There are several markups used to specify anaphora type (e.g., pronominal, superficial, adverbial, ellipse and definite descriptions) and others to specify the relation type between anaphoric expression and its direct or bridging antecedent. The following is an example, where <t> = topic, <subt>=subtopic, <q>= question, <de>=discourse entity, <link>= anaphora, <rel>=relationship, <status>= sure or uncertain, <ant>=antecedent, <refq>=question-answer pair:

QurAna (our corpus)	**Classical Arabic**	**128,000 word segments**	**24,679 pronouns**
(Weischedel and Brunstein 2005)	English/Penn	1 million words	24,104 pronouns
(Ge, Hale and Charniak 1998)	English	93,931 words	2,477
(Hasler et al 2006)	NP4E/English	55,000 words	2,100 pronouns
(Barbu 2003)	English	55,000 words	653
(Hervas and Finlayson 2010)	English	24,422 words	7,207 referring expressions
(Barbu 2003)	French	36,000 words	482
(Hammami and Belguith 2011)	Arabic	164,051 words	4,300

Table 2. Comparison of QurAna with other available corpora for anaphora resolution

```
<t>
<q id="q538">
What was the name of the plane used by
<de id="n52">John Paul II</de> in
<link rel="indir" status="ok" ant="q"
refq="q538" type="dd" ref="n52"> his
travel</link> to the USA in 1995?
</q>
<subt>
<q id="q539">
What instrument did Niccol Paganini
play?
</q>
</subt>
</t>
```

Using this scheme a pilot evaluation corpus was manually annotated out of the CLEF multilingual corpus with 600 questions: 200 for each English, Italian and Spanish with an average agreement of 87%.



```
    <exp id="e2" cat="Np" fc="sujet">خديجة</exp>
  </s>
- <s>
    حملت على عاتق :
  - <exp id="e3" cat="pln" dist="1" rec="true">
      <ptr type="coref" src="e2" />
      ها
    </exp>
```

(Hammami et al 2009) presents a corpus annotated with coreference chains for Arabic using a custom-designed XML-tool called AnATAr. This corpus is of size 77,457 words (very close to the size of the Qur'an) and includes newspaper articles, technical manual, a book on education and a novel. The scheme is adopted from (Tutin et al 2000) and is compatible with MUC scheme. Here is an example output.

2.2 Available Corpora

Table 2 gives comparative information on available corpora annotated with anaphoric reference. It is evident that our QurAna corpus ranks high in terms of the number of pronouns tagged. Note the frequent use of pronouns in the Quran compared to English Penn corpus, where both had similar number of pronouns though Penn corpus is 10 times larger in size. Note also that Quran researchers usually report its size as about 80,000 words; however Arabic words are morphologically complex, consisting of a root plus affixes and clitics (such as pronouns). Hence for pronoun reference research, it is more useful to count number of word segments, which is about 128,000 segments.

2.3 Annotation Process

Guided by the previous annotation schema, and by the nature of Arabic usage of pronouns, aand in particular domain specific usage of pronouns in the Quran, we started the annotation process. First, the 128,000 word segments of the Quran were maintained in a MySQL database and unique IDs were assigned to each word segment. Next, QAC was used to identify those targeted segments that contain pronouns, and for each pronoun the starting and ending IDs of the text span that represents antecedents were recorded manually through forms developed using PHP scripting language. We chose QAC as it underwent various verification levels for accuracy of part-of-specch annotation, and is placed for online collaboration for further validation. We took the instances of pronouns that were tagged as 'PRON' in the QAC corpus. This tag covers all kind of personal pronouns: 1st, 2nd and 3rd persons; singular, dual and plural; connected pronouns (where the personal pronoun is suffixed with noun or verb) and separate stand-alone pronouns. However, we left out demonstrative and relative pronouns as they are less in number (approx. 15%) and often their antecedents are non-anaphoric .

As we progressed with tagging pronoun antecedents in the Quran, we maintained a concept ontology out of these antecedents. In total we gathered over 1050 concepts. For example, a concept in our list is "Quran" and all pronouns in the Quran referring to "Quran" were linked to this concept regardless of the presence or absence of the actual antecedent in the immediately surrounding text, or even various different names by which the concept "Quran" is referred to in the Quran: like *Kitab* (book), *Dhirk* (remembrance), *al-Furqan* (the criteria), and such other attributes. Similarly, all pronouns referring to prophet Muhammad were linked although the actual antecedents might have different words like *Rasoul* (messenger) or *Nabi'* (prophet). Keeping an ontology of concepts is very helpful for information retrieval and many other useful applications. Table 3 (next page)gives the 20 most frequently referred-to concepts in our list.

Freq.	Arabic	English
3061	الله	Allah
1145	الذين آمنوا	those who believe
1141	محمد	Prophet Muhammad
1110	الناس	Mankind
1073	الكافرين	(Kaafir) the infidels
912	المشركين	the polytheists
727	كفار قريش	the infidels of Quraish
655	المنافقين	the hypocrites
651	المؤمنين	the believers
549	بني إسرائيل	Children of Israel
542	المسلمون	Muslims
360	موسى	Moses
288	اليهود	the Jews
221	آل فرعون	Pharaoh's folk
216	القرآن	the Qur'an
204	الإنسان	Mankind
202	أهل الكتاب	people of the Book
201	الأمم السابقة	the past nations
196	منكروا البعث	those who deny resurrection
190	إخوة يوسف	brothers of Joseph

Table 3. 20 Most frequent concepts in the Quran

We call this collection of referents an *ontology* as the referents constitute the comprehensive set of nominal concepts found in the Quran. Other ontologies of the Quran exist, but are based on Quranic scholars' observations and intuitions about the core concepts in the Quran, rather than data-oriented extraction of nominal referents. For example the ontology used in the Qurany search-by-concept tool (Abbas and Atwell 2012) is derived from the index terms in a scholarly analysis of the Quran.

As indicated earlier, access to books of *tafsir* (scholarly comments) are important to resolve certain ambiguous cases, especially those instances where antecedents are absent. Consider for example verse 23:67 below.

مُسْتَكْبِرِينَ بِهِ سَامِرًا تَهْجُرُونَ

(Being) arrogant / about it, / conversing by night, / speaking evil." /
In scorn thereof. Nightly did ye rave together.

The pronoun 'it' refers to the 'house of Allah' which was never mentioned before. However, it becomes clear after consulting books of tafsir. Similarly the pronoun 'him' in verse 22:15 refers to Prophet Muhammad without any previous mention in the context.

مَن كَانَ يَظُنُّ أَن لَّن يَنصُرَهُ اللَّهُ فِي الدُّنْيَا وَالْآخِرَةِ فَلْيَمْدُدْ بِسَبَبٍ إِلَى السَّمَاءِ ثُمَّ لْيَقْطَعْ فَلْيَنظُرْ هَلْ يُذْهِبَنَّ كَيْدُهُ مَا يَغِيظُ

Whoever / [is] / thinks / that / not / Allah will help him / in / the world / and the Hereafter, / then let him extend / a rope / to / the sky, / then / let him cut off, / then let him see / whether / will remove / his plan / what / enrages. /
Whoso is wont to think (through envy) that Allah will not give him (Muhammad) victory in the world and the Hereafter (and is enraged at the thought of his victory), let him stretch a rope up to the roof (of his dwelling), and let him hang himself. Then let him see whether his strategy dispelleth that whereat he rageth!.

This manual annotation was done by the first author and it took him over one year to annotate a total of 24,679 pronouns that cover the entire Quran.

2.4 QurAna corpus

Following the process described above, the entire Quran was annotated. Table 4 below gives a quantitative account of key statistics of this corpus. Note that the 24,679 tagged pronouns include anaphoric as well as non-anaphoric cases, and relative and demonstrative pronouns are excluded.

Measure	Count
# of word segments	127,795
# of pronouns	24,679
# of third person pronouns	11,544
# of sentences	6,236
Average Distance between pronoun and antecedent	30 word segments
% of antecedents within the same sentence as the pronoun	56%
% availability of antecedents	54%
Total number of concepts	1054

Table 4. Quantitative measures from QurAna corpus

The majority of our pronouns are anaphors, and only 90 instances (0.3%) showed cataphor relation where the antecedents were mentioned after the pronoun. Although in certain cases the antecedent is mentioned way back, in the majority of cases they are found within 200 word segments from the pronoun. Among the 13,158 pronouns which have antecedents, only 2,309 (17.5%) antecedents matched with the nearest preceding noun. Considering the whole population of pronouns only 9% of antecedents are captured correctly when attached with the nearest preceding noun. Among the total 2nd person singular pronouns 27% of them referred to Prophet Muhammad.

This corpus is made public for both online query – as described in the following section - or for download[5].

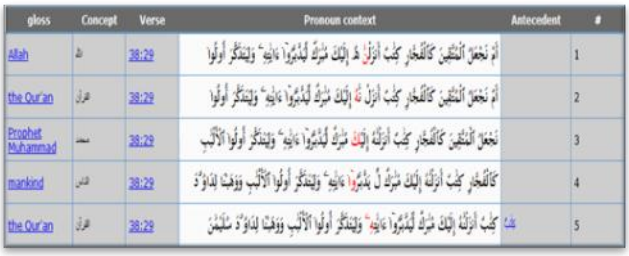
3. Applications using QurAna

3.1 Online Visualization

Using PHP scripting and access to the annotated corpus captured as a MySQL database, a number of query pages

[5] http://www.textminingthequran.com/wiki/Pronoun_Reference_in_the_Quran

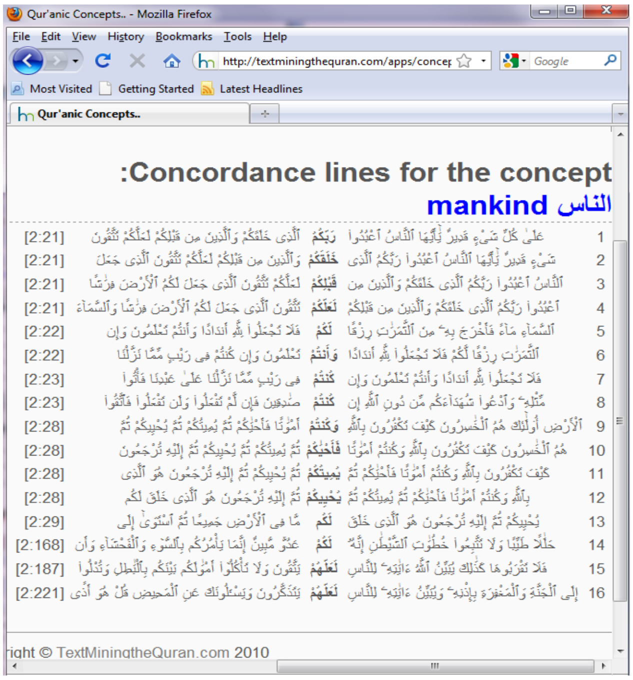
were made online[6]. Entering a verse number, a user can get all pronouns along with their antecedence and all concepts this verse has. Figure 1 below gives an example screenshot from the online query page. The actual verses are quoted in Arabic, however, the verse number leads to English – and potentially many other language translations through hyperlinks to an external site.



gloss	Concept	Verse	Pronoun context	Antecedent	#
Allah	الله	38:29	أَمْ نَجْعَلُ ٱلْمُتَّقِينَ كَٱلْفُجَّارِ كِتَٰبٌ أَنزَلْ نَٰ هُ إِلَيْكَ مُبَٰرَكٌ لِّيَدَّبَّرُوٓا۟ ءَايَٰتِهِۦ وَلِيَتَذَكَّرَ أُو۟لُوا۟		1
the Qur'an	قرآن	38:29	أَمْ نَجْعَلُ ٱلْمُتَّقِينَ كَٱلْفُجَّارِ كِتَٰبٌ أَنزَلْنَٰ هُ إِلَيْكَ مُبَٰرَكٌ لِّيَدَّبَّرُوٓا۟ ءَايَٰتِهِۦ وَلِيَتَذَكَّرَ أُو۟لُوا۟		2
Prophet Muhammad	محمد	38:29	نَجْعَلُ ٱلْمُتَّقِينَ كَٱلْفُجَّارِ كِتَٰبٌ أَنزَلْنَٰهُ إِلَيْ كَ مُبَٰرَكٌ لِّيَدَّبَّرُوٓا۟ ءَايَٰتِهِۦ وَلِيَتَذَكَّرَ أُو۟لُوا۟ ٱلْأَلْبَٰبِ		3
mankind	ناس	38:29	كَٱلْفُجَّارِ كِتَٰبٌ أَنزَلْنَٰهُ إِلَيْكَ مُبَٰرَكٌ لِّ يَدَّبَّرُوٓا۟ ءَايَٰتِهِۦ وَلِيَتَذَكَّرَ أُو۟لُوا۟ ٱلْأَلْبَٰبِ وَوَهَبْنَا لِدَاوُۥدَ		4
the Qur'an	قرآن	38:29	كِتَٰبٌ أَنزَلْنَٰهُ إِلَيْكَ مُبَٰرَكٌ لِّيَدَّبَّرُوٓا۟ ءَايَٰتِ هِۦ وَلِيَتَذَكَّرَ أُو۟لُوا۟ ٱلْأَلْبَٰبِ وَوَهَبْنَا لِدَاوُۥدَ سُلَيْمَٰنَ	كتب	5

Figure 1. pronoun resolution of verse 38:29

The user may explore from the concepts listed for this verse, to all other verses that share this same concept, represented as concordance lines for convenient analysis. Figure 2 shows instances where the concept 'mankind' is repeated in the Quran as pronouns.



Qur'anic Concepts.. - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://textminingthequran.com/apps/concep
Google
Most Visited
Getting Started
Latest Headlines
Qur'anic Concepts..

:Concordance lines for the concept

mankind الناس

1	عَلَىٰ كُلِّ شَىْءٍ قَدِيرٌ يَٰٓأَيُّهَا ٱلنَّاسُ ٱعْبُدُوا۟	رَبَّكُمُ	ٱلَّذِى خَلَقَكُمْ وَٱلَّذِينَ مِن قَبْلِكُمْ لَعَلَّكُمْ تَتَّقُونَ	[2:21]
2	شَىْءٍ قَدِيرٌ يَٰٓأَيُّهَا ٱلنَّاسُ ٱعْبُدُوا۟ رَبَّكُمُ ٱلَّذِى	خَلَقَكُمْ	وَٱلَّذِينَ مِن قَبْلِكُمْ لَعَلَّكُمْ تَتَّقُونَ ٱلَّذِى جَعَلَ	[2:21]
3	ٱلنَّاسُ ٱعْبُدُوا۟ رَبَّكُمُ ٱلَّذِى خَلَقَكُمْ وَٱلَّذِينَ مِن	قَبْلِكُمْ	لَعَلَّكُمْ تَتَّقُونَ ٱلَّذِى جَعَلَ لَكُمُ ٱلْأَرْضَ فِرَٰشًا	[2:21]
4	ٱعْبُدُوا۟ رَبَّكُمُ ٱلَّذِى خَلَقَكُمْ وَٱلَّذِينَ مِن قَبْلِكُمْ	لَعَلَّكُمْ	تَتَّقُونَ ٱلَّذِى جَعَلَ لَكُمُ ٱلْأَرْضَ فِرَٰشًا وَٱلسَّمَآءَ	[2:21]
5	ٱلسَّمَآءِ مَآءً فَأَخْرَجَ بِهِۦ مِنَ ٱلثَّمَرَٰتِ رِزْقًا	لَّكُمْ	فَلَا تَجْعَلُوا۟ لِلَّهِ أَندَادًا وَأَنتُمْ تَعْلَمُونَ وَإِن	[2:22]
6	ٱلثَّمَرَٰتِ رِزْقًا لَّكُمْ فَلَا تَجْعَلُوا۟ لِلَّهِ أَندَادًا	وَأَنتُمْ	تَعْلَمُونَ وَإِن كُنتُمْ فِى رَيْبٍ مِّمَّا نَزَّلْنَا	[2:22]
7	فَلَا تَجْعَلُوا۟ لِلَّهِ أَندَادًا وَأَنتُمْ تَعْلَمُونَ وَإِن	كُنتُمْ	فِى رَيْبٍ مِّمَّا نَزَّلْنَا عَلَىٰ عَبْدِنَا فَأْتُوا۟	[2:23]
8	مِّثْلِهِۦ وَٱدْعُوا۟ شُهَدَآءَكُم مِّن دُونِ ٱللَّهِ إِن	كُنتُمْ	صَٰدِقِينَ فَإِن لَّمْ تَفْعَلُوا۟ وَلَن تَفْعَلُوا۟ فَٱتَّقُوا۟	[2:23]
9	ٱلْأَرْضِ أُو۟لَٰٓئِكَ هُمُ ٱلْخَٰسِرُونَ كَيْفَ تَكْفُرُونَ بِٱللَّهِ	وَكُنتُمْ	أَمْوَٰتًا فَأَحْيَٰكُمْ ثُمَّ يُمِيتُكُمْ ثُمَّ يُحْيِيكُمْ ثُمَّ	[2:28]
10	هُمُ ٱلْخَٰسِرُونَ كَيْفَ تَكْفُرُونَ بِٱللَّهِ وَكُنتُمْ أَمْوَٰتًا	فَأَحْيَٰكُمْ	ثُمَّ يُمِيتُكُمْ ثُمَّ يُحْيِيكُمْ ثُمَّ إِلَيْهِ تُرْجَعُونَ	[2:28]
11	كَيْفَ تَكْفُرُونَ بِٱللَّهِ وَكُنتُمْ أَمْوَٰتًا فَأَحْيَٰكُمْ ثُمَّ	يُمِيتُكُمْ	ثُمَّ يُحْيِيكُمْ ثُمَّ إِلَيْهِ تُرْجَعُونَ هُوَ ٱلَّذِى	[2:28]
12	بِٱللَّهِ وَكُنتُمْ أَمْوَٰتًا فَأَحْيَٰكُمْ ثُمَّ يُمِيتُكُمْ ثُمَّ	يُحْيِيكُمْ	ثُمَّ إِلَيْهِ تُرْجَعُونَ هُوَ ٱلَّذِى خَلَقَ لَكُم	[2:28]
13	يُحْيِيكُمْ ثُمَّ إِلَيْهِ تُرْجَعُونَ هُوَ ٱلَّذِى خَلَقَ	لَكُم	مَّا فِى ٱلْأَرْضِ جَمِيعًا ثُمَّ ٱسْتَوَىٰٓ إِلَى	[2:29]
14	حَلَٰلًا طَيِّبًا وَلَا تَتَّبِعُوا۟ خُطُوَٰتِ ٱلشَّيْطَٰنِ إِنَّهُۥ	لَكُمْ	عَدُوٌّ مُّبِينٌ إِنَّمَا يَأْمُرُكُم بِٱلسُّوٓءِ وَٱلْفَحْشَآءِ وَأَن	[2:168]
15	فَلَا تَقْرَبُوهَا كَذَٰلِكَ يُبَيِّنُ ٱللَّهُ ءَايَٰتِهِۦ لِلنَّاسِ	لَعَلَّهُمْ	يَتَّقُونَ وَلَا تَأْكُلُوٓا۟ أَمْوَٰلَكُم بَيْنَكُم بِٱلْبَٰطِلِ وَتُدْلُوا۟	[2:187]
16	إِلَى ٱلْجَنَّةِ وَٱلْمَغْفِرَةِ بِإِذْنِهِۦ وَيُبَيِّنُ ءَايَٰتِهِۦ لِلنَّاسِ	لَعَلَّهُمْ	يَتَذَكَّرُونَ وَيَسْـَٔلُونَكَ عَنِ ٱلْمَحِيضِ قُلْ هُوَ أَذًى	[2:221]

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Figure 2. concordance lines for the concept 'mankind'

3.2 Verse Distance using Vector Space Model

The vector space model is widely used in information retrieval where the query terms and each document are represented as vectors and the distance between query and document is measured by comparing the cosine of angle between them. We followed the same methodology and considered each verse of the Quran as a separate document.

Each verse then was modeled as a term vector taking roots of the Quran as the terms. The Quran has 1,226 unique roots, from these we have kept roots repeated over 2 times, and removed the first 3 most frequent roots. Thus, our vector for each verse contains 758 roots as term indices. Next, in order to give a weight for each term, we used term frequency – inverse document frequency (*tf-idf)* metric, using the following formula adapted from (Sebastiani 2002):

$$tfidf(t_k, d_j) \;=\; \#(t_k, d_j) \cdot \log \frac{|Tr|}{\#_{Tr}(t_k)}$$

Where *#(t$_k$,d$_j$)* denotes the number of times the root t_k occurs in the verse d_j, and *#* $T_r(t_k)$ denotes the verse frequency of root t_k, that is, the number of verses in the Quran T_r in which the root t_k occurs.

In order for the weights to fall in [0,1] interval and for the verses to be represented by vectors of equal length, the weights (w_{kj}) resulting from *tfidf* were normalized according to the following formula for *cosine normalization*:

$$w_{kj} \;=\; \frac{tfidf(t_k, d_j)}{\sqrt{\sum_{s=1}^{|T|} (tfidf(t_s, d_j))^2}}$$

To find the distance (or measure of similarity) between two vectors, cosine angle is measured using the formula below, where A, B denotes two verses' vectors:

$$\text{similarity} = \cos(\theta) = \frac{A \cdot B}{\|A\|\|B\|} = \frac{\sum_{i=1}^{n} A_i \times B_i}{\sqrt{\sum_{i=1}^{n} (A_i)^2} \times \sqrt{\sum_{i=1}^{n} (B_i)^2}}$$

Similarity values fall between [0,1], where 0 indicates no similarity, and 1 indicates identical matching. Using the above setup, we have evaluated a dataset of 7,679 related verse pairs we created from scholarly works (Sharaf and Atwell 2012) and found out that only 428 pairs (6%) produced similarity value above 0.5. This finding confirms the assumption that automatic computation of verse relatedness requires integration with domain specific knowledge source and relying only on lexical matching produces poor results.

Given these results we considered next how to enrich a verse vector with concepts from our ontology. Instead of constructing root vectors for a verse from only that verse's root, we augmented this verse's roots with roots of all other verses that share common antecedent. For example consider verse 27:26 below:

بَلِ ادَّارَكَ عِلْمُهُمْ فِي الْآخِرَةِ ۚ بَلْ هُمْ فِي شَكٍّ مِّنْهَا ۖ بَلْ هُم مِّنْهَا عَمُونَ

Nay, / is arrested / their knowledge / of / the Hereafter? / Nay / they / (are) in / doubt / about it. / Nay, / they / about it / (are) blind. /
Nay, but doth their knowledge reach to the Hereafter? Nay, for they are in doubt concerning it. Nay, for they cannot see it.

[6] http://www.textminingthequran.com/apps/pron.php

This verse contains 3 concepts marked by pronoun referents: ‘the polytheists’, ‘those who deny resurrection’ and ‘the world Hereafter’. Therefore, we have augmented the term vector of the verse 27:66 with the terms from all other verses that have any of these three concepts.

The similarity measurement experiment described above was repeated using these improved vectors, and the same dataset was used. While in the early experiment, only 428 pairs showed similarity distance over 0.5, augmenting verses with their concepts showed 869 pairs from the total of 7,679 pairs in our dataset, i.e., over 50% improvement.

4. Challenges

We have encountered a number of challenges while pursuing this task. Often, the distance between the pronoun and its antecedent is too far. This is evident more in the case of long stories, where the main characters might be mentioned only once at the beginning and all subsequent references are done through pronouns. For example, in Chapter 2, a series of verses addressed the ‘Children of Israel’ where explicit mention is made at the beginning of the dialogue but most subsequent reference are made through 2nd person pronouns sometimes as far as 33 verses away. Also, as our annotation scheme does not allow discontinuous antecedents or multiple antecedents, in such cases we had to include as antecedents the whole text span, resulting in some compound concepts.

Often the Quran makes grammatical shifts deliberately for various purposes (for example to draw attention), and as a result the number or person agreement between the pronoun and the antecedent is violated. Consider for example verse 65:1 where the singular noun antecedent ‘prophet’ disagrees with the plural 2nd person pronoun used (you):

يَا أَيُّهَا النَّبِيُّ إِذَا طَلَّقْتُمُ النِّسَاءَ فَطَلِّقُوهُنَّ لِعِدَّتِهِنَّ وَأَحْصُوا الْعِدَّةَ

O Prophet! / When / you divorce / [the] women, / then divorce them / for their waiting period,

“O Prophet, when you [Muslims] divorce women, divorce them for [the commencement of] their waiting period and keep count of the waiting period..”

There were a number of challenges faced while tagging pronouns with a concept name. Often a decision to create a new specific concept or maintain an already available generic concept was required. For example, in verse 67:5 the word ‘lamp’ was used to mean ‘stars’, and hence pronouns could be tagged with either of these two concepts. In this particular case, we decided to tie the pronoun to the concept ‘star’ rather than the concept “lamp” so that all verses referring to ‘star’ can be linked plus as we keep reference to actual antecedence, we still can retrieve that stars are referred to in the Quran as lamps.

وَلَقَدْ زَيَّنَّا السَّمَاءَ الدُّنْيَا بِمَصَابِيحَ وَجَعَلْنَاهَا رُجُومًا لِّلشَّيَاطِينِ

And certainly / We have beautified / the heaven / nearest / with lamps, / and We have made them / (as) missiles / for the devils,

And verily We have beautified the world's heaven with lamps, and We have made them missiles for the devils,

5. Conclusion

We have presented QurAna as a language resource for Quranic scholars, students and for researchers in the computational linguistics community, particularly those investigating computational anaphora resolution systems. We have tagged over 24,000 Quranic pronouns with their antecedence information. QurAna is characterized by: (a) comparatively large number of pronouns tagged with antecedent information, and (b) maintenance of an ontological concept list out of these antecedents. We have shown useful applications of this corpus. This corpus is the first of its kind considering Classical Arabic text, and would find interesting applications for Modern Standard Arabic as well.

6. References

Abbas, N., Atwell, E. (2012). Qurany: how to search for concepts rather than words in a corpus. *Proc IVACS’2012*, Leeds, UK.

Barbu, C. (2003). Bilingual Pronoun Resolution: Experiments in English and French. PhD Thesis. *Univeristy of Wolverhampton*. 2003.

Boldrini, E., Puchol-Blasco, M. Navarro, B, Martínez-Barco, P., Vargas-Sierra, C. (2009). AQA: a multilingual Anaphora annotation scheme for Question Answering . *Procesamiento del Lenguaje Natural*, Revista nº 42

Dukes, K.; Atwell, E.; and Sharaf, A. (2010). Syntactic Annotation Guidelines for the Quranic Arabic Dependency Treebank. *Proc LREC’2010*, Valetta, Malta.

Gabrilovich, E.; and Markovitch. S., (2007). Computing semantic related-ness using wikipedia-based explicit semantic analysis. *In Proceedings of the 20th International Joint Conference on Artificial Intelligence*, January.

Garside, R., Fligelstone, S. and Botley, S. (1997). Discourse annotation: anaphoric relations in corpora. In Corpus Annotation, Pearson .

Ge, N., Hale,J., and Charniak, E.,(1998). A statistical approach to anaphora resolution. *In Proceedings of the Sixth Workshop on Very Large Corpora, pages 161–170.*

Hammani, S. and Lamia Hadrich Belguith,(2011) التحليل الألي للضمائر العائدة ودورها في المعالجة الآليّة للّغة العربية 7th International Computing Confrence in Arabic (ICCA'2011), Riyadh-Saudi Arabia, 31 may-2 june 2011

Hammami, S., Belguith, L. And Hamadou, A. (2009) “Arabic Anaphora Resolution: Corpora Annotation with Coreferential Links”. *The International Arab Journal of Information Technology*, Vol. 6 No. 5, pp

481 – 489.

Hasler, L., Orasan, C., and Naumann, K. (2006) NPs for Events: Experiments in Coreference Annotation. *In Proceedings of the 5th edition of the International Conference on Language Resources and Evaluation* (LREC2006), 24 -- 26 May, Genoa, Italy, pp. 1167 -- 117

Hervas, R. and Finlayson, M. (2010). “The prevalence of descriptive referring expressions in news and narrative.” In Proceedings of the ACL2010 Conference Short Papers, Uppsala, Sweden, July 2010.

Hirschman, L. and Chinchor, N. (1997). MUC-7 coreference task definition. *In MUC-7 Proceedings. Science Applications International Corporation*.

Poesio, M. (2004). "The MATE/GNOME Scheme for Anaphoric Annotation, Revisited", *Proc. of SIGDIAL, Boston.*

Resnik, P.; Olsen, M.B.; and Diab, M. (1999) The Bible as a Parallel Corpus: Annotating the `Book of 2000 Tongues, *Computers and the Humanities*, 33(1-2), pp. 129-153.

Sebastiani, F. (2002). Machine learning in automated text categorization. *ACM Comp. Survey*, 34(1):1-47.

Sharaf, A., Atwell, E. (2012) QurSim: A corpus for evaluation of relatedness in short texts. *LREC 2012*, Istanbul, Turkey.

Tutin A., Trouilleux F., Clouzot C., Gaussier E.,Zaenen A., Rayot S., and Antoniadis G.(2000) “Annotating a Large Corpus with Anaphoric Links,” *in Proceedings of the Discourse Anaphora and Reference Resolution Conference*,pp. 134-137, UK, 2000.

Weischedel, R. and Brunstein, A. (2005) BBN pronoun coreference and entity type corpus. *Linguistica Data Consortium.*