Discovering Parallel Language Resources for Training MT Engines

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Abstract
Web crawling is an efficient way for compiling the monolingual, parallel and/or domain-specific corpora needed for machine translation and other HLT applications. These corpora can be automatically processed to generate second order or synthesized derivative resources, including bilingual (general or domain-specific) lexica and terminology lists. In this submission, we discuss the architecture and use of the ILSP Focused Crawler (ILSP-FC), a system developed by researchers of the ILSP/Athena RIC for the acquisition of such resources, and currently being used through the European Language Resource Coordination effort. ELRC aims to identify and gather language and translation data relevant to public services and governmental institutions across 30 European countries participating in the Connecting Europe Facility (CEF).

Keywords: parallel language resources, document pair detection, web crawling, machine translation

1. ILSP-FC Architecture
ILSP-FC\(^1\) is a comprehensive solution for acquiring domain-specific, monolingual and bilingual datasets from the web. One of the main components of the system is an efficient crawler that initializes its frontier (i.e. the list of pages to be visited) from a seed URL list provided by the user, classifies fetched pages as appropriate for the user’s aims (i.e. in the targeted language and/or relevant to the targeted domain), extracts links from fetched web pages, adds them to the list of pages to be visited and repeats this process until an expiration criterion is reached. In the case of focused crawls for domain-specific content, the input expected from the user also includes a domain profile, i.e. a list of terms that describe the domain.

In order to ensure scalability, the system is based on open-source libraries that allow configuration of workflows that can be executed on top of the Hadoop framework for distributed data processing. Due to its modular architecture, each of the system’s components can be easily substituted by alternatives with the same functionalities. The main components integrated in ILSP-FC (Papavassiliou et al., 2013) are:

- **Page Fetcher** adopts a multi-threaded crawling implementation in order to ensure concurrent visiting of multiple web pages/hosts and fetching of user-targeted specific document types (e.g. html, docx, pdf).
- **Normalizer** detects the text encoding of the downloaded web pages and if needed, converts it to UTF-8. It also parses the structure of each web page and extracts its metadata (e.g. title, description, keywords, publisher, author, license etc.). In order to extract textual content and metadata from a set of formats (txt, docx and pdf), it uses open libraries\(^2\).
- **Cleaner** segments the main text in paragraphs, identifies boilerplate (e.g. advertisements, disclaimers) and extracts structural information like titles, headings and list items.

For this task, a modified version of Boilerpipe (Kohlschütter et al., 2010) is used.

\(^1\)\url{http://nlp.ilsp.gr/ilsp-fc/}
\(^2\)\url{https://pdfbox.apache.org/}, \url{https://poi.apache.org/text-extraction.html}

![Figure 1: ILSP-FC workflow for acquisition of parallel LRs](image)

**Language Identifier** detects the language of a document, as well as paragraphs in a language different from the main one. It uses open source language identification libraries like lang-detect\(^3\), that perform at over 99% precision at document level for more than 50 languages.

**Domain checker** compares the content of the page to a user-provided domain profile. Based on the number of terms’ occurrences, their location in the web page and the weights of found terms, a page relevance score is calculated. This score is compared with a predefined threshold and the web page is categorized as relevant to the domain.

**Link Extractor** examines the “neighbourhood” of links for terms, special patterns and/or semantic annotations (e.g. TMX files).
alternatives for commercial uses and applications are also
FC is available under a GPL license. Licensing and support
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relative tasks. They can therefore be used for the processing
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modules (e.g. domain checking, document pairing, and sen-
sition of parallel LRs from the web (cf. Figure 1), specific
uses open-source aligners (e.g. Hunalign
detection.
Sentence Aligner uses open-source aligners (e.g. Hunalign
Varga et al., 2005), Maligna (Jassem and Lipski, 2008)) to
extract sentence alignments from document pairs, and ex-
ports results in TMX (i.e. a TMX file for each identified
document pair).
As an alternative to the pipeline use of the tool for acqui-
sition of parallel LRs from the web (cf. Figure 1), specific
modules (e.g. domain checking, document pairing, and sen-
tence alignment) can be called as standalone modules for all
relative tasks. They can therefore be used for the processing
of resources residing in proprietary data repositories. ILSP-
FC is available under a GPL license. Licensing and support
alternatives for commercial uses and applications are also
available.

2. Adapting to ELRC requirements for parallel LRs

The European Language Resource Coordination (Lösch et
al., 2018) effort aims to identify and gather language and
translation data relevant to public services and government-
al institutions across 30 European countries participating
in the Connecting Europe Facility. Through a series of
workshops, ELRC has been showcasing the benefits of the
CEF automated translation platform (CEF eTranslation) and
has been trying to mobilize public sector representatives to
share public language resources. These LRs will contribute in
enhancing CEF eTranslation and, in the end, providing EU citizens with better multilingual services. To comple-
ment these data gathering efforts, ELRC has also employed
ILSP-FC and other automatic methods for acquiring multi-
lingual LRs. In the course of the project and based on feedback
by all consortium partners, the tool was continuously
tested and enhanced at ILSP in order to provide more ac-
accurate results. It was eventually deployed at all four ELRC
partner sites for acquiring language resources for specific
(EN-X) language pairs, where X stands for official EU lan-
guages in CEF-affiliated countries.

In order to meet ELRC needs to cover all CEF languages,
missing resources were constructed and integrated in the
tool (for example language profiles for both Norwegian
written standards, Bokmål and Nynorsk). The accuracy of
the language identifier, when examining Norwegian texts
is 98%/90% for text chunks of at least 500/100 characters,
respectively.

Turning to the identification of bitexts, the tool employs a
combination of methods that are language-pair agnostic, i.e.
they do not use bilingual lexica or MT results that are of-
ten difficult to generate. For evaluation purposes, the bi-
text identification module was submitted (Papavassiliou et
al., 2016) in the WMT 2016 Bilingual Document Alignment
Shared Task (Buck and Koehn, 2016) and scored a high re-
call of 91%. It ranked 7th among 21 participations, and,
to the best of our knowledge, first among those not using
language-pair specific resources or MT output as a feature
for document alignment.
For segment alignment, the system uses open source align-
ers to construct collections of candidate parallel segments.
A battery of criteria are applied on these candidates with
the purpose of filtering out or annotating automatically spe-
cific types of translation units (TUs) (i.e. detecting poten-
tial alignment or translation issues, or sentence pairs of lim-
ited or no use) and of generating precision-high multilingual
LRs for training MT systems. This filtering was carried out by:

(i) identifying duplicate TUs, or TUs with identical text
in both languages,
(ii) estimating the alignment quality by calculating the so-
called alignment score,
(iii) excluding TUs based on the segment length ratio
(note: segments with a length ratio close to 1 have
similar length, whereas segments having a ratio far
from 1 would indicate potential alignment problems)
(iv) identifying TUs in which numbers in the segment for
one language are different compared to the segment
for the other language,
(v) excluding TUs that are included in document pairs
that contain many TUs (e.g. over 40%) of type 0:1, an
indication that such document pairs consist of comparable
rather than parallel documents,
(vi) excluding TUs consisting solely of URLs, emails, and
dates.

4http://lr-coordination.eu
5https://ec.europa.eu/inea/en/
connecting-europe-facility

6Responsibility for data collection was shared among all ELRC
consortium members in the following way: DFKI (6 countries):
Germany, Austria, Luxembourg, Netherlands, Hungary, Czech
Republic; ELDA (8 countries): Iceland, Spain, Portugal, Belgium,
Italy, Malta, France, (U.K.); Tilde (8 countries): Latvia, Estonia,
Lithuania, Finland, Sweden, Denmark, Iceland, Norway; ILSP (8
countries): Greece, Cyprus, Slovakia, Slovenia, Bulgaria, Poland,
Romania, Croatia
The optional domain checking procedure during crawling can be complemented by the use of post-crawling topic classification with tools like the JRC Eurovoc Indexer (JEX (Steinberger et al., 2012)). We have used JEX to tag multilingual documents with identifiers that correspond to domains, micro-thesauri and thesauri concepts from Eurovoc7, the EU’s multilingual thesaurus.

3. Construction of parallel LRs out of public sector data

One of the methods employed for the construction of parallel LRs in the ELRC project, was to identify public administration websites (e.g. websites of ministries, local authorities, embassies, courts, etc.) as candidate sources for extracting content relevant to the CEF Digital Service Infrastructures (DSIs)8. Then ELRC consortium partners used ILSP-FC to crawl these websites and process their content in order to construct a mono/bilingual collection for each website. Finally, the outcomes of the websites were merged based on the language and the relevance of their content. For instance, the acquired content from websites of Polish cultural organizations was merged to generate a monolingual LR of 10.2M tokens and a parallel EN-PL LR of 36.3K TUs.

Although crawling with the tool for the purposes of ELRC is ongoing work, parallel LRs for several language pairs have already been generated and a number of them (EN-EL, EN-BG, EN-MT, EN-SV, EN-IS, EN-ET, EN-ES) have become available through the ELRC repository9 (Piperidis et al., 2018) by consortium members.

4. Evaluation experiments

Assessing the usefulness of a system that discovers, acquires and transforms bitexts from the web involves many different evaluation questions: Does the system identify most of the document pairs published on a web site? Are these document pairs as noise-free as possible? Are the aligned sentences extracted from the document pairs clean enough for training MT systems? Apart from our participation in the WMT 2016 shared task, we also conducted experiments covering a variety of language pairs, in order to evaluate both the acquisition procedure and the acquired resources, focusing on parallelness (at document and segment level) and domainess.

Table 1: Automatic evaluation of parallel sentences contained in two LRs generated with ILSP-FC

| lr-id | lr-name                                             | “good” (%) | “bad” (%) |
|-------|-----------------------------------------------------|------------|-----------|
| 115   | Parallel corpus (Greek - English) in public admin-  | 12332      | 177 (1.41%) |
|       |istration domain                                     | (98.59%)   |           |
| 379   | Parallel corpus (Bulgarian - English) in the public | 11094      | 168 (1.49%) |
|       | administration domain                                | (98.51%)   |           |

In an effort to evaluate recall for the pair detector module, we used parallel datasets crawled by the Global Voices group of websites (Prokopidis et al., 2016). In this dataset, documents are connected with specific links when one is the translation of the other. Since this is not the case for many multilingual web sites, during the evaluation of the pair detector we omitted the tool’s methods that exploit special patterns in URLs and links that point to translations. Thus, we only used methods that are based on a) cooccurrences of images with the same filename in HTML source, b) edit distance of sequences of digits in the main content of webpages and c) structural similarity. We evaluated these methods in the task of reconstructing the English-Greek parallel collection, i.e. of identifying the 3581 document pairs for this language pair. The recall and precision rates were 68.56% and 92.50% respectively. The main reason for the relatively low document-level recall is that many document pairs consisting of very short documents were not identified. However, the recall at token level (i.e. the percentage of tokens retrieved from all translated sentences) was 91.18%, a fact that implies that “lost” bitexts contained less than 9% of the actual parallel content.

In another evaluation experiment, we automatically estimated the quality of the sentence-level parallelness of the LRs created with ILSP-FC. To this end, we trained the C-Eval (Zariņa et al., 2015) parallel corpora cleaning and evaluation tool on the DGT-TM 2015 release10 to build an automatic classifier identifying non-parallel sentences in a parallel corpus. We then classified the parallel sentences contained in two datasets delivered as ELRC LRs #115 (EN-EL) and #379 (EN-BG). Results in Table 1 indicate that LRs created with the tool include a high percentage (≈ 98.5% for these specific LRs) of useful translation segments.

In order to test domaininess, we used JEX to assign Eurovoc identifiers on the English text of LRs #115 and #379. In the results shown in Table 2, the assigned identifiers seem to correctly depict the “nature” of #155, for which about 47% and 29% of its content was acquired from the websites of the Greek Ministry of National Defence and the Ministry of Foreign Affairs respectively. Similarly, about 85% of the sentence pairs in #379 were compiled from the websites of the Ministry of Foreign Affairs, and the President of the Republic of Bulgaria. We also examined two parallel collections (EN-HR and EN-PL) in the culture domain. In the results in Table 3 only one identifier (approximation of laws) seems irrelevant to the targeted domain.

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7http://eurovoc.europa.eu/
8CEF DSIs include Online Dispute Resolution; Europeana; Open Data Portal; eJustice; and Electronic Exchange of Social Security Information
9https://elrc-share.eu
10https://ec.europa.eu/jrc/en/language-technologies/dgt-translation-memory
tract. Access to the Okeanos cloud service to acquire parallel resources for the purposes of the con-
reported issues and used the system described in this paper from DFKI, TILDE, and ELDA, who provided feedback, "form". We would like to thank ELRC consortium members
Resource Repository of CEF Automated Translation Plat-
cal work" and SMART 2015/1091 LOT 3 "Acquisition
April 2017. ELRC continues until December 2019 un-
der SMART 2014/1074 programme from April 2015 to
language domain

Table 2: Eurovoc identifiers assigned automatically by JEX for LRs #115 (EN-EL, top) and #379 (EN-BG, bottom)

| id   | label                          | weight |
|------|--------------------------------|--------|
| 1182 | Greece                         | 0,324  |
| 5335 | military intervention          | 0,189  |
| 3489 | cooperation policy             | 0,186  |
| 2628 | armed forces                    | 0,184  |
| 5786 | military personnel             | 0,183  |
| 2499 | European defence policy         | 0,176  |

Table 3: Eurovoc identifiers assigned automatically by JEX for an EN-PL (top) and an EN-HR (bottom) LR in the culture domain

| id   | label                          | weight |
|------|--------------------------------|--------|
| 2023 | music                          | 0,217  |
| 2543 | Poland                         | 0,19   |
| 2459 | cultural policy                | 0,157  |
| 208  | cultural cooperation           | 0,143  |
| 529  | copyright                      | 0,138  |
| 2897 | approximation of laws          | 0,109  |

Table 5: Eurovoc identifiers assigned automatically by JEX for an EN-EL, top) and #379 (EN-BG, bottom)

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