Structured lexical data: how to make them widely available, useful and reasonably protected? A practical example with a trilingual dictionary

Abstract
We are studying under which constraints structured lexical data can be made, at the same time, widely available to the general public (freely or not), electronically supported, published and reasonably protected from piracy? A three facet approach - with dictionary tools, web servers and e-mail servers - seems to be effective. We illustrate our views with Alex, a generic dictionary tool, which is used with a French-English-Malay dictionary. The very distinction between output, logical and coding formats is made. Storage is based on the latter and output formats are dynamically generated on the fly at request times - making the tool usable in many configurations. Keeping the data structured is necessary to make them usable also by automated processes and to allow dynamic filtering.

Introduction
In the framework of the development of a French-English-Malay Dictionary (FEM - the producing methodology of which has been discussed in [2]), we try to address the question of making the produced lexical data widely available to the public. Although, the first goal of the project is to publish a paper dictionary (due summer 96), it appears that some other forms of distribution and presentation could be valuable. As the dictionary contractors want to keep their work proprietary while expecting a large diffusion, we have to cope with the following dilemma: how can we, at the same time, widely distribute and reasonably protect structured lexical data?

The analysis and implementation results presented here are twofold. Firstly, we identified three distribution modes that could be implemented simultaneously at a low cost. They take the form of a resident dictionary tool, a world-wide-web (or web for short) service and an e-mail service. Secondly, the problem of how to structure and represent entries had to be tackled to keep the manipulation convenient (reduced data size, readability, version management, etc.). The proposed solution is based on a strong distinction between encoding, logical and formatting levels.

This paper is organized as follows. First, we present the objectives and constraints we identified regarding the outcome of the linguistic production of the FEM project. Then, we present three distribution models that could respond to what we identified as the needs and desires of end-users but also of the computational linguistics community. The third and last part explains our methodology and the kind of format retained to make our models a reality. We actually implemented and experimented the solutions we propose.

Constraints and desires
Beside its printed declination, we investigated some other distribution and exploitation means for the FEM. The advent of the Internet seems to offer some good opportunities for making our data widely available, but concerns have been expressed on several points: usefulness, protection and production cost.

Making data available is meaningless if they are not in a useful format. Most of the time, designing a good format and converting the data to it, is an unanticipated expenditure. The question of copyright is also an obstacle that arises much before the purely technical difficulties (see [7] for that question).

The visual appearance (opposed to the conveyed informative contents) of the data may be crucial for making them palatable to the general public. The question is in fact not only to make the data available but mainly to make people willingly use it. For these
reasons, we think the data layout proposed to
the end-user is one of the main factors of
success or failure of such an enterprise. But
it is very difficult to forecast which kind of
formatting could be "felt" by end-users as
exploitable. It may depend on the task
undergone, on established standards or tools
available, on the user intentions, culture, etc.
A presentation close to what can be found in
a paper dictionary might be desirable but it
can become intricate with complex data.
Visual clues can help locate information
(see [3]); this becomes especially critical
with multilingual dictionaries. For
automated processes, an explicit tagged
format is more appropriate.

In fact, we would like to freely "give
access" to the dictionary without "giving up"
the control over its source. The legal context
can be covered by copyrights, but some
technical adjustments are still needed to give
real protection to such a work. The dictionary
should not be accessible as a whole, but
merely through requests concerning one (or
several) entry. Even if one entry has links to
the next or previous ones as parts of its
information, fetching the completedictionary
will definitely prove a painful task (as
difficult as to scanning a paper dictionary).
This scheme is not foolproof to hackers, but
it is inconvenient enough to rebuke most
users.

In an academic context, making data freely
available is viable only through low cost
solutions. We have to make the distinction
between costs for producer (the academics
and/or the researchers and linguists) and
costs for the end-user. The process of
formatting the data for end-users should be
fast, painless and not resource-demanding.
Similarly, the user will not make use of (or
even fetch) the data, if that gobbles up the
resources of his/her own personal
computer (disk space, memory, or network
access time). While free of charge, the
acceptance of the dictionary will be greatly
improved if it is easy to manipulate. The
main relevant factor is a good ratio between
compactness of the data and length of the
processing time.

Three distribution models and a common tool

It is possible to distribute data in an
encrypted (protected) form by distributing a
free "reader". The data are located on the
user computer and a dictionary tool (the
reader) allows browsing among
distributed dictionaries. The user can create
and modify personal dictionaries, handle
multiple dictionaries, copy and paste the
displayed information in other
applications, etc. We implemented such a
tool – called Alex.

The FEM dictionary has been made
accessible on the Web. The main
advantages over resident tools are the
transparent updates of the dictionary
contents and the reduced resources needed on
a local personal computer. However, one has
to own an Internet connection. Moreover, the
hypertext nature of Web pages can be the
occasion to offer some extended features
compared to paper dictionaries (which are
similar to the ones found in resident dictionary
tools), among which access to previous or
next entries, dynamic filtering and look up
by patterns.

The Web approach is well adapted to end-
users but (1) people having a Web access are
still a minority compared with people having
an e-mail account, and (2) we also would
like to make our dictionary useful to
automated processes. For example, e-mail
access to large linguistic resources can allow
regular update requests of small local
linguistic databases. If the task does not
require real time, communication by e-mail
presents many advantages. The mail request
format – which should stick to one (or sev-
erald format – can define the nature of inform-
ation looked for much more precisely than
what an end-user would accept to specify).

Alex is a simple dictionary tool with two
main features – (1) a high level of
scriptability (declined on MacOS with
AppleScript) and (2) built-in extension
facilities – allowing to make it the core of
Web and e-mail servers. As handling several
versions of the database or pre-transcribing its contents into several formats are not viable solutions for implementation or exploitation, Alex is used as a unique engine, which operates on a unique database (one per dictionary) and produces multipletrepreresentations.

**Coding format vs. Logical format vs. Output format**

We have designed a mechanism that permits to produce on the fly any kind of output (or external) formats from a logical format. The chosen format is at the same time compact and adequate for fast processing.

As coding directly the logical format was too space costly for our purposes, we defined a coding (or internal) format in which the data are actually stored. Processing a request for an entry is then executed in three steps: retrieving the entry, translating the coding format into the logical format, and translating the logical format into one output format.

The logical format for one entry has been intentionally made simple. An entry kind indicator (symbol), is followed by an open list of field names (symbols) and values (strings) pairs: \((n_1, v_1)(n_2, v_2)\ldots\). The ordering of the pairs in the list is relevant and several pairs with the same symbol can be contiguous. For example, the logical format for the entry "aimer" (love) is given below.

```plaintext
/**fsm-entry (entry
"aimer")\{\{Pronunciation_French "E-ME-"
\}/\{\{French_Category "v.tr."\}/\{\{English_Equivalent "like"\}/\{\{Malay_Equivalent "menyuaki"\}/\{\{Malay_Equivalent "menyuangai"\}/\{\{Gloss_In_French "apprecier"\}/\{\{English_Equivalent "like"\}/\{\{Malay_Equivalent "menggemari"\}/\{\{Malay_Equivalent "menyenangi"\}/\{\{Malay_Equivalent "mencintai"\}/\{\{Gloss_In_French "d'amour"\}/\{\{English_Equivalent "love"\}/\{\{Malay_Equivalent "mencintai"\} ...
```

Figure 1. Part of logical format for "aimer".

In fact, the choice of the exact kind of the logical format is somewhat arbitrary as long as we keep the structure of the entry. The point to keep in mind is that the adequacy of the format depends on the kind of processing intended. The one we adopted fits reasonably well for most of the processes we are dealing with. But sometimes small details can have a big impact on processing costs. For example, the fact that we do not factorize a sequence of several pairs with the same field name, \((n_1, v_1)(n_2, v_2)\ldots\) as a list composed of the field name followed by the values, \((n, v_1, v_2, \ldots)\) is relevant. The first solution is slightly less efficient in space, but systematically dealing with pairs leads to a major performance gain in formatting.

We designed and developed a set of useful output formats with their respective producing procedures – all of them are string-based. Some are HTML strings (for Web based requests), others are labeled formats for e-mail based requests. Generally, an output format loses some of the explicit structure of the entry. An example of formatting for the entry "aimer" is given below (actually it is an RTF format - but we "interpreted" it for readability).

```
aimer /eem/, vt menyukai, menyangai;
(apprecier)menyenangi, menyenangi, menyukai;
d'amour) mencintai, mengasihi; ~ bien suka juga;
~ mieux lebih suka; /'aimer mieux lire que regarder
la television, saya lebih suka membaca
drpdmemoton television; ~ autant suka lagi;
ji'-aisque saya ingin sekitanya.
```

Figure 2. Formatting of the entry "aimer" as it appears on the paper dictionary (French-Malay only, the English information has been filtered out)

When Alex is used as a standalone dictionary tool, the format presented to the user is similar to the paper dictionary. The fact that we have a full control over the displaying allows, for example, to investigate the usage of some anti-aliased fonts and softly tainted background for an increased on-line readability. The filtering functions and some aspects of the formatting are customizable by the user.

The approach we have taken for our trilingual dictionary for the Web is to include visual clues to help the user locate the information. Diamond shapes of different colors are referring to different languages (like \(\bigotimes\) and \(\bigodot\)), thus making an extension to
other languages, without losing coherence, relatively easy. Also, the filtered outputs seem to be more intuitive to the user.

The multiple e-mail formats cannot take advantage of styled text or pictures and thus have been made more explicit (and more verbose) by the use of tags. An e-mail request can specify the kind of formatting desired and generally offers a finer tuning than the two solutions above mentioned. We consider, however, that e-mail based requests are primarily aimed at automated processes.

The actual coding in which each dictionary entry is stored has been designed to be as compact as possible while allowing a fast decoding (generation of the logical format). The format can be described as containing a structural part and a textual part. In the structural part, an entry is coded as a vector. This vector does not contain any text but (1) an identifier indicating the field kind and (2) indexes to the textual part. The textual part is a buffer containing the dictionary strings. Basically, when an entry is added each field value is cut into words, which are stored in the buffer in exchange of a location (where the strings begin in the buffer) and a length (allowing to compute where it ends). Such collections of location and length constitute the indexes kept as vectors. Now words are stored twice, and a reverse alphanumeric sort increases their probability of factorization by prefix.

For example, in a first mockup of our French-English-Malay dictionary containing over 8000 entries (about 25% of the whole), the size of the structural part is about 3200 Ko and that of the buffer part is around 450 Ko. These figures are comparable to the size of the dictionary on a plain text file format.

**Advantages and drawbacks of multiple formats**

The first obvious gain of our solution is the reduction in the space needed for coding our dictionary. Compared to producing in advance several formats – a solution not only painful and error prone but which would also have cluttered the server resources – a multi-server (Web and e-mail) reduced to one engine and one database per dictionary allows us to save enough resources to handle several dictionaries at the same time. Another very important aspect is the avoidance of the often nightmarish problem of synchronizing several versions of the data.

Filtering is a feature that is naturally derived from the conversion of the structure. Especially with multilingual dictionaries, it is to be expected that users will want to have access to more or less information according to their needs. This flexibility is implemented through our dictionary tool, both on the Web and by e-mail.

Generating output formats on the fly is time consuming compared to retrieving pre-formatted data. But, this is a marginal loss if we consider that the resources, effort and time devoted to the implementation of a new format can be drastically reduced.

**Implementation, availability and future work**

Alex has been implemented with Macintosh Common Lisp ([1] and [9]) at the top of our Dictionary Object Protocol, DOP [5], itself built using a persistent object-oriented database, WOOD [8]. A more detailed account on the architecture and implementation of Alex and its derivations can be found in [4]. Prototype versions are already available on an experimental basis.

We are investigating how to actually make a Malay thesaurus based on the same criteria available. The formatting would include references and back-references. We also are looking for dictionaries dealing with more than three languages (adding Thai to our current French-English-Malay, for instance) and some work has already been undertaken with the Arabic transcription of Malay (Jawi).

**Conclusion**

Once a long term and costly project has produced a large amount of lexical data, it often run into the questions of making its results available, usable and protected. More
often than not, they remain unused and forgotten. We presented some practical solutions for making multilingual dictionaries (in particular) and lexical data (in general) widely available, reasonably protected from piracy and useful both to the general public and to applications. We have actually implemented our solutions and made several prototypes available through a Web server and an e-mail server.

The solution we presented here is based on a common engine - Alex -, one unique database per dictionary and several formats. A logical format is used as "pivot" between a coding format and several output formats. It has been kept as simple as possible to be both easily understood and efficient for the dynamic generation of "external representations". The coding format is used for the actual storage and has been designed to be compact enough for fast retrieval but also for efficient transcription into the logical format.

We hope that the framework of this work can inspire some other projects and help reducing the number of lexical treasures that remain unknown and unreachable both to the general public and the (computational) linguistics community.

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