Machine Learning Reference Extraction Using GROBID

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November 23rd, 2015

Use cases

Curators often find themselves in one of the following situations:

1. They only have the PDF of a paper, but no metadata.
2. The source provides only part of the metadata, but they want to extract more from the PDF.
3. They want to save the time spent entering metadata manually.

Legacy: RefExtract

These problems were partially solved in the past by RefExtract, a series of heuristic based regular expressions to extract references from the output of `pdftotext`.

This solution eventually grew out of proportions and became hard to mantain, so we approached a library called GROBID as a better **off-the-shelf** solution.

Future: GROBID

GROBID (GeneRation Of BIbliographical Data) is a machine learning library for parsing unstructured PDFs in structured XML documents, with a focus on technical and scientific publications.

It is a Java library that wraps Wapiti, a C++ toolkit for segmenting and labeling sequences using Conditional Random Fields.

Its starting point is the output of `pdftoxml`, which retains much more of the PDF structure than `pdftotext`.

GROBID is widely used, for example at ResearchGate, Mendeley, HAL...

Labeling sequences and PDFs, 1/2

Let's see why extracting metadata from a PDF can be reduced to labeling a sequence. Let's consider for example a reference:

> G. Isidori and F. Teubert, *Status of indirect searches for New Physics with heavy flavour decays after the initial LHC run, Eur.Phys.J.Plus* **129** (2014) 40

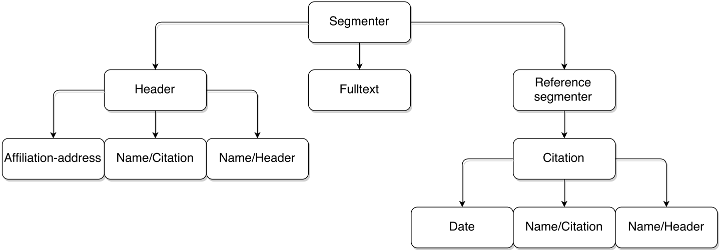
Labeling sequences and PDFs, 2/2

Extracting metadata can be seen as labeling each word with a category, encoded in this case as a color:

G. Isidori and F. Teubert, *Status of indirect searches for New Physics with heavy flavour decays after the initial LHC run,* Eur.Phys.J.Plus **129** (2014) 40

GROBID architecture

In GROBID parlance, the *knowledge* that is used to extract metadata from data is called a **model**. GROBID is nothing more than a cascade of models, each acting on the output of the previous one.



GROBID's output: TEI

TEI (Text Encoding Initiative) publishes a set of guidelines which specify encoding methods for machine-readable texts. By extension, we will call "TEI" the format described by these guidelines. GROBID's output conforms to a subset of TEI.

```xml
<biblStruct xml:id="b2">
  <analytic>
    <title level="a" type="main">
      Status of indirect searches for New Physics with heavy flavour decays after the initial LHC run
    </title>
    <author>
      <persName>
        <forename type="first">G</forename>
        <surname>Isidori</surname>
      </persName>
    </author>
    <author>
      <persName>
        <forename type="first">F</forename>
        <surname>Teubert</surname>
      </persName>
    </author>
  </analytic>
  <monogr>
    <title level="j">Eur.Phys.J.Plus</title>
    <imprint>
      <biblScope unit="volume">129</biblScope>
      <biblScope unit="issue">40</biblScope>
      <date type="published" when="2014" />
    </imprint>
  </monogr>
</biblStruct>
```

GROBID credits

GROBID is the work of Patrice Lopez, developer at INRIA. It has been adapted to papers from the HEP community by Joseph Boyd as part of his Master's Thesis for EPFL, under the supervision of Gilles Louppe, Senior Fellow at Inspire.

In particular, Joseph added to GROBID the concept of a *collaboration*, such as ATLAS or CMS, and improved considerably the accuracy of GROBID's models by providing lots of training data, taken from Inspire.

Caveat emptor

> "Converting PDF to XML is a bit like converting hamburgers into cows."
>
> — Michael Kay

That is, GROBID is not magic: it will misclassify things in various ways, and requires lots of training data to function properly.

DEMO