A rediscovered Llull tract and the Augsburg Web Edition of Llull's electoral writings

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Summary

We present a Web edition of the three writings on electoral systems by Ramon Llull (1232-1316). The first of these, *Artifitium electionis personarum,* which has come down to us only as a fifteenth century manuscript, is exhibited here for the first time. We discuss the goals of providing our Web edition, and outline the implementation we have chosen.

Zusammenfassung

Wir präsentieren eine Web-Edition der drei Wahlsystemschriften des Raimund Lull (1232-1316). Deren erste, *Artifitium electionis personarum,* ist einzig in einer Handschrift des fünfzehnten Jahrhunderts überliefert und wird hier erstmals vorgestellt. Wir diskutieren die Ziele unserer Web-Edition und skizzieren die softwaretechnische Umsetzung, für die wir uns entschieden haben.

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1. Introduction

This note reports on the results of a three-way interdisciplinary cooperation between mathematics, philology, and computer science. The mathematicians' interest in current electoral systems and their historical roots led to a medieval manuscript unedited to date, the philologist transcribed and translated it, and the computer scientists implemented a Web presentation of this and of two related texts of the same author.

The author is Ramon Llull (1232-1316), Christian philosopher and missionary. The Catalan Llull was a prolific writer producing close to three hundred philosophical and religious texts. A first list of his publications was compiled in 1311, during his lifetime. That list, the list of *Platzeck* [1962], and other lists have been amalgamated by *Bonner* [1985] into the current catalogue of Llull's work. We quote the manuscript numbers of Bonner's catalogue (= BC) together with the year of origin given there.

The three Llull texts dealing with electoral systems are outlined in Section 2. In Section 3 we discuss the goals for our Web edition of these texts. Section 4 comments on the implementation www.uni-augsburg.de/llull/.

2. Llull's electoral writings

The primary text is the tract *Artifitium electionis personarum* (BC II.A.10: 1274-1283), *Platzeck* [1962, no. 12] dates it from the period 1273-1275. The only copy known today, the rediscovered medieval manuscript mentioned in the Introduction, appears on four pages (folios 11r-12v) in the Codex Vaticanus latinus 9332 (paper, 336 folios, Italy, second half of the fifteenth century) of the Biblioteca Apostolica Vaticana.

Pérez Martínez [1959] rediscovered the four page manuscript, and *Ruysschaert* [1960] showed that it was written by the Renaissance scholar Pier Leoni (d. 1492), court physician of the Medici ruler Lorenzo il Magnifico (1449-1492). Neither Pérez Martínez nor Ruysschaert recognized the specific merits of this text for the understanding of Llull's electoral systems. The *Artifitium electionis personarum* comes first in chronological order and exceeds in length and in detail each of the other two of Llull's writings on this topic.

The second text in which Llull advertised his electoral system occurs in his novel *Blaquerna* (BC II.A.17: 1283) when, in Chapter 24, the nun Natana is elected abbess of her convent. This source has been well known over the years. In our Web edition we rely on the Catalan manuscript of the novel in the Codex Hispanicus 67 (paper, 268 folios, end of fourteenth/beginning of fifteenth century) of the Bayerische Staatsbibliothek in Munich. Chapter 24 appears on folios 32v-34r. The Catalan transcription was provided by *Soler Llopart* [2000]. Being part of a novel, the operational details of the electoral procedure are deemphasized, and the combinatorial finesse for which Llull is so famous does not figure as prominently as in the first and the third text.

The third text, entitled *De arte eleccionis* (BC III.38: 1299), addresses the electoral topic quite explicitly. In the colophon the text is dated July 1, 1299. The only transmission is a manuscript which was discovered by *Honecker* [1937] in the library of the Sankt Nikolaus Hospital-Cusanusstift in Bernkastel-Kues, Germany, on folios 47v-48r of the Codex Cusanus 83 (paper, 325 folios, fifteenth century). According to Honecker the manuscript was written by Nicholas Cusanus (1401-1464) who, in his copy, faithfully included the original colophon with its rather exact dating.

A joint view of Llull's electoral systems is given by *Hägele/Pukelsheim* [2001], including further bibliographic references, transcriptions and translations of the three texts, and a comparison of the electoral instructions they contain. The three electoral procedures have in common that they build on pairwise comparisons of two candidates at a time, but they differ in detail. The first two texts stipulate a complete series of pairwise comparisons; the candidate who scores the most victories across all voting duels is the winner of the whole electoral tournament. The third text proposes a system of successive elimination, and hence a partial series of pairwise comparisons; the candidate winning the last round is the winner of the election.

3. Goals for the Web edition

The question is what goals a Web exhibition of these texts should achieve, over and beyond a paper publication in conventional format such as in *Hägele/Pukelsheim* [2001]. Of course, there are many Web sites, of varying degree of sophistication, where electronic editions are being developed. *Schmitz* [2000] discusses some general principles of what an electronic edition should achieve, with a special emphasis whether or not to include a facsimile of the original text. As an example we mention the German-Italian cooperative project to electronically re-present Galilei's manuscripts, reported by *Damerow/Renn* [2000]. *Sahle* [2001] provides a comprehensive list of Web links pointing to a large number of similar projects.

In our Web edition we concentrate on the use of the World Wide Web as a platform for communication, by exploiting the Web's potential to promote cooperative research and multilateral discussion. We do not treat the question of whether a computerized archive satisfies long-term archiving standards. Rather, with communication as our primary goal, we wish to strike a balance between completeness and speed. While users want a reasonably complete view of the material, they also expect a prompt flow of information.

From the viewpoint of communication, we find that there are three essential goals for a Web edition. Firstly, the user's judgment should not be hindered by hiding essentials. To this end we exhibit text triples, consisting of facsimile, transcription, and translation. Secondly, within a selected text triple, the machine should assist the user in focusing on passages which correspond to one another. We achieve this by undirected, linked highlighting. That is, the facsimile, the transcription, and the translation are subdivided into corresponding fragments that are then linked. When the user points at any one fragment of a set of three, the machine highlights the three fragments that are linked together. Thirdly, the highlighting should signal the distinct levels of reliability of our proposed reading. We use different colors to do this, yellow for places that come with an annotation (shown in a fourth, bottom frame if applicable), and green for all other places. A sample screen layout is shown in Figure 1.

We think that there are good reasons to implement a Web edition along these lines, reflecting the interests of the potential user groups. The general scientific community is offered an easy instant access to the material (Subsection 3.1), smaller expert groups are aided to discuss details (Subsection 3.2), and an individual researcher may profit from a computer supported environment in his or her daily work (Subsection 3.3).

3.1. Global instant access

The Web edition is instantly available to all of the global scientific community. Llull's texts on electoral systems are of interest not only to Llull experts. *Honecker* [1937] was the first to point out that Llull's work is fundamental to the thoughts of Cusanus. New insights into Llull's voting system thus have a direct effect on our understanding of Cusanus' voting system.

Furthermore, *McLean/London* [1990] and *Meuthen* [1992] noticed that, even though the electoral systems proposed by Llull and Cusanus appear in the current politological and social science literature, Llull and Cusanus themselves are not mentioned at all. Instead, the systems are attributed to Condorcet (1743-1794), and Borda (1733-1799). That the rediscovered roots find their way into the textbook literature is testified by *McLean/Urken* [1995] and *Colomer* [2001].

From the viewpoint of the sociology of science it is indeed most remarkable that the historic roots of Cusanus and of Llull were neglected in all literature prior to 1990. These medieval testimonies on electoral systems are thus of interest to a wide group of political and social science experts, in addition to Llull and Cusanus scholars and manuscript researchers. This fairly broad scientific audience is reached much more efficiently through the World Wide Web than through a paper publication in a journal specializing in just one of the many fields concerned.

3.2. Expert discussion forum

Any project concerning a medieval manuscript invites an expert discussion on the validity of the transcription and of the translations. This demands codicologists who are experts in the hands of Leoni or Cusanus, as well as philologists with a special expertise in Llull's wording and phrasing. We feel that a Web edition is helpful in fostering such cooperation. After all, the *codex unicus* of the first text resides in Italy, and the *codex unicus* of the third text is kept in Germany. It is easier to retrieve them from the Web than ordering them through interlibrary loan, even for experts.

Furthermore the texts pose some reading problems. Leoni's hand, in the first manuscript, looks somewhat obscure in places. In contrast, the hand of Cusanus, in the third text, looks clear. Surprisingly, after having transcribed and translated these two texts, we find these ratings reversed. In the *Artifitium electionis personarum,* despite the obscure hand of Leoni, we regard our interpretation as rather definite, with only a few annotations. Contrary to the neat hand of Cusanus and to being shorter, *De arte eleccionis* features plenty of annotations. In order to alert the user of the Web edition to such editing problems, the annotated fragments are marked with a yellow ball and are highlighted in yellow. Definite fragments appear in green. Thus the World Wide Web edition should provide a convenient way to facilitate the expert discussion of the texts shown.

3.3. Computer supported editing

A computer supported editing environment should enable the researcher to build a complete Web edition like the one shown here. It should support the definition of fragments within a single document, as well as the linking of fragments between several related documents. The editing environment should automize the generation of the image maps defining the polygonal facsimile fragments, the creation of the graphics overlay files, and the adjustment of the JavaScript source file.

The system should not be restricted to our particular setting, where the contents of the three linked documents (facsimile, transcription, translation) run in parallel. When the user wants to link some of the fragments in one facsimile file with some of the fragments in another facsimile file, the system should permit this to be done. For example, when the researcher compares several manuscripts that represent distinct records of the same text, like a set of all manuscripts transmitting the novel *Blaquerna,* interest may be in linking the fragments that are common to all of the records, and in specifying the fragments that appear only in some of them.

In addition, a more elaborate support might include a distributed discussion forum, so that several researchers can join together in a computer supported cooperative editing project. Changes to the transcriptions or to the translations could automatically be tracked and documented in a version history.

4. Software implementation

4.1. Document object model and browser orientation

Our Web edition is oriented towards the browser capabilities of the user's computing equipment. In order to serve as large a community as possible, to maximize transparency of the files needed, and to minimize their maintenance expense, we decided to base the Web edition on the Document Object Model Level 1 Specification, and on the HyperText Markup Language (HTML) 4.01 Specification of the *World Wide Web Consortium* [1998, 1999]. This standard is supported by quite a few browser programs, such as Netscape Navigator beginning with version 6, Microsoft Internet Explorer beginning with version 5, Opera beginning with version 5, and recent versions of Mozilla. Thus a broad collection of Web browsers will be able to handle the electronic edition.

We may then assume that a user's Web browser is capable of subdividing a window into frames. First the user selects a translation language, English or German. Then the user opens an extra window that is divided into frames. The top frame displays the facsimile, a graphics file. The middle left and right frames contain the transcription and the translation. If applicable, the annotations are shown in a bottom frame. See Figure 1.

The browser permits the usual operations on the frames. The user can resize a frame, print its contents, or load it into a separate window. The frame's contents can be scrolled up or down. Within a frame, the user can navigate with the mouse cursor, or with the TAB, SHIFT-TAB, and ENTER keys. The text frames can be searched for the occurrence of a user-defined string.

4.2. JavaScript-based dynamic HTML

In order to enable the highlighting of linked text fragments, dynamic manipulation of HTML is needed. This is achieved with techniques commonly subsumed under the term dynamic HTML (DHTML). We decided to choose the JavaScript programming language, rather than Java, or Macromedia Flash. With Java we would have had to program the desired functionality ourselves, instead of relying on browser capabilities. It also would have meant a larger code and a longer download time. Macromedia Flash has the disadvantage of requiring additional software that is available only for some platforms. A Macromedia Flash presentation is also more time consuming to set up and to maintain than is JavaScript.

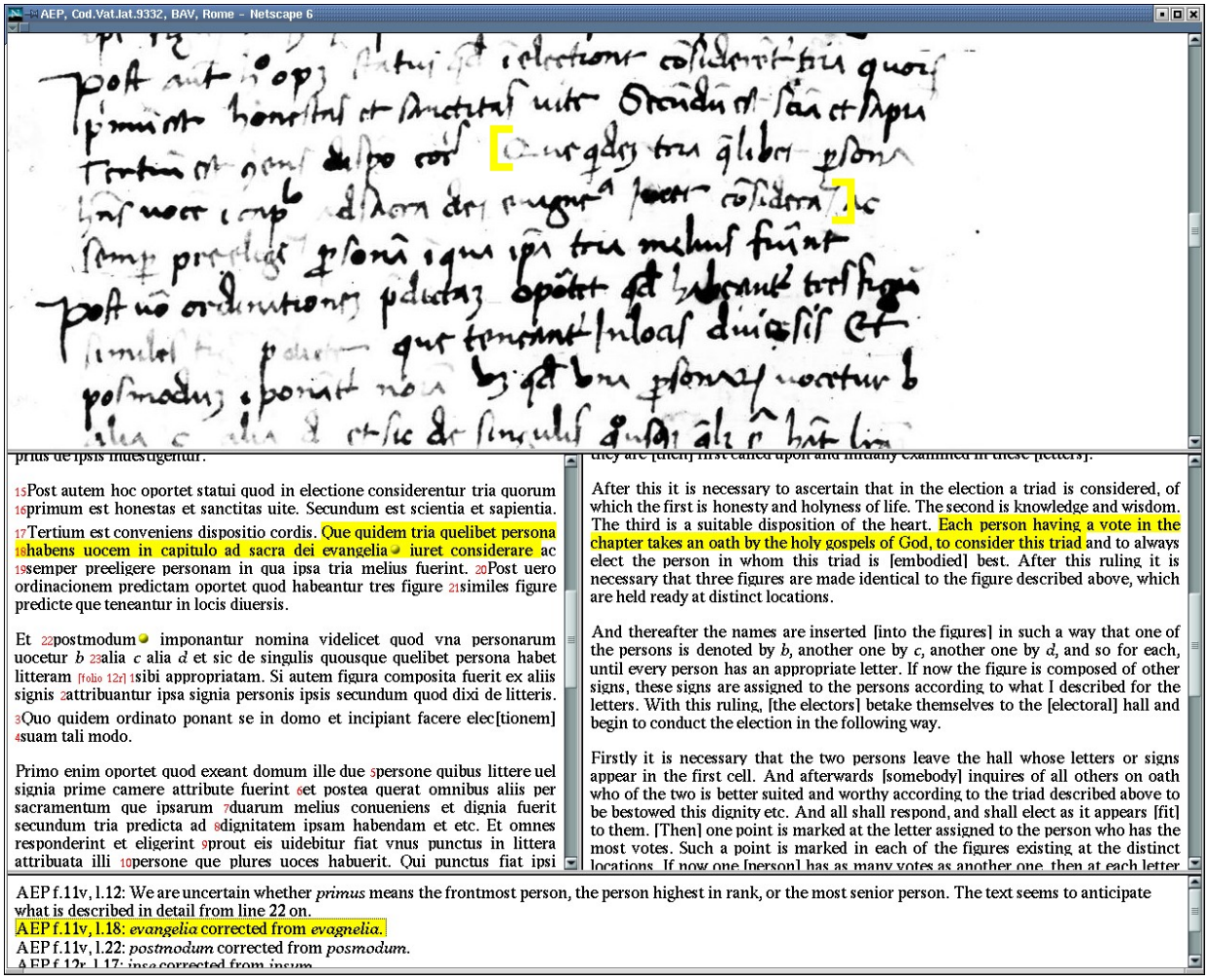

Figure 1: *Triple highlighting.* The facsimile, transcription, and translation (top, middle left, right) consist of linked fragments. A click at any one highlights all three and, if applicable, an annotation (bottom), as is shown with the *Artifitium electionis personarum* (Cod.Vat.lat.9332, f.11v).

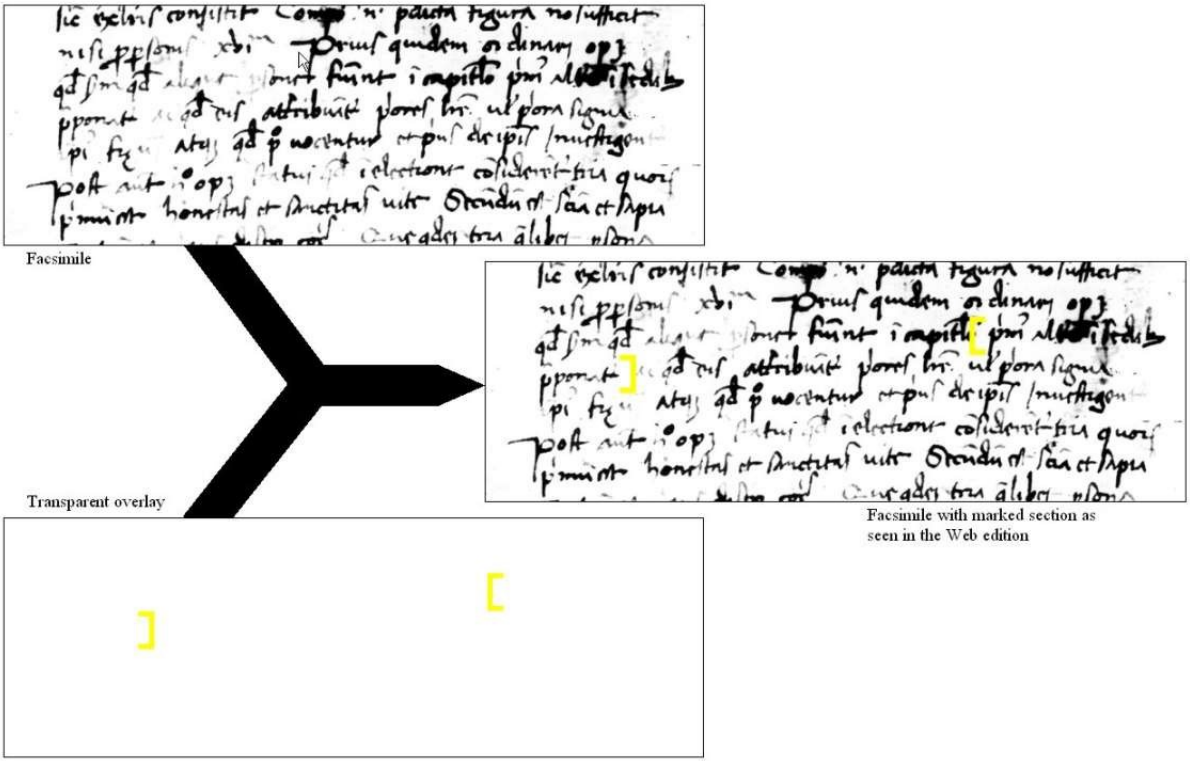

Figure 2: *A facsimile fragment with brackets overlay.* Fragments in the facsimile frame are marked on the computer screen by overlaying a second graphics file that contains the brackets, but is otherwise transparent.

4.3. Text fragmentation and linked highlighting

In the JavaScript-based dynamic HTML environment, we implemented the highlighting of the linked passages in the three frames in the following way. For each of the three manuscripts, we decomposed the facsimile file, the transcription file, and the translation files into an equal number of fragments (namely 68, 77, and 55 fragments for the first, second, and third manuscript, respectively).

In the facsimile graphics file, a fragment is a polygonal region to which a JavaScript function is linked. These links are established by HTML image maps. In the transcription and translation HTML files, a fragment is an anchor element, extending from a start tag `<A>` to an end tag `</A>` and containing a piece of text. The start tag specifies several attributes determining the behavior of the anchor element. For example, the transcription fragment of the *Artifitium electionis personarum* (Cod.Vat.lat. 9332) that is highlighted in Figure 1 reads as follows:

```
<A id="TranscriptionFragment25"
   href="javascript:HighlightTriple(25)"
   style="text-decoration:none">
Que quidem tria quelibet persona ...
iuret considerare
</A>
```

The attribute `id` assigns the name `TranscriptionFragment25` to the text fragment `Que ... considerare`. The attribute `href` is a hypertext reference, pointing to the JavaScript command `HighlightTriple` and to the current fragment number. The command is defined in a separate JavaScript source file, and is executed in three steps. Firstly, the command visits a table from which it reads the color green or yellow that is prescribed for the current fragments. Next, it highlights the linked fragments in the transcription, translation and, if applicable, annotation files, and it delimits the corresponding facsimile

fragment by brackets. Finally, the command scrolls the highlighted fragments close to the top of their respective frames. The attribute `style="text-decoration:none"` disables the defaults with which the browser otherwise indicates an anchor element.

The transcription file includes the folio and line numbering, showing in red. When a fragment carries an annotation, it is marked with a yellow ball and the linked fragment set is highlighted in yellow. Otherwise, when there is no annotation and we regard our reading as definite, the fragment triple is colored green.

The actual highlighting is implemented in two different ways. In a text file, a fragment is highlighted by changing the background color of the text between the start tag and the end tag of the anchor element. The facsimile files are handled differently, since JavaScript cannot write the brackets into the graphics file nor can it draw them into the browser window. As a solution, we provide a set of overlay graphics files, one file for each facsimile fragment (except for page breaks where two files are needed). The small overlay files (of less than three kBytes) are downloaded on demand only, and at most once per session since they are saved in the browser cache. Each overlay file contains one set of premanufactured brackets, but is otherwise transparent. To mark a facsimile fragment, the corresponding overlay graphic is loaded on top of the facsimile file. See Figure 2.

4.4. Future work

Our Web edition reaches the goals set out in Subsections 3.1 and 3.2, but only parts of those listed in Subsection 3.3. In particular, missing the interactive features from Subsection 3.3, it conveys a somewhat static impression of the end result, rather than showing the process that gets us there, or inviting the user to go further. We feel that for a first implementation this level provides a natural starting point. Yet it demonstrates that a minimum number of actions on the user's side (selections of a translation language, and of a manuscript) suffices to make the system display a maximum amount of information (triple documents, with corresponding fragments linked).

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