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# The Authorship of the Works of Chrétien de Troyes: a Stylometric Examination

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## 1. Introduction

Chrétien de Troyes, a pivotal and inspirational figure in medieval French literature (Kibler, 2007), played a crucial role in shaping the Arthurian romance genre. Despite his prominent role and heritage, little is known of Chrétien’s life. Active in the late 12th century, he was a poet for the court of Marie de Champagne (Doudet, 2009). The lack of reliable sources about Chrétien has allowed numerous controversies to arise regarding the delimitation of his works. A sentence at the end of *Lancelot ou le Chevalier de la charrette* states that a Godefroi de Leigni would have finished the text, but the extent of the work of this unknown author remains somewhat unclear, despite previous interesting quantitative analyses (Reilly and Dillon, 2013). The romance *Guillaume d’Angleterre*, signed under the name “Crestiens” has sometimes been attributed to Chrétien de Troyes, fostering a decades-long debate (Slautina, 2012, Williams, 1987, Zufferey, 2008), and is considered by some as certainly not a work by Chrétien de Troyes (Lacy and Grimbert, 2005, Walter, 1997). Some specialists have suggested that the style used in Chrétien de Troyes’ supposed adaptations of Ovid (*Philomena*) is too different from the style for which he is known (Krueger, 2005).

Finally, the different *Continuations* to Chrétien’s *Perceval* are also a topic in themselves, having been variously attributed to Chrétien himself, Wauchier de Denain (Second Continuation), or Gerbert de Montreuil (Fourth Continuation), among other hypotheses (Bruckner, 2006). Though we include Gerbert de Montreuil’s alleged Continuation in our corpus, we set aside the question of the authorship of all continuations as the topic of a future investigation.

In this paper, we try to address these debates using stylometry, an approach that has proven useful to attribute literary texts, even in the case of collaborations or sequential authorship (Cafiero and Camps, 2021, Plecháč, 2021), and in the complex context of medieval texts (Camps et al., 2021b, Kestemont et al., 2015, Van Dalen-Oskam and Van Zundert, 2007). We build a corpus by breaking the silos between different data sources, and then subject it to both unsupervised and supervised analysis, the latter using a rolling approach suited to the suspicions of collaborative authorship present in Chrétien’s later works.

## 2. Material and methods

### 2.1. Corpus and Data

The corpus was built around the works of Chrétien de Troyes (fl. c. 1170-1190) himself, including all his certainly attributed romances, as well as the *Lancelot*, started by Chrétien and supposedly finished by another author, Godefroi de Leigni. The disputed works of *Philomena* and *Guillaume d'Angleterre* were included in order to be analysed.

Two imposters were then added: Gerbert de Montreuil (fl. first half of the 13th c.) was chosen, as the author of a *Continuation* to Chrétien's works, and therefore producer of texts very close in terms of genre, form and content. Finally, Jean Renart (fl. end of the 12th-beg. of the 13th c.) was included as an outsider.

To that end, we have compiled data from various sources to design a corpus: the works of Chrétien reused the data of a digital edition of the copy made by the scribe *Guiot de Provins* (Kunstmann, 2009); other texts were selected from the *Base de français médiéval* (Guillot et al., 2018), that provides the text of digitised editions. Finally, we completed the corpus by performing OCR and post-correction on some texts for which no digital editions were available, using eScriptorium (Kiessling et al., 2019) and the model *CATMUS Print* (Gabay et al., 2024). The detailed composition of the corpus is presented in Appendix A.

Lemmatization was performed using Pie (Manjavacas et al., 2019) and a model trained specifically for Old French (Camps et al., 2020, 2021a)<sup>1</sup>.

Function words were then extracted on the lemmatised text, using a custom list, built from the lemmatised Gold data of the 0F3C Corpus (Camps et al., 2021a).

### 2.2. Stylometric Analysis

To build a training corpus, we carefully select works that appear mostly free of doubts regarding attribution. In particular, for Chrétien de Troyes, his two earlier kept romances were selected, under the assumption that they are the ones with the least risk of collaborative authorship. Indeed, there is no mention of such collaboration before *Lancelot*, nor are there known *Continuations*.

Yet, since medieval texts are rarely free of doubts about authorship, and before proceeding to a supervised analysis, we still need to check the consistency of the traditional attribution of the works of our corpus – that is, their homogeneity in terms of style and attribution.

For this, we selected a potential training corpus of two works by each author (Chrétien de Troyes, Gerbert de Montreuil and Jean Renart) and submitted it to unsupervised analysis. If this step confirms their homogeneous nature, we can then proceed to using them as training material in the next step, using SVM to perform rolling analyses on the texts.

In both cases, we sample the texts in 3000 words chunks, and then extract lemmata frequencies of function words.

#### 2.2.1. Unsupervised analysis

Data is normalised, and distance computed using a combination of Burrow's delta and L2-norm, and then hierarchical clustering is applied, using Ward's method (Cafiero

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<sup>1</sup> This model actually includes works from Chrétien de Troyes in the training data, which can in the same time improve its efficiency on our corpus, and create biases between the lemmatisation success of the works of this author and the rest.

and Camps, 2019, Evert et al., 2017).

### 2.2.2. Supervised analysis

We then train support vector machines, with a linear kernel, using group-k-fold as a cross-validation strategy (i.e., each work is iteratively removed from the training data and its samples used as a test set, before a global score is computed). The computations were performed using the software Superstyl (Camps, 2021). Results of training are presented in Table 1. The most important contributing features for each classifier are provided in Appendix B.

Table 1: Classification Metrics

Class	Precision	Recall	F1-Score	Support
ChrTr	0.81	0.81	0.81	26
GerbM	1.00	0.91	0.95	23
JnRen	0.81	0.87	0.84	30
<i>accuracy</i>			0.86	79
<i>macro avg</i>	0.87	0.86	0.87	79
<i>weighted avg</i>	0.87	0.86	0.86	79

## 3. Results

Hierarchical clustering results (Figure 1) can be cut into three main clusters. One contains all samples from works attributed to Gerbert de Montreuil, the second all samples from works of Jean Renart, plus two samples drawn from *Cliges* and *Erec et Enide*. The third one contains all the remaining samples from the works attributed to Chrétien de Troyes, as well as *Philomena* and *Guillaume d’Angleterre*. Most samples from this last work are clustered together in a sub-branch, at the frontier between the works of Chrétien de Troyes and those of Jean Renart.

The results of rolling analyses are shown in Figure 2. In both *Lancelot* and *Perceval* there is a significant drop towards the end in Chrétien de Troyes’ curve (representing the value of the SVM classifier for Chrétien’s style), and increase in Gerbert’s (who is even shown as a better candidate for some limited portions, but without a value  $> 0$ ).

In both *Philomena* and *Guillaume d’Angleterre*, Chrétien globally scores the highest, but with relatively low values concerning the last of these texts, apart from a section representing roughly the third quarter of this work, in which values similar to those observed for *Yvain* are found.

## 4. Discussion

Our results can be arranged in three groups: first, some of them seem to confirm current consensus on the authorship of these works; secondly, another group contains potentially new findings, even on works until now not debated as far as we know; and thirdly, there are some partially inconclusive results, that call for further investigation.

Firstly, the unsupervised analysis seem to globally confirm the coherence of three groups of works, usually attributed to, respectively Chrétien de Troyes, Gerbert de Montreuil (*Violette* and Fourth Continuation) and Jean Renart.

In what concerns suspicions of collaborative authorship in Chrétien de Troyes’ later works, our rolling analysis seems to confirm a significant drop in Chrétien’s stylistic

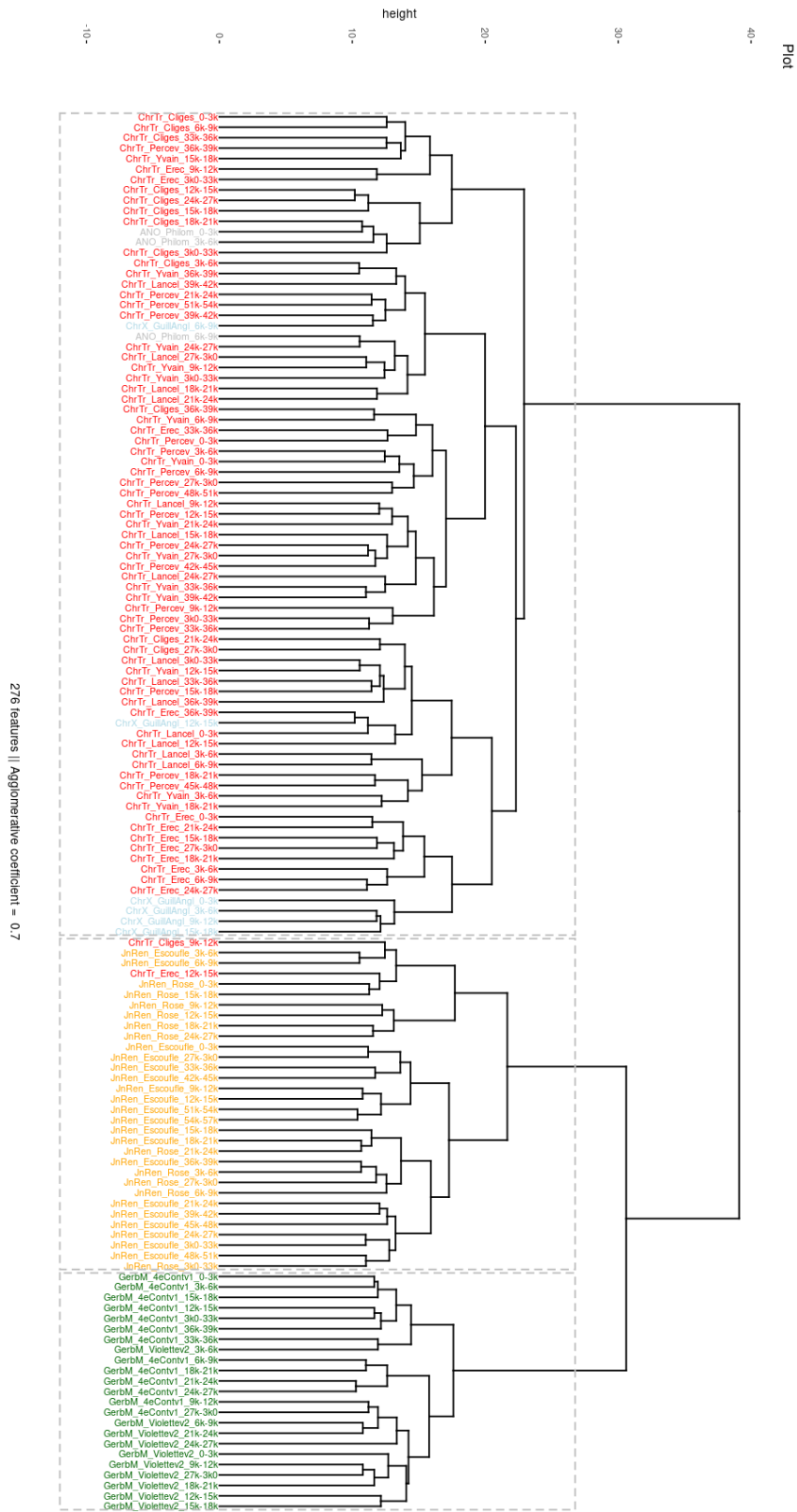


Figure 1: Hierarchical clustering of the corpus (Ward's method, Burrows' delta and L2 norm)

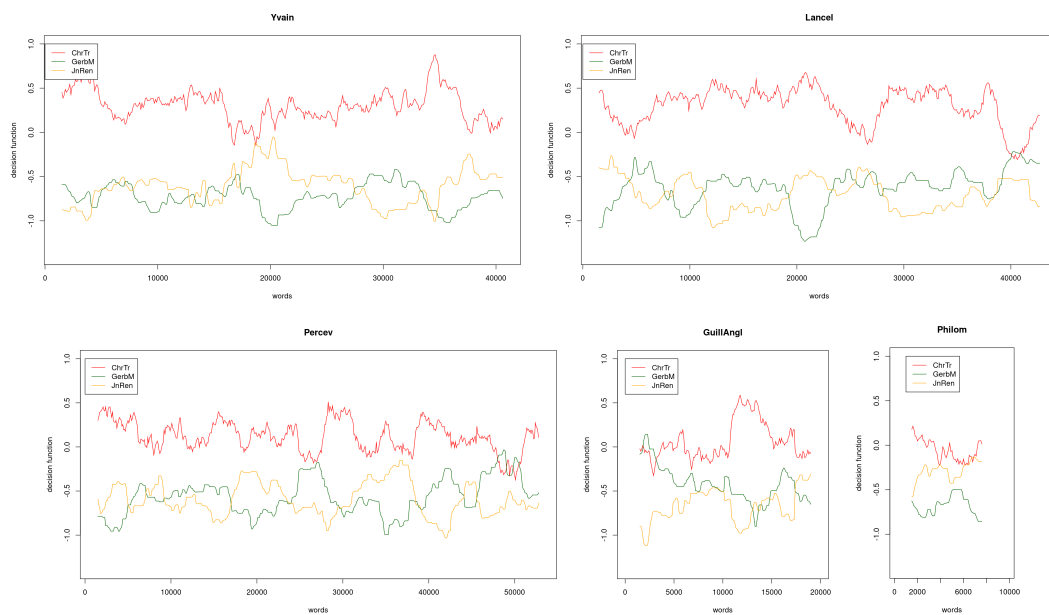


Figure 2: Rolling SVM analyses of all texts unseen in training

signature at the end of *Lancelot*, roughly from word 38 200 in our analysis, which matches the verse 6156 in our edition (“*Mes de Lancelot n’i voi mie*”). This is quite coherent with both the stylistic expertise of James-Raoul (2007) and the quantitative analysis of Reilly and Dillon (2013), who posit a transition from Chrétien de Troyes to Godefroi de Leigni around verse 6150.

But there are results on collaborative authorship that are also novel. In particular, there is at least one drop similar to the one observable in *Lancelot* (roughly v. 6150-end), but this time at the end of *Perceval*. It spans from word 47 500 to 51 000, that is, roughly, from verse 7841 (“*Lors s’est la reine esmeüe*”) to 8416 (“*qu’ausinc orroie ge conter*”), before Chrétien’s signal takes over again. This is quite an interesting finding inasmuch as *Perceval* is known to be an unfinished work, probably interrupted by Chrétien’s death, that has spurred the contribution of several continuators. Is it possible too that, like for *Lancelot*, Chrétien obtained the contribution of an anonymous hand towards the end of the text. Or, perhaps, are we faced with the presence of a posthumous interpolation?<sup>2</sup> In both cases, the curves goes up slightly again at the very end, perhaps indicating that the last few verses are in Chrétien’s own writing.

Regarding the case of *Philomena* and *Guillaume d’Angleterre*, our current results call for further investigation. In the case of *Philomena*, both the unsupervised and the rolling analyses seem to confirm that *Chrétien* is globally the best candidate in our set, but without a strong certainty.

The case of *Guillaume d’Angleterre* apparently calls for nuance: both analyses show that some portions of this work are quite close to Chrétien de Troyes’ style, while other are more autonomous. In particular, in the rolling analysis, the portion from word 10 500 to 14 500 (roughly, from v. 1692, ‘*Et Loviax s’est tos resjois*’, to 2332, ‘*S’il vos*

<sup>2</sup> Interestingly, the end of this portion matches a response from Grinomalanz to Gauvain, in which he contests the veracity of the Gauvain’s narrative in these words: “Or m’est il solaz et deliz / de tes mançonges escouter, / qu’ausinc orroie ge conter / .i. fableor con ge faz toi. / Tu es juglerres, bien le voi.” (*It is to me agreeable and pleasurable to listen to your lies, in the same way as I would hear a composer of fiction telling a tale. I can tell you are a minstrel*).

venoit a volanté’). A possible explanation to this could be that we are faced with a composite work, partially preserving and partially rewriting and interpolating a work of Chrétien de Troyes (or at least mixing the styles of different authors).

To further explore the stylometric analysis of Chrétien authorship, and specifically the problems of *Guillaume d’Angleterre* and *Philomena*, further research should envision an authorship verification approach, such as ‘impostors’, with a larger corpus, including more contemporaries of Chrétien (for instance, Benoît de Sainte-Maure). In addition, the topic of the *Perceval* and all its *Continuations* should be investigated in more detail. Finally, other features that have proven interesting for medieval texts could be used in addition to lemmatised function words, in particular rhyme words, that are considered less subject to scribal variation (Kestemont et al., 2012).

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## A. Corpus

Table 2: Composition of the corpus; all texts are Romances in octosyllabic verses (BFM = *Base de français médiéval*, Guillot et al. (2018); AO = *Archive.org*)

Author	Title	Genre	Date Work	MS Ed.	Date MS	Ed	Source
Chrétien de Troyes	Erec et Enide	Arthur.	1170	BNE, fr. 794 (C)	c. 1235	(Kunstmann, 2009)	BFM
Chrétien de Troyes	Cligès	Arthur.	1176	BNE, fr. 794 (C)	c. 1235	(Kunstmann, 2009)	BFM
Chrétien de Troyes	Yvain	Arthur.	1178-1181	BNE, fr. 794 (C)	c. 1235	(Kunstmann, 2009)	BFM
Chrétien de Troyes & Godefroi de Leigni	Lancelot	Arthur.	1178-1181	BNE, fr. 794 (C)	c. 1235	(Kunstmann, 2009)	BFM
Chrétien de Troyes	Perceval	Arthur.	1182-1190	BNE, fr. 794 (C)	c. 1235	(Kunstmann, 2009)	BFM
Chrétien 'li Gois'	Philomena	Antiqu.	1165-1170	Rouen O.4 (1044) (A1)	c. 1325	(Baumgartner, 2000)	BFM
Chrétien	Guillaume d'Angleterre	Advent.	12 <sup>ex</sup> -13 <sup>in</sup>	BNE, fr. 375 (P)	1290-1317	(Wilmotte, 1927)	Gallica
Gerbert de Montreuil	Perceval's Fourth Continuation	Arthur.	1235	BNE fr. 12576 (A)	13 <sup>3/4</sup>	(Williams, 1922)	AO
Gerbert de Montreuil	Violette	Courtly	1227-1229	BNE fr. 1374+ fr. 1553	13 <sup>in</sup> + 1285-90	(Michel, 1834)	AO
Jean Renart	Rose/Guillaume de Dole	Courtly	1200-11	BAV, Reg. lat. 1725	13 <sup>ex</sup> -14 <sup>in</sup>	(Lecoy, 1962)	BFM
Jean Renart	L'Escoufle	Advent.	c. 1200-02	Arsenal 6565	13 <sup>ex</sup>	(Sweetser, 1974)	BFM

## B. Coefficients of the SVM models

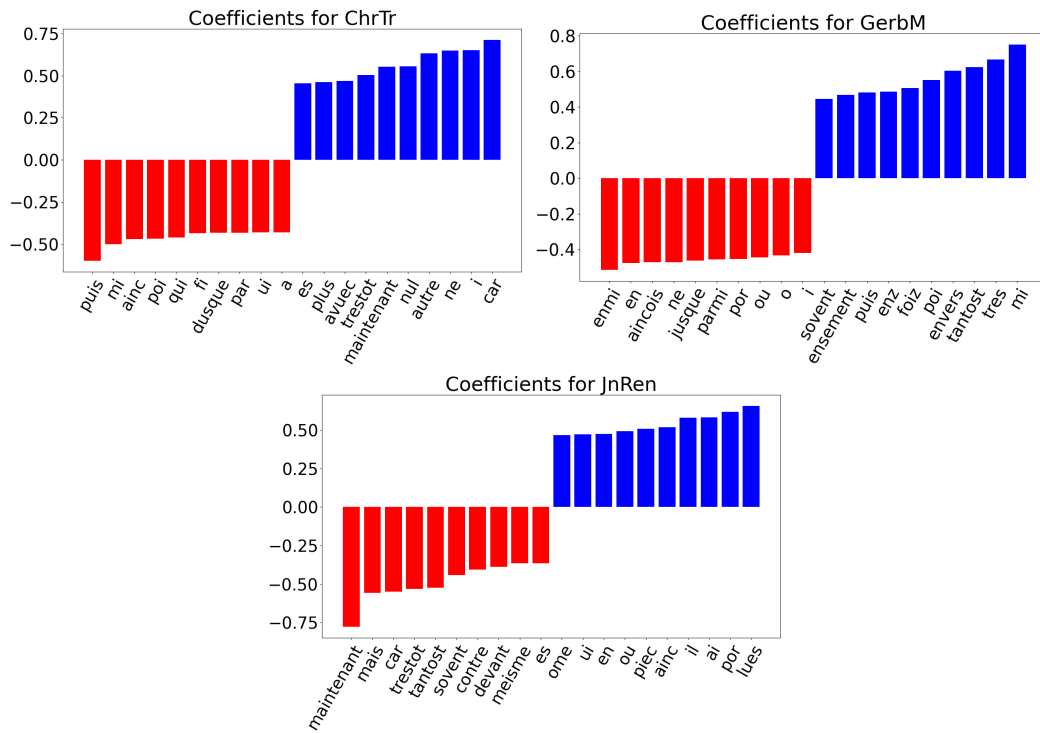


Figure 3: Coefficients of the SVM models for the three authors