Mining for characterising patterns in literature using Correspondence Analysis
An experiment on French novels

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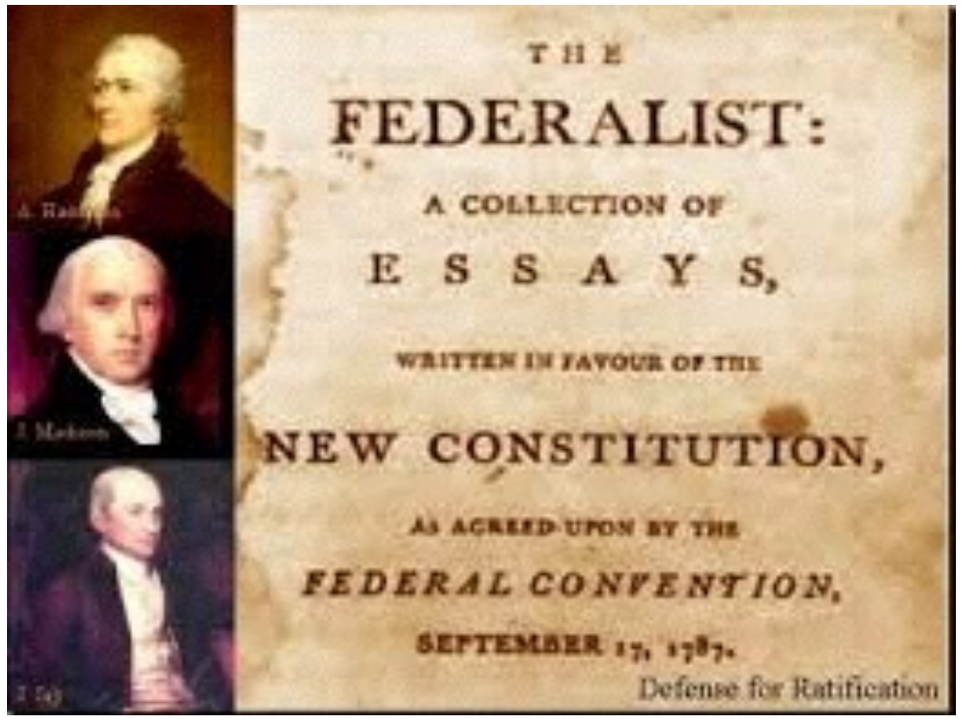
Outline

- Small excursus on the study of literature using computational / algorithmic means
- Where does the present study stand
- Our methodology
- The case study on novels
- What does this tell us

Modern day stylometry

- Mosteller and Wallace's (1964) analysis of the distribution of function words (e.g., prepositions, conjunctions, articles) in a corpus of the 85 'Federalist Papers'.

- "In summary, we can say with better foundation than ever before that Madison was the author of the 12 disputed papers"



The Federalist Papers were written in 1787-1788 by Alexander Hamilton, John Jay and James Madison, under the pseudonym of Publius

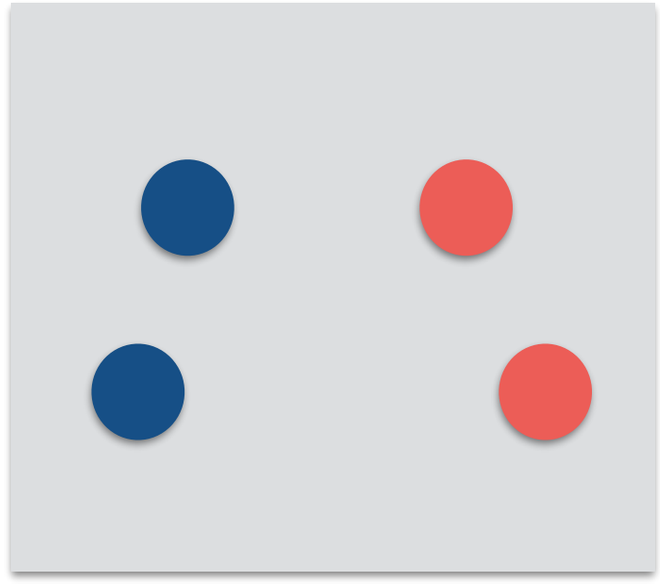
Modern day stylometry

- Used for authorship attribution
- Writer's invariance; stylistic fingerprints of the author
- Statistical analysis, classification, multivariate analysis, MDS, PCA, …
- Linguistic features of variable degree of complexity (average word length, … , function words distribution)

	T1	T2	T3	T4
f1	1	2	2	3
f2	3	4	0	2
f3	0	1	0	6
f4	1	6	1	9

Texts are represented as vectors of features

distances between vectors represent distances between texts



Computational stylistics

- Stylometric methods applied not only to authorship attribution, but also to **computational analysis of style**

- Useful tools such as Stylo for R, allow for basic stylometric analysis

- No complex linguistic features (word or character ngrams)

- Burrows 1987 (on Austen), and many others…

Critique

- Willie van Peer 1989 *Quantitative Studies of Literature. A Critique and an Outlook.*

- Hugh Craig 1999. *Authorial attribution and computational stylistics: if you can tell authors apart, have you learned anything about them?*

- What features for computational stylistics? **Subconscious fingerprints vs author's choice**

Corpus stylistics

- Geoffry Leech; Semino & Short 2004; Mahlberg 2012

- corpus linguistics, discourse analysis

- rich linguistic analysis

- attention to the form - function relationship, and to linguistic bases of literary style

- Douglas Biber's work on the linguistic traits defining Genre, Register, Style

Concordance Results

KWIC Plot

Searched for **poor** within **whole text**.

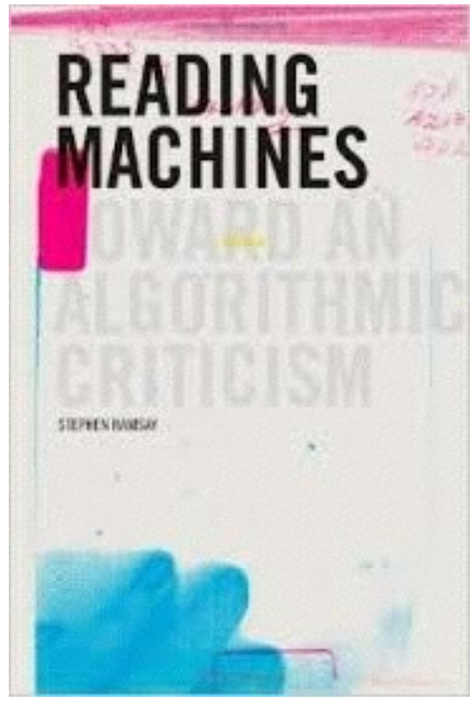
1 to 1000 of 2326 entries | CSV | Print | Toggle metadata | Filter concordance:

	Left	Node	Right	Book	Ch	Par	Sen	In bk
1	…differenbetween a child and a woman; I felt so	poor,	so trifling, and so far off that I never could	Bleak House	3	3	19	
2	…froremained unsoftened. On the day after my	poor	good godmother was buried, the gentleman in …	Bleak House	3	28	104	
3	…tlittle school, and the unexpected sight of the	poor	children outside waving their hats and bonnets…	Bleak House	3	107	270	
4	Lord High Chancellor, at his best, appeared so	poor	a substitute for the love and pride of parents. "…	Bleak House	3	135	336	
5	Ada was a little frightened, I said, to humour the	poor	old lady, that we were much obliged to her. "Y…	Bleak House	3	169	400	
6	leading the way back. "By no means," said the	poor	old lady, keeping up with Ada and me. "Anythi…	Bleak House	3	172	408	
7	…agot his head through the area railings!" "Oh,	poor	child," said I; "let me out, if you please!" "Pray	Bleak House	4	19	39	
8	…somethisaid Mr. Guppy. I made my way to the	poor	child, who was one of the dirtiest little unfortun…	Bleak House	4	21	42	
9	… came into Mrs. Jellyby's presence, one of the	poor	little things fell downstairs-- --down a whole fli…	Bleak House	4	22	48	

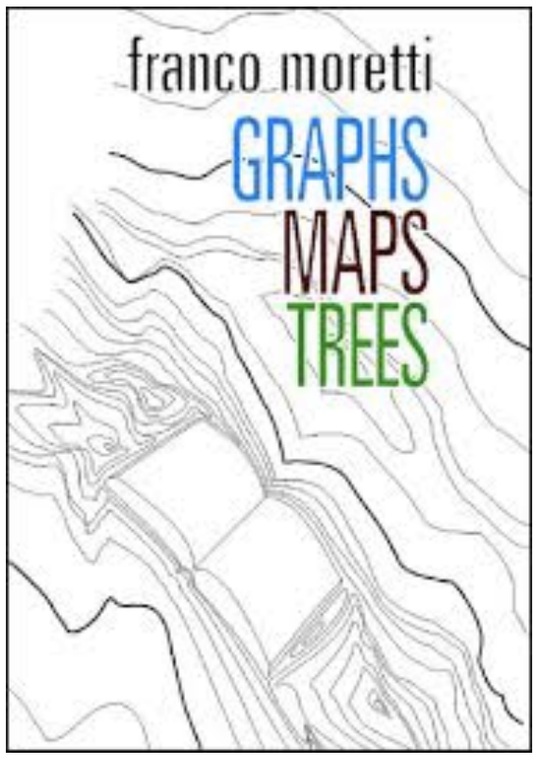
Concordancers used to extract lexical bundles
Interpretative work has greater weight

Algorithmic criticism

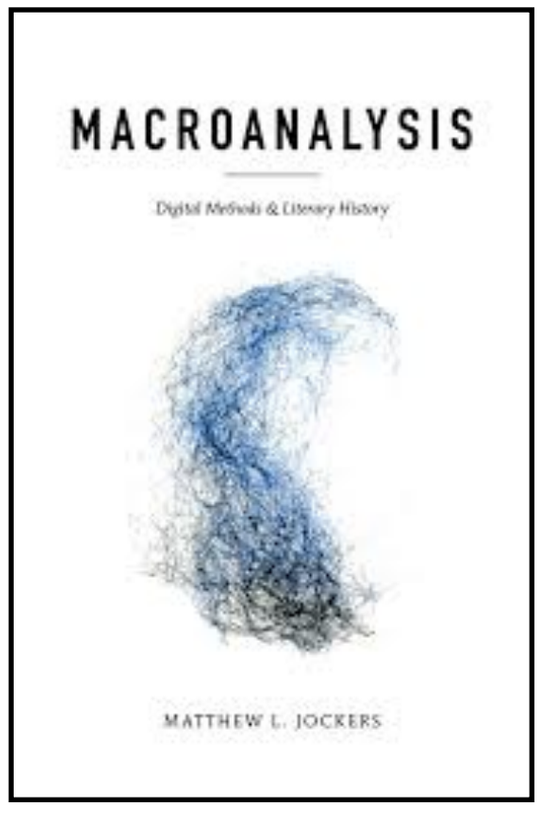
- Stephen Ramsay 2011 *Reading machines*
- **hermeneutical vs experimental methods**
  - *“This work takes the contrary view and proposes that scientific method …. is, for the most part, incompatible with the terms of humanistic endeavor”*
  - <u>investigate/manipulate the text</u> with computational methods vs <u>prove</u> with computational methods



Distant reading & macro analysis



Moretti, 2005



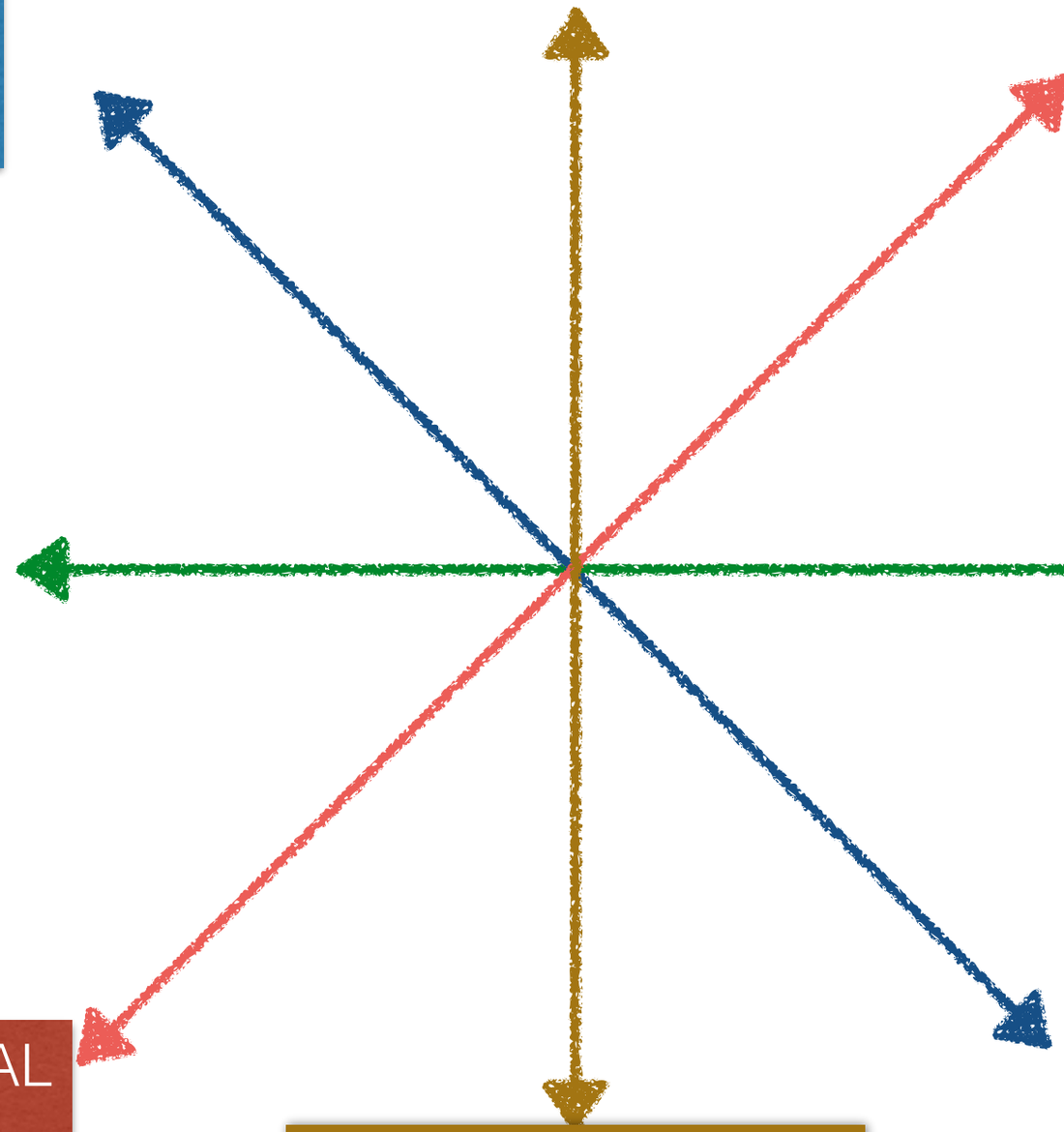
Jockers, 2013

Large quantities of texts, diachronic approach, metadata, visualisations

COUNT FEATURES IN TEXT
statistics, plots

MICRO
focus on few works/authors

HERMENEUTIC APPROACH (EXPLAIN)



SIMPLE LINGUISTIC FEATURES

COMPLEX LINGUISTIC FEATURES

EXPERIMENTAL APPROACH (PROVE)

MACRO
many books
historical perspective

MANIPULATE TEXT
search, visualise

COUNT FEATURES IN TEXT
statistics, plots

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HERMENEUTIC APPROACH (EXPLAIN)

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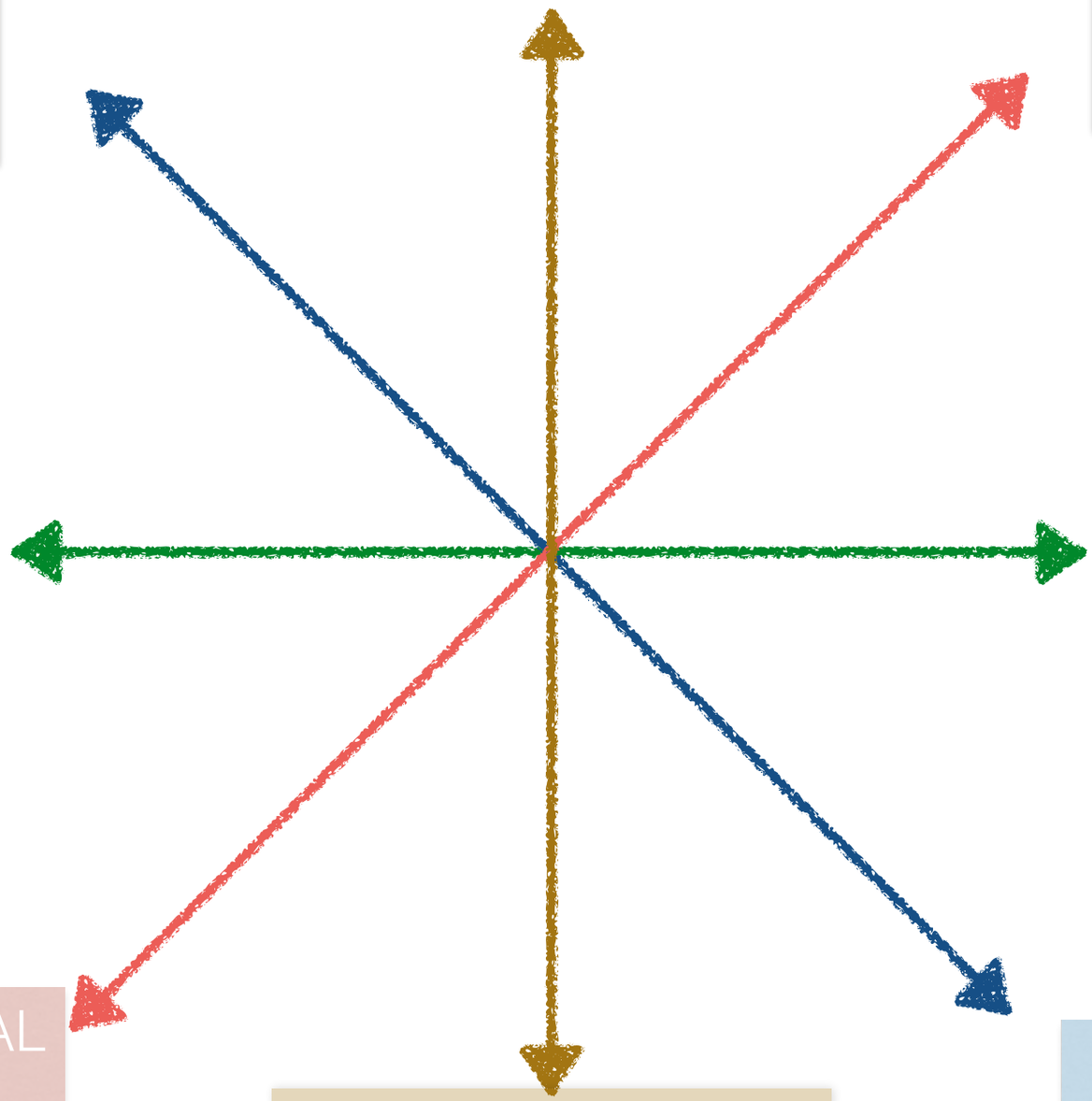

EXPERIMENTAL APPROACH (PROVE)

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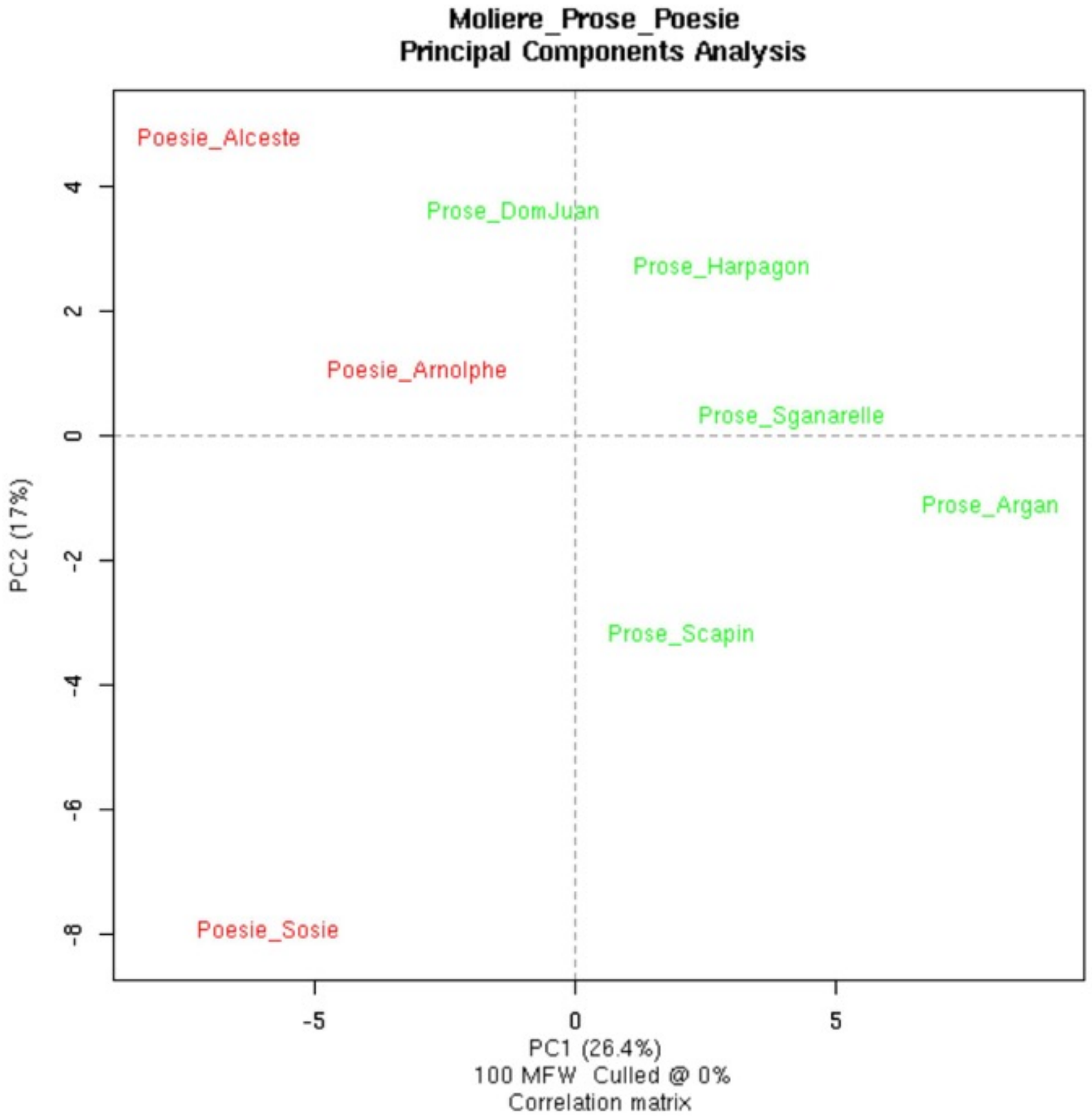
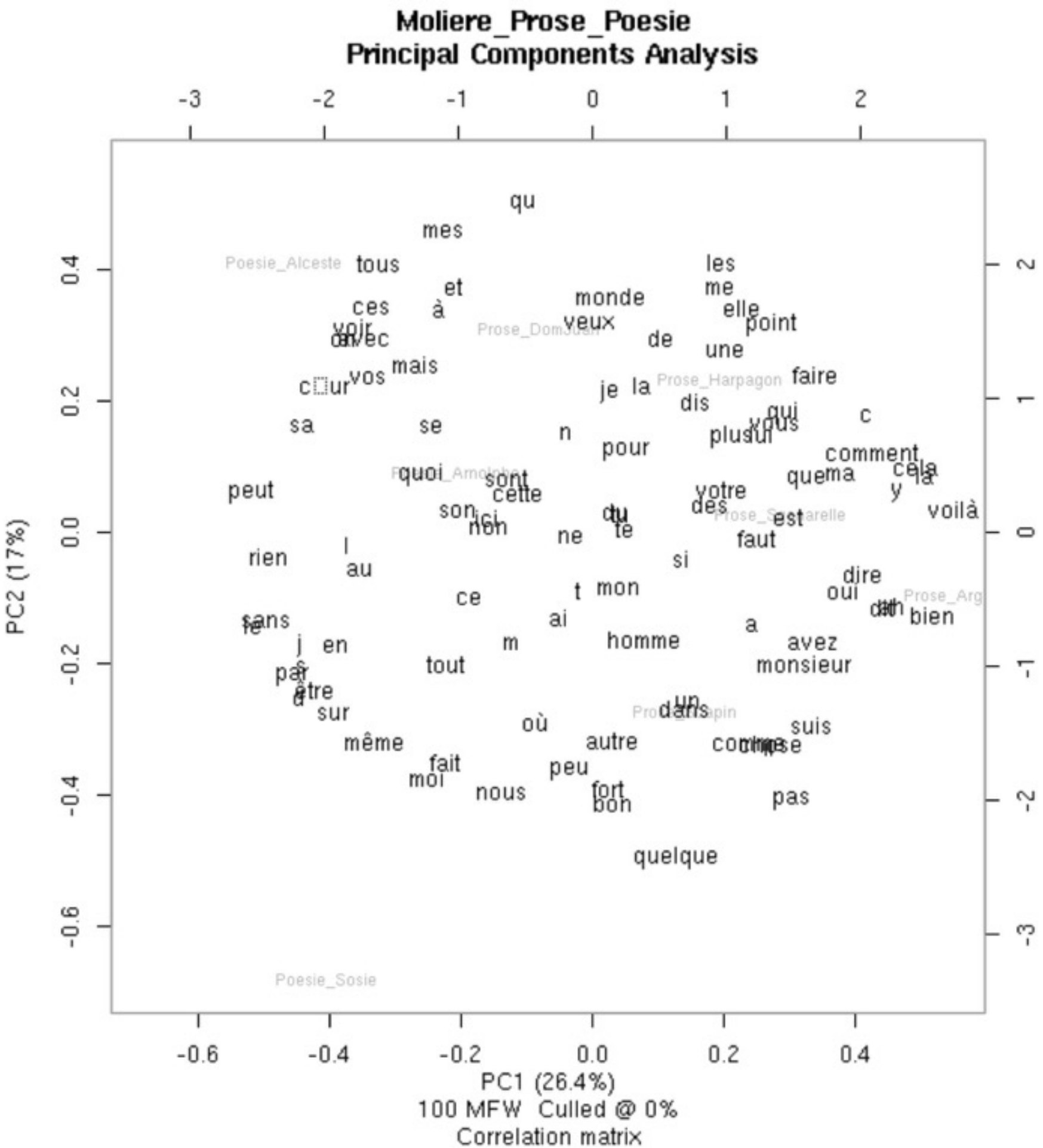
Multivariate analysis


Moliere_Prose_Poesie
Principal Components Analysis
Poesie_Alceste
Prose_DomJuan
Prose_Harpagon
Poesie_Arnolphe
Prose_Sganarelle
Prose_Argan
Prose_Scapin
Poesie_Sosie
PC2 (17%)
4
2
0
-2
-4
-6
-8
-5
0
5
PC1 (26.4%)
100 MFW Culled @ 0%
Correlation matrix

Issue with multivariate analysis

- Why this distribution?
- What patterns make it happen?
- What do they have in common?
- Real motivations for these similarities, based on the text!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Poesie_Sosie
qu
mes
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veux
de
une
mais
vos
faire
je
la
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homme
avez
tout
monsieur
sur
où
suis
même
autre
peu
fait
moi
nous
fort
bon
pas
quelque

Our work

- Focus on syntax
- EREMOS: a tool to extract all possible **<u>syntactic patterns</u>** for a given text
- Find **interestingness measures** to automatically rank and filter features
- Similar works on theatre, poetry, …

Methodology 1

- tokenise, lemmatise, PoS tag (TreeTagger) each novel

- **sequential pattern mining** (Agrawal 1993, Fournier-Viger et al 2014) extracts sequences of PoS, with possible gaps

- describe each novel with a vector of pattern frequencies

Methodology 2

- “Je suis perdu, je suis assassiné, on m'a coupé la gorge, on m'a dérobé mon argent. “

- Je_je_PRO suis_être_VER…

- (PRO) (VER) (VER) (PUN) **f. 2**
  (PRO)(PRO)(VER)(VER)(DET)(NOM) **f. 2**

Methodology 3

- Extract **thousands of patterns** for each text; no previous feature selection. **Bottom up approach**.

- How to filter out the irrelevant patterns?

- Perform **Correspondence Analysis** (Benzécri, 1977)

- Possible to **filter for contribution, extracting patterns that contribute the most to the final plot**

- instance retrieval with EREMOS for significant patterns **(interpretation!)**

Style in novels

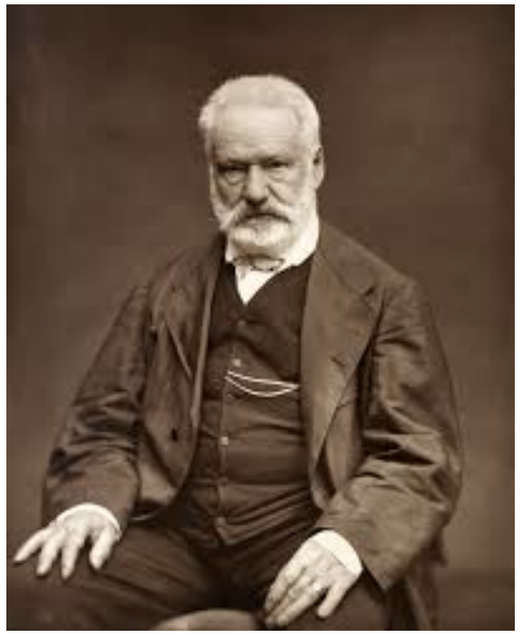
- Analyse novels of same author

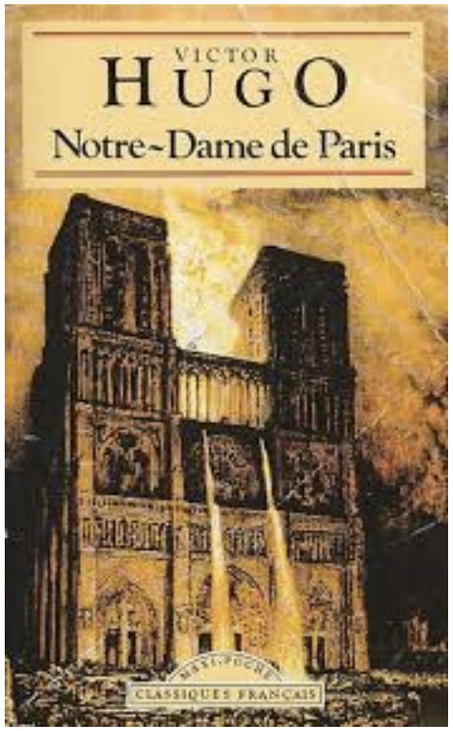
- Analyse **novels of different authors** (style)

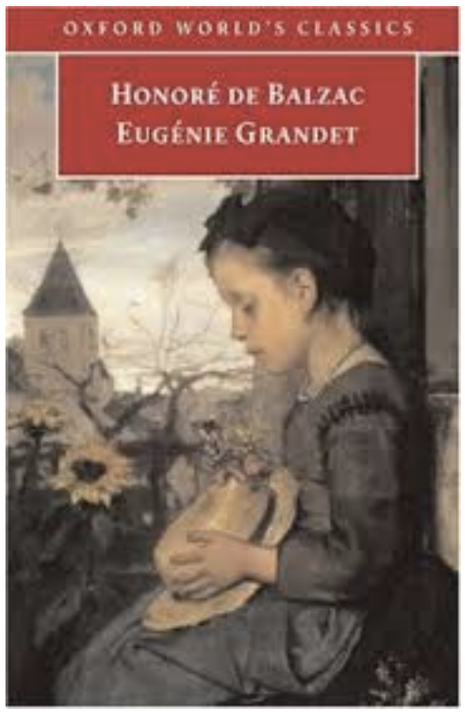
Approach

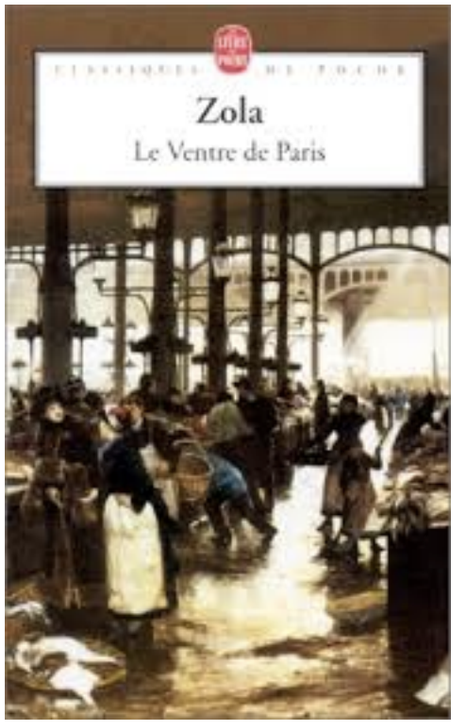
- Compare syntactic style of four memorable novels
- Bottom up feature selection and filtering
    - PoS ngrams 3-5
- Instance retrieval
- See if the emerging patterns match with expectations

Four classic French Novels





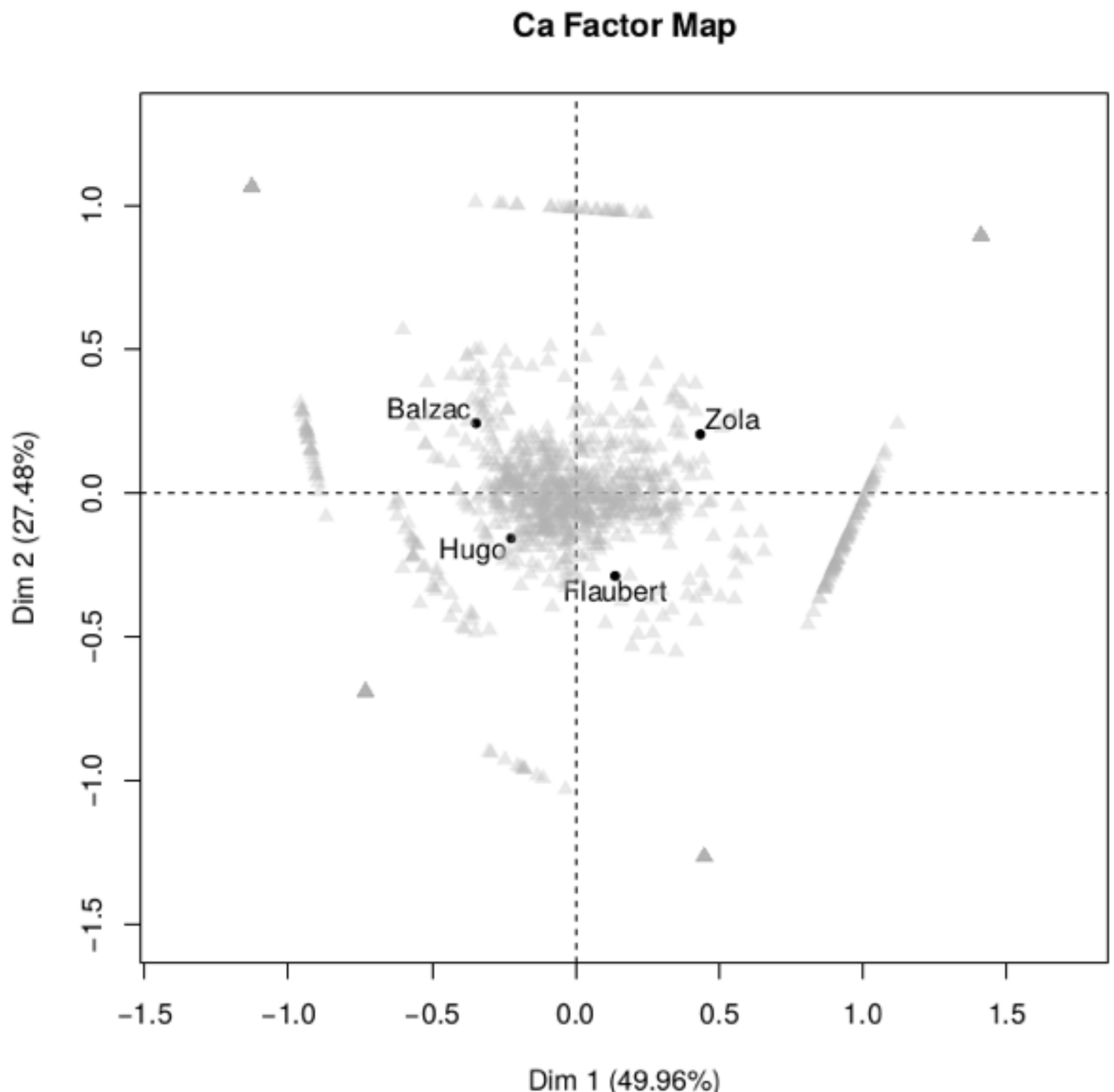




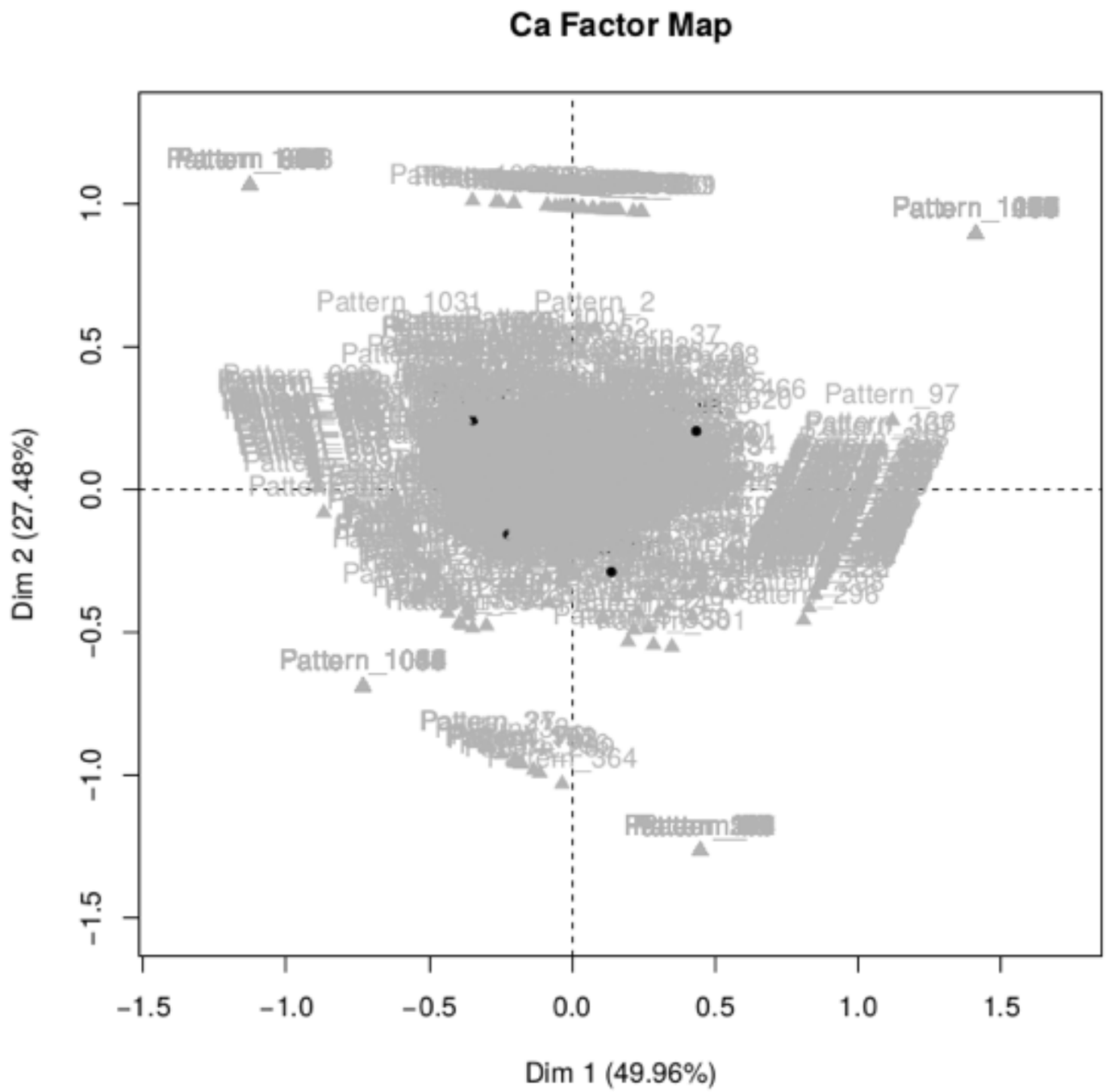
4 Novels

Hugo	**Notre Dame de Paris**	**1831**
Balzac	**Eugenie Grandet**	**1833**
Flaubert	**Madame Bovary**	**1856**
Zola	**Ventre de Paris**	**1873**

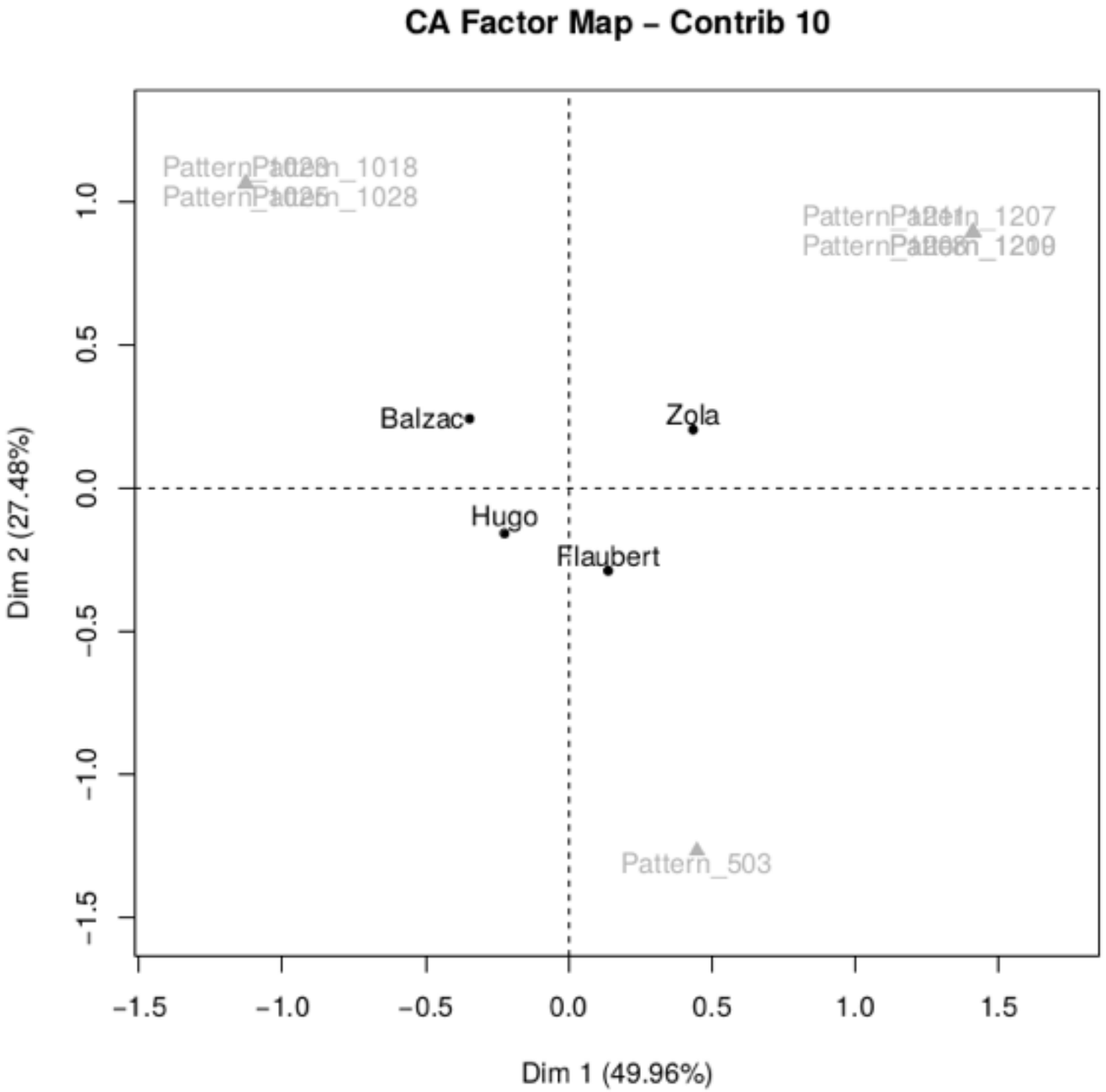
Correspondence Analysis



Bi-plot without filtering



Filtering by contribution



Top 10 patterns

Contri	Pattern ID	Pattern	Novel/Author
1	Pattern_1211	NOM - ADJ - PUN - DET - NOM	Zola
2	Pattern_1028	VER – NAM - PRP	Balzac
3	Pattern_1025	NOM – PRP – VER – DET - NOM	Balzac
4	Pattern_1023	PRP – NAM – VER	Balzac
5	Pattern_1210	DET – ADJ - NAM	Zola
6	Pattern_503	NOM – PUN – KON - PUN	Flaubert
7	Pattern_1209	PUN – DET – NOM – ADJ - PUN	Zola
8	Pattern_1208	DET – NOM – ADJ – PUN - DET	Zola
9	Pattern_1018	VER – DET – NOM – PRP - VER	Balzac
10	Pattern_1207	VER – PUN – VER - PRP	Zola

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2	Pattern_1028	VER – NAM - PRP	Balzac
3	Pattern_1025	NOM – PRP – VER – DET - NOM	Balzac
10	Pattern_1207	VER – PUN – VER - PRP	Zola

Zola and Balzac are more “syntactically marked”

Top 5 per novel

```
for a in authors:

    for p in listOfPatternsOrderedByDecreasingContribution:

        n = getNearestNovel(p)

        add p to listOfPatterns[a]

        if listOfPatterns[a] has length = 5:

            exit
```

Zola

Contrib. rank	Pattern ID	Pattern
1	Pattern_1211	NOM - ADJ - PUN - DET - NOM
5	Pattern_1210	DET – ADJ - NAM
7	Pattern_1209	PUN – DET – NOM – ADJ - PUN
8	Pattern_1208	DET – NOM – ADJ – PUN - DET
10	Pattern_1207	VER – PUN – VER - PRP

Zola

[1211_A] Elle parut l' âme , la **clarté vivante , l' idole** saine et solide de la charcuterie ; et on ne la nomma pl

[1211 B] avec des ra le poussaie ' il longeait s de crampes et de souleurs , le ventre plié , la **vue troublée , les pieds** comme tirés , sans qu' il en eût conscience , par cette image de Paris , au loin , très -loin , derrière l' horizon , qui l' appelait , qui l' attendait .

Vivid descriptions, enumerations

Zola

Contrib. rank	Pattern ID	Pattern
1	Pattern_1211	NOM - ADJ - PUN - DET - NOM
5	Pattern_1210	DET – ADJ - NAM
7	Pattern_1209	PUN – DET – NOM – ADJ - PUN
8	Pattern_1208	DET – NOM – ADJ – PUN - DET
10	Pattern_1207	VER – PUN – VER - PRP

Zola

[1209_A] le ventre plié **<u>, la vue troublée ,</u>** les pieds comme tirés , ...

[1208_A] le ventre pieds comme tirés , ...

Verbless constructions

Zola

Contrib. rank	Pattern ID	Pattern
1	Pattern_1211	NOM - ADJ - PUN - DET - NOM
5	Pattern_1210	DET – ADJ - NAM
7	Pattern_1209	PUN – DET – NOM – ADJ - PUN
8	Pattern_1208	DET – NOM – ADJ – PUN - DET
10	Pattern_1207	VER – PUN – VER - PRP

Zola

[1207_A] Il **marchait , dormant à** demi , dodelinant des oreilles , lorsque , à la hauteur de la rue de Longcha es quatre

Implicit, parenthetical constructions

Zola

Contrib. rank	Pattern ID	Pattern
1	Pattern_1211	NOM - ADJ - PUN - DET - NOM
5	Pattern_1210	DET – ADJ - NAM
7	Pattern_1209	PUN – DET – NOM – ADJ - PUN
8	Pattern_1208	DET – NOM – ADJ – PUN - DET
10	Pattern_1207	VER – PUN – VER - PRP

Zola

[1210_A] la petite Pauline ...
[1210_B] la belle Normande ...

Modifiers of proper nouns

Stylistic traits

- Rich descriptions and enumerations (typical of Zola's early style)
- Strong preference for implicit clauses
- Mimic jargon of Parisian populace

Balzac

Contrib. rank	Pattern ID	Pattern
2	Pattern_1028	VER – NAM - PRP
3	Pattern_1025	NOM – PRP – VER – DET - NOM
4	Pattern_1023	PRP – NAM – VER
9	Pattern_1018	VER – DET – NOM – PRP - VER
11	Pattern_1016	PUN – VER – PRO - PRP

Balzac

```
[1028_A] dit Grandet en ..
[1028_B] reprit Charles en ..
[1028_C] dit Eugé
```

Dialogue markers

Balzac

Contrib. rank	Pattern ID	Pattern
2	Pattern_1028	VER – NAM - PRP
3	Pattern_1025	NOM – PRP – VER – DET - NOM
4	Pattern_1023	PRP – NAM – VER
9	Pattern_1018	VER – DET – NOM – PRP - VER
11	Pattern_1016	PUN – VER – PRO - PRP

Balzac

[1016_A] Bonjour , Grandet **<u>, dit -il au</u>** vigneron
[1016_B] Mademoise

Dialogue markers

Balzac

Contrib. rank	Pattern ID	Pattern
2	Pattern_1028	VER – NAM - PRP
3	Pattern_1025	NOM – PRP – VER – DET - NOM
4	Pattern_1023	PRP – NAM – VER
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Balzac

[1025_A] Depuis le classement de ses différents clos , ses vignes , grâce à des soins constants , étaient devenues la tête du pays , mot technique en **usage pour indiquer les vignobles** qui produisent la première qualité de vin .

[1025_B] et le président eux ; mais l' a résuma leurs **pen** , et offrant s x que madame , dit -il , pourrait faire à monsieur les honneurs de Saumur ?

explicit subordination markers

Balzac

Contrib. rank	Pattern ID	Pattern
2	Pattern_1028	VER – NAM - PRP
3	Pattern_1025	NOM – PRP – VER – DET - NOM
4	Pattern_1023	PRP – NAM – VER
9	Pattern_1018	VER – DET – NOM – PRP - VER
11	Pattern_1016	PUN – VER – PRO - PRP

Balzac

[1023_A] L' Histoire **de France est** là tout entière .
[1023_A] Les habitants **de Saumur étant** peu révolutionnaires ,....

toponyms

Balzac

Contrib. rank	Pattern ID	Pattern
2	Pattern_1028	VER – NAM - PRP
3	Pattern_1025	NOM – PRP – VER – DET - NOM
4	Pattern_1023	PRP – NAM – VER
9	Pattern_1018	VER – DET – NOM – PRP - VER
11	Pattern_1016	PUN – VER – PRO - PRP

Balzac

[1018_A] Charles **tendit la main en défaisant** son anneau

[1018_B] G[illegible] mot à dire .

explicit subordination markers

Stylistic traits

- Frequent dialogues
- Preference for explicit subordination: style more “accessible” than Zola’s?
    - *Grandet regarda sa fille sans trouver un mot à dire . > Grandet, la bouche fermée, ….*

Flaubert

Contrib. rank	Pattern ID	Pattern
6	Pattern_503	NOM – PUN – KON - PUN
20	Pattern_364	NOM – PUN – KON - ADV
31	Pattern_ 362	PUN – ADV – PRO - VER
35	Pattern_ 289	PUN – KON – DET – NOM - PRP
42	Pattern_ 327	PUN – KON – PUN - PRP

Flaubert

Le soir , quand Charles rentrait , elle sortait de dessous ses draps ses longs bras maigres , les lui passait **autour du cou , et , l' ayant fait** asseoir au bord du lit , se metta de ses chagrins : il l' oubliait , il tre !

punctuation

Stylistic trait

- Mangiapane (2012): rythmic rather than logic role of punctuation in Flaubert

Hugo

Contrib. rank	Pattern ID	Pattern
80	Pattern_ 31	NOM – KON – DET – NOM - PRP
85	Pattern_ 27	KON – PRO - NOM
184	P	
185	P	
339	P	

First pattern has rank 80!
Less marked style

Hugo

Contrib. rank	Pattern ID	Pattern
80	Pattern_ 31	NOM – KON – DET – NOM - PRP
85	Pattern_ 27	KON – PRO - NOM
184	Pattern_ 520	PUN – KON – VER
185	Pattern_ 833	NOM – PUN - KON
339	Pattern_ 190	ADV – ADJ - KON

Hugo

[31_A]Au centre de la haute façade gothique du Palais , le grand escalier , sans relâche remonté et descendu par un double courant qui , après s' être brisé sous le perron intermédiaire , s' épandait à larges vag , le grand esca mment dans la **pla**

descriptions, mostly of places

Hugo

Contrib. rank	Pattern ID	Pattern
80	Pattern_ 31	NOM – KON – DET – NOM - PRP
85	Pattern_ 27	KON – PRO - NOM
184	Pattern_ 520	PUN – KON – VER
185	Pattern_ 833	NOM – PUN - KON
339	Pattern_ 190	ADV – ADJ - KON

Hugo

[27_A] Ajoutons que Coppenole était du peuple , et **que ce public** qui l' entourait était du peuple .
[27_B] Et songer **que ce peuple** avait été sur le point de se rebel , par impatience d'

repetitions, demonstratives

Hugo

Contrib. rank	Pattern ID	Pattern
80	Pattern_ 31	NOM – KON – DET – NOM - PRP
85	Pattern_ 27	KON – PRO - NOM
184	Pattern_ 520	PUN – KON – VER
185	Pattern_ 833	NOM – PUN - KON
339	Pattern_ 190	ADV – ADJ - KON

Hugo

[520_A] Quasimodo se plaça devant le prêtre , fit jouer les muscles de ses poings athlétiques **, et regarda** les assaillant[illegible]ncement de dents d' un tigre fâché .

punctuation

Hugo

Contrib. rank	Pattern ID	Pattern
80	Pattern_ 31	NOM – KON – DET – NOM – PRP
85	Pattern_ 27	KON – PRO – NOM
184	Pattern_ 520	PUN – KON – VER
185	Pattern_ 833	NOM – PUN – KON
339	Pattern_ 190	ADV – ADJ – KON

Hugo

[190_A]Qui est aussi fraîche et **aussi gaie que** si elle était veuve .

comparisons

Stylistic trait

- Popular, narrative style. Not very marked.

- Rich descriptions that help us to visualise medieval Paris

Recap

- basic NLP pre-processing
- sequential pattern mining (computationally complex technique that avoids feature pre-selection)
- Correspondence Analysis and filtering for interesting patterns
- Instance retrieval for textual analysis

Conclusions

- Confirm prior knowledge about authors by using a completely bottom up methodology
- Compare authors and find out peculiarities in style
- Rank them in terms of more or less “marked” style

http://obvil.paris-sorbonne.fr

Thanks for your attention!