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ARTS

MAPPING THE RELATIONSHIPS OF CONCEPTS IN TEXT

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GROUP OF EIGHT AUSTRALIA

Distributional hypothesis

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- Harris (1954:156):
  “difference of meaning correlates with difference of distribution”
- Firth (1957):
  “a word is characterized by the company it keeps”
- Can such distributional relations be made precise?
- The distribution of words can be expressed mathematically as **vectors**
- A vector is a table with a single row
- The vector for any given word records its co-occurrence with other words
  - Each entry in the row corresponds to another word
  - The entry records some information about the co-occurrence of the two words

What does a vector represent?

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- Two questions:
  - What is the domain within which co-occurrence is tracked?
  - What information is stored? E.g. is it just the fact of co-occurrence or is it richer information such as distance between words?
- Example with a simple approach:
  - Domain is a sentence
  - Information stored is number of times a word occurs

Vector example

	Half	Mushrooms	Onion	The	thinly
a. Thinly SLICE half the onion	1	0	1	1	1
b. SLICE the mushrooms thinly	0	1	0	1	1

Information overload

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- Vectors derived from any large corpus will be very large
- Data is sparse – a very large proportion of the entries are zeroes
- Various algorithms have been developed to reduce the size of the output while preserving information
- One approach reduces the raw vectors to a multidimensional spatial model
- Word2vec uses this approach
  - Word2vec uses neural networks to get from text to spatial model
- Output is an n-dimensional model which locates all words (lemmas) in relation to each other

Further reduction – Principal Components Analysis

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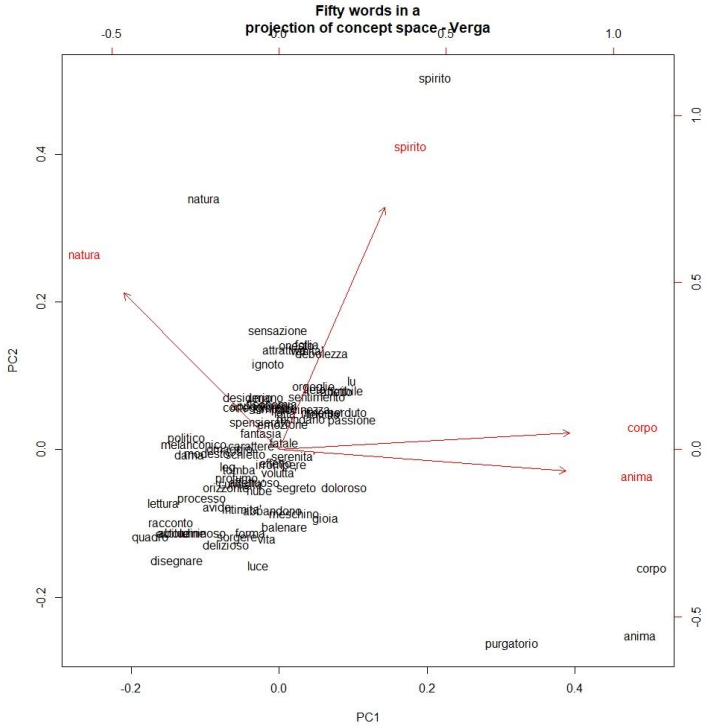
- 100 dimensions is still not manageable for visualisation
- We take a small group of words denoting central concepts: *anima, corpo, spirit, natura, organism*
- 50 words which are all close to these concepts are extracted
- PCA gives us the two components in that groups of data which:
  - Are orthogonal to each other
  - Account for the greatest amount of the variance in the data
- This can be plotted in 2D

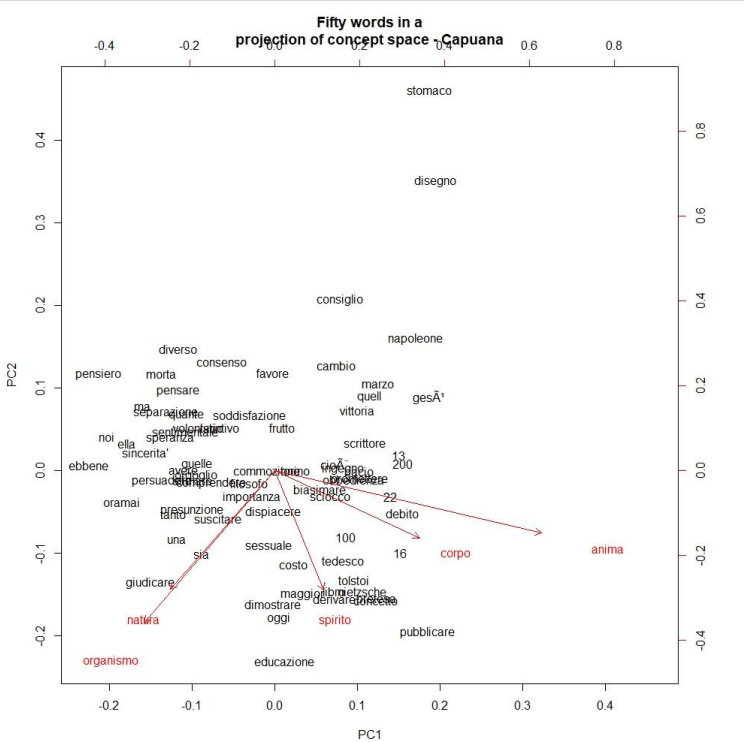
Reading the visualisation – some caveats

- We could try to attribute meaning to the principal components, but it is not useful
  - Cf. topic models – the technique tells us words that are associated, but we have to try to give meanings to those groups
- Even if we can attribute meaning to the PCs in one visualisation, we know that they will not be the same in comparing visualisations
- Therefore we cannot compare directionality across visualisations
- Clustering and relative configurations are what we can try to interpret

Visualising ‘concept space’

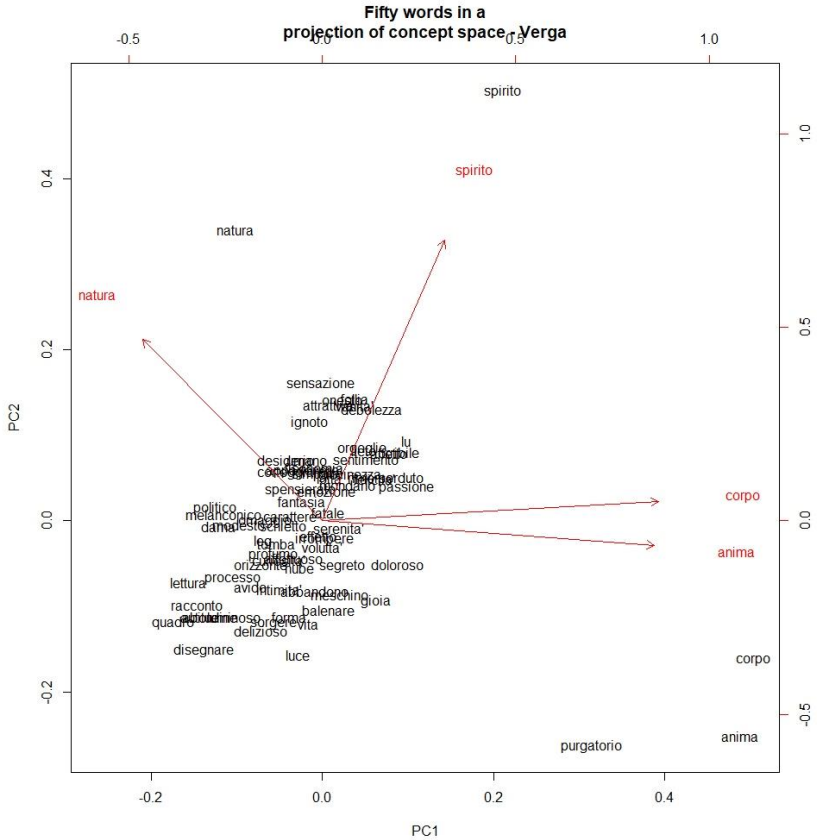


Verga

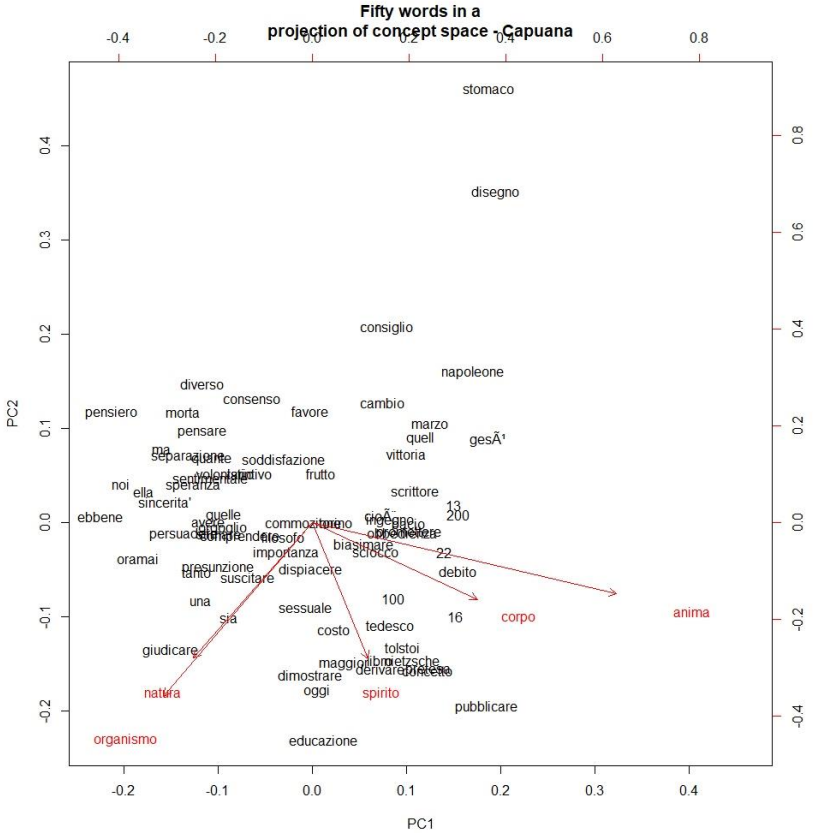


Capuana

Verga


Fifty words in a
projection of concept space - Verga
PC1
PC2
spirito
spirito
natura
natura
corpo
anima
corpo
anima
purgatorio
sensazione
ignoto
fantasia
luce
disegnare
delizioso
balenare
gioia
segreto
doloroso
lettura
racconto
processo
volutta
serenita
fatale
-0.5
0.0
0.5
1.0
-0.2
0.0
0.2
0.4

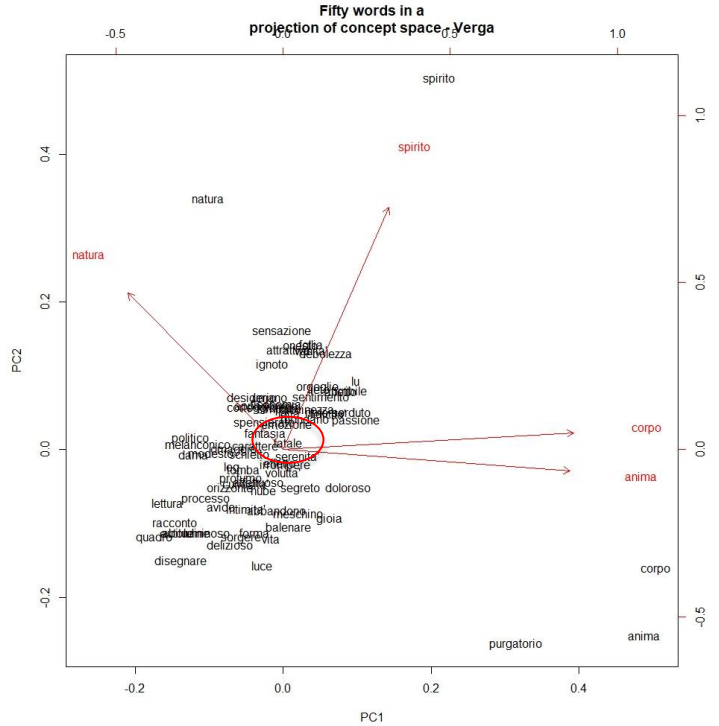
Capuana


Fifty words in a
projection of concept space - Capuana
PC1
PC2
stomaco
disegno
consiglio
napoleone
cambio
marzo
quell
gesÃ¹
vittoria
scrittore
13
200
22
debito
16
corpo
anima
pubblicare
tedesco
tolstoi
nietzsche
costo
sessuale
100
una
sia
giudicare
natura
organismo
educazione
spirito
oggi
dimostrare
maggiore
derivare
diverso
consenso
favore
pensiero
morta
pensare
soddisfazione
frutto
noi
ella
sincerita'
speranza
ebbene
persuadere
filosofo
importanza
oramai
presunzione
tanto
suscitare
dispiacere
biasimare
sciocco
commozione
ma
quelle

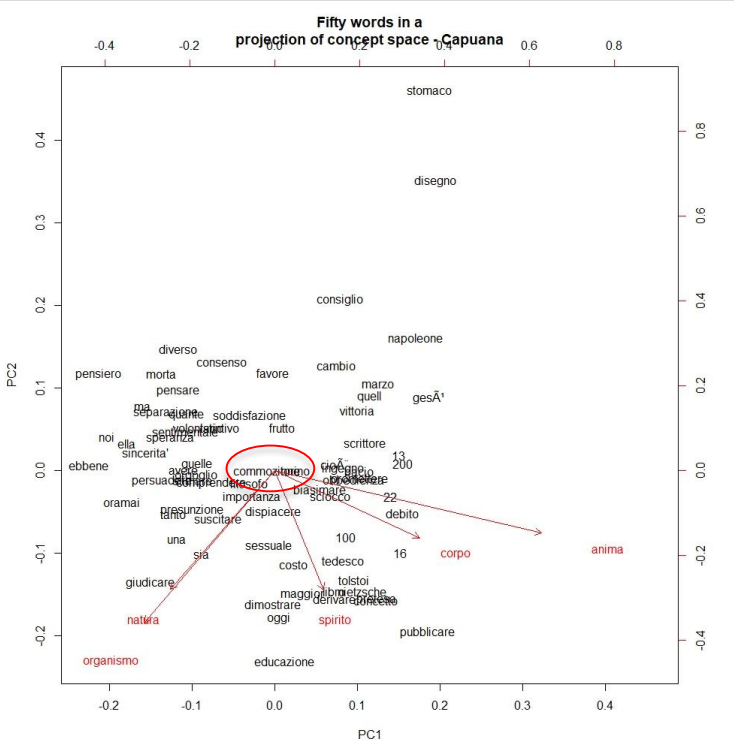
Comparison – 1: Density

- Verga word cloud is denser, Capuana more dispersed
- Positivism peaks in Italian culture around Verga's time
- Seen in cultural studies as:
  - a deterioration of the epistemological unity of the world
  - a subsequent fragmentation of the psychological unity of the human subject
- This is reflected in our visualisation of concept space

Visualising ‘concept space’



Verga



Capuana

Comparison 2: Apexes

- Verga's concept space centres on *fatale*
  - (Many of) Verga's characters are subaltern, trapped by inescapable socio-economic forces
- Capuana's concept space centres on *commozione*
  - For Capuana one of the crucial aims of literature itself
  - Art must go about the representation of its subjects in such a way as to reach the reader's nervous system and trigger their emotions

A pedagogical thought

- Students often have problems keeping track of the ‘-isms’ of literature
- These visualisations can assist in showing:
  - Differences between authors
  - Differences across time