Authorship Attribution

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English for Computer Science II

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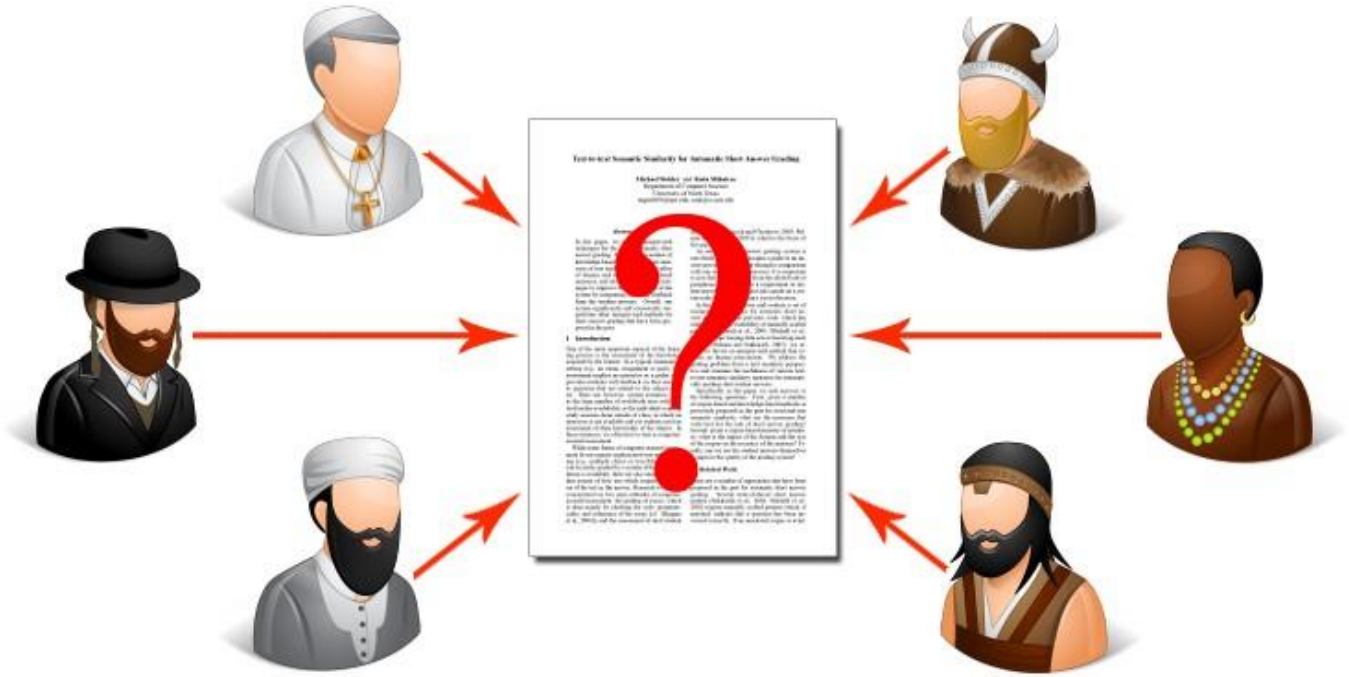

Overview

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- Motivation
- How does it work?
- Take-Home-Messages
- Discussion
- References

Motivation

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- In this day and age there is an incredible amount of information worldwide

> Quote [1]:
>
> *"The Amount of Digital Information Reached 281 Exabytes (281 Billion Gigabytes)".*

- Rough estimate: ~ 85% of these are available in a textual representation

Motivation

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- As far as we know there are ~ 7.000.000.000 humans on earth
- From this it follows that there must be many (different) authors, who have produced these textual information !
- Sometimes it is not clear **which** author wrote a specific text
- In order to determine an author of an unknown text, so-called "authorship attribution methods" might be helpful
- These methods offer a wide range of applications…

Motivation

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Applications:

- Plagiarism detection (remember the Guttenberg Affair ?)
- Forensic evidence in court (verifing confessions)
- Unmasking pseudonymous authors (e.g. in terror extremist blogs)
- Finding additional material of the same author
- Categorization of texts by authors (e.g. in unstructured text collections)
- And many more…

Motivation

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- Authorship Attribution is an extensively researched topic

- Researchers claim: task is not far from being solved

(…for some scenarios)

Quote [2]:

"Trying to classify an unseen text as being written by one of two or of a few authors is a relatively simple task, which in most cases can be solved with high reliability and accuracies over 95%".

Motivation

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- But, how is it actually possible to recognize **who** wrote a given text?
- Dozens of techniques have been proposed to answer this question…
- Due to a lack of time, we will focus only on one ☺

How does it work?

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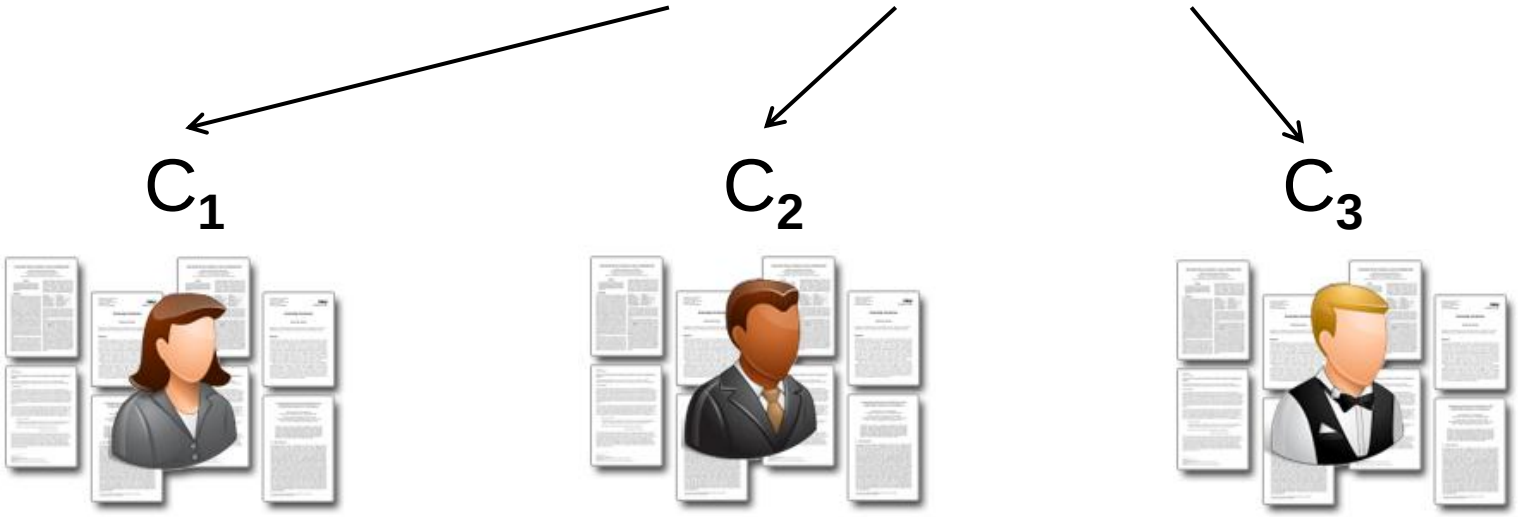
Profile-based approach (proposed in: [5])

- Assume we have a document collection: **D** = { D_1, D_2 , D_3, … }
- That have been produced by several authors: **A** = { A_1, A_2, A_3, … }
- Merge both into clusters: **C** = { (A_1, D_3), (A_2, D_4, D_5), (A_3 , D_7, D_8, D_{12}), … }



How does it work?

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Profile-based approach (proposed in: [5])

- Build for each document cluster $\mathbf{C_i}$ one big textfile $\mathbf{T_i}$

$\mathbf{T_1}$ $\mathbf{T_2}$ $\mathbf{T_3}$

How does it work?

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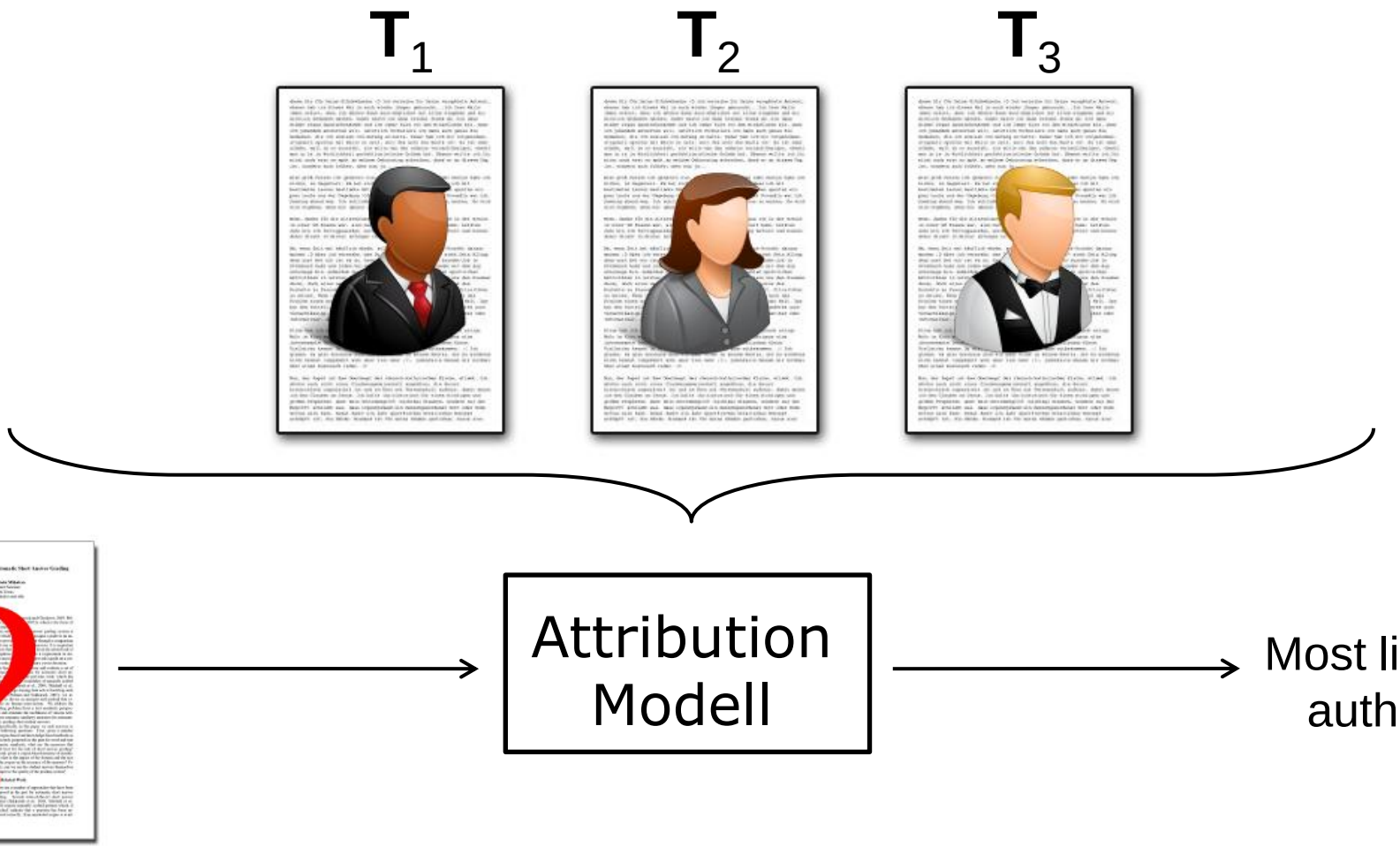
Profile-based approach:

- What is the reason we should do that?
- Imagine we collect from an author A_1 documents like:
  private e-Mails, scientific papers, blogs, reports, …
- Merging these texts will lead to an abstraction of style variation
- Specific style patterns of A_1 remain in T_i (the big textfile)
- We need a modell to find these patterns…

How does it work?



How does it work?

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- Sounds simple? Let‘s have a look behind the scenes…
- If we want to discriminate authors (represented thorugh $\mathbf{T_i}$) we first must understand how to distinguish their style
- Bad news → there is no definition for style ☹
- However, style can be approximated through a combination of various **features**

  - vocabulary richness
  - average word/sentence length
  - number of specific symbols (-.:,#?!‘&)
  - number of: adjectives, nouns, verbs, …
  - …

How does it work?

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- What we have so far: $T_1, T_2, T_3, \ldots$

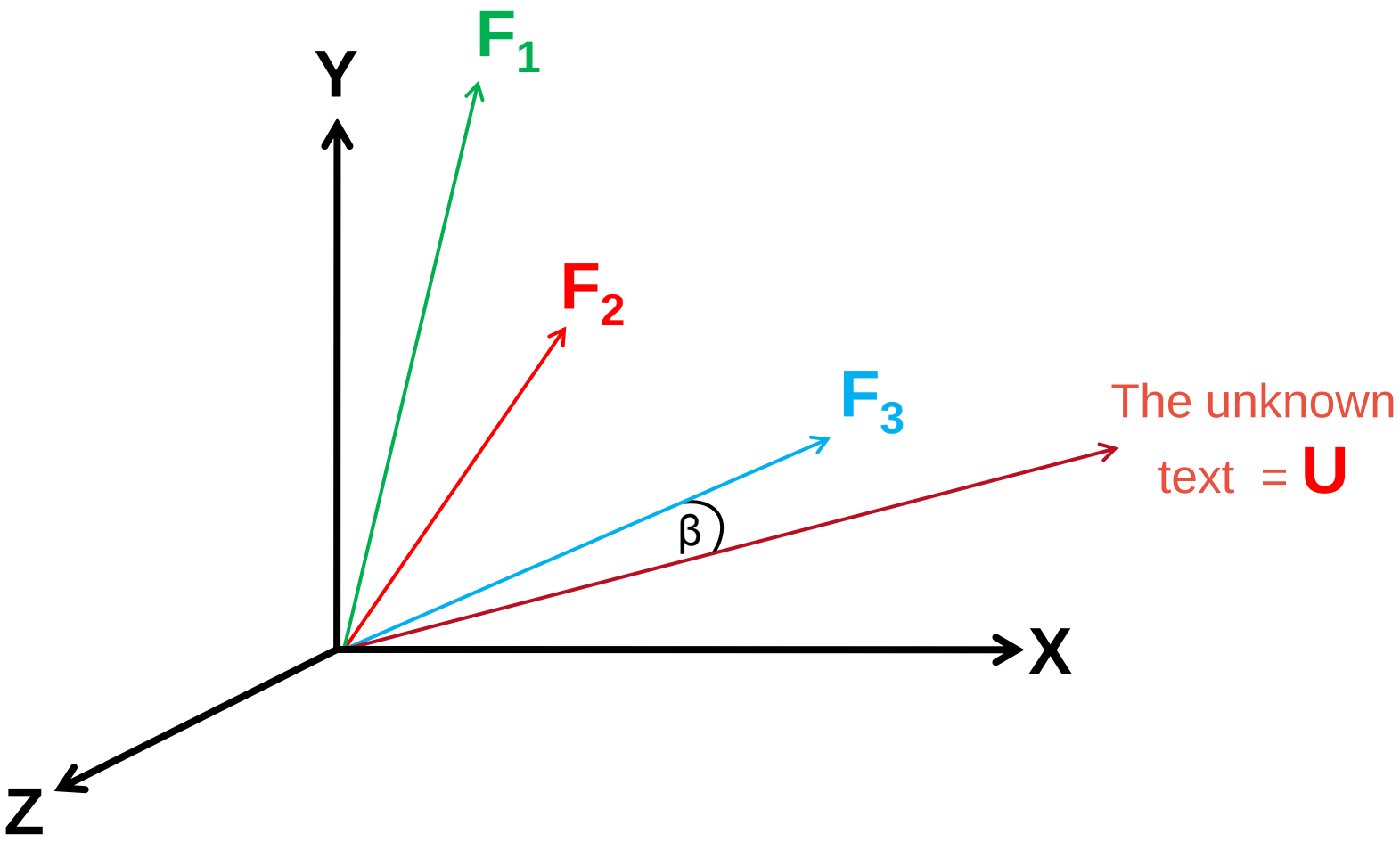
- Applying feature extraction on the T_i will result in the so-called feature vectors:

$$F_i = \begin{pmatrix} 23 \\ 7 \\ 54 \\ 109 \\ \ldots \\ .. \end{pmatrix}$$

- Task of the model: find the most similar F_i in comparsion to the features of the unknown text document

- most similar = shortest distance (e.g. in a vector space…)

Recap: Linear Algebra



Recap: Linear Algebra

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- The angle **β** represents similarity between 2 vectors
- Can be computed as fallows:

$$\cos(\beta) = \frac{F_i * U}{\| F_i \| * \| U \|}$$

- Standardized resulting number is between: [0 ; 1]

completely different — absolutely similar

Recap: Linear Algebra

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- Besides the cosine similarity many other "**metrics**" are typically used

- Dice coefficient
- Jaccard coefficient
- Overlap measure
- Minkowski distance
- …

- All of these metrics share the same idea:

→ Figure out if two vectors correlate with each other !

Take-Home-Messages

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Authorship Attribution:

…is no longer a utopian vision !

…is useful in many scenarios beyond Computer Science !

…is something that could affect you too (hopefully not)

Thanks for your attention !

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[3]

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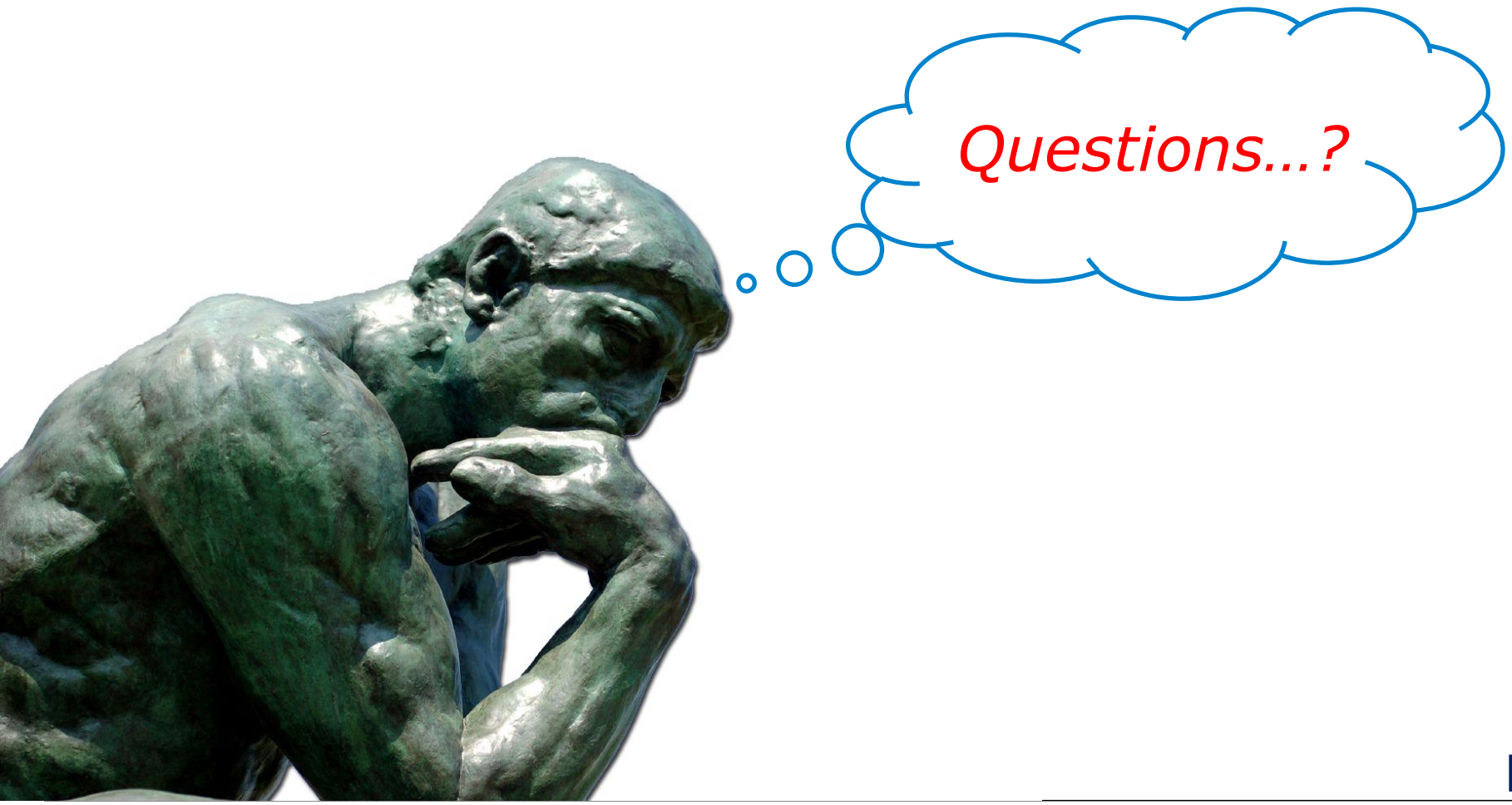

[4]

Your turn ;-)

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- A couple of features have been mentioned during the presentation, can you think of additional features?
- Do you think that symbol-related features (number of hyphens, commas, etc.) are useful to discriminate the style of authors?
- Imagine we have 1000 features to train the modell, how should we handle less useful features without discarding them?
- Name at least one application where you could use Authorship Attribution for your own purpose

References

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