Towards a flexible author name disambiguation framework

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Motivation

- **Information storage shortcomings**
  1. Authors unique id
  2. Binding between author and his articles
  3. Authors' id mapping across libraries
- **Problem with name representation**
  1. Different forms
     - "M. Brown"
     - "Michael Brown"
     - "M. A. Brown"
  2. metadata extraction deficiencies
     - OCR
     - defective handling of diacritics
- **Solution**
  - Name Disambiguation

Problem statement

- Three stages of creating the solution
  1. Affinity measures definition
  2. Training
  3. Infrastructure

Definitions

- **Author.** A human who writes an article/articles.
- **Contribution.**
  - An author's signature on his paper.
  - A unique contribution id: document id + author's order on the list of authors
  - Example: an article with **id 123** has two authors **R. Black** and **J. Smith**.
  - Contributions: **123#1** and **123#2**
- **Shard.** A group of contributions which shares the same hash function result (e.g. having same surname).
- **Identity.** A group of contributions (stored in the same shard!) believed to be done by the same person.

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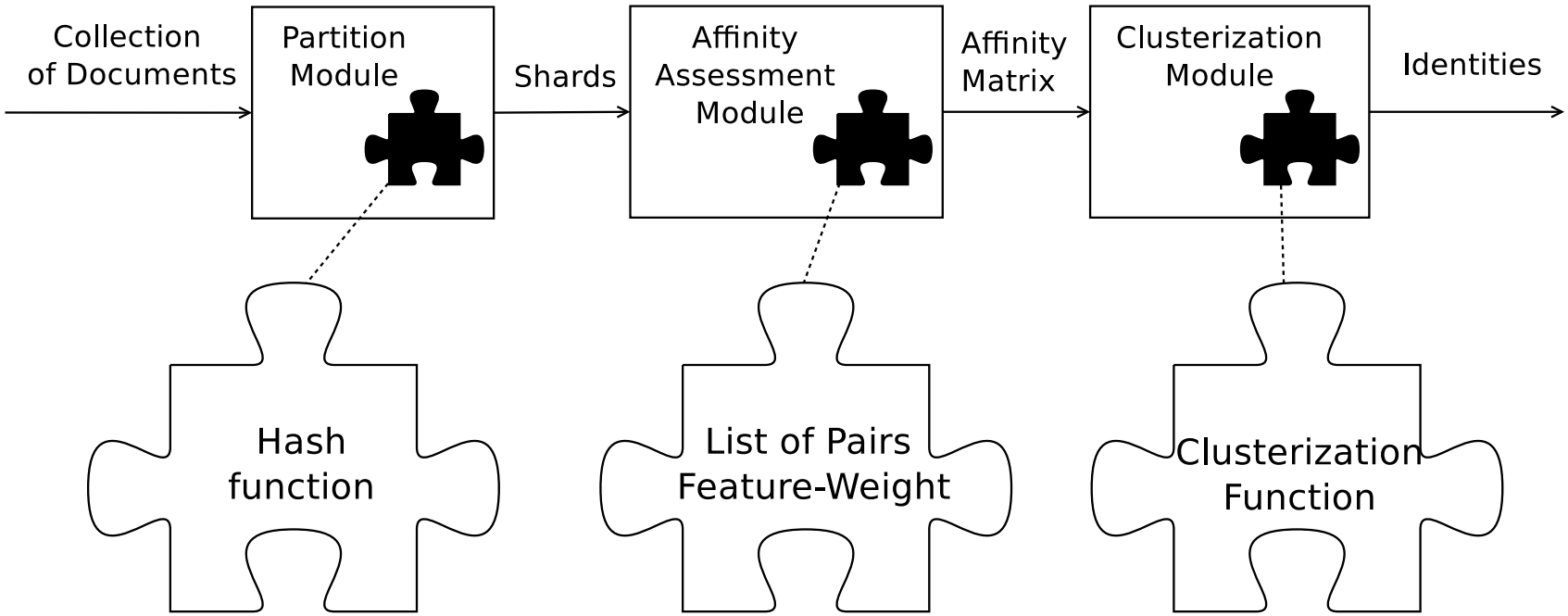
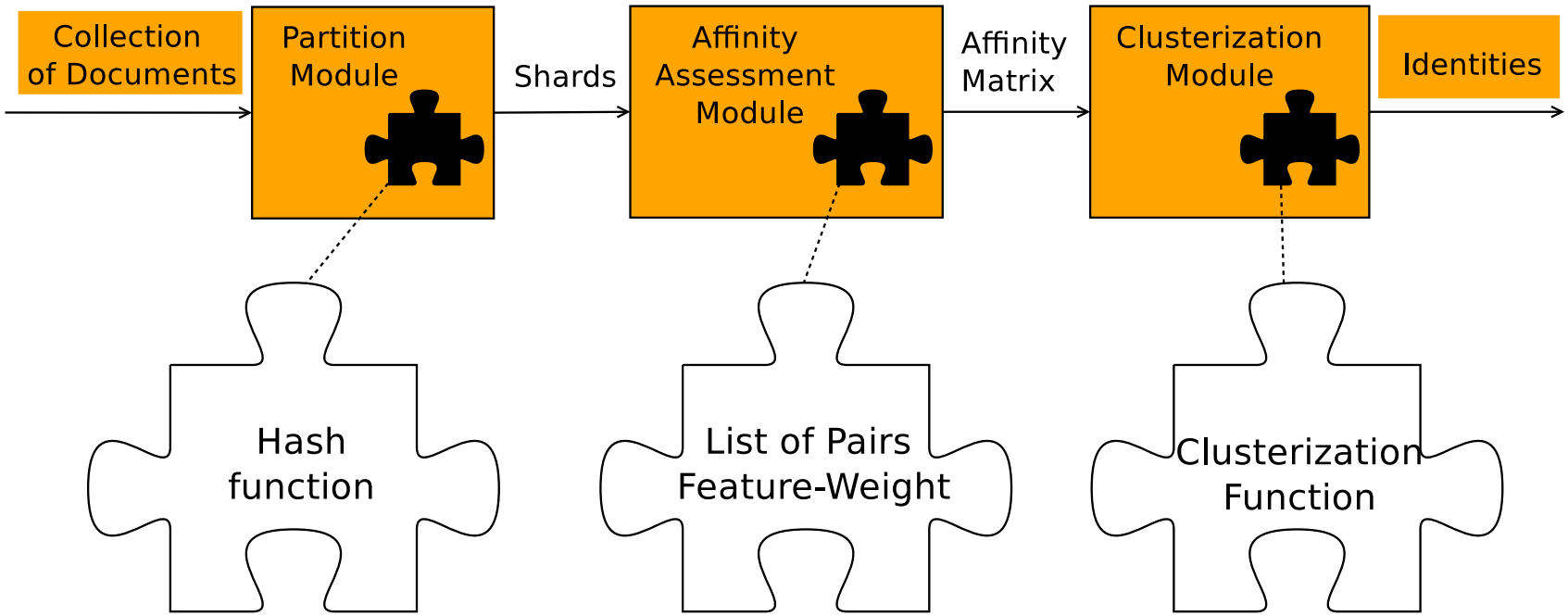
Definitions (continued)

- **Feature.**
  - A function which compares two contributions with respect to some field(s) (e.g. year of publication)
  - Result: a value between $[-1, 1]$
    - -1 contributions made by different authors
    - 0 undetermined
    - 1 contributions are made for sure by same author
- **Weight.**
  - An indicator of feature's importance.
  - A non-negative real number.
- **Atomic affinity.** A product of feature's result and weight.
- **Total affinity.** The sum of atomic affinities.

Process stages



Process stages



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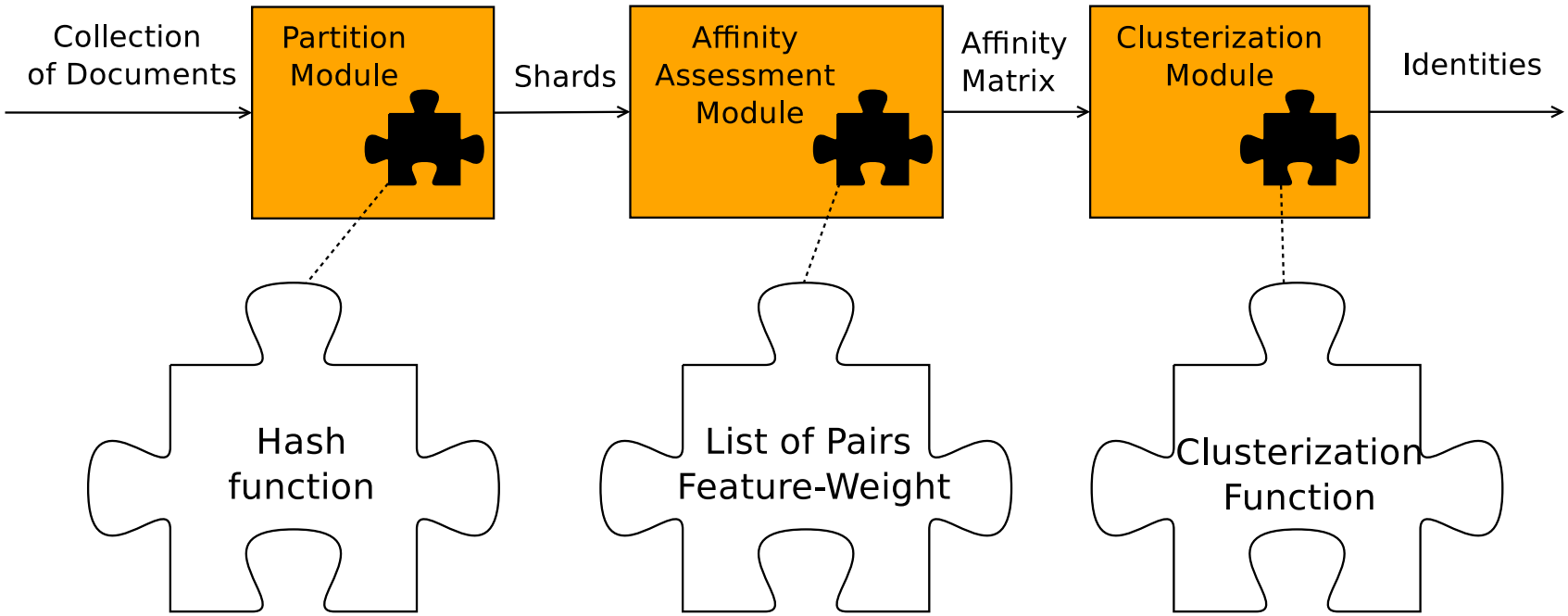

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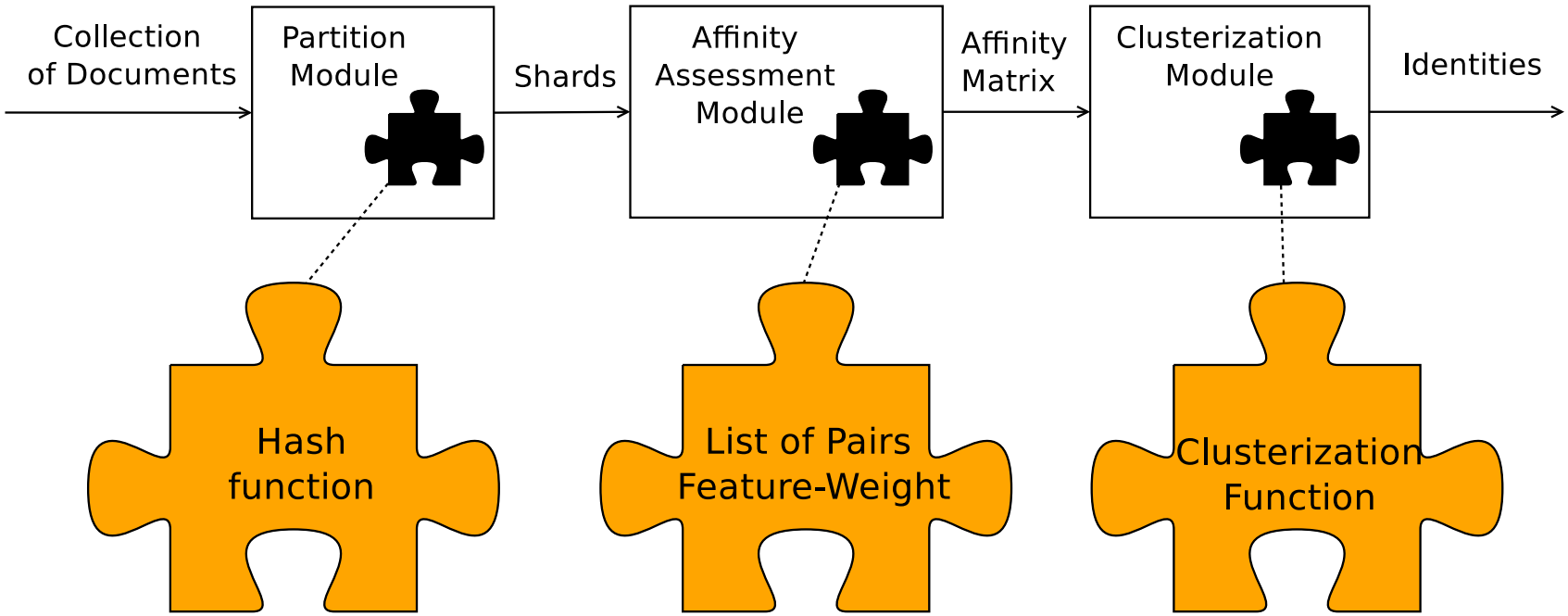
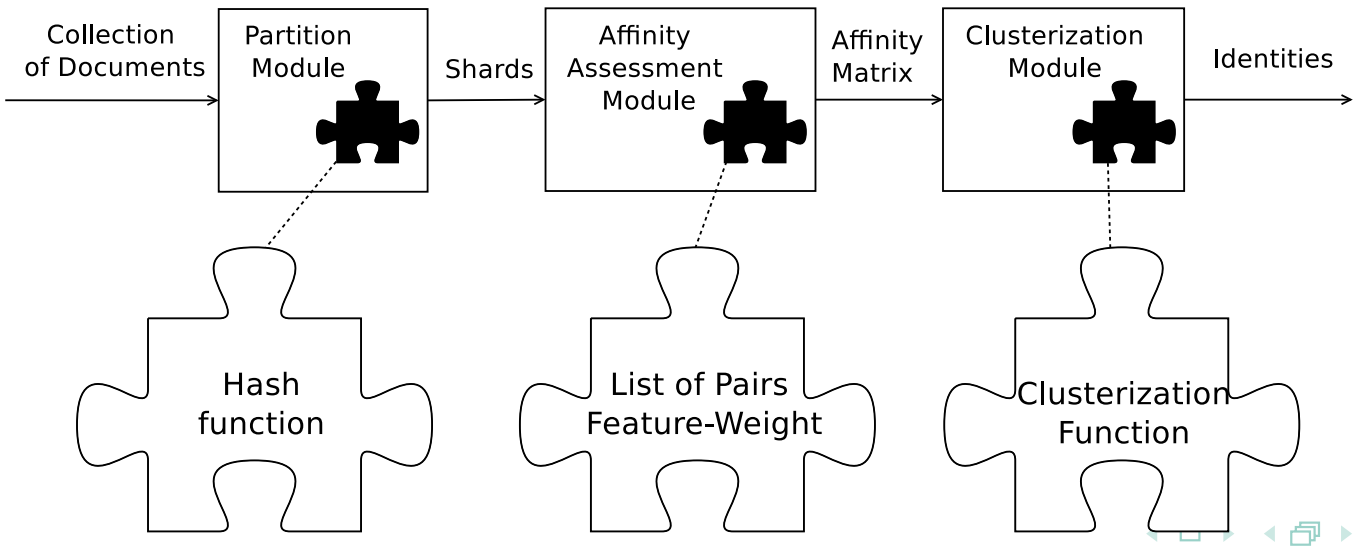


Process stages

1. Data import
2. Contributions decomposition
3. Affinity calculation
4. Clusterization
5. Result persistence



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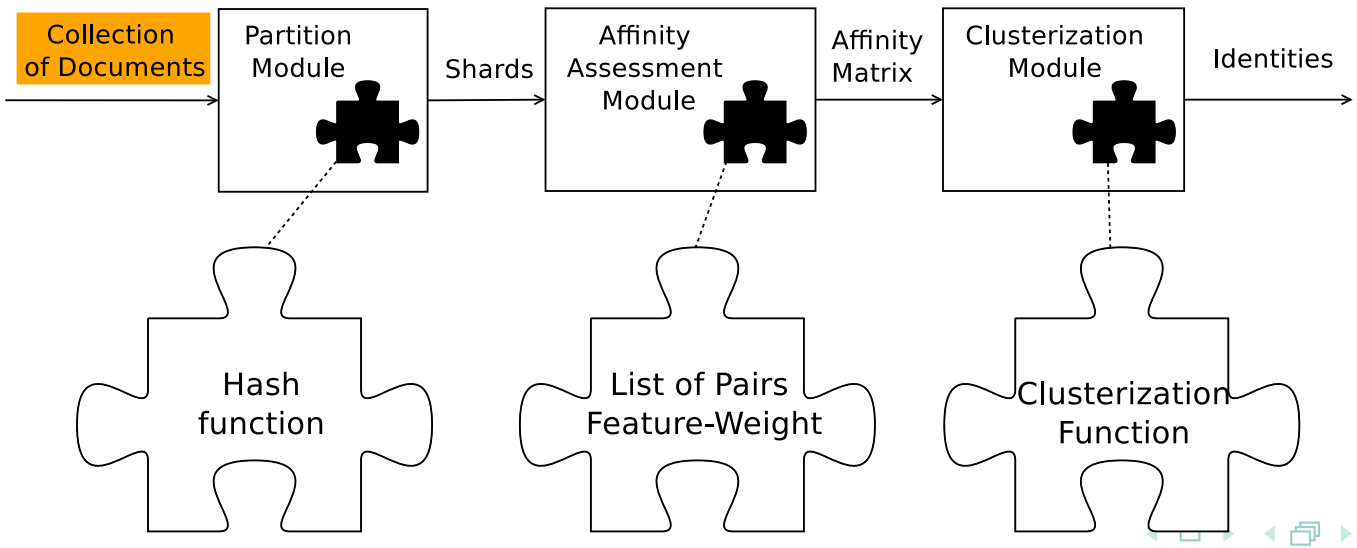

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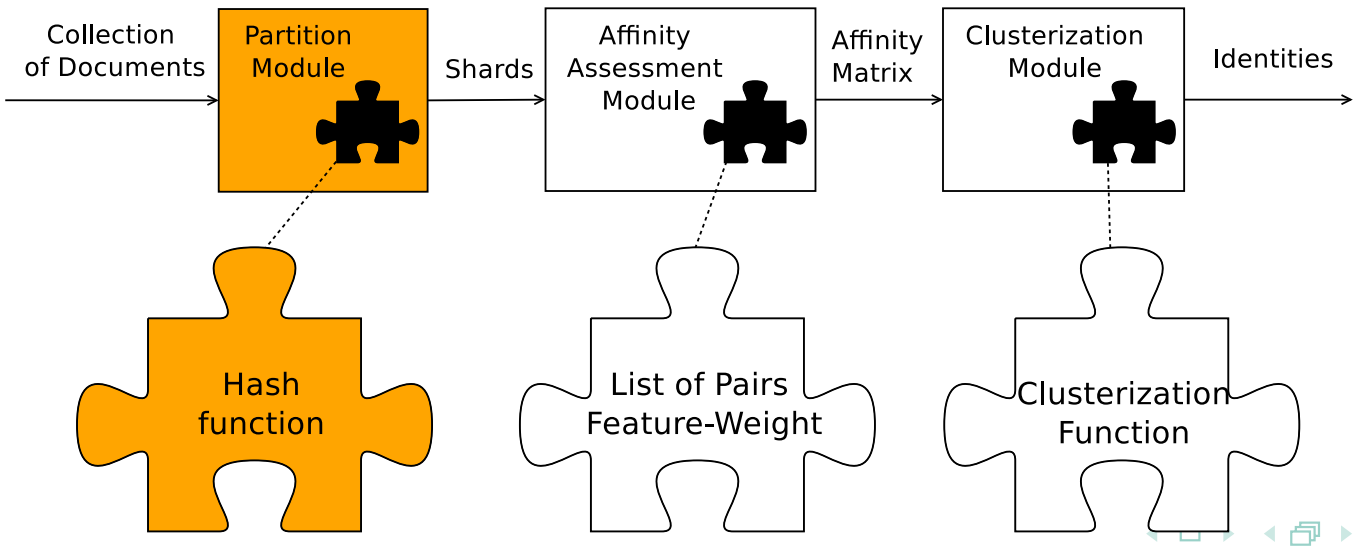

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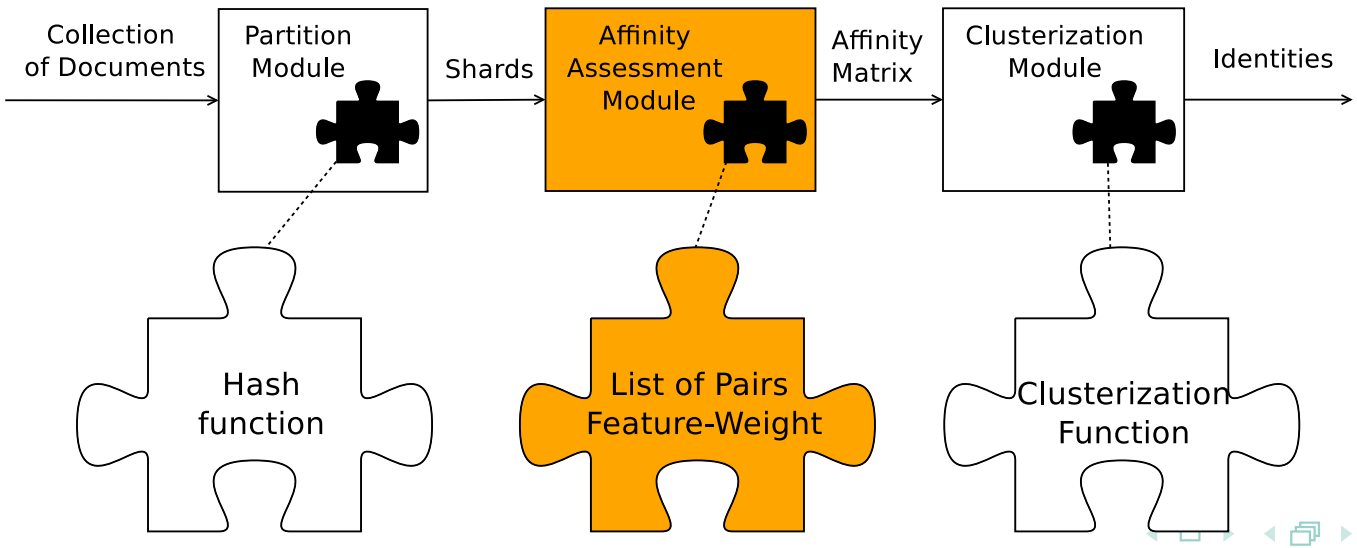

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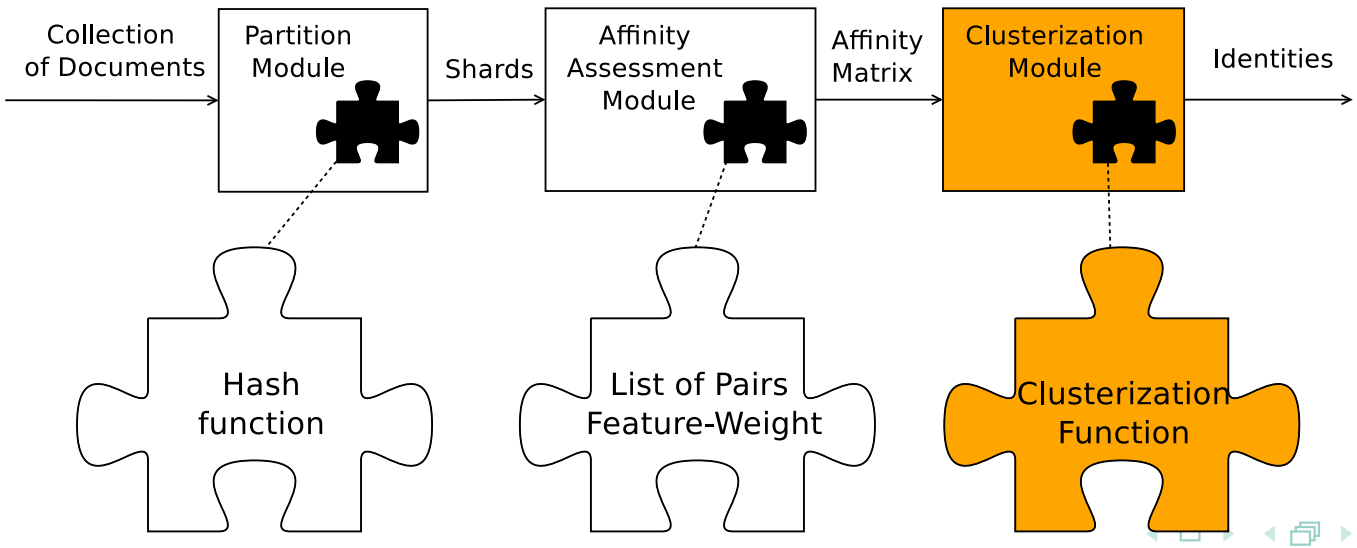

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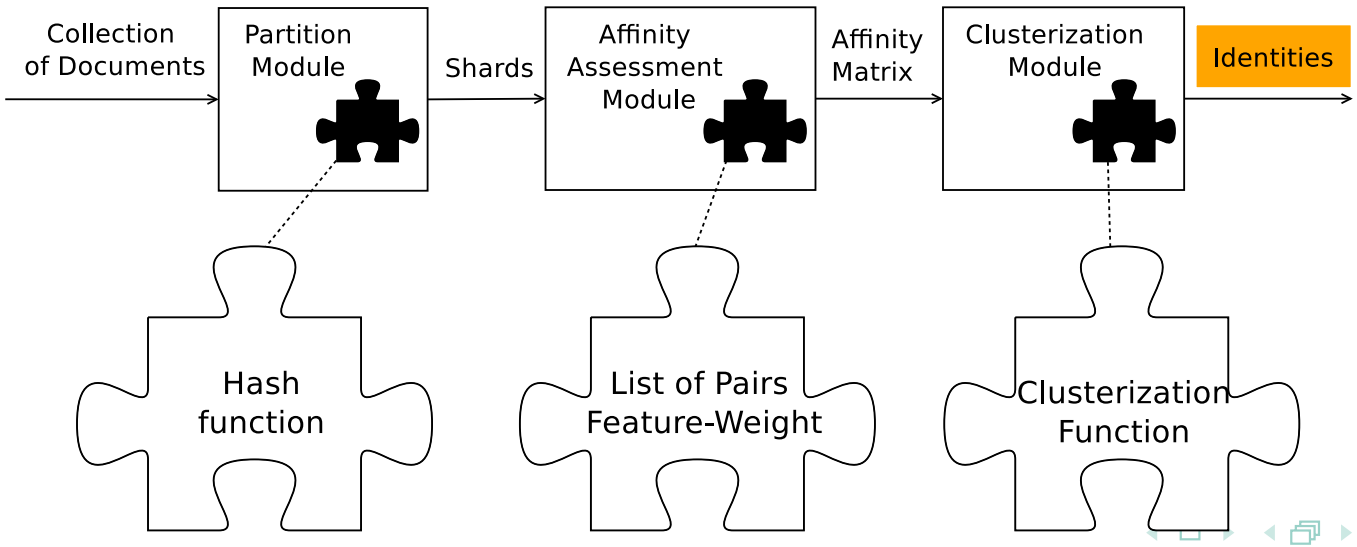
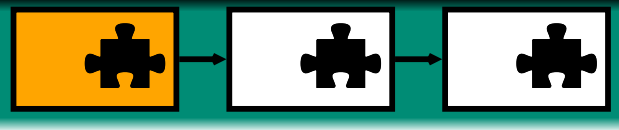
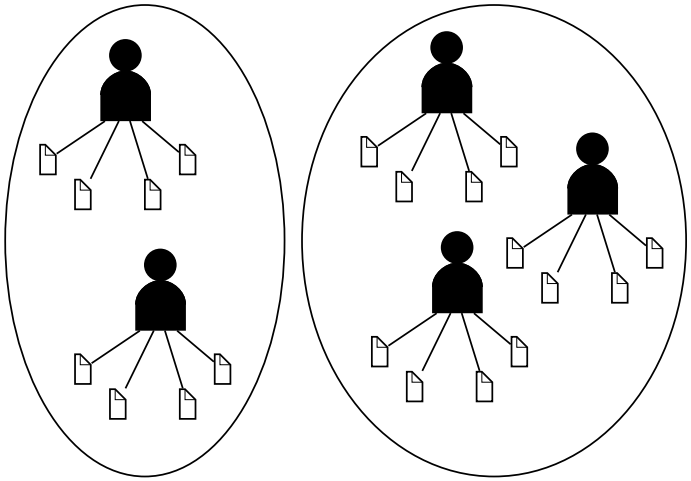


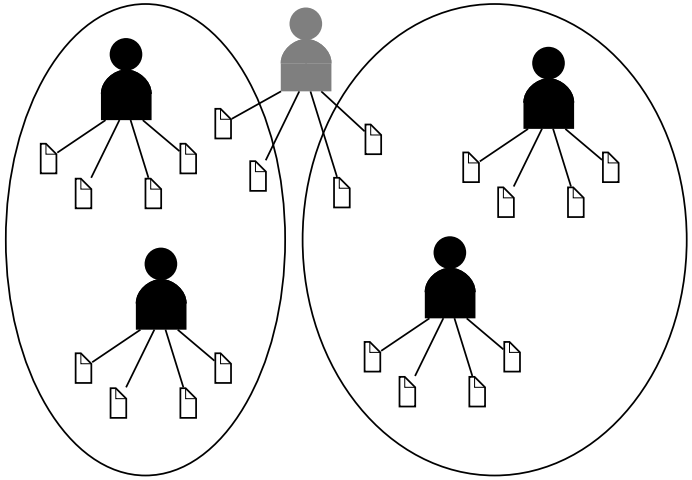
Hash function



- **Goal** - ability to cope with a large dataset
- **Requirements**
  - Contributions of the same person must be in the same subset (shard)
  - A shard may contain contributions of more then one author
  - Shards should not overlap!
- A hash function **example**:
  - function which returns the lower-cased surname of a name with all the diacritic marks removed

Shards





- Contributions – document icons
- Author – human icons
- Shard – ellipse
- Contributions of same author must be in the same shard!
- Defective hash function put them in different shards

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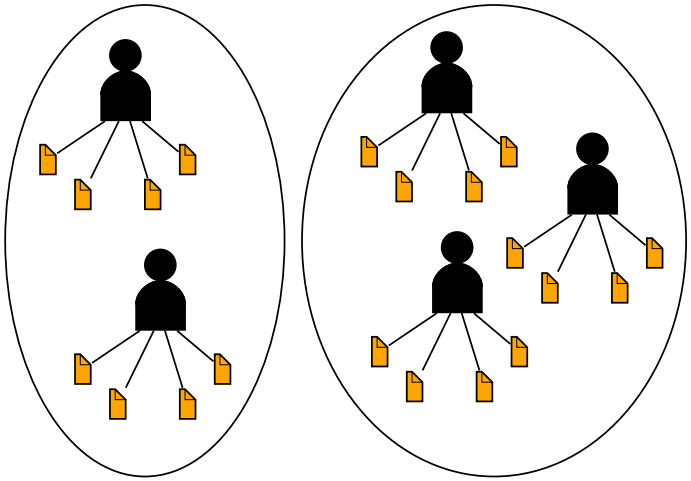

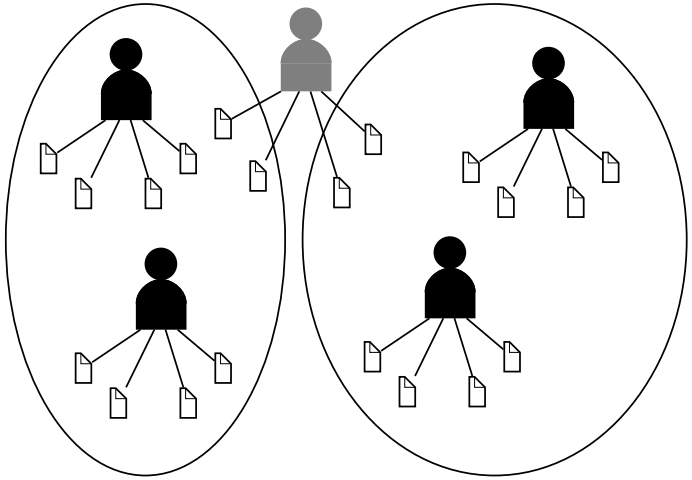

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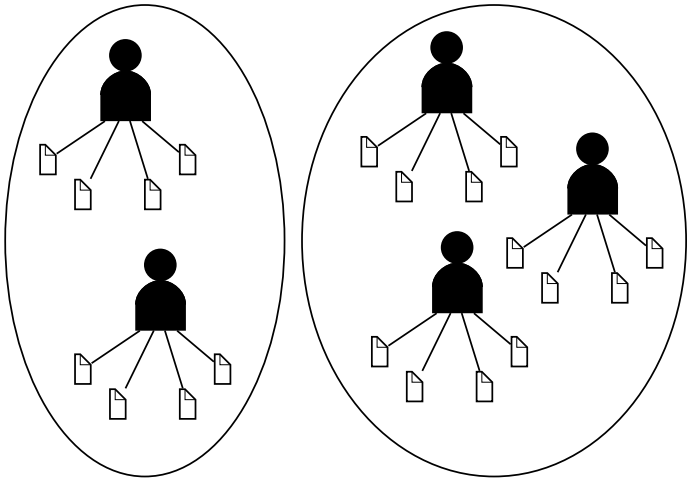

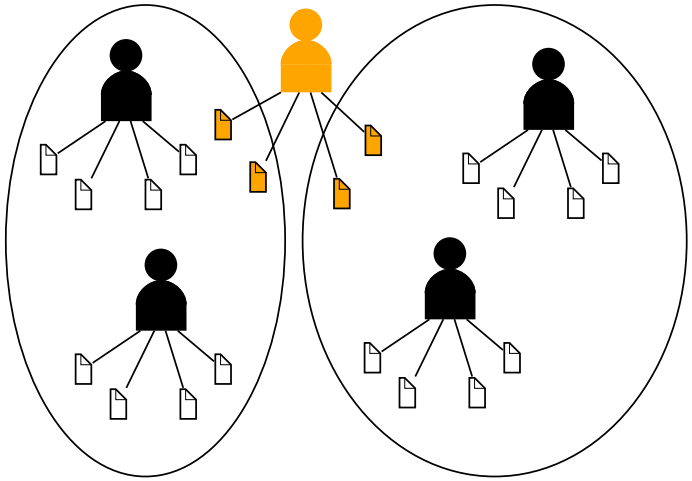

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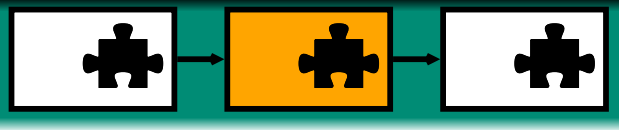
Features



Time distance (continuous)

$$= \begin{cases} 0 & \text{year}(c_1) = \perp \\ & \vee\ \text{year}(c_2) = \perp \\ -1 & |\,\text{year}(c_1) - \text{year}(c_2)| > 70 \\ 1 - \left(\frac{\text{year}(c_1) - \text{year}(c_2)}{70}\right)^2 & \text{otherwise} \end{cases}$$

Time distance (discrete)

$$= \begin{cases} 0 & \text{year}(c_1) = \perp \vee \text{year}(c_2) = \perp \\ -1 & |\,\text{year}(c_1) - \text{year}(c_2)| > 70 \\ 1 & \text{otherwise} \end{cases}$$

Journal

$$= \begin{cases} 0 & \text{journal}(c_1) = \perp \vee \text{journal}(c_2) = \perp \\ 1 & \text{journal}(c_1) = \text{journal}(c_2) \\ -0.1 & \text{otherwise} \end{cases}$$

Email

$$= \begin{cases} 0 & \text{email}(c_1) = \perp \vee \text{email}(c_2) = \perp \\ 1 & \text{email}(c_1) = \text{email}(c_2) \\ -0.1 & \text{otherwise} \end{cases}$$

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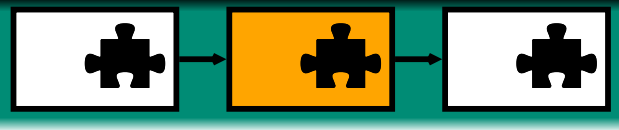


Language

$$= \begin{cases} 0 & \text{language}(c_1) = \perp \vee \text{language}(c_2) = \perp \\ 0.05 & \text{language}(c_1) = \textit{eng} \vee \text{language}(c_2) = \textit{eng} \\ 0.1 & \text{language}(c_1) = \text{language}(c_2) \\ -1 & \text{otherwise} \end{cases}$$

Keywords (discrete)

$$= \begin{cases} 0 & \text{keyword}(c_1) = \emptyset \vee \text{keyword}(c_2) = \emptyset \\ -1 & \frac{|\text{keyword}(c_1) \cap \text{keyword}(c_2)|}{|\text{keyword}(c_1) \cup \text{keyword}(c_2)|} < 0.25 \\ 1 & \text{otherwise} \end{cases}$$

Keywords (continuous)

$$= \begin{cases} 0 & \text{keyword}(c_1) = \emptyset \\ & \vee \text{keyword}(c_2) = \emptyset \\ \frac{|\text{keyword}(c_1) \cap \text{keyword}(c_2)|}{|\text{keyword}(c_1) \cup \text{keyword}(c_2)|} * 2 - 1 & \text{otherwise} \end{cases}$$

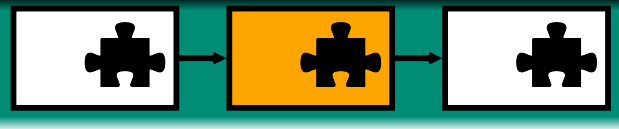
Self-citation

$$= \begin{cases} 1 & \textit{name}(c_1) = \textit{name}(\textit{reference}(c_1)) \\ 0 & \text{otherwise} \end{cases}$$

Co-authorship

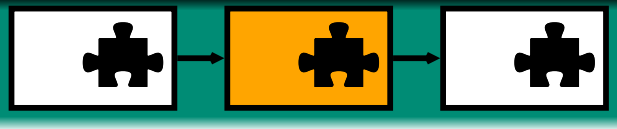
$$= \begin{cases} 0.7 & |\text{coauthors}(c_1) \cap \text{coauthors}(c_2)| = 1 \\ 1 & |\text{coauthors}(c_1) \cap \text{coauthors}(c_2)| > 1 \\ 0 & \text{otherwise} \end{cases}$$

Features' aspects



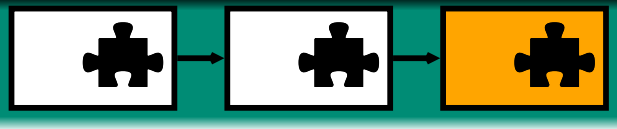
- **Discretization level**
  1. Discrete.
  2. Continuous.
- **Polarisation level**
  1. Polarised. Highly positive (negative) indicator and simultaneously weak negative (positive) indicator, e.g. e-mail or journal feature.
  2. Fair. A feature can be equally important as positive and negative indicator, e.g. discrete time distance features.
- **Structure**
  1. Flat structure.
  2. Graph structure.

Weights



- Some features can single-handedly prove that two contributions belong to the same author.
- Other features are only weak indicators (e.g. contributing to the same journal)
- The weight of a feature reflects the feature's impact on the name disambiguation process.

The clusterization function



- Goes according to an exchangeable clustering function
- Threshold
- Modification of single-linkage clustering

Work completed

- author name disambiguation framework
- basic feature set
- sketch of weights
- clusterization function

Future plans

- Feature generator (by a genetic programming or the Apriori algorithm)
- Weight estimator (the AdaBoost algorithm)
- Incremental version of the framework

Acknowledgements

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- The authors would like to thank Zentralblatt MATH for providing their authority file for the purpose training and evaluation of our name disambiguation module

Thank you

Thank you!
Questions?

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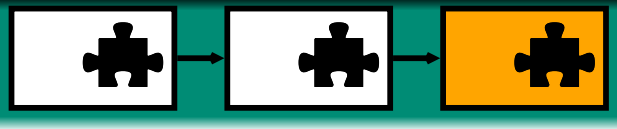
The clusterization function - steps



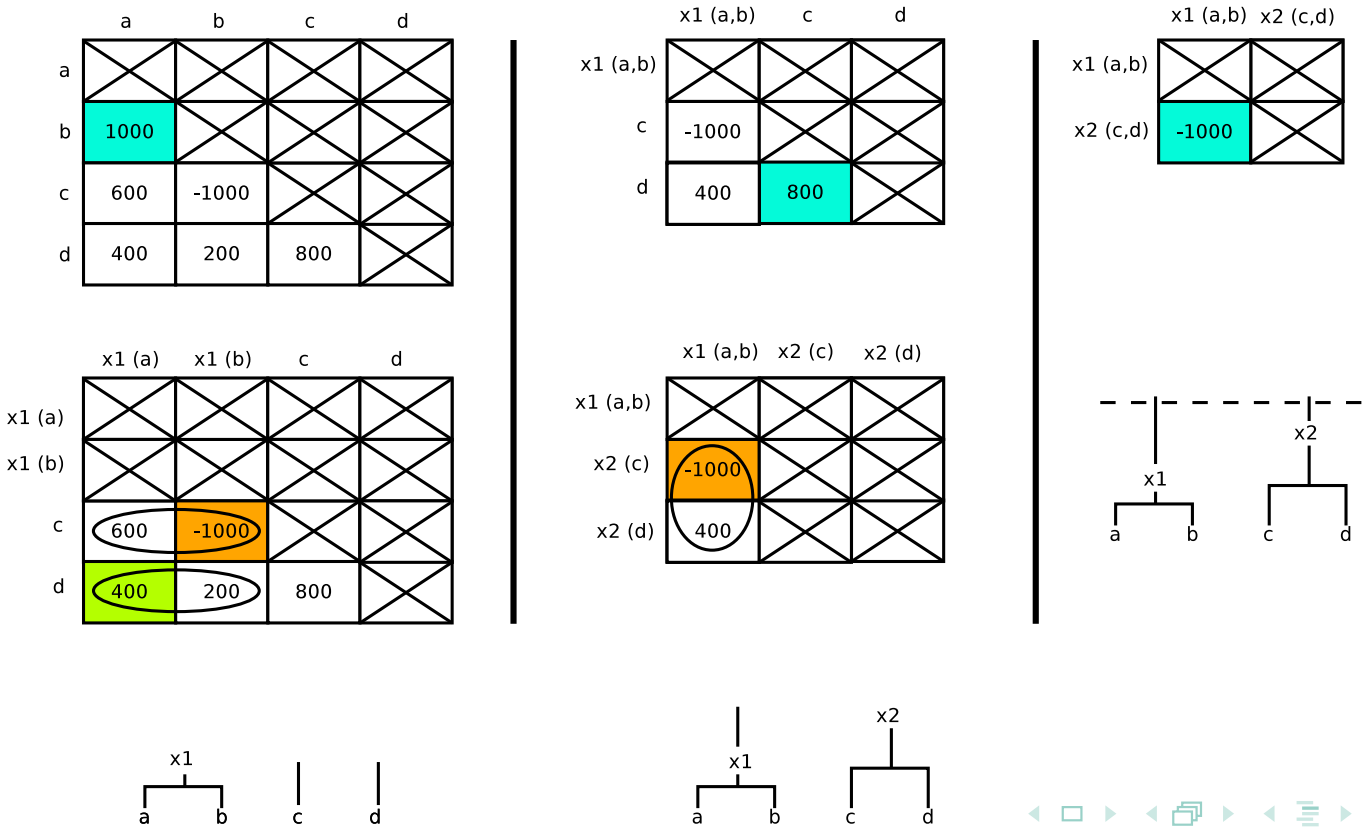
1. Take two “active” contribution clusters with top level score
2. If this score is below a given threshold – procedure ends.
3. Deactivate one of clusters.
4. Merge chosen clusters into one and recalculate new cluster affinities
5. Repeat step 1.

The clusterization function – equation

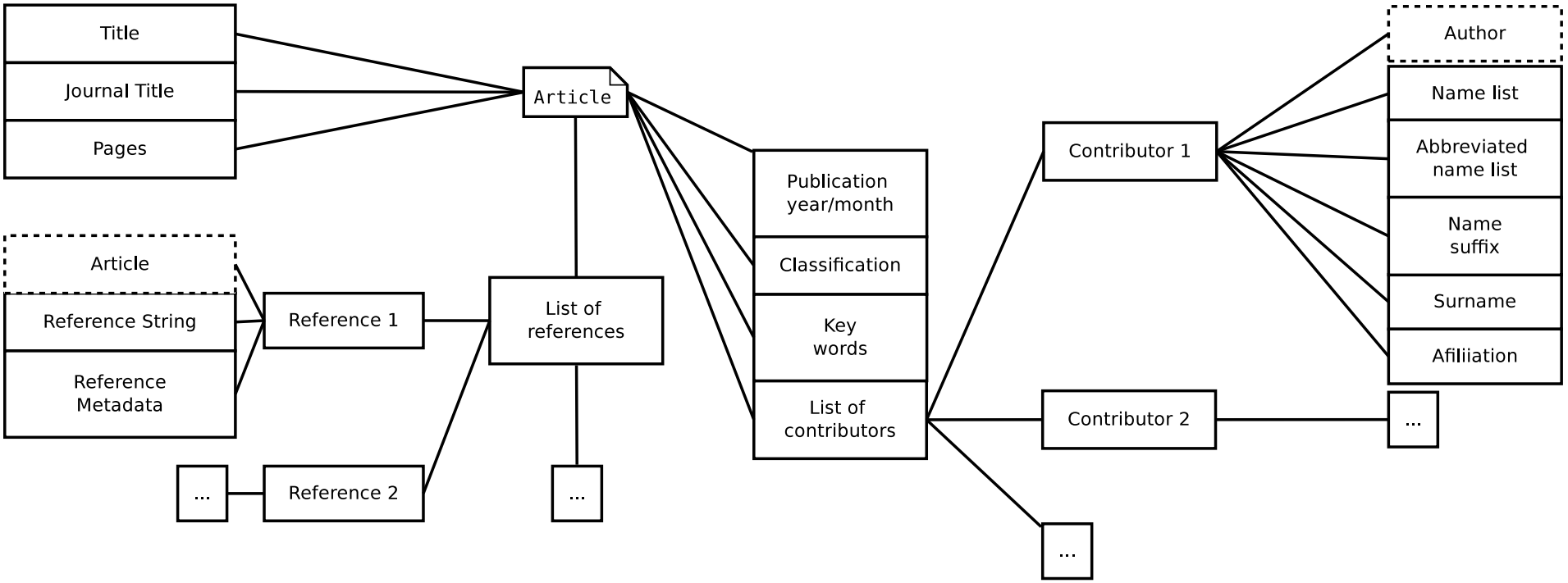
- Recalculation equation:

$$\forall_{1<i<N}\forall_{i\neq a}\forall_{i\neq b}\sigma(c_a, c_i) = \sigma(c_b, c_i) = \begin{cases} -\infty & \sigma(c_a, c_i) < T \\ & \vee\ \sigma(c_b, c_i) < T \\ \sigma(c_a, c_i) & \sigma(c_a, c_i) > \sigma(c_b, c_i) \\ \sigma(c_b, c_i) & \sigma(c_a, c_i) \leqslant \sigma(c_b, c_i) \end{cases}$$

- Example



Document metadata as a graph



Relations to be retrieved

- Information to be retrieved: