Approaches for Source Retrieval and Text Alignment of Plagiarism Detection

Kong Leilei, Qi Haoliang, Du Cuixia, Wang Mingxing, Han Zhongyuan

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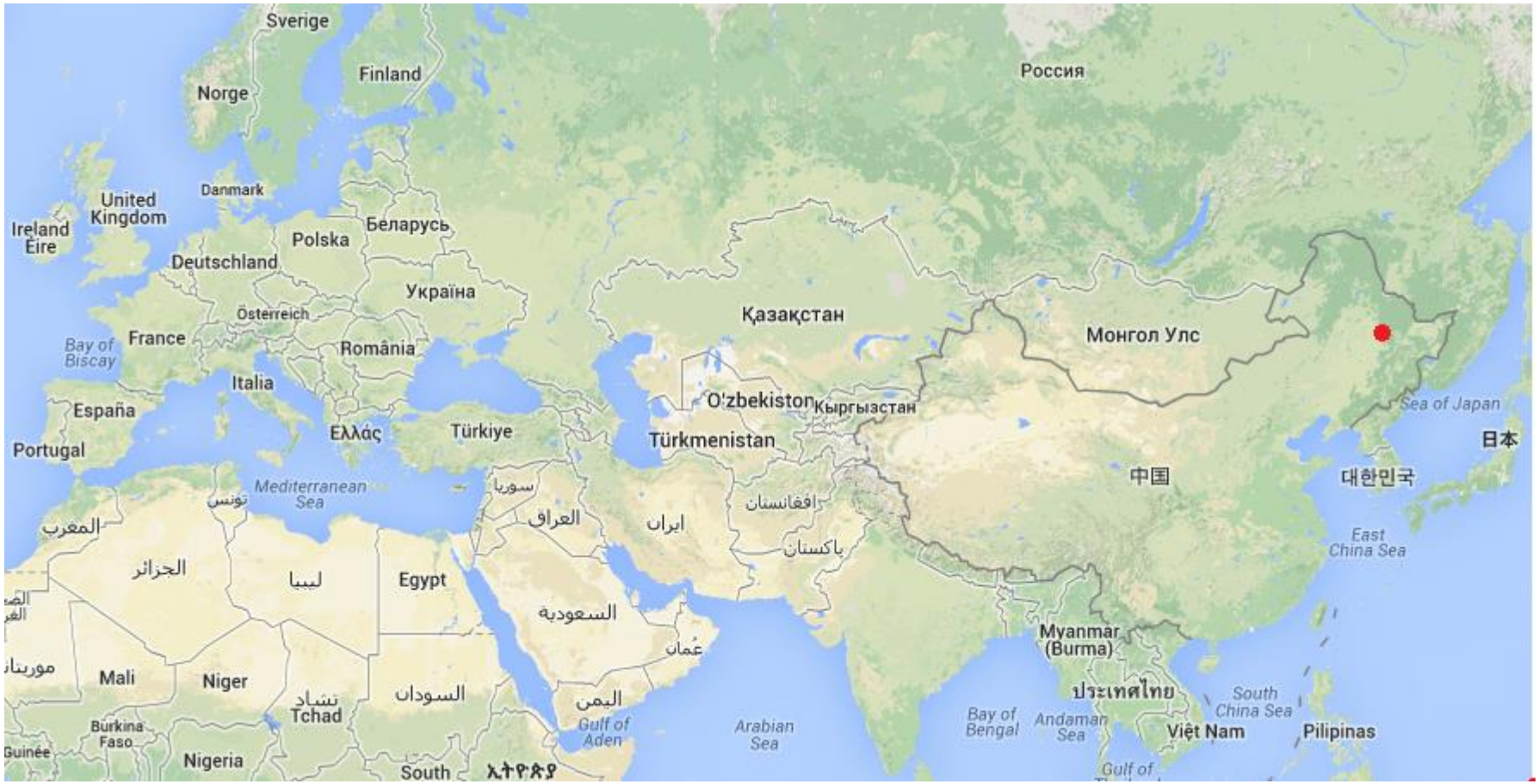
Who are we?

Who are we?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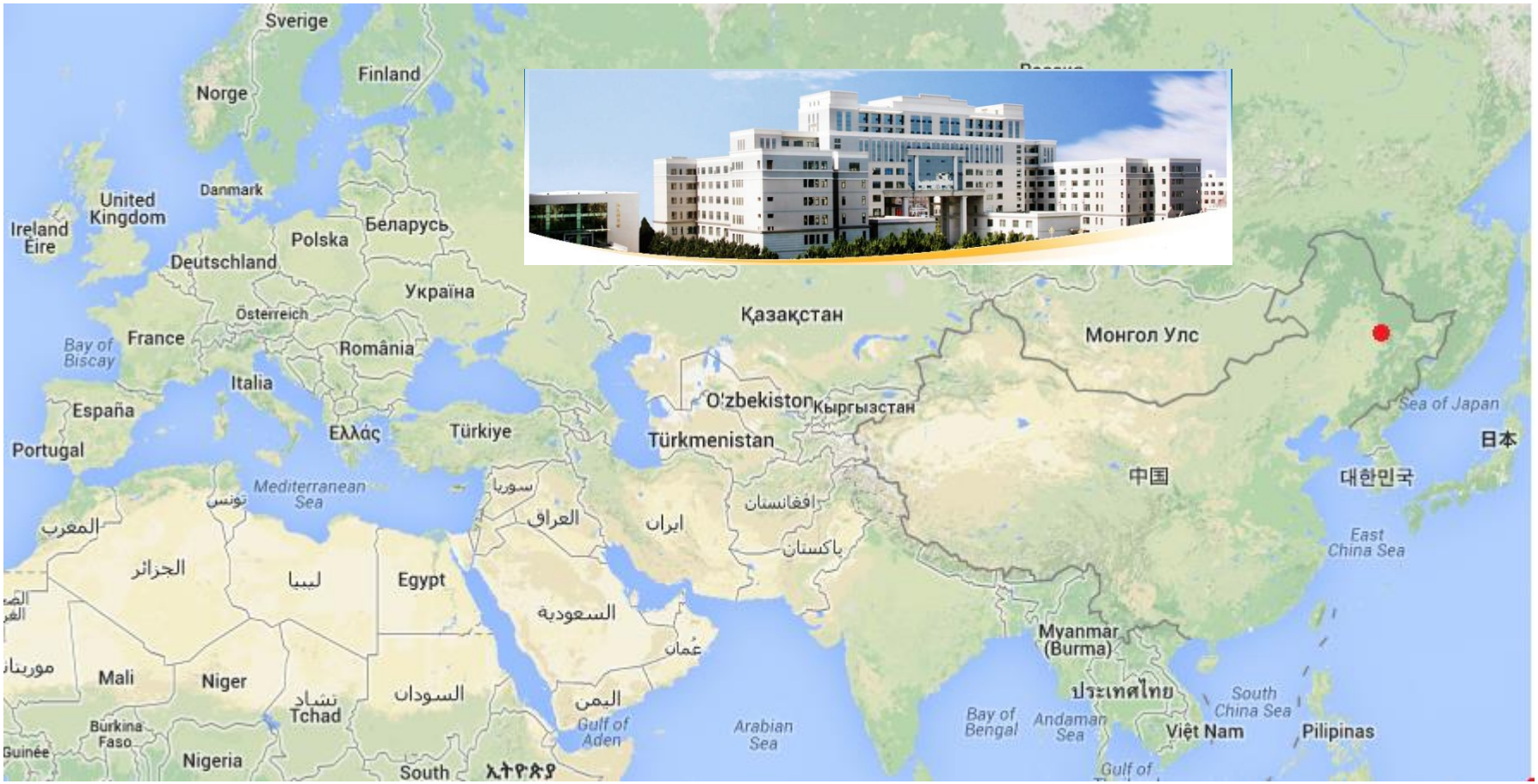
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Who are we?


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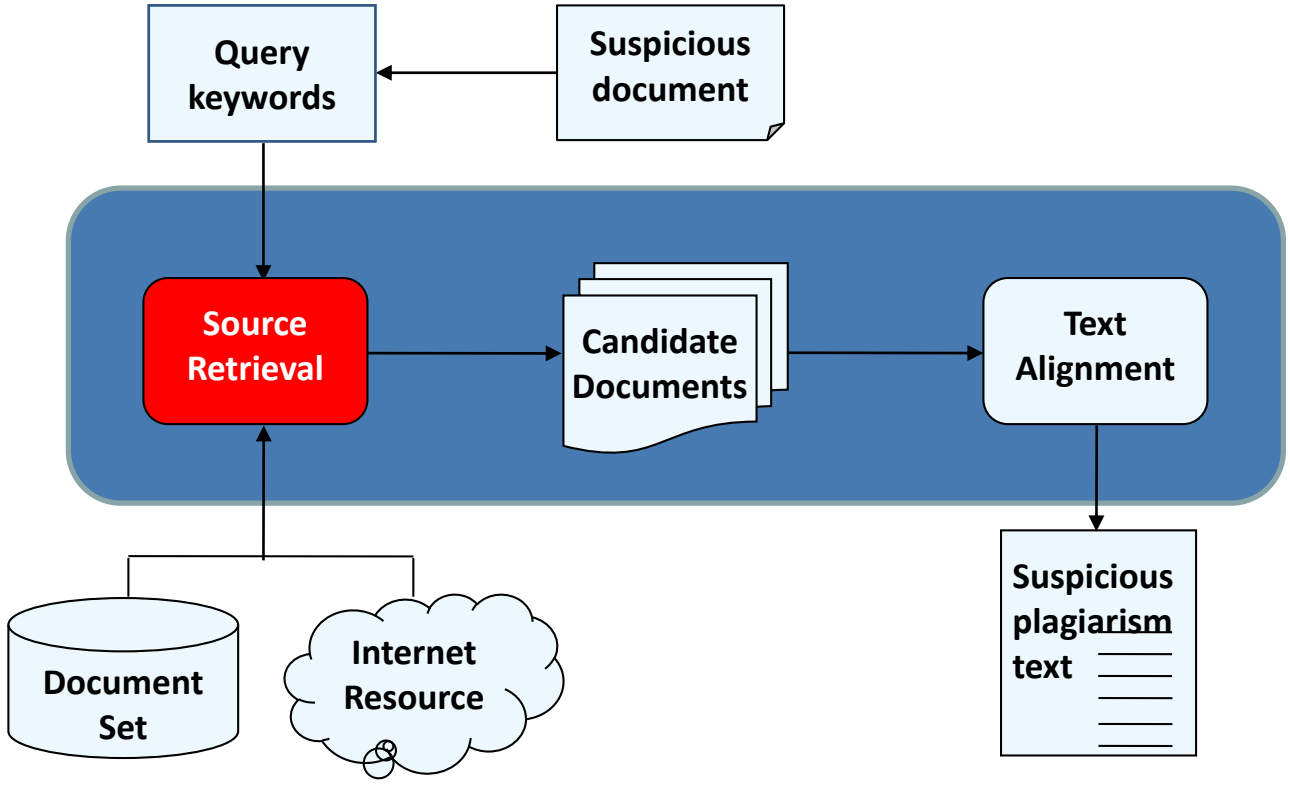
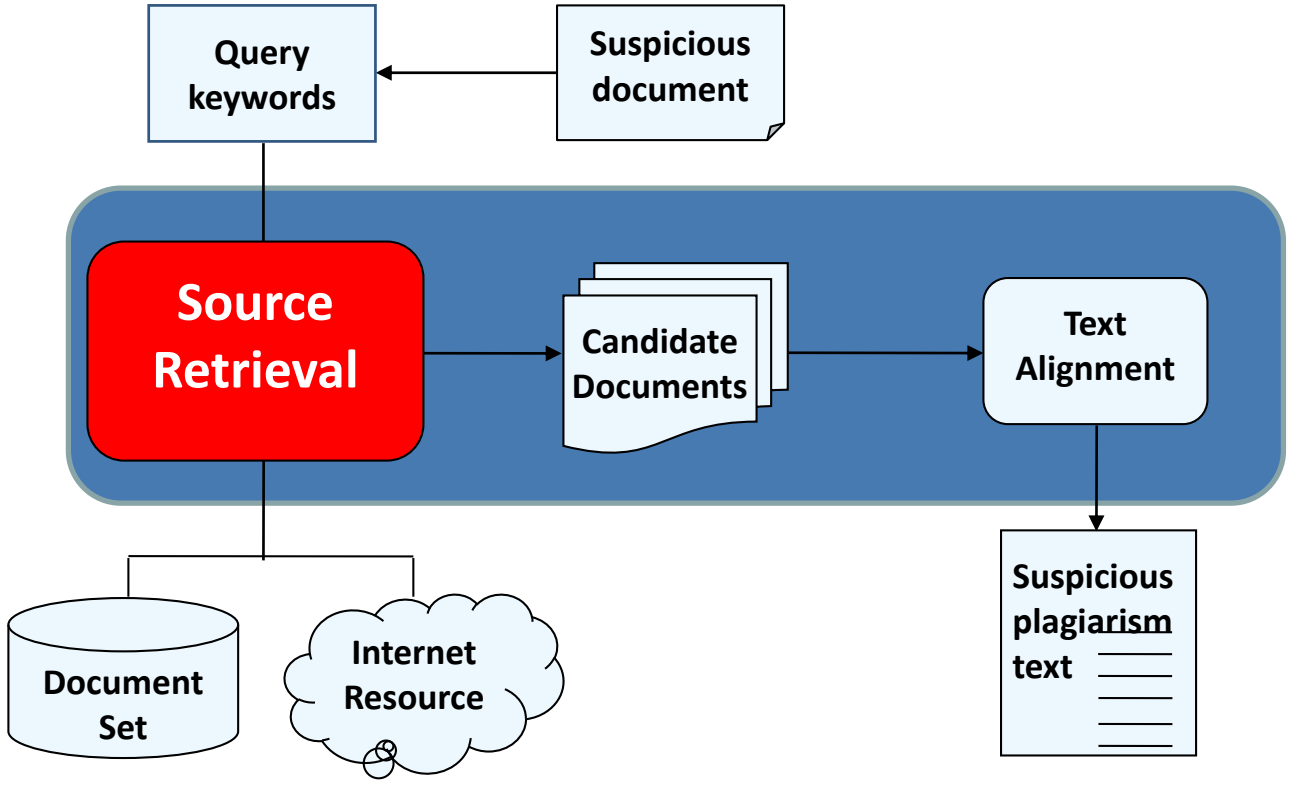
Index

- Approaches for Source Retrieval
- Approaches for Text Alignment
- Further works

Source Retrieval



Source Retrieval



2 problmes of source retrieval

- Tow core problem of source retrieval
  - Retrieval source is millions of documents from the Internet
    - This work was done by PAN
  - The query keywords of suspicious document which would be used for retrieval are not specified
    - How to extract query keyword is one of important issues of our work

Query Keywords Extraction

- Query Keywords Extraction Based on TF-IDF
- Query Keywords Extraction Based on Weighted TF-IDF
- Adjacent Query Keywords Extraction by PatTree
- Combination of Queries and Execution of Retrieval

Keywords Based on TF-IDF

- TF - term frequency, denotes the frequency of term i in document j

$$TF_i = tf_{ij}$$

- IDF - inverse document frequency

$$IDF = \log_2 (N / df_j)$$

- TF-IDF of term i is:

$$TFIDF(i) = TF(i) * IDF(i)$$

- *Tips: we found that the top 10 terms with the highest TF-IDF can obtain a good results*

Keywords Based on Weighted TF-IDF

- Weighted TF-IDF

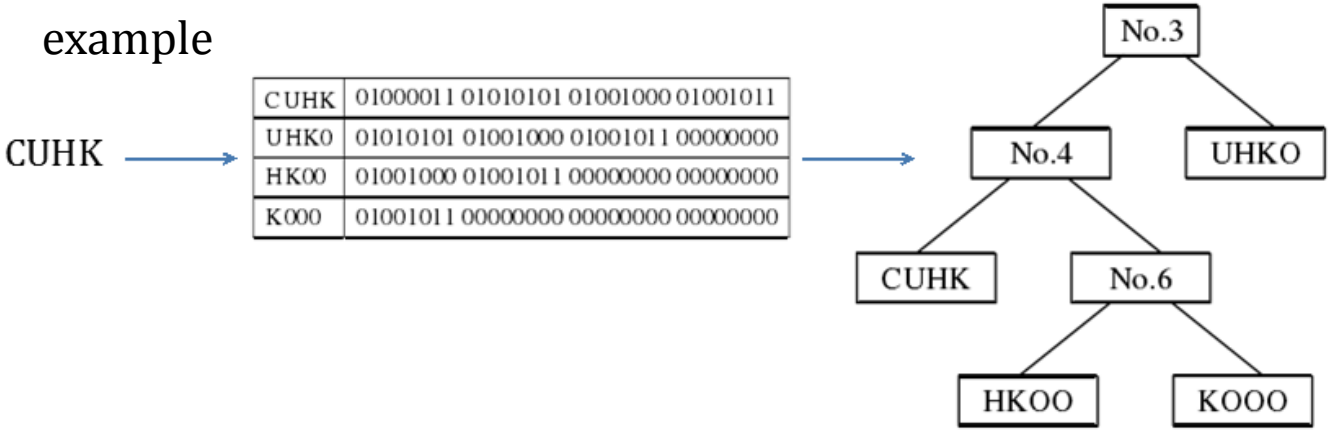
$$WTFIDF_i = weight * TFIDF_i$$

- Where *weight* is a weighted parameter, and we calculate the weight of term i according to its location

- *Tips: the keywords extraction based on the weighted TF-IDF sometimes is useful, sometimes useless.*

Adjacent Query Keywords Extraction by PatTree

- The adjacent string with high frequency is more important than a single word
- We use PatTree - an efficient data structure– to get the adjacent strings and their frequency



Combination of Queries

Table 1: Query Combination and Group

Query	Query Keywords
1	Top 1 to 5 query keywords based on TF-IDF
2	Top 2 to 10 query keywords based on TF-IDF
3	2-Gram query keywords based on PatTree
4	3-Gram query keywords based on PatTree
5	4-Gram query keywords based on PatTree
6	4-Gram query keywords based on PatTree
7	Top 1 to 5 query keywords based on weighted TF-IDF
8	Top 6 to 10 query keywords based on weighted TF-IDF
9	5-Gram query keywords based on PatTree

Results Source Retrieval subtask

Table2： Results Source of PAN@CLEF2013 Retrieval subtask

Workload	Queries	48.50
	Downloads	5691.47
Time to 1st Detection	Queries	2.46
	Downloads	285.66
Retrieved Performance	Precision	0.01
	Recall	0.65
No Detection		3

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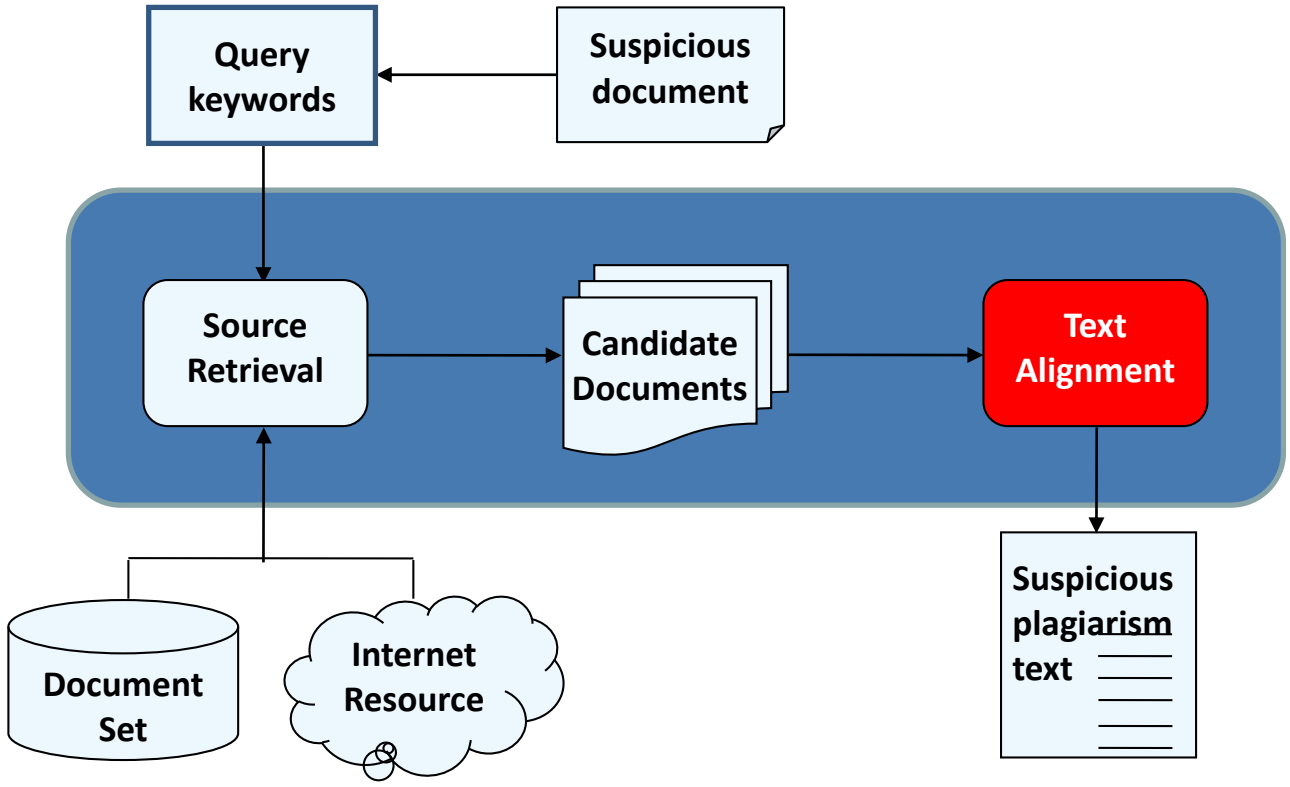

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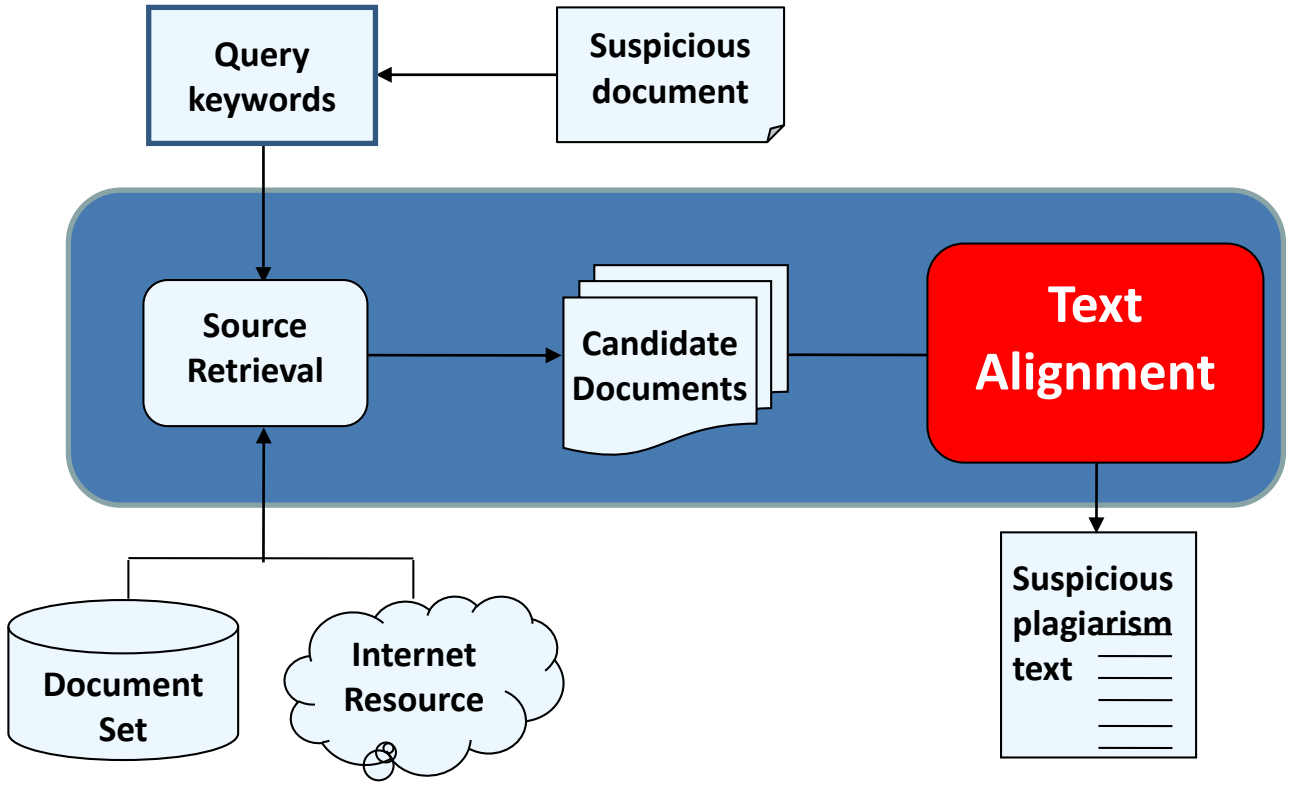

Text Alignment

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Seeding

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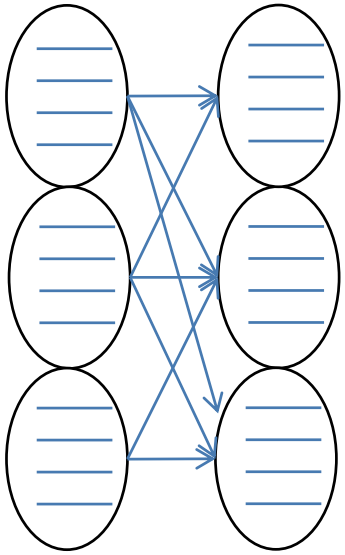
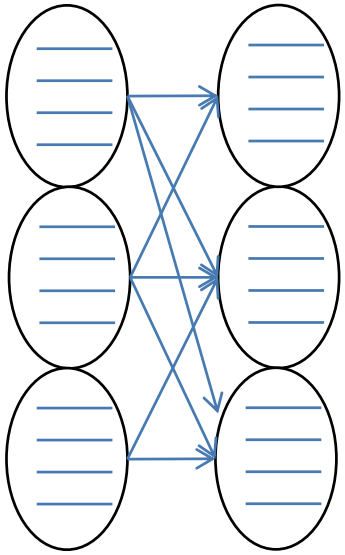


Text Alignment

Seeding **Match Merging**



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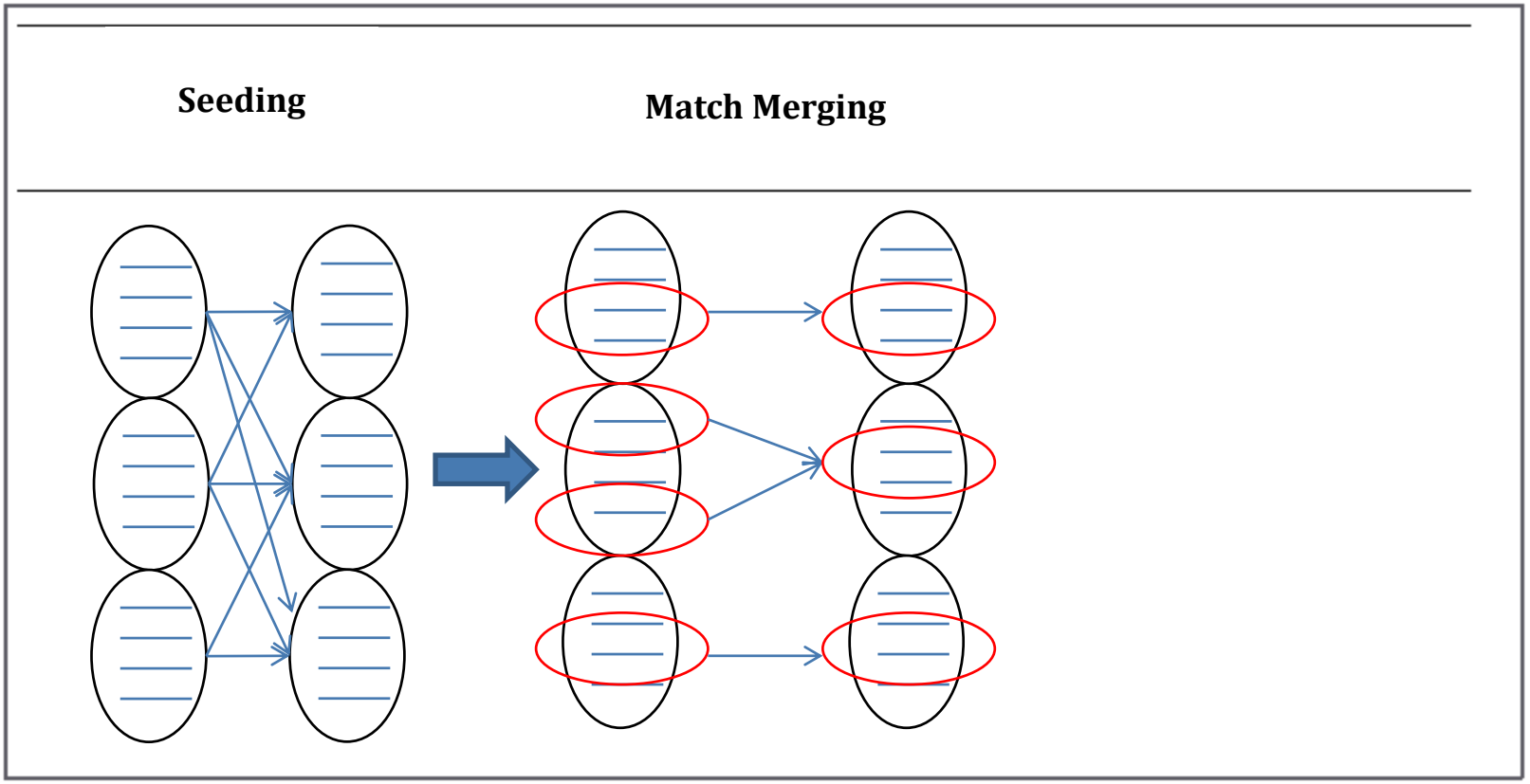

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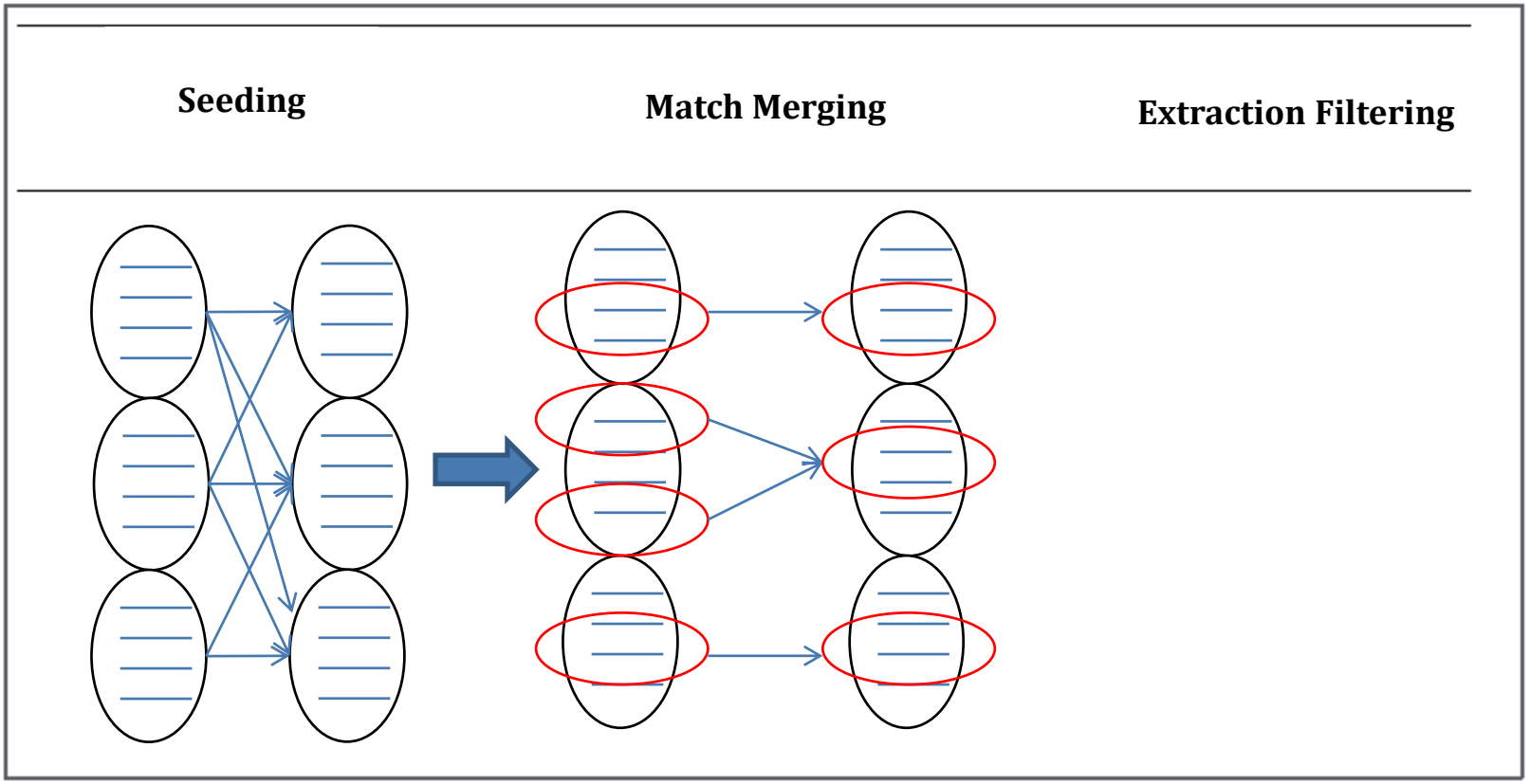

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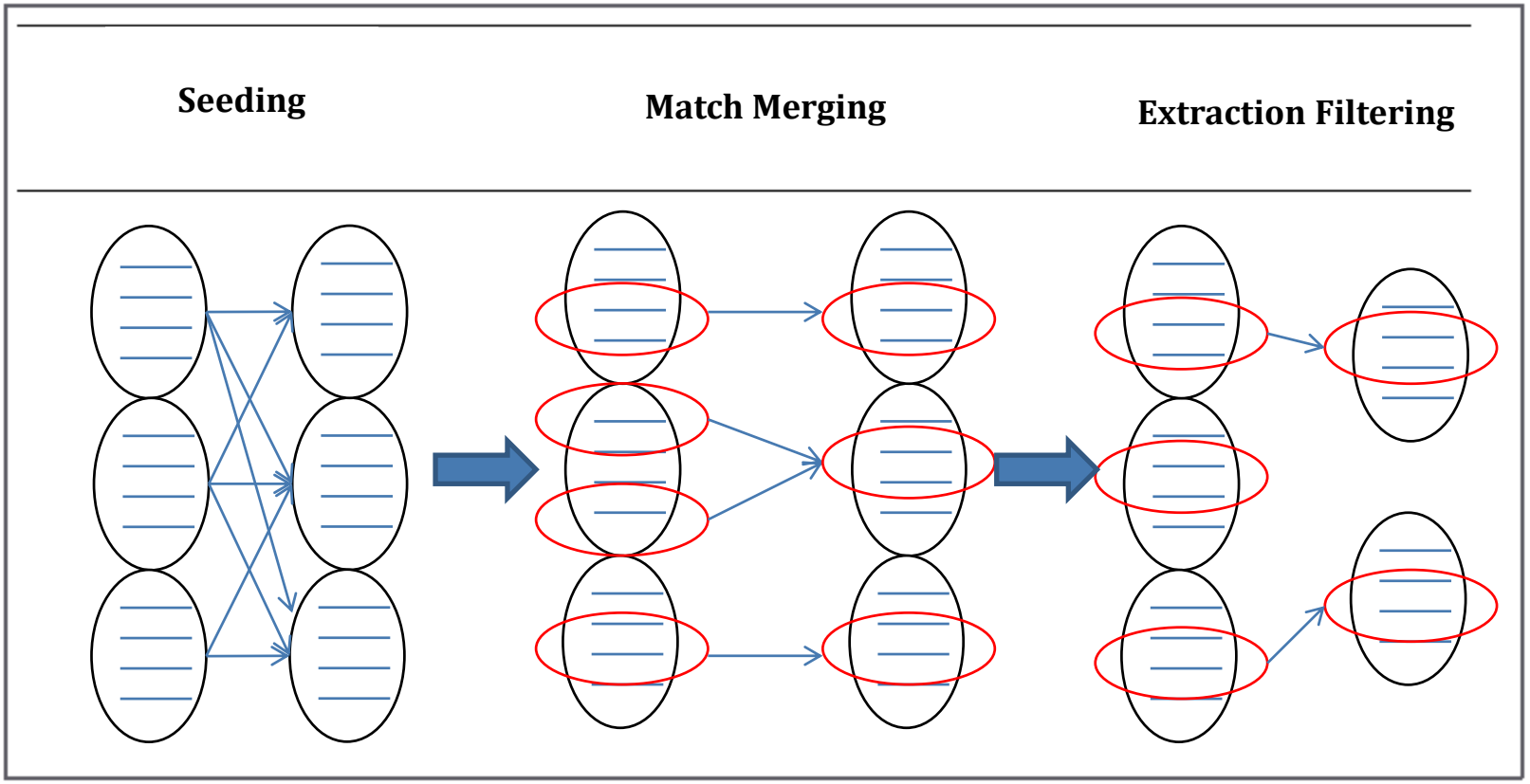

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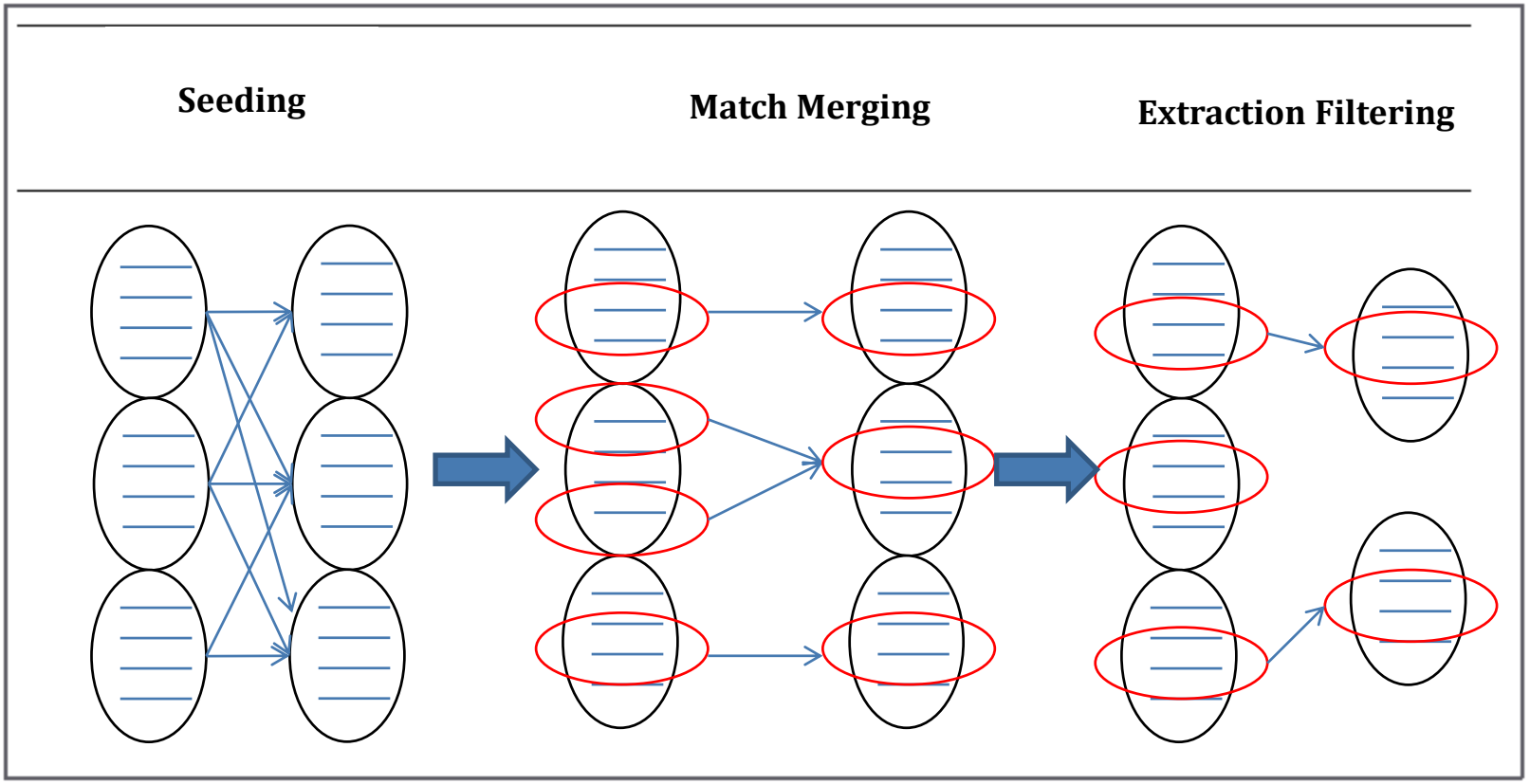
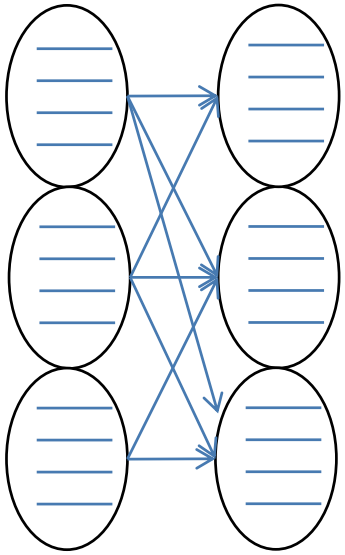


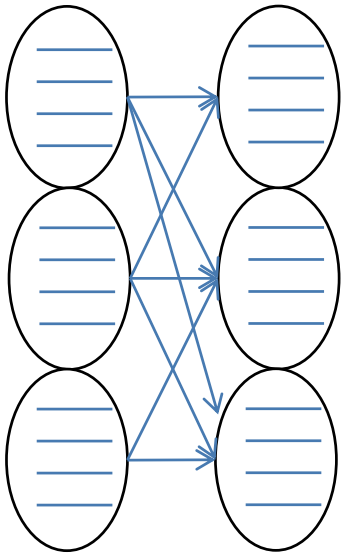
Text Alignment

Seeding	Match Merging	Extraction Filtering



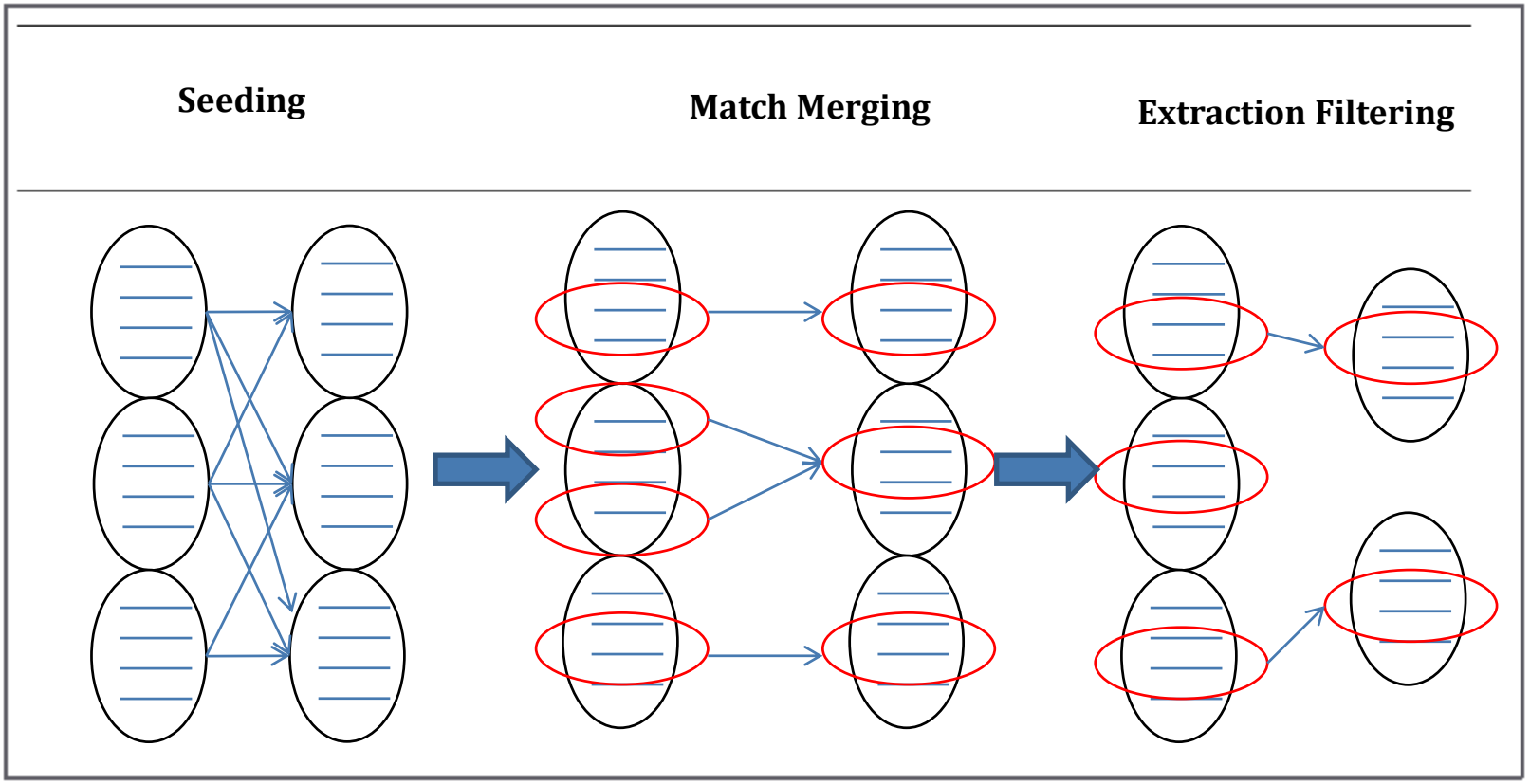
Text Alignment

Seeding **Match Merging** **Extraction Filtering**



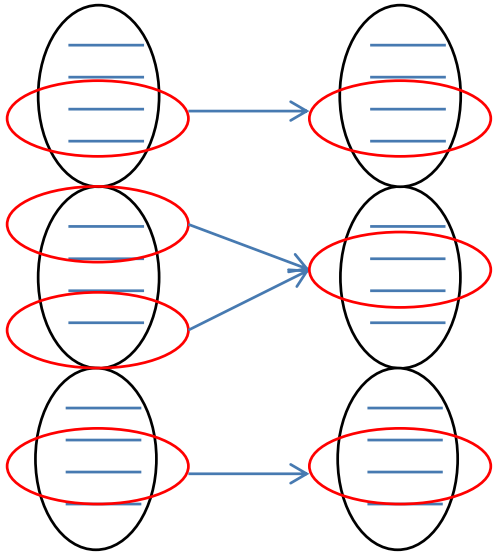
$$Sim(S,R) = \cos\theta = \frac{\sum_{k=1}^{n} W_{Sk} * W_{Rk}}{\sqrt{(\sum_{k=1}^{n} W_{Sk}^{2})(\sum_{k=1}^{n} W_{Rk}^{2})}} > t1$$

Text Alignment

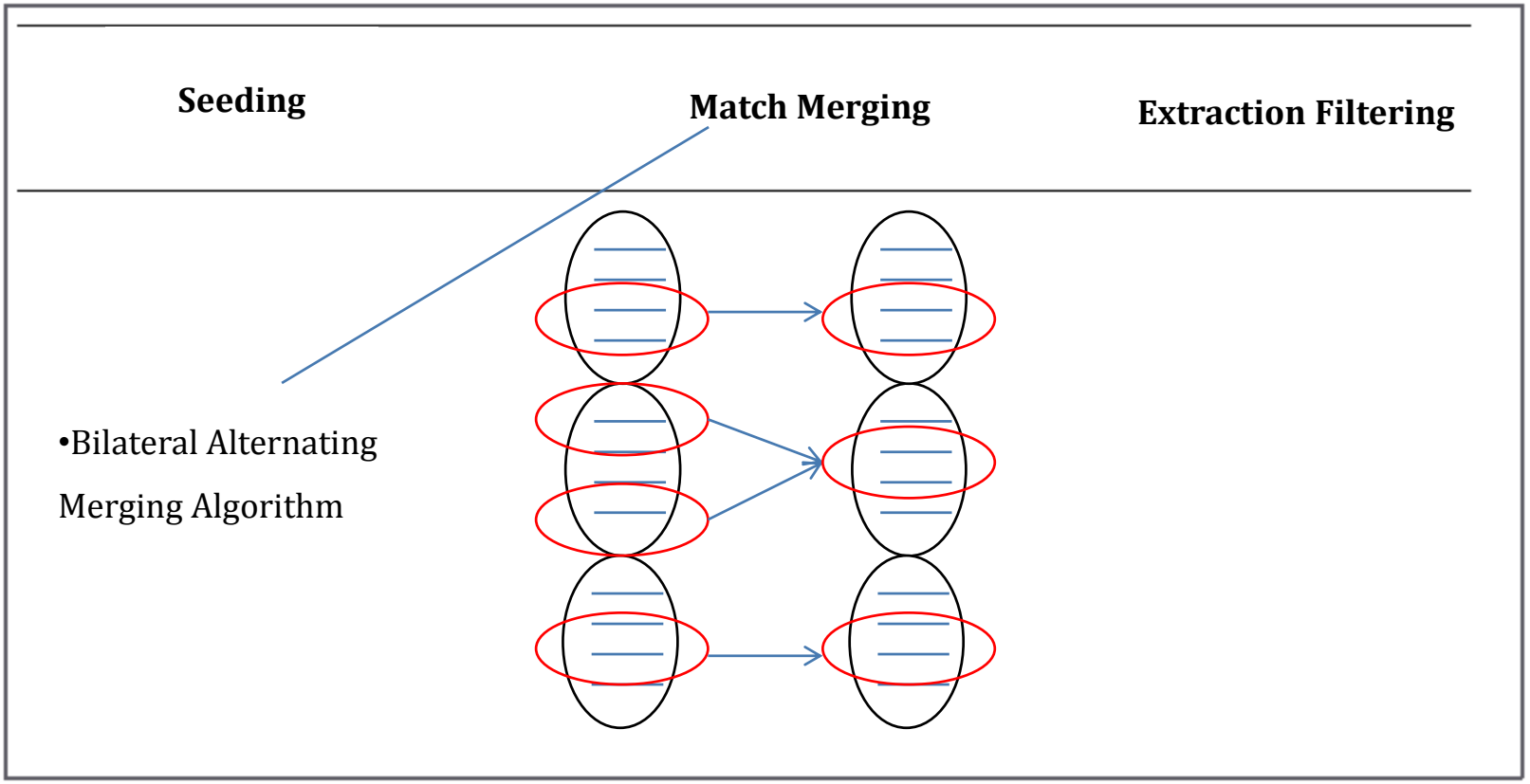


Text Alignment

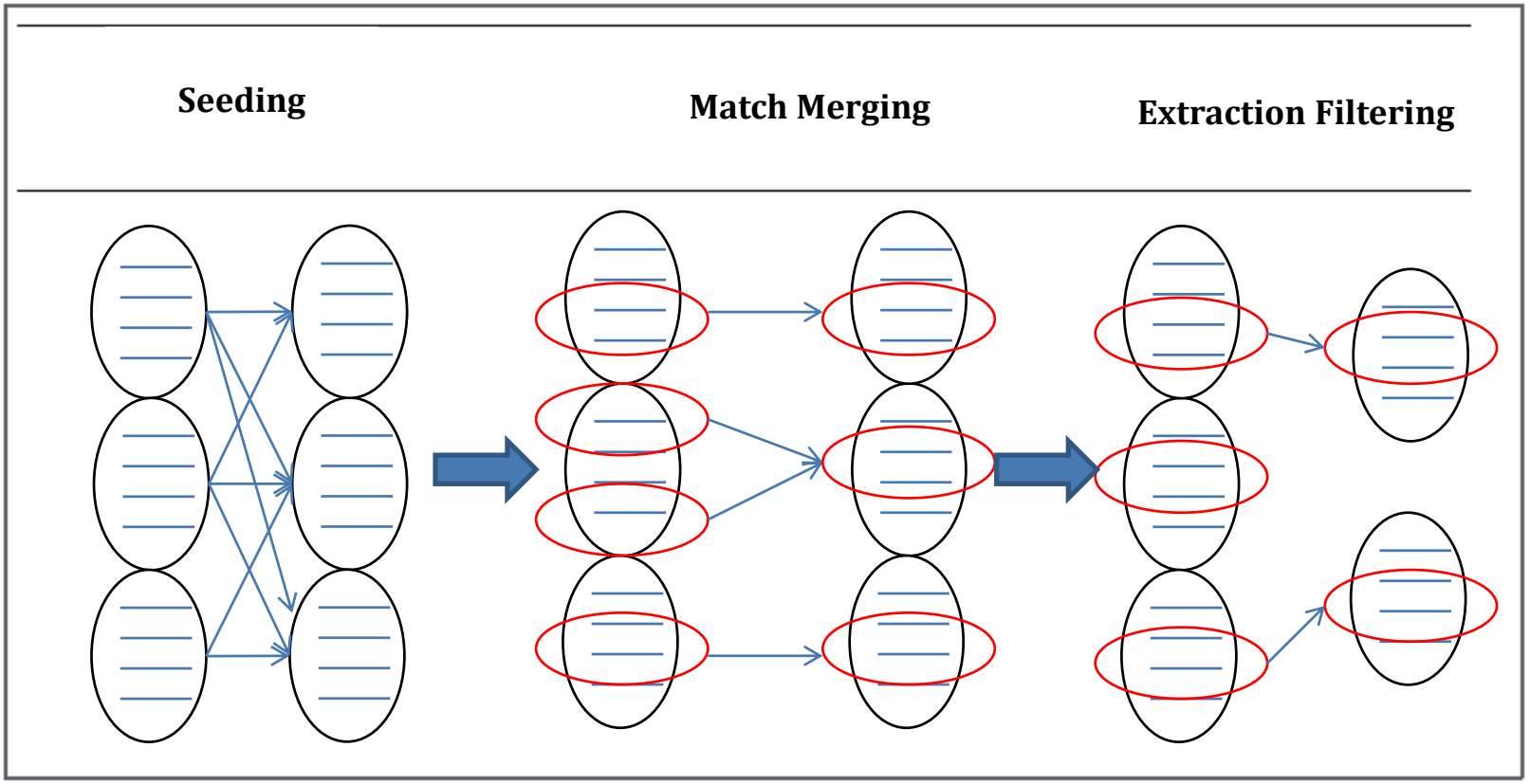
Seeding	Match Merging	Extraction Filtering



Text Alignment



Text Alignment



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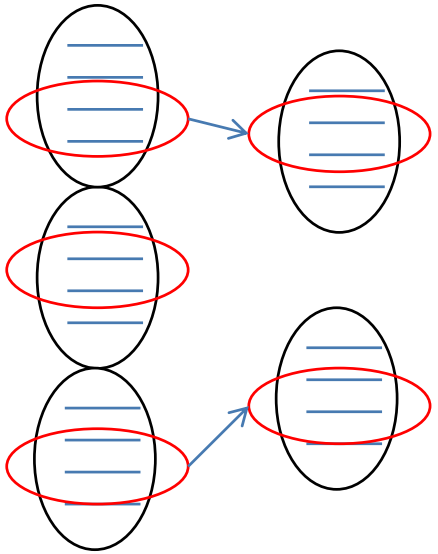
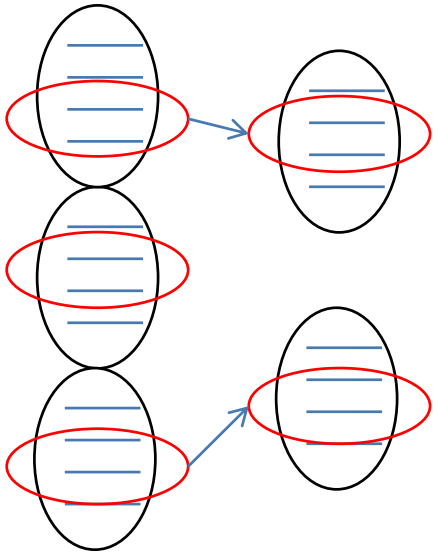


Text Alignment

Seeding **Match Merging** **Extraction Filtering**

$$J(I_S, I_R) = \frac{2 * \sum_{t \in I_S \cap I_R} Min(N_{I_S}(t), N_{I_R}(t))}{|I_S| + |I_R|}$$



Performance on the PAN2012 test corpus

Table 3: Overall evaluation results for the final test corpus

	Submission	PlagDet	Recall	Precision	Granularity	Runtime
1	torrejon13	0.82220	0.76190	0.89484	1.00141	72508 ms
2	kong13	0.81896	0.81344	0.82859	1.00336	364064 ms
3	suchomel13	0.74482	0.76593	0.72514	1.00028	1681835 ms
4	saremi13	0.69913	0.77123	0.86509	1.24450	26762432 ms
5	shrestha13	0.69551	0.73814	0.87461	1.22084	41070802 ms
6	palkovskii13	0.61523	0.53561	0.81699	1.07295	390020 ms
7	nourian13	0.57716	0.43381	0.94707	1.04343	2406514 ms
-	baseline	0.42191	0.34223	0.92939	1.27473	1831812 ms
8	gillam13	0.40059	0.25890	0.88487	1.00000	1278518 ms
9	jayapal13	0.27081	0.38187	0.87901	2.90698	289229 ms

Performance on the PAN2012 test corpus

Table 4: Results for the 02-no-obfuscation sub-corpus

	Submission	Dataset	PlagDet	Recall	Precision	Granularity
-	baseline	02	0.93404	0.99960	0.88741	1.00912
1	torrejon13	02	0.92586	0.95256	0.90060	1.00000
2	nourian13	02	0.90136	0.87626	0.92921	1.00092
3	shrestha13	02	0.89369	0.99902	0.80933	1.00083
4	gillam13	02	0.85884	0.83788	0.88088	1.00000
5	saremi13	02	0.84963	0.95416	0.82676	1.06007
6	kong13	02	0.82740	0.90682	0.76077	1.00000
7	palkovskii13	02	0.82431	0.85048	0.79971	1.00000
8	suchomel13	02	0.81761	0.99637	0.69323	1.00000
9	jayapal13	02	0.38780	0.86040	0.91989	3.90017

Performance on the PAN2012 test corpus

Table 5: Results for the 03-random-obfuscation

	Submission	Dataset	PlagDet	Recall	Precision	Granularity
1	kong13	03	0.82281	0.78682	0.86224	1.00000
2	suchomel13	03	0.75276	0.68886	0.82973	1.00000
3	torrejon13	03	0.74711	0.63370	0.90996	1.00000
4	shrestha13	03	0.66714	0.71461	0.92335	1.30962
5	saremi13	03	0.65668	0.68877	0.91810	1.29511
6	palkovskii13	03	0.49959	0.36420	0.93137	1.06785
7	nourian13	03	0.35076	0.23609	0.96274	1.11558
8	jayapal13	03	0.18148	0.18182	0.92314	2.19096
-	baseline	03	0.07123	0.04181	0.98101	1.18239
9	gillam13	03	0.04191	0.02142	0.95968	1.00000

Performance on the PAN2012 test corpus

Table 6: Results for the 04-translation-obfuscation

	Submission	Dataset	PlagDet	Recall	Precision	Granularity
1	kong13	04	0.85181	0.84626	0.85744	1.00000
2	torrejon13	04	0.85113	0.81124	0.89514	1.00000
3	saremi13	04	0.70903	0.80473	0.84819	1.24204
4	suchomel13	04	0.67544	0.66621	0.68494	1.00000
5	shrestha13	04	0.62719	0.63618	0.88008	1.26184
6	palkovskii13	04	0.60694	0.49667	0.82207	1.02825
7	nourian13	04	0.43864	0.28568	0.95856	1.00485
8	jayapal13	04	0.18181	0.19411	0.85653	2.34218
-	baseline	04	0.10630	0.08804	0.97825	1.86726
9	gillam13	04	0.01224	0.00616	0.97273	1.00000

Performance on the PAN2012 test corpus

Table 7: Evaluation results for the 05-summary-obfuscation

	Submission	Dataset	PlagDet	Recall	Precision	Granularity
1	suchomel13	05	0.61011	0.56296	0.67088	1.00476
2	kong13	05	0.43399	0.30017	0.96384	1.07742
3	torrejon13	05	0.34131	0.21593	0.90750	1.03086
4	shrestha13	05	0.11860	0.09897	0.90455	1.83696
5	nourian13	05	0.11535	0.07622	0.99972	1.34234
6	saremi13	05	0.11116	0.10209	0.94600	2.15556
7	palkovskii13	05	0.09943	0.08082	0.67604	1.73596
8	jayapal13	05	0.05940	0.07236	0.68832	3.60987
-	baseline	05	0.04462	0.03649	0.91147	1.97436
9	gillam13	05	0.00218	0.00109	0.99591	1.00000

Further work

- Use different methods to deal with different plagiarism problems to obtain a better performance
- Query keywords extraction and ranking

Thank you for your attention!

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