Iterative Mining Translations from the Web

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Outline

- Introduce
- former research on mining translation pairs on the Internet
- Iterative mining approach

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Introduction

- The number of bilingual or multilingual web pages is increasing faster than people’s expectation.
  - Parallel web pages
  - Comparable web pages
- Approach of mining translations on line
  - Alignment methods (STRAND)
  - Hyperlink methods
  - Other methods

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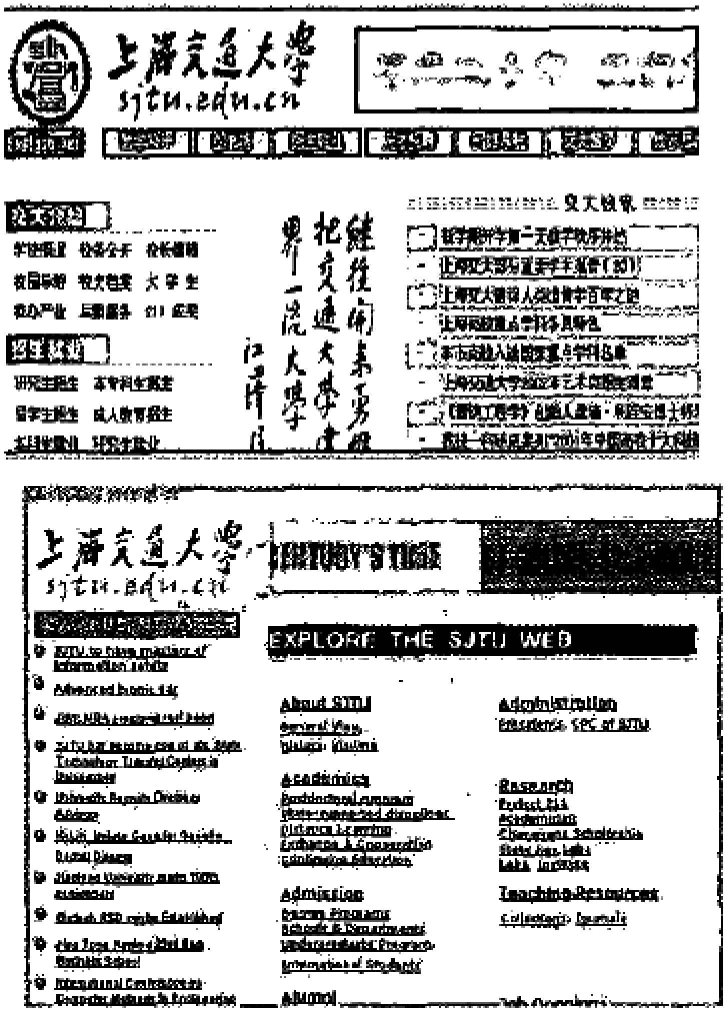
Web page components

- Four components
  - Title of the web page
  - Text of the web page
  - Markups (tags)
  - Hyperlinks
    - <a href=“http://www.lib.sjtu.edu.cn”>圖書館
    - <a href=“http://www.lib.sjtu.edu.ch/english/”>Libraries

Fig.1. Unparallel web pages



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Algorithm

1. Find the anchor point of two hyperlink vectors and DIS
2. Calculate Length penalty
3. Calculate the similarity of each term
4. Calculate the final result

Hyperlink vector

- Separate hyperlink by “/”
  - $H_e(T_1,T_2,\ldots,T_n)$
    - <a href=“http://www.lib.sjtu.edu.cn/english/”>
    - H_e(“http:”,”www.lib.sjtu.edu.cn”,”english”)
  - $H_c(M_1,M_2,\ldots,M_n)$
    - <a href=“http://www.lib.sjtu.edu.cn”>
    - H_c(“http:”,”www.lib.sjtu.edu.cn”)

Find out the anchor point for two hyperlinks

- The form of a hyperlink
    - Complete path
        - http://www.chian-cts.com/service/tele.htm
    - Relative path
        - service/tele.htm
    - Starting from its parent path
        - ../service/tele.htm

- Example
    - <a href="sitemap/index.html">網站地圖
      <a href="../eng/sitemap/index.html">sitemap
    - The anchor point is "sitemap"
        - H_c("sitemap","index.html")
          H_c("eng","sitemap","index.html")
            - The displacement (DIS) in a example is 1.
        - $H_{cc}(T_1,T_2,\ldots,T_n)$ and $H_{ee}(M_1,M_2,\ldots,M_m)$
            - H_c("sitemap","index.html")
              H_c("sitemap","index.html")

Length Penalty and Dice coefficient

- Length Penalty

$$Length\_Penalty = \frac{2 \times \min(n, m)}{m + n}$$

- The similarity of each term
  - Dice coefficient

$$Dice(T_i, M_i) = 2 \times \frac{\left|T_i \cap M_i\right|}{\left|T_i\right| + \left|M_i\right|} = sim_i$$

    - $\left|T_i \cap M_i\right|$: the length of common sub-string of T_i and M_i
    - $|M_i|$, $|T_i|$: the lengths of M_i and T_i individually

The similarity of H_{ee} and H_{cc}

- $sim(H_{ee}, H_{cc}) = Length\_Penalty \times \frac{1}{DIS} \times \sqrt{\frac{\sum_{i=1}^{\min(n,m)} sim_i^2}{\min(n,m)}}$

Evaluation

- Hyperlinks from about 100 web sites with Chinese and English version
  - 2567 Chinese hyperlinks
  - 771 English hyperlinks
  -

Similarity	Total items	Correct items	Precision
1	50	45	90%
0.9-1	18	18	100%
0.8-0.9	22	20	90%
0.7-0.8	15	7	47%
0.5-0.7	13	4	38%
<0.5	58	2	5%

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Definition and Principle

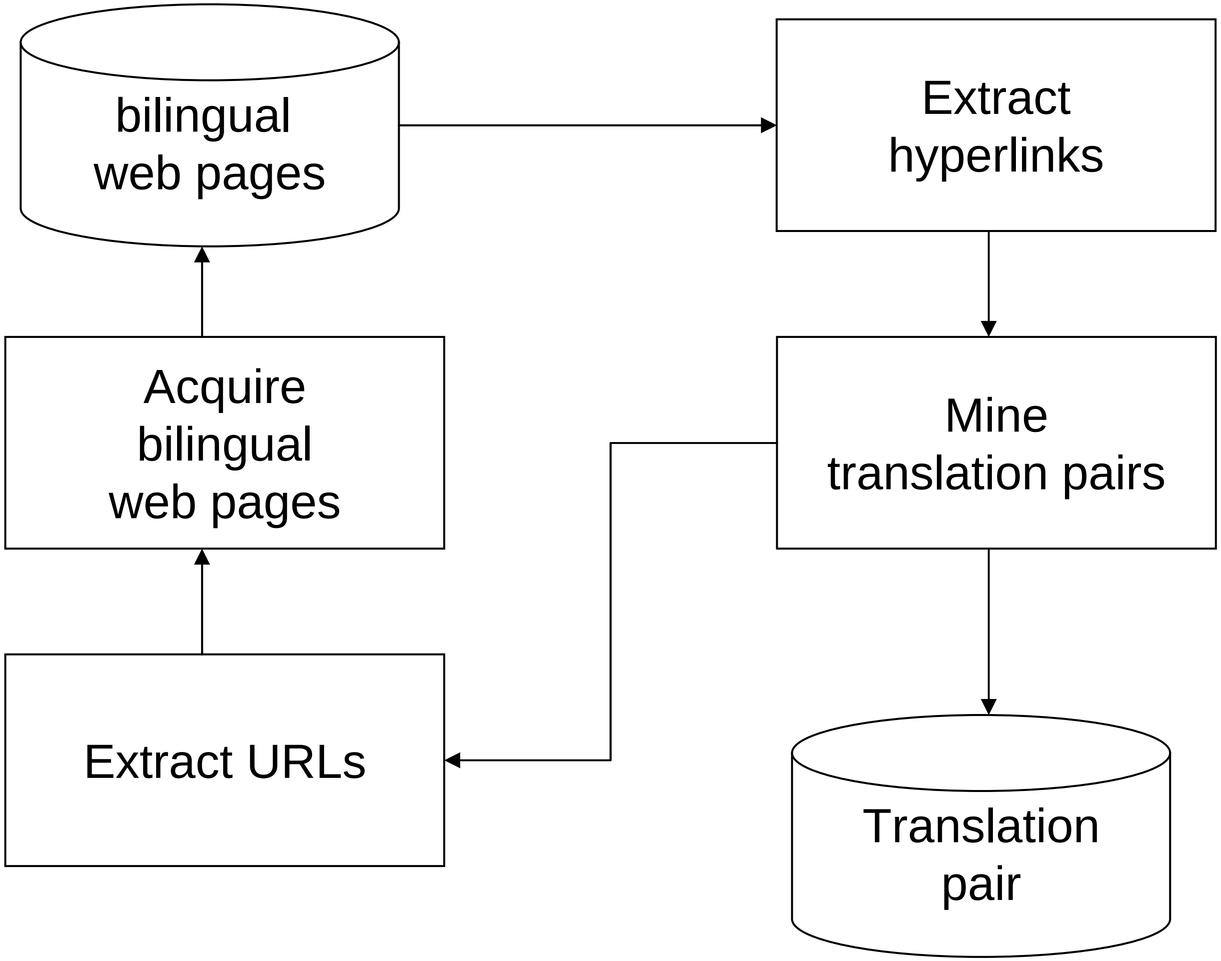
- Definition
  - a hyperlink triple
    <Content, SrcURL, HrefValue>
    - example
      - <“上海交通大學計算機系”, http://www.sjtu.edu.cn, “http://cs.sjtu.edu.cn”>
- Principle
  - Link_1<Content_1, SrcURL_1, HrefValue_1>
    Link_2<Content_2, SrcURL_2, HrefValue_2>
    1. the more similar of HrefValue_1 and HrefVaule_2, the more likely that Content_1 and Content_2 become translation
    2. the higher the weight of translation pair <Content_1, Content_2>, the more likely that HrefValue_1 and HrefValue_2 become a pair of bilingual page

Definition and Principle

- Definition
  - a hrefvalue triple
    <protocol, hostname, pathList>
    - pathList (p_1\\$p_2$\\...\\$p_n$)
      - <p_1,p_2,…,p_n>
  - prefix or postfix in path
    - example
      - <a href=“e_other/rmbcredit.jsp”>
    - hyperlinks from 333 pairs Chinese-English web pages
      -

	Number of hyperlink	With prefix or postfix	rate
Chinese Web page	15,695	3,896	24.8%
English Web page	12,211	3,963	32.5%

The system architecture



Algorithm of Extracting Translation Pairs

- ExtractTP(Link1<Content_1,SrcURL_1,HrefValue_1>, Link2<Content_2,SrcURL_2,HrefValue_2>)

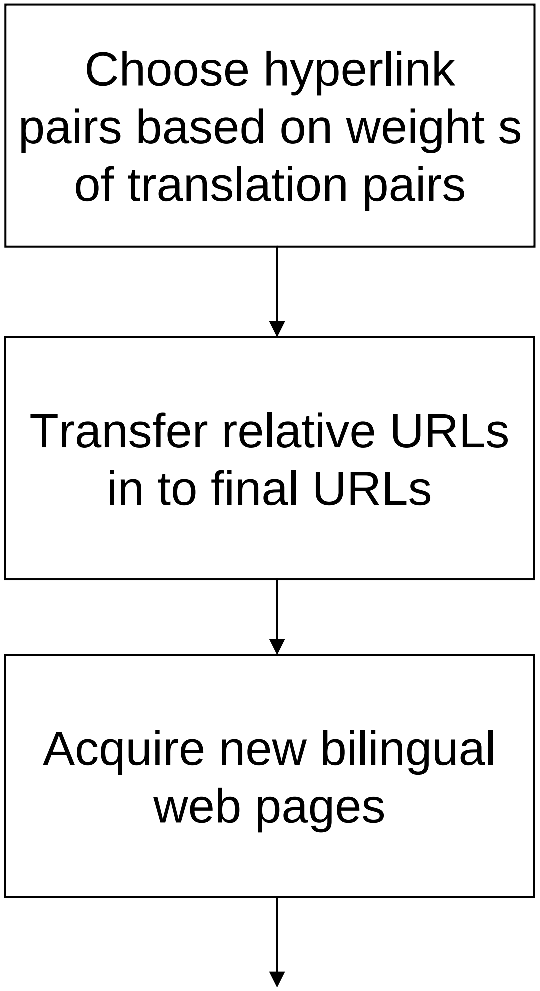
  1. form two sets of links $\textit{Link-set}_1$ and $\textit{Link-set}_2$ from web page $\textit{SrcURL}_1$ and $\textit{SrcURL}_2$
  2. compare Link_i in $\textit{Link-Set}_1$ with Link_j in $\textit{Link-Set}_2$ (the similarity score)
  3. if score is greater than the threshold (0.5), Content_1 and Content_2 are regarded as translations of each other

The Similarity

- N: the number of equal parts
  M: the number of not equal
  S: N/(N+M)

```
if $hostname_i$ != $hostname_j$ then S = 0;
else if
$pathList_i$ or $pathList_j$ has prefix or postfix, then
Delete its prefix or postfix
else if
$p_i$ (in $pathList_i$<$p_1$,$p_2$,…,$p_n$>) == $q_i$ (in $pathList_j$<$q_1$,$q_2$,…,$q_n$>)
then N++, else M++
```

Bilingual Web pages acquisition



Choose hyperlink pairs based on weight s of translation pairs

Transfer relative URLs in to final URLs

Acquire new bilingual web pages

- If the weight (similarity) of any translation is greater than or equal to the threshold (1), their hyperlinks are regarded as potential bilingual web pages.

Results and analysis

- Initial 333 bilingual (Chinese-English) web pages
- threshold
  - for translation pairs: 0.5
  - for new bilingual web pages: 1
- Results

Iteration	New bilingual web page pairs	Bilingual translation pairs	Precision of translation pairs
1	453	775	89.1%
6	898	1261	90.2%

Hyperlinks	Precision
Without deleting prefix /postfix	74.5%
Deleting prefix/postfix	90.2%

Conclusion

- mine translation from bilingual web pages
- This paper introduces two new features
  - get more translation pairs to improve hyperlink-based method by iterative process
  - prefix/postfix filter processing