NTNU – Trondheim
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IAD
INFORMATION ACCESS DISRUPTIONS

Indexing and Querying of Overlapping Structures

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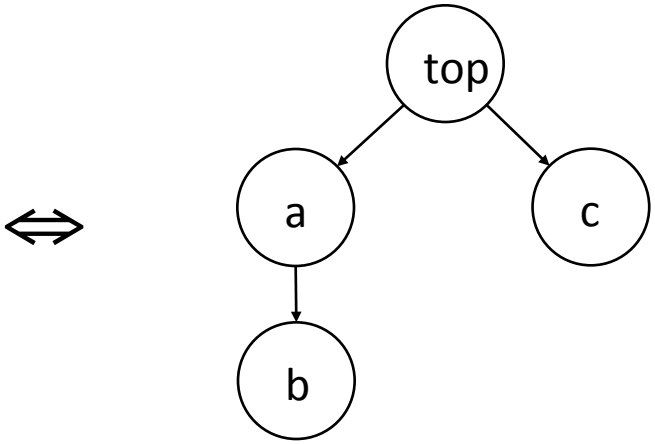
What we have

```
<top>
  <a>
    <b  />
  </a>
  </c>
</top>
```



- Indexing methods: Dewey, PrePost,…
- Query processing: Twig Pattern Matching
- Query language: XPath, XQuery, …

But …

In real life information is not purely hierarchical.

- Example: Annotating structure of documents
  - Physical view: page/ line
  - Logical view: section/ paragraph/ sentence
- There are several solutions for **encoding overlaps in XML**
  - E.g.: TEI guidelines for non-hierarchical structures

```
<page>
    <sentence>
        <line>Example</line>
        Overlapping
</page>
<page>
        Section
    </sentence>
</page>
```

But …

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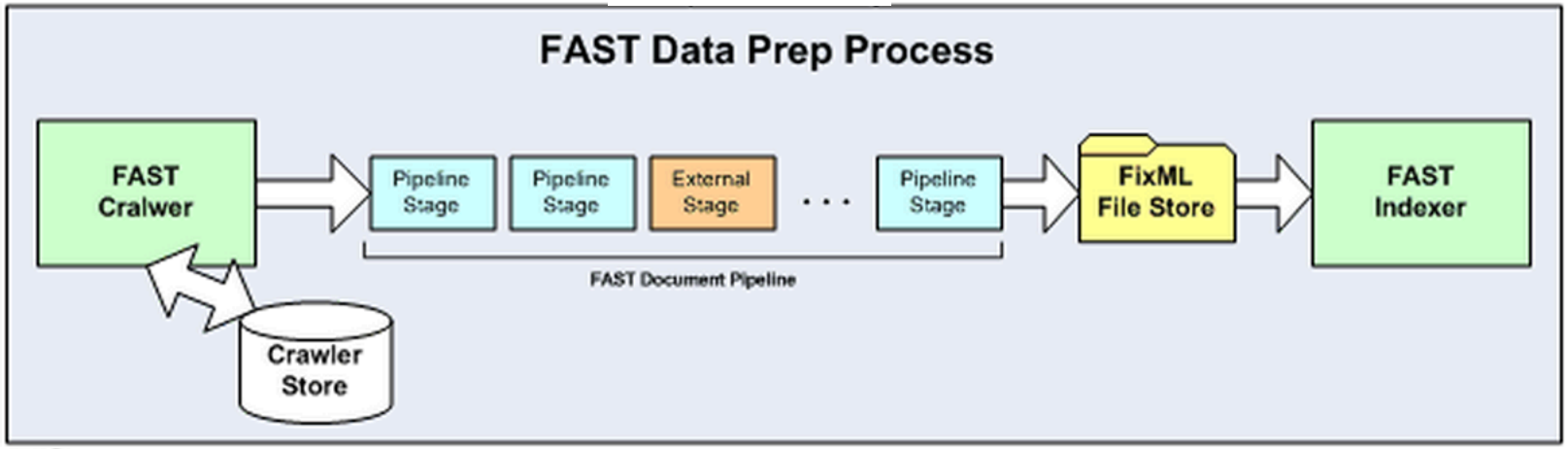
- There are several solutions for **encoding overlaps in XML**
  - E.g.: TEI guidelines for non-hierarchical structures

```
<page>
    <sentence n="1">
        <line>Example</line>
        Overlapping
    </sentence>
</page>
<page>
    <sentence n="2">Section</sentence>
</page>
```

Why Overlapping Matters?

Overlaps in **"Content Analysis" process of search engines**

- Microsoft FAST search server (ESP and FSIS):
  - Several components for analyzing input data
  - Each component adds annotations to input data
  - ➢ Annotations created by one component may overlap others



Research Questions

Main Research Question:

"How to efficiently handle overlaps in large-scale search engine?"

- **RQ1. Data model**
  Which data model can represent overlapping structures?
  How to map annotations to this data model?

- **RQ2: Indexing approach**
  How to index non-hierarchical structures?

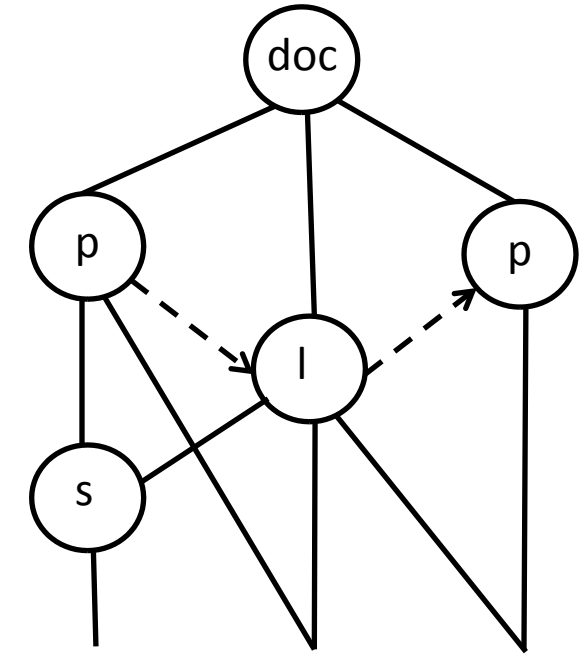
- **RQ3: Query processing approaches**
  - How to process queries of overlapping structures in search engines?
  - processing full text and structural queries

- **RQ4: Query language**
  - How users can ask queries on overlapping structures

Overlapping Data Model

Approach:
Extending GODDAG to a tree-like data model

- Each node can have multiple parents
- Inheritance is represented by solid arcs
- Overlapping is represented by dashed arcs
- **P - - -> S** means:
  1. Node P and node S are overlapping
  2. Node P precedes node S



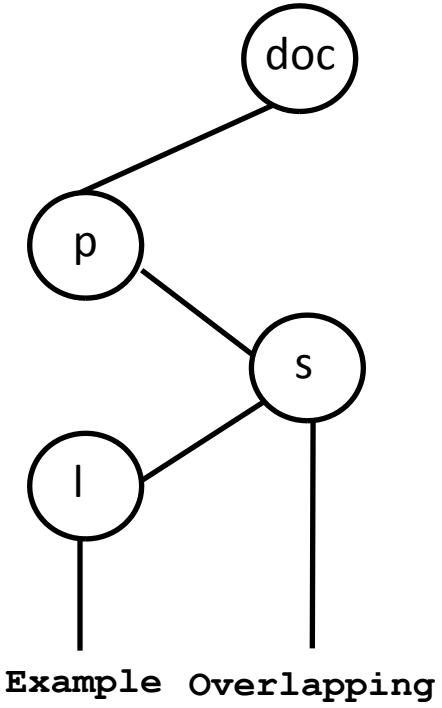
Example Overlapping section

Parsing Documents

Given adjacent opening tag <p> … <s>:

- Node <p> either contains or overlaps <s>
- Assume <p> contains <s>
- Parse the document like a tree

```
<doc>
  <p>
    <s>
      <l>Example</l>
      Overlapping
  </p>
  <p>
      Section
    </s>
  </p>
</doc>
```

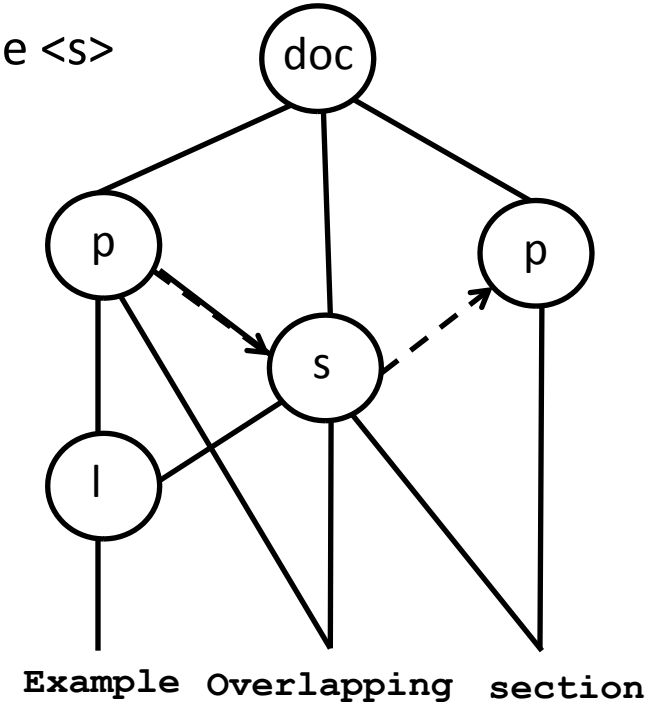


Parsing Documents

If node <p> and <s> are overlapping:

1. Change solid arc to dashed arc
2. Add a solid arc from parent of node <p> to node <s>
3. Add solid arcs from node <p> to children of node <s>

```
<doc>
  <p>
    <s>
      <l>Example</l>
      Overlapping
  </p>
  <p>
      Section
    </s>
  </p>
</doc>
```



Indexing Method

Approach: Extending XML Pre-post indexing method

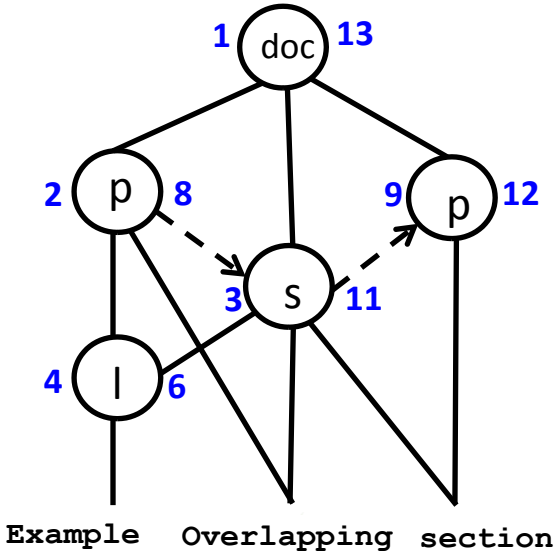
- Element index: (**docNo, start, end, parent(s)**)
  - **Start, end**: starting and end position of element
  - **Parent(s)**: start position of parent(s) node
- Text index: : (**docNo, position, parent(s)**)

(Element index)

<p>	(1, 2, 8, [1]) (1, 9, 12, [1]) ...
<s>	(1, 3, 11, [1]) ...
<l>	(1, 4, 6, [2, 3]) ...

(Text index)

Example	(1, 5, [4]) ...
Overlapping	(1, 7, [2, 3]) ...
Section	(1, 10, [3, 9]) ...



Indexing Method

The index can efficiently support:

- Overlapping:
  - <a> precedes and overlaps <b> IFF **a.start < b.start** AND **a.end < b.end**
- Ancestor-descendant:
  - <a> is ancestor of <b> IFF **a.start < b.start** AND **b.end < a.end**
- Parent-child:
  - <a> is parent of <b> IFF **b.parent = a.start**

Issue:

Not easy to maintain under dynamic updates

Challenges

1. The lack of **proper dataset**
   - A corpus collection that satisfies these properties:
     i. Real overlapping data
        - Most of overlapping datasets are artificially created for special purposes
     ii. Data with deep hierarchical structure
     iii. Large enough for indexing purpose
2. No appropriate framework
   - Existing open-source search engines can retrieve hierarchical structures
3. The lack of proper **baseline system**
   - No standard test set
   - Current approaches mostly use no indexing methods for handling overlaps

References

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