Introduction to Xaira

TEI@Oxford

July 2009
What is XAIRA?

- XML Aware Indexing and Retrieval Architecture
- Developed from the British National Corpus SARA program, it provides
  - a platform-independent XML indexer
  - a platform-independent server
  - a toolkit and a sophisticated query client interface for Windows
  - interface libraries for developing new clients in Java and PHP
- Developed with funding from the Andrew W Mellon foundation, xaira is an open source system released under the GPL
Historical Background (c.1994)

- Original design goals
  - robust searching of very large (c. 1 Gb) amount of SGML data
  - re-use available indexing tools
  - usable by researchers in CL, NLP, lexicography
- Original assumptions
  - client/server architecture
  - index build once only
  - one specific corpus (the BNC) only
Historical Background (c.2004)

• Design goals
  • robust searching of any amount of XML data
  • offload processing to other components wherever possible
  • assume nothing about input DTD/Schema
• Architecture
  • client/server still valid
  • expect to re-index often
  • expect multiple interfaces
Why another search engine?

- Can't you do all this with Google?
- Digital texts are not just for discovery and display of information
- Can't you do all this with eXist or CQP or Lucene or mySQL or ...?
- Probably, especially if you have a team of programmers at your disposal!
Xaira: the key features

• Indexes words as well as document structure
• Uses XML annotation to the max and thus supports XML-aware complex queries
• Leverages existing standards
  • TEI/XCES; Unicode; CSS and XML; SOAP
• Uses efficient and compact indexing appropriate to small or huge corpora
• Provides multiple interfaces to a common object model
Hoorah for Unicode

- All data is held internally as Unicode
- this allows us to defer most problems (e.g. tokenization, case-folding, line-breaking, character normalization, glyph composition) to someone else
- User interface issues
- For output, use one or more appropriate fonts
- For input, we provide a keyboard definition utility
Yes, but what does it do?

- XAIRA facilitates linguistic exploration of corpora, with or without XML markup
- Specifically, it produces
  - word lists and lexica
  - KWIC concordances
  - collocation and colligation lists
  - frequency distributions
- It facilitates intelligent search and retrieval, based on markup and marked up structures.
First catch your corpus...

- any collection of well-formed XML documents
- if a DTD is supplied, the corpus must be valid
- if no TEI header is present, one will be created
- if no XML tags are found, the wizard will put some in
- the more you put in, the more you get out
- "texts" are defined independently of file structure, as are the relevant units within them
- all indexing information is stored in the corpus header
Typical food for XAIRA (1)

Typical food for XAIRA (1)
Typical food for XAIRA (2)

<teiHeader> <fileDesc>
<titleStmt><title>[ACET factsheets & newsletters]. Sample containing about 6688 words of miscellanee (domain: social science)</title>
<respStmt> <resp>Data capture and transcription</resp> <name>Oxford University Press</name> </respStmt> <titleStmt>
<extent>6688 tokens; 6708 w-units; 423 s-units</extent>
<publishStmt><distributor>Distributed under licence by Oxford University Computing Services on behalf of the BNC Consortium.</distributor> <availability>This material is protected by international copyright laws and may not be copied or redistributed in any way.</availability> <idno type="bnc">A00</idno> </publishStmt>
<sourceDesc> <bibl> <title>[ACET factsheets & newsletters].</title> <publisher>Aids Care Education & Training</publisher> <pubPlace>London</pubPlace> <date value="1991-09">1991-09</date></bibl></sourceDesc>
<fileDesc><profileDesc>
<creation date="1991">1991-09</creation>
<textClass> <catRef targets="WRI ALLTIM3 ALLAVA2 ALLTYP5 WRIAAGO WRIADO WRIASEO WRIATY2 WRIAUD3 WRIDOM4 WRILEV2 WRIMED3 WRIPPP5 WRISAM5 WRISTA2 WRITAS3" />
<classCode scheme="DLEE">W nonAc: medicine</classCode>
<keywords><term>Health</term> <term>Sex</term></keywords>
</textClass> </profileDesc> ... </teiHeader>
The word query

- texts are made up of word forms
- word forms can have multiple *additional keys*
- for example the word form "aids" can be a noun (singular or plural), or a verb (singular only)
- XAIIRA can distinguish these and other cases, provided that additional keys have been defined for the corpus
XAIRA word query

A lemmatisation scheme determines how individual words are grouped under headwords. Select from the options below.

- null

Null lemmatisation, each word is its own headword.
The traditional KWIC display

- displays word occurrences in any order but in context
- can be sorted by left or right
- a stylesheet can be used to hide or use the XML markup
XAIRA KWIC display
You shall know a word by the company it keeps (J.R. Firth)

• lists word forms (or words) that appear significantly more frequently in the company of a given word than they do elsewhere
• statistics mutual information and Z-score are used to calculate "significantly more frequently"
• "the company" can be defined as words to the left or right, or within a given XML element
• colligation looks at the additional keys of the company kept by a word form
XAIRA collocations query

The window for a collocation is the number of words to the left and right of the hit which are searched for collocates.

Left: 0
Right: 4

Instead of a numeric window, a non-empty XML tag may be used.

- activity
- address
- age
- align
- attDef
- attList
- attributePolicy
- author
- availability
- bibfile
Partitions

- A corpus can be *partitioned* in several different ways
  - by pre-assigned category, domain, text-type, topic etc. specified in the markup, typically in the header
  - into texts that do or do not contain words that match a query (a partition of two halves)
  - arbitrarily, by hand

- Analysis shows the different rate of occurrence of hits in different classes of text within the partition
- Searches can be restricted to texts of a given classification (subcorpora)
XAIRA analysis display

### Analysis of Query 5

#### Text class

- **Measure size of XML hits**: Off
- **Downloads only**: Off
- **Omit #unc**: Off

<table>
<thead>
<tr>
<th>Class</th>
<th>Hits</th>
<th>Words</th>
<th>%</th>
<th>Hit texts</th>
<th>Texts</th>
</tr>
</thead>
<tbody>
<tr>
<td>header</td>
<td>0</td>
<td>9941</td>
<td>0.000</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Academic prose</td>
<td>212</td>
<td>17835229</td>
<td>0.001</td>
<td>42</td>
<td>497</td>
</tr>
<tr>
<td>Fiction and verse</td>
<td>46</td>
<td>19422757</td>
<td>0.000</td>
<td>20</td>
<td>452</td>
</tr>
<tr>
<td>Non-academic prose and bi...</td>
<td>883</td>
<td>27326165</td>
<td>0.003</td>
<td>76</td>
<td>744</td>
</tr>
<tr>
<td>Newspapers</td>
<td>245</td>
<td>10664356</td>
<td>0.002</td>
<td>59</td>
<td>486</td>
</tr>
<tr>
<td>Other published written mate...</td>
<td>360</td>
<td>20328945</td>
<td>0.002</td>
<td>91</td>
<td>711</td>
</tr>
<tr>
<td>Unpublished written material</td>
<td>73</td>
<td>5026021</td>
<td>0.001</td>
<td>22</td>
<td>251</td>
</tr>
<tr>
<td>Spoken conversation</td>
<td>19</td>
<td>4968198</td>
<td>0.000</td>
<td>8</td>
<td>153</td>
</tr>
<tr>
<td>Other spoken material</td>
<td>47</td>
<td>6995021</td>
<td>0.001</td>
<td>13</td>
<td>755</td>
</tr>
<tr>
<td>#unc</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1885</td>
<td>112576633</td>
<td>0.002</td>
<td>331</td>
<td>4051</td>
</tr>
</tbody>
</table>

#### Graphs

- **Histogram**: showing frequency distribution of various classes.
- **Pie chart**: showing percentage distribution of classes.
Other kinds of query

- Pattern query
- Additional key
- XML query
XML Queries - 1

- Search for an XML element or attribute value
XML Queries -1

- Display list of values found for an attribute

```
<table>
<thead>
<tr>
<th>Value</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>playing piano</td>
<td>96</td>
</tr>
<tr>
<td>telephone conver...</td>
<td>32</td>
</tr>
<tr>
<td>telephone conver...</td>
<td>30</td>
</tr>
<tr>
<td>dog barks</td>
<td>22</td>
</tr>
<tr>
<td>phone rings</td>
<td>17</td>
</tr>
<tr>
<td>speaking Italian</td>
<td>11</td>
</tr>
<tr>
<td>baby talk</td>
<td>9</td>
</tr>
<tr>
<td>Blowing whistle</td>
<td>9</td>
</tr>
<tr>
<td>noise</td>
<td>8</td>
</tr>
<tr>
<td>classroom chatter</td>
<td>8</td>
</tr>
<tr>
<td>television on</td>
<td>8</td>
</tr>
<tr>
<td>speaking Italian</td>
<td>8</td>
</tr>
<tr>
<td>music</td>
<td>7</td>
</tr>
<tr>
<td>muttering</td>
<td>7</td>
</tr>
<tr>
<td>break in tape</td>
<td>7</td>
</tr>
<tr>
<td>music playing</td>
<td>7</td>
</tr>
<tr>
<td>baby noise</td>
<td>7</td>
</tr>
<tr>
<td>children screaming</td>
<td>7</td>
</tr>
<tr>
<td>talking from other</td>
<td>6</td>
</tr>
</tbody>
</table>
```
Different views...
Different views...

The introduction

The introduction

Yeah that'll do.

Hold it, two of those, two of those coming down the stairs you might need you for something else up there, you'll never know. You're very good for something else up there, you'll never know. You're very good wait for it no, any minute now

You're very good

I'll tell you what we'll sing the five verse and then you can pick Can you hat this time frog

Here goes the introduction, are you ready to sing? Right, here's the bear song

Hey go, you'll be able to sing beautifully won't you? It goes like this ready off we go

OK Let's go

sshh, ooh if every body was as good as Victoria that would be somewhere else will you cos they're in a bit of a state there, alright, if you're in Mrs class

stand up, if you can tip toe without faffing, go to your classroom just Mrs class, tip toe, 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tip toe, ti...
Different views...
Different views...

PS087: Well there we go, you’ll be able to sing beautifully won’t you? It goes like this (playing piano).

PS001: [singing] The bear went over the mountain the bear went over the mountain, the bear went over the mountain, to see what he could see, and all that he could see, and all that he could see was the other side of the mountain, the other side of the mountain the other side of the mountain was all that he could see.

PS087:
Building complex queries

- visual interface
- scope node defines where to look
- an XML element
- by span
- query nodes define what to look for
- word, phrase, addkey, pattern, XML
- link types define sequence in which query node targets should occur
- next, one-way, two-way
Sentences beginning with conjunctions

...
Sequences of four adjectives

against a current Late Modern Western convention of identifying a parent...

Old good old Stubby.

and a policeman was supposed to be on duty because it was this great big wide Upper Parliament Street, and going across it, if I looked pulled back on the stick, and our plane was screaming up into the wide blue lovely bullet-free sky and the Maggot was laughing and...

Lynch, who fell at the first fence on his only other Grand National ride in 1981, had looked likely to miss...

The jubilant 46-year-old Argentinian celebrated landing the £91,660 first...

...after St George's finished on 175–7, despite a 2–55 return from 18-year old slow left arm bowler Howard Jones on his debut.

The Orange Beast, recalcitrant hero/heroine (politically correct transsexual eastern European motorcycle and sidecar) co...
Using Xaira as a back end

- PHP interface
- supports all calls to the Xaira object model
- php5-compatible library
- runs on any platform supporting php
Using the PHP interface

<table>
<thead>
<tr>
<th>View:</th>
<th>Hit:</th>
<th>Context:</th>
<th>Sort:</th>
<th>Script:</th>
</tr>
</thead>
</table>

| 10    | tobhya ta tadajhyeyam sa dharma iti nicayay akṣujjena ca mokṣap nātra | mahabarata 7955 |
| 11    | duḥkhataraṃ jīvaṃ dvipāyajesam ayaṃ vā rocataṃ dharma iti vācyah prayatnataḥ na kaś ca cid | mahabarata 7976 |
| 12    | sānantah vyavahāraś ca yo drstah sa dharma iti nāh śrutah yaś ca vedah | mahabarata 6008 |
| 13    | na ca mādrīśrutāv ubhau bhavān dharma ca iti sataham vratakarisah kaccid rājan na | mahabarata 2471 |
| 14    | pratīṣṭhānasya tasyaṃ kṣīṃ sāyaṃ prāparaṇīṣanam adharmo dharma iti ha yo 'jñānād ācāre | mahabarata 8957 |
| 15    | ghrasthāya tu gacchati nānāṃ tasmāt paro dharma iti prāhar maniśinah prānā hi mama | mahabarata 296 |
| 16    | mahān dosa vadhena saha kalpate ahimsālaksana dharma iti vedaviḍo viduḥ yad ahimsam bhavet | mahabarata 10899 |
| 17    | sūkṣmatvād gatam vicāraṃ kathāṃ ca na adharmo dharma iti va vyavāsayo na sakyate kartum | mahabarata 13048 |
| 18    | bhavasyati duṣkaram paramāpiñīmānāṃ tankerāra vyavasyati śrūti dharma iti hy eke veḍanta bahavo janāḥ | mahabarata 3816 |
| 19    | dhrārayati praśāh yād dhrāranamayuktām ca dharma iti nicayay ye 'ryāyena jihirasanto | mahabarata 5922 |
| 20    | loke vīgarhitam kṛta-pūrvinās tu tyajato mahān dharma iti śrūtiṃ samsiddhān puruṣo loke yad | mahabarata 20793 |
| 21    | prakalpayet yam ete 'bhuyanāturvedaḥ sa dharma iti nicayay eta eva trayo lokā | mahabarata 7874 |
| 22    | kurupravāram parivāra testhūḥ hā nātha hā dharma iti bruvaṇto ; hiṛyā ca sarve | mahabarata 1734 |
| 23    | dhanam dēyam śūdrāputrāya bhātāḥ ānṛmāṃyam paro dharma iti tasmā pradīyatā yatra tatra samutpanno | mahabarata 4527 |
| 24    | stipāṃsus tulya eva sah rathis sādhūrano dharma iti cāhā sa pārthivāh ațhā kena | mahabarata 4427 |
| 25    | vidhītāḥ praśāh yat śāya dhrāranamayuktām sa dharma iti nicayay śrutdharma iti hy eke | mahabarata 7951 |
Using the PHP interface