HS Corpus Linguistics / Korpuslinguistik

5. Representation formats & corpus queries

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Catching up: Overview of existing corpora

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Types of corpora

- written vs. spoken vs. multimodal/multi-media
- reference corpus vs. specialized corpus
- synchronic vs. diachronic (discrete, continuous)
- closed corpus vs. monitor corpus
- monolingual vs. multilingual (parallel, comparable)
- unannotated (raw text) vs. annotated
  - metadata = information about texts & speakers/authors
  - linguistic annotation = systematically coded interpretation
- corpus size: small & clean vs. large & messy
  - measured in M = million (or G = billion) running words

Some corpora everybody should know

- Brown Corpus (Francis & Kucera 1964)
  - American English, written (edited), texts published in 1961
  - 500 samples @ 2000 words from 15 text genres (*categories*)
- Brown Family
  - Brown (AmE, 1961), LOB (BrE, 1961) – Frown (AmE, 1991), FLOB (BrE, 1991) – BLOB (BrE, 1931), BE2006 (BrE, 2006)
- Penn Treebank (Marcus, Santorini & Marcinkiewicz, 1993)
  - ca. 3 million words of AmE with syntactic analyses (*parse trees*)
- British National Corpus (Aston & Burnard 1998)
  - British English, 90% written / 10% spoken, collected ca. 1991
  - approx. 100 million words in 4048 files (= texts / collections)
- Web as Corpus: WaCky (Baroni et al. 2009)
  - ca. 2 billion words of text from automatically crawled Web pages for each of DE, EN, FR, IT
  - many other Web as Corpus projects: larger corpora, additional languages (Arachnea, COW, SkE 10^{10})

Corpora: English

- British National Corpus — 100 M
  http://www.natcorp.ox.ac.uk/
  - BNC v2 in progress, with texts from around 2015
- Movie subtitles (DESC) — 90 M
- Gigaword newspaper corpus — 4 G
  - current: 5th edition (2011) / 2nd edition ca. 2 G words
    https://catalog.ldc.upenn.edu/LDC2011T07
- New York Times Annotated — 1.2 G
  https://catalog.ldc.upenn.edu/LDC2008T19
  - articles from 1987–2007 with manual categorization
- Corpus of Contemporary AmE (COCA) — 440 M
  http://corpus.byu.edu/coca/
  - only limited access via BYU Web interface
- Wackypedia (English Wikipedia of 2009) — 1 G
  http://wacky.sslmit.unibo.it/doku.php?id=corpora

Corpora: Other languages

- Few reference corpora available (similar to BNC)
  - American National Corpus aborted at 15 M words
    http://www.anc.org/
  - German DeReKo (53 G words) and DWDS (balanced core 100 M, extension 28 G)
    https://cosmas2.ids-mannheim.de/cosmas2-web/ http://www.dwds.de/ressourcen/korpora/
    only with limited Web access
  - Frantext only paid & limited Web access (ca. 200 M words)
    http://www.frantext.fr/
  - Hungarian National Corpus (ca. 100 M words)
    http://corpus.nytud.hu/mnsz/index_eng.html
  - Corpus Brasileiro (ca. 1 G words)
    http://corpusbrasileiro.pucsp.br/cb/Inicial.html
  - most w/o substantial amounts of spoken language

- Newspaper corpora difficult to acquire
  - LexisNexis does not allow systematic download & analysis
    http://www.lexisnexis.com/
  - newspaper publishers often ask steep prices

Corpora: Parallel corpora

- EuroParl debates of the EU Parliament — 10 – 60 M
  http://diates.lingfil.uu.se/Europarl.php
  - parallel corpus with translations into 21 EU languages
  - aligned at sentence level
- OpenSubtitles 2016 — up to 2.5 G
  http://diates.lingfil.uu.se/OpenSubtitles2016.php
  - parallel corpus of movie subtitles in 60 languages
- Parallel Web corpus (linguatools) — ca. 200 M
  http://linguatools.org/tools/corpora/webcrawl-parallel-corpus-german-english-2015/

Corpora: Web corpora

- WaCky (Web as Corpus kool ynitiative) — ca. 2 G
  http://wacky.sslmit.unibo.it/doku.php?id=corpora
  - first publicly available Web corpora (EN, DE, FR, IT)
- Aranea collection — 1 G
  http://sketch.juls.savba.sk/aranea_about/
  - Web corpora in 12 languages
- Corpora from the Web (COW) — 5 – 20 G
  http://corporafromtheweb.org/
  - up-to-date Web corpora in DE, EN, FR, ES, NL, SV
- USENET newsgroup corpus — ca. 7 G
  http://www.psych.ualberta.ca/~westburylab/downloads/usenetcorpus.download.html
  - newsgroup postings from 2005–2011
- Global Web-based English (GloWbE) — ca. 2 G
  http://corpus.byu.edu/glowbe/
  - onle limited Web access via BYU
- TenTen corpus family (≥ 10^{10} tokens in many languages) — up to 36 G
  https://www.sketchengine.eu/documentation/tenten-corpora/
  - only accessible in commercial Sketch Engine
- Crawl your own (specialized) corpus with BootCaT
  http://bootcat.dipintra.it/

Catching up: Corpus design

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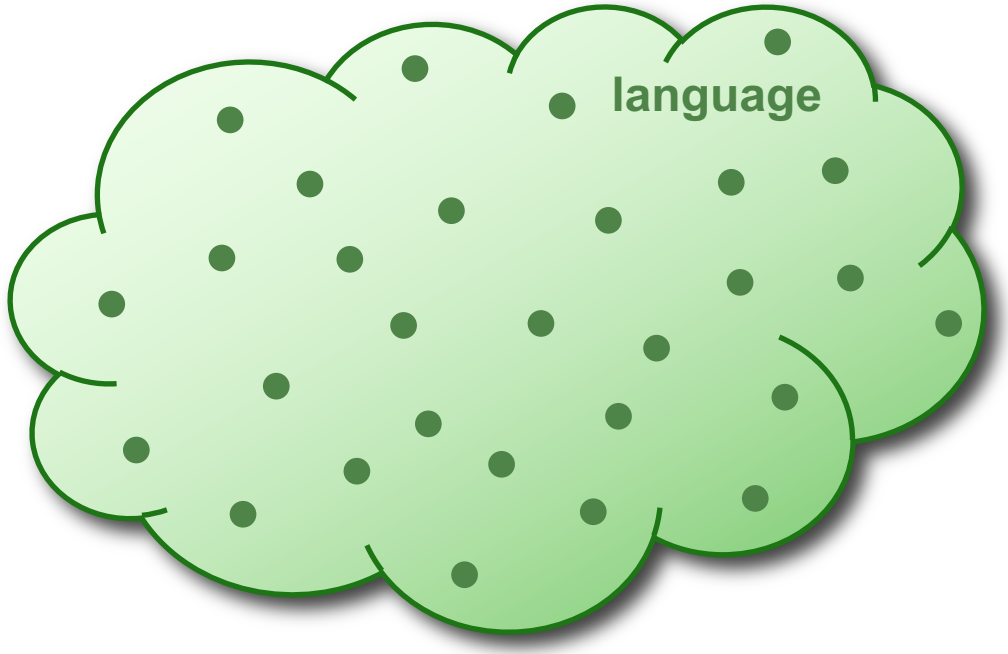
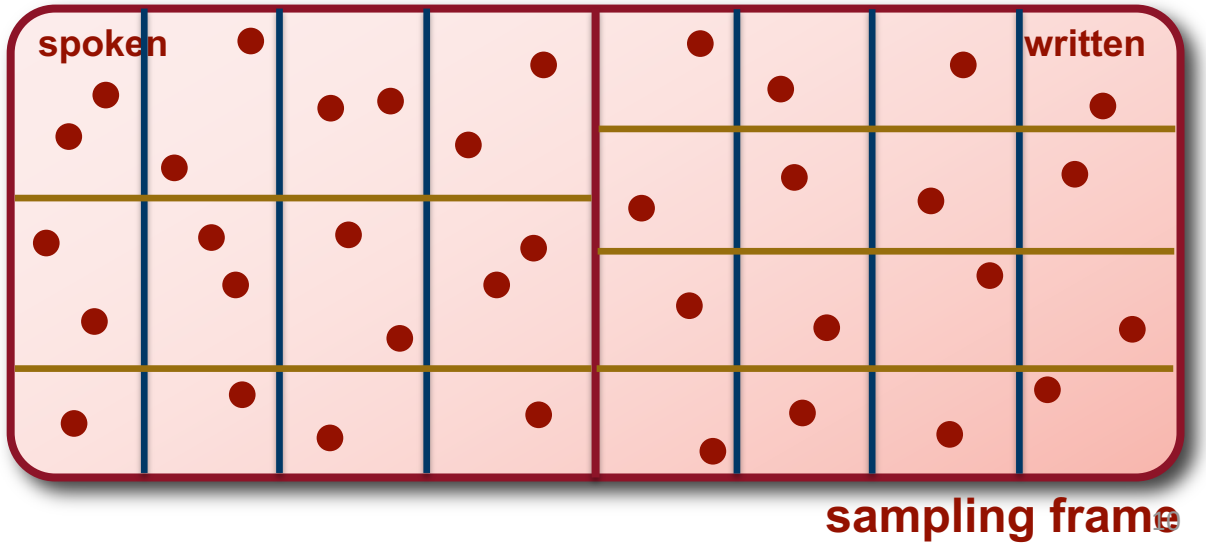
Representativeness & sampling

- Representativeness: corpus as completely **random sample**
  - **language** = extensional population, i.e. a (possibly infinite) collection of utterances
  - randomly select *n* objects from population



- Design criteria → **sampling frame**
  - dices up and defines linguistic population → make relevant texts **identifiable**
  - "A sampling frame is an operational definition of the population, an itemized listing of population members from which a representative corpus can be chosen." (Biber 1993, 244)
  - pick specified number of items from each cell (related to stratified sampling)



Representativeness & sampling

- Definition of a sampling frame
  - fundamental distinctions: mode (spoken/written/written-to-be-spoken), medium
  - text characteristics: (publication) date, author (single/multi/anon), region, target audience, …
  - function of text: genre / text type (factuality, purpose, situation, …), topic domain, …
  - properties of author/speaker: sex, age, dialect, social class, …
  - see Atkins et al. (1992) for a comprehensive system of categories

- Balance
  - include texts from all (combinations of) categories in the sampling frame = grid cells
  - avoids bias/skew → balanced coverage of the “language” population

- Representativeness
  - sampling frame makes population identifiable (for each combination of categories)
    → random selection of texts for each cell
  - must specifiy **proportion of texts** to be sampled from each category = prevalence in language

Brainstorming

How would you design a corpus for a study of evaluative language in music reviews?

… or another research question?

Representation formats

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Corpus annotation:
raw text + metadata

It seemed a day much as any other until I happened to look out of the back window. There was a little garden behind the house; a well-mown lawn surrounded by a neatly cut hedge, a few bushes and colourful flowers.

metadata

title:	The Garden
author:	Stefan Evert
author sex:	male
date:	05.08.1991

Corpus annotation: tokenization

It seemed a day much as any other until I happened to look out of the back window . There was a little garden behind the house ; a well-mown lawn surrounded by a neatly cut hedge , a few bushes and colourful flowers .

Corpus annotation:
sentence segmentation

<s> It seemed a day much as any other until I happened to look out of the back window . </s>

<s> There was a little garden behind the house ; a well-mown lawn surrounded by a neatly cut hedge , a few bushes and colourful flowers . </s>

Corpus annotation:
part-of-speech (POS) tagging

<S> It$_{PP}$ seemed$_{VBD}$ a$_{DT}$ day$_{NN}$ much$_{RB}$ as$_{IN}$ any$_{DT}$ other$_{JJ}$ until$_{IN}$ I$_{PP}$ happened$_{VBD}$ to$_{TO}$ look$_{VB}$ out$_{RP}$ of$_{IN}$ the$_{DT}$ back$_{JJ}$ window$_{NN}$.$_{SENT}$ </S>

<S> There$_{EX}$ was$_{VBD}$ a$_{DT}$ little$_{JJ}$ garden$_{NN}$ behind$_{IN}$ the$_{DT}$ house$_{NN}$;$_{:}$ a$_{DT}$ well-mown$_{VBN}$ lawn$_{NN}$ surrounded$_{VBN}$ by$_{IN}$ a$_{DT}$ neatly$_{RB}$ cut$_{VBN}$ hedge$_{NN}$,$_{,}$ a$_{DT}$ few$_{JJ}$ bushes$_{NNS}$ and$_{CC}$ colourful$_{JJ}$ flowers$_{NNS}$.$_{SENT}$ </S>

Corpus annotation: lemmatization

<s> It$_{PP}^{it}$ seemed$_{VBD}^{seem}$ a$_{DT}^{a}$ day$_{NN}^{day}$ much$_{RB}^{much}$ as$_{IN}^{as}$ any$_{DT}^{any}$ other$_{JJ}^{other}$ until$_{IN}^{until}$ I$_{PP}^{I}$ happened$_{VBD}^{happen}$ to$_{TO}^{to}$ look$_{VB}^{look}$ out$_{RP}^{out}$ of$_{IN}^{of}$ the$_{DT}^{the}$ back$_{JJ}^{back}$ window$_{NN}^{window}$.$_{SENT}^{.}$ </s>

<s> There$_{EX}^{there}$ was$_{VBD}^{be}$ a$_{DT}^{a}$ little$_{JJ}^{little}$ garden$_{NN}^{garden}$ behind$_{IN}^{behind}$ the$_{DT}^{the}$ house$_{NN}^{house}$;$_{:}^{;}$ a$_{DT}^{a}$ well-mown$_{VBN}^{???}$ lawn$_{NN}^{lawn}$ surrounded$_{VBN}^{surround}$ by$_{IN}^{by}$ a$_{DT}^{a}$ neatly$_{RB}^{neatly}$ cut$_{VBN}^{cut}$ hedge$_{NN}^{hedge}$,$_{,}^{,}$ a$_{DT}^{a}$ few$_{JJ}^{few}$ bushes$_{NNS}^{bush}$ and$_{CC}^{and}$ colourful$_{JJ}^{colorful}$ flowers$_{NNS}^{flower}$.$_{SENT}^{.}$ </s>

need a better representation format

XML markup of annotation

Standard for data interchange & archiving

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root element

element annotated with attributes

start tag of XML element

```
<corpus>
  <story num="6" title="The Garden">
    <p>
      <s>
        <token pos="PP"  lemma="it">It</token>
        <token pos="VBD" lemma="seem">seemed</token>
        <token pos="DT"  lemma="a">a</token>
        <token pos="NN"  lemma="day">day</token>
        <token pos="RB"  lemma="much">much</token>
        <token pos="IN"  lemma="as">as</token>
        <token pos="DT"  lemma="any">any</token>
        <token pos="JJ"  lemma="other">other</token>
        <token pos="IN"  lemma="until">until</token>
        <token pos="PP"  lemma="I">I</token>
      </s>
    </p>
  </story>
</corpus>
```

corresponding end tag

XML markup of annotation

Standard for data interchange & archiving

XML declaration

```
<?xml version="1.0" encoding="UTF-8"?>
<corpus>
  <story num="6" title="The Garden">
    <p>
      <s>
        <token pos="PP"  lemma="it">It</token>
        <token pos="VBD" lemma="seem">seemed</token>
        <token pos="DT"  lemma="a">a</token>
        <token pos="NN"  lemma="day">day</token>
        <token pos="RB"  lemma="much">much</token>
        <token pos="IN"  lemma="as">as</token>
        <token pos="DT"  lemma="any">any</token>
        <token pos="JJ"  lemma="other">other</token>
        <token pos="IN"  lemma="until">until</token>
        <token pos="PP"  lemma="I">I</token>
        ...
      </s>
    </p>
  </story>
</corpus>
```

XML markup of annotation

Standard for data interchange & archiving

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```
<?xml version="1.0" encoding="UTF-8"?>
<corpus>
 <metadata>
    <author>
      <name>Stefan Evert</name>
      <sex>male</sex>
    </author>
    <publication>
      <title>Very Short Stories</title>
      <type>collection</type>
      <genre>fiction</genre>
    </publication>
  </metadata>
  <story num="6" title="The Garden">
    <p>
      <s>
        <token pos="PP"  lemma="it">It</token>
        <token pos="VBD" lemma="seem">seemed</token>
        <token pos="DT"  lemma="a">a</token>
        <token pos="NN"  lemma="day">day</token>
        ...
```

metadata header

XML standards

- XML (Extensible Markup Language) is a widely-used standard for structured annotation
- A well-formed XML document only specifies the structure of annotation, not its semantics

- DTD (document type declaration) or XML Schema specify valid element names, their attributes and how they can be nested
  - still doesn't explain semantics without documentation!

- Exchange formats for text corpora:
  TEI (Text Encoding Initiative), XCES (Corpus Encoding Standard),
  ISO 24612: LAF (Linguistic Annotation Framework)
  - but more efficient representation required for corpus search etc.

TEI standard (BNC)

H9C.xml*

```
<bncDoc xml:id="H9C">
    <teiHeader>
        <fileDesc>
            <titleStmt>
                <title> The prince of darkness. Sample containing about 44223 words from a book
                    (domain: imaginative) </title>
                <respStmt>
                    <resp> Data capture and transcription </resp>
                    <name> Oxford University Press </name>
                </respStmt>
            </titleStmt>
            <editionStmt>
                <edition>BNC XML Edition, December 2006</edition>
            </editionStmt>
            <extent> 44223 tokens; 44797 w-units; 3933 s-units </extent>
            <publicationStmt>
                <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. Consult the BNC Web Site at
                    http://www.natcorp.ox.ac.uk for full licencing and distribution
                    conditions.</availability>
                <idno type="bnc">H9C</idno>
                <idno type="old"> PDarkn </idno>
            </publicationStmt>
            <sourceDesc>
                <bibl>
                    <title>The prince of darkness. </title>
                    <author domicile="Epping" n="DoherP1">Doherty, P C</author>
                    <imprint n="HEADLI1">
                        <publisher>Headline Book Publishing plc</publisher>
                        <pubPlace>London</pubPlace>
                        <date value="1992">1992</date>
                    </imprint>
                </bibl>
            </sourceDesc>
        </fileDesc>
        <encodingDesc>
            <tagsDecl>
                <namespace name="">
```

TEI header = metadata

text from British National Corpus

information about this text

TEI standard (BNC)

```
<wtext type="FICTION">
    <pb n="69"/>
    <div level="1">
        <head>
            <s n="2">
                <w c5="NN1" hw="chapter" pos="SUBST">Chapter </w>
                <w c5="CRD" hw="5" pos="ADJ">5</w>
            </s>
        </head>
        <p>
            <s n="3">
                <w c5="VVB-NN1" hw="ranulf" pos="VERB">Ranulf </w>
                <w c5="CJC" hw="and" pos="CONJ">and </w>
                <w c5="NP0" hw="dame" pos="SUBST">Dame </w>
                <w c5="NP0" hw="agatha" pos="SUBST">Agatha </w>
                <w c5="VBD" hw="be" pos="VERB">were </w>
                <w c5="VVG" hw="wait" pos="VERB">waiting </w>
                <w c5="PRP" hw="for" pos="PREP">for </w>
                <w c5="PNP" hw="he" pos="PRON">him </w>
                <w c5="PRP" hw="near" pos="PREP">near </w>
                <w c5="AT0" hw="the" pos="ART">the </w>
                <w c5="NN1-NP0" hw="galilee" pos="SUBST">Galilee </w>
                <w c5="NN1" hw="gate" pos="SUBST">Gate</w>
                <c c5="PUN">, </c>
                <w c5="AT0" hw="the" pos="ART">the </w>
                <w c5="AJ0" hw="young" pos="ADJ">young </w>
                <w c5="NN1" hw="nun" pos="SUBST">nun </w>
                <w c5="AV0" hw="apparently" pos="ADV">apparently </w>
                <w c5="VVG" hw="enjoy" pos="VERB">enjoying </w>
                <w c5="AT0" hw="an" pos="ART">an </w>
                <w c5="NN1" hw="account" pos="SUBST">account </w>
                <w c5="PRF" hw="of" pos="PREP">of </w>
                <w c5="CRD" hw="one" pos="ADJ">one </w>
                <w c5="PRF" hw="of" pos="PREP">of </w>
                <w c5="DPS" hw="he" pos="PRON">his </w>
                <w c5="NN1" hw="manservant" pos="SUBST">manservant</w>
                <w c5="POS" hw="'s" pos="UNC">'s </w>
                <w c5="DT0" hw="many" pos="ADJ">many </w>
                <w c5="NN2" hw="escapade" pos="SUBST">escapades </w>
                <w c5="PRP" hw="in" pos="PREP">in </w>
                <w c5="NP0" hw="london" pos="SUBST">London</w>
                <c c5="PUN">.</c>
```

TEI body = object data + annotation

structure & typographic markup

tokens + token-level annotations

principle:
raw text (= object data)
can be reconstructed by
deleting all XML tags

Vertical text format (.vrt)

Simpler, more efficient format → used by CWB & NLP tools

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```
<corpus>
<story title="The Garden">
<p>
<s>
It      PP   it
seemed  VBD  seem
a       DT   a
day     NN   day
much    RB   much
as      IN   as
any     DT   any
other   JJ   other
until   IN   until
I       PP   I
...
</s>
</p>
</story>
</corpus>
```

TAB characters (\t, \x09)

metadata

title:	The Garden
author:	Stefan Evert
author sex:	male
date:	05.08.1991

Vertical text format (.vrt)

Text metadata encoded in XML start tags (not in header!)

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```
<corpus>
<text title="The Garden" author="Stefan Evert" author_sex="male"
      date="1991-08-05">
<p num="1">
<s>
It        PP    it
seemed    VBD   seem
a         DT    a
day       NN    day
much      RB    much
as        IN    as
any       DT    any
other     JJ    other
until     IN    until
I         PP    I
...
</s>
</p>
</text>
</corpus>
```

CQPweb requires **<text>**,
SketchEngine prefers **<doc>**

sub-text level metadata

CoNLL format

Vertical text without the metadata

http://universaldependencies.org/docs/format.html

```
# story: "The Garden"
# paragraph #1
1   It       PP   it
2   seemed   VBD  seem
3   a        DT   a
4   fine     JJ   fine
5   day      NN   day
6   .        SENT .

1   There    EX   there
2   was      VBD  be
3   an       DT   a
4   elephant NN   elephant
5   .        SENT .

# this is the end of the file
```

these are just comments

blank lines = sentence boundaries

token numbers (within sentence)

CWB data model

Efficient binary format used by indexing & query tools

#	word	pos	lemma
0	A	DET	a
1	fine	ADJ	fine
2	example	NN	example
3	.	PUN	.
4	Very	ADV	very
5	fine	ADJ	fine
6	examples	NN	example
7	!	PUN	!

corpus position (“cpos”)

CWB data model

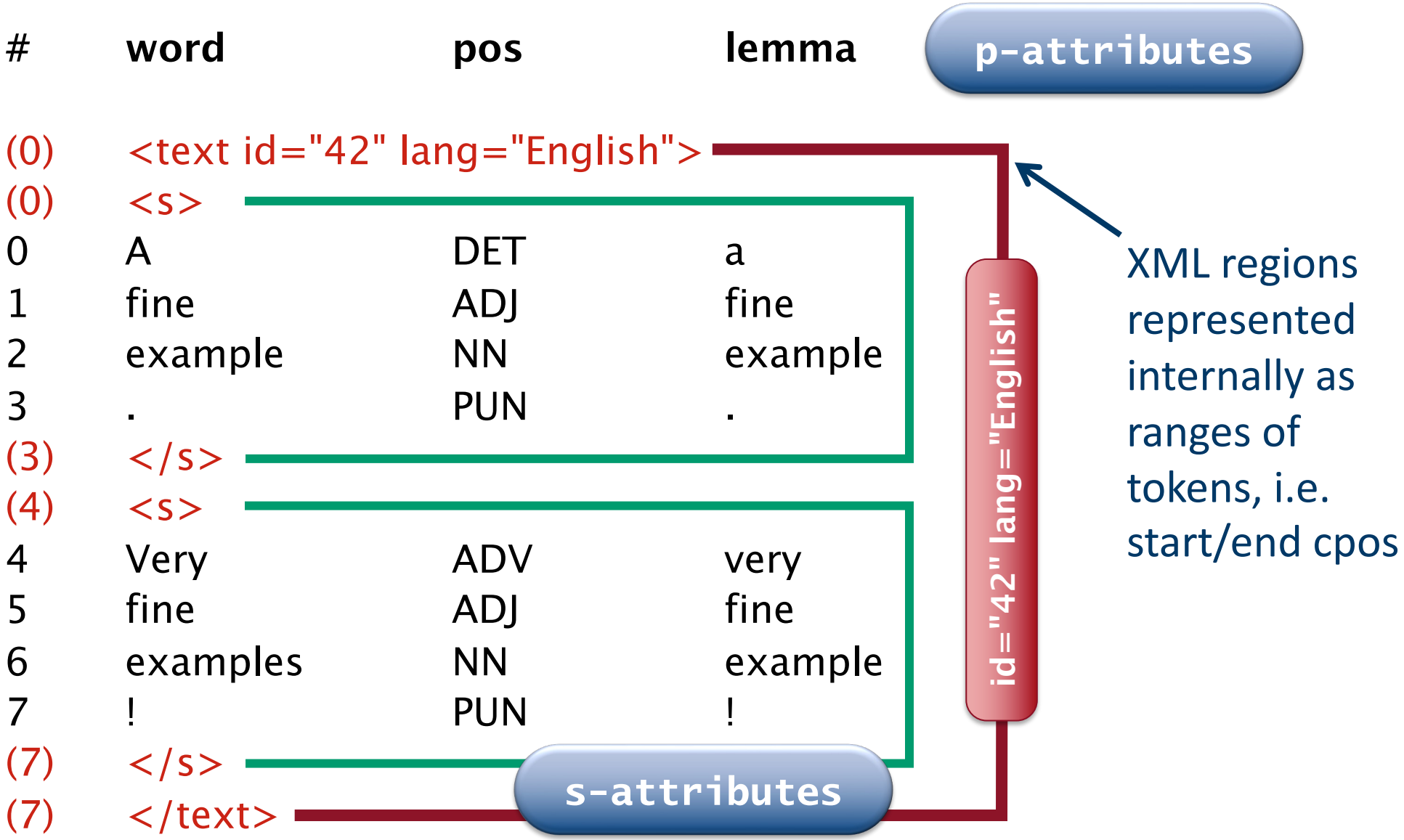
Efficient binary format used by indexing & query tools

#	word	pos	lemma
(0)	<text id="42" lang="English">		
(0)	<s>		
0	A	DET	a
1	fine	ADJ	fine
2	example	NN	example
3	.	PUN	.
(3)	</s>		
(4)	<s>		
4	Very	ADV	very
5	fine	ADJ	fine
6	examples	NN	example
7	!	PUN	!
(7)	</s>		
(7)	</text>		

XML tags inserted as “invisible” tokens

CWB data model

Efficient binary format used by indexing & query tools



Corpus queries

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CQPweb

- https://corpora.linguistik.uni-erlangen.de/cqpweb/
  - Login: `studentX` (1 … 15)
  - Password: `erlangen`

CEQL*

- Background information
  - Hardie (2012); Evert & Hardie (2011)
  - http://cwb.sourceforge.net/

- Documentation: YouTube tutorial videos
  https://www.youtube.com/user/CorpusWorkbench

*http://cwb.sourceforge.net/ceql.php

Other Web UIs @ FAU

- BNCweb
  https://corpora.linguistik.uni-erlangen.de/bncweb/
  CEQL*
  - Login: `studentX` (`1` … `15`)
  - Password: `erlangen`
  - for use with textbook *Corpus Linguistics with BNCweb – a Practical Guide* (Hoffmann et al. 2008)

- EuroParl debates
  https://corpora.linguistik.uni-erlangen.de/demos/CQP/Europarl/
  CEQL*

- HGC German Newspapers
  https://corpora.linguistik.uni-erlangen.de/demos/auth/HGC/
  CEQL*
  - Login: `demo`
  - Password: `demo`
  - annotated with morphological information

*http://cwb.sourceforge.net/ceql.php

Other Web interfaces using the same CWB technology

- OPUS collection of parallel corpora
  http://diates.lingfil.uu.se/
- Leeds IntelliText (multilingual, Web corpora)
  http://corpus.leeds.ac.uk/itweb/htdocs/Query.html
- BFSU CQPweb (Chinese & English corpora at BFSU)
  http://111.200.194.212/cqp/ http://www.bfsu-corpus.org/channels/corpus
- Linguateca AC/DC (Portuguese)
  http://www.linguateca.pt/ACDC/
- Hungarian National Corpus
  http://corpus.nytud.hu/mnsz/index_eng.html
- Corpus del Español Actual (Spanish)
  http://spanishfn.org/tools/cea/english
- Varitext (French)
  http://syrah.uni-koeln.de/varitext
- Spraakbanken (Swedish)
  http://spraakbanken.gu.se/parole/
- KorpusDK (Danish)
  http://ordnet.dk/korpusdk/
- Georgetown University CQPweb (some free corpora)
  https://corpling.uis.georgetown.edu/cqp/

Other Web interfaces using the same CWB technology

- TSCorpus (Turkish)
  http://tscorpus.com/
- CORIS/CODIS (Italian)
  http://corpora.ficlit.unibo.it/
- SSLMIT La Repubblica (Italian newspapers)
  http://dev.sslmit.unibo.it/corpora/corpus.php?path=&name=Repubblica
- BwanaNet (Catalan, Spanish, English)
  http://bwananet.iula.upf.edu/
- PolMine (German political corpora)
  http://polmine.sowi.uni-due.de/cwb/
- Perugia Corpus (Italian)
  https://www.unistrapg.it/cqpweb/
- CorpusEye (several languages, few free corpora)
  http://corp.hum.sdu.dk/
- CorpusWiki initative (multilingual, still very small)
  http://www.corpuswiki.org/

Further Web interfaces

- **BYU Corpora** (by Mark Davies)
  https://www.english-corpora.org
  - COCA, COHA, Soap Operas, GloWbE, TIME, Spanish, Portuguese, …
- Google Web 1T 5-Grams (n-gram database)
  http://corpora.linguistik.uni-erlangen.de/cgi-bin/demos/Web1T5/Web1T5_freq.perl
  - search n-gram tables, pre-computed (quasi-)collocation
  - NetSpeak offers a nicer Web interface to the database
    http://www.netspeak.org/
- Google Books Ngram Viewer (info)
  https://books.google.com/ngrams/ https://books.google.com/ngrams/info
  - visualize frequency changes over time (words, phrases)
- Linguee: English, German, French
  http://www.linguee.de/ http://www.linguee.com/ http://www.linguee.fr/
  - Web-crawled parallel corpora for many language pairs
  - useful to find possible translations (but *caveat emptor*)
- Treebank.info (automatically parsed corpora)
  http://treebank.info/
- Commercial **Sketch Engine** platform
  https://www.sketchengine.eu/
  - many large & small corpora in different languages
  - free access for master students in EMLex (MA Lexikographie)

Simple query syntax

- Most Web interfaces offer a “simple” query syntax
  - simply type a word or phrase
  - limited support for wildcards
- In this course: CEQL syntax
  - relatively powerful simple query language
  - supported by BNCweb, CQPweb and a few other UIs
- Tutorial & documentation
  - **Ch. 6** of Hoffmann, Sebastian *et al.* (2008). *Corpus Linguistics with BNCweb – a Practical Guide*, vol. 6 of English Corpus Linguistics. Peter Lang, Frankfurt.
  - official documentation: https://cwb.sourceforge.io/ceql.php
  - CQPweb simple query manual
    https://cqpweb.lancs.ac.uk/doc/cqpweb-simple-syntax-help.pdf

CEQL quickstart

`speak`	matches specific word form
`{speak}`	matches all inflected forms
`at the end of the day`	specific phrase
`is n't it \?`	tokenization rules & escapes
`*able`	suffix *-able*
`+able`	without the word *able*
`light_JJ`	the adjective *light*
`Mr _N*`	person (male)
`[Mr,Mrs] _N*`	person (male or female)
`Mr _N* {be} _J*`	what is said about the person
`Mr (_N*)+ {be} (_RB)? _J*`	

CEQL quickstart

`Smith:C`	turn off case folding
`deja:d vu:d`	ignore diacritics
`\D`	number (one or more digits)
`\u\u\u\u:C`	acronym (4 uppercase letters, e.g. *YMCA*)
`\u\L:C`	starts with uppercase letter
`take * off`	optional word
`take ++*** off`	between 2 and 5 words
`in ( _JJ* )? time`	optional adjective
`Mr (_N*)+ {be} (_RB)? _J*`	what is said about a person (refined query)
`his ( _JJS | most _JJ )* _N*`	alternatives
`<s> but`	start of sentence
`<ne_type=PERSON> (+)+ </ne_type>`	

CQPweb & CEQL practice

- What are the most frequent *uber-* words?
- Search for your favourite topic (one or more lemmas)
- In which year and newspaper is it most frequent?
- Carry out a collocation analysis for this topic
- Find different kinds of numbers and acronyms
- Can you identify predications like *austerity is good*?
- Find different types of named entities
- What are the typical patterns of headlines? (`<title>` …)

CQP query syntax

- Formal query notation
  - based on regular expression at multiple levels
  - allows precise specification of search pattern
  - much more flexible and powerful than CEQL syntax
- Supported by all CWB-based Web interfaces!
- Tutorial & documentation
  - **Ch. 12** of Hoffmann, Sebastian *et al.* (2008). *Corpus Linguistics with BNCweb – a Practical Guide*, vol. 6 of English Corpus Linguistics. Peter Lang, Frankfurt.
  - CQP Query Language Tutorial (online version)
    http://cwb.sourceforge.net/files/CQP_Tutorial.pdf http://cwb.sourceforge.net/files/CWB_Encoding_Tutorial/

CQP queries: single tokens

- Quoted regexp matches surface form of a token
  - `"(over|under)\w+"` or `'(over|under)\w+'`
  - duplicate embedded quotes: `""""` matches `"`

- Append flags for case/diacritic-insensitive search
  - `"deja"%c` … case-insensitive
  - `"deja"%d` … ignore diacritics
  - `"deja"%cd` … both
  - `"?"%l` … literal string (no metacharacters)

Regular expressions

- Regular expressions (regexp) are a sophisticated formal wildcard notation from computer science, used to describe patterns of characters or other elements
- Fundamental building blocks of regular expressions
  - `(…)?` optional element (0 or 1)
  - `(…)*` any number of repeats, incl. 0 (Kleene star)
  - `(…)+` at least one repetition
  - `(…|…|…)` alternatives
  - nesting of such elements makes regexp very powerful
- CEQL uses regexp notation over *tokens*
  - for optional tokens, repetitions and alternatives
- CQP & full-text search use regexp notation over individual characters (letters, digits, punctuation, …)
  - CQP also uses regexp notation over tokens (→ later)
- Different regexp "flavours": CQP supports PCRE
  - POSIX, PCRE = Perl-compatible regexp, Python, Oniguruma, …

PCRE regular expressions
PCRE = Perl-compatible regular expressions

- `(…)?` = optional (0 or 1)
- `(…)*` = any number of repeats (0 or more)
- `(…)+` = at least one repeat (1 or more)
- `(…){3}` = exactly 3
- `(…){2,4}` = between 2 and 4
  - applies to single character if parentheses are omitted
- `(…|…|…)` = alternatives (matches exactly one)
- `.` = any character (matchall)
  - esp.: `.?` (optional character), `.*` (arbitrary string), `.+`
- escapes: `\.` = ., `\*` = *, `\?` = ?, `\+` = +, …

PCRE regular expressions
PCRE = Perl-compatible regular expressions

- `[aeiou]` = character class (matches exactly one)
  - `[a-z]` = `[abc … z]` and `[A-Z]` = `[ABC … Z]`
  - `[0-9]` = `[0123456789]`
- `[^aeiou]` = everything(!) except `[aeiou]`
- escape sequences:
  - `\w` = letters, digits and `_` (word character)
  - `\s` = any single whitespace (blank, TAB, newline, …)
  - `\d` = digit
  - `\pL` = letter, `\p{Ll}` = lowercase, `\p{Lu}` = uppercase
  - `\pN` = digit, `\p{Cyrillic}` = cyrillic letter, …
    - see https://www.pcre.org/original/doc/html/pcrepattern.html#SEC5

CQP queries: single tokens

- Search token annotation with attribute-regexp pair:
  - `[lemma = "(over|under)\w+_ADJ"]` (BNC)
  - `[pos = "AJS"]` … superlatives (BNC)
  - `"deja"%cd` is shorthand for `[word = "deja"%cd]`

- Combine constraints with Boolean operators:
  - operators: `&` (and), `|` (or), `!` (not), `!=` (doesn't match)

  - `[(word="can"%c) & (pos!="VM.*")]`
  - same as: `[(word="can"%c) & !(pos="VM.*")]`

- All examples for BNCweb with CLAWS tagset

CQP queries: token sequences

- CQP queries are regular expressions over token descriptions (`[…]`)
  - `"in" [pos="AJ.*"]? [hw="year"]` … optional
  - `"in" [pos="AJ.*"]+ [hw="year"]` … one or more
  - `"in" [pos="AJ.*"]{2} [hw="year"]` … exactly two
  - `([pos="AJS"] | "most"%c [pos="AJ0"])` … either

- Skipping arbitrary tokens
  - `[]` … matchall (any token)
  - `"dog" []{0,4} "cat"` … within 5-token span
  - `"dog" []{0,4} "cat" within s` … must not cross a sentence boundary (s-attribute)

CQP queries: s-attributes

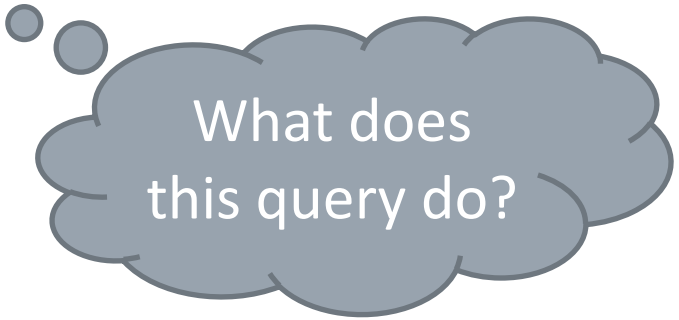
- XML tags match start/end of s-attribute regions
  - `<head> "UK"` … as first word of heading
  - `"UK" </head>` … as last word of heading
  - `<head>` … doesn't match anything (0 tokens)
  - `<mw> []* </mw>` … paired tags match entire region

- Search within a region:
  - `"Twain" within quote;`
  - `[pos="NN.*"] :: match.mw_pos = "PRP";`
    … add “global constraint” to check s-attribute annotation
  - pre-defined anchors: `match`, `matchend`, `target` (`@`)

CQP queries: token sequences

- Repetition operators and alternatives can be nested to search for complex lexicogrammatical patterns:

```
([pos="AJS"] | "most"%c [pos="AJ0"])
(
  "(and|\,)"%c
  ([pos="AJS"] | "most"%c [pos="AJ0"])
)+
[pos = "NN.*"]
```



- Matching strategy defaults to non-greedy
  - `"ho"%c ("," "ho"%c)+` … always matches *ho, ho*
  - `(?longest) "ho"%c ("," "ho"%c)+`
    … recent CQP versions support inline modifier at start of query

CQP query practice

- Find noun compounds / names with 4+ components
  - What are the longest compounds/names in the BNC?
- Find bare nouns (e.g. *went to school*)
- Find co-occurrences of *coffee* and *drink* (5-word span)

- Find verb-object combinations (active voice)
  - design flexible pattern for matching noun phrases
  - don't forget about phrasal verbs and adverbs

- What are the typical patterns of headlines?
  - Does your query account for all headlines in the BNC?

- Can you find inflected forms of verbs (≠ base form)?
  - hint: `normalize(word, "c")` → lowercased word form