EDAN20
Language Technology
http://cs.lth.se/edan20/
Chapter 3: Encoding and Annotation Schemes

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September 3, 2015

Character Sets

Codes are used to represent characters.
ASCII has 0 to 127 code points and is only for English
Latin-1 extends it to 256 code points. It can be used for most Western European languages but forgot many characters, like the French *Œ*, *œ*, the German quote „ or the Dutch *IJ*, *ij*.
Latin-1 was not adopted by all the operating systems, MacOS for instance; Windows used a variant of it.
Latin-9 is a better character set (published in 1999).

Unicode

Unicode is an attempt to represent most alphabets.
From *Programming Perl* by Larry Wall, Tom Christiansen, Jon Orwant, O'Reilly, 2000:

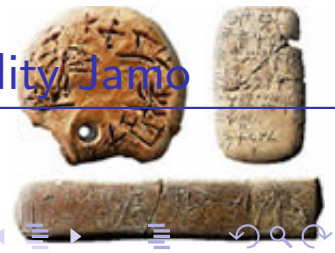
> *If you don't know yet what Unicode is, you will soon—even if you skip reading this chapter—because working with Unicode is becoming a necessity.*

It started with 16 bits and now uses 32 bits.
Ranges from 0 to 10FFFF in hexadecimal.
The standard character representation in many OSes and programming languages, including Java
Characters have a code point and a name as:

```
U+0042 LATIN CAPITAL LETTER B
U+0391 GREEK CAPITAL LETTER ALPHA
U+00C5 LATIN CAPITAL LETTER A WITH RING ABOVE
```

Unicode Blocks (Simplified)

Code	Name	Code	Name
U+0000	Basic Latin	U+1400	Unified Canadian Aboriginal Syllab
U+0080	Latin-1 Supplement	U+1680	Ogham, Runic
U+0100	Latin Extended-A	U+1780	Khmer
U+0180	Latin Extended-B	U+1800	Mongolian
U+0250	IPA Extensions	U+1E00	Latin Extended Additional
U+02B0	Spacing Modifier Letters	U+1F00	Extended Greek
U+0300	Combining Diacritical Marks	U+2000	Symbols
U+0370	Greek	U+2800	Braille Patterns
U+0400	Cyrillic	U+2E80	CJK Radicals Supplement
U+0530	Armenian	U+2F80	KangXi Radicals
U+0590	Hebrew	U+3000	CJK Symbols and Punctuation
U+0600	Arabic	U+3040	Hiragana, Katakana
U+0700	Syriac	U+3100	Bopomofo
U+0780	Thaana	U+3130	Hangul Compatibility Jamo



Unicode Blocks (Simplified) (II)

Code	Name	Code	Name
U+0900	Devanagari, Bengali	U+3190	Kanbun
U+0A00	Gurmukhi, Gujarati	U+31A0	Bopomofo Extended
U+0B00	Oriya, Tamil	U+3200	Enclosed CJK Letters and Months
U+0C00	Telugu, Kannada	U+3300	CJK Compatibility
U+0D00	Malayalam, Sinhala	U+3400	CJK Unified Ideographs Extension A
U+0E00	Thai, Lao	U+4E00	CJK Unified Ideographs
U+0F00	Tibetan	U+A000	Yi Syllables
U+1000	Myanmar	U+A490	Yi Radicals
U+10A0	Georgian	U+AC00	Hangul Syllables
U+1100	Hangul Jamo	U+D800	Surrogates
U+1200	Ethiopic	U+E000	Private Use
U+13A0	Cherokee	U+F900	Others

Regular Expressions and Unicode (I)

Perl defines classes using the \p{class} construct that matches the symbols in class and \P{class} that matches symbols not in class.

Expression	Description	Equivalent	\p{...} equiv.
\d	Any digit	[0-9]	\p{IsDigit}
\D	Any nondigit	[^0-9]	\P{IsDigit}
\s	Any whitespace character: space, tabulation, new line, carriage return, or form feed	[\t\n\r\f]	\p{IsSpace}
\S	Any nonwhitespace character	[^\s]	\P{IsSpace}
\w	Any word character: letter, digit, or underscore	[a-zA-Z0-9_]	\p{IsWord}
\W	Any nonword character	[^\w]	\P{IsWord}
\p{IsAlpha}	Any alphabetic character. It includes accented characters		
\p{IsAlnum}	Any alphanumeric character. It includes accented characters	[\p{IsAlpha} \p{IsDigit}]	
\p{IsPunct}	Any punctuation sign		
\p{IsLower}	Any lowercase character. It includes accented characters		
\p{IsUpper}	Any uppercase character. It includes accented characters		

Regular Expressions and Unicode (II)

Perl classes are compatible with Unicode.

- `\N{LATIN CAPITAL LETTER E WITH CIRCUMFLEX}` and `\x{CA}` that match Ê and
- `\N{GREEK CAPITAL LETTER GAMMA}` and `\x{393}` that match γ.

We match code points in blocks, categories, and scripts with the `\p{property}` construct or its complement `\P{property}`.
For example, `\p{InGreek_and_Coptic}`, for a block, `\p{Currency_Symbol}` matches currency symbols, `\P{L}` all nonletters, `\p{Greek}`, the Greek characters.
The three instructions below match lines consisting respectively of ASCII characters, of characters in the Greek and Coptic block, and of Greek characters:

```
$line =~ m/^\p{IsASCII}+$/;
$line =~ m/^\p{InGreek_and_Coptic}+$/;
$line =~ m/^\p{Greek}+$/;
```

The Unicode Encoding Schemes

Unicode offers three different encoding schemes: UTF-8, UTF-16, and UTF-32.
UTF-16 was the standard encoding scheme.
It uses fixed units of 16 bits – 2 bytes –
FÊTE 0046 00CA 0054 0045
UTF-8 is a variable length encoding.
It maps the ASCII code characters U+0000 to U+007F to their byte values 0x00 to 0x7F.
All the other characters in the range U+007F to U+FFFF are encoded as a sequence of two or more bytes.

UTF-8

Range	Encoding
U-0000 – U-007F	0xxxxxxx
U-0080 – U-07FF	110xxxxx 10xxxxxx
U-0800 – U-FFFF	1110xxxx 10xxxxxx 10xxxxxx
U-010000 – U-10FFFF	11110xxx 10xxxxxx 10xxxxxx 10xxxxxx

Encoding FÊTE in UTF-8

The letters F, T, and E are in the range U-00000000..U-0000007F.
Ê is U+00CA and is in the range U-00000080..U-000007FF.
Its binary representation is 0000 0000 1100 1010.
UTF-8 uses the eleven rightmost bits of 00CA.
The first five underlined bits together with the prefix 110 form the octet 1100 0011 that corresponds to C3 in hexadecimal.
The seven next boldface bits with the prefix 10 form the octet 1000 1010 or 8A in hexadecimal.
The letter Ê is encoded or C3 8A in UTF-8.
FÊTE and the code points U+0046 U+00CA U+0054 U+0045 are encoded as 46 C3 8A 54 45

Locales and Word Order

Depending on the language, dates, numbers, time is represented differently:
Numbers: 3.14 or 3,14?
Time: 01/02/03

- 3 februari 2001?
- January 2, 2003?
- 1 February 2003?

Collating strings: is Andersson before or after Åkesson?

The Unicode Collation Algorithm

The Unicode consortium has defined a collation algorithm that takes into account the different practices and cultures in lexical ordering. It has three levels for Latin scripts:

- The primary level considers differences between base characters, for instance between A and B.
- If there are no differences at the first level, the secondary level considers the accents on the characters.
- And finally, the third level considers the case differences between the characters.

Differences

These level features are general, but not universal.
Accents are a secondary difference in many languages but Swedish sorts accented letters as individual ones and hence sets a primary difference between A and Å or O and Ö.

1. First level: {a, A, á, Á, à, À, etc.} < {b, B} < {c, C, ć, Ć, ĉ, Ĉ, ç, Ç, etc.} < {e, E, é, É, è, È, ê, Ê, ë, Ë, etc.} < ...
2. Second level: {e, E} << {é, É} << {è, È} << {ê, Ê} << {ë, Ë}
3. Third level: {a} <<< {A}

The comparison at the second level is done from the left to the right of a word in English, the reverse in French.

Sorting Words in French and English

English	French
Péché	*pèche*
PÉCHÉ	*pêche*
pèche	*Pêche*
pêche	*Péché*
Pêche	*PÉCHÉ*
pêché	*pêché*
Pêché	*Pêché*
pécher	*pécher*
pêcher	*pêcher*

Markup Languages

Markup languages are used to annotate texts with a structure and a presentation
Annotation schemes used by word processors include LaTex, RTF, etc.
XML, which resembles HTML, is now a standard annotation and exchange language
XML is a coding framework: a language to define ways of structuring documents.
XML is also used to create tabulated data (database-compatible data)

XML

XML uses plain text and not binary codes.
It separates the definition of structure instructions from the content – the data.
Structure instructions are described in a document type definition (DTD) that models a class of XML documents.
Document type definitions contain the specific tagsets to mark up texts.
A DTD lists the legal tags and their relationships with other tags.
XML has APIs available in many programming languages: Java, Perl, SWI Prolog, etc.

XML Elements

A DTD is composed of three kinds of components: elements, attributes, and entities.
The elements are the logical units of an XML document.
A DocBook-like description (http://www.docbook.org/)

```
<!-- My first XML document -->
<book>
  <title>Network Processing Cookbook</title>
  <author>Pierre Cagné</author>

  <!-- The image to show on the cover -->
  <img></img>
  <text>Here comes the text!</text>
</book>
```

Differences with HTML

XML tags must be balanced, which means that an end tag must follow each start tag.
Empty elements `<img></img>` can be abridged as `<img/>`.
XML tags are case sensitive: `<TITLE>` and `<title>` define different elements.
An XML document defines one single root element that spans the document, here `<book>`

XML Attributes

An element can have attributes, i.e. a set of properties.
A <title> element can have an alignment: flush left, right, or center, and a character style: underlined, bold, or italics.
Attributes are inserted as name-value pairs in the start tag

```
<title align="center" style="bold">
  Network Processing Cookbook
</title>
```

Entities

Entities are data stored somewhere in a computer that have a name.
They can be accented characters, symbols, strings as well as text or image files.
An entity reference is the entity name enclosed by a start delimiter & and an end delimiter ; such as `&EntityName;`
The entity reference will be replaced by the entity.
Useful entities are the predefined entities and the character entities

Entities (II)

There are five predefined entities recognized by XML.
They correspond to characters used by the XML standard, which can't be used as is in a document.

Symbol	Entity encoding	Meaning
<	<	Less than
>	>	Greater than
&	&	Ampersand
"	"	Quotation mark
'	'	Apostrophe

A character reference is the Unicode value for a single character such as Ê for Ê (or Ê)

Writing a DTD: Elements

A DTD specifies the formal structure of a document type.
A DTD file contains the description of all the legal elements, attributes, and entities.
The description of the elements is enclosed between the delimiters `<!ELEMENT` and `>`.

```
<!ELEMENT book (title, (author | editor)?, img, chapter+)>
<!ELEMENT title (#PCDATA)>
```

Character Types

Character type	Description
PCDATA	Parsed character data. This data will be parsed and must only be text, punctuation, and special characters; no embedded elements
ANY	PCDATA or any DTD element
EMPTY	No content – just a placeholder

Writing a DTD: Attributes

Attributes are the possible properties of the elements.
Their description is enclosed between the delimiters <!ATTLIST and >.

```
<!ATTLIST title
  style (underlined | bold | italics) "bold"
  align (left | center | right) "left">
```

Some XML Attribute Types

Attribute types	Description
CDATA	The string type: any character except <, >, &, ', and "
ID	An identifier of the element unique in the document; ID must begin with a letter, an underscore, or a colon
IDREF	A reference to an identifier
NMTOKEN	String of letters, digits, periods, underscores, hyphens, and colons. It is more restrictive than CDATA, for instance, spaces are not allowed

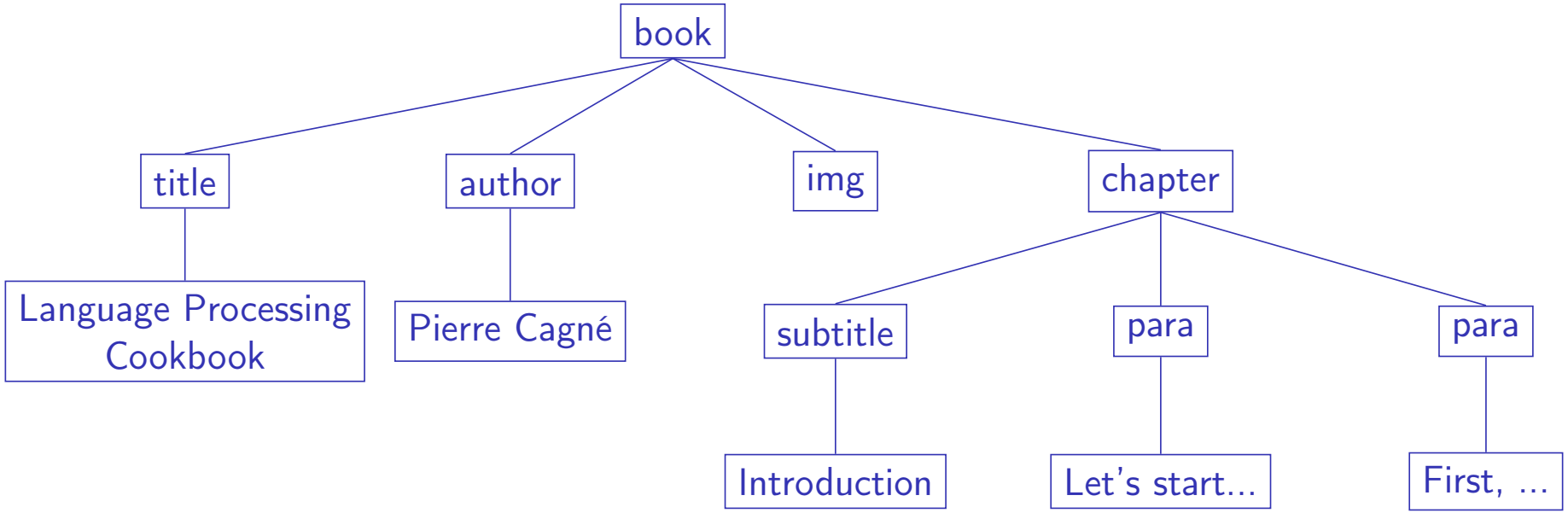
Some Default Value Keywords

Predefined default values	Description
`#REQUIRED`	A value must be supplied
`#FIXED`	The attribute value is constant and must be equal to the default value
`#IMPLIED`	If no value is supplied, the processing system will define the value

Writing an XML Document

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE book [
<!ELEMENT book (title, (author | editor)?, img, chapter+)>
<!ELEMENT title (#PCDATA)>
...
]>
<book>
  <title style="i">Language Processing Cookbook</title>
  <author style="b">Pierre Cagné</author>
  <img src="pierre.jpg"/>
  <chapter number="c1">
    <subtitle>Introduction</subtitle>
    <para>Let&apos;s start doing simple things: collect texts.
    </para>
    <para>First, choose a site you like</para>
  </chapter>
</book>
```

Tree Representation



Parsing XML

SWI Prolog has a package to process XML files:
http://www.swi-prolog.org/packages/sgml2pl.html
It makes it very easy to load and parse an XML document.
The most useful predicate is:

```
load_xml_file(+File, -ListOfContent)
```

as in

```
load_xml_file('MyBook.xml', Term), write(Term).
```

The element predicate has the form:

```
element(Name, ListAttributes, ListOfContent)
```

Linguistic Annotation

Some text and language processing tools use XML.
Document from `http://xml.openoffice.org/` are interesting to read
See also `http://www.ecma-international.org/publications/standards/Ecma-376.htm`
See also EPUB: `http://www.idpf.org/specs.htm`
Granska and CrossCheck projects are other examples.
The reference tagset for Swedish comes from the Stockholm-Umeå Corpus.
`http://www.nada.kth.se/~johnny/corpus/format.html`

> *Bilen framför justitieministern svängde fram och tillbaka över vägen så att hon blev rädd.*
> *"The car in front of the Justice Minister swung back and forth and she was frightened."*

Parts of Speech with Lemmas

```
<taglemmas>
  <taglemma id="1" tag="nn.utr.sin.def.nom" lemma="bil"/>
  <taglemma id="2" tag="pp" lemma="framför"/>
  <taglemma id="3" tag="nn.utr.sin.def.nom" lemma="justitiemini
  <taglemma id="4" tag="vb.prt.akt" lemma="svänga"/>
  <taglemma id="5" tag="ab" lemma="fram"/>
  <taglemma id="6" tag="kn" lemma="och"/>
  <taglemma id="7" tag="ab" lemma="tillbaka"/>
  <taglemma id="8" tag="pp" lemma="över"/>
  <taglemma id="9" tag="nn.utr.sin.def.nom" lemma="väg"/>
  <taglemma id="10" tag="ab" lemma="så"/>
  <taglemma id="11" tag="sn" lemma="att"/>
  <taglemma id="12" tag="pn.utr.sin.def.sub" lemma="hon"/>
  <taglemma id="13" tag="vb.prt.akt.kop" lemma="bli"/>
  <taglemma id="14" tag="jj.pos.utr.sin.ind.nom" lemma="rädd"/>
  <taglemma id="15" tag="mad" lemma="."/>
```