Markup Languages
SGML, HTML, XML, XHTML

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Problem

- Richness of text
  - Elements: letters, numbers, symbols, case
  - Structure: words, sentences, paragraphs, headings, tables
  - Appearance: fonts, design, layout
  - Multimedia integration: graphics, audio, math
  - Internationalization: characters, direction (up, down, right, left), diacritics
- Its not all text

Text vs. Data

- Something for humans to read
- Something for machines to process
- There are different types of humans
- Goal in information infrastructure should be as much automation as possible
- Works vs. manifestations
- Parts vs. wholes
- Preservation: information or appearance?

Who controls the appearance of text?

- The author/creator of the document
- Rendering software (e.g. browser)
  - Mapping from markup to appearance
- The user
  - Window size
  - Fonts and size

Important special cases

- User has special requirements
  - Physical abilities
  - Age/education level
  - Preference/mood
- Client has special capabilities
  - Form factor (mobile device)
  - Network connectivity

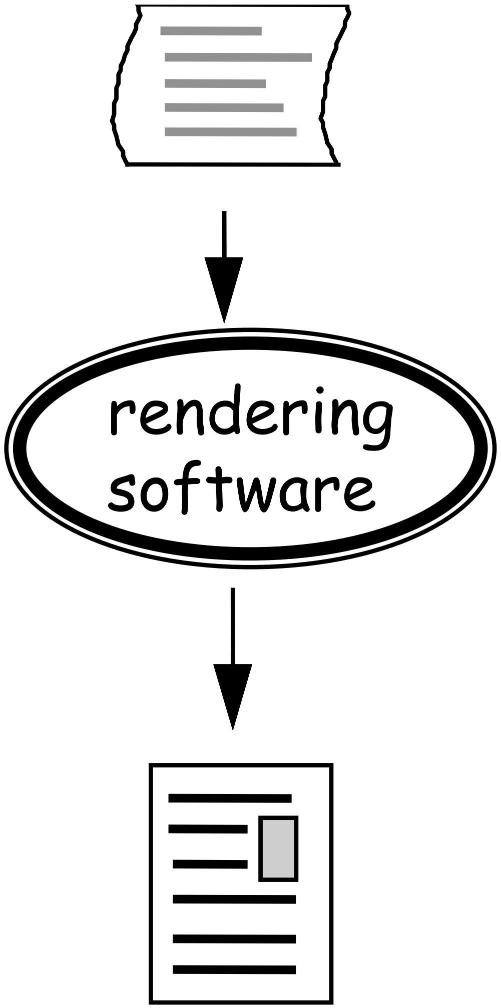
Page Description Language

- Postscript, PDF
- Author/creator imprints rendering instructions in document
  - Where and how elements appear on the page in pixels

Markup languages

- SGML, XML
- Represent structure of text
- Must be combined with style instructions for rendering on screen, page, device

Markup and style sheets



Marked-up document

document content
& structure

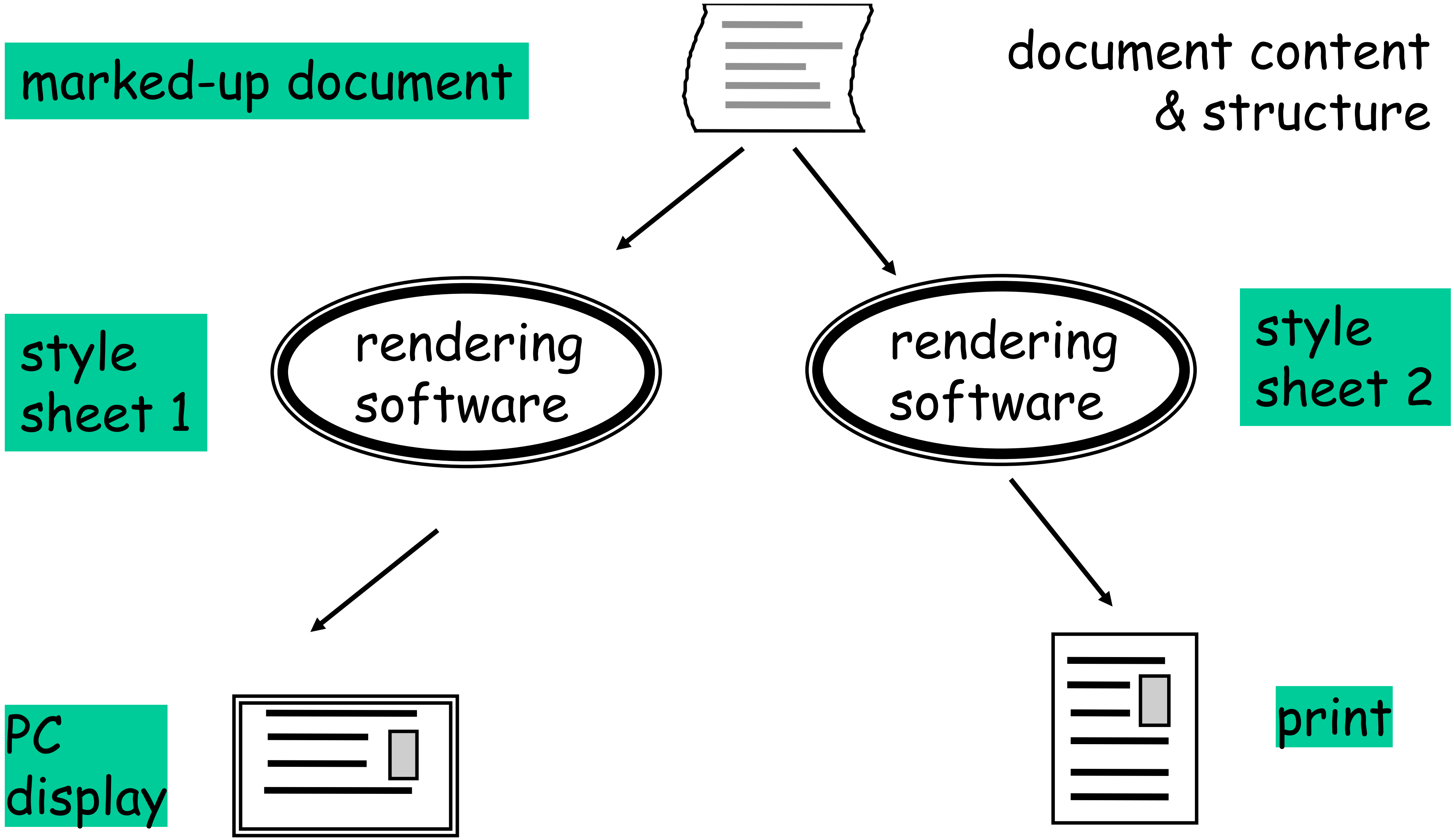
style sheet

rendering
software

rendering
instructions

formatted document

Multiple renderings from same marked-up documents



marked-up document

document content
& structure

style
sheet 1

rendering
software

rendering
software

style
sheet 2

PC
display

print

A short history of markup (b.w.)

- Def.: A method of conveying information (metadata) about a document
- Special characters used by proofreaders, typesetters
- Standard Generalized Markup Language
  - Standardized (ISO) in 1986
  - Powerful, complex markup language widely used by government and publishers
  - Also used in the exchange of technical information in manufacturing (Boeing design descriptions)
  - Functional overkill limited widespread implementation and use

HTML – Markup for the masses

- Core technology of web (along with URLs, HTTP)
- Simple fixed tag set
- Highly tolerant
  - Tag start/close
    - <p>blatz<p>scrog
    - <p>blatz</p><p>scrog</p>
  - Capitalization
- 7-bit ASCII based
- Tags express both appearance and structure
  - <title>This is structure</title>
  - What do <b>bold</b> or <i>italics</i> mean?

What is wrong with HTML?

- Fixed tag set
  - Extension has been difficult and chaotic?
    - Pages that can be rendered by IE and not other browsers
  - Prevents localization
- 7-bit ASCII
  - What about kanji, arabic, math, chemistry, etc?
- Tolerance
  - Non-specific syntax – can't be expressed in formal manner like BNF
  - Parsing is difficult, non-deterministic. Leads to "screen scraping"
- Non-structural markup
  - Prevents clean distinction of meaning from appearance

eXtensible Markup Language

- Subset of SGML improving ease of implementation
- Meta-language that allows defining markup languages
  - No defined tags
  - Meta tools for definition of purpose specific tags
    - DTDs, Schema
- Syntax is defined using formal BNF
  - Documents can be parsed, manipulated, stored, transformed, stored in databases….
- Unicode character set
- W3C Recommendation (1998)

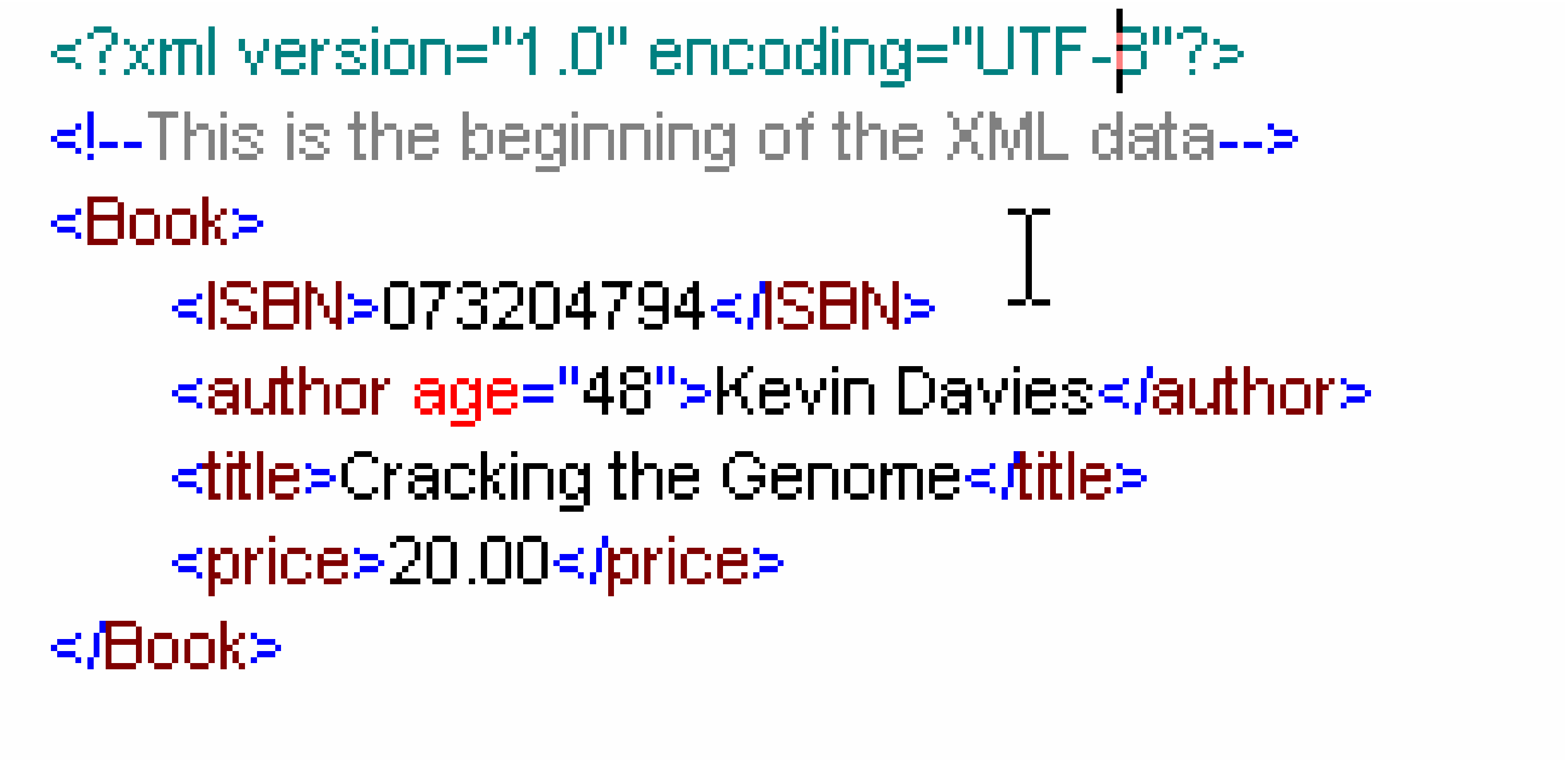
XML Suite

- XML syntax – "well-formedness"
- XML namespaces – global semantic partitions
- XML schema – semantic definitions, "validity"
- XSLT – language for transforming XML documents
  - One application is stylesheets
- XPATH – specifying individual information items in XML documents
- Xpointer – syntax for stating address information in a link to an xml document.
- Xlink – specifying link semantics, types and behaviors of links

Basic XML building blocks

- One or more elements
  - Opening tag <tag>
  - Empty element
    - <picture></picture>
    - <picture />
  - Non-empty element
    - Simple (CDATA) value
      - <author>Paul Smith</author>
    - Complex value
      - <author><name>Smith</name><age>48</age></author>
- One or more attributes per element
  - <title lang="fr">Les Miserables</title>

XML - sample instance document



```xml
<?xml version="1.0" encoding="UTF-8"?>
<!--This is the beginning of the XML data-->
<Book>
      <ISBN>073204794</ISBN>
      <author age="48">Kevin Davies</author>
      <title>Cracking the Genome</title>
      <price>20.00</price>
</Book>
```

XML – well formed-ness

- Every XML document must have a declaration
- Every opening tag must have a closing tag.
- Tags can not overlap (well-nested)
- XML documents can only have 1 root element
- Attribute values must be in quotation marks (single or double) – Only one value per attribute.

XML - well formed-ness

- reserved characters should be encoded

<	&lt;
&	&amp;
]]>	]]&amp;
>	&gt;
"	&quot;
'	&apos;

XML – well formed-ness

- element names must obey XML naming conventions:
  - start with letter or underscore
  - can contain letters, numbers, hyphens, periods, underscores
  - no spaces in names!
  - no leading space after <
  - colon can only be used to separate namespace of the element from the element name
  - case-sensitive
  - can not start with xml, XML, xML, …

XML – well formed-ness

White Spaces: space, tab, line feed, carriage return

- in HTML: must explicitly write white spaces as &nsbsp; because HTML processors strip off white spaces
- not so in XML:
    - space in CDATA stays
    - tab in CDATA stays
    - multiple new line characters transformed into a single one

XML as semi-structured data

The Networked Computer Science Technical Report Library

James R. Davis* Carl Lagoze†

Submitted to May 1996 IEEE Computer special issue on "Building Large-scale Digital Libraries".

Abstract

The Networked Computer Science Technical Report Library (NCSTRL‡) is a distributed digital library of research results from computer science departments and laboratories in the USA and abroad. NCSTRL benefits readers, authors, and departments. Researchers throughout the world can use familiar Internet tools (the World Wide Web) to search for, browse, read, and download technical reports from participating institutions. Authors benefit by reaching a wider audience. Departments gain a clean, effective management system for distributing their technical reports and eliminate much of their current copying and mailing charges. This article describes the design of NCSTRL, its historical basis in earlier work, and the expected course of its development.

Keywords: *protocols, document management, digital libraries*

Introduction

A good library is a carefully selected collection of materials systematically organized in a manner accessible to users. Computer scientists have long desired to use the Internet as the basis of a library of computer science research. Until recently sharing of research was usually done either by email or in anonymous FTP archives. Archives, while essential, lack many services required of a library. Over the past few years, three systems have appeared that bring us closer to having a true library of computer science research over the Internet.

The UCSTRI system[7] made FTP archives more useful by collecting indexes of their contents at a centrally searchable site. UCSTRI's weakness was that the descriptions of contents on which it based its search were relatively crude and uncontrolled, usually being "README" files, which are intended for human eyes rather than automated search engines. Besides being unstructured, these files were rarely maintained with care. As a result, UCSTRI often returned imprecise results.

The next two systems, WATERS[5] and Dienst[4] improve on UCSTRI. WATERS mandates a uniform file format (an extended version of refer) for cataloging. This removes a lot of confusing

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‡pronounced "ancestral" and hopefully connoting beautiful progeny

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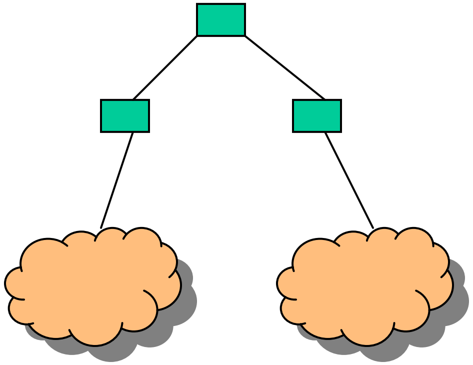
Unstructured data



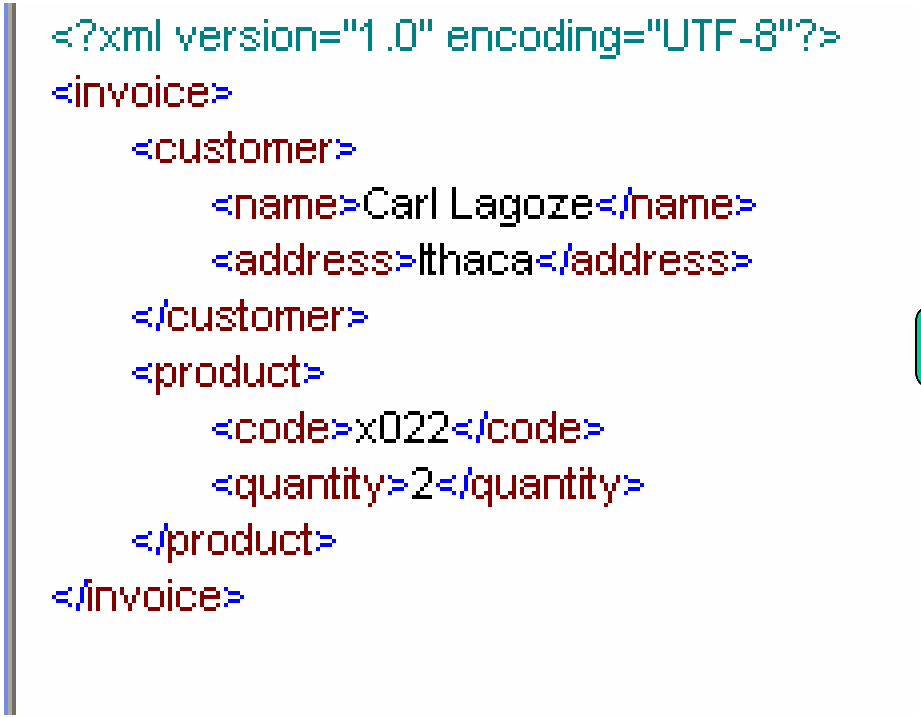
Semi-structured data

Carl	Lagoze	Ithaca
George	Bush	Washington

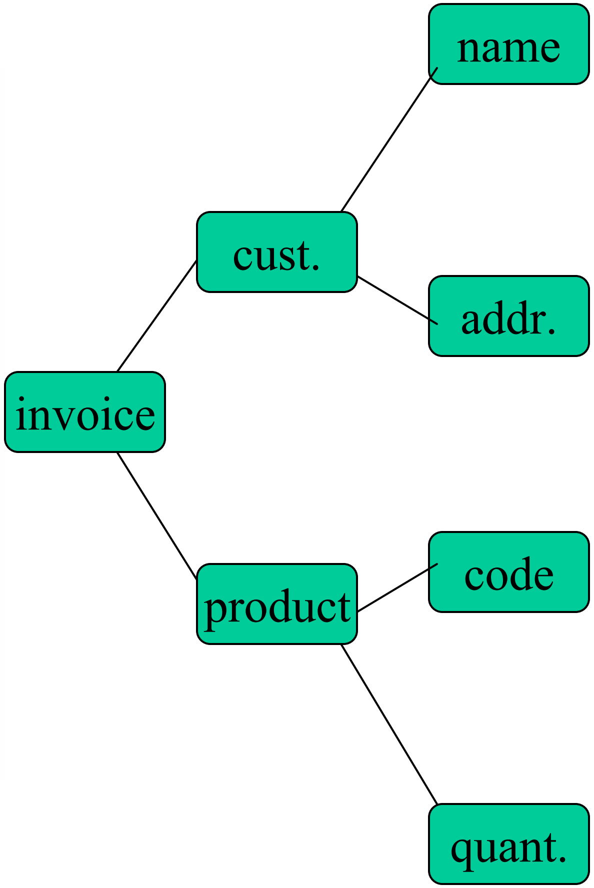
Ithaca	NY	27000
Washington	DC	650000

Structured data

XML data representation



```
<?xml version="1.0" encoding="UTF-8"?>
<invoice>
      <customer>
            <name>Carl Lagoze</name>
            <address>Ithaca</address>
      </customer>
      <product>
            <code>x022</code>
            <quantity>2</quantity>
      </product>
</invoice>
```



Document Object Model (DOM)

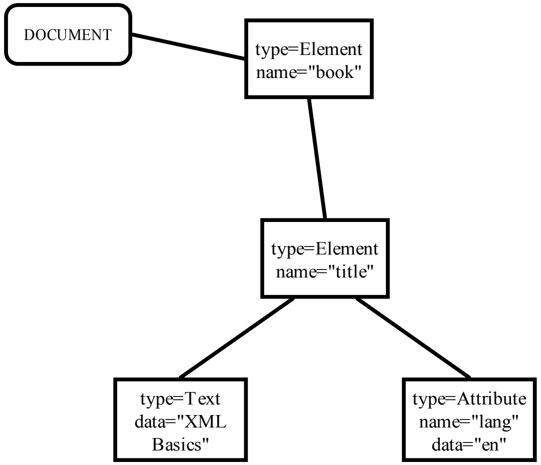
- W3C standard interface for accessing and manipulating an XML document
- Represents document as a tree with typed nodes
  - Document
  - Element
  - Attribute
  - Text
  - Comment
- DOM parser reads an XML document and builds a tree from it

DOM Interface Features

- Class structure for entities in XML documents
- Construct tree nodes of various types
  - E.g. construct element
- Create nesting structure (linkages) among nodes
  - E.g. appendChild
- Traverse trees
  - E.g. getFirstChild, getNextSibling
- Specialized sub-classes for HTML

Simple DOM Example

```
<?xml version="1.0"
   encoding="UTF-8"?>
<book>
   <title lang='"en"'>"XML
   Basics"</title>
</book>
```



DOCUMENT

type=Element
name="book"

type=Element
name="title"

type=Text
data="XML
Basics"

type=Attribute
name="lang"
data="en"

DOM support in multiple languages

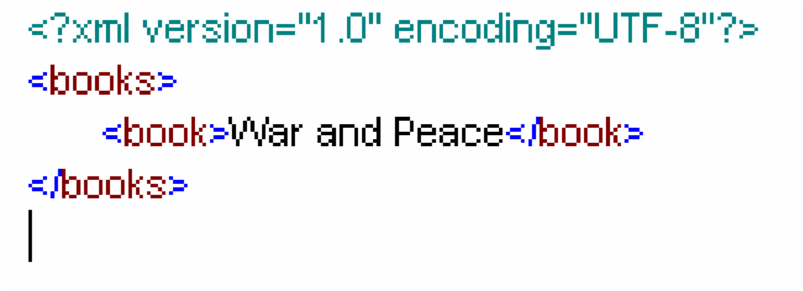
- Java
  - JAXP (Sun)
  - Xerces (Apache)
- Perl
  - XML::parser module

Simple API for XML (SAX)

- Event-based interface
- Does not build an internal representation in memory
- Available with most XML parsers
- Main SAX events
  - startDocument, endDocument
  - startElement, endElement
  - characters

Simple SAX Example

Document



```
<?xml version="1.0" encoding="UTF-8"?>
<books>
      <book>War and Peace</book>
</books>
```

Events

startDocument()
startElement(“books”)
startElement(“book”)
characters(“War and Peace”)
endElement(“book”)
endElement(“books”)
endDocument()

Why use SAX?

- Memory efficient
- Data structure independent (not tied to trees)
- Care only about a small part of the document
- Simplicity
- Speed

Why use DOM?

- Random access through document
- Document persistence for searches, etc.
- Read/Write
- Lexical information
  - Comments
  - Encodings
  - Attribute order

xHTML

- HTML “expressed” in XML
- Corrects defects in HTML
  - All tags closed
  - Proper nesting
  - Case sensitive (all tags lower case)
  - Strict well-formedness
- Defined by a DTD
  - Strict
  - Transitional
  - Frameset
  - <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Transitional//EN" "http://www.w3.org/TR/xhtml1/DTD/xhtml1-transitional.dtd">

xHTML (cont.)

- All new HTML SHOULD be xHTML
- W3C validator
  - http://validator.w3.org/
- Tidy
  - http://sourceforge.net/projects/jtidy