XML

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Introduction

Markup Languages

- A **markup language** is a set of words and symbols for describing the identity or function of the component parts of a document.
- Programs can use markup with a **stylesheet** to transform the document into output for screen, print, audio, video, Braille, or reprocessable data formats.

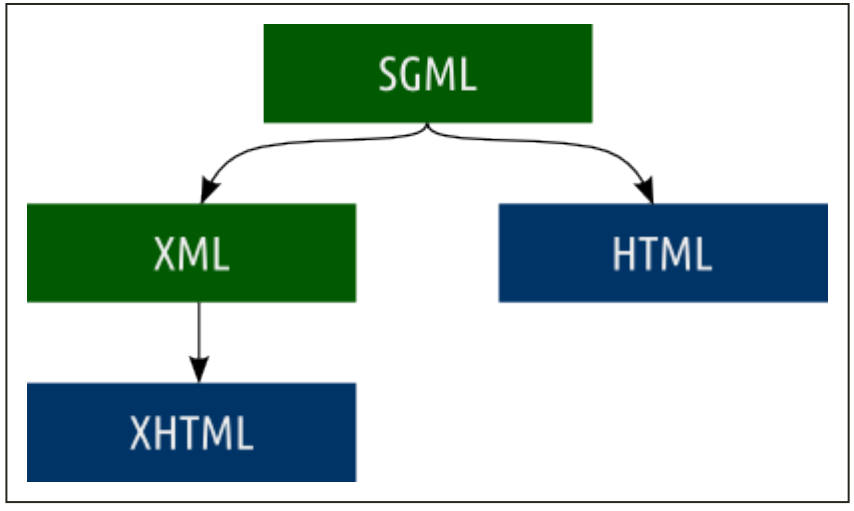
XML

- Extensible Markup Language (XML)
- A **markup language** that defines a set of rules for encoding documents in a format which is both human-readable and machine-readable.
- It is **extensible** because it is not a fixed format like HTML (which is a single, predefined markup language).
- XML is a metalanguage which lets you design your own markup languages for limitless different types of documents.

SGML

- SGML is the **S**tandard **G**eneralized **M**arkup **L**anguage, the international standard for defining markup to describe the structure of different types of electronic document.
- SGML is very **large**, **powerful**, and **complex**.
- XML is a **lightweight** cut-down version of SGML.

SGML, XML and HTML



- SGML and XML are **metalanguages**. They allow users to develop their own languages.
- HTML and XHTML are **concrete** languages with a fixed format.

XML

Well Formed

An XML document is considered well formed if it:

- contains **one** or **more** elements.
- it has exactly **one root**.
- elements **nest properly** with each other.

Processing Instructions

Processing instructions allow documents to contain instructions for applications

Since **XML 1.1**, all XML documents must start with a processing instruction (prolog) indicating the XML version. If not, the document is considered to be **XML 1.0**.

```
<?xml version="1.1" encoding="utf-8"?>
```

The encoding is **utf-8** by default.

Comments

Comments start with a `<!--` and end with `-->`.

```
<!-- This is a comment -->
```

Comments cannot contain double hyphens (`--`).

CDATA

CDATA sections are used to escape blocks of text containing characters which would otherwise be recognized as markup.

They begin with the string `<![CDATA[` and end with the string `]]>`.

```
<![CDATA[
  <warning>These tags are not markup</warning>
]]>
```

Elements

- Elements are defined by a **start tag** and an **end tag**.
- All elements **must be closed**.
- All elements opened inside an element must be closed **before** the **parent** element is **closed**.
- Element names are case sensitive. The element **start tag** must match the element **end tag** case.
- Empty elements can use a `/` in the end instead of a closing tag.

```
<?xml version="1.1"?>
<message>
    <to>Mr. John Doe</to>
    <from>Ms. Jane Doe</from>
    <text>How are you?</text>
    <private/> <!-- this is an empty element -->
</message>
```

Attributes

- Attributes are used to associate **name-value** pairs with elements.
- Attributes only appear in element **start** tags (or empty element tags).
- Attributes must be single or double **quoted**.

```
<?xml version="1.1"?>
<message date="2014-12-03" private="yes">
    <to>Mr. John Doe</to>
    <from>Ms. Jane Doe</from>
    <text>How are you?</text>
</message>
```

Attributes should be used for **metadata**.

Valid XML

Valid XML

XML is a **metalanguage** as it doesn't impose the use of a restricted set of elements.

If we want to **restrict** the structure of a document to a certain format we can use one of several existing **schema** languages:

- Document Type Definition (**DTD**)
- XML Schema Definition (**XSD**)
- Relax NG

An XML document is considered **valid** if it is **well-formed** and **conforms** to its **schema**.

Document Type Definition (DTD)

Model that defines the structure of a valid XML document:

- specifies the **names** of all elements and attributes
- specifies the **type** of content of the elements and attributes
- specifies the **sequence** of the elements in the document
- specifies the document tree **structure**

Document Type Declaration used to associate DTD to XML document:

```
<?xml version="1.1"?>
<!DOCTYPE message SYSTEM "message.dtd">
<message>Hello, world!</message>
```

XML Schema Definition (XSD)

W3C's proposal for replacing DTD

Design principles:

- More **expressive** than DTD.
- Use **XML** notation.
- Self-describing.
- **Simplicity**.
- Embedded **documentation**.

Technical requirements:

- **Namespace** support.
- User-defined **datatypes**.
- **Inheritance**.
- **Evolution**.

Relax NG

An alternative to XML Schemas:

- Very **simple** to understand.
- **XML** Syntax (or compact non-XML).
- Supports **namespaces**.
- Self-describing.

Example

XML

```
<addressBook>
  <card>
    <name>John Smith</name>
    <email>js@example.com</email>
  </card>
  <card>
    <name>Fred Bloggs</name>
    <email>fb@example.net</email>
  </card>
</addressBook>
```

Example

DTD

```
<!DOCTYPE addressBook [
<!ELEMENT addressBook (card*)>
<!ELEMENT card (name, email)>
<!ELEMENT name (#PCDATA)>
<!ELEMENT email (#PCDATA)>
]>
```

Example

XSD

```
<xs:schema elementFormDefault="qualified">
  <xs:element name="addressBook">
    <xs:complexType>
      <xs:sequence>
        <xs:element name="card" minOccurs="0" maxOccurs="unbounded">
          <xs:complexType>
            <xs:sequence>
              <xs:element name="name" type="xs:string"/>
              <xs:element name="email" type="xs:string"/>
            </xs:sequence>
          </xs:complexType>
        </xs:element>
      </xs:sequence>
    </xs:complexType>
  </xs:element>
</xs:schema>
```

Example

Relax NG

```
<element name="addressBook" xmlns="http://relaxng.org/ns/structure/1.0">
  <zeroOrMore>
    <element name="card">
      <element name="name">
        <text/>
      </element>
      <element name="email">
        <text/>
      </element>
    </element>
  </zeroOrMore>
</element>
```

Namespaces

Motivation

A **single XML** document should be able to contain elements and attributes that are defined for and used by **multiple** software modules.

Binding

- An XML **namespace** is identified by a **URI** reference.
- To declare a **default** namespace the attribute `xmlns` is used. A default namespace declaration applies to all unprefixed element names within its scope.
- To declare a **prefixed** namespace an attribute of the form `xmlns:prefix` is used. Such a namespace declaration applies to all element and attribute names within its scope whose prefix matches that specified in the declaration.
- The prefix **xml** is by definition bound to the namespace name `http://www.w3.org/XML/1998/namespace`.
- The prefix **xmlns** is used only to declare namespace bindings and is by definition bound to the namespace name `http://www.w3.org/2000/xmlns/`.

Example

Namespace

```
<?xml version="1.0"?>
<bk:book xmlns:bk='urn:loc.gov:books'
         xmlns:isbn='urn:ISBN:0-395-36341-6'>
    <bk:title>Cheaper by the Dozen</bk:title>
    <isbn:number>1568491379</isbn:number>
</bk:book>
```

Namespace Scope

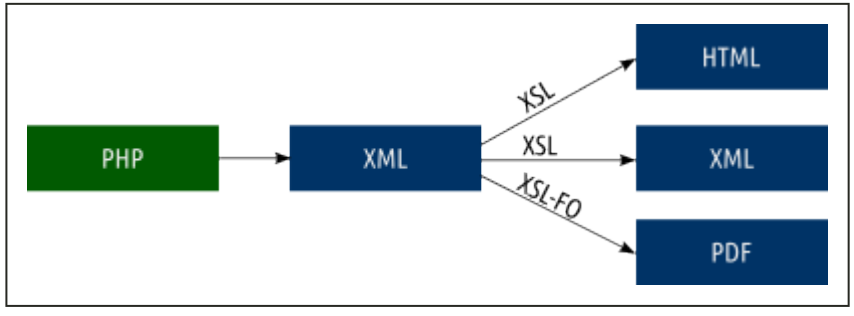
The **scope** of a namespace declaration extends from the beginning of the **start-tag** in which it appears to the end of the corresponding **end-tag**.

```
<?xml version="1.0"?>
<!-- initially, the default namespace is "books" -->
<book xmlns='urn:loc.gov:books'
      xmlns:isbn='urn:ISBN:0-395-36341-6'>
    <title>Cheaper by the Dozen</title>
    <isbn:number>1568491379</isbn:number>
    <notes>
      <!-- make HTML the default namespace for some commentary -->
      <p xmlns='http://www.w3.org/1999/xhtml'>
          This is a <i>funny</i> book!
      </p>
    </notes>
</book>
```

Technologies

XSL(t) and XSL-FO

- XSLT (Extensible Stylesheet Language Transformations) is a language for transforming XML documents into other XML documents.
- XSL-FO (XSL Formatting Objects) is a markup language for XML document formatting which is most often used to generate PDFs.



XPath

A query language for **selecting** nodes from an XML document.

Used in several other technologies like **XSL** and **XSD**.

XQuery

A **query** and **functional** programming language that is designed to query and transform collections of structured and unstructured data, usually in the form of **XML**.

Applications

Applications

- XHTML (a XML variant of HTML)
- CML - Chemical Markup Language
- MathML - Mathematical Markup Language
- RDF - Resource Description Framework
- GraphML - File Format for Graphs
- MusicXML - Digital Sheet Music
- SVG - Scalable Vector Graphics
- OSD - Open Software Description
- SOAP - Simple Object Access Protocol
- WSDL - Web Service Description Language
- UDDI - Universal Description Discovery and Integration