XML Basics

eXtensible Mark-up Language (XML)

- XML is "Programing Language & Platform Independent Language" which helps to store and transport data
- Different Applications which are developed using different technologies can Transfer the Data among themselves with the help of XML
- As the name implies it's an extension of HTML & hence XML looks similar to HTML but it's not a HTML
- XML has User-defind Tags. XML tags are also called as "elements"
- XML Elements are "Case Sensitive"
- XML is "Strictly Typed" Language hence,
  - For every element data, "data-type" should be defined,
  - every opening element should have corresponding closing element and
  - also XML elements must be properly nested/closed

Ex:

```
<employee>
        <name>Praveen</name>
</employee>
```

Note:-

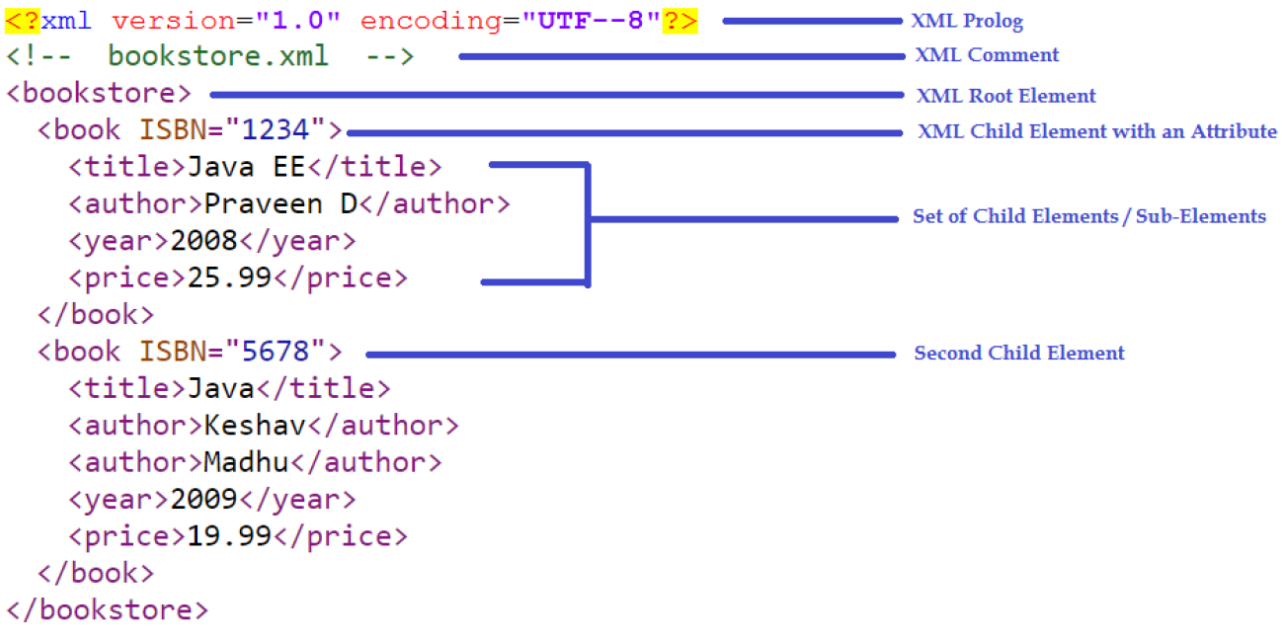
In the above example first you should closed </name> & then </employee> but in HTML it's not mandatory. For example, <B><U><I>My Text</U></I></B> works perfectly fine

- Below line is called as "XML prolog", which is optional. If it exists, it must be the First Line of XML
  <?xml version="1.0" encoding="UTF-8" ?>
- The syntax of XML comment is similar to that of HTML
  <!-- This is a comment -->
- File extension of XML is ".xml"
- MIME type (Content Type) of XML is "application/xml"

1. XML Structure

- Like HTML, XML follows a Tree Structure
- An XML tree starts at a "root element" and branches from "root element" will have "child elements"
- XML Consists of "Only One" root element which is parent of all other elements
  "child elements" can have "sub elements / child elements"
- Structure

```
<root>
<child>
<subchild>.....</subchild>
</child>
</root>
```



2. Entity References

 Some characters have a special meaning in XML. If you place a character like "<" inside an XML element, it will generate an error because it represents the start of a new element

Ex: <message>salary<1000</message>

- To avoid this error, we can replace the "<" character with an "entity reference" as shown below
  <message>salary **<** 1000</message>
- There are 5 pre-defined entity references in XML:
  < < less than
  > > greater than
  & & ampersand
  ' ' apostrophe
  " " quotation mark

3. PCDATA: Parsed Character Data

 Text between start-element and end-element is called as PCDATA which will be examined by the parser

Example:-
<employee>Praveen</employee>
The string "Praveen" is considered as PCDATA

4. CDATA: Character Data

- W.K.T special characters (such as "<", "&") must be referenced through pre-defined entities
- If XML data contain many special characters, it is cumbersome to replace all of them. Instead we can use "CDATA (character data) section"
- A CDATA section starts with the following sequence:

<![CDATA[
and ends with the next occurrence of the sequence:
]]>
All characters enclosed between these two sequences are interpreted as characters

- The XML parsers ignores all the mark-up within the CDATA section.

Example: -

<employee>Praveen</employee>
the start and end "employee" elements are interpreted as mark-up. However, if written like this:
<![CDATA[<employee>Praveen</employee>]]>

then the parsers interprets the same as if it had been written like this:
<employee**>**Praveen**<**/employee**>**

5. XML Elements

- XML element is everything from (including) the element's start tag to (including) the element's end tag
- An element can contain:
  1. data
  2. Attributes
  3. other elements OR
  4. All of the above
- In the above example
  - <title>, <author>, <year>, and <price> have text content
  - <bookstore> and <book> have element contents
  - <book> has an attribute (ISBN="------")

- An element with no content is said to be "empty". In XML, we can indicate an empty element like this
  <element></element>
  OR
  <element />
- Empty elements can have attributes <book ISBN="5678" />
- If data present between elements consist of white spaces then they are considered in XML. However HTML truncates multiple white-spaces to one single white-space

6. XML Elements Naming Rules

- they are case-sensitive
- they cannot contain spaces
- they must start with a letter or underscore
- they are cannot start with the letters like xml or XML or Xml etc.,
- they can contain letters, digits, hyphens, underscores, and periods
- Any name can be used, no words are reserved (except xml)

Best Naming Practices

- Avoid "." and ":"
- Create descriptive names, like
  <person>, <firstname>, <lastname>
- Create short and simple names, like
  <book_title> not like this: <the_title_of_the_book>
- Non-English letters are perfectly legal in XML but avoid them

7. XML Attributes

- Like HTML, XML elements can also have attributes
- Attributes are designed to contain data related to a specific element
- XML Attributes Must be Quoted either single or double quotes can be used

Ex:

<person gender="female">

OR

<person gender='female'>

- If the attribute value itself contains double quotes then we can use single quotes

Ex:

<person name='Praveen "Bangalore" D'>

OR

<person name='Praveen **"**Bangalore**"** D'>

8. XML Elements v/s Attributes

Example 1:-

<person gender="male">
<name>Praveen</name>
</person>

Example 2:-

<person>
<gender>male</gender>
<name>Praveen</name>
</person>

Note:

- In Example 1 gender is an attribute &
- In Example 2 gender is an element
- Both examples provide the same information
- There are no rules about when to use attributes or when to use elements in XML

When to avoid XML Attributes?

- Attributes cannot contain multiple values but Elements can
- Attributes cannot contain tree structures but Elements can
- Attributes are not easily expandable for future changes but Elements can

9. XML Schema's

- W.K.T XML helps us to store & transfer the data

- When sending data from one application to an another, it is essential that both applications have the same "expectations / agreement" about the content/data
- for example, A date like "03-11-2004"
  - in some countries, be interpreted as 3rd November and
  - in other countries as 11th March
- With XML Schemas, the sender application can describe the data in a way that the receiver application will understand
- Schema is nothing but a "Structure". It is a formal description of structure of an XML.
  - i.e., which elements are allowed,
  - which elements must be present,
  - which elements are optional,
  - the sequence and relationship of the elements, etc.,
- For example,
  - abc@gmail.com is a Valid Email ID. However
  - abc#gmail is Invalid because there is "NO @ and ."
  - hence email schema looks something like some-name@domain-name.com
- Schema "does not validate the data" instead "it validates the structure"

- There are two ways to define a Schema for XML
  1. Document Type Definition (DTD)
  2. XML Schema Definition (XSD)

1) XML Document Type Definition (DTD)

- A DTD defines the structure and the legal elements and attributes of an XML document
- An application can use a DTD to verify that XML data is valid
- There are 2 ways to declare the DTD
  1. An Internal DTD Declaration
  2. An External DTD Declaration
- An Internal DTD Declaration has the following syntax:
  <!DOCTYPE root-element [
  declarations
  ]>

XML document with an internal DTD

```
<?xml version="1.0"?>
<!DOCTYPE note [
<!ELEMENT note (to,from,heading,body)>
<!ELEMENT to (#PCDATA)>
<!ELEMENT from (#PCDATA)>
<!ELEMENT heading (#PCDATA)>
<!ELEMENT body (#PCDATA)>
]>
<note>
<to>Tove</to>
<from>Jani</from>
<heading>Reminder</heading>
<body>Don't forget me this weekend</body>
</note>
```

A DTD can also be stored in an external file. An XML can reference an external DTD via the following syntax:
<!DOCTYPE root-element SYSTEM "DTD-filename">

XML document with a reference to an external DTD

```
<?xml version="1.0"?>
<!DOCTYPE note SYSTEM "note.dtd">
<note>
  <to>Tove</to>
  <from>Jani</from>
  <heading>Reminder</heading>
  <body>Don't forget me this weekend!</body>
</note>
```

"note.dtd"

```
<!ELEMENT note (to,from,heading,body)>
<!ELEMENT to (#PCDATA)>
<!ELEMENT from (#PCDATA)>
<!ELEMENT heading (#PCDATA)>
<!ELEMENT body (#PCDATA)>
```

XML Schema Definition (XSD)

- XSD also describes the structure, legal elements and attributes for an XML

- It defines,

- the elements and attributes that can appear in XML
- the number of and also the order of child elements
- data types for elements and attributes
- default and fixed values for elements & attributes

- One of the greatest strength of XML Schemas is the support for data types

- For Example, the following is an example of a date declaration in XSD:

<xs:element name="start-date" type="xs:date"/>
it defines the structure/format of the Date as "YYYY-MM-DD"
An element in XML might look like <start-date>2002-09-24</start-date>

- Another great strength about XML Schemas is that they are written in XML

- Hence XSD's are extensible so, we can

- Reuse Schema in other Schemas
- Create your own data types derived from the standard types
- Reference multiple schemas in the same document

NOTE:

- Functionality wise both XSD & DTD similar in nature but XSD's are more sophisticated compared to DTD
- In other words, DTD provides less control on XML structure whereas XSD provides more control

- Hence XSD's preferred over DTD's

- Without an XSD/DTD, an XML need only follow the rules for being well-formed

- With an XSD/DTD, an XML must adhere to additional constraints placed upon the names and values of its elements and attributes in order to be considered valid

10. Differences between DTD & XSD

DTD	XSD
DTD's are written in Mark-up Language	XSD's are written in XML
DTD is not extensible i.e. We cannot inherit one DTD into an another	XSD is extensible. We can inherit one XSD into an another
DTD doesn't support data types (limited to string)	XSD supports data types for elements and attributes
DTD doesn't define order for child elements	XSD defines order for child elements
DTD's occurrence indicator is limited to 0, 1 and many; cannot support a specific number such as 8	XSD can support a specific number
DTD doesn't support namespace	XSD supports namespace
We cannot inherit one DTD into an another	We can inherit one XSD into an another
DTD provides less control on XML structure	XSD provides more control on XML structure

Parsing XML Documents (XML Parsers)

- To process the data contained in XML documents, we need to write a application program (in any programming language such as Java/C/C++, etc)

- The program makes use of an XML parser to tokenize and retrieve the data from the XML documents

- An XML parser is the software that sits between the application and the XML documents to shield the application developer from the details of the XML syntax.

- The parser reads a raw XML document, ensures that is well-formed, and may validate the document against a DTD or XSD