What is xml

- **Xml** (eXtensible Markup Language) is a mark up language.
- XML is designed to store and transport data.
- Xml was released in late 90's. it was created to provide an easy to use and store self describing data.
- XML became a W3C Recommendation on February 10, 1998.
- XML is not a replacement for HTML.
- XML is designed to be self-descriptive.
- XML is designed to carry data, not to display data.
- XML tags are not predefined. You must define your own tags.
- XML is platform independent and language independent.

Note: Self-describing data is the data that describes both its content and structure.

What is mark-up language

A **mark up language** is a modern system for highlight or underline a document.

Students often underline or highlight a passage to revise easily, same in the sense of modern mark up language highlighting or underlining is replaced by tags.

Prerequisite

Before you start to learn xml, you should know basic of HTML & JavaScript.

Why xml

Platform Independent and Language Independent: The main benefit of xml is that you can use it to take data from a program like Microsoft SQL, convert it into XML then share that XML with other programs and platforms. You can communicate between two platforms which are generally very difficult.

The main thing which makes XML truly powerful is its international acceptance. Many corporation use XML interfaces for databases, programming, office application mobile phones and more. It is due to its platform independent feature.

Features and Advantages of XML

XML is widely used in the era of web development. It is also used to simplify data storage and data sharing.

The main features or advantages of XML are given below.

1) XML separates data from HTML

If you need to display dynamic data in your HTML document, it will take a lot of work to edit the HTML each time the data changes.

With XML, data can be stored in separate XML files. This way you can focus on using HTML/CSS for display and layout, and be sure that changes in the underlying data will not require any changes to the HTML.

With a few lines of JavaScript code, you can read an external XML file and update the data content of your web page.

2) XML simplifies data sharing

In the real world, computer systems and databases contain data in incompatible formats.

XML data is stored in plain text format. This provides a software- and hardware-independent way of storing data.

This makes it much easier to create data that can be shared by different applications.

3) XML simplifies data transport

One of the most time-consuming challenges for developers is to exchange data between incompatible systems over the Internet.

Exchanging data as XML greatly reduces this complexity, since the data can be read by different incompatible applications.

4) XML simplifies Platform change

Upgrading to new systems (hardware or software platforms), is always time consuming. Large amounts of data must be converted and incompatible data is often lost.

XML data is stored in text format. This makes it easier to expand or upgrade to new operating systems, new applications, or new browsers, without losing data.

5) XML increases data availability

Different applications can access your data, not only in HTML pages, but also from XML data sources.

With XML, your data can be available to all kinds of "reading machines" (Handheld computers, voice machines, news feeds, etc), and make it more available for blind people, or people with other disabilities.

6) XML can be used to create new internet languages

A lot of new Internet languages are created with XML.

Here are some examples:

- **XHTML**
- **WSDL** for describing available web services
- **WAP** and **WML** as markup languages for handheld devices
- **RSS** languages for news feeds
- **RDF** and **OWL** for describing resources and ontology
- **SMIL** for describing multimedia for the web

XML Syntax Rules

The syntax rules of XML are very simple and logical. The rules are easy to learn, and easy to use.

XML Documents Must Have a Root Element

XML documents must contain one **root** element that is the **parent** of all other elements:

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

In this example **<note>** is the root element:

```
<?xml version="1.0" encoding="UTF-8"?>
<note>
  <to>Tove</to>
  <from>Jani</from>
  <heading>Reminder</heading>
```

```
  <body>Don't forget me this weekend!</body>
</note>
```

The XML Prolog

This line is called the XML **prolog**:

```
<?xml version="1.0" encoding="UTF-8"?>
```

The XML prolog is optional. If it exists, it must come first in the document.

XML documents can contain international characters, like Norwegian øæå or French êèé.

To avoid errors, you should specify the encoding used, or save your XML files as UTF-8.

UTF-8 is the default character encoding for XML documents.

UTF-8 is also the default encoding for HTML5, CSS, JavaScript, PHP, and SQL.

All XML Elements Must Have a Closing Tag

In XML, it is illegal to omit the closing tag. All elements **must** have a closing tag:

```
<p>This is a paragraph.</p>
<br />
```

Note: The XML prolog does not have a closing tag! This is not an error. The prolog is not a part of the XML document.

XML Tags are Case Sensitive

XML tags are case sensitive. The tag <Letter> is different from the tag <letter>.

Opening and closing tags must be written with the same case:

```
<message>This is correct</message>
```

"Opening and closing tags" are often referred to as "Start and end tags". Use whatever you prefer. It is exactly the same thing.

XML Elements Must be Properly Nested

In HTML, you might see improperly nested elements:

```
<b><i>This text is bold and italic</b></i>
```

In XML, all elements **must** be properly nested within each other:

```
<b><i>This text is bold and italic</i></b>
```

In the example above, "Properly nested" simply means that since the <i> element is opened inside the <b> element, it must be closed inside the <b> element.

XML Attribute Values Must Always be Quoted

XML elements can have attributes in name/value pairs just like in HTML.

In XML, the attribute values must always be quoted:

```
<note date="12/11/2007">
  <to>Tove</to>
  <from>Jani</from>
</note>
```

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 the parser interprets it as the start of a new element.

This will generate an XML error:

```
<message>salary < 1000</message>
```

To avoid this error, replace the "<" character with an **entity reference**:

```
<message>salary &lt; 1000</message>
```

There are 5 pre-defined entity references in XML:

<	<	less than
>	>	greater than
&	&	ampersand

&apos;	'	apostrophe
&quot;	"	quotation mark

Only < and & are strictly illegal in XML, but it is a good habit to replace > with > as well.

Comments in XML

The syntax for writing comments in XML is similar to that of HTML:

<!-- This is a comment -->

Two dashes in the middle of a comment are not allowed:

<!-- This is an invalid -- comment -->

White-space is Preserved in XML

XML does not truncate multiple white-spaces (HTML truncates multiple white-spaces to one single white-space):

XML:	Hello Tove
HTML:	Hello Tove

XML Stores New Line as LF

Windows applications store a new line as: carriage return and line feed (CR+LF).

Unix and Mac OSX use LF.

Old Mac systems use CR.

XML stores a new line as LF.

XML Example

XML documents create a hierarchical structure looks like a tree so it is known as XML Tree that starts at "the root" and branches to "the leaves".

Example of XML Document

XML documents uses a self-describing and simple syntax:

```
<?xml version="1.0" encoding="UTF-8" standalone=”no”?>
<note>
  <to>Tove</to>
  <from>Jani</from>
  <heading>Reminder</heading>
  <body>Don't forget me this weekend!</body>
</note>
```

The first line is the XML declaration. It defines the XML version (1.0)

The next line describes the root element of the document (like saying: "this document is a note"):

```
<note>
```

The next 4 lines describe 4 child elements of the root (to, from, heading, and body).

```
<to>Tove</to>
<from>Jani</from>
<heading>Reminder</heading>
<body>Don't forget me this weekend!</body>
```

And finally the last line defines the end of the root element.

```
</note>
```

XML documents must contain a **root element.** This element is "the parent" of all other elements.

The elements in an XML document form a document tree. The tree starts at the root and branches to the lowest level of the tree.

All elements can have sub elements (child elements).

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

The terms parent, child, and sibling are used to describe the relationships between elements. Parent elements have children. Children on the same level are called siblings (brothers or sisters).

All elements can have text content and attributes (just like in HTML).

Another Example of XML: Books

File: books.xml

```
<bookstore>
  <book category="COOKING">
    <title lang="en">Everyday Italian</title>
    <author>Giada De Laurentiis</author>
    <year>2005</year>
    <price>30.00</price>
  </book>
  <book category="CHILDREN">
    <title lang="en">Harry Potter</title>
    <author>J K. Rowling</author>
    <year>2005</year>
    <price>29.99</price>
  </book>
  <book category="WEB">
    <title lang="en">Learning XML</title>
    <author>Erik T. Ray</author>
    <year>2003</year>
    <price>39.95</price>
  </book>
</bookstore>
```

The root element in the example is <bookstore>. All elements in the document are contained within <bookstore>.The <book> element has 4 children: <title>,< author>, <year> and <price>.

Another Example of XML: Emails

File: emails.xml

```
<?xml version="1.0" encoding="UTF-8"?>
    <emails>
    <email>
      <to>Vimal</to>
      <from>Sonoo</from>
      <heading>Hello</heading>
      <body>Hello brother, how are you!</body>
    </email>
    <email>
      <to>Peter</to>
      <from>Jack</from>
      <heading>Birth day wish</heading>
      <body>Happy birth day Tom!</body>
    </email>
    <email>
      <to>James</to>
      <from>Jaclin</from>
      <heading>Morning walk</heading>
      <body>Please start morning walk to stay fit!</body>
    </email>
    <email>
      <to>Kartik</to>
      <from>Kumar</from>
      <heading>Health Tips</heading>
      <body>Smoking is injurious to health!</body>
    </email>
    </emails>
```

XML Attributes

XML elements can have attributes. By the use of attributes we can add the information about the element.XML attributes enhance the properties of the elements.

Note: XML attributes must always be quoted. We can use single or double quote.

Let us take an example of a book publisher. Here, book is the element and publisher is the attribute.

```
<book publisher="Tata McGraw Hill"></book>
```

Or

```
<book publisher='Tata McGraw Hill'></book>
```

Metadata should be stored as attribute and data should be stored as element.

```
<book>
<book category="computer">
<author> A & B </author>
</book>
```

Data can be stored in attributes or in child elements. But there are some limitations in using attributes, over child elements.

Why should we avoid XML attributes

- Attributes cannot contain multiple values but child elements can have multiple values.
- Attributes cannot contain tree structure but child element can.
- Attributes are not easily expandable. If you want to change in attribute's vales in future, it may be complicated.
- Attributes cannot describe structure but child elements can.
- Attributes are more difficult to be manipulated by program code.
- Attributes values are not easy to test against a DTD, which is used to define the legal elements of an XML document.

Difference between attribute and sub-element

In the context of documents, attributes are part of markup, while sub elements are part of the basic document contents.

In the context of data representation, the difference is unclear and may be confusing.

Same information can be represented in two ways:

1st way:

```
<book publisher="Tata McGraw Hill"> </book>
```

2nd way:

```
<book>
<publisher> Tata McGraw Hill </publisher>
</book>
```

In the first example publisher is used as an attribute and in the second example publisher is an element.

Both examples provide the same information but it is good practice to avoid attribute in XML and use elements instead of attributes.

XML Comments

XML comments are just like HTML comments. We know that the comments are used to make codes more understandable other developers.

XML Comments add notes or lines for understanding the purpose of an XML code. Although XML is known as self-describing data but sometimes XML comments are necessary.

Syntax

An XML comment should be written as:

```
<!-- Write your comment-->
```

You cannot nest one XML comment inside the another.

XML Comments Example

```
<?xml version="1.0" encoding="UTF-8" ?>
<!--Students marks are uploaded by months-->
<students>
  <student>
    <name>Ratan</name>
    <marks>70</marks>
  </student>
  <student>
    <name>Aryan</name>
    <marks>60</marks>
  </student>
 </students>
```

Rules for adding XML comments

- Don't use a comment before an XML declaration.
- You can use a comment anywhere in XML document except within attribute value.
- Don't nest a comment inside the other comment.

XML Tree Structure

An XML document has a self descriptive structure. It forms a tree structure which is referred as an XML tree. The tree structure makes easy to describe an XML document.

A tree structure contains root element (as parent), child element and so on. It is very easy to traverse all succeeding branches and sub-branches and leaf nodes starting from the root.

Example of an XML document

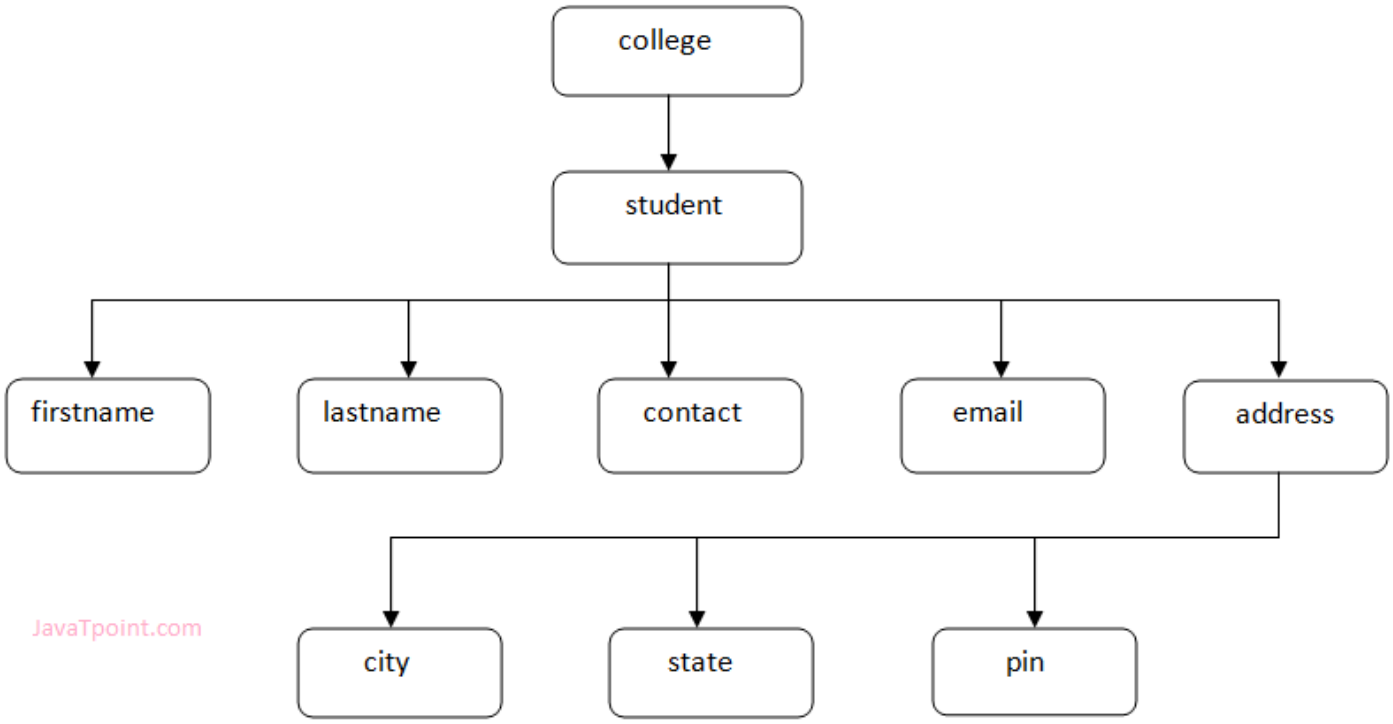
```
<?xml version="1.0"?>
<college>
  <student>
    <firstname>Tamanna</firstname>
    <lastname>Bhatia</lastname>
    <contact>09990449935</contact>
    <email>tammanabhatia@abc.com</email>
    <address>
      <city>Ghaziabad</city>
      <state>Uttar Pradesh</state>
      <pin>201007</pin>
    </address>
  </student>
</college>
```

Let's see the tree-structure representation of the above example.

In the below example, first line is the XML declaration. It defines the XML version 1.0. Next line shows the root element (college) of the document. Inside that there is one more element (student). Student element contains five branches named <firstname>, <lastname>, <contact>, <Email> and <address>.

<address> branch contains 3 sub-branches named <city>, <state> and <pin>.

Note: DOM parser represents the XML document in Tree structure.



XML DTD

What is DTD

DTD stands for **Document Type Definition**. It defines the legal building blocks of an XML document. It is used to define document structure with a list of legal elements and attributes.

Purpose of DTD

Its main purpose is to define the structure of an XML document. It contains a list of legal elements and define the structure with the help of them.

Checking Validation

Before proceeding with XML DTD, you must check the validation. An XML document is called "well-formed" if it contains the correct syntax.

A well-formed and valid XML document is one which have been validated against DTD.

Valid and well-formed XML document with DTD

Let's take an example of well-formed and valid XML document. It follows all the rules of DTD.

employee.xml

```
<?xml version="1.0"?>
<!DOCTYPE employee SYSTEM "employee.dtd">
<employee>
  <firstname>vimal</firstname>
  <lastname>jaiswal</lastname>
  <email>vimal@javatpoint.com</email>
</employee>
```

In the above example, the DOCTYPE declaration refers to an external DTD file. The content of the file is shown in below paragraph.

employee.dtd

```
<!ELEMENT employee (firstname,lastname,email)>
<!ELEMENT firstname (#PCDATA)>
<!ELEMENT lastname (#PCDATA)>
<!ELEMENT email (#PCDATA)>
```

Description of DTD

<!DOCTYPE employee : It defines that the root element of the document is employee.

<!ELEMENT employee: It defines that the employee element contains 3 elements "firstname, lastname and email".

<!ELEMENT firstname: It defines that the firstname element is #PCDATA typed. (parse-able data type).

<!ELEMENT lastname: It defines that the lastname element is #PCDATA typed. (parse-able data type).

<!ELEMENT email: It defines that the email element is #PCDATA typed. (parse-able data type).

Example of Valid XML Documents

A "Valid" XML document is "Well Formed", as well as it conforms to the rules of a DTD:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE note SYSTEM "Note.dtd">
<note>
<to>Tove</to>
<from>Jani</from>
<heading>Reminder</heading>
```

```
<body>Don't forget me this weekend!</body>
</note>
```

The DOCTYPE declaration above contains a reference to a DTD file. The content of the DTD file is shown and explained below.

!DOCTYPE note defines that the root element of this document is note.

Note.dtd:

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

The DTD above is interpreted like this:

- !DOCTYPE note - Defines that the root element of the document is note
- !ELEMENT note - Defines that the note element must contain the elements: "to, from, heading, body"
- !ELEMENT to - Defines the to element to be of type "#PCDATA"
- !ELEMENT from - Defines the from element to be of type "#PCDATA"
- !ELEMENT heading - Defines the heading element to be of type "#PCDATA"
- !ELEMENT body - Defines the body element to be of type "#PCDATA"

Tip: #PCDATA means parseable character data.

When to Use a DTD?

With a DTD, independent groups of people can agree to use a standard DTD for interchanging data.

With a DTD, you can verify that the data you receive from the outside world is valid.

You can also use a DTD to verify your own data.

When NOT to Use a DTD?

XML does not require a DTD.

When you are experimenting with XML, or when you are working with small XML files, creating DTDs may be a waste of time.

If you develop applications, wait until the specification is stable before you add a DTD. Otherwise, your software might stop working because of validation errors

An XML DTD can be either specified inside the document, or it can be kept in a separate document and then the document can be linked to the DTD document to use it.

Syntax

Basic syntax of a DTD is as follows −

```
<!DOCTYPE element DTD identifier
[
  declaration1
  declaration2
  ........
]>
```

In the above syntax −

- **DTD** starts with <!DOCTYPE delimiter.
- An **element** tells the parser to parse the document from the specified root element.
- **DTD identifier** is an identifier for the document type definition, which may be the path to a file on the system or URL to a file on the internet. If the DTD is pointing to external path, it is called **external subset.**
- The **square brackets [ ]** enclose an optional list of entity declarations called **internal subset**.

Internal DTD

A DTD is referred to as an internal DTD if elements are declared within the XML files. To reference it as internal DTD, *standalone* attribute in XML declaration must be set to **yes**. This means the declaration works independent of external source.

Syntax

The syntax of internal DTD is as shown −

```
<!DOCTYPE root-element [element-declarations]>
```

where *root-element* is the name of root element and *element-declarations* is where you declare the elements.

Example

Following is a simple example of internal DTD −

```
<?xml version = "1.0" encoding = "UTF-8" standalone = "yes" ?>

<!DOCTYPE address [
  <!ELEMENT address (name,company,phone)>
  <!ELEMENT name (#PCDATA)>
  <!ELEMENT company (#PCDATA)>
  <!ELEMENT phone (#PCDATA)>
]>

<address>
  <name>Tanmay Patil</name>
  <company>TutorialsPoint</company>
  <phone>(011) 123-4567</phone>
</address>
```

Let us go through the above code −

Start Declaration − Begin the XML declaration with following statement.

```
<?xml version = "1.0" encoding = "UTF-8" standalone = "yes" ?>
```

DTD − Immediately after the XML header, the *document type declaration* follows, commonly referred to as the DOCTYPE −

```
<!DOCTYPE address [
```

The DOCTYPE declaration has an exclamation mark (!) at the start of the element name. The DOCTYPE informs the parser that a DTD is associated with this XML document.

DTD Body − The DOCTYPE declaration is followed by body of the DTD, where you declare elements, attributes, entities, and notations −

```
<!ELEMENT address (name,company,phone)>
<!ELEMENT name (#PCDATA)>
<!ELEMENT company (#PCDATA)>
<!ELEMENT phone_no (#PCDATA)>
```

Several elements are declared here that make up the vocabulary of the <name> document. <!ELEMENT name (#PCDATA)> defines the element *name* to be of type "#PCDATA". Here #PCDATA means parse-able text data.

End Declaration − Finally, the declaration section of the DTD is closed using a closing bracket and a closing angle bracket (]>). This effectively ends the definition, and thereafter, the XML document follows immediately.

Rules

- The document type declaration must appear at the start of the document (preceded only by the XML header) - it is not permitted anywhere else within the document.
- Similar to the DOCTYPE declaration, the element declarations must start with an exclamation mark.
- The Name in the document type declaration must match the element type of the root element.

External DTD

In external DTD elements are declared outside the XML file. They are accessed by specifying the system attributes which may be either the legal *.dtd* file or a valid URL. To reference it as external DTD, *standalone* attribute in the XML declaration must be set as **no**. This means, declaration includes information from the external source.

Syntax

Following is the syntax for external DTD −

```
<!DOCTYPE root-element SYSTEM "file-name">
```

where *file-name* is the file with *.dtd* extension.

Example

The following example shows external DTD usage −

```
<?xml version = "1.0" encoding = "UTF-8" standalone = "no" ?>
<!DOCTYPE address SYSTEM "address.dtd">

<address>
  <name>Tanmay Patil</name>
  <company>TutorialsPoint</company>
  <phone>(011) 123-4567</phone>
</address>
```

The content of the DTD file **address.dtd** are as shown −

```
<!ELEMENT address (name,company,phone)>
<!ELEMENT name (#PCDATA)>
<!ELEMENT company (#PCDATA)>
<!ELEMENT phone (#PCDATA)>
```

Types

You can refer to an external DTD by either using **system identifiers** or **public identifiers**.

System Identifiers

A system identifier enables you to specify the location of an external file containing DTD declarations. Syntax is as follows −

```
<!DOCTYPE name SYSTEM "address.dtd" [...]>
```

As you can see it contains keyword SYSTEM and a URI reference pointing to the location of the document.

Public Identifiers

Public identifiers provide a mechanism to locate DTD resources and are written as below −

```
<!DOCTYPE name PUBLIC "-//Beginning XML//DTD Address Example//EN">
```

As you can see, it begins with keyword PUBLIC, followed by a specialized identifier. Public identifiers are used to identify an entry in a catalog. Public identifiers can follow any format, however, a commonly used format is called *Formal Public Identifiers, or FPIs.*

PCDATA

PCDATA means parsed character data.

Think of character data as the text found between the start tag and the end tag of an XML element.

PCDATA is text that WILL be parsed by a parser. **The text will be examined by the parser for entities and markup**.

Tags inside the text will be treated as markup and entities will be expanded.

However, parsed character data should not contain any &, <, or > characters; these need to be represented by the & < and > entities, respectively.

CDATA

CDATA means character data.

CDATA is text that will NOT be parsed by a parser. Tags inside the text will NOT be treated as markup and entities will not be expanded.