XML & XML PROCESSING

PREREQUISITES JAVA WEB SERVICE

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Session-1

Agenda

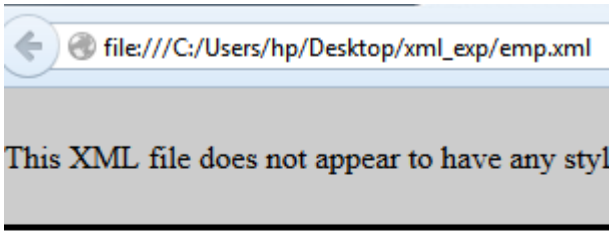
- Introduction to XML
- Well formed XML
- NameSpace
- XML validation
  - DTD
  - Schema


```
<?xml?>
```

Introduction to XML

- XML vs. HTML
  - Predefined Tags vs. extended (user define) markup language
- binary data vs. text data
- Idea of universal data format: SGML
  - there were a format that combined the universality of text files with the efficiency and rich information storage capabilities of binary files?
- XML parsers
  - parsers read XML syntax and extract the information for us

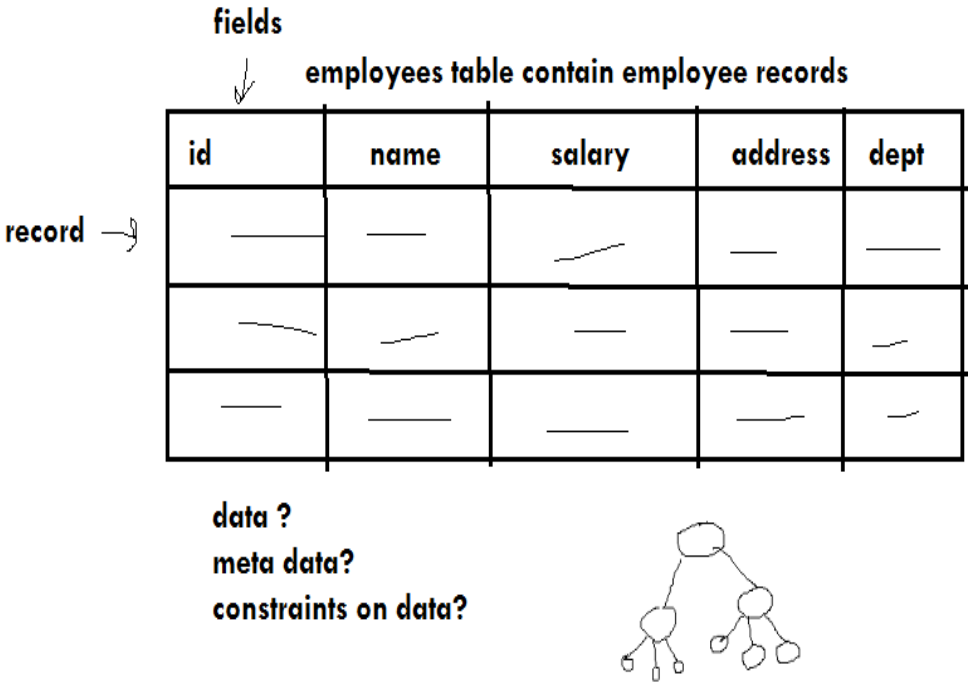
```
<?xml version="1.0" encoding="utf-8"?>
  <name>
    <first id="2">ravi</first>
    <middle>kumar</middle>
    <last>gupta</last>
  </name>
```

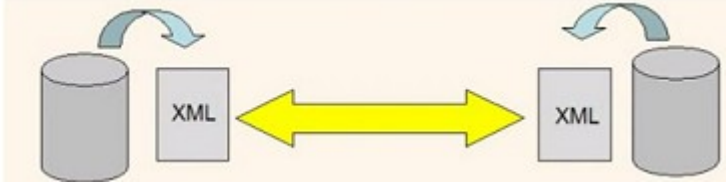



```
- <name>
    <first id="2">ravi</first>
    <middle>kumar</middle>
    <last>gupta</last>
  </name>
```

XML comparing with RDBMS

- XML is very similar to database concept
- XML can be used to store , retrieve and transmit data
  - XML databases
  - **Most of the time XML is used for data interchange bw two system in inter-operatable way**





Nut and Bolt of XML

```
<?xml version="1.0" encoding="utf-8"?>
<people>
    <husband>
        <name>raja</name>
        <age>33</age>
        <employed >yes</employed>
    </husband>

        <husband employed="no">
        <name>amit</name>
        <age>23</age>
        <employeed >yes</employeed>
    </husband>
    <wife>
        <name>foo</name>
        <age>30</age>
    </wife>

        <wife>
        <name>bar</name>
        <age>22</age>
    </wife>
</people>
```

root element

element

Attribute

start tag

end tag

<fun/> empty element

<!-- comments -->

shows as it is on browser

must not contain --

it is not an element

Well formed XML

- Every start-tag must have a matching end-tag, or be a self-closing tag.
- Tags can't overlap; elements must be properly nested.
- XML documents can have only one root element
- Element names must obey XML naming conventions
- XML is case sensitive
- XML will keep whitespace in your PCDATA ie In XML, the whitespace stays
- Example : Order.xml

```
<!DOCTYPE orderform SYSTEM "order.dtd">
<orderform>
    <customer>
        <name>Jenny</name>
        <address>Tokyo</address>
        <tel>
            <portable>555-5555-5555</portable>
        </tel>
    </customer>
    <product>
        <product_name>washing machine</product_name>
        <num>1</num>
    </product>
    <product>
        <product_name>television</product_name>
        <num>2</num>
    </product>
</orderform>
```

Entity Reference

- Well formed XML can not have symbol like > < &, we need to use Entity in place of them
  - <comparison>6 is < 7 & 7 > 6 </comparison>
  - &—the & character
  - < —the < character
  - >—the > character
  - '—the ‘ character
  - "—the “ character

CDATA character data

- If you have a lot of < and & characters that need escaping, you may find that your document become ugly
- Using CDATA sections, you can tell the XML parser not to parse the text, but to let it all go by until it gets to the end of the section.
- CDATA sections look like this:
- <comparison><![CDATA[6 is < 7 & 7 > 6]]></comparison>

```
<script language='JavaScript'><![CDATA[
function myFunc()
{
if(0 < 1 && 1 < 2)
alert("Hello");
}
]]></script>
```

DTD valid xml

- Need of Schema?
  - Two parties must agree on some agreement
  - Aka contract bw two software systems

- **What schema tell us?**
  - What data is allowed?
  - What data is required?
  - How data is organized?

- An Valid XML document must be valid but reverse may not be true

DTD (Document Type Definition)

- A way to validate xml document.
  - What DTD can tell us
    - What element can appear/must appear?
    - what should be order of element?
    - Information about data that contain?
    - attribute information required?
  - What DTD do not tell?
    - DTD do not support namespace concept
    - data type
    - Semantic meaning of an element(whether data is name or date?)

Understanding DTD

```
<?xml version="1.0" encoding="utf-8"?>
<!DOCTYPE people SYSTEM "people.dtd">
<people>
    <husband>
        <name>mark</name>
        <age>45</age>
        <wife>
            <wname>leena</wname>
            <age>43</age>
        </wife>
    </husband>

    <husband>
        <name>matt</name>
        <age>55</age>
        <wife>
            <wname>anne</wname>
            <age>45</age>
        </wife>
    </husband>
</people>
```

```
<!ELEMENT people (husband)*>
<!ELEMENT husband (name, age, wife)>
<!ELEMENT name (#PCDATA)*>
<!ELEMENT age (#PCDATA)*>
<!ELEMENT wife (wname,age)*>
<!ELEMENT wname (#PCDATA)*>
```

* - zero or more times

\+ - one or more times

? – zero or one time

| - or

No symbol means child element must appear only once

```
<!ELEMENT people (husband)*>
<!ATTLIST husband employed CDATA "Yes">
<!ELEMENT husband (name,age,wife)>
<!ELEMENT name (#PCDATA)*>
<!ELEMENT age (#PCDATA)*>
<!ELEMENT wife (wname,age)*>
<!ELEMENT wname (#PCDATA)*>
```

default

- Attribtues in XML
  - <!ATTLIST contact person ID #REQUIRED>
  - In the document you could add the unique ID: <contact person=”Jeff_Rafter”>

XML Namespaces

- A namespace is a purely abstract entity, aka java package
- It's nothing more than a group of names that belong with each other conceptually
- **Two <title> tags represent different semantics?**

```
<?xml version="1.0"?>
<person>
<name>
    <title>Sir</title>
    <first>John</first>
    <middle>Fitzgerald Johansen</middle>
    <last>Doe</last>
</name>
<position>Vice President of Marketing</position>
<resume>
    <html>
        <head><title>Resume of John Doe</title></head>
        <body>
            <h1>John Doe</h1>
            <p>John's a great guy, you know?</p>
        </body>
    </html>
</resume>
```

Two <title> tags represent different sementics?

Approach 1 Using prefix

- **Problem with approach 1**
  - Who will monitor the prefixes?
  - The whole reason for using them is to distinguish names from different document types, but if it is going to work, then the prefixes themselves also have to be unique

```
<?xml version="1.0"?>
<pers:person>
<pers:name>
<pers:title>Sir</pers:title>
<pers:first>John</pers:first>
<pers:middle>Fitzgerald Johansen</pers:middle>
<pers:last>Doe</pers:last>
</pers:name>
<pers:position>Vice President of Marketing</pers:position>
<pers:resume>
<xhtml:html>
<xhtml:head><xhtml:title>Resume of John Doe</xhtml:title></xhtml:head>
<xhtml:body>
<xhtml:h1>John Doe</xhtml:h1>
<xhtml:p>John's a great guy, you know?</xhtml:p>
</xhtml:body>
</xhtml:html>
</pers:resume>
</pers:person>
```

Approach 2 using URI

- A URI (Uniform Resource Identifier) is a string of characters that identifies a resource, URI may be an valid URL

  <?xml version=”1.0”?>

  <{http://www.wiley.com/pers}person>

  <{http://www.wiley.com/pers}name>

  <{http://www.wiley.com/pers}title>

```
<?xml version="1.0"?>
<pers:person xmlns:pers="http://www.wiley.com/pers"
             xmlns:html="http://www.w3.org/1999/xhtml">
  <pers:name>
    <pers:title>Sir</pers:title>
    <pers:first>John</pers:first>
    <pers:middle>Fitzgerald Johansen</pers:middle>
    <pers:last>Doe</pers:last>
  </pers:name>
  <pers:position>Vice President of Marketing</pers:position>
```

Default namespace

- We can use default namespace to simplify last approach
- We can make one of the namespace as default Here xmlns="http://www.wiley.com/pers" is default namespace
- A espace in

```
<person xmlns="http://www.wiley.com/pers"
  xmlns:html="http://www.w3.org/1999/xhtml">
<name>
  <title>Sir</title>
  <first>John</first>
  <middle>Fitzgerald Johansen</middle>
  <last>Doe</last>
</name>
```

xml Schema

- **Why XML Schema?**
  - XML Schemas are created using basic XML, while DTDs utilize a separate syntax.
  - XML Schemas fully support the Namespace Recommendation.
  - XML Schemas enable you to validate text element content based on built-in and user-defined data types
  - XML Schemas enable you to more easily create complex and reusable content models
  - XML Schemas enable the modelling of programming concepts such as object inheritance and type substitution

Example: name.xsd

```xml
<?xml version="1.0"?>
<name xmlns="http://www.example.com/name"
  xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:schemaLocation="http://www.example.com/name name.xsd"
  title="Mr.">
   <first>John</first>
   <middle>Fitzgerald Johansen</middle>
   <last>Doe</last>
</name>
```

```xml
<?xml version="1.0"?>
<schema xmlns="http://www.w3.org/2001/XMLSchema"
  xmlns:target="http://www.example.com/name"
  targetNamespace="http://www.example.com/name"
  elementFormDefault="qualified">
  <element name="name">
    <complexType>
      <sequence>
        <element name="first" type="string"/>
        <element name="middle" type="string"/>
        <element name="last" type="string"/>
      </sequence>
      <attribute name="title" type="string"/>
    </complexType>
  </element>
</schema>
```

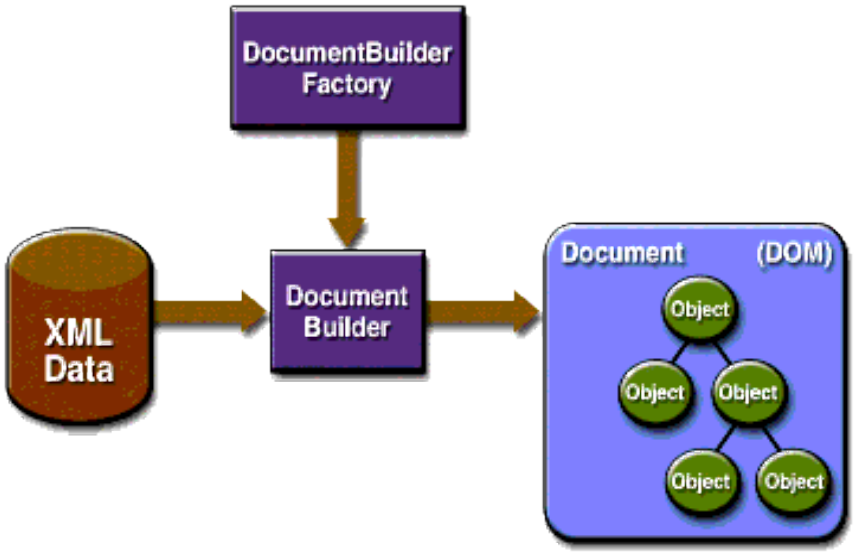
Session-2

Agenda

- Introduction to XML data processing
- XML processing techniques
  - DOM
  - SAX
  - JAXB
  - JSON

DOM XML Parser

- The DOM is the easiest to use Java XML Parser.
- It parses an entire XML document and load it into memory, modelling it with Object for easy model traversal.
- DOM Parser is slow and consume a lot memory if it load a XML document which contains a lot of data.



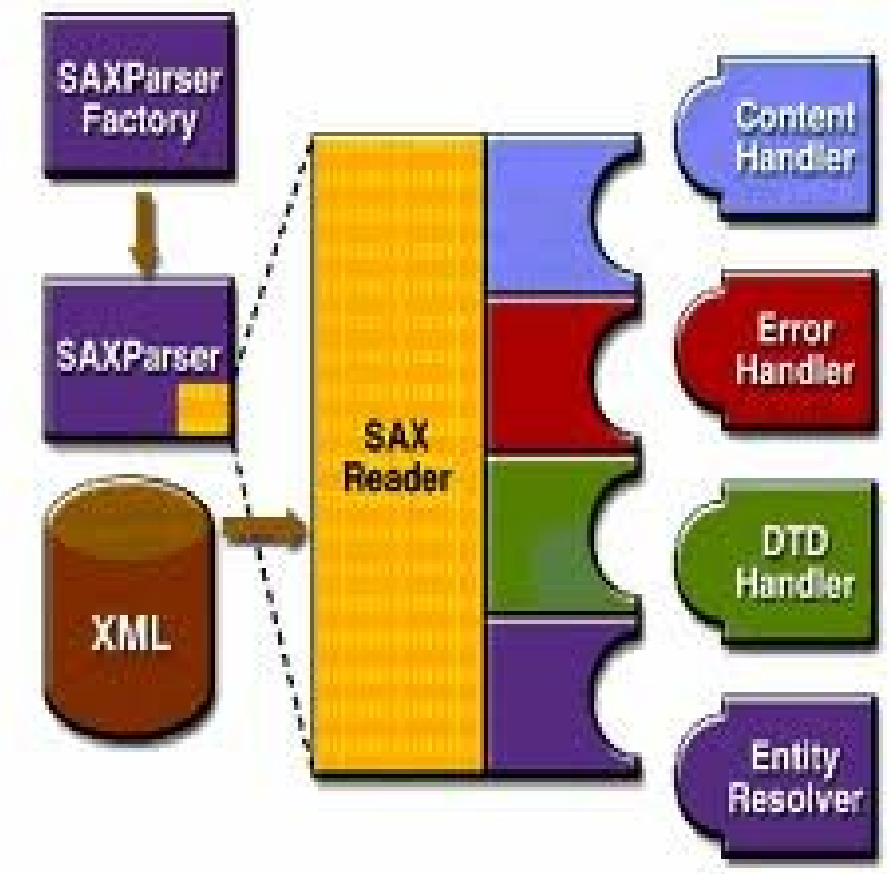
XML DOM processing

- Reading XML file in Java using DOM
- DOM parser to modify an existing XML file
  - Add a new element
  - Update existing element attribute
  - Update existing element value
  - Delete existing element

http://www.mkyong.com/java/how-to-read-xml-file-in-java-dom-parser/

SAX XML Parser

- SAX parser use callback functions (org.xml.sax.helpers.DefaultHandler) to informs clients about the XML document structure
- It is faster then DOM
- Do not require complete xml document in advance



Reading XML file in using SAX

- **Following are SAX callback methods :**
  - **startDocument() and endDocument()**
    - Method called at the start and end of an XML document
  - **startElement() and endElement()**
    - Method called at the start and end of a document element
  - **characters()**
    - Method called with the text contents in between the start and end tags of an XML document element

Hello World SAX

```java
public class EmployeeHandler extends DefaultHandler {

	@Override
	public void characters(char[] ch, int start, int length)throws SAXException {
		for(int i=start; i<(start+length);i++){
			System.out.print(ch[i]);
		}
	}

	@Override
	public void endDocument() throws SAXException {
		System.out.println("finishing processing xml doc");
	}

	@Override
	public void endElement(String uri, String localName, String qName)throws SAXException {
		System.out.print("</"+qName+ ">");

	}

	@Override
	public void startDocument() throws SAXException {
		System.out.println("Starting processing xml doc");
	}

	@Override
	public void startElement(String uri, String localName, String qName,Attributes attributes)
	throws SAXException {
		System.out.print("<"+qName+ ">");
	}
}
```

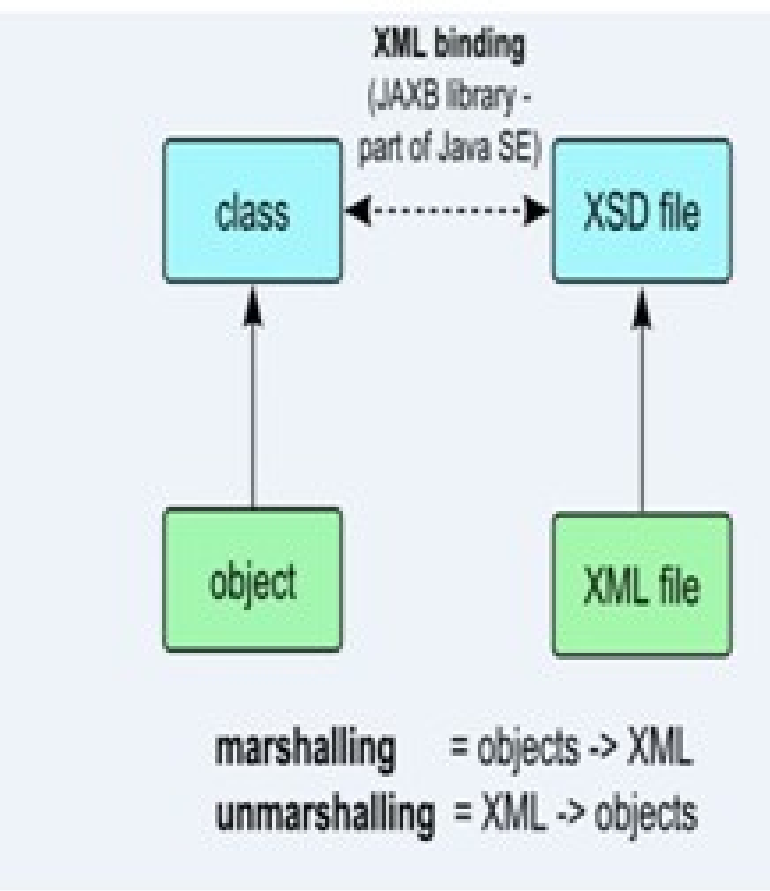
company.xml

```xml
<?xml version="1.0"?>
<company>
	<staff id="1001">
		<firstname>yong</firstname>
		<lastname>mook kim</lastname>
		<nickname>mkyong</nickname>
		<salary>100000</salary>
	</staff>
	<staff id="2001">
		<firstname>low</firstname>
		<lastname>yin fong</lastname>
		<nickname>fong fong</nickname>
		<salary>200000</salary>
	</staff>
</company>
```

```java
XMLReader reader=XMLReaderFactory.createXMLReader();
reader.setContentHandler(new EmployeeHandler());
reader.parse("company.xml");
```

JAXB

- **JAXB, stands for Java Architecture for XML Binding,**
- **Using JAXB annotation to convert Java object to / from XML file.**
- Marshalling
  - Convert a Java object into a XML file.
- Unmarshalling
  - Convert XML content into a Java Object.



Why JAXB?

- JAXB is at higher level of abstraction then DOM and SAX, it directly convert an xml data to object orientation

- JAXB helps Java developers to map Java classes to XML representations.
- JAXB provides two main features: the ability to marshal Java objects into XML and the inverse, i.e. to unmarshal XML back into Java objects.
- JAXB mostly is used while implementing web services or any other such client interface for an application where data needs to be transferred in XML format instead of HTML format which is default in case of visual client like web browsers.

Convert Object to XML

Steps:

1. Have pojo with Jaxb annotation

```
@XmlRootElement
public class Customer {
    ...
    ...
```

2. Convert Object to XML

Use jaxbMarshaller.marshal();

3. **Convert XML to Object**

Use `jaxbMarshaller.unmarshal();`

JAXB Hello World

- @XmlAccessorType annotation used to determine how to marshal a file to/from XML:
- Normally the main decision to be made is between FIELD & PROPERTY/PUBLIC. FIELD is particularly useful when you have logic in your get/set methods that you do not want triggered during marshalling/unmarshalling

Employee.java

```
@XmlRootElement(name = "employee")
@XmlAccessorType (XmlAccessType.FIELD)
public class Employee
{
    private Integer id;
    private String firstName;
    private String lastName;
    private double income;

    //Getters and Setters
}
```

Employees.java

```
@XmlRootElement(name = "employees")
@XmlAccessorType (XmlAccessType.FIELD)
public class Employees
{
    @XmlElement(name = "employee")
    private List<Employee> employees = null;

    public List<Employee> getEmployees() {
        return employees;
    }

    public void setEmployees(List<Employee> employees) {
        this.employees = employees;
    }
}
```

JAXB Marshalling

Marshalling example

```
//Initialize the employees list
static Employees employees = new Employees();
static
{
    employees.setEmployees(new ArrayList<Employee>());
    //Create two employees
    Employee emp1 = new Employee();
    emp1.setId(1);
    emp1.setFirstName("Lokesh");
    emp1.setLastName("Gupta");
    emp1.setIncome(100.0);

    Employee emp2 = new Employee();
    emp2.setId(2);
    emp2.setFirstName("John");
    emp2.setLastName("Mclane");
    emp2.setIncome(200.0);

    //Add the employees in list
    employees.getEmployees().add(emp1);
    employees.getEmployees().add(emp2);
}
private static void marshalingExample() throws JAXBException
{
    JAXBContext jaxbContext = JAXBContext.newInstance(Employees.class);
    Marshaller jaxbMarshaller = jaxbContext.createMarshaller();

    jaxbMarshaller.setProperty(Marshaller.JAXB_FORMATTED_OUTPUT, true);

    //Marshal the employees list in console
    jaxbMarshaller.marshal(employees, System.out);

    //Marshal the employees list in file
    jaxbMarshaller.marshal(employees, new File("c:/temp/employees.xml"));
}
```

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<employees>
    <employee>
        <id>1</id>
        <firstName>Lokesh</firstName>
        <lastName>Gupta</lastName>
        <income>100.0</income>
    </employee>
    <employee>
        <id>2</id>
        <firstName>John</firstName>
        <lastName>Mclane</lastName>
        <income>200.0</income>
    </employee>
</employees>
```

JAXB marshalling example output

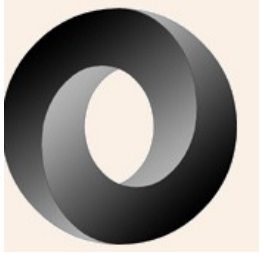
JAXB Unmarshalling

Unmarshalling example

Unmarshalling is the process of converting the xml back to java object. Let's see the example of our Employees class.

```
1  private static void unMarshalingExample() throws JAXBException
2  {
3      JAXBContext jaxbContext = JAXBContext.newInstance(Employees.class);
4      Unmarshaller jaxbUnmarshaller = jaxbContext.createUnmarshaller();
5
6      //We had written this file in marshalling example
7      Employees emps = (Employees) jaxbUnmarshaller.unmarshal( new File("c:/temp/employees.xml") );
8
9      for(Employee emp : emps.getEmployees())
10     {
11         System.out.println(emp.getId());
12         System.out.println(emp.getFirstName());
13     }
14 }
15
16 Output:
17
18 1
19 Lokesh
20 2
21 John
```

JSON



- **JSON** (JavaScript Object Notation) is text-based lightweight data interchange format.
- JSON is a subset of Java Script. JSON can be parsed by a Java Script parser.
- The most important aspects of JSON data transfer are simplicity, extensibility, interoperability, openness and human readability
- JSON represent object data in the form of key-value pairs. We can have nested JSON objects too and it provides an easy way to represent arrays also.
- It can represent either complex or simple data

```
{
   "name": "Jonathan",
   "age": 29,
   "address": {
      "state": "MH",
      "zip": 400024,
      "country":"INDIA"
   },
   "petnames": ["John","Johny"]
}
```

JSON is widely used in web applications or as server response because it's lightweight and more compact than XML. JSON objects are easy to read and write and most of the technologies provide support for JSON objects.

Why JSON is used in AJAX (optional topic)

- JSON is widely used in AJAX, WS ?

```
{
"fullname": “Rajeev Gupta",
"org": “India",
}
```

```
<?xml version='1.0‘ encoding='UTF-8'?>
<element>
<fullname> Rajeev Gupta </fullname>
<org>India</org>
</element>
```

- Lighter and faster than XML as on-the-wire data format
- JSON objects are typed while XML data is typeless
  - JSON types: string, number, array, boolean,
  - XML data are all string
- Native data form for JavaScript code
  - Data is readily accessible as JSON objects in your JavaScript code vs. XML data needed to be parsed and assigned to variables through tedious DOM APIs
  - Retrieving values is as easy as reading from an object property in your JavaScript code

JSON vs. JavaScript

JSON

```
{
        "name": "rajiv gupta",
        "country":"india",
        "qualification":"MTech"
}
```

#JSON is not a programming language, just an data interchange technology

#Key should be in double quotes

#Value should be in double quotes

JavaScript

```
var trainer={
        name: "rajiv gupta",
        country:'india',
        qualification:"MTech"
};
```

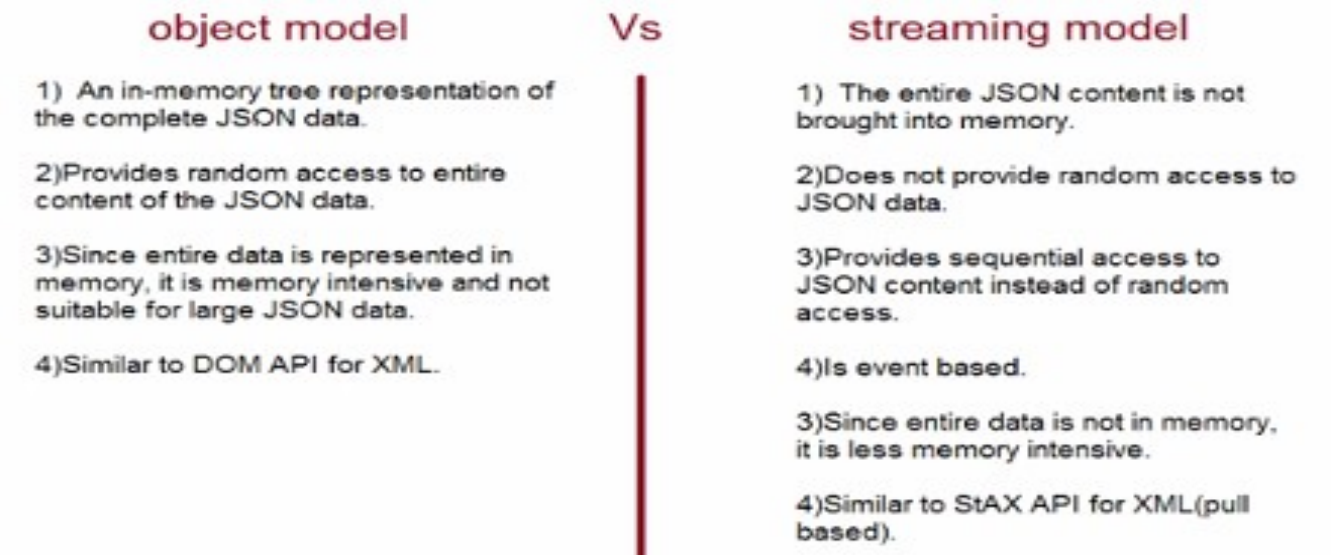
JavaScript is an programming language

key can be without quotes

value can be in ' ' or " ", value can be function too !

JSON processing

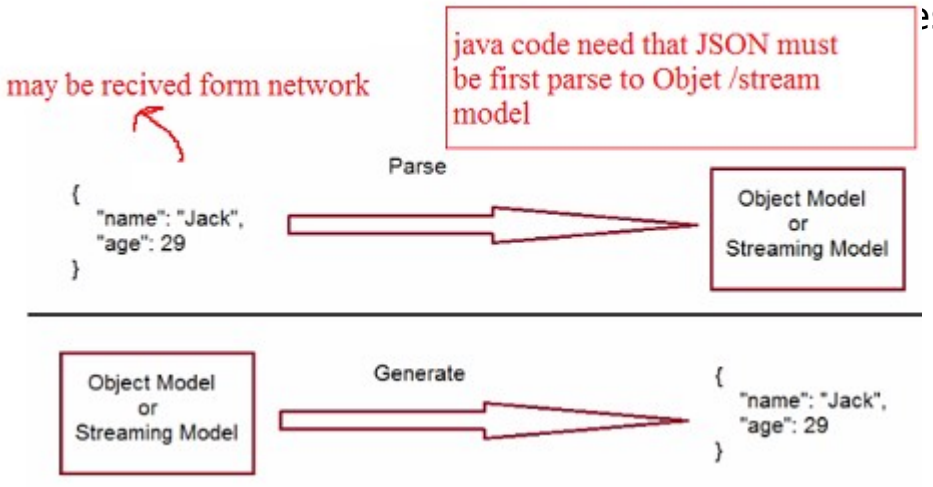
- **JSON API provides two ways for JSON processing:**
  - Object Model API
    - It’s similar to DOM Parser and good for small objects.
  - Streaming API
    - It’s similar to StaX Parser and good for large objects where you don’t want to keep whole object in memory.

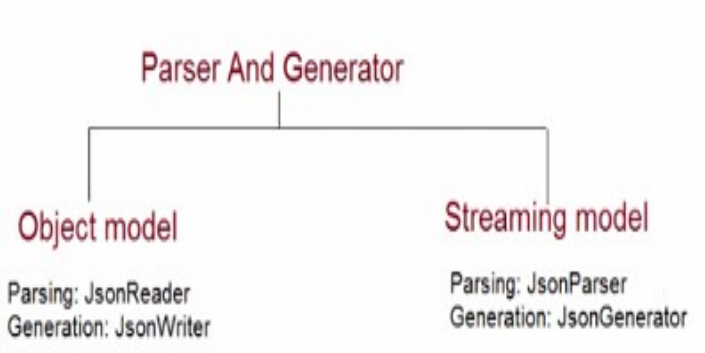


JSON API (Important Interface)

- **javax.json.JsonReader**: We can use this to read JSON object or an array to JsonObject. We can get JsonReader from Json class or JsonReaderFactory.
- **javax.json.JsonWriter**: We can use this to write JSON object to output stream.
- **javax.json.stream.JsonParser**: This works as a pull parser and provide streaming support for reading JSON objects.
- **javax.json.stream.JsonGenerator**: We can use this to write JSON object to output source in streaming way.
- **javax.json.Json**: This is the factory class for creating JSON processing objects. This class provides the most commonly used methods for creating these objects and their corresponding factories. The factory classes provide all the various ways to create these objects.

esents an immutable ISON obiect value

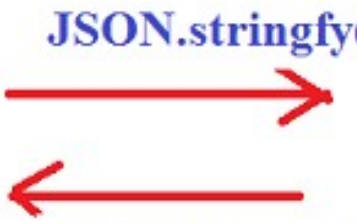




JSON to JavaScript notation interchange

json object

```
{
        "name": "rajiv gupta",
        "country":"india",
        "qualification":"MTech"
}
```



string

```
var trainer={
        name: "rajiv gupta",
        country:'india',
        qualification:"MTech"
};
```

JSON Parser and Generator