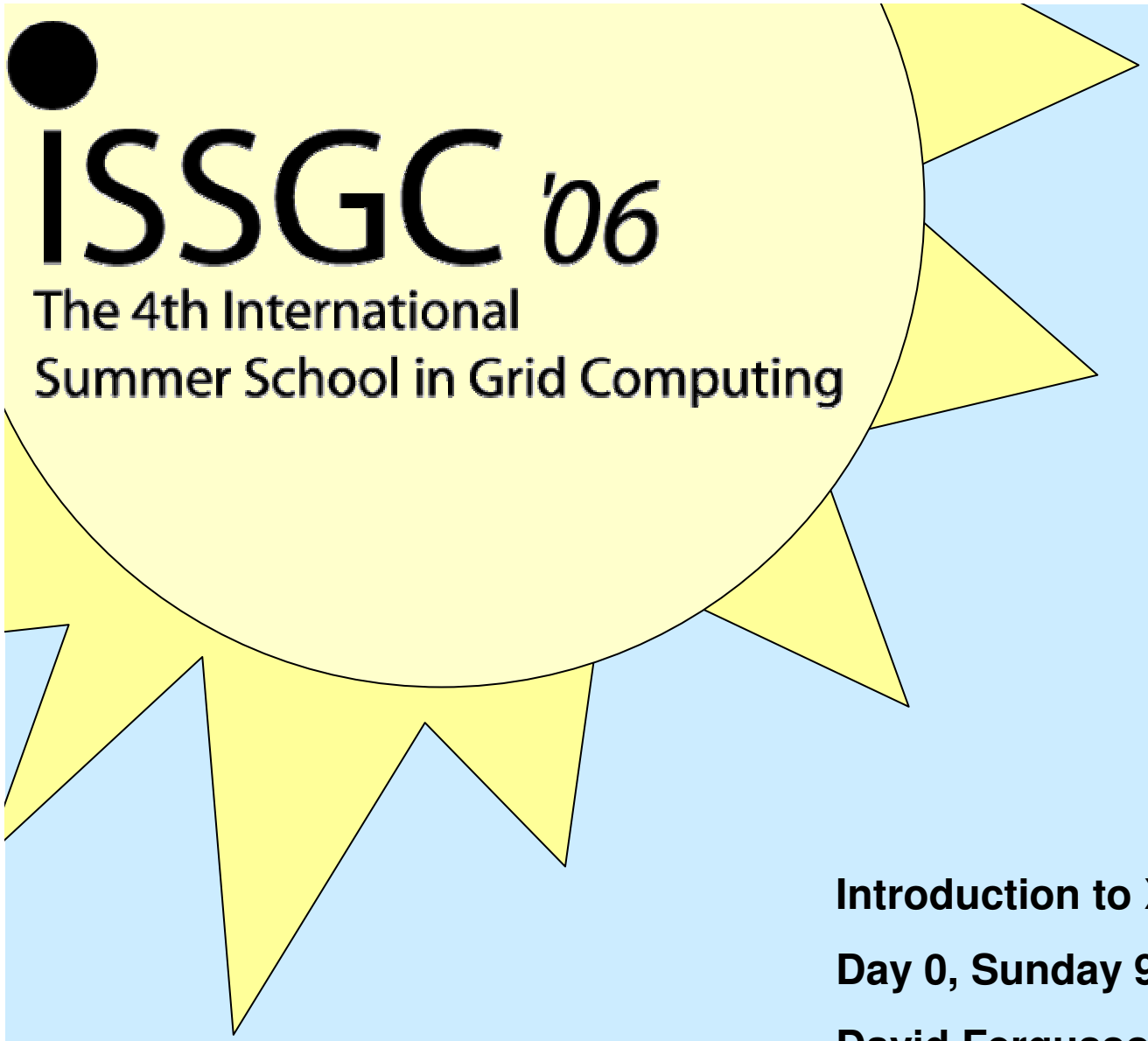



# Introduction to XML

**Day 0, Sunday 9 July,**

**David Fergusson**

# Objectives

- To understand basic XML syntax
- To explore the concept of namespaces
- To understand the role of Schema

# What is XML

- XML stands for extensible markup language
- It is a hierarchical data description language
- It is a sub set of SGML a general document markup language designed for the American millitary.
- It is defined by w3c.

# How does XML differ from HTML?

- HTML is a presentation markup language – provides no information about content.
- There is only one standard definition of all of the tags used in HTML.
- XML can define both presentation style and give information about content.
- XML relies on custom documents defining the meaning of tags.

# What is a Schema?

- A schema is the definition of the meaning of each of the tags within a XML document.
- *Analogy: A HTML style sheet can be seen as a limited schema which only specifies the presentational style of HTML which refers to it.*
- *Example: in HTML the tag  pre-defined. In XML you would need to define this in the context of your document.*

# Pre-existing schema

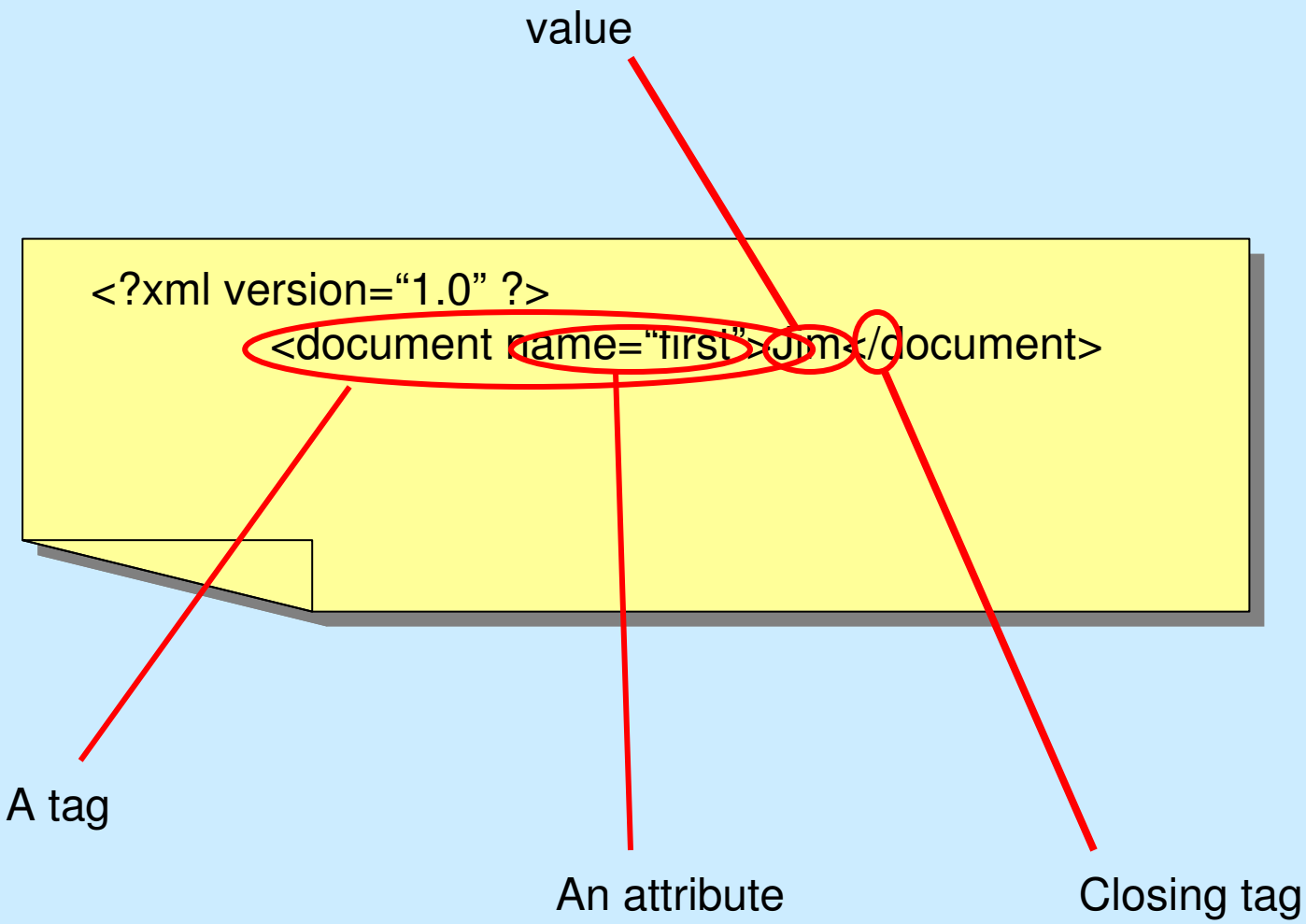
- A schema can ‘inherit’ from another and extend it.

  (*analogous to extending a class in JAVA*)

- For example the basic tags which allow you to write schema are defined in :

  http://www.w3.org/2001/XMLSchema

# A minimal XML document



# Valid and well formed

- A correct XML document must be both valid and well formed.
- Well formed means that the syntax must be correct and all tags must close correctly (eg <…> </…>).
- Valid means that the document must conform to some XML definition ( a DTD or Schema).

(Otherwise there can be no definition of what the tags mean)

# Namespaces in XML

- Schema require namespaces.
- A namespace is the domain of possible names for an entity within a document.
- Normally a single namespace is defined for a document. In this case fully qualified names are not required.

# Common namespace prefixes

| | |
|---|---|
| xsi | http://www.w3c.org/2000/10/XMLSchema-instance<br>*namespace governing XMLSchema instances* |
| xsd | http://www.w3c.org/2000/10/XMLSchema<br>*namespace of schema governing XMLSchema (.xsd) files* |
| tns | by convention this refers to “this” document<br>*refers to the current XML document* |
| | wsdl http://schemas.xmlsoap.org/wsdl/<br>*WSDL namespace* |
| soap | http://schema.xmlsoap.org/wsdl/soap/<br>*WSDL SOAP binding namespace* |

# Using namespaces in XML

- To fully qualify a namespace in XML write the namespace:tag name. eg.

  <my_namespace:tag> </my_namespace:tag>

- In a globally declared single namespace the qualifier may be omitted.

- More than one namespace:

  <my_namespace:tag> </my_namespace:tag>

  <your_namespace:tag> </your_namespace:tag>

  can co-exist if correctly qualified.

# Namespaces in programming languages

- In C/C++ defined by #includes and classes (eg. myclass::variable).
- In PERL defined by package namespace, $local and $my (eg. myPackage::variable).
- In JAVA defined by includes and package namespace (eg. java.lang.Object)
- **Defines the scope of variables**

# Why namespaces in XML?

- A namespace is used to ensure that a tag (variable) has a unique name and can be referred to unambiguously.
- Namespaces protect variables from being inappropriately accessed – encapsulation.
- This makes sure that when you access a variable correctly it has the expected value.

# Schema

```
<?xml version="1.0"?>
<xs:schema xmlns:xs=http://www.w3.org/2001/XMLSchema
xmlns="document" >
<xs:element name = "DOCUMENT">
        <xs:element name="CUSTOMER"> </xs:element>
</xs:element>
</xs:schema>
```

Simple schema saved as order.xsd

```
<?xml version="1.0"?>
<DOCUMENT xmlns="document"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
Xsi:schemaLocation="order.xsd">
<DOCUMENT>
        <CUSTOMER>sam smith</CUSTOMER>
        <CUSTOMER>sam smith</CUSTOMER>
</DOCUMENT>
```

XML document derived from schema.

# Document Type Definition (DTD)

```
<?xml version="1.0">
<!DOCTYPE DOCUMENT [
<!ELEMENT DOCUMENT (CUSTOMER)>
<!ELEMENT CUSTOMER (#PCDATA)>
]>
```

Simple DTD saved as order.dtd

```
<?xml version="1.0"?>
<!DOCTYPE DOCUMENT SYSTEM "order.dtd">
<DOCUMENT>
        <CUSTOMER>sam smith</CUSTOMER>
        <CUSTOMER>sam smith</CUSTOMER>
</DOCUMENT>
```

XML document derived from DTD.

# URI vs URL

- This is similar to the distinction between an class and an instance in Object Oriented Programming.
- A URI is a universal resource identifier which could have many forms (ie could be an ISBN number if these were in a URN scheme)
- A URL is a http instance of a URI
- URN (universal resource name) is the declared name of a resource
- URC {citation} would point to metadata

# Areas of XML Application

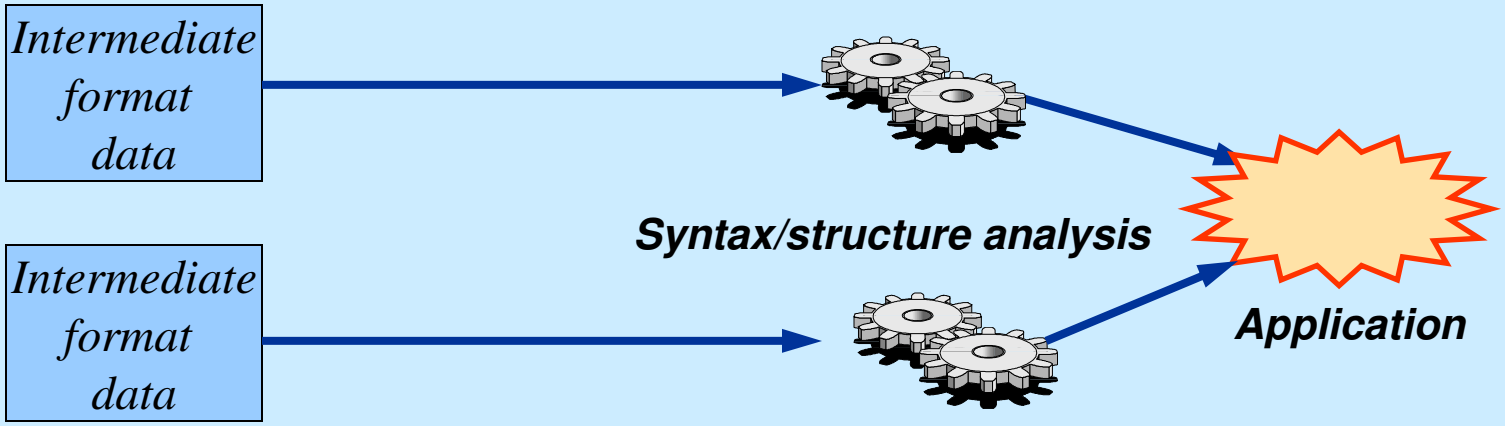
- Document Definition
- Data Exchange
- Metadata (Data about Data)
- Remote Procedure Calls

# Document Definition

- XML used in particular applications – SGML users
  - Specialised XML Editors
- Word2000 uses XML/HTML hybrid, all OS X applications use XML configuration files.
- Microsoft .NET initiative
  - – - Documents encoded in XML
  - Information providers expose data in XML
  - More widespread tools (MS Word?)

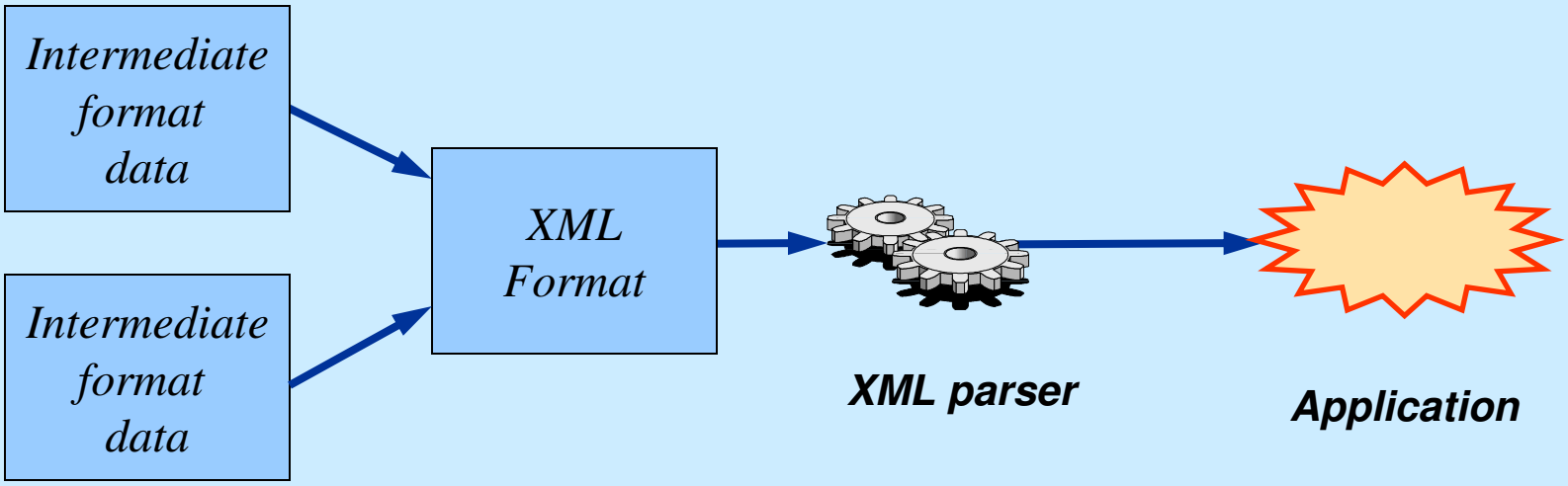
# Using XML for Data Exchange - Current

- Many applications express their data in an intermediate format, to aid interoperability with other applications
  - Other applications parse these documents to reconstitute the data



# Using XML for Data Exchange - Future

- XML can help, because its (standard) notation can be analysed by off-the-shelf XML parsers



# Using XML as Metadata

- XML metadata provides information about the structure and meaning of any data
- XML metadata can be used to perform more intelligent web searches for goods or information
- Cross-site searches are difficult (depends on metadata info in pages)
- XML metadata is more self-describing and meaningful, for example ...
  - Search for all plays written by William Shakespeare
  - Rather than every web site that mentions him!

# Using XML for Remote Procedure Calls

- XML used to exchange data between Software Components
- Simple Object Access Protocol – SOAP
  - A lightweight protocol for exchange of information in a decentralised, distributed environment
  - Web-Sites expose interfaces for interrogation
- Universal Description, Discovery and Integration – UDDI
  - Integrating business services
  - 'Yellow/White Pages'

# Support for XML

- Driven by World Wide Consortium (W3C)
- Industry bodies (OASIS, BizTalk)
- Microsoft, Sun, Oracle, IBM, Novell…
- Dell – large implementation of XML
- Inland Revenue - eGIF

# Industry perspectives

“I believe both Microsoft and the industry should really bet their future around XML, the standards around XML are key to where we need to go.”

**Bill Gates, Microsoft**

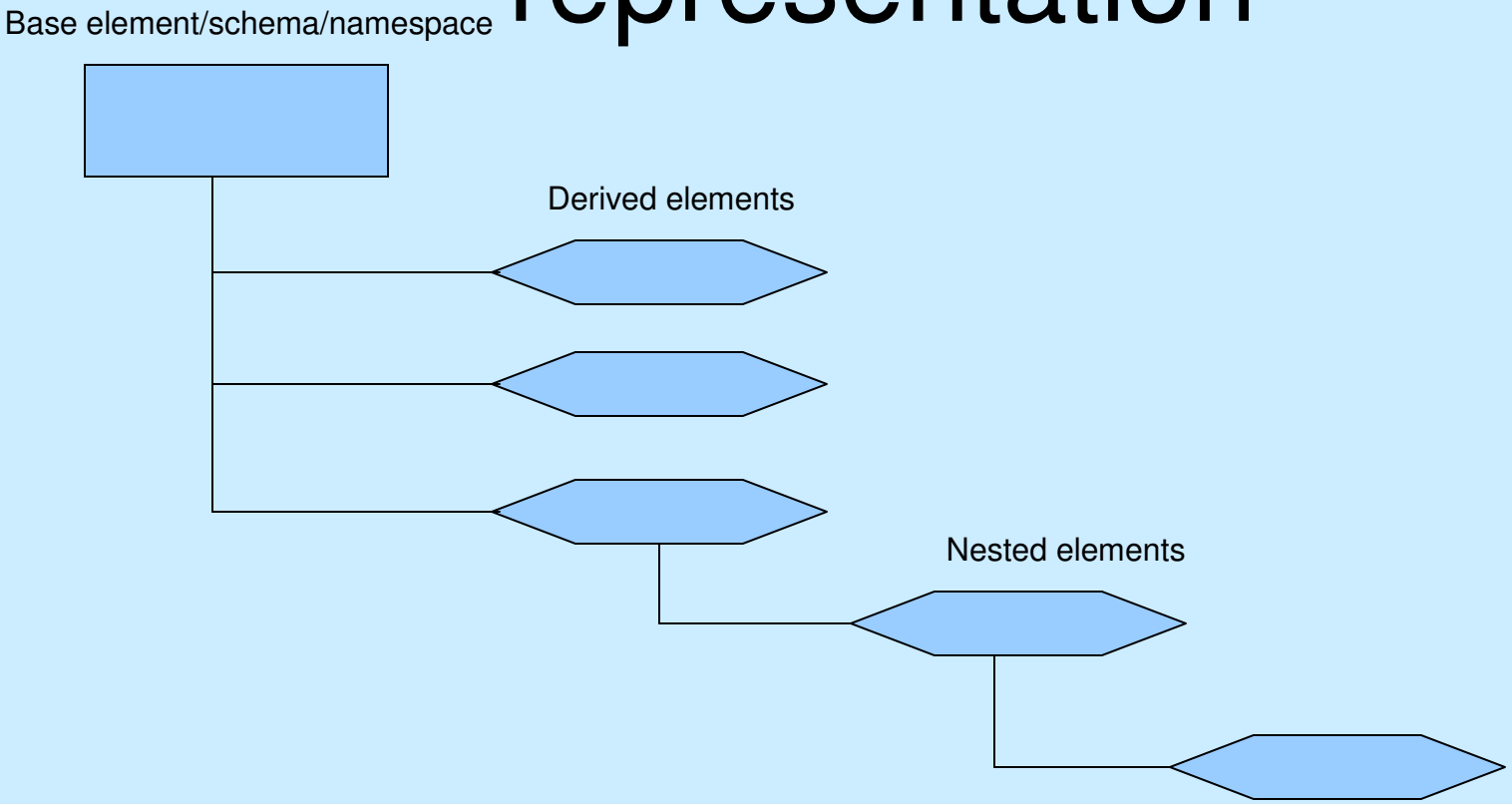
“XML has the potential to address some of the traditional failings of message standards. Its impact could be considerable.”

**Bank of England**

# Use of XML in biological databases

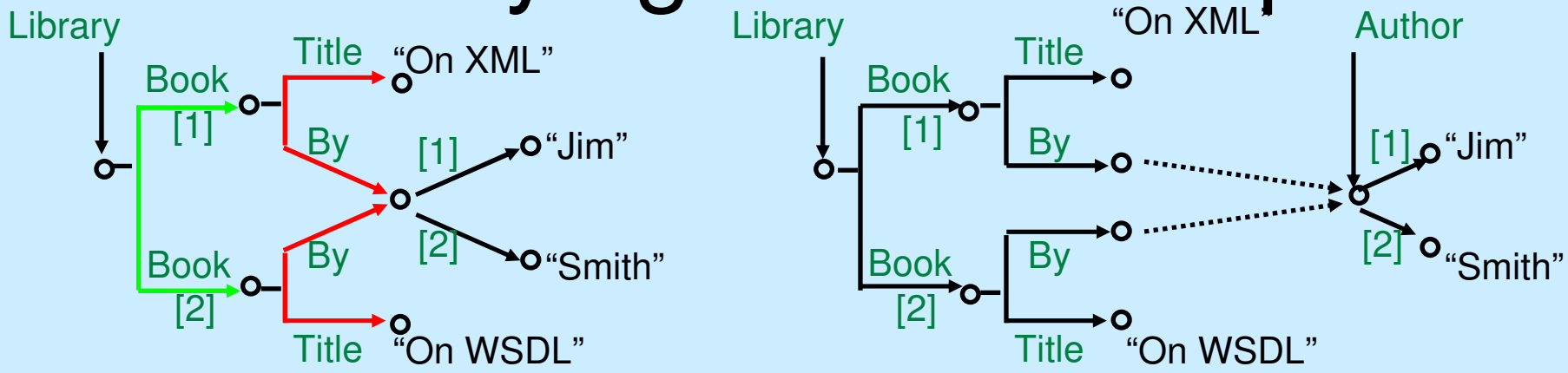
- EBI Molecular Structure Database (MSD) is an extraction from PDB (Protein Data Bank) which is encoded in XML.
- Uses DTDs
- Initiatives at EBI, NCBI and else where to use XML to make heterogeneous databases interoperable

# XML is tree based representation




XML is an acyclic graphical structure - ie. Does not contain loops

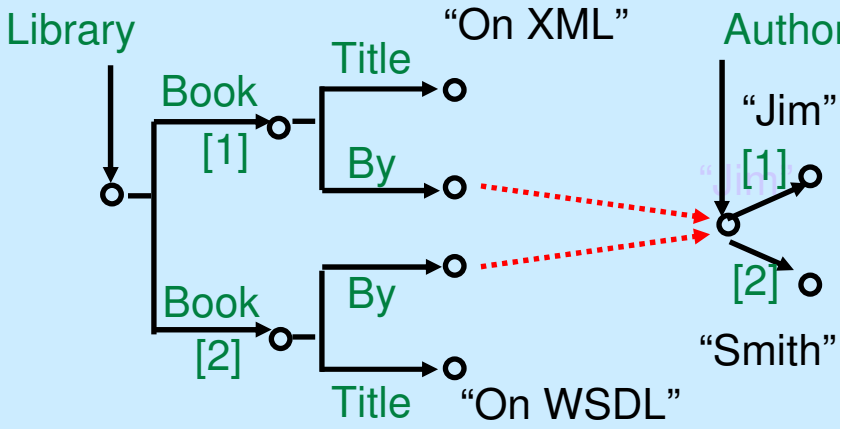
# Tree-ifying A value Graph




- Value Node
  - **Simple** – character data – as can be defined in a Schema
  - **Struct** – outgoing edges distinguished by role name (its accessor)
  - **Array** - outgoing edges distinguished by position (its accessor)
  - Otherwise – by role name and position (its accessor)
  - Every node has a type – explicit or determined by associated schema
- Serialisation – to a forest with reference links
  - A node with N incoming edges becomes
    - A top level node
    - N leaf nodes referencing it and having no components

# Tree-ifying A value Graph

```
<env:Envelope
        xmlns:env="…/soap/envelope"
        xlmns:m="http://company"
        env:encodingStyle="…encoding/" >
  <env:Body>
    <m:Library se:root="1">
      <book>  <Title> On XML</>
                <By href="A1"/>  </>
       <book>  <Title>On WSDL</>
                <By href="A1"/>  </>
    <m:Author id="A1" se:root="0">
      <Name>Jim</>
      <Name>Smith</> </></></></>
```




- No attributes for values; all values as
  - Child elements, for complex types
  - Character data for simple types
- Unqualified names for local;
- Otherwise qualified

- Use href and id for cross-tree links
- Linked-to value must be top-level body entry
- Link can cross resource boundaries –

  href is full URL

# Simple Types

- Every simple value has a type which is a (derivation of a) primitive type, as defined in Schemas standard, which defines their lexical form – (Review)
- Primitive Types
  - string
  - Boolean
  - Float
  - Double
  - Decimal
  - hexBinary
  - base64Binary
  - anyURI
  - QName
  - NOTATION
  - duration
  - dateTime
  - time
  - date
  - gYearMonth
  - gYear
  - gMonthDay
  - gDay
  - gMonth
- Derivations
  - Lengths - length, maxLength,minLength
  - Limits – minInclusive, maxInclusive, minExclusive, maxExclusive
  - Digits – totalDigits, fractionalDigits – (value range and accuracy)
  - pattern – regular expression [A-Z]
  - enumeration – list of allowed values

# Compound Types

- If the order is significant, encoding must follow that required order
  - For Schema **sequence** – order is significant
  - For Schema **any** – order is not significant
- Soap encoding schema provides two compound types
- Se:Struct – components are uniquely named
- Se:Array – components are identified by position
- Both have href and id atributes
- Arrays have further attributes

# Compound Types - Arrays

- Array is of type SEnc:Array or some derivative thereof
  - Attibutes SEnc:href SEnc:id for referencing
- Can specify shape and component type

```
<element name="A" type="se:Array"/>
```

Schema

```
<A se:arrayType="xsd:integer [2,3] [2]">
      <A1>
          <n>111</n> <n>112</n> <n>113</n>
          <n>121</n> <n>122</n> <n>123</n>  </>
      <A2>
          <n>211</n> <n>112</n> <n>213</n>
          <n>221</n> <n>122</n> <n>223</n>  </>
</>
```

Message

- [2] - An array of 2 elements -
- [2,3] Each is a 2 x 3 array of
- Xsd:integer

# Partial Arrays

- Partially transmitted array, offset at which it starts

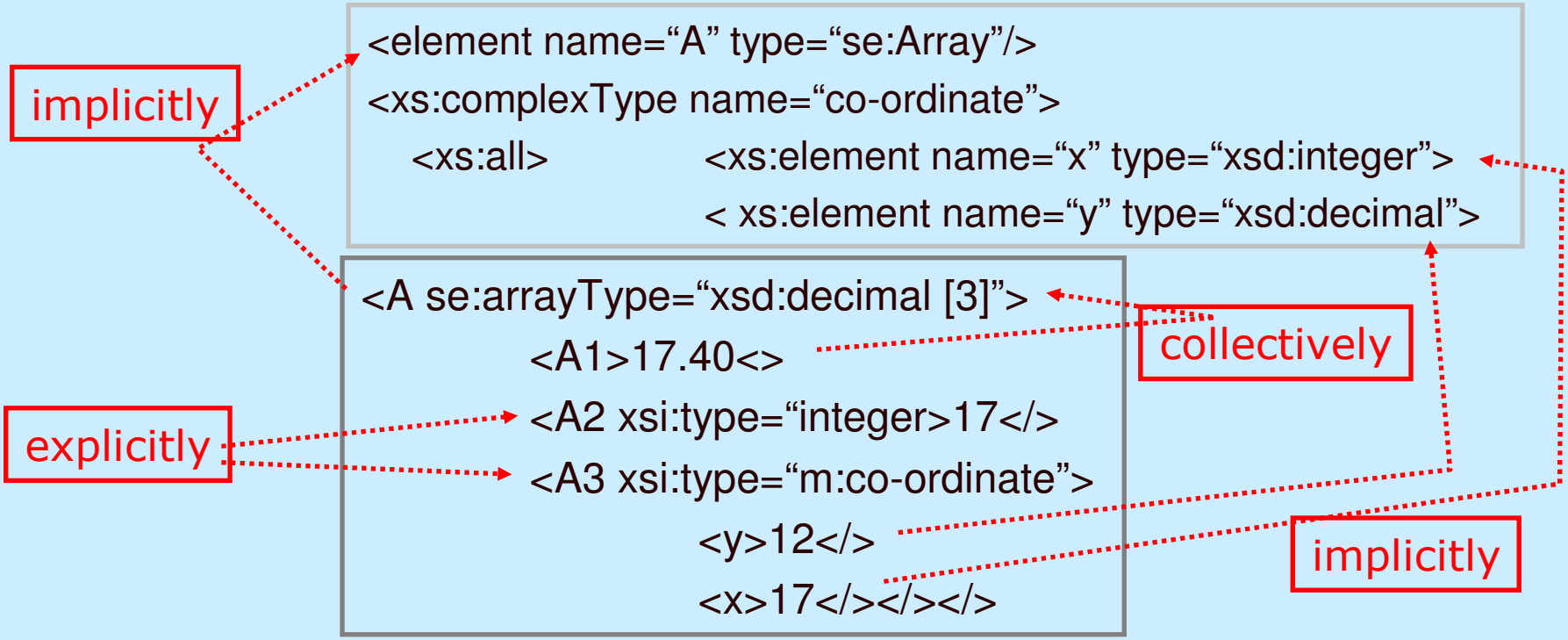
```
<se:Array    se:arrayType="xsd:integer [5]"     se:offset="[2]" >
          <! - - omitted elements 0, 1 and 2-- >
          <i>3</>  <i>4</>   </>
```

- Sparse Array – each element says its position

```
<se:Array          se:arrayType="xsd:integer [ , ] [4]">
    <se:Array      se:position="[2]"
                   se:arrayType="xsd:integer[10,10]">
          <i se:position="[0,0]">11</>
          <i se:position="[3,8]">49</>    </></>
```

# Typing

- **Type of a value** must **be determined, either –**
  - Explicitly - as xsi:type attribute for the element itself
  - Collectively - via type of containing compound value
  - Implicitly - by name and schema definition



# Summary

- XML is a language that provides
  - A mark-up specification for creating self descriptive data
  - A platform and application independent data format
  - A way to perform validation on the structure of data
  - A syntax that can be understood by computers and humans
  - The way to advance web applications used for electronic commerce.