Introduction to XML

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The origins of XML

- XML (eXtensible Markup Language) derives from SGML (Standard Generalized Markup Language).
- Both with XML and SGML it is possible to define markup languages specific to several domains, such as finance or math.
- For instance, HTML is one of the languages derived from SGML.
- With respect to SGML, XML is easier to use, and it's designed to specify markup languages to be used on the Internet.
- Initially XML was born as a format for data exchange
- We will look at XML for its data storage and data lookup capabilities.
- Consequently, we will not go through all the in-depth details but only the aspects relevant to data management.

Example of XML document

```
<?xml version="1.0"?>
<?tex doctype[report] ?>
<doc isbn="2-266-04744-2">
    <!-- editor is missing! -->
    <author>T. Harris</author>
    <title xml:lang="en">The silence of the lambs</title>
    <title xml:lang="fr">Le silence des agneaux</title>
    <comment>
        A book full of <i>suspance</i>.
    </comment>
    <price currency="euro">7</price>
</doc>
```

Markup and *character data*

```
<?xml version="1.0"?>
<?tex doctype[report] ?>
<doc isbn="2-266-04744-2">
    <!-- editor is missing! -->
    <author>T. Harris</author>
    <title xml:lang="en">The silence of the lambs</title>
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    <price currency="euro">7</price>
</doc>
```

Prolog (1/2)

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```

PROLOG

Prolog (2/2)

- The prolog contains information useful for the interpretation of the document.
- In particular, it can contain:
  - A declaration that the document is in XML format (optional).
  - A *grammar* that allows to validate the content of the document (optional).
  - Comments and information for software applications that will use the document (Processing Instructions, or PI) (zero or more).

Body of the document (1/2)

```
<?xml version="1.0"?>
<?tex doctype[report] ?>
<doc isbn="2-266-04744-2">
    <!-- editor is missing! -->
    <author>T. Harris</author>
    <title xml:lang="en">The silence of the lambs</title>
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    </comment>
    <price currency="euro">7</price>
</doc>
```

DOCUMENT BODY

Body of the document (2/2)

- The body of the document is made of one **element**, which itself can contain other nested elements in its content, and also comments.
- We will see, through some examples, how to write *well-formed* elements.

Elements

- An element can be of two forms:

<*name attributes_list***>** *(extended form)*

content...

</*name***>**

<*name attributes_list* ***/>*** *(short form)*

Well-formed elements and attributes (1/5)

- Each element must be contained between an opening tag and a closing /tag or with a short form.

```
<?xml version="1.0"?>
<?tex doctype[report] ?>
<doc isbn="2-266-04744-2">
    <title xml:lang="en">
    The silence of the lambs
    </title>
    <price euro="7"/>
</doc>
```

```
<BR>
```

ERROR:
this tag (BR) is opened but never closed!

Well-formed elements and attributes (2/5)

- The names of elements and attributes are *case-sensitive*.

ERROR

```
<?xml version="1.0"?>
<?tex doctype[report] ?>
<doc isbn="2-266-04744-2">
    <title xml:lang="en">
    The silence of the lambs
    </title>
    <price euro="7"/>
</DOC>
```

Well-formed elements and attributes (3/5)

- Elements must be nested correctly, and there is only one element that contains all the other elements.

```
<?xml version="1.0"?>
<?tex doctype[report] ?>
<doc isbn="2-266-04744-2">
      <b><i>Missing book</b></i>
</doc>
```

ERROR

Well-formed elements and attributes (4/5)

- Values of the attributes must be contained between quotes or double quotes.

```
<?xml version="1.0"?>
<?tex doctype[report] ?>
<doc isbn="2-266-04744-2">
    <title xml:lang=en>
    The silence of the lambs
    </title>
    <price euro="7"/>
</doc>
```

ERROR

Well-formed elements and attributes (5/5)

- An element cannot have more than one attribute with the same name.

WRONG

```
<book author="Doe" author="Blake"/>
```

CORRECT

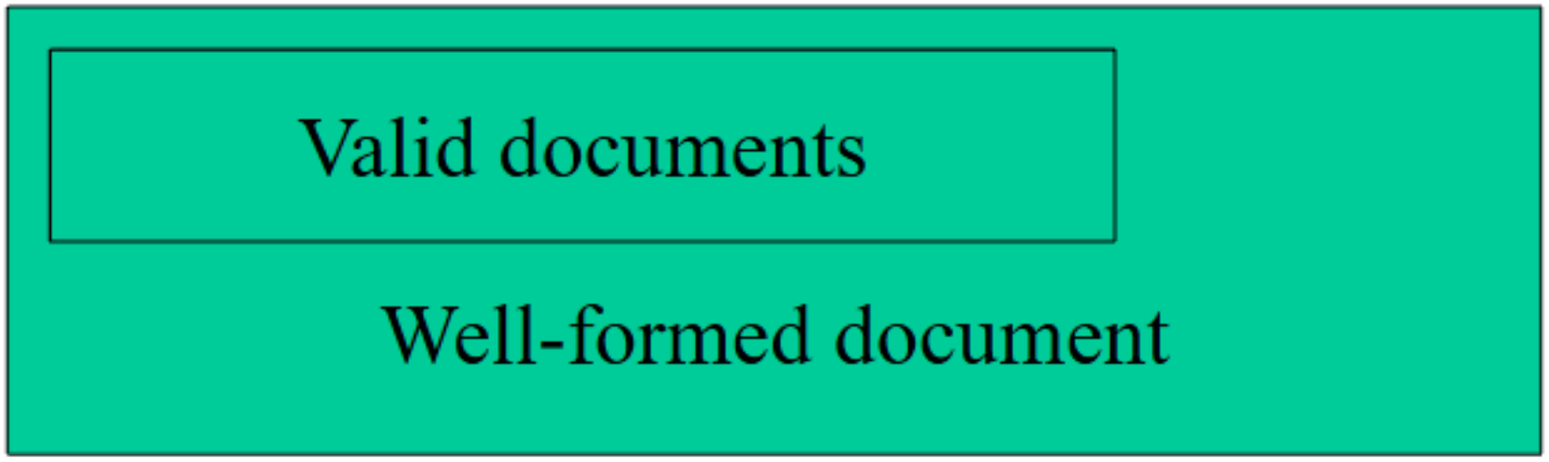
```
<book>
  <author>Doe</author>
  <author>Verdi</author>
</book>
```

Document Type Declaration

- In the beginning of an XML document there can be a **document type declaration**.
- This declaration contains a grammar, named **Document Type Definition**, or **DTD**, with the double purpose of *constrain* and *complete* the documents.
- The DTD is made of **markup declarations**, which define what can be and cannot be written in the related XML document.
- The DTDs determine which elements can be included in the document, how they can be used, what are the default values of the attributes of the elements, and other constraints.

Valid (and well-formed) documents

- An XML document is valid if:
  - It contains a DTD
  - It complies to it



The following is a well-formed document but it's not valid, because it doesn't have a DTD :

```
<greetings>Hello, world!</greetings>
```

Examples of Document Type Declaration 1/2

- We define a type of document named *greetings* that contains an element <greetings>, which do not contain any other element. Then, the attributes of <greetings> are declared, in this example only the *id* attribute.

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE greetings [
    <!ELEMENT greetings (#PCDATA)>
    <!ATTLIST greetings
            id          ID      #REQUIRED>
]>
<greetings id="0001">Hello,
world!</greetings>
```

DTD

Examples of Document Type Declaration 2/2

- The same constraints can be specified inside an external file (hello.dtd) and declared in the following way.

```
<?xml version="1.0"?>
<!DOCTYPE greetings SYSTEM "hello.dtd">
<greetings>Hello, world!</greetings>
```

DTD and XML Schema

- A DTD constrain an XML document.
- It is however possible to specify constraints more complex than the one allowed by DTD.
- For instance: imported keys, uniqueness constraints, or the domains of elements and attributes (as in SQL).
- The XML Schema allows to specify this kind of constraints, and it is therefore an alternative to the DTD.
- Moreover, the constraints of XML Schema are expressed in XML.

Proper and improper usage of XML

- XML allows a great degree of freedom to the designers of XML documents.
- The designer can decide the tags and attributes to use, and where to put the data.
- When XML is used to store data, particular attention must be paid to the correct usage of the elements of the data model: elements, attributes, contents, hierarchies.
- We will now provide some guidelines.

1 – Data in elements content

- Data must be stored in the content of the elements.
- For instance,

```
<book>
    <title>The Great Gatsby</title>
</book>
```

Must be preferred to

```
<book title="The Great Gatsby" />
```

AVOID THIS

2 – Metadata in attributes or names of elements

```
<book>
    <property>
        <name>title</name>
        <value>The Great Gatsby</value>
    </property>
</book>
```

TO AVOID

- In this example, title is a metadata, therefore it must not appear as content.

3 – (In)Correct usage of hierarchies

```
<db>
    <title>The Great Gatsby</title>
    <author>F Scott Fitzgerald</author>
    <title>For Whom the Bell Tolls</title>
    <author>Ernest Hemingway</author>
</db>
```

TO AVOID

- The two titles and the two authors are only separated by the order of elements, while they compose well distinct objects (the refer to different books).
- <title> and <author> must be child of one element <book>, and not child of the elment <db>.

4 – Correct use of hierarchies

```
<db>
    <book>
        <title>The Great Gatsby</title>
        <author>F Scott Fitzgerald</author>
    </book>
    <book>
        <title>For Whom the Bell Tolls</title>
        <author>Ernest Hemingway</author>
    </book>
</db>
```