XML and DTD

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Outline

1 Introduction

2 XML syntax

3 Namespace

4 Document Type Definition (DTD)

5 Exercises

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5 Exercises

Why Semantic Web?

- WWW history
  - 1980ies: Hypertext
  - 1990/1991: http://info.cern.ch
  - 1993: Mosaic Web Browser (later Netscape Navigator)
  - 1994: World Wide Web Consortium (W3C)
  - 1995: HTML 2.0
  - 1997: HTML 3.2
  - 1997: HTML 4.0
  - 2000: HTML 4.01

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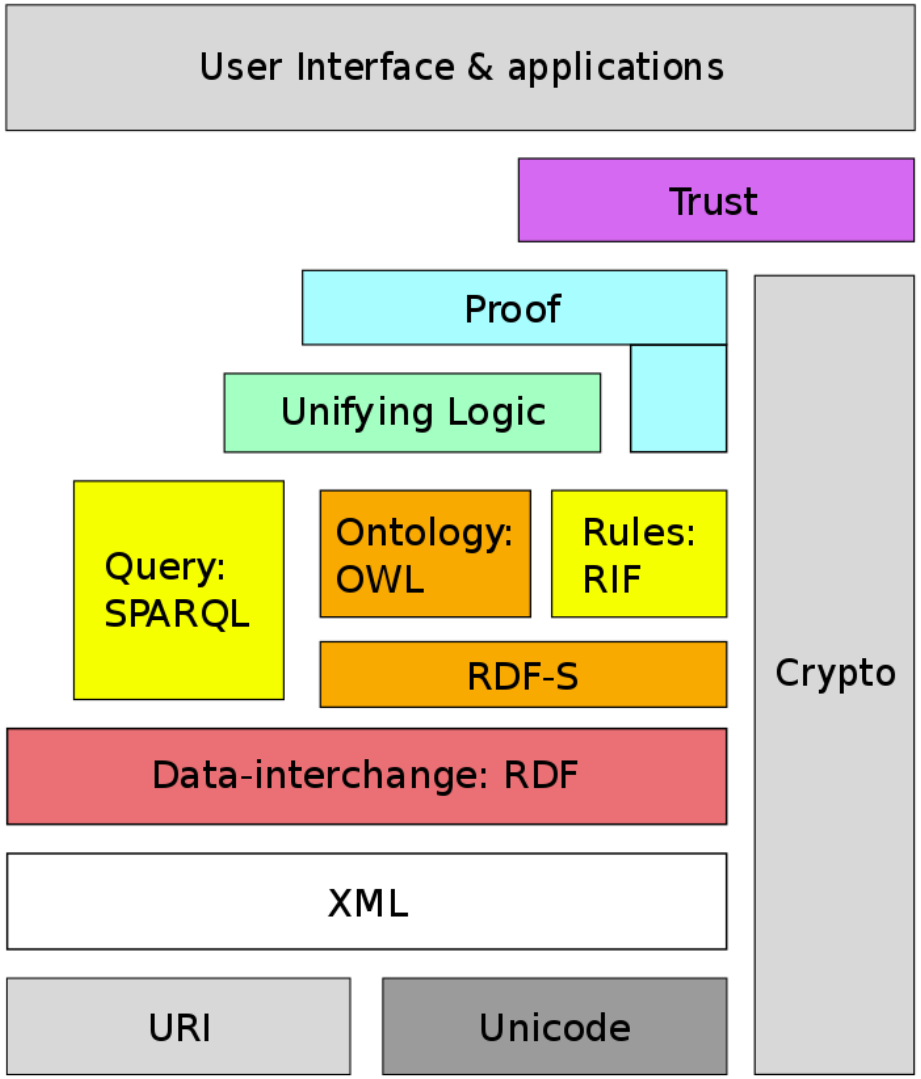
  - 2000: HTML 4.01
- Hyperlinked documents for humans are difficult to access for machines
- Semantic Web: WWW also for machines

Semantic Web Stack



Documents versus Data

- Documents
  - Human-readable
  - Basically unstructured text
  - Markup indicates some structure
- Data
  - Human- and machine-readable
  - Structured text
  - Schema for structure

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XML (Extensible Markup Language) unifies these paradigms

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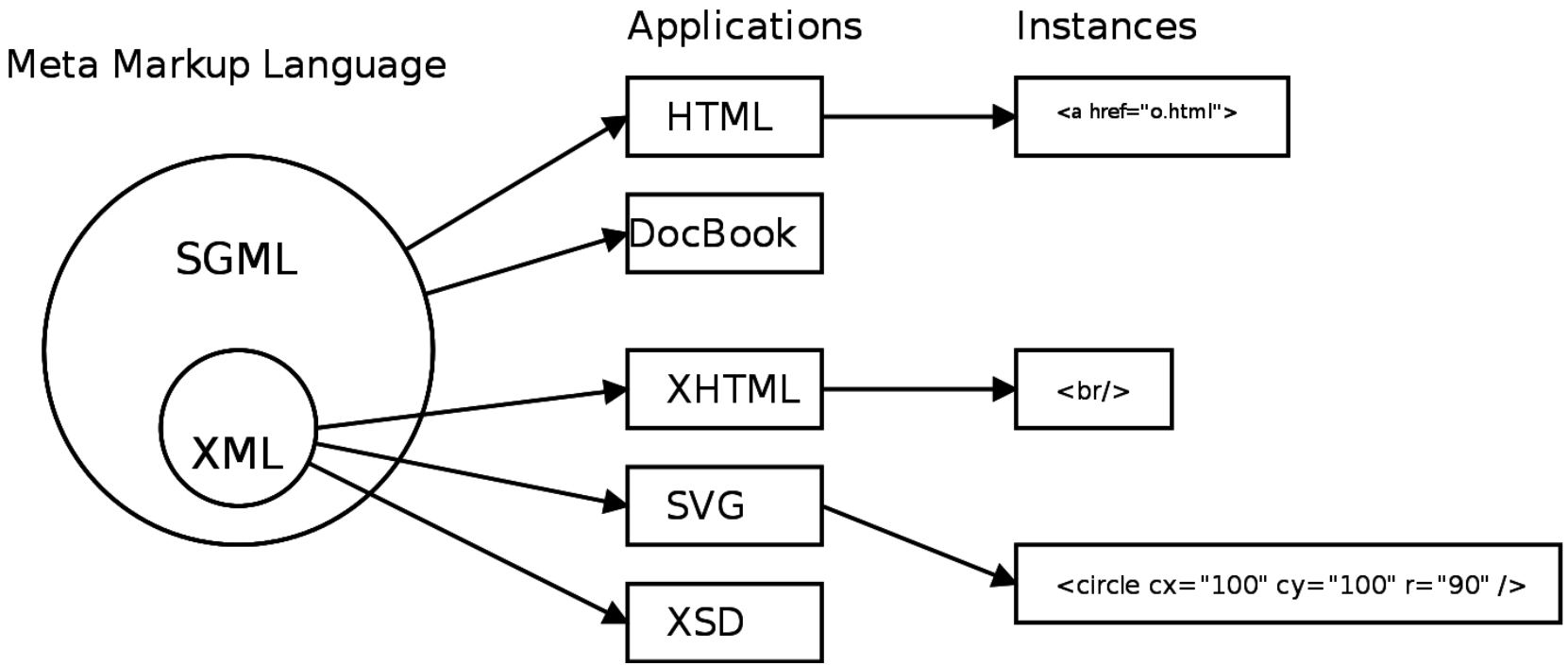
> *XML will be the ASCII of the Web – basic, essential, unexciting*
>
> — Tim Bray, 1997

XML versus HTML



- HTML is an application of SGML
  - Around 100 fixed tags
  - Used mostly for presentation and layout
  - Proprietary extensions and variations
  - Error-tolerant browsers
- XML is subset of SGML
  - Meta-language
  - No fixed tags
  - Applications specify their own document/data types
  - Strict syntax

Why XML? (1)

- How to represent data?

Example. Text file

```
Joe Fawcett
Danny Ayers
Mario Alviano
```

Example. XML file

```
<applicationUsers>
    <user firstName="Joe" lastName="Fawcett" />
    <user firstName="Danny" lastName="Ayers" />
    <user firstName="Mario" lastName="Alviano" />
</applicationUsers>
```

Why XML? (2)

- Less ambiguities
- Easily extensible

Example. Text file

```
Joe John Fawcett
Danny John Ayers
Mario Alviano
```

Examle. XML file

```
<applicationUsers>
    <user firstName="Joe" middleName="John"
lastName="Fawcett" />
    <user firstName="Danny" middleName="John"
lastName="Ayers" />
    <user firstName="Mario" lastName="Alviano" />
</applicationUsers>
```

Why XML? (3)

- Hierarchical data representation

Examle. Text file

```
/
/home
/home/malvi
/proc
/sys
```

Examle. XML file

```
<directory>
    <directory name="home" >
        <directory name="malvi" />
    </directory>
    <directory name="proc" />
    <directory name="sys" />
</directory>
```

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XML syntax (1)

- First line of an XML file is called **prolog**
  - Must specify XML version (1.0 oppure 1.1)
  - May specify a Unicode encode (UTF-8, UTF-16, etc.)
- Comments use the same syntax of HTML

Example. Prolog

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

Example. Comment

```
<!-- This is a comment -->
```

XML syntax (2)

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  2. Only for elements with no content: `<myElement />`

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- Elements have the following forms:
  1. Opening tag, content, closing tag:
     `<myElement>Content</myElement>`
  2. Only for elements with no content: `<myElement />`
- Element may have attributes:

```
<myElement myFirstAttribute="One"
           mySecondAttribute="Two" />
```

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  & &
  < <
  > >
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XML syntax (3)

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  & &
  < <
  > >
  " "
  ' '
- Character references
  - E.g., `
` (exadecimal) or ` ` (decimal) add a space
- Contents containing many invalid character can be denoted by **CDATA**

```
<conversionData>
    <![CDATA[
        1 kilometer < 1 mile
        1 pint < 1 liter
        1 pound < 1 kilogram
    ]]>
</conversionData>
```

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Namespace (1)

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- More XML documents must coexist
- How to handle documents using the same names for elements and attributes?

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Example. Clash on element names

```
<employee>
  <firstName>Joe</firstName>
  <lastName>Fawcett</lastName>
  <title>Mr</title>
  <biography>
      <html>
          <head><title>Joe's Bio</title></head>
          <body>
              <p>After graduating from...</p>
          </body>
      </html>
  </biography>
</employee>
```

Namespace (2)

- Namespaces allow to avoid clashes
  - URI (Uniform Resource Identifier), i.e.
    URL (Uniform Resourse Locator) +
    URN (Uniform Resource Name)

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URL: `[Scheme]://[Domain]:[Port]/[Path]?[QueryString]#[FragmentId]`

```
http://www.wrox.com/remtitle.cgi?isbn=0470114878
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```

URN: `urn:[namespace identifier]:[namespace specific string]`

```
urn:isbn:9780470114872
```

Example. Default namespace

```
<applicationUsers
      xmlns="http://alviano.net/km/examples">
   <user firstName="Joe" lastName="Fawcett" />
   <user firstName="Danny" lastName="Ayers" />
   <user firstName="Mario" lastName="Alviano" />
</applicationUsers>
```

Namespace (3)

- Namespaces identified by a **prefix** can be declared in addition to the default namespace

  `xmlns:km="http://alviano.net/km/examples"`

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  `xmlns:km="http://alviano.net/km/examples"`

Example. Namespace with prefix

```
<km:applicationUsers
      xmlns:km="http://alviano.net/km/examples">
   <km:user firstName="Joe" lastName="Fawcett" />
   <km:user firstName="Danny" lastName="Ayers" />
   <km:user firstName="Mario" lastName="Alviano" />
</km:applicationUsers>
```

Namespace (3)

- Namespaces identified by a **prefix** can be declared in addition to the default namespace

  `xmlns:km="http://alviano.net/km/examples"`

Example. Namespace with prefix

```
<km:applicationUsers
      xmlns:km="http://alviano.net/km/examples">
   <km:user firstName="Joe" lastName="Fawcett" />
   <km:user firstName="Danny" lastName="Ayers" />
   <km:user firstName="Mario" lastName="Alviano" />
</km:applicationUsers>
```

Warning!

- Namespace declarations are inherited
- Attributes are usually associated with no namespace (default namespaces do not apply to attributes)

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Document Type Definition (DTD) (1)

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- The DTD is declared before the root element

```
<!DOCTYPE root-element
      optional-external-reference
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Document Type Definition (DTD) (1)

- A DTD specifies what data are contained in a XML file (i.e., DTD is a schema for XML)
- The DTD is declared before the root element

```
<!DOCTYPE root-element
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      optional-internal-declarations>
```

- Internal declarations are enclosed on brackets and are of the following form

```
<!ELEMENT element-name structure>
```

where “structure” can be

  - `EMPTY`
  - `ANY`
  - `#PCDATA`
  - the name of another element
  - a combination of the previous with `|` `?` `,` `*` `+`

Document Type Definition (DTD) (2)

Example

```
<?xml version="1.0"?>
<!DOCTYPE name [
    <!ELEMENT name (first, middle, last)>
    <!ELEMENT first (#PCDATA)>
    <!ELEMENT middle (#PCDATA)>
    <!ELEMENT last (#PCDATA)>
]>
<name>
    <given>Joseph</given>
    <middle>John</middle>
    <last>Fawcett</last>
</name>
```

Document Type Definition (DTD) (2)

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</name>
```

Is the content valid? How to fix it?

Document Type Definition (DTD) (3)

- Attributes of an element can be specified as follows

```
<!ATTLIST element-name
    attribute-name type default
    ...
>
```

- The type of an attribute can be `CDATA, ID, IDREF, IDREFS, ...`
- The default value may also indicate that an attribute is required (`#REQUIRED`) or optional (`#IMPLICIT`)

Document Type Definition (DTD) (4)

Example

```
<?xml version="1.0"?>
<!DOCTYPE name [
    <!ELEMENT name EMPTY>
    <!ATTLIST name
        first CDATA #REQUIRED
        middle CDATA #IMPLICIT
        last CDATA #REQUIRED>
]>
<name first="Joseph" middle="John"
        last="Fawcett" />
```

Document Type Definition (DTD) (4)

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- `PUBLIC` is used for DTDs in the catalog of the XML parser

```
<!DOCTYPE HTML PUBLIC
    "-//W3C//DTD HTML 4.01//EN">
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<!DOCTYPE HTML PUBLIC
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```

- Optionally, a file may be specified to be used in case the DTD is not in the catalog

```
<!DOCTYPE HTML PUBLIC
    "-//W3C//DTD HTML 4.01//EN"
    "http://www.w3.org/TR/html4/strict.dtd">
```

Document Type Definition (DTD) (5)

- New entity references may be specified

```
<!ENTITY entity-name definition>
```

```
<!ENTITY author "Mario Alviano">
```

`&author;` can now be used in the XML document

Document Type Definition (DTD) (5)

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`&author;` can now be used in the XML document

- Entities can be extern (as for `DOCTYPE`, `SYSTEM` and `PUBLIC` are used)
- Parameter entities are similar, but can be used in the DTD (to split it in files)

```
<!ENTITY % entity-name definition>
```

```
<!ENTITY % address SYSTEM "address.dtd">
```

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How to validate an XML document against a DTD

- XML validation with libxml
  - `xmllint -valid XMLfile -noout`
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- XML validation with libxml
  - `xmllint -valid XMLfile -noout`
  - `xmllint -dtdvalid DTDfile XMLfile -noout`
- XML validation with Eclipse EE
  - Right-click on the file(s) to be validated, then **Validate**

Exercises

1. Given the document **order.xml**, write a DTD that allows its validation
2. Given the document **letter.xml**, write a DTD that allows its validation
3. Given the DTD **mountainRanges.dtd**, write a valid XML document
4. Given the DTD **dealership.dtd**, write a valid XML document
5. Given the description in **football-matches.txt**, write a DTD and a valid XML document

END OF THE LECTURE