BASI DI DATI II – 2 modulo
COMPLEMENTI DI BASI DI DATI
Parte II: XML e namespaces

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Outline

- What is **XML**, in particular in relation to HTML
- The XML **data model** and its **textual** representation
- The XML **Namespace** mechanism

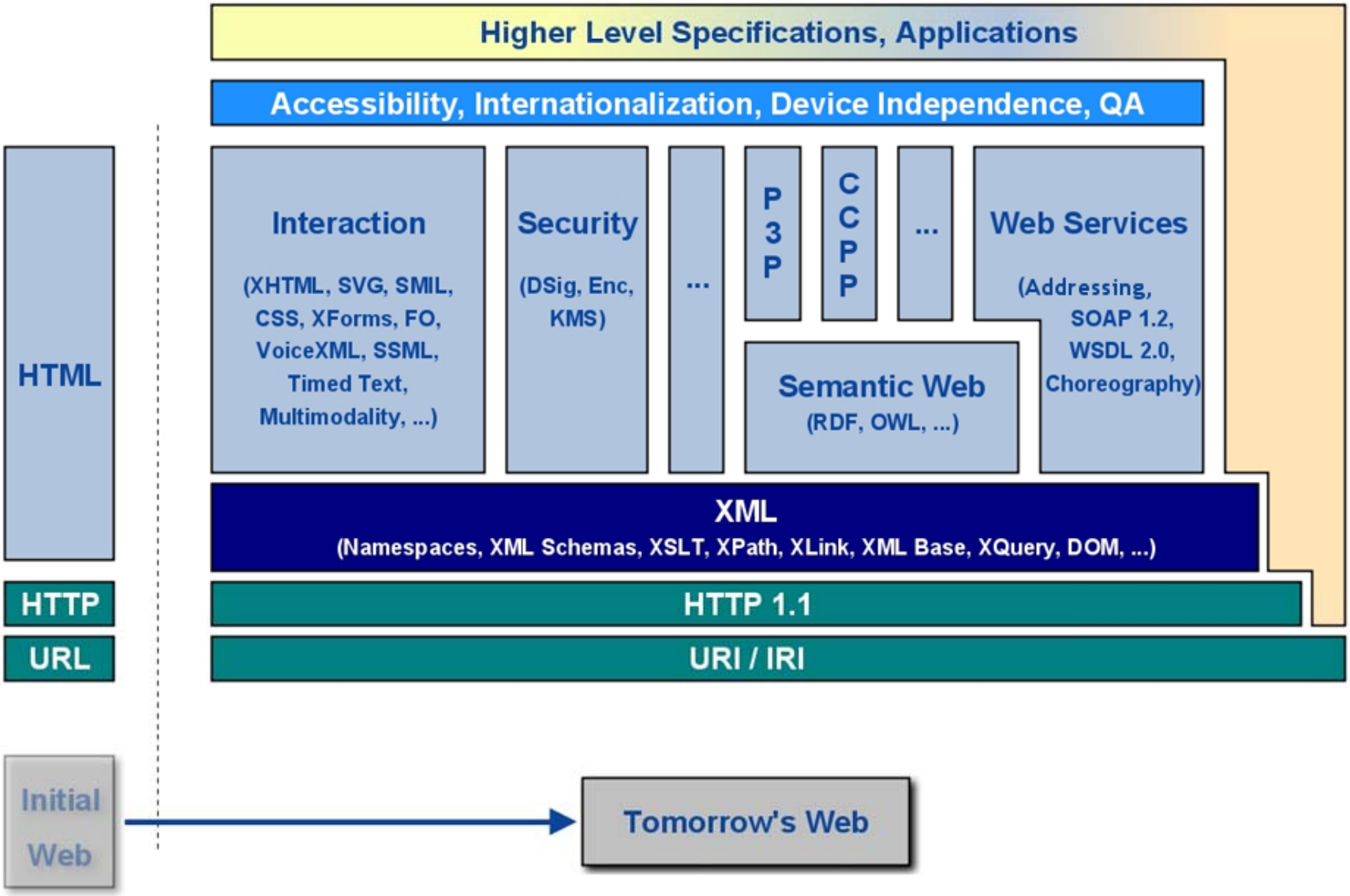
What is XML?

- XML: *E**x**tensible **M**arkup **L**anguage*
- A **framework** for defining markup languages
- Each language is targeted at its own **application domain** with its own markup tags
- There is a common set of **generic tools** for processing XML documents
- **XHTML**: an XML variant of HTML
- Inherently **internationalized** and **platform independent** (Unicode)
- Developed by W3C, standardized in 1998

Evolution

- 1986: Standard Generalized Markup Language (SGML) ISO 8879-1986
- November 1995: HTML 2.0
- Jan 1997: HTML 3.2
- Aug 1997: XML W3C Working Draft
- Feb 10, 1998: XML 1.0 Recommendation
- Dec 13, 2001: XML 1.1 W3C Working Draft
- Oct 15, 2002 : XML 1.1 W3C Candidate Recommendation
- Aug 16, 2006: XML 1.1, Recommendation

Role of XML


Higher Level Specifications, Applications
Accessibility, Internationalization, Device Independence, QA
HTML
Interaction
(XHTML, SVG, SMIL, CSS, XForms, FO, VoiceXML, SSML, Timed Text, Multimodality, ...)
Security
(DSig, Enc, KMS)
...
P3P
CCPP
...
Web Services
(Addressing, SOAP 1.2, WSDL 2.0, Choreography)
Semantic Web
(RDF, OWL, ...)
XML
(Namespaces, XML Schemas, XSLT, XPath, XLink, XML Base, XQuery, DOM, ...)
HTTP
HTTP 1.1
URL
URI / IRI
Initial Web
Tomorrow's Web

Goal

- Nov 96: initial XML draft "The design goals for XML are:
  - XML shall be straightforwardly usable over the Internet
  - XML shall support a wide variety of applications
  - XML shall be compatible with SGML
  - It shall be easy to write programs which process XML documents
  - The number of optional features in XML is to be kept to the absolute minimum, ideally zero
  - XML documents should be human-legible and reasonably clear
  - The XML design should be prepared quickly
  - The design of XML shall be formal and concise
  - XML documents shall be easy to create
  - Terseness is of minimal importance

Recipes in XML

- Define our own “***Recipe Markup Language***”
- Choose markup tags that correspond to concepts in this application domain
  - *recipe*, *ingredient*, *amount*, ...
- No canonical choices
  - granularity of markup?
  - structuring?
  - elements or attributes?
  - ...

Example (1/2)

```
<collection>
  <description>Recipes suggested by Jane Dow</description>

  <recipe id="r117">
    <title>Rhubarb Cobbler</title>
    <date>Wed, 14 Jun 95</date>

    <ingredient name="diced rhubarb" amount="2.5" unit="cup"/>
    <ingredient name="sugar" amount="2" unit="tablespoon"/>
    <ingredient name="fairly ripe banana" amount="2"/>
    <ingredient name="cinnamon" amount="0.25" unit="teaspoon"/>
    <ingredient name="nutmeg" amount="1" unit="dash"/>

    <preparation>
      <step>
        Combine all and use as cobbler, pie, or crisp.
      </step>
    </preparation>
```

Example (2/2)

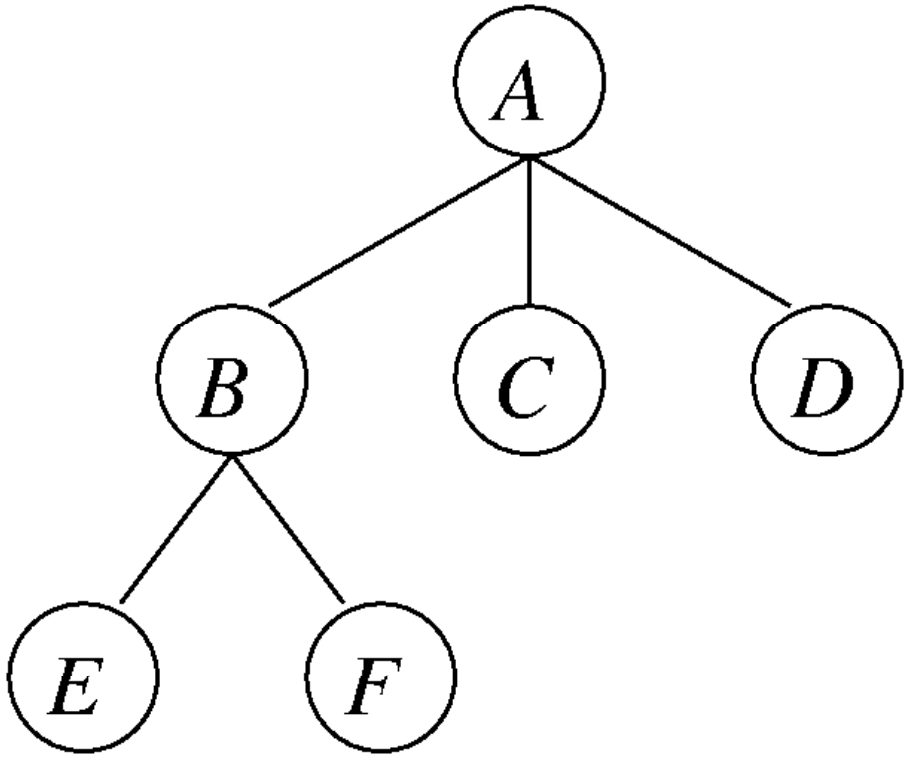
```
    <comment>
      Rhubarb Cobbler made with bananas as the main sweetener.
      It was delicious.
    </comment>

    <nutrition calories="170" fat="28%"
               carbohydrates="58%" protein="14%"/>
    <related ref="42">Garden Quiche is also yummy</related>
  </recipe>
</collection>
```

Building on the XML Notation

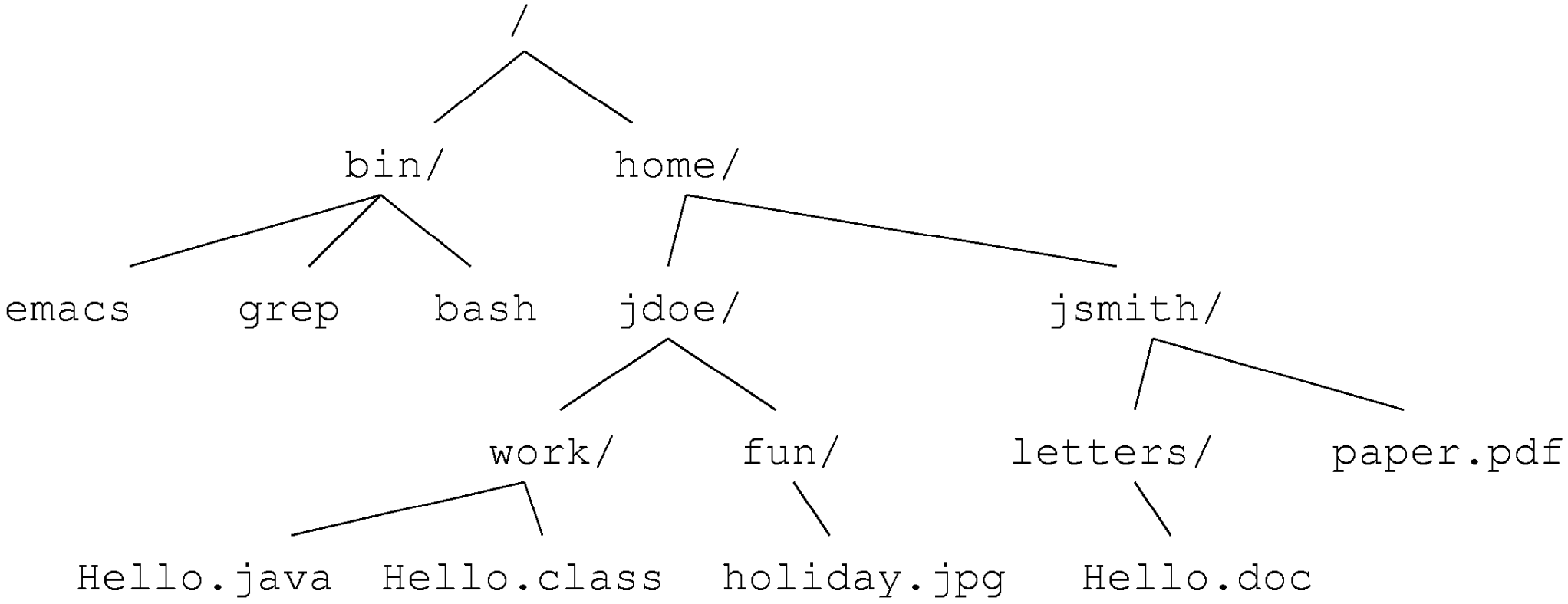
- Defining the **syntax** of our recipe language
  - DTD, XML Schema, ...
- Showing recipe documents in **browsers**
  - XPath, XSLT
- Recipe collections as **databases**
  - XQuery
- Building a **Web-based** recipe editor
  - HTTP, Servlets, JSP, ...
- ...

XML Trees

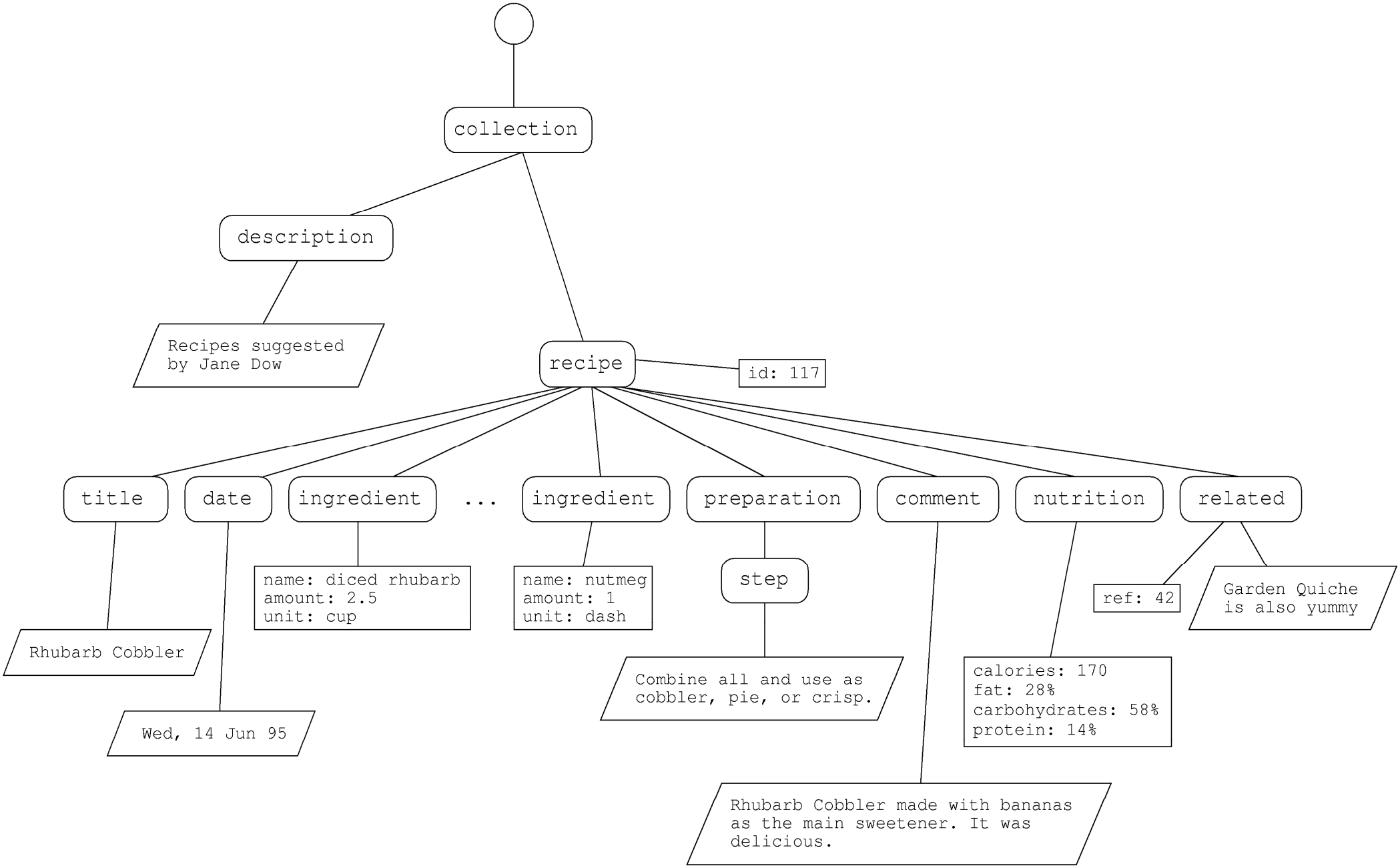
- Conceptually, an XML document is a **tree structure**
  - node, edge
  - root, leaf
  - child, parent
  - sibling (ordered), ancestor, descendant



An Analogy: File Systems



Tree View of the XML Recipes



Nodes in XML Trees

- **Text nodes**: carry the actual contents, leaf nodes
- **Element nodes**: define hierarchical logical groupings of contents, each have a name
- **Attribute nodes**: unordered, each associated with an element node, has a name and a value
- **Comment nodes**: ignorable meta-information
- **Processing instructions**: instructions to specific processors, each have a target and a value
- **Root nodes**: every XML tree has one root node that represents the entire tree

Textual Representation

- **Text nodes**: written as the text they carry
- **Element nodes**: start-end tags
  - `<bla ...> ... </bla>`
  - short-hand notation for empty elements: `<bla/>`
- **Attribute nodes**: `name="value"` in start tags
- **Comment nodes**: `<!-- bla -->`
- **Processing instructions**: `<?target value?>`
- **Root nodes**: implicit

Elements in XML

- Element only
  - ex:
```
<course>
    <start> ... </start>
    <end> ... </end>
    <name> ... </name>
</course>
```
- Content only
  - “text”
  - ex: `<coursename>Java</coursename>`

Elements in XML

- Mixed
  - es:
```
<comments>
        An interesting course but …
        <summary>the lenght…</summary>
        Therefore ...
</comments>
```
- Empty
  - es: `<coordinator prof="d01"/>`

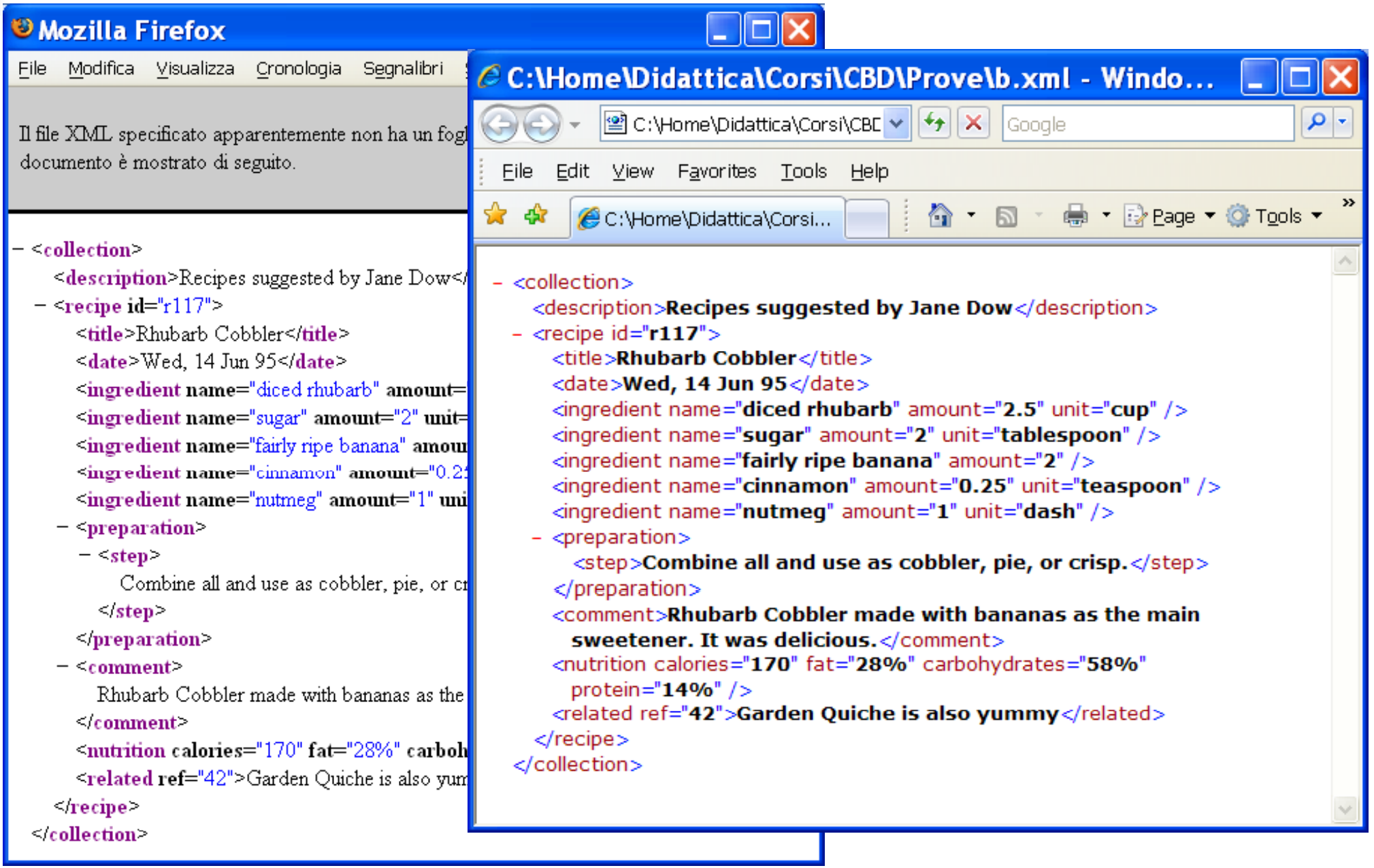
Elements in XML

- General rules
  - Case sensitive
    - Usually: lowercase for element names and attributes
  - Names
    - Usually: starts with a alphabetic char or with “_” :
    - Example: `exam, _course`
  - Comments
    - `<!– this is a comment -->`

Attributes in XML

- Syntax
  - pair name+value (between “ ” or ‘ ’)
- Use
  - Special values
    ex: identifiers and references
  - Metadata
- Attributes or elements?
  - Free, but it is better to be consistent

Browsing XML (without XSLT)



More Constructs

- XML declaration
- Character references
- CDATA sections
- Document type declarations and entity references explained later...

- Whitespace?

Example

```
<?xml version="1.1" encoding="ISO-8859-1"?>
<!DOCTYPE features SYSTEM "example.dtd">
<features a="b">
  <?mytool here is some information specific to mytool?>
  El señor está bien, garçon!
  Copyright &#169; 2005
  <![CDATA[ <this is not a tag> ]]>
  <!-- always remember to specify the
       right character encoding -->
</features>
```

Well-formedness

- Every XML document must be ***well-formed***
  - start and end tags must **match** and **nest** properly
    - <x><y></y></x> ✓
    - ~~</z><x><y></x></y>~~
  - exactly one **root element**
  - ...
- in other words, it defines a proper tree structure
- **XML parser**: given the textual XML document, constructs its tree representation

XML Namespaces

```
<widget type="gadget">
  <head size="medium"/>
  <big><subwidget ref="gizmo"/></big>
  <info>
    <head>
      <title>Description of gadget</title>
    </head>
    <body>
      <h1>Gadget</h1>
      A gadget contains a big gizmo
    </body>
  </info>
</widget>
```

- When combining languages, element names may become **ambiguous**!
- Common problems call for common solutions

The Idea

- Assign a URI to every (sub-)language

  e.g. for XHTML 1.0:
  `http://www.w3.org/1999/xhtml`

- Qualify element names with URIs:

  `{http://www.w3.org/1999/xhtml}``head`

The Actual Solution

- Namespace declarations bind URIs to prefixes

```
<... xmlns:foo="http://www.w3.org/TR/xhtml1">
    ...
    <foo:head>...</foo:head>
    ...
</...>
```

- Lexical scope
- Default namespace (no prefix) declared with `xmlns="..."`
- Attribute names can also be prefixed

Widgets with Namespaces

```
<widget type="gadget" xmlns="http://www.widget.inc">
  <head size="medium"/>
  <big><subwidget ref="gizmo"/></big>
  <info xmlns:xhtml="http://www.w3.org/TR/xhtml1">
    <xhtml:head>
      <xhtml:title>Description of gadget</xhtml:title>
    </xhtml:head>
    <xhtml:body>
    <xhtml:h1>Gadget</xhtml:h1>
      A gadget contains a big gizmo
    </xhtml:body>
  </info>
</widget>
```

- **Namespace map:** for each element, maps prefixes to URIs

Applications of XML

Rough classification:

- Data-oriented languages
- Document-oriented languages
- Protocols and programming languages
- Hybrids

Example: XHTML

```
<?xml version="1.0" encoding="UTF-8"?>
<html xmlns="http://www.w3.org/1999/xhtml">
  <head><title>Hello world!</title></head>
  <body>
    <h1>This is a heading</h1>
    This is some text.
  </body>
</html>
```

Example: CML

```
<molecule id="METHANOL">
 <atomArray>
  <stringArray builtin="id">a1 a2 a3 a4 a5 a6</stringArray>
  <stringArray builtin="elementType">C O H H H H</stringArray>
  <floatArray builtin="x3" units="pm">
    -0.748 0.558 ...
  </floatArray>
  <floatArray builtin="y3" units="pm">
    -0.015 0.420 ...
  </floatArray>
  <floatArray builtin="z3" units="pm">
    0.024 -0.278 ...
  </floatArray>
 </atomArray>
</molecule>
```

Example: ebXML

```
<MultiPartyCollaboration name="DropShip">
 <BusinessPartnerRole name="Customer">
  <Performs initiatingRole='//binaryCollaboration[@name="Firm Order"]/
                            InitiatingRole[@name="buyer"]' />
 </BusinessPartnerRole>
 <BusinessPartnerRole name="Retailer">
  <Performs respondingRole='//binaryCollaboration[@name="Firm Order"]/
                            RespondingRole[@name="seller"]' />
  <Performs initiatingRole='//binaryCollaboration[...]/
                            InitiatingRole[@name="buyer"]' />
 </BusinessPartnerRole>
 <BusinessPartnerRole name="DropShip Vendor">
  ...
 </BusinessPartnerRole>
</MultiPartyCollaboration>
```

Example: ThML

```
<h3 class="s05" id="One.2.p0.2">Having a Humble Opinion of Self</h3>
<p class="First" id="One.2.p0.3">EVERY man naturally desires knowledge
  <note place="foot" id="One.2.p0.4">
    <p class="Footnote" id="One.2.p0.5"><added id="One.2.p0.6">
      <name id="One.2.p0.7">Aristotle</name>, Metaphysics, i. 1.
    </added></p>
  </note>;
  but what good is knowledge without fear of God? Indeed a humble
  rustic who serves God is better than a proud intellectual who
  neglects his soul to study the course of the stars.
  <added id="One.2.p0.8"><note place="foot" id="One.2.p0.9">
    <p class="Footnote" id="One.2.p0.10">
      Augustine, Confessions V. 4.
    </p>
  </note></added>
</p>
```

Summary

- XML: a notation for hierarchically structured text
- Conceptual tree model vs. concrete textual representation
- Well-formedness
- Namespaces

Essential Online Resources

- http://www.w3.org/TR/xml11/
- http://www.w3.org/TR/xml-names11
- http://www.unicode.org/