Network Services

XML & Web 2.0

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Agenda

- XML
- DTD & XML Schema
- XPath & XSL
- Web 2.0
  - Ajax

HTML

- No Description in this lecture (!)
- http://de.selfhtml.org/
- http://www.w3.org/TR/REC-html40/

- Every technician should be aware of HTML
  - Especially computer scientists

SGML

- Standard Generalized Markup Language
  - Initial goal to represent text in electronic form
  - Device & System Independent
- Meta-Language
  - Means for formally describing a language = Markup Language
  - Powerful
  - Very complex
- Separation of Content, Structure and style
- Logical ancestor of HTML, XML
- Used in Publishing industry
  - Continously replaced by XML

XML

- eXtended Markup Language
  - Initial goal to represent data in electronic form
  - Device & System independent
- Meta-Language
  - Markup language
  - Less complex than SGML
  - Powerful
  - May be parsed by SGML parsers with special extensions
- Base for almost all new data representation languages

Motivation for XML

- Problems with HTML
  - Intended for visualization
  - Mixes content and style (layout)
  - Difficult to automatically transform
- XML
  - Describes information in a document
  - No visualization
  - Says what a document means

More HTML problems

- HTML is static
  - Not extensible
  - Set of elements is fixed
- No Semantic information
- Not designed for device-independence
  - Different on desktop browsers, PDAs, ...
- Layouting features rather weak
  - CSS

XML / 1

- Meta-language
  - Defining new languages
  - Example: XHTML
    - Redesigned HTML, conforms to XML
- Application of XML
  - Introducing such a language
- Supports structure
  - Through structure of tags
- Supports semantics
  - Meaning of tags
    - <Person>Mustermann</Person> vs. "Mustermann"
  - Important for automation

XML / Example 1

```
<Person>
    <Nachname>Mustermann</Nachname>
    <Vorname>Vorname</Vorname>
    <Addresse>
        <Strasse>Argentinierstrasse 8</Strasse>
        <Ort>Wien</Ort>
        <PLZ>1040</PLZ
    </Addresse>
</Person>
```

XML / Example 2

- Whitespaces don't matter:

```
<Person>
<Nachname>Mustermann</Nachname>
  <Vorname>Vorname</Vorname><Add
  resse     <Strasse>Argentinierstrasse
  8</Strasse><Ort>Wien</Ort><PLZ>1
  040</PLZ</Addresse></Person>
```

Goals for XML

- Easy to read and process
  - More important: easy for machines
- Separation of layout and content
- Typed documents
- Compatible with SGML
- Unicode

Application Areas / 1

- World Wide Web
  - XML sent to client, rendering on client
  - XML rendered on server, HTML sent to client
- Separation of layout and content
- Automatic generation of navigational structures

Application Areas / 2

- Data Exchange / Interoperability
  - SOAP (later)
  - WebDAV (later)
  - BPEL (Business Process Execution Language)
- XML to enhance databases
  - Most commercial DBs support XML as result-set
  - Next generation:
    - Support XML as first class datatype
    - Supports querying within XML structures
- XML as structured databases
  - Eg. Apache Xindice

Application Areas / 3

- Domain Specific Languages (DSL)
  - MathML, SVG, MusicML, RDF, XMI
  - Ant build.xml
  - .NET Configuration files

XML Structure

XML Preamble

Document Type Definition

```
<?xml version="1.0" encoding="UTF-
   8"?>
<!DOCTYPE students="students.dtd">
<students>
  <student matnr="e8888888">
        <lastname>Meier</lastname>
        <firstname>Klara</firstname>
        <address/>
   </student>
</students>
```

Attribute

Elements

Empty tag

Document Element

XML Parts

- XML Preamble
  - Not required, highly recommended
  - "1.0" fixed version
  - Encoding: US-ASCII, UTF-8, ISO-8859-,1 UTF-16
  - Standalone: yes/no
- Document Type Definition
  - defines structure of XML file (=XML Infoset)
  - Defines root element name
  - Only required for valid documents
- Document Element
  - Root of XML tree
  - At the same level as Comments and processing instructions
- Processing Instructions
  - At same level as XML Preamble
  - <?mso-application progid="Excel.Sheet"?>
  - Special meaning for some programs

XML Infoset

- Elements
  - Structuring facility, can be nested
  - Opening and closing tag
  - Empty tags (closed)
  - Content Models
    - Elements only
    - Mixed (text & child element)
- Attribute
  - Information bundled within attributes (name-value)
  - Multiple attributes
  - Never nested
- Text
  - Strings & characters in encoding format
  - Meta character need to be escaped
    - &lt; &gt; &amp; &apos; &quote
- Comments
  - <!- - an XML comment - ->

DTD / Schema

- Valid XML documents
  - Well-Formed & conforms to rules in DTD or Schema
  - An application may required a certain structure
- Meta-Information about documents
  - DTD / Schema describe a set of documents (that conform to the rules)
- Parsers and representation classes can be generated from DTDs / Schemas

DTD (Document Type Definition)

- Written in its own language
  - not XML
- Rules
  - Which elements may be used
  - Which content models they have
    - element, text, empty, mixed, any
  - How may elements be nested
  - Which Attributes are allowed
- External vs. Internal
  - If DTD is external to XML document

DTD Sample

```
<!ELEMENT students(student+)>
<!ELEMENT student(lastname,firstname,adress)>
<!ATTLIST student matnr CDATA #required>
<!ELEMENT lastname(#PCDATA)>
<!ELEMENT firstname(#PCDATA)>
<!ELEMENT adress(#PCDATA)>
<!ENTITY city "Vienna">
```

```
<students>
  <student matnr="e8888888">
          <lastname>Meier</lastname>
          <firstname>Klara</firstname>
          <adress>&city;</adress>
    </student>
</students>
```

XML Schema

- Successor of DTD
- Formulated in XML
- Context-free regular grammar for defining arbitrary XML structures
- Better support for versions of elements and attributes
  - More restrictions, more checks
- No support for Entities!
  - Entities in DTDs are like macros

XML Namespaces

- Avoid name clashes when documents are merged or interchanged
  - Unique naming
  - <Address> element of two different origins do not have necessarily the same structure
  - Otherwise complete XML file (or schema) has to be parsed
- Prefix + Unique identifier
  - Prefix is abbreviation for unique identifier
  - Unique identifier is usually a URL
- Used namespaces are declared in document element

XML Schema / Sample

```
<student matnr="e8888888">
    <lastname>Meier</lastname>
    <firstname>Klara</firstname>
    <adress>Vienna</adress>
</student>


<element name="student">
    <complexType>
          <sequence>
                    <element name="lastname" type="string"/>
                    <element name="firstname" type="string"/>
                    <element name="address" type="string"/>
          </sequence>
    </complexType>
</element>
```

XML – Valid & Wellformed

- Wellformed
  - Minimal Requirements for "good" XML document
  - = syntactic correctness
    - For all start tags exist end tag
    - Exactly one document element
    - Correct cascading of elements
    - Only comments and PIs out of document element
    - All attributes in quotes
    - No double attributes in one element
- Valid
  - XML file conforms to one particular DTD or XML Schema file
  - = structural correctness
    - No elements that are not defined within Schema
    - Correct order, correct attributes, ...

Cascading Style Sheets - CSS

- Allows attachment of style information to HTML
- Modifies Layout of Input elements
- Nesting / Cascading of stylesheets
- External vs. Internal
- May also be applied to XML files!
  - Eg. Automatic rendering of XML files in tabular form (instead of tree)

CSS - Structure

- Generic Structure for Styles

Selector { Property: Value }

- Selector specifies class that is modified
- Property denotes a particular property which value is modified

CSS - Sample

HTML: <body bgcolor="#FF0000">

CSS: body { background-color: #FF0000; }

Selector Property Value

CSS – Used within HTML

1. In-line
   - Using style attribute in arbitrary HTML tags
     - `<body style="background-color: #FF0000;">`
2. Internal
   - Using style tag in HTML header (eg. after <title></title>) that contains whole CSS

     -
       ```
       <style type="text/css">
       Body { background-color: #FF0000;"}
       </style
       ```
3. External
   - Link to a style sheet in HTML header (after <title></title>)
   - Example

```
<head>
        <title>My homepage with stylesheet</title>
                <link rel="stylesheet" type="text/css" href="style/style.css"/>
 </head>
```

Cascading Style Sheets - CSS

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XSL

- eXtended Stylesheet Language
- Consists of
  - XPath (XML Path Language)
  - XSLT (XSL Transformations)
  - XSL-FO XSL Formatting Objects

XPath

- Selection and addressing language
  - for XML (of course)
  - Based on XML's tree structure
- Result of XPath expressions
  - Select single nodes or nodesets (collection of nodes)
- Evaluation always based on local node (context)

XPath - Example

```
<students>
    <student matnr="7523333">
            <lastname>Gates</lastname></student>
    <student matnr="8524234">
            <lastname>Torvalds</lastname></student>
</students>
```

```
/
/student
/student/lastname
//lastname
/students/*/lastname
/students/*/lastname/../
/student[@matnr='7523333']/lastname
```

XPath - Axes

- Navigation within XML tree with so-called axes
  - child, parent (abbreviation ..), self (.)
  - ancestor, ancestor-or-self (parent)
  - descendant,descendant-or-self (children)
  - following, following-sibling (sequence)
  - preceding, preceding-sibling (sequence)
- Within XPath: [axis-name]::[node-name]
  - /student/child::lastname = /student/lastname
- attributes axis (@)
- namespace axis

XPath – testing with predicates

- Predicate within [ ]
  - evaluated relative to a node expression
- /student/[predicate]/lastname
- Multiple predicates in one expression
  - /student[@matnr='7523333']/name[@nametype='first']
- Attribute testing by value good
- Element testing by value may be difficult
  - because of whitespaces

XPath – Selecting other nodes

- Text Nodes: text()
  - Example:
    /student[@matnr='7523333']/lastname/text()
- Any node
  - node()
  - /student/* <> /student/node()
  - Difference: node() selects any node, * selects only element nodes

XPath – Expression Types

- Node sets
  - All Node selecting expressions
- Boolean
- Numbers
- Strings
- Result tree fragments
  - Portion of XML document not complete node or node set
  - May be converted to string

XPath – Expressions and Functions

- Functions may be used in predicates
- Node-sets
  - position() returns number of current node in node-set
    - eg. /student[position() = 2]
  - last() (= last node)
  - count(node-set)
    - eg. count(//students)
  - name(node-set)
    - Name of first node in node set
    - local-name, namespace-uri

XPath – Datatypes Boolean & Numbers

- Boolean values
  - Predefined: true & false
  - Results of relational operators (=,!=,<,>,<=,>=)
    - Use &lt; instead of <
- Numbers
  - Expressions implicitly converted to a number
  - Arithmetic operators
    - +, -, *, div, mod
  - Functions: floor(), ceiling(), round(), sum()

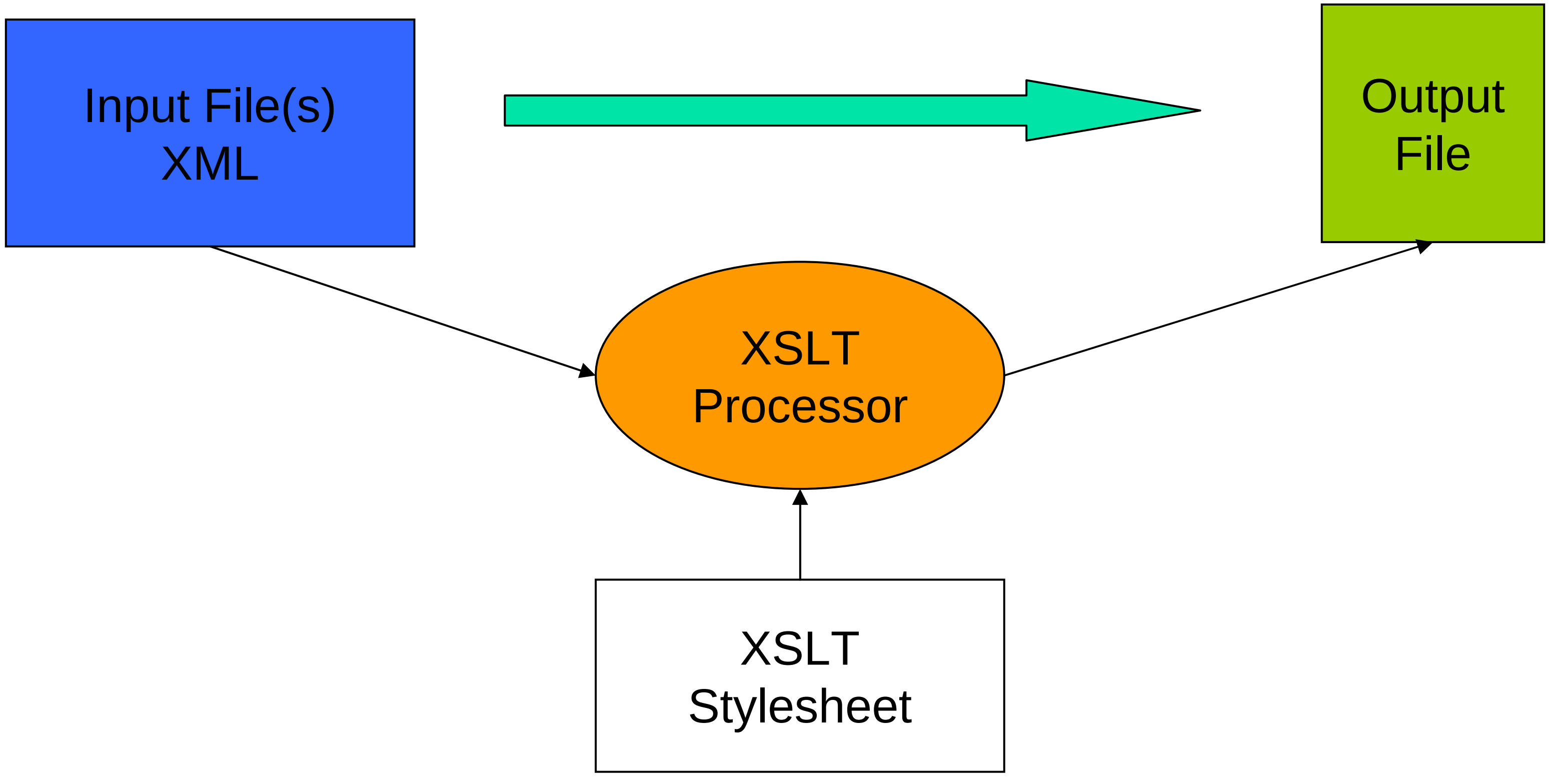
XPath – String

- Functions on string
  - starts-with(s, prefix)
  - contains(s, substring)
  - substring(s, offset, length)
  - normalize-space(s)
  - string-length
  - concat(s1,s2)
  - format-number(number, format-string)
  - …

XSL Transformations

- Transformation language
  - Written In XML
- Input is XML
- Output may be
  - XML
  - Text
  - HTML
  - Other formats supported via extensions
- Rule based
  - Rules are matched against input

XSLT Transformation



XSLT – Basic principles

- Transformation rule

```
<xsl:template match="[XPath-Expression]">
  Substitution-Part
</xsl:template>
```

When XPath-Expression evaluates to true for a node the substitution part is applied and allows modification of the tested node.

XSLT – Elements for Substitution

- <xsl:value-of select="xpath-expr">
  - Inserts the text value of an XPath expression into the output

- <xsl:template match="//student">

  <xsl:value-of select="lastname"/>
- </xsl:template>

XSLT – Elements for Substitution

- <xsl:apply-templates select="xpath-expr">
  - Specifies where processing shall continue
  - Searches for template rules in select attribute
  - If select omitted processing is done for all elements
- <xsl:text>
  - Outputs normal text
- <xsl:element>, <xsl:attribute>
  - Outputs an element or an attribute
  - Only useful for XML-like output

XSLT - Sample

```
<?xml version="1.0"?>

<xsl:stylesheet version="1.0"
    xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
        <xsl:template match="/">
            <xsl:apply-templates select="student">
        </xsl:template>

        <xsl:template match="student">
            <xsl:text>Student:</xsl:text>
            <xsl:value-of select="lastname/text()"/>
        </xsl:template>
</xsl:stylesheet>
```

XSLT – Default Rules

- Normally each node requires a rule
  - Otherwise processing stops
  - Tedious to write a node for all elements
- Solution: Default Rules
  - <xsl:template match="*|/">
    - <xsl:apply-templates/>
  - </xsl:template>

XSLT Sample – Generate HTML

```
<?xml version="1.0"?>
<xsl:stylesheet version="1.0"
    xmlns:xsl=http://www.w3.org/1999/XSL/Transform>
    <xsl:output method="html"/>
    <html>
            <head>...</head>
            <body>
                    <ul>
                            <xsl:apply-templates select="//student"/>
                    </ul>
            </body>
    </html>

    <xsl:template match="student">
            <lil><xsl:value-of select="lastname/text()"/></li>
    </xsl:template>
</xsl:stylesheet>
```

XSLT Sample – Resulting HTML

- Gates
- Torvalds

XSLT Choices

- <xsl:if test="xpath-expr">
  - Supports conditional processing based on an expression
  - Thee is No else (!)

- <xsl:choose>
  - Like statements switch in Java
  - Single cases in <xsl:when test="xpe"> elements
  - With <xsl:otherwise> else clause possible

XSLT – Iteration / 1

- <xsl:for-each>
  - Iterates over a node-set

- Example
  - <xsl:template match="/">
    - <xsl:for-each select="student">
      - <xsl:value-of select="lastname"/>
    - </xsl:for-each>
  - </xsl:template>
- What's the difference to <xsl:apply-templates>?

XSLT – Other Features / 1

- <variable>
  - Supports declaration of variables that refer to xpath expressions
  - Variables can be reused with $varname
- <for-each>
  - Supports iteration
    - Over xpath expressions

XSLT – Other Features / 2

- <sort>
  - Supports arranging of elements in different order
    - As child of <xsl:for-each>, <xsl:apply-templates>
- <number>
  - Inserts formatted integer numbers in output document
- Named templates
  - Parameterized processing
  - Like a subroutine call
  - Recursion is possible and important
- <include>, <import>

XSL:FO

- XSL – Formatting Objects
  - XML vocabulary
  - for Formatting documents (layout)
  - Page oriented
  - >50 elements defined for layouting
    - Similar to what word-processors use
- Idea
  - Document content is written in XML
    - Without considering layout
  - Transformed to XSL:FO file with XSLT
    - XSLT adds layout to document

XSL:FO

- XSL:FO Renderer
  - Transforms XSL:FO file into other formats
    - Eg. PDF (Apache FOP)
    - RTF, Latex
  - Used by publishers
- XSL:FO Formatting model
  - Content broken in pages
  - Each contains number of areas
  - Similarities to RTF

Web 2.0

- Web is currently moving to
  - Rich clients
    - Real applications that run in browsers
  - Support for cooperation of Web applications

Problem of "Web1.0" applications

- Each get/post HTTP request
  - Sends a request to Web Server
  - Waits until response comes back from Web Server
  - Until the response comes back the browser blocks working with Web applications

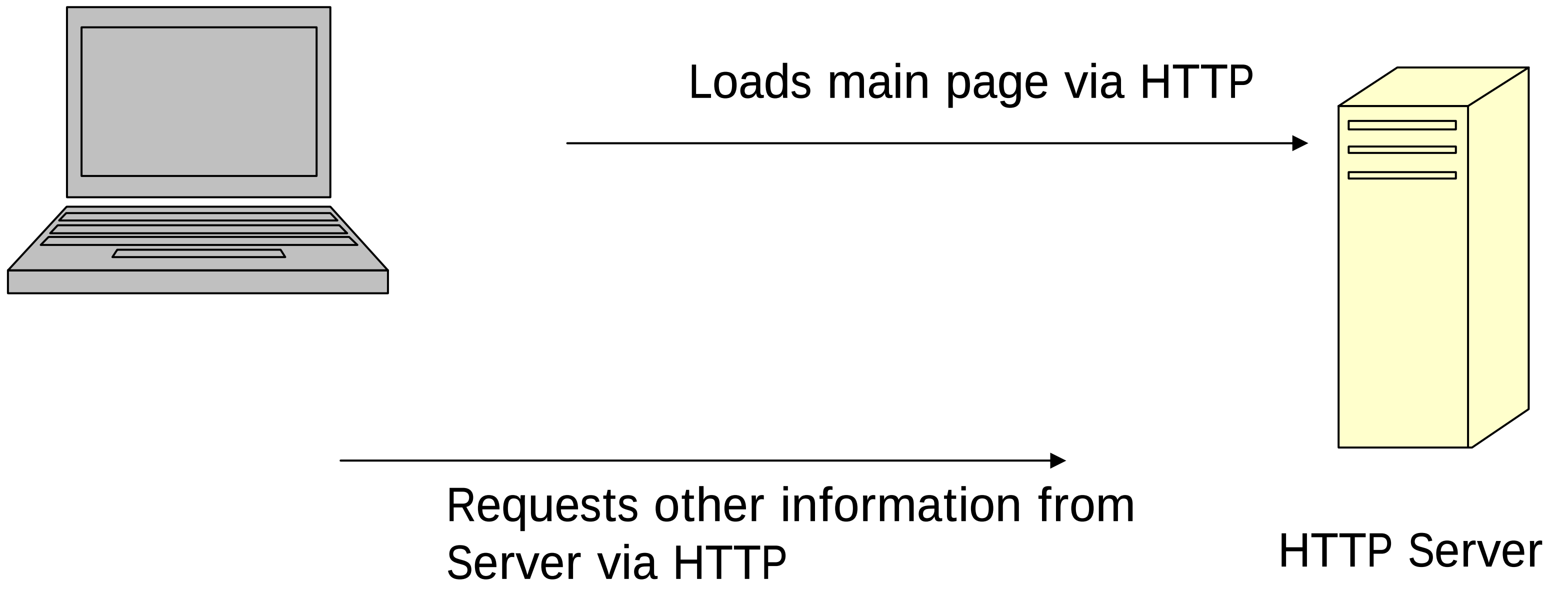
AJAX - Asynchronous JavaScript

- Solves this problem
  - by sending requests in the background
  - Waits for answers in the background
  - Updates the screen asynchronously
    - End users don't have to wait until page is reloaded

AJAX – Key Components

- JavaScript
  - Embedded in HTML pages
    - Executed in the Web browser at the client
  - Supports quicker UI interaction mechanisms in the browser
  - without interaction with the Web server
- DOM Tree
  - (X)HTML is modified directly by JavaScript
- CSS
- XMLHttpRequest
  - JavaScript object that supports submitting HTTP Requests asynchronously

Ajax - Principle



Ajax –Working Principle / 1

- JavaScript Startup Code registers JavaScript functions as notification handlers
  - Being called when HTML hyperlinks or HTML form elements are clicked/used
    - Example: Text is entered in a text field
    - Example: Hyperlink is clicked
  - Result: JavaScript handler is invoked when hyperlink clicked, form element is used

Ajax –Working Principle / 2

- JavaScript notification handler is invoked synchronously by browser
  - As in rich GUI applications
  - Uses HTTPXMLRequest object to setup a HTTP request
    - Often a Web Service is called via SOAP
      - But May just be a request to a Web page
    - Registers another JavaScript function as a HTTP response notification handler
      - A different function is used(!)
- The HTTP request is sent asynchronously
  - Notification handler for the GUI elements is returned after starting the HTTP request
  - User can continue working in the browser

Ajax –Working Principle / 3

- Some time later the HTTP request is received by the Web Server
  - Sends a response
  - Response comes to the XMLHttpRequest object
    - Processes the response asynchronously
    - Invokes the previously registered Response notification handler

Ajax –Working Principle / 4

- Response notification handler
  - Modifies DOM tree (=XML tree) of the HTML document currently displayed in the browser
  - Supports asynchronous modification of the GUI without stopping the end user in working with the currently displayed window

Web 2.0 / Other developments

- RSS
  - Really Simple Syndication (RSS 2.0)
  - Rich Site Summary (RSS 0.91, RSS 1.0)
  - RDF Site Summary (RSS 0.9, 1.0)
- Goal
  - Sharing news
  - Subscription to parts of web pages
  - So-called Feeds are sent when web page changes
- XML based
  - RSS 1.0 – based on RDF (resource description framework)
  - RSS 2.0 – not based on RFD(!)
- Feed readers may be used to read this news

Summary

- XML
  - Ascii of 21st century
- XPath & XSLT
- Web 2.0 Technologies