Introduction to XML

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Topics

- What is XML?
- Why XML?
- Where does XML come from?
- Where is XML being used today?
- What is going on standards front?

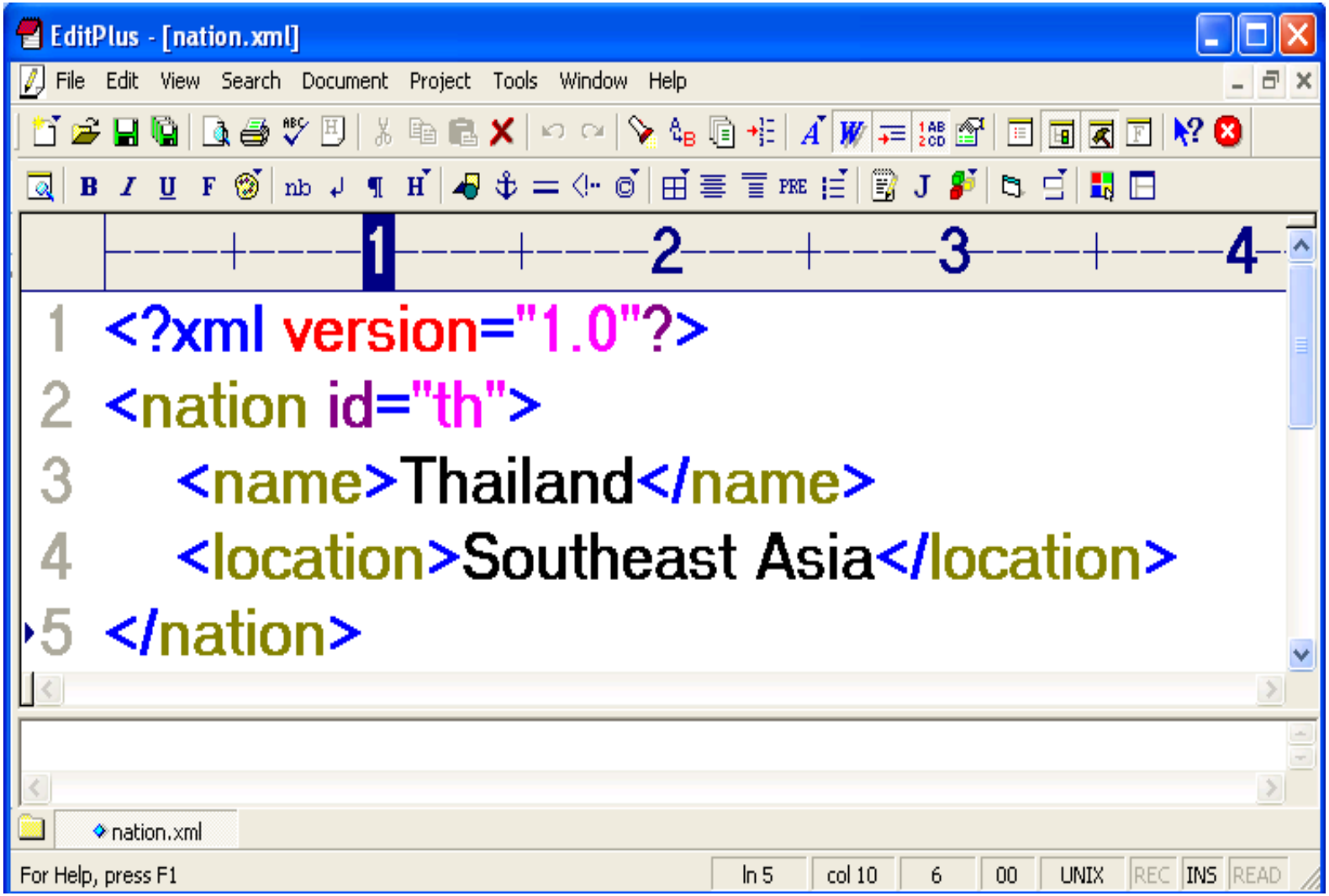
What is XML? (1/2)

```
<?xml version="1.0"?>
<nation id="th">
  <name>Thailand</name>
  <location>Southeast Asia
  </location>
</nation>
```

What is XML? (2/2)

- XML stands for Extensible Markup Language
- It becomes the standard for data interchange on the Internet
- XML is a text-based markup language
  - Encode the meaning of data by using tags which are acted as markup
  - Tags are surrounded by < and >
  - Example: <Nationality>Thai</Nationality>
- It is also a meta-markup language

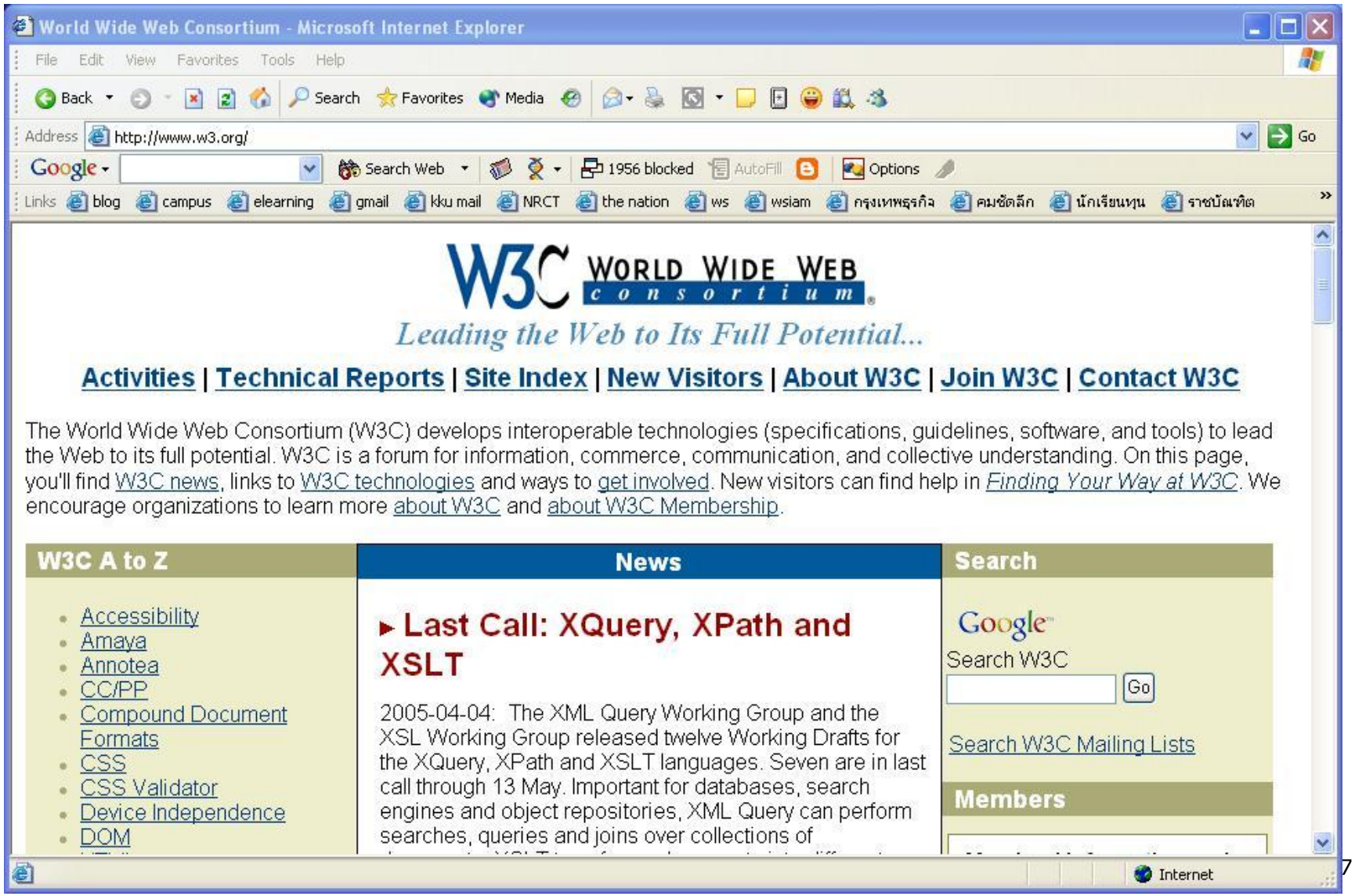
An XML Document in Text Editor



Markup Language

- Used to markup data
  - Methodology for encoding data with some information
- Examples
  - Yellow highlighter on a string of text as emphasizer
    - Example: Many people view Thai as friendly people
  - Comma between pieces of data as separator
    - Example: People need food, clothes, medicine, and house

XML: Markup Language by W3C



XML, HTML, and SGML

- XML is a markup language defined by the World Wide Web Consortium (W3C, www.w3c.org)
- Markup languages describe the way the content of the document should be interpreted
- The markup language that most people know is HTML
- Both HTML and XML are defined based on SGML (Standard Generalized Markup Language)

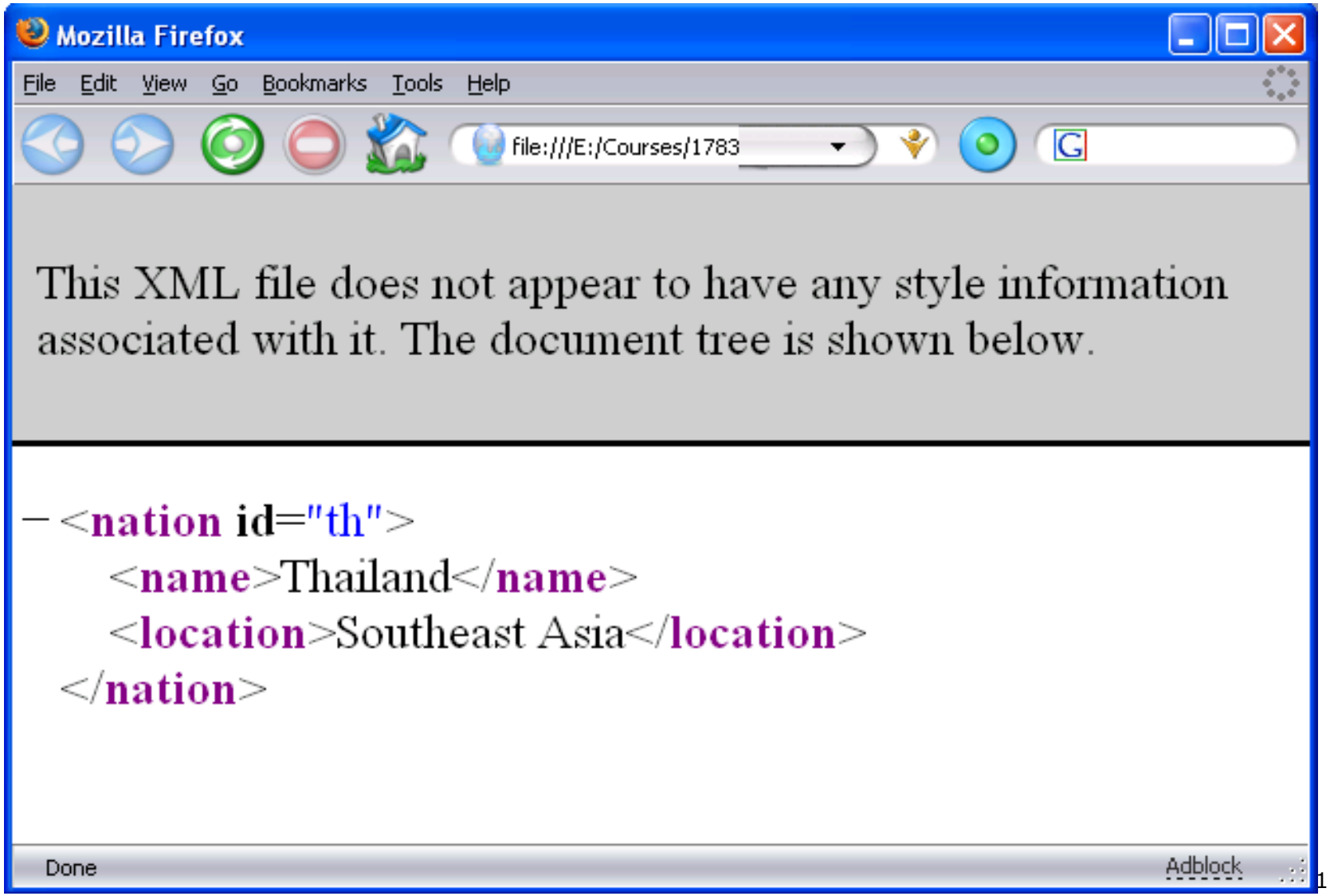
SGML

- SGML is used for documents in many fields, such as Aerospace, Semiconductor, and Publishing
- Several barriers prevented SGML over the Web
  - Complex and unstable software
  - Obstacles to interchange of SGML data
  - No widely supported style sheets

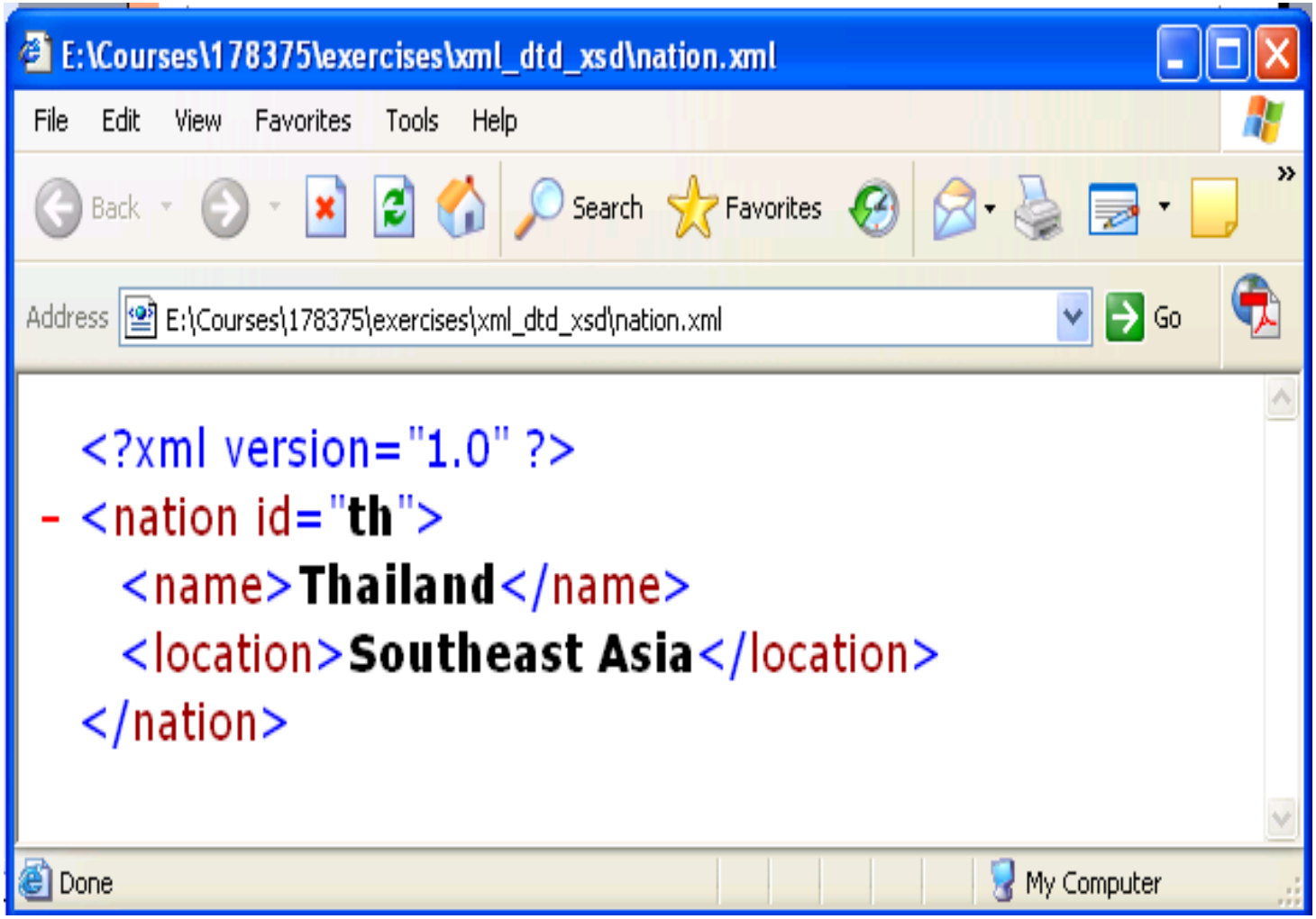
HTML

- The most popular markup language
  - In 1998, Google search 28 million pages
  - In 2005, Google search 8 billion pages
  - In 2008, Google search 1 trillion pages
- Designed for presentation for data
  - Examples: <html>, <head>, <body>, <title>
- HTML documents are processed by HTML processing application (Browser)
  - Examples: Microsoft Internet Explorer, Mozilla FireFox

View an XML Document with Firefox Browser



View an XML Document with Internet Explorer Browser



Strengths of HTML

- Easy to implement and author
  - Small number of tags
  - Simple relationship between tags
  - Syntax-checking is very forgiving
  - Limited number of formats possible
  - Viewers can be small and simple
- HTML trades power for ease of use

Weaknesses of HTML (1/2)

- Fixed set of tags
  - Not user extensible
    - Dependency to “markup language” definition process
  - Dependency to vendors
    - Vendor proprietary tags
    - Implementation not in sync
      - Netscape browser vs. Internet Explorer browser
- Predefined semantics for each tag
- Predefined data structure

Weaknesses of HTML (2/2)

- No formal validation
- Does not support semantic search
- Based on solely on appearance (rendering) NOT on content
- Formatting too simple
  - Limited control
- Cannot process complex documents
- Have no document structure to enable automation

What We Cannot Do with HTML

- We cannot create our own tags that are meaningful for each application
- We cannot have the way to specify a set of data that everyone agrees upon
- We cannot change shared data easily with minimal effort

The Purpose of XML

- Easy for information to be reused, interchanged, and automated
- Deliver information on the Web
- Let users design their own markup language
- Could drive arbitrarily complex distributed processes

XML Design Goals

- 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
- XML documents shall be easy to create

Key Features of XML

- Extensibility
- Media and Presentation independence
  - Separation of contents from presentation
- Structure
- Validation

Extensibility (1/3)

- XML is Meta-markup language
- You define your own markup languages (tags) for your own problem domain
- Infinite number of tags can be defined
  - Need for domain-specific standards
  - XSLT

Extensibility (2/3)

- Tags can be more than formatting
- Tags can be anything
  - Semantics data representation
  - Business rules
    - ebXML
  - Data relationship
    - EJB 2.0 Container Managed Persistence
  - Formatting
    - XSL
  - Anything you want

Extensibility (3/3)

- Many domain-specific markup languages
  - Portable data within domain-specific industry
  - Portable across the various domain
    - Healthcare and Insurance
    - Chemical and Medicine

Media (Presentation) Independence (1/2)

- Clear separation between contents and presentation
- Contents of data
  - What the data is
  - Is represented by XML document
- Presentation of data
  - What the data looks like
  - Can be specified by stylesheet

Media (Presentation) Independence (2/2)

- Stylesheet
  - Instruction of how to present XML data
  - CSS
    - Tailored for HTML browser
  - XSL
    - XML based
    - General purpose
    - Work with XSLT

Separation of Contents from Presentation

- Searching and retrieving data is easy and efficient
  - Tags give search'able information
- Many applications use the same data in different ways
  - Employee data can be used by
    - Payroll application and Facilities application
- Enables portability of data
  - Portable over time and space

XSLT Transformation

- Example (XML -> HTML)

XML:

<email>joe@nbc.com</email>

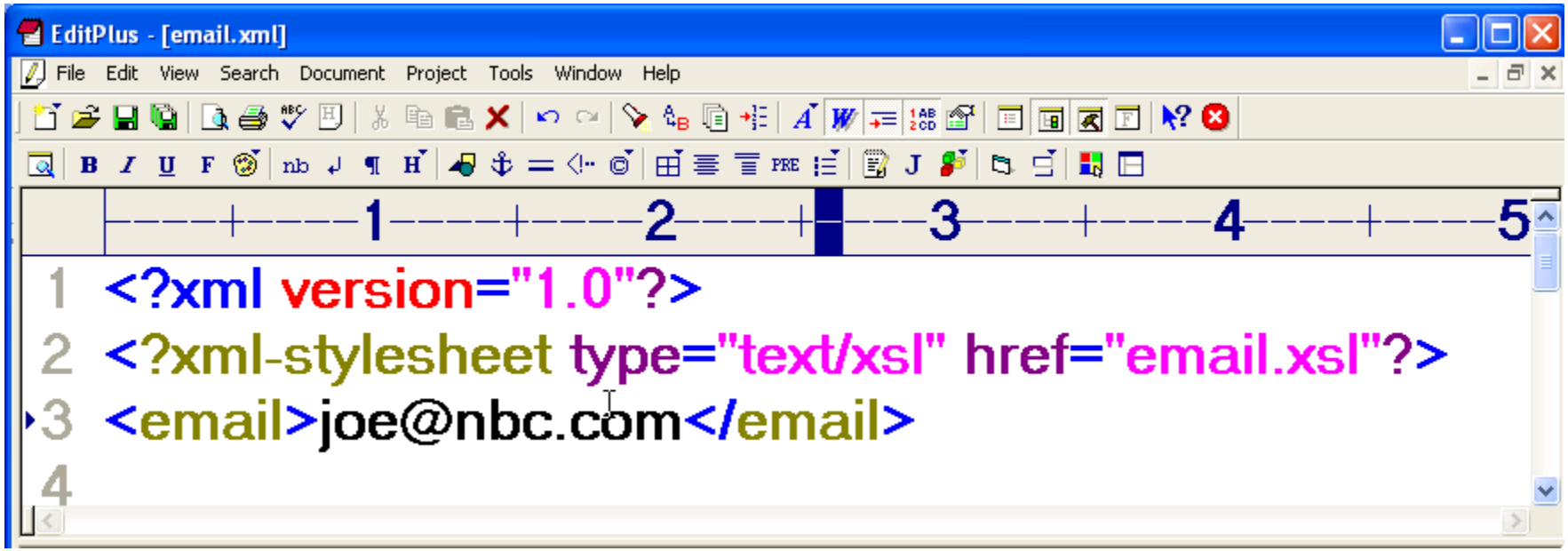
XSLT stylesheet can say:

- Start a new line
- Convert “email” XML tag to “To:” HTML tag
- Display “To:” in bold, followed by a space
- Display your email address

Which produces

To:joe@nbc.com

Input XML File



Output HTML File in Browsers

Input XSL File

EditPlus - [email.xsl]

File Edit View Search Document Project Tools Window Help

```
1  <?xml version="1.0"?>
2  <xsl:stylesheet version="1.0"
3  xmlns:xsl="http://www.w3.org/1999/XSL/Transform">
4  <xsl:output method="html"/>
5  <xsl:template match="/">
6  <html>
7      <body>
8          <b>To:</b>
9          <xsl:value-of select="email"/>
10     </body>
11 </html>
12 </xsl:template>
13 </xsl:stylesheet>
```

Structure: HTML vs. XML

- HTML (Automatic Presentation of Data)

```
<b> John Doe 1234 </b> // Display in bold
```

- XML (Automatic Interpretation of Data)

```
<employee>
    <name>John Doe</name>
    <employeeID>1234</employeeID>
</employee>
```

XML Structure

- Relationship
  - Employee is made of Name and EmployeeID
- Hierarchical (Tree-form)
  - Faster to access
  - Easier to rearrange
  - Can be any number of depth
- Enables to build large and complex data
- Portability of relationship and hierarchical structure

Desirable Features of XML

- Semantics of data
- Plain Text
- Easily Processed
- Inline usability
- Internationalized
- License-free

Semantics of Data

- Meaning of data
- XML tags "indirectly" specifies the semantical meaning
  - Does <name> means "firstname lastname" or "lastname firstname"?
- Potential for divergence
  - Industry collaboration to agree upon the semantical meanings of tags
  - Need for transformation (XSLT)

Plain Text

- Can use any text-editing tool
- Easier for humans to read and edit
  - Configuration information
  - Information description
  - Short notices
- Any operating system supports reading and writing text

Easily Processed

- Set of Well-formed rules
- Validity checking
- Ready-to-use tools
  - Parsers and validators
  - Transformers
  - Browsers
  - Class generators
  - IDE

Inline Usability

- Can integrate data from multiple resources
  - Can be displayed or processed as a single document
- Modularization without using Linking
- Example
  - A book made of independently written chapters
  - Same Copyright text in many books

Internationalized

- XML is Unicode-based
  - You can mix languages
- Both markup and content
- XML tools must support both UTF-8 and UTF-16 encodings
- Critical for world-wide adoption of XML as universal data representation

Where Does XML Get Used?

- Simple and complex data representation
- Integration of heterogeneous applications
- Portable data representation
- Displaying and publishing

Data Representation

- XML encodes the data for a program to process
- Readable by humans
- Be able to be processed by computers
- Complex relationship can be represented
- Internationalized
- Many 3rd-party tools
  - Editing, Syntax checking

Data Representation Examples

- Configuration files
  - EJB deployment descriptor
- “make” files (Apache ANT project)
- MSN message history
- File format for electronic office documents
  - OASIS OpenDocument format (ODF)
  - Microsoft Office Open XML (OOXML)

Integration of Heterogeneous Applications

- Typically used with Messaging system
- XML message is minimum contract for communication
  - Loosely-coupled communication
- Enables easy EAI (Enterprise Application Integration)
  - Payroll, Finance, Products
- E-commerce
  - Supplier, distributor, manufacturer, retail

Portable Data Representation

- Non-proprietary
  - Application independent
  - Object-model independent
  - Language independent
  - Platform independent
  - Communication protocol independent
  - Communication media independent
- Used for means of “information exchange”

Portable Data Representation Examples

- Purchase order, Invoice
- Business transactional semantics
- Patient record
- Mathematical formula
- Musical notation
- Manufacturing process

Displaying and Publishing

- Common data for different presentations
- Separation of contents from presentation
- Examples
  - Web information presented to different client types
  - Information rendered to different medium

Developer Activities on XML (1/2)

- Creating XML document
  - Mostly by text-editor or WISWIG tools
  - Programmatically
- Sending and Receiving XML document
  - Over any kind of transports
    - HTTP, SMTP, FTP, …
  - Through programming APIs
    - Socket APIs

Developer Activities on XML (2/2)

- Parsing XML document
  - Convert XML document into programming objects
- Manipulating programming objects
  - Application specific way
  - Examples
    - Display
    - Save them in database
    - Create new XML document

XML Standards (1/10)

- XML Specification
  - XML, Namespaces
- Validation
  - W3C XML Schema
- Parser
  - DOM, SAX , StAX
- Style and Query
  - XSL, XSLT, XPath
- Security
  - XML Digital Signature, XML Encryption

XML Standards (2/10)

- The XML specification (http://www.w3.org/TR/REC-xml)
  - Define the basic rules for XML documents
- The Namespaces specification (http://www.w3.org/TR/REC-xml-names/)
  - Define the namespaces standard at the W3C

XML Standards (3/10)

- XML Schema
  - Defines the mechanisms of how to specify the document structure and element data types
  - A primer
    http://www.w3.org/TR/xmlschema-0
  - A standard for document structures
    http://www.w3.org/TR/xmlschema-1
  - A standard for data types
    http://www.w3.org/TR/xmlschema-2

XML Standards (4/10)

- XSL (http://www.w3.org/TR/xsl/)
  - Extensible Stylesheet Language
  - Define a set of elements (called formatting objects)
  - Describe how data should be formatted.
  - Referred to as XSL-FO to distinguish it from XSLT

XML Standards (5/10)

- XSLT (http://www.w3.org/TR/xslt)
  - Extensible Stylesheet Language Transformations
  - Describe how to convert an XML document into something else, which can be HTML documents, PDF documents, or even XML documents

XML Standards (6/10)

- XPath(http://www.w3.org/TR/xpath)
  - The XML Path Language
  - Describe locations in XML documents
  - You can use XPath in XSLT stylesheets to describe which portion of an XML document you want to transform

XML Standards (7/10)

- DOM (http://www.w3.org/DOM/)
  - The Document Object Model
  - Define how an XML document is converted to an in-memory tree structure
- SAX (http://sax.sourceforge.net/)
  - Define the events and interfaces with a SAX-compliant XML parser

XML Standards (8/10)

- StAX:the Streaming API for XML (http://stax.codehaus.org/)
  - StAX is a parser-independent, streaming pull-based Java API for reading and writing XML data
  - It is a memory-efficient, simple, and convenient way to process XML while retaining control over the parsing and writing process.

XML Standards (9/10)

- XML Digital Signature (http://www.w3.org/TR/xmldsig-core/)
  - Define an XML document structure for digital signatures
  - An XML digital signature can be used for any kind of data, such as plain text and binary data
  - Can verify that a particular file wasn't modified after it was signed

XML Standards (10/10)

- XML Encryption (http://www.w3.org/TR/xmlenc-core/)
  - Define how parts of an XML document can be encrypted
  - Secure sessions between more than two parties

XML Applications

- Web Services
  - XML data is exchanged between service provider & service requester
- AJAX
  - Asynchronous JavaScript and XML
  - AJAX allows Web developers to create interactive Web pages without having to wait for pages to load

RSS 2.0

- RSS 2.0 specification is copyrighted by Harvard University and is frozen.
- No significant changes can be made
- It is intended that future work be done under a different name

RSS 2.0 Sample File

```
<?xml version="1.0" encoding="utf-8"?>
<rss version="2">
        <channel>
                <title>Example Feed</title>
                <description>Insert witty or insightful
                remark here</description>
                <link>http://example.org/</link>
                …
                <item>
                        <title>Atom-Powered Robots
                                Run   Amok</title>
                        …
        </channel>
</rss>
```

Summary

- XML is self-describing, simple, and extensible
- XML becomes the XML documents facilitate the data exchange between different parties
- XML is now at everywhere
  - Microsoft Office
  - Apache Ant Configuration file
  - Business Process Execution Language (BPEL)

References (1/2)

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