Verteilte Web-basierte Systeme - SS 2006

Verteilte Web-basierte Systeme
Dr.-Ing. Martin Gaedke
Universität Karlsruhe (TH)

Programm heute & morgen
- Vorbemerkungen
- Kapitel 1-3 (Block 1)

Ziele
- Einführung in das "Phänomen Web"
- Entwicklung Web-basierter Systeme
- Evolution – Stetige Weiterentwicklung

Schwerpunkte
- Entwicklung von Web-Anwendungen
- Service-orientierte Architekturen (SOA)
- Web Services & Web 2.0 Technologien
- XML-Familie & Standards

Historie
- Grundlage Themengebiet Web Engineering
  - WS99/00 und WS00/01 - Fokus auf Technologie
  - Seit WS01/02 komplett neu ausgearbeitet
  - Seit WS02/03 Basis für die Vorlesung Web Engineering an der TU Darmstadt sowie Uni Augsburg, Stanford University, University of San Francisco, University of Hong Kong
  - Seit WS2004/2005 - Erneute Überarbeitung/Aktualisierung
- Feedback berücksichtigt
- Ausgezeichnet durch MSDN AA

Vorbemerkungen
- Vorlesungsstil
  - Interaktiv
  - Hausaufgaben
  - Reviews
- Sprache
  - Vorlesung in Deutsch
  - Folien in Englisch
- Empfohlen, aber nicht notwendig
  - Grundlagen aus den Bereichen Telematik, Softwaretechnik und Informationssysteme / Datenbanken

Lecture VWBS
- Art der Veranstaltung: Vorlesung
- Dozent: Dr.-Ing. Martin Gaedke
- Ort und Zeit: Blockveranstaltung, Termine siehe nächste Folie
- Prüfbar: Ja, je nach Zahl der Anmeldungen schriftlich oder mündlich.
Anrechenbar bei Prof. Dr. Lars Wolf im Vertiefungsfach
- SWS: 2+1
Verteilte Web-basierte Systeme Vorlesung SS2006

Organisatorisches

- Block-Vorlesung
  - Jeweils Informatikzentrum, Raum 033
  - Credits 2+1 Stunden und prüfbar
- Termine
  - Mo 19.06., 13:15-18:15 Uhr
  - Di 20.06., 08:00-11:15 Uhr
  - Do 29.06., 13:15-18:15 Uhr
  - Fr 30.06., 09:45-13:00 Uhr
  - Do 20.07., 13:15-18:15 Uhr
  - Fr 21.07., 09:45-13:00 Uhr

Details zur Vorlesung unter:
http://www.ibr.cs.tu-bs.de/lehre/ss06/vwbs/

Prerequisites

- No prerequisites
- Basic knowledge of Internet/Web technologies (HTTP and HTML) is highly recommended
- Ideally, you have suffered from your Portal or Web Site solution/project – in other words: experienced your own kind of Web Crisis or Lost-In-Hyperspace syndrome
- Willingness to learn and do homework
  - And to wake up at 8 a.m. tomorrow ;-)
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Part I

Introduction

Part 1 – Overview

1. World Wide Web and the early beginning
2. A look at Resources
3. The Change of Technology
4. Web application production
5. The need for process
6. Further Readings

Part I – World Wide Web and the early beginning

Vannevar Bush

As We May Think. July 1945, Atlantic Monthly

The human mind operates by association

Memex Idea: Selection by association, rather than by indexing, may yet be mechanized.

Device for individual use in which an individual stores all books, records, and communications → supplement to user’s memory

Supplement to memory

Documents – contain artifacts (data), which exists as a vehicle for conveying information

Interpretation in Context

Information – the interpretation of data within a context set by a priori knowledge and the current environment

Integration and Usage

Knowledge – the base of personal information, which is integrated in a fashion that allows it to be used in further interpretation and analysis of data

Ted Nelson on Hypertext

© 1999-2006 by Dr.-Ing. M. Gaedke
**How to feed your head…**

- Sequential Writing
- E.g. Books, Papers (works also for Audios, Movies)

**How to feed your head…**

- Ted Nelson (1965): “By hypertext I mean non-sequential writing”

**What is Hypertext?**

- Concept for organizing knowledge
  - **Hypertext** – An application that allows a user to navigate through an information space using associative linking
- Non-linear nodes of information
  - Book and traditional media like audio are linear – one single path through the material
  - Hypertext provides several different ways through the material

**Hypertext-Documents**

- Hypertext-Documents inherently maintain the relation between information units
- Graph structure of Hypertext-Document
  - Node: Unit of information (data)
  - Links: Edges connecting nodes (support interpretation in context)
  - Anchor: Fragment of node dedicated to a link

**Hypermedia?**

- The “glorified” definition:
  - Multimedia
  - Hypermedia
  - Hypertext

- Hypertext-Community uses Hypertext and Hypermedia term synonymously
- **Hypermedia** – application that uses associative relationships among information contained within multiple media data for the purpose of facilitating access to, and manipulation of, the information encapsulated by the data

**Hypertext History**

- 1945: Vannevar Bush – Memex
  - “As we may think”
- 1962-76: Doug Englebart – oN Line System
  - Inventor of the Mouse (used in NLS)
- 1965: Ted Nelson – Xanadu
  - Coined “Hypertext”
- 1985: Bill Atkinson (Apple) – HyperCard
  - First “usable” Hypertext application
World Wide Web

- 1989 initiated by Tim Berners-Lee at CERN
  - **Goal**: Support the cooperation of distributed research teams (e.g., to exchange research documents) on top of a heterogeneous system environment
- 1991 originally proposed
- WWW application of the Hypermedia paradigm
- For further information visit: http://w3.org

The Early Beginning

- The WorldWideWeb browser (1st Web Browser)

Concept

- **Idea**: "Universe of network-accessible information"
  - Everyone may act as Author of Resources
- Uniform Addressing
  - Unique, world-wide addresses
  - Abstracts geographical distribution of information nodes (resources)
- Uniform Access
  - Browser offer uniform access to any resource in the WWW

**WWW** is a collection of resources, software, protocols, standards, and recommendations providing a Hypermedia system

Where it all starts...

- **Markup** – Text that is added to the data of a document in order to convey information about it
  - For further information: http://www.w3.org/MarkUp/
- Resource as HTML-Document
  - Markup Language: Hypertext Markup Language (HTML)
  - Can contain links to other resources
    - Images, Documents, and other Pages
    - Tag used to markup: `<A>`
  - Rendered and viewed in a Web Browser

Example 1 – Table

```html
<html>
<body>
<table border="1">
<tr>
<td>Water</td>
<td>1 EUR</td>
</tr>
<tr>
<td>Beer</td>
<td>1.5 EUR</td>
</tr>
<tr>
<td>Wine</td>
<td>1.5 EUR</td>
</tr>
</table>
</body>
</html>
```
Example 2 – Table

```html
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">
<html><body>
<table border="1">
<tr>
<td>Water</td>
<td>Beer</td>
<td>Wine</td>
</tr>
<tr>
<td>1 EUR</td>
<td>1.5 EUR</td>
<td>1.5 EUR</td>
</tr>
</table>
</body></html>
```

Example 3 – Navigation

```html
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">
<html><body>
The following drinks are served:
- [Water](#water)
- [Beer](#beer)
- [Wine](#wine)
</body></html>
```

Example 4 – Navigation

```html
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.0 Transitional//EN">
<html><body>
The following drinks are served:
- [Water](#water)
- [Beer](#beer)
- [Wine](#wine)
</body></html>
```

WWW's Technical Aspects

- **WWW is a distributed System**
  - Based on a Client-Server architecture
  - Supporting the Hypertext Paradigm
- **Server** provide access to resources
  - E.g. HTML-documents, images, audio, etc.
  - Resources may be created dynamically
- **Client (User Agent)** interpret resources
  - Browser present interpretation (Layout, play sound etc.)
  - Other kinds of User Agents may use the resource in other ways (e.g. robots - indexing words)
  - Every request implies a new connection (Stateless)
Verteilte Web-basierte Systeme Vorlesung

Part I | Chapter://3 | Change of Technology

1st Generation

<table>
<thead>
<tr>
<th>Client-Side</th>
<th>Request</th>
<th>Server-Side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Application</td>
<td>Browser / User Agent</td>
<td>Web Application</td>
</tr>
</tbody>
</table>

Web System Application protocol: HTTP

- Browser
  - Mosaic
  - HTML
  - Images (GIF)
  - HTML-Forms
  - Helper
  - Audio, Video, etc.

Part I | Chapter://3 | Change of Technology

2nd Generation

<table>
<thead>
<tr>
<th>Client-Side</th>
<th>Request</th>
<th>Server-Side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Application</td>
<td>Browser / User Agent</td>
<td>Web Application</td>
</tr>
</tbody>
</table>

Web System Application protocol: HTTP

- Browser
  - Mosaic, Netscape
  - HTML, Images
  - HTML-Forms
  - Helper
  - Audio, Video, etc.

Part I | Chapter://3 | Change of Technology

3rd Generation (Multi-Tier)

<table>
<thead>
<tr>
<th>Client-Side</th>
<th>Request</th>
<th>Server-Side</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Application</td>
<td>Browser / User Agent</td>
<td>Web Application</td>
</tr>
</tbody>
</table>

Web System Application protocol: HTTP, SOAP, WebDAV, other

- User Agent
  - Netscape, IE, and PDA
  - Browser etc.
  - Other Types of User Agent
  - Plug-ins, ActiveX
  - Script-Code
  - DHTML, More

Part I | Chapter://3 | Change of Technology

4th Generation?

Cluster: UDDI, EJB, COM+, etc.

Web System Application protocol: HTTP/SOAP

- Server
  - Identification Provider / Security Token Service
  - Configuration/Context

Part I | Chapter://3 | Web Application Production

Technology Drivers

- Computing power
  - Still doubling every 18 months
  - PC-based data centers
- Connectivity
  - Low cost, broad reach Internet
  - Wireless, broadband access
- Device proliferation (THE Clients and Servers of the Distributed System)
  - PDAs, cell phones, gas pumps
  - Towards a digital devices decade
- Internet standards
  - XML-based integration
- User Interface
  - Many (!) possibilities

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Chapter://4

Web Application Production
Characteristics

Today's focus on large-scale and ubiquitously usable Web Applications:
- Many Users – many languages – many cultures
- Different access mechanisms
- Many User Agents
- Present large volumes of interrelated information (including different media) and processes
- Appropriate presentation
- Progression through activities – finish one thing before starting another
- Often guides user
- Growing and increasing complexity
- Many product iterations/versions/refinements (calls for Reuse)
- Many developers and operators, complex handling of temporal media (e.g. publishing of company news)
- Customization, Personalization, Security issues
- and a lot more...

E.g. “Up-to-date” by following trends

All Aspects of Heterogeneity

Developing Web Applications

Still Ad-hoc instead of a disciplined procedure
- Copy-and-Paste Paradigm
- Lack between design-model and implementation-model
- Design-concepts get lost in the underlying model
- Many short lifecycle of a Web Application: Maintenance and Evolution problems → Reuse Problems

→ Web-Crisis

Need for Process

Domination of the different requirements calls for a systematic approach
- Producing high-quality Products in a cost-effective way
- Goal – Product should be
  - Maintainable and evolvable
  - Reliable
  - Efficient
  - Appropriate for User Interface (also wrt Hypermedia)
  - Delivered in time with predictable cost

Or simply Software Engineering?

"Fundamental differences [between hypermedia and other disciplines] however, make a pure transposition of techniques both difficult and inadequate. An important part of hypertext design concerns aesthetic and cognitive aspects that software engineering environments do not support."
(Nanard and Nanard, 1995)
Evolution of “WebE”
- Web Engineering is a young discipline
- Early 1995/1996 notion of Web Page Design and Web Site Development
  - Development suffers from ad hoc processes
  - Déjà-vu experience of software development in the sixties (cf. Software Engineering, Software Crisis – Workshop 1968)
- 1998 Workshop Web Engineering at the 7th World Wide Web Conference, Brisbane
- Further activities at conferences and workshops
  - WWW, ICWE, HISSE, ICSE, IWWOST etc.
- Journal of Web Engineering (JWE), Rinton Press
  - http://www.rintonpress.com/journals/jwe

What is Web Engineering?
- Attention, often no common answer
  - “Web Engineering is concerned with establishment and use of sound scientific, engineering and management principles and disciplined and systematic approaches to the successful development, deployment and maintenance of high quality Web-based systems and applications”, SIGWEB Newsletter
  - “Web Engineering is a discipline among disciplines, cutting across computer science, information systems, and software engineering, as well as benefiting from several non-IT specializations”, IEEE Multimedia
  - “While Web Engineering adopts and encompasses many software engineering principles, it incorporates many new approaches, methodologies, tools, techniques, and guidelines to meet the unique requirements of Web-based systems. Developing Web-based systems is significantly different from traditional software development and poses many additional challenges”, IEEE Multimedia

Engineering
- Discussing the term in the context of (software) engineering:
  “Engineering is about the systematic application of scientific knowledge in creating and building cost-effective solutions to practical problems”, Berry [Report No. CMU/SEI-92-TR-34]

Web Engineering
- Web Engineering – is the application of systematic, disciplined, and quantifiable approaches to the design, production, deployment, operation, maintenance and evolution of Web-based software products. [Gaedke, 2000]

Web-based Software Products
- Web System – a hypermedia infrastructure or system enabling the operation of a Web Application
- Web Application – a distributed application that accomplishes a certain business need based on technologies of the World Wide Web and that consists of a set of Web-specific resources
- Resource – an object specified by a MIME-type that is delivered by a Web Server or system using a standardazed Protocol as a response of a request from a User Agent (Web Client)
<table>
<thead>
<tr>
<th><strong>Part I</strong></th>
<th><strong>Chapter 6</strong></th>
<th><strong>Further Readings</strong></th>
</tr>
</thead>
</table>

## Literature

- Thomas A. Powell, *Web Site Engineering*, Prentice Hall PTR
- SELFHTML, cf. Lecture Web Site
- Gerti Kappel, Birgit Pröll, Siegfried Reich, Werner Retschitzegger (Hrsg.), *Web-Engineering – Systematische Entwicklung von Web-Anwendungen*, dpunkt.verlag

Further information available at [Lecture Web Site](#)