

Vorlesung Advanced Topics in HCI (Mensch-Maschine-Interaktion 2)

Ludwig-Maximilians-Universität München
LFE Medieninformatik
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SS2005
<http://www.medien.ifi.lmu.de/>

Advanced Topics in HCI Vorlesung Mensch-Maschine-Interaktion 2

Lehr- und Forschungseinheit Medieninformatik

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- Vorlesung: Donnerstag, 12-14 Uhr, Theresienstraße, Raum 139
- Übungen: Mittwoch, 10.00 bis 12.00 c.t oder Freitag, 12.00 bis 14.00 c.t, Amalienstraße 17, Raum 105 oder Computerraum EG
Übungsleitung: Heiko Drewes, Richard Atterer
- Informationen zur Vorlesung und Übung:
<http://www.medien.ifi.lmu.de/lehre/ss2005/mmi2.html>

Inhalt

- Die Vorlesung „Advanced Topics in HCI“ (Mensch-Maschine-Interaktion 2) behandelt weitergehende Aspekte der Interaktion zwischen Mensch und Computer. Prinzipien und Konzepte der Mensch-Maschine-Interaktion werden in konkreten Anwendungsbereichen behandelt.
- Themen
 - Hypertext, Web Design, Web Usability, Accessibility
 - Desktopanwendungen, GUI-Toolkits, User Interface Softwareentwicklung
 - Adaptive Benutzerschnittstellen, Intelligente UIs
 - Multimodale Benutzerschnittstellen, Sprachdialog, Gesten, Stifteingabe
 - Tangible User Interfaces
 - UIs für mobile Geräte und Wearable Computer
 - Groupware, CSCW, CSCL
 - Physiologische Fähigkeiten des Menschen, Psychologische Grundlagen

Ablauf und Anforderungen

- Vorlesung mit Übung, 2h+2h
- Lesematerial (ca. ein Artikel pro Woche)
- Übungsaufgaben
- Scheinkriterien
 - Erfolgreiche, termingerechte Abgabe aller Übungsaufgaben (oder aller bis auf eine)
 - Die abgegebenen Lösungen müssen von ausreichender Qualität sein.
 - Zusammenfassung der Pflichtlektüre (ca. 100 Worte pro Artikel)
 - Bei nicht ausreichender Qualität der abgegebenen Lösungen: 10-minütige mündliche Prüfung am Semesterende
- Vorkenntnisse
 - Grundstudium Medieninformatik oder Informatik
 - Grundkenntnisse im Bereich Mensch-Maschine-Interaktion
 - Grundkenntnisse in der Programmierung von graphischen Benutzerschnittstellen
 - Englische Sprachkenntnisse

Books

- Alan Dix, Janet Finlay, Gregory Abowd and Russell Beale. (2003) Human Computer, Interaction (third edition), Prentice Hall, ISBN 0130461091
- Ben Shneiderman. (1998) Designing the User Interface, 3rd Ed., Addison Wesley; ISBN: 0201694972
- Alan Cooper, Robert M. Reimann. (2003) About Face 2.0: The Essentials of Interaction Design; ISBN: 0764526413.
- John M. Carroll. Human-Computer Interaction in the New Millennium. Addison-Wesley Professional (2001), ISBN: 0201704471
- Jennifer Preece, Yvonne Rogers, Helen Sharp. Interaction Design. John Wiley and Sons Ltd (2002). ISBN: 0471492787



Structure

- Chapter 1:
HCI and the WWW
- Chapter 2:
Information Visualization
- Chapter 3:
Mobile and Ubiquitous User Interfaces



Chapter 1: HCI and the WWW

Table of Content

- Human Computer Interaction (HCI)
 - a quick reminder
- Web Usability
 - Web Technology
 - Web Design
 - Management of Web projects
 - Usability evaluation of Web sites and applications
- Web Accessibility, Universal Access to Information
- Usability Report

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Human Computer Interaction (HCI)

- *“Human-computer interaction is a discipline concerned with the **design, evaluation and implementation** of interactive computing systems for human use and with the study of major phenomena surrounding them”*
(working definition in the ACM SIGCHI Curricula for HCI)
- Computer science view point:
“Interaction between one or more **humans** and one or more **computational machines**”

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Building Successful Digital Products

- tension
 - different objectives
 - different design goals
- step by step 1-2-3
- solution
 - Products in the overlapping space



From A. Cooper, About Face 2.0

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What is Usability

- “Usability is a quality attribute that assesses how easy user interfaces are to use. The word ‘usability’ also refers to methods for improving ease-of-use during the design process.” (Jakob Nielson)
- “Scientific discipline using observation, measurement and design principles to enhance a site visitor’s ability to perform specific tasks” (Kathy Gill)
- “... the **effectiveness, efficiency and satisfaction** with which a specified set of users can achieve a specified set of tasks ...” (ISO)

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Why is Usability Important?

- Improving usability can
 - increase productivity of users
 - reduce costs (support, efficiency)
 - increase sales/revenue (web-shop)
 - enhance customer loyalty
 - win new customers
- Several case studies that show the benefit of usability
- Usability is often considered as sign of quality
- Working with users can create ideas for new products, e.g. “similarities” feature (*people who bought this also bought that*) at amazon.com, see Interview Maryam Mohit

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Web Usability

- Usability of Web sites and applications delivered over the WWW
- Dependent on several issues related to
 - Web technology
 - Web design
 - Project Management
 - Usability evaluation
- Web usability is **not** about “adding some fancy graphics, color, and cool styles at the end of the project”
- Web usability can be measured!

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Excuse: Web Technology

- Web technology basics
- Heterogeneous distributed systems
- Hypertext and Hypermedia
- Media, Media Types, MIME
- Caching

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What do we need for a distributed system to share documents

- How are documents encoded?
 - content
 - semantics
 - presentation
- How documents are identified?
 - Where is data held?
 - How can data be accessed?
- How are the documents transmitted/transported to the user?

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The WWW Approach

- Document format
 - Hypertext Markup Language, HTML
 - Document Type Definition (DTD)
 - Standardized General Markup Language (SGML)
- Mechanism for identification
 - Uniform Resource Identifier, URI
 - use as Uniform Resource Locator, URL
- Transfer protocol
 - Hypertext Transfer Protocol, HTTP
 - ASCII-coded Request-Reply protocol using TCP/IP

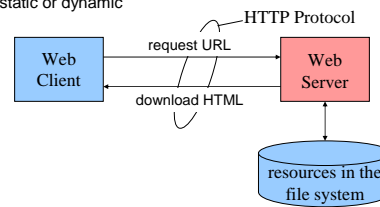
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Architecture and Protocol (simplified)

- client-server architecture
- synchronous communication model (request/response)
- resources
 - Unit that is communicated between Client and Server
 - static or dynamic



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Resources in the WWW

- Structure of the documents exchanged
 - HTML, images, ...
 - MIME-types communicate document type
- Visualization on the screen
 - Client parses HTML und visualizes the content
 - non-HTML is displayed by
 - the browser
 - client extension
 - plug-in
 - helper application

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Documents contain Resources I

- reply of the servers

```
HTTP/1.0 200 OK
Content-Type: text/html
Content-Length: 3213

<html>
<head>
<title>Oracle Corporation - Home</title>
...
</head>
<body bgcolor="#ffffff" link="#000000" vlink="#ff0000">
...
<INPUT NAME=q size=10 maxlength=800 VALUE=""><INPUT
TYPE="image" src="/templates/images/search_btn.gif"
width=36 height=18 value="go" border=0>
...
<a href="/html/dev_it.html">
</a>
...

...
</body>
</html>
```

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Documents contain Resources I

- reply of the servers

```

HTTP/1.0 200 OK
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<body bgcolor="#ffffff" link="#000000" vlink="#ff0000">
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TYPE="image" src="/templates/images/search_btn.gif"
width=36 height=18 value="go" border=0>
...
<a href="/html/dev_it.html">
</a>
...

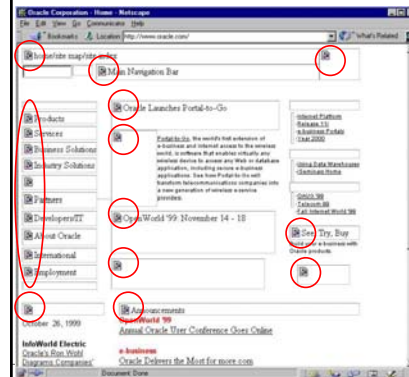
...
</body>
</html>
    
```

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Documents contain Resources II



- images
- background
- buttons
- music
- audio

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Documents contain Resources III

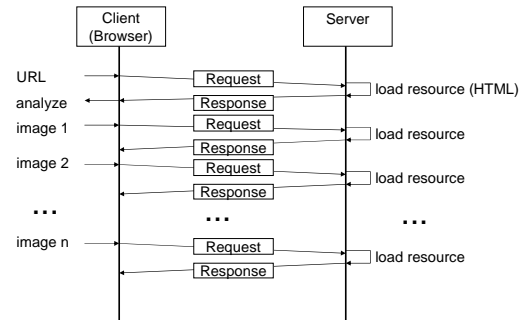


- images
- background
- buttons
- music
- audio

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Documents contain Resources IV

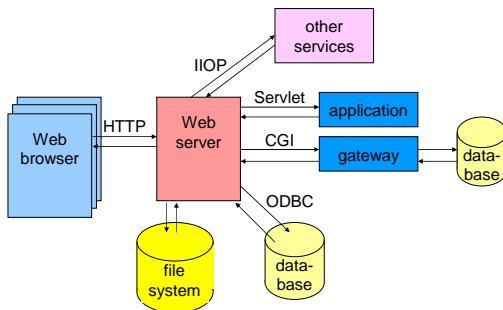


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More Realistic Example Architecture



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The WWW is a Distributed System

- What is a distributed System?
 - Tanenbaum, A.,S. (from Computer Networks)

"... in a distributed system, the existence of multiple autonomous computers is transparent (i.e., not visible) to the user."
 - Lamport (?)

a distributed system is a system that you can not use at a certain moment because a machine is crashed which you even do not know that this exists.

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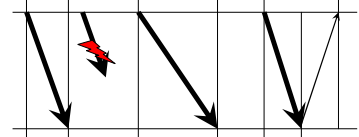
Information Exchange Between Browser and Server

- Obviously the document
- Further information available (e.g. header fields)
 - Browser type and version
 - Operating system (version)
 - Referer
 - Cookies
 - Screen size, window size
 - If Java/JavaScript/VBScript are enabled
 - List of plug-ins installed
 - Network parameter and route
 - ...
- Rich source of information
 - Can make applications more usable
 - Information may not be complete or may be wrong

Try it out at:
<http://network-tools.com/analyze/>

The WWW is a Distributed System Usability Issues

- Network
 - Delay
 - Failure
 - Jitter
 - Latency
 - Bandwidth
- Multi-user System
 - Work load, system performance
 - Concurrency problems



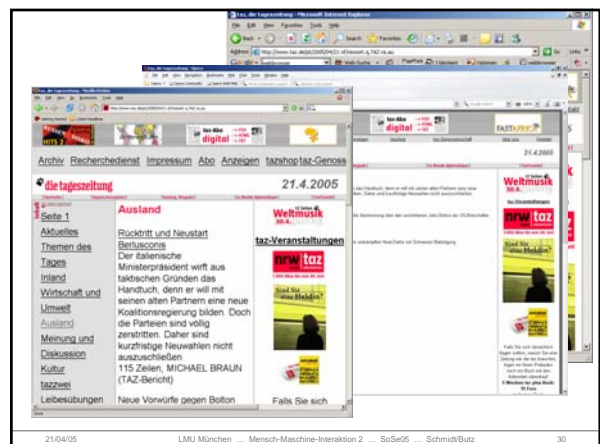
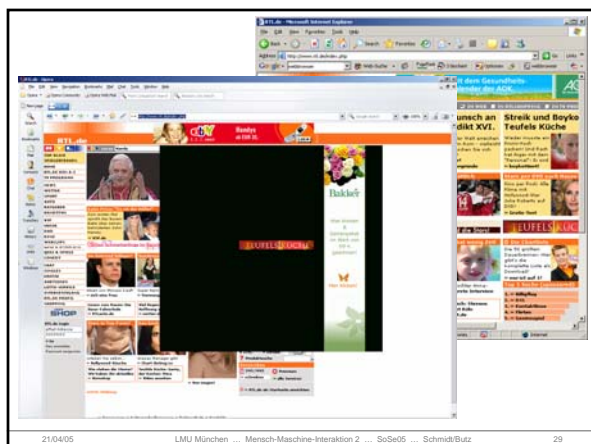
Designing Distributed Applications

- Basics
 - applications consist of several parts (e.g. different processes)
 - in general these parts are executed on different machines
 - these parts of the application are executed concurrently or one after another
 - there is communication between these parts
- Software/Application Design Aspects
 - data
 - analyzing data transfer (optimize for minimum)
 - investigate how caching can be supported
 - keep data save (minimize data that is given away)
 - functional
 - execute functions where it is most reasonable
 - regard the infrastructure on that the applications will be executed
 - response time (optimize for minimum)

Systems are Heterogeneous

Platform may vary to a great extent – it still should be usable

- Processing power
 - processor, co-processors, cache
 - RAM
- I/O-performance
 - hard drive speed
 - network
- Input and Output
 - displays
 - keyboard layout
- Additional Hardware and Periphery
 - video and audio (in/out)
 - card reader, printer, scanner
- Operating System



Graphical Browser - WebTV



Other Graphical Browser



Text or Audio Browser, e.g. Lynx



Compatibility

- To ensure usability define systems and environments that are supported (e.g. functional specification)
 - hardware
 - operating system
 - browser
 - network (bandwidth)
- the logfiles of an existing website for this user group can be used to calculate the percentage of compatibility
- Example (logfile 2001)

29% MSIE 5.X on Win95/Win98/NT	85%
14% MSIE 4.X on Win95/Win98/NT	
10% Mozilla4.X on Win95/Win98/NT	
15% Mozilla4.X on Unix	
3% Mozilla3.X on Win95/Win98/NT	
6% Mozilla3.X on Unix	
17% Robots	
5% others	

Organizing Information in the WWW

- based on a open hypertext system
- information can be organized in any way
 - partly „real“ hypertext with links based on content
 - partly indexed documents and catalogs
 - Partly simple collections of resources
- information is structured very differently
 - often mixture of linear and hierarchal structure
 - hypertext links are often not associative, but just to build a linear hierarchical navigation structure
 - previous/next
 - up/down/home

Hypertext

- concept to organize information
- motivation
 - “knowledge” is not linear, it is associative
 - authoring a document = making knowledge linear
 - reading a document = reproduce the non-linear structure of the knowledge → navigation



- hypertext-documents:
 - keep the inherent association of information in a document

Roots of Hypertext

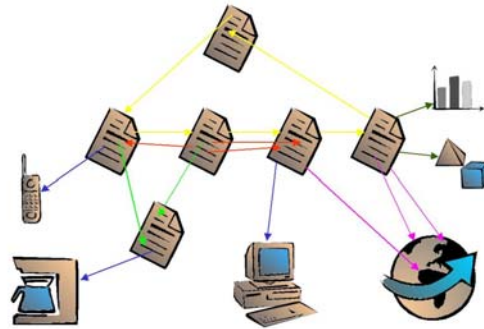
- "Memex"
 - Vannevar Bush: "As we may think", 1945
 - "Memory Expander"-Machine
 - associative storage/access
 - personal annotation linked to documents
- Xanadu
 - Ted Nelson, 1965/1981
 - term Hypertext
 - Docuverse: global hypertext system, Pay per View
- Augment/NLS (oNLine System)
 - Douglas Englebart, 1968
 - Shared Hypertext Document Spaces

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Hypertext – Example I



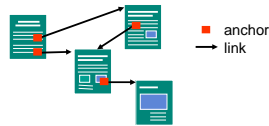
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Hypertext Components

- structure
 - hypertext document: directed graph
- components
 - node: information unit
 - anchor: Information chunk within a node, target for a link
 - link: connections between nodes



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Node

- single media nodes
 - only one media type per node
- mixed media nodes
 - different media types possible per node
 - alternatives, combination
- systems with limited content size
 - no internal navigation
 - e.g. HyperCard
- systems with unlimited content size
 - internal navigation necessary
 - e.g. Scrolling

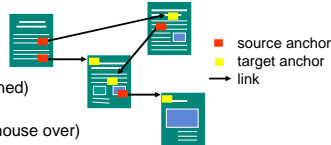
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Anchor

- types of anchors
 - source anchor
 - target anchor
- represented as
 - button
 - icon
 - text (e.g. Underlined)
 - hidden
 - animation (e.g. mouse over)
 - ...
- representation of source anchors as link
- representation of target anchors is often hidden



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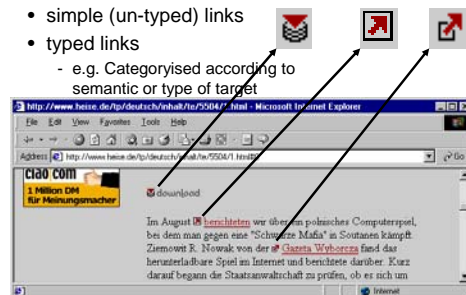
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Links

- information content of a link

- simple (un-typed) links
- typed links
 - e.g. Categorized according to semantic or type of target



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Media Types in the Web

- text / hypertext
- Inline graphics in Hypertext
- icons / graphics (bitmap, vector) / drawings / photos
- interactive graphics: active maps
- animations
- programs (e.g. JavaScript)
- audio clips / video clips (e.g. MP3, MPG)
- audio / video streams
- 3D-scenes (e.g. VRML)
- objects, like Applets, Flash, ---
- any type of media ...

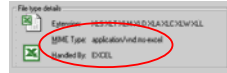
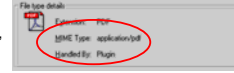
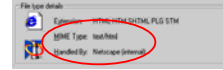
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Media Types in the Web - Concept

- open concept to integrate arbitrary media
 - transmitted in the MIME format
- interpretation of different Media types in the WWW
 - browser build-in for most basic types
 - text, HTML hypertext, GIF and JPEG images
 - using browser Plug-Ins
 - e.g. for Acrobat PDF, Real-Audio, RealVideo, Shockwave, Flash
 - using external applications (helper applications)
 - e.g. ghostscript for PostScript, other proprietary formats/applications
 - save files
 - Download of arbitrary formats



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MIME Extension

- mapping of file types (e.g. extensions in the file system, UNIX) onto MIME types (on the server)

foo.ps → application/postscript

application/postscript → ghostview

- mapping of MIME types to applications (in the browser)
- ... it is open – but this may be a serious usability problem
 - Do the users have the right connection?
 - Does the external program, plug-in work?

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Technology Overview Client

- content that can be displayed/provided
 - text, HTML, images, videos, audio, ...
- content and programs that can be interpreted by the browser
 - dynamic HTML
 - browser script: JavaScript, VBScript, SMIL, MathML, ...
- programs that are executed in the context of the browser
 - Java Applets (Byte Code, Virtual Machine)
 - ActiveX (Native Code, executed directly by the operating system)
- programs that are plugged into the browser and executed in the context of the browser for specific data types
 - Plug-Ins
- external programs that are started by the browser to handle data that can not be handled by the browser
 - helper applications

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Technology Overview Server

- content (e.g. HTML-pages) that contains statements that can be replaced or executed:
 - SSI, XSSI
 - server side scripting (ASP, PHP, JSP, ...)
- programs that create content
 - additional process: CGI
 - In the context of the servers: Servlets, ...
- extensions of web servers
 - NSAPI, IISAPI, Apache-Modules, ...
- gateways and front-ends for databases
- application server
- dedicated/specific server

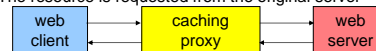
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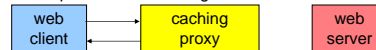
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Caching-Proxy - Example

- Cache - MISS
 - The requested resource is not stored in the cache
 - The resource is requested from the original server



- Cache - HIT
 - The requested resource is stored in the cache of the proxy and is still valid
 - The resource sent back directly from the caching proxy, it is not requested from the original host



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Cache-Control Header

```
Cache-Control = "Cache-Control" ":" 1#cache-directive

cache-directive = cache-request-directive
                  | cache-response-directive

cache-request-directive = "no-cache" | "no-store"
                        | "max-age" "=" delta-seconds
                        | "max-stale" [ "=" delta-seconds ]
                        | "min-fresh" "=" delta-seconds
                        | "no-transform" | "only-if-cached" | cache-extension

cache-response-directive = "public"
                          | "private" [ "=" <"> 1#field-name <"> ]
                          | "no-cache" [ "=" <"> 1#field-name <"> ]
                          | "no-store" | "no-transform" | "must-revalidate"
                          | "proxy-revalidate" | "max-age" "=" delta-seconds
                          | "s-maxage" "=" delta-seconds | cache-extension
```

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Web Error Messages I

- categories of errors (see HTTP)
 - most often : 404 (file not found)
 - 4xx – error on client side
 - 5xx – error on server side
- errors should be intercepted
 - define useful reaction
 - make specific pages for errors
 - e.g. 404 – file not found
 - possible reasons: file does not exist (anymore), typos, ...
 - some possible solutions
 - show an error page – tell the user that the page is not available :-)
 - show the main page of the server
 - show a search page on the server, tell the user to search
 - try to find with the filename and the path the page or a related page in the internal search engine and show this page :-)

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Web Error Messages II

- errors should be intercepted!
 - e.g. 500 – server error
 - possible reasons: CGI-program crashed, hard drive full, database down, permission changes, gateway not available, ...
 - some possible solutions
 - show CGI/Server error messages :-)
 - give the user an alternative: e.g.
„Sorry our WWW online ordering system is currently not available. Please print out your order and send us a fax (0815/007007) or order by email (orders@shop.com). The system will be online in a minute. Sorry for any inconvenience.“

```
SoftArtisans.SAFile.1 error '80020009'
Error occurred when moving cached file to final destination. Please
check the NTFS permissions for the directory "C:\WINNT\" and the
directory containing the file "D:\CMTLibrary\SIGCHIShort\523_admin.pdf".
These directories require Read, Write and Delete permissions by the
anonymous user ( NT account: IUSR_computername ) as well as for your
authenticated users.
/sigchishort/PaperEditProcess.asp, line 107
```

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Excuse: Web Technology Essentials

- Be aware that
 - That the web is heterogeneous distributed systems
 - Hypertext and Hypermedia allows complex information architecture
 - That any media type can be used, however there is little control how they are handled at the client
 - There is a mixture of code and content
- Try to minimize technical complexity
- Specify technical requirements
 - Minimal setup
 - Anticipated setup
 - Test under these conditions

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References

- ACM SIGCHI Curricula for Human-Computer Interaction
<http://www.acm.org/sigchi/cdg/>
- Vorlesung Web Engineering, Uni Karlsruhe
<http://www.teco.edu/lehre/webe/>

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