Web Engineering

Introduction and Overview

What is the course about?

• Web Engineering
  – Requirements collection
  – Design
  – Development
  – Testing

• Web Technologies
  – HTML, JSP, AJAX, JASON, JQuery, ...

• Project Management
  – CVS/SVN/GIT, JUnit, ...
**Course Goals**

- The goals of the course are as follows:
  - To be able to analyze and design comprehensive Web application.
  - To learn and use some of the languages currently used to manipulate information on the World Wide Web – i.e. Java and Javascript.
  - To learn techniques and evaluation metrics for ensuring the proper operability, maintenance and security of a web application.

**Course Organization**

- Course is organized into:
  - 15 lectures (Tuesday, 09:15 – 12:00, HS11)
- The lecture(r) :
  - Ioan Toma (ioan.toma@sti2.at)
    - Ask for f2f meeting by email
  - If any problem arises I will try to move lectures or use someone of my staff to replace me
  - We will try to be interactive
Course Material

- **Books**

- **Web site**
  - Slides will be published online after each lecture

- **Mailing list**
  - [https://lists.sti2.at/mailman/listinfo/we2013](https://lists.sti2.at/mailman/listinfo/we2013)

What is the course structure?

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- Exam grade:

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- Tutorial and Exam have separate grades since this is not an integrated course

Why do we need Web Engineering?

INTRODUCTION
Why do we want to learn about WE at all?

Cisco estimates based on CAIDA publications, Andrew Odlyzko

What is Web Engineering?

• “The application of systematic and quantifiable approaches to cost-effective analysis, design, implementation, testing, operation, and maintenance of high-quality Web applications.” – Kappel et al.

• Extends Software Engineering to Web applications, but with Web-centric approaches.
  – And other relevant contributions from many disciplines
Defining Web Applications

- Unlike traditional software, the Web serves as both development & user platform.

- A Web application is a system that utilizes W3C standards & technologies to deliver Web-specific resources to clients (typically) through a browser.
  - Kind of …

- Technology + interaction.
  - Web site with no software components?
  - Web services?

The Case for Web Engineering

- Application development on the Web remains largely ad hoc.
  - Spontaneous, one-time events
  - Individual experience
  - Little or no documentation for code/design

- Short-term savings lead to long-term problems in operation, maintenance, usability, etc.

- Because Web apps are so interdependent, the problem is compounded.
The Case for Web Engineering II

- Root Causes of poor design
  - Development as an authoring activity
  - Development is “easy”
  - Techniques that should not be used are misapplied.
  - Techniques that should be used are not.

- Particularly alarming given...
  - Most projects are now Web-based
  - More “mission-critical” apps moving to the Web

The Case for Web Engineering III

- Top project pitfalls (Cutter, 2000)
  - 84% - Failure to meet business objectives
  - 79% - Project schedule delays
  - 63% - Budget overrun
  - 53% - Lack of functionality

- Web Engineering’s solution:
  - Clearly defined goals & objectives
  - Systematic, phased development
  - Careful planning
  - Iterative & continuous auditing of the entire process
The Case for Web Engineering IV

- Web Technologies pose new restrictions to software development
  - HTTP
  - URL
  - HTML

- HTTP is stateless
  - Unless you use tricks

- Web is based on the pull mechanism
  - Unless you use tricks

- Why can’t we change this? Tricks are not good!
  - It’s a trade off…

Categories of Web Applications

- Doc-Centric
- Interactive
- Transactional
- Workflow Based
- Collaborative
- Social Web
- Ubiquitous
- Portal Oriented
- Semantic Web

Development History vs. Complexity
Document-Centric Web sites

- Precursors to Web applications
- Static HTML documents
- Manual updates

**Pros**
- Simple, stable, short response times

**Cons**
- High management costs for frequent updates & large collections.
- More prone to inconsistent/redundant info.

Interactive & Transactional

- The Common Gateway Interface
  - [http://hoohoo.ncsa.uiuc.edu/cgi/interface.html](http://hoohoo.ncsa.uiuc.edu/cgi/interface.html)
- Simple interactivity
- Dynamic page creation

Content updates -> Transactions
- Decentralized
- Database connectivity
- Increased complexity
Workflow-Based Applications

• Designed to handle business processes across departments, organizations & enterprises

• Business logic defines the structure

• The role of Web services
  – Interoperability
  – Loosely-coupled
  – Standards-based

• Examples: B2B & e-Government

• High complexity; autonomous entities

Collaborative & Social Web

• Unstructured, cooperative environments

• Interpersonal communication is paramount

• Classic example: Wikis

• The Social Web
  – Anonymity traditionally characterized WWW
  – Moving towards communities of interest
  – Examples: Blogs, collaborative filtering systems, social bookmarking (e.g., del.icio.us)
  – Integration with other forms of web applications (e.g., NetFlix)
Portal-Oriented

- Single points-of-entry to heterogeneous information
  - Yahoo!, AOL.com, my.pitt.edu
- Specialized portals
  - Business portals (e.g., employee intranet)
  - Marketplace portals (horizontal & vertical)
  - Community portals (targeted groups)

Ubiquitous

- Customized services delivered anywhere via multiple devices
- HCI is critical
  - Limitations of devices (screen size, bandwidth?)
  - Context of use
- Still an emerging field; most devices have single focus:
  - Personalization
  - Location-aware
  - Multi-platform delivery
Semantic Web

- Berners-Lee: Information on the Web should be readable to machines, as well as humans.
- Using metadata and ontologies to facilitate knowledge management across the WWW.
- Content syndication (RSS, Atom) promotes re-use of knowledge.
- Is the Semantic Web even possible?
- Authors devote a chapter to the Semantic Web, but we will not focus on it in this course.

Semantic Web

Serious Problems in
- information finding,
- information extracting,
- information representing,
- information interpreting and
- and information maintaining.

Static
- WWW
  - URI, HTML, HTTP

Semantic Web
- RDF, RDF(S), OWL
Semantic Web

• “An extension of the current Web in which information is given well-defined meaning, better enabling computers and people to work in cooperation.”
  • Sir Tim Berners-Lee et al., Scientific American, 2001: tinyurl.com/i59p
  • “…allowing the Web to reach its full potential…” with far-reaching consequences
  • “The next generation of the Web”

Semantic Web

• Web Data Annotation
  – connecting (syntactic) Web objects, like text chunks, images, … to their semantic notion (e.g., this image is about Innsbruck, Dieter Fensel is a professor)

• Data Linking on the Web (Web of Data)
  – global networking of knowledge through URI, RDF, and SPARQL (e.g., connecting my calendar with my rss feeds, my pictures, …)

• Data Integration over the Web
  – Seamless integration of data based on different conceptual models (e.g., integrating data coming from my two favorite book sellers)
Characteristics of Web Apps

• How do Web applications differ from traditional applications?

• Or, another way, what Software Engineering methods & techniques can be adapted to Web Engineering?

• 3 dimensions of the ISO/IEC 9126-1 standard (*Software engineering — Product quality*)
  – Product
  – Usage
  – Development

• To this we can add a 4th dimension peculiar on the web, need for continuous and fast evolution!

Characteristics - Product

• The “building blocks” of a Web application

• Content
  – Document character & multimedia (# of dimensions?)
  – Quality demands

• Navigation Structure (Hypertext)
  – Non-linearity
  – Disorientation & cognitive overload

• User interface (Presentation)
  – Aesthetics
  – Self-explanation
Characteristics - Usage

• Much greater diversity compared to traditional non-Web applications

• Social Context (Users)
  – Spontaneity
  – Heterogeneous groups

• Technical Context (Network & Devices)
  – Quality-of-Service
  – Multi-platform delivery

• Natural Context (Place & Time)
  – Globality
  – Availability

Characteristics - Development

• The Development Team
  – Multidisciplinary
  – Community (including Open Source)

• Technical Infrastructure
  – Lack of control on the client side
  – Immaturity

• Process
  – Flexibility
  – Parallelism

• Integration
  – Internal
  – External
The 4th Dimension: Evolution

- All the above mentioned dimension are governed by the evolution principle
  - Continuous change
  - Competitive pressure
  - Fast pace

- Software Engineering: evolution is planned in a constant number of release version

- Web Engineering: evolution is continuous
  - Nowadays this is becoming true also for SE... it’s a loop, when a discipline overlaps its ancestor, the ancestor learn something back!

Key Knowledge Areas

- Software Engineering
  - Process
  - Design
  - Implementation
  - Test
  - Operation
  - Maintenance

- Network Engineering
  - Physical Layer
  - Internet Layer
  - Transport Layer
  - Performance

- Information Systems
  - Data Design, ER, ...
  - RDBMS
  - Query Languages
  - Strg Devices: FS...

- Hypermedia
  - Design & Structure
  - Information Space
  - Navigation
  - Usability
  - Collaboration

- Web Engineering

Others...
Standardization I

W3C
- Produces W3C Recommendations on Web protocols
- Managed approach to developments
- Protocols initially developed by W3C members
- Decisions made by W3C, influenced by member and public review

ISO
- Produces ISO Standards
- Can be slow moving and bureaucratic
- Produce robust standards

IETF
- Produces Internet Drafts on Internet protocols
- Bottom-up approach to developments
- Protocols developed by interested individuals
- "Rough consensus and working code"

Proprietary
- De facto standards
- Often initially appealing (cf PowerPoint, PDF)
- May emerge as standards

HTML extensions
- PNG
- PDF
- Java

Standardization II

- Standards are important, especially for national initiatives and other large-scale services
  - More easy to integrate different projects if they adopt standards

- Proprietary solutions are often tempting because:
  - They are available
  - They are often well-marketed and well-supported
  - They may become standardized

- Solutions based on standards may not be properly supported by applications
That's almost all for day…

WRAP-UP

Things to keep in mind
(or summary)

• Web Engineering is not about HTML and JavaScript
  – Like Software Engineering is not about C or Java!

• It aims at systematic development of Web applications according to a specific methodology

• Web Engineering is not just Software Engineering for the Web

• Web Engineering asks for multidisciplinary approach

• Standards are important in Web like in all the other engineering fields
Bibliography

• Mandatory reading

• Wiki and Web references
  – Web engineering http://en.wikipedia.org/wiki/Web_engineering

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