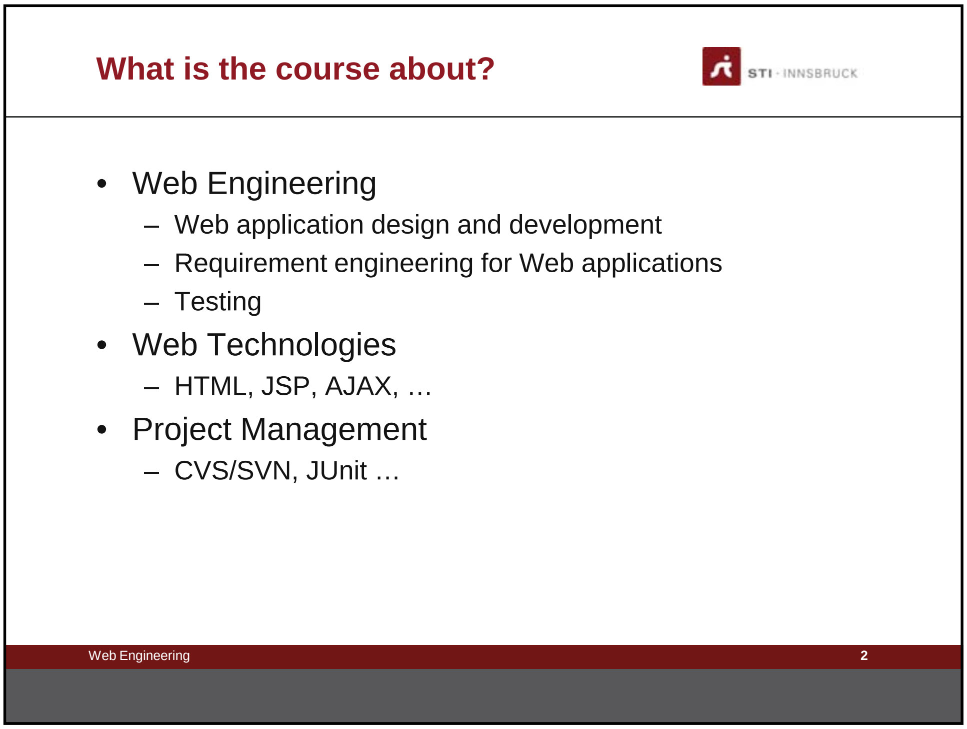
Web Engineering

Introduction

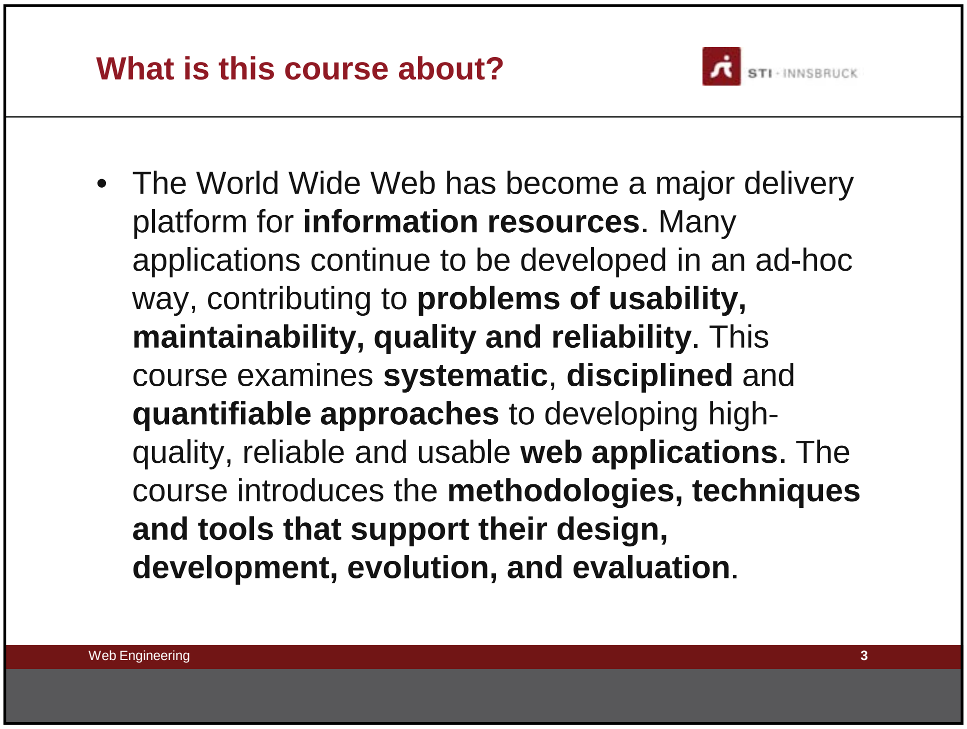
Lecture I – Oct. 5, 2009

Katharina Siorpaes



What is the course about?

- Web Engineering
  - Web application design and development
  - Requirement engineering for Web applications
  - Testing
- Web Technologies
  - HTML, JSP, AJAX, …
- Project Management
  - CVS/SVN, JUnit …



What is this course about?

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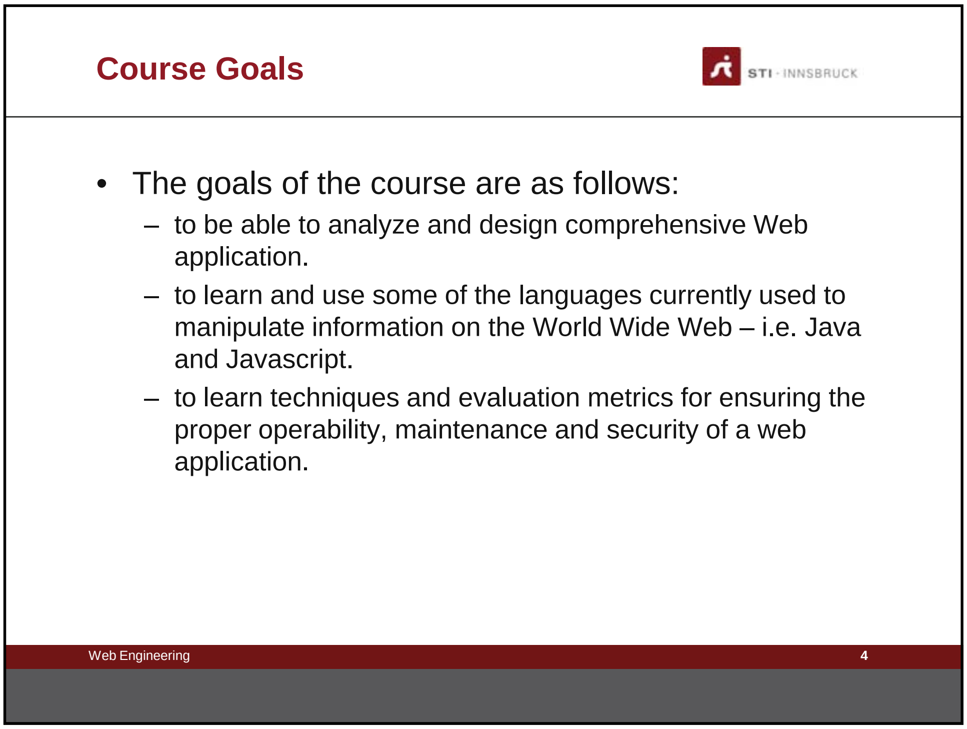
- The World Wide Web has become a major delivery platform for **information resources**. Many applications continue to be developed in an ad-hoc way, contributing to **problems of usability, maintainability, quality and reliability**. This course examines **systematic**, **disciplined** and **quantifiable approaches** to developing high-quality, reliable and usable **web applications**. The course introduces the **methodologies, techniques and tools that support their design, development, evolution, and evaluation**.



Course Goals

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- 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

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- Course is organized into:
  - 14 lectures (7 blocks of 2 lectures)
  - 1 exam
  - Bi-weekly starting Oct. 5, 2009
- The lecture(r) :
  - katharina.siorpaes@sti2.at
    - Ask for f2f meeting by email
    - RR 20
  - One or two guest lectures on special topics will be organized… this may cause changes in the schedule
- Web Engineering is a lecture, hence attendance is not required.
- Exam
  - Final exam at the end of the semester
  - Optional: assignments where you can earn points that will be added to the points in the final exam.
  - However, without doing any assignment it is still possible to get grade 1 in the final exam (given good work, of course ☺).

Course Material

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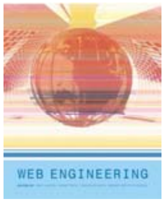

- Book
  - Kappel, G., Proll, B. Reich, S. & Retschitzegger, W. (2006). **Web Engineering**, Wiley & Sons.
- Web site
  - http://www.sti-innsbruck.at/teaching
  - Slides will be published online after each lecture
  - News and changes of dates, etc. will be announced here. Please check regularly.
  - Additional reading published on website
- Mailing list
  - https://lists.sti2.at/mailman/listinfo/webengineering20092010
  - Please subscribe.

What is the course structure?

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Mo 05.10.2009 14:15-18:00: Rechnerraum 20
Mo 19.10.2009 13:15-17:00: Rechnerraum 20
Mo 16.11.2009 14:15-18:00: Rechnerraum 20
Mo 30.11.2009 14:15-18:00: Rechnerraum 20
Mo 14.12.2009 14:15-18:00: Rechnerraum 20
Mo 18.01.2010 14:15-18:00: Rechnerraum 20
Mo 01.02.2010 14:15-18:00: Rechnerraum 20

14.15 – 15.45

16.00 – 17.30

Assignments

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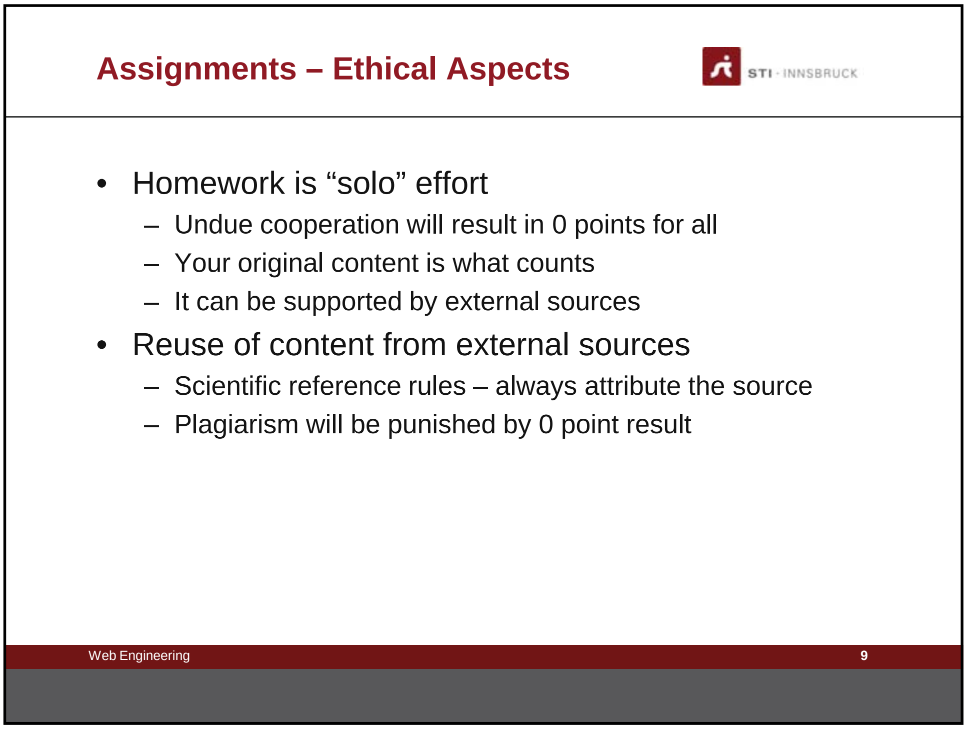
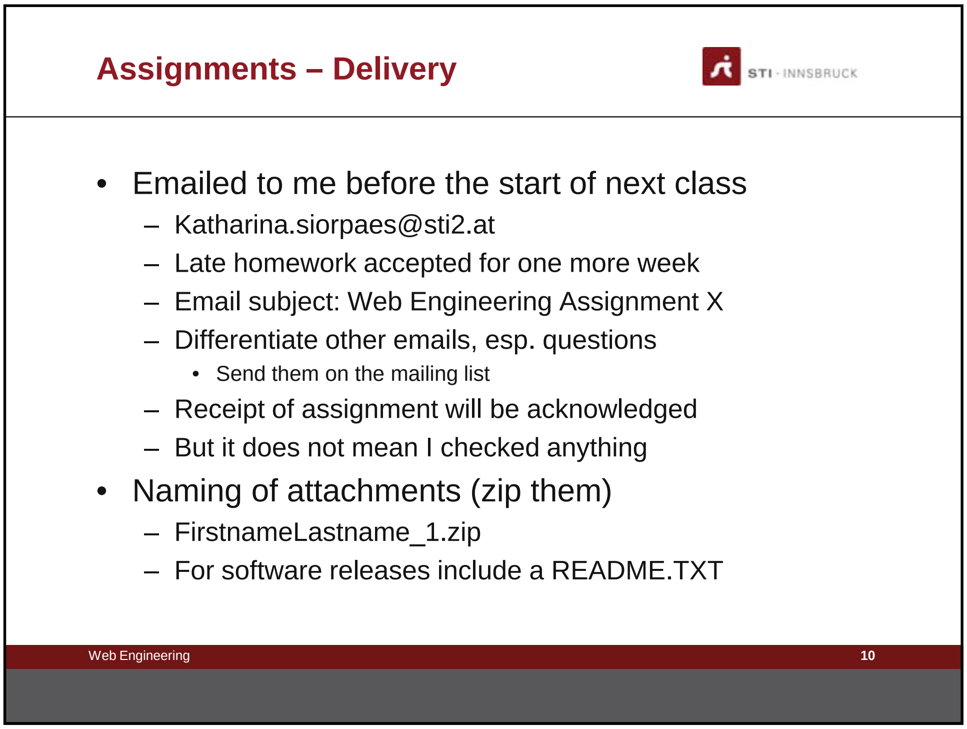
- Some theoretic work
  - Prepare a presentation on some topic
  - Write an essay on some topic
- … and some practical work
  - Write some code
  - Make a SW review
- Some to be performed by single students
- … some by group of students
- Grades vary from 1 point to 8 point, according to complexity.
- Points will be added to the score in the final exam.



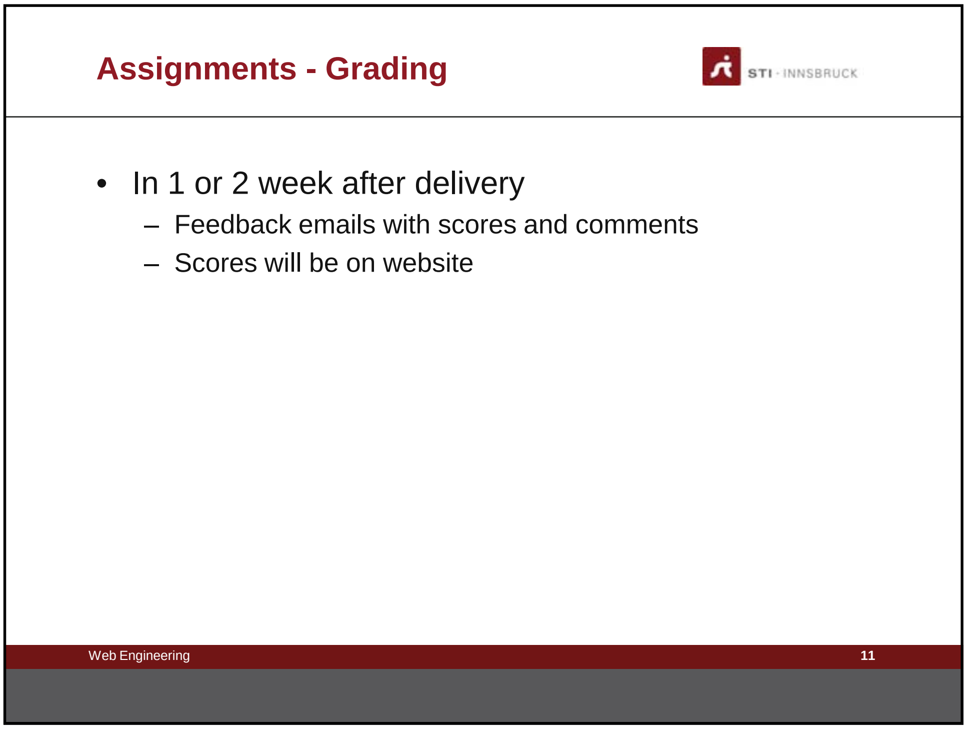
Assignments – Ethical Aspects

- Homework is “solo” effort
  - Undue cooperation will result in 0 points for all
  - Your original content is what counts
  - It can be supported by external sources
- Reuse of content from external sources
  - Scientific reference rules – always attribute the source
  - Plagiarism will be punished by 0 point result



Assignments – Delivery

- Emailed to me before the start of next class
  - Katharina.siorpaes@sti2.at
  - Late homework accepted for one more week
  - Email subject: Web Engineering Assignment X
  - Differentiate other emails, esp. questions
    - Send them on the mailing list
  - Receipt of assignment will be acknowledged
  - But it does not mean I checked anything
- Naming of attachments (zip them)
  - FirstnameLastname_1.zip
  - For software releases include a README.TXT



Assignments - Grading

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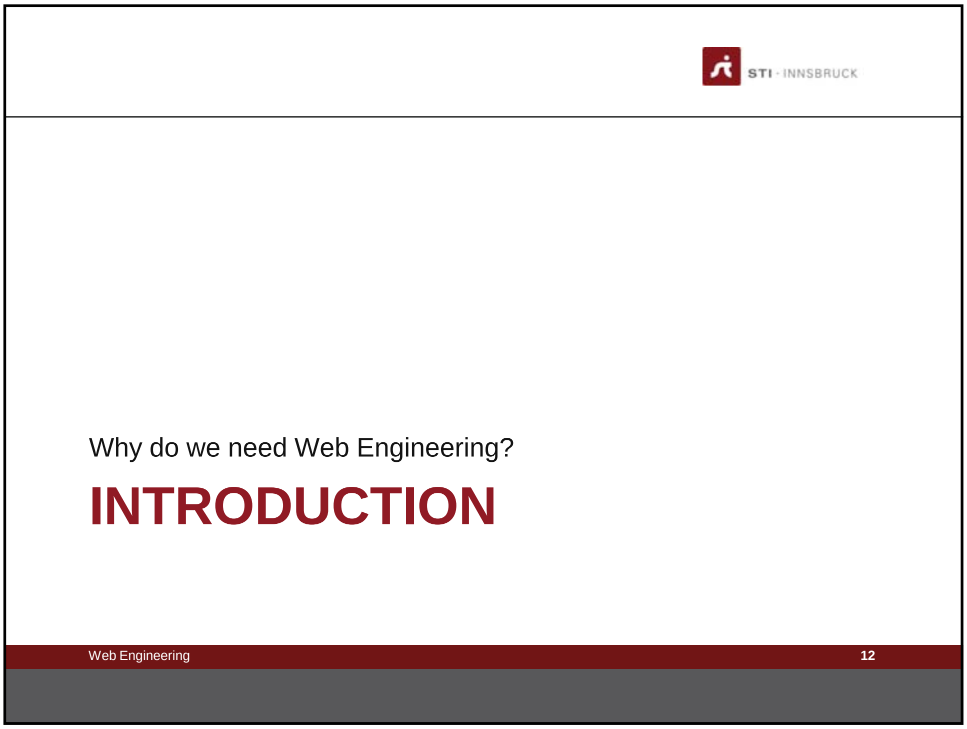
- In 1 or 2 week after delivery
  - Feedback emails with scores and comments
  - Scores will be on website



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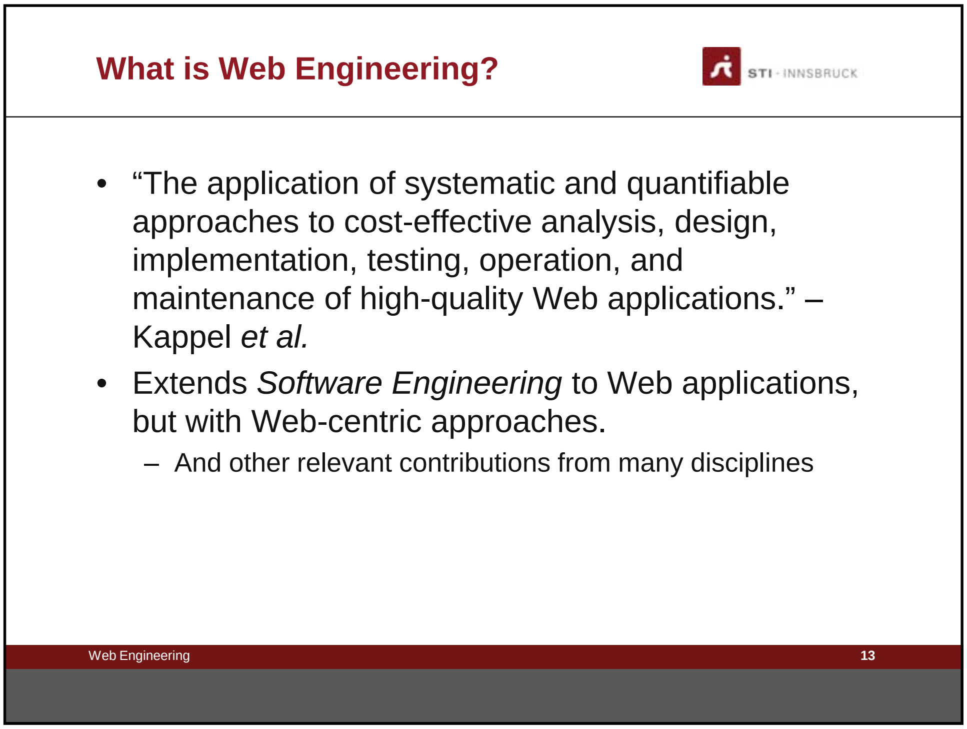
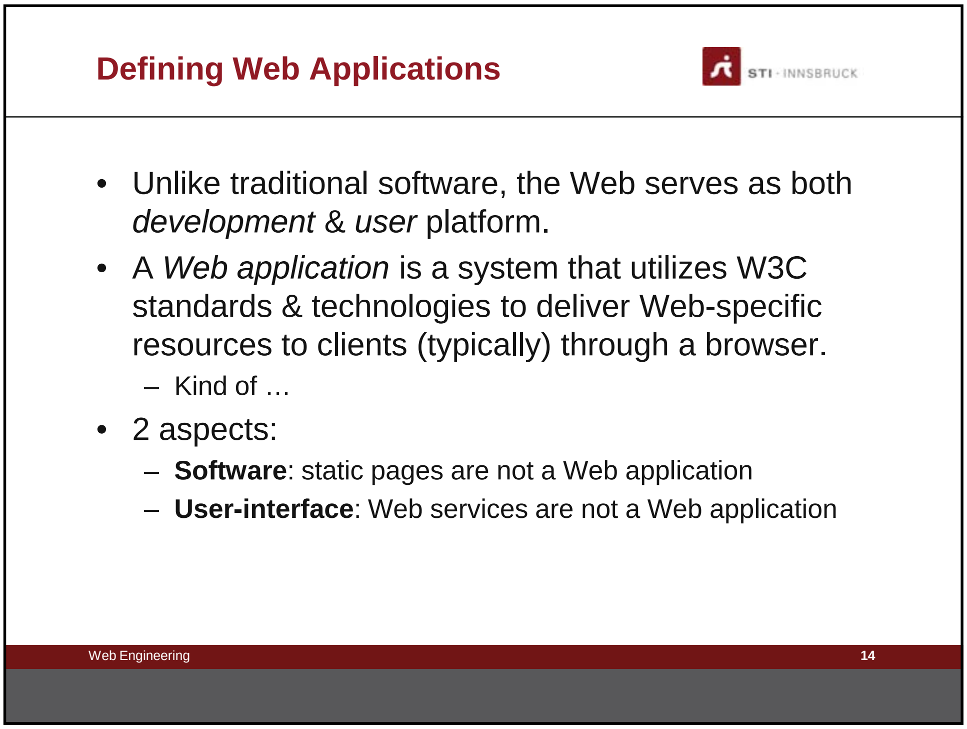
Why do we need Web Engineering?

INTRODUCTION



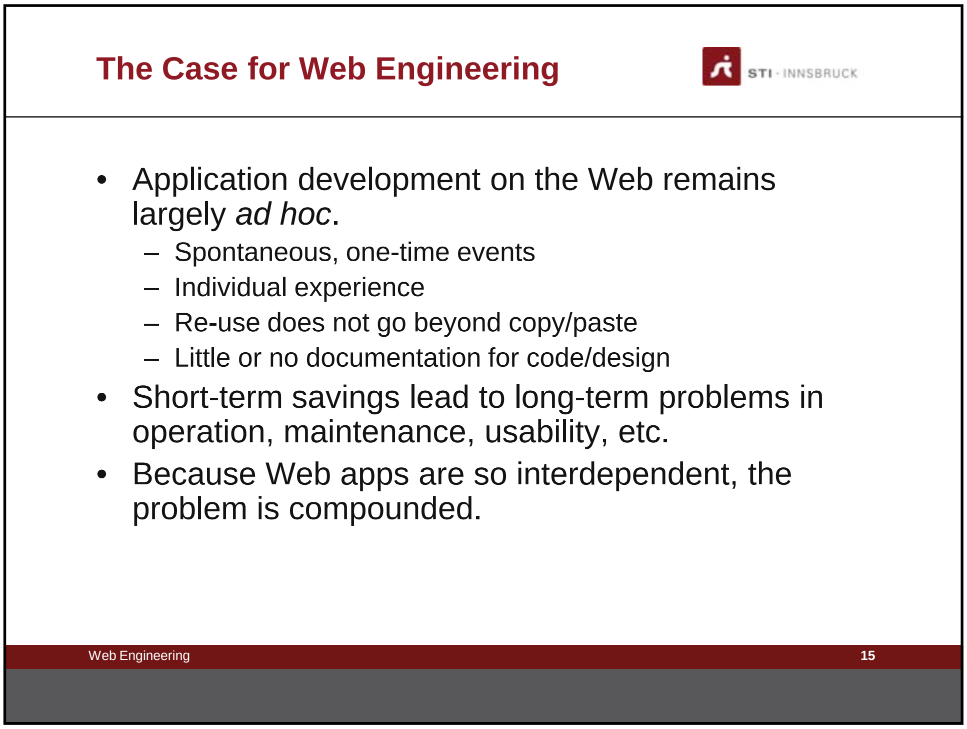
What is Web Engineering?

- “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



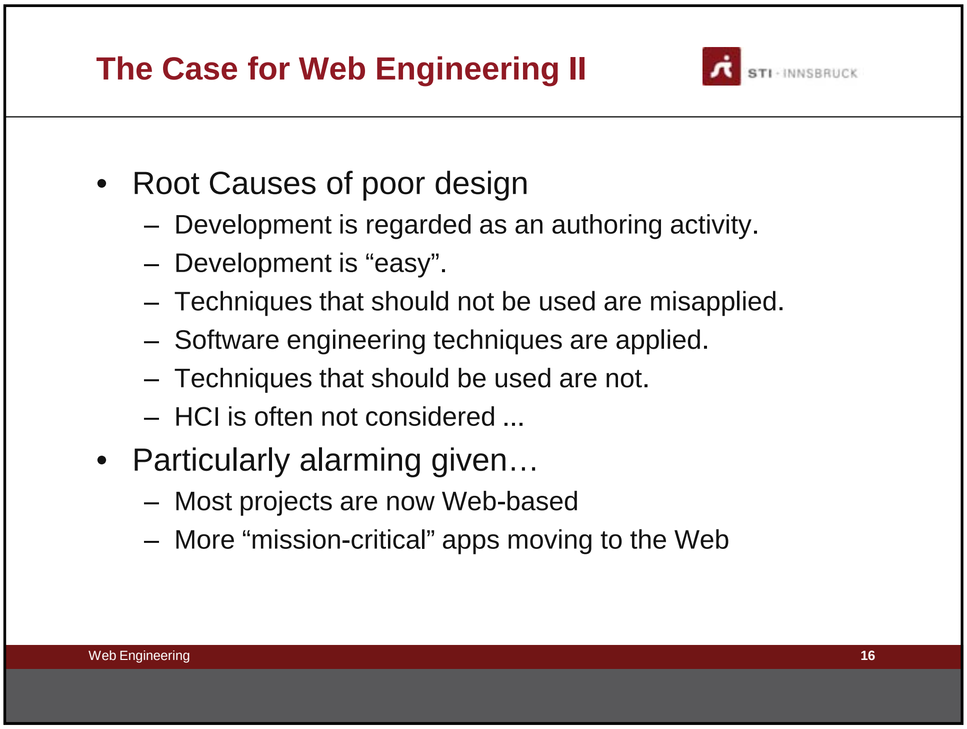
Defining Web Applications

- 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 …
- 2 aspects:
  - **Software**: static pages are not a Web application
  - **User-interface**: Web services are not a Web application



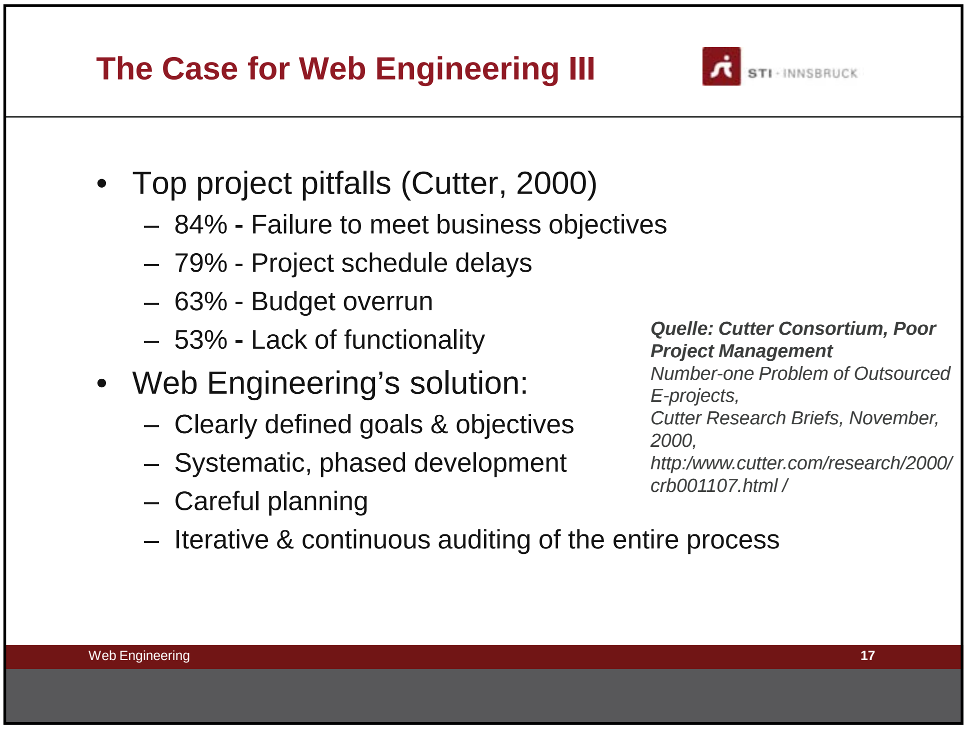
The Case for Web Engineering

- Application development on the Web remains largely *ad hoc*.
  - Spontaneous, one-time events
  - Individual experience
  - Re-use does not go beyond copy/paste
  - 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

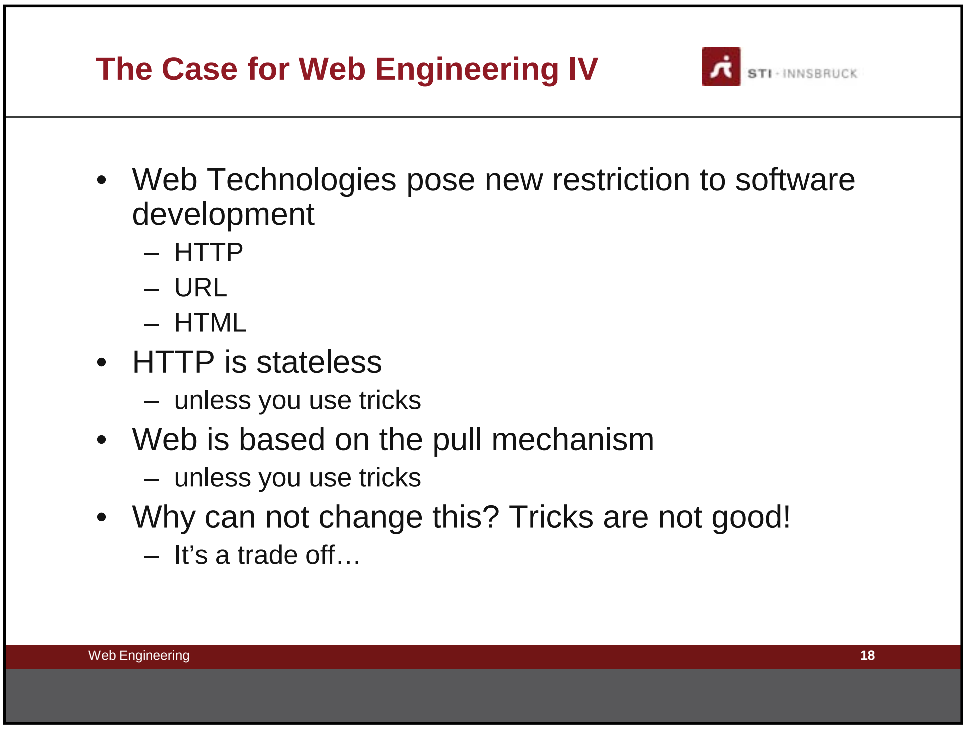
- Root Causes of poor design
  - Development is regarded as an authoring activity.
  - Development is “easy”.
  - Techniques that should not be used are misapplied.
  - Software engineering techniques are applied.
  - Techniques that should be used are not.
  - HCI is often not considered ...
- Particularly 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

Quelle: Cutter Consortium, Poor Project Management
Number-one Problem of Outsourced E-projects,
Cutter Research Briefs, November, 2000,
http:/www.cutter.com/research/2000/crb001107.html /



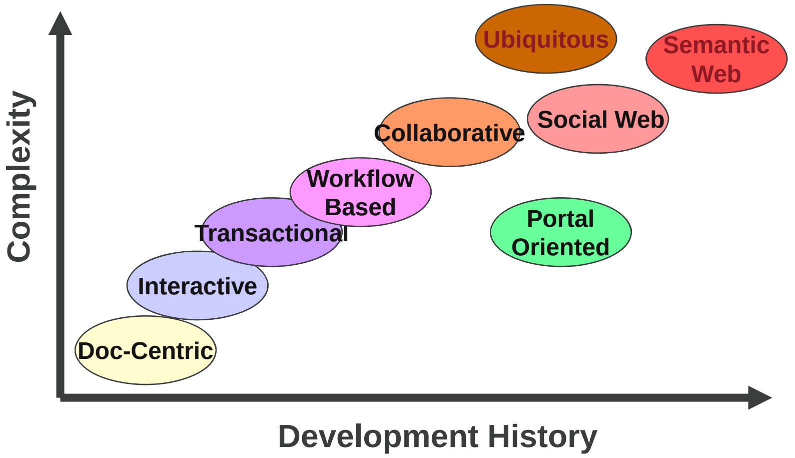
The Case for Web Engineering IV

- Web Technologies pose new restriction 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 not change this? Tricks are not good!
  - It’s a trade off…

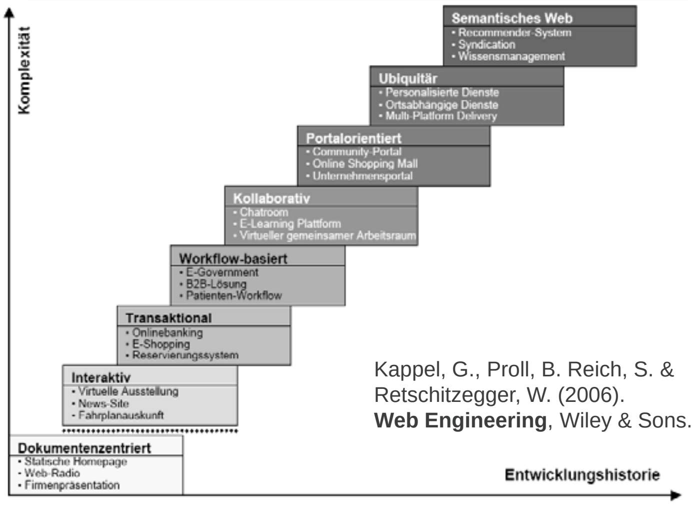
Principles

1. Clearly defined goals and requirements
2. Systematic development of a Web applicatin in phases
3. Careful definition of these phases
4. Continuous monitoring of the development process

Categories of Web Applications



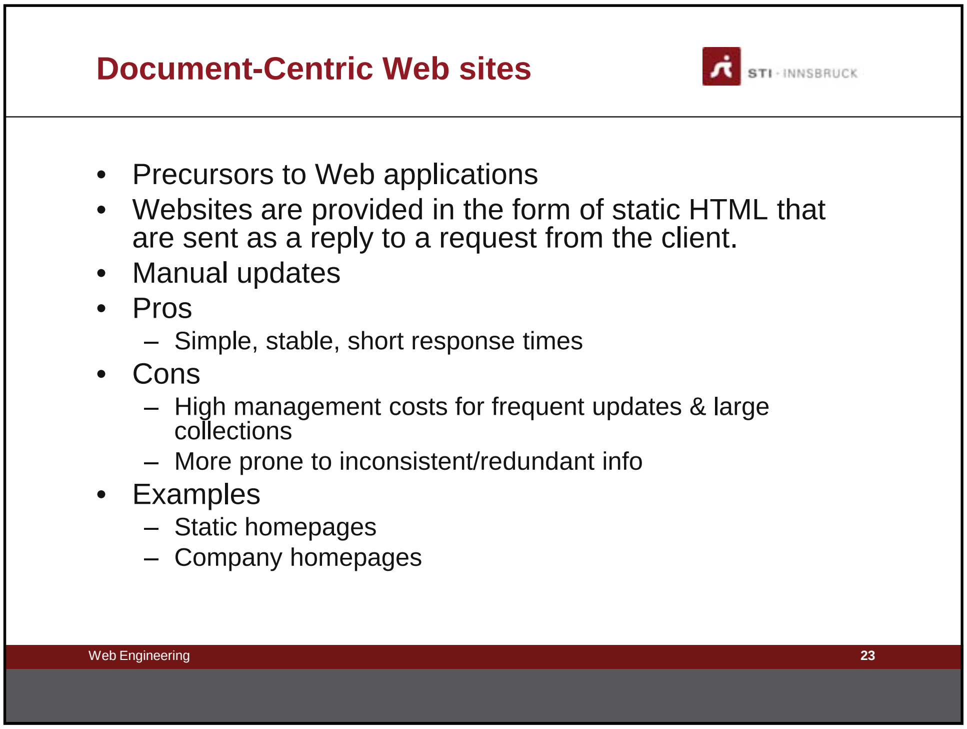
Categories of Web applications



Kappel, G., Proll, B. Reich, S. &
Retschitzegger, W. (2006).
Web Engineering, Wiley & Sons.

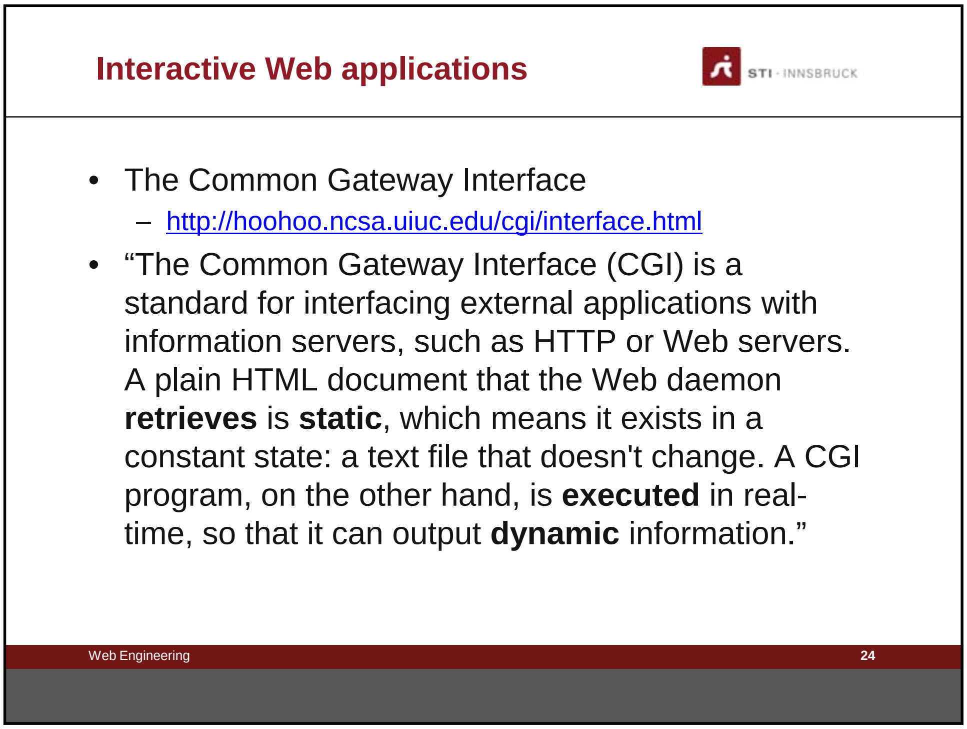
Categories of Web applications

- The development can be started in any category.
- Newer categories show a higher complexity.
  - Older categories are not necessarily replaced by newer ones.
  - Each category has its major application area.
- Complex applications often fit into several categories. Example: online shopping mall
  - Integration of providers of various services.
  - Various search possibilities.
  - Monitoring of transactions.
  - Online auctions.
- Many traditional areas are covered (e.g. Online banking).
- Creation of novel areas (e.g. Location-based services).



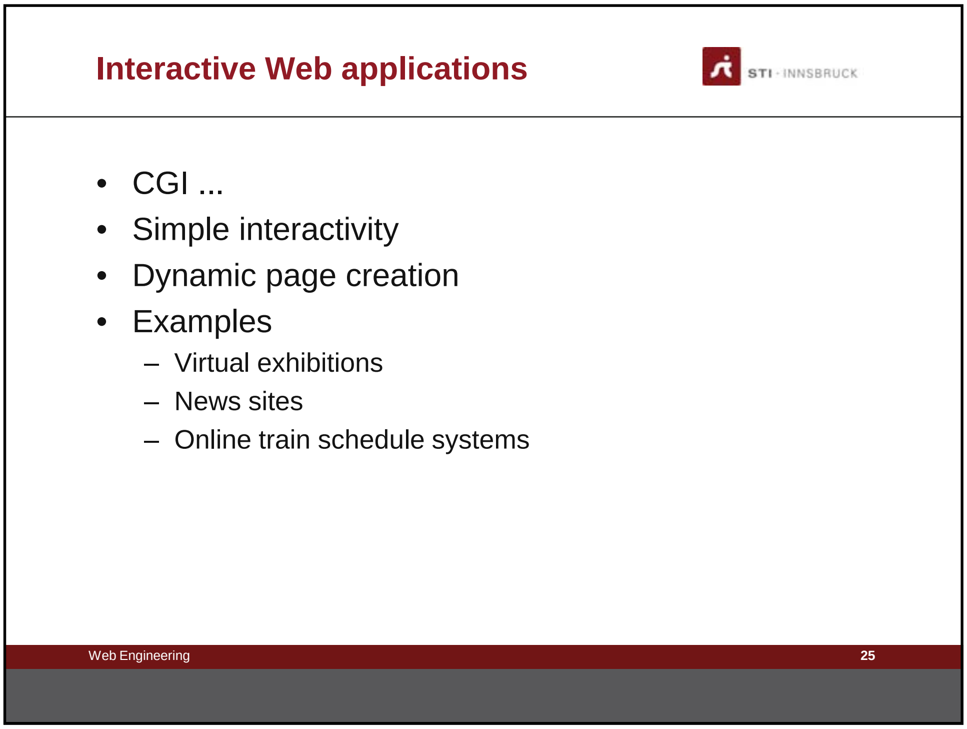
Document-Centric Web sites

- Precursors to Web applications
- Websites are provided in the form of static HTML that are sent as a reply to a request from the client.
- Manual updates
- Pros
  - Simple, stable, short response times
- Cons
  - High management costs for frequent updates & large collections
  - More prone to inconsistent/redundant info
- Examples
  - Static homepages
  - Company homepages



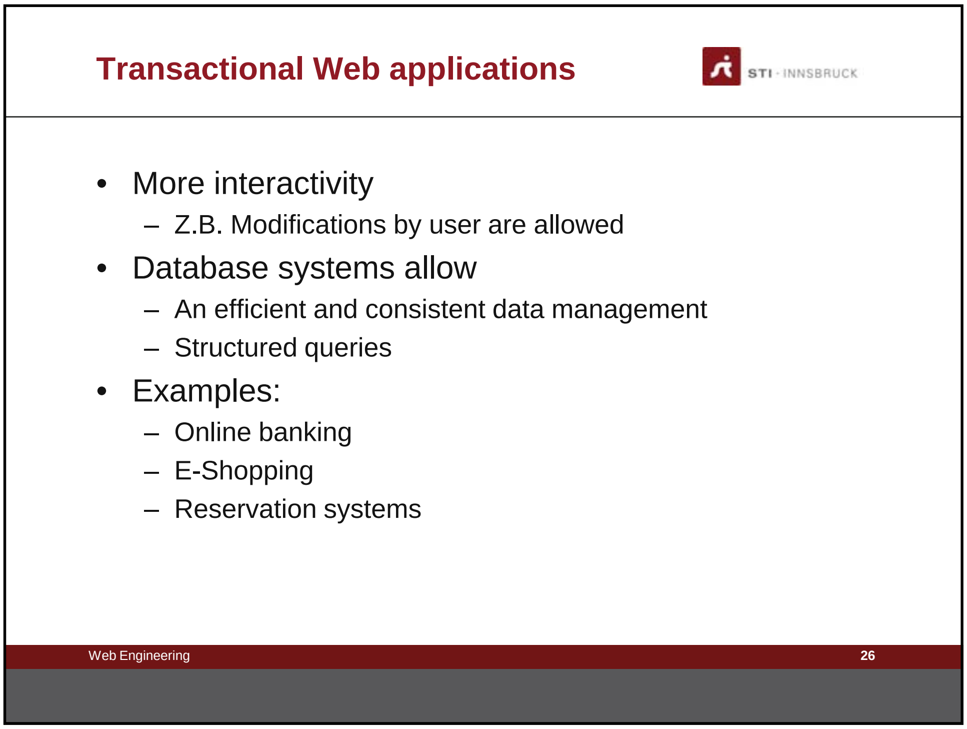
Interactive Web applications

- The Common Gateway Interface
  - http://hoohoo.ncsa.uiuc.edu/cgi/interface.html
- “The Common Gateway Interface (CGI) is a standard for interfacing external applications with information servers, such as HTTP or Web servers. A plain HTML document that the Web daemon **retrieves** is **static**, which means it exists in a constant state: a text file that doesn't change. A CGI program, on the other hand, is **executed** in real-time, so that it can output **dynamic** information.”



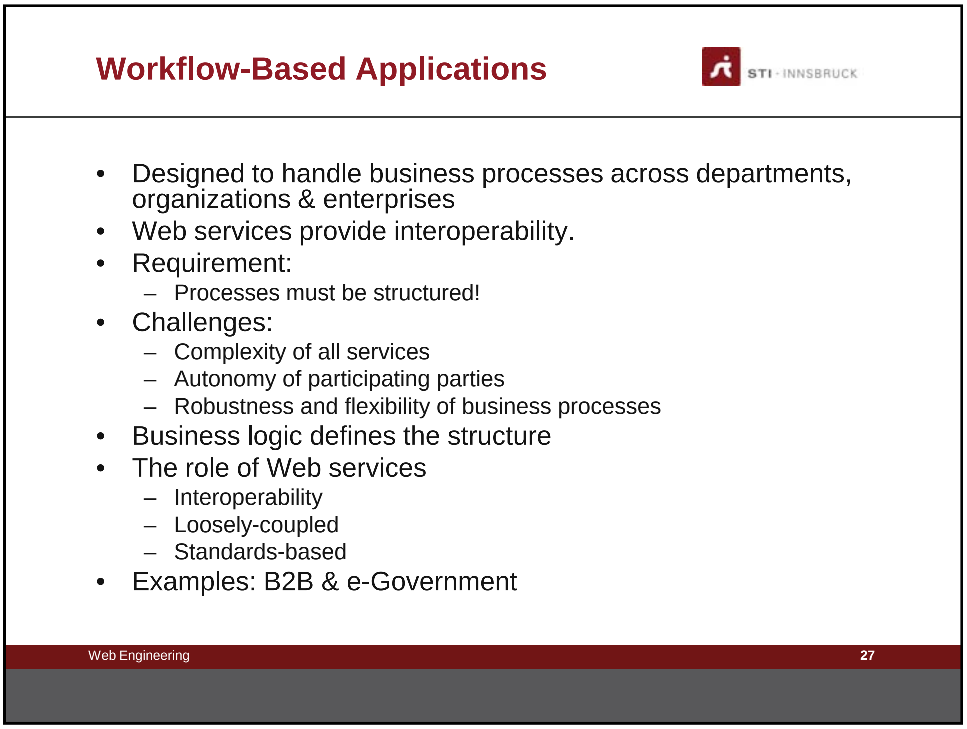
Interactive Web applications

- CGI ...
- Simple interactivity
- Dynamic page creation
- Examples
  - Virtual exhibitions
  - News sites
  - Online train schedule systems



Transactional Web applications

- More interactivity
  - Z.B. Modifications by user are allowed
- Database systems allow
  - An efficient and consistent data management
  - Structured queries
- Examples:
  - Online banking
  - E-Shopping
  - Reservation systems



Workflow-Based Applications

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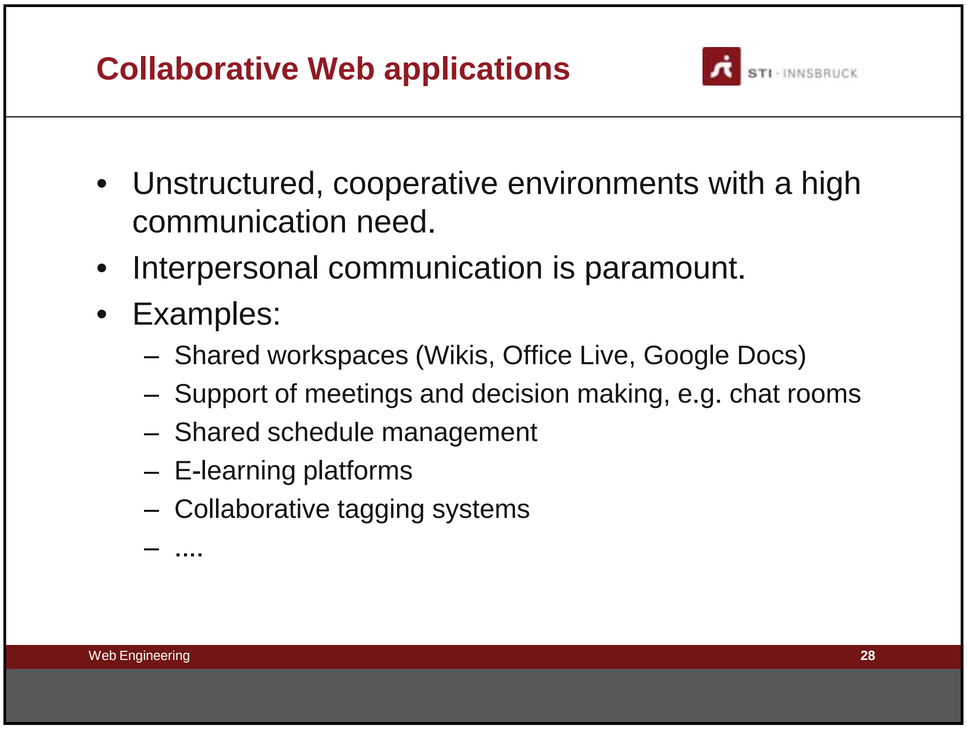
- Designed to handle business processes across departments, organizations & enterprises
- Web services provide interoperability.
- Requirement:
  - Processes must be structured!
- Challenges:
  - Complexity of all services
  - Autonomy of participating parties
  - Robustness and flexibility of business processes
- Business logic defines the structure
- The role of Web services
  - Interoperability
  - Loosely-coupled
  - Standards-based
- Examples: B2B & e-Government



Collaborative Web applications

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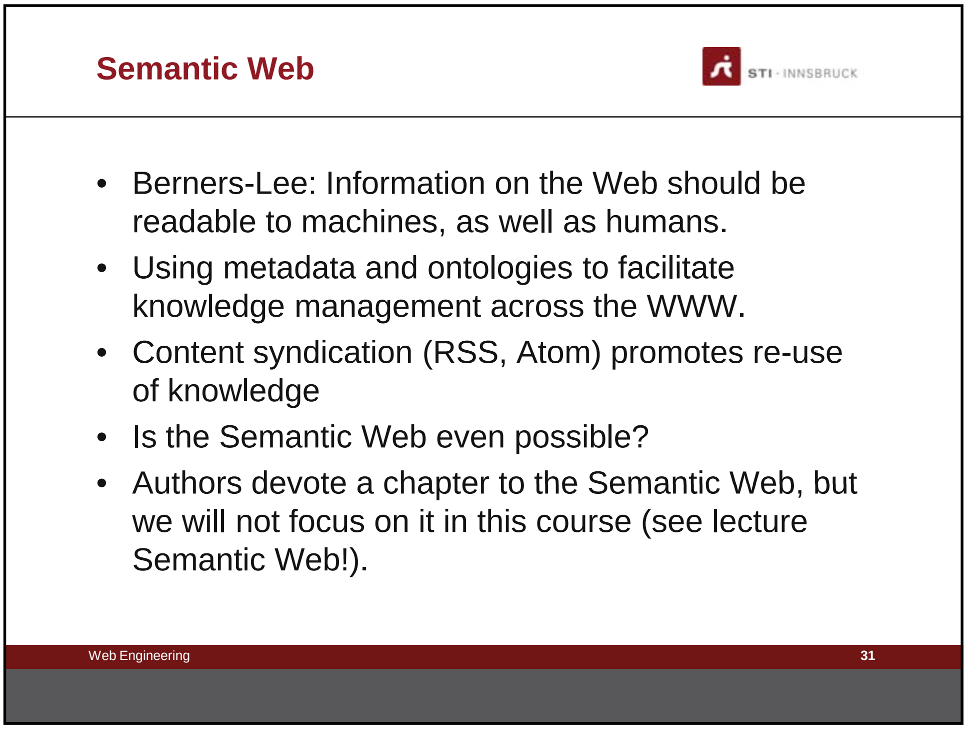
- Unstructured, cooperative environments with a high communication need.
- Interpersonal communication is paramount.
- Examples:
  - Shared workspaces (Wikis, Office Live, Google Docs)
  - Support of meetings and decision making, e.g. chat rooms
  - Shared schedule management
  - E-learning platforms
  - Collaborative tagging systems
  - ....

Portal-Oriented

- Single points-of-entry to heterogeneous information
- General portals for access to Web
  - Browser, such as Firefox or IE
  - Search services, such as Google or Yahoo!
  - Onlineservices such as AOL
  - Media groups
- Specialized portals
  - Business portals
    - employee intranet to share information
  - Marketplace portals
    - horizontal : B2C and B2B
    - Vertical: unifying companies in a sector
  - Community portals
    - Target groups
    - Interactivity and foster customer loyality
    - One-to-one marketing

Ubiquitous

- Customized services delivered anywhere via multiple devices. Access everywhere at any time.
- Example
  - Menus for users that enter a restaurant between 11am and 2pm.
- Requirement: extraction of context information.
- 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

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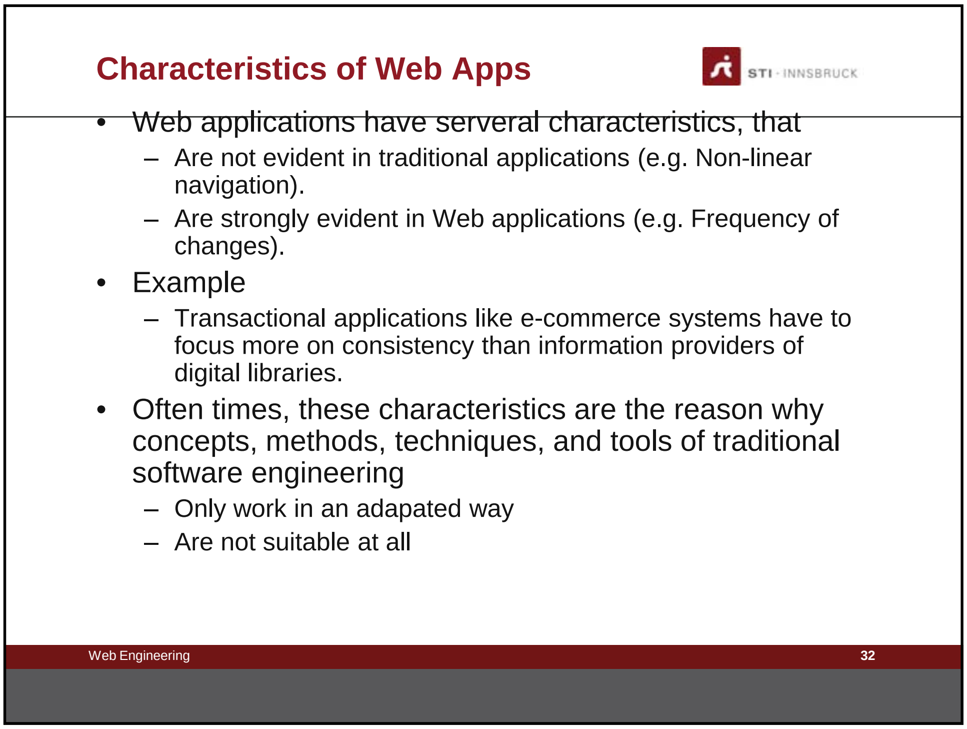
- Berners-Lee: Information on the Web should be readable to machines, as well as humans.
- Using metadata and ontologies to facilitate knowledge management across the WWW.
- Content syndication (RSS, Atom) promotes re-use of knowledge
- Is the Semantic Web even possible?
- Authors devote a chapter to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



Characteristics of Web Apps

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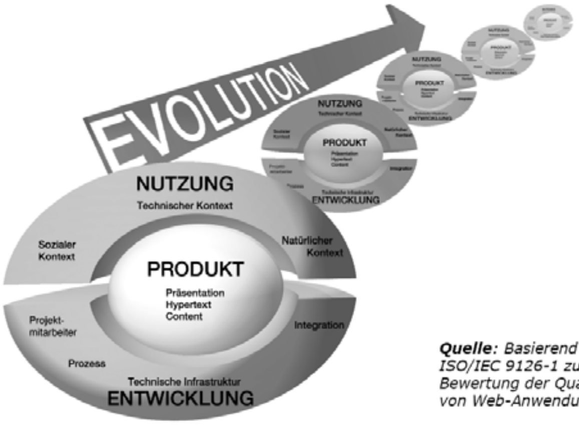
- Web applications have serveral characteristics, that
  - Are not evident in traditional applications (e.g. Non-linear navigation).
  - Are strongly evident in Web applications (e.g. Frequency of changes).
- Example
  - Transactional applications like e-commerce systems have to focus more on consistency than information providers of digital libraries.
- Often times, these characteristics are the reason why concepts, methods, techniques, and tools of traditional software engineering
  - Only work in an adapated way
  - Are not suitable at all

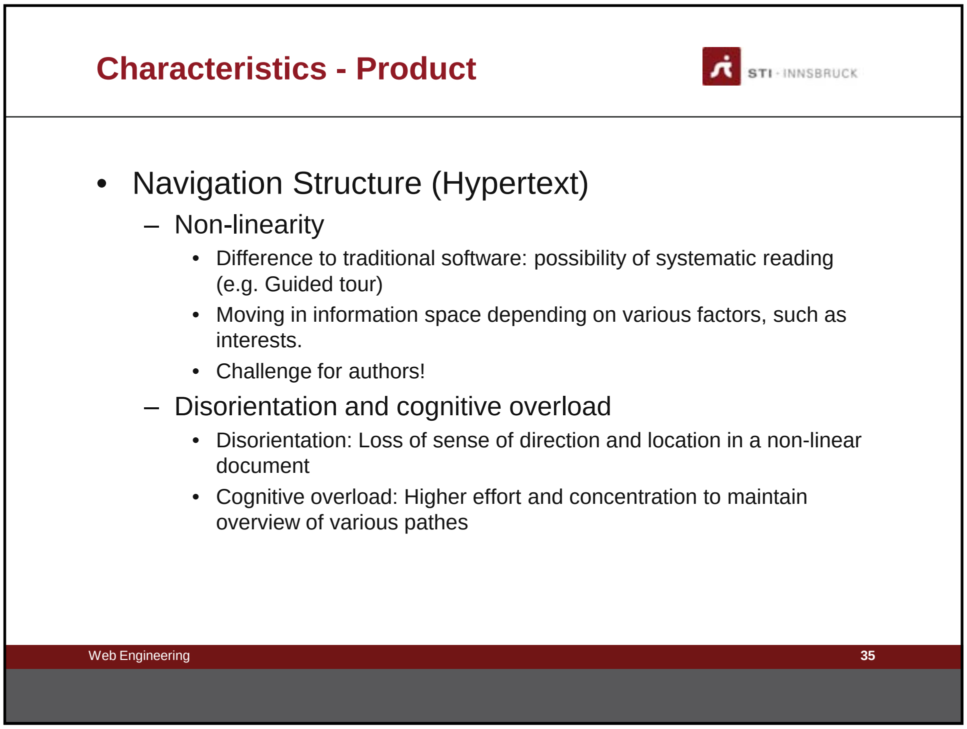
Characteristics of Web Apps



Quelle: *Basierend auf ISO/IEC 9126-1 zur Bewertung der Qualität von Web-Anwendungen*

Characteristics - Product

- The “building blocks” of a Web application
  - Content
  - Hypertext
  - Presentation
- Content
  - Document-centric character and multimedia (# of dimensions?)
    - Presentation in the form of tables, text, graphics, animations, video, audio
    - Communication of contents
    - Didactiv presentation of contents
    - Usability challenge!
  - Quality demands
    - Up-to-dateness, consistency, reliability, volume
    - Price or availability of products
    - Critical factor for acceptance!



Characteristics - Product

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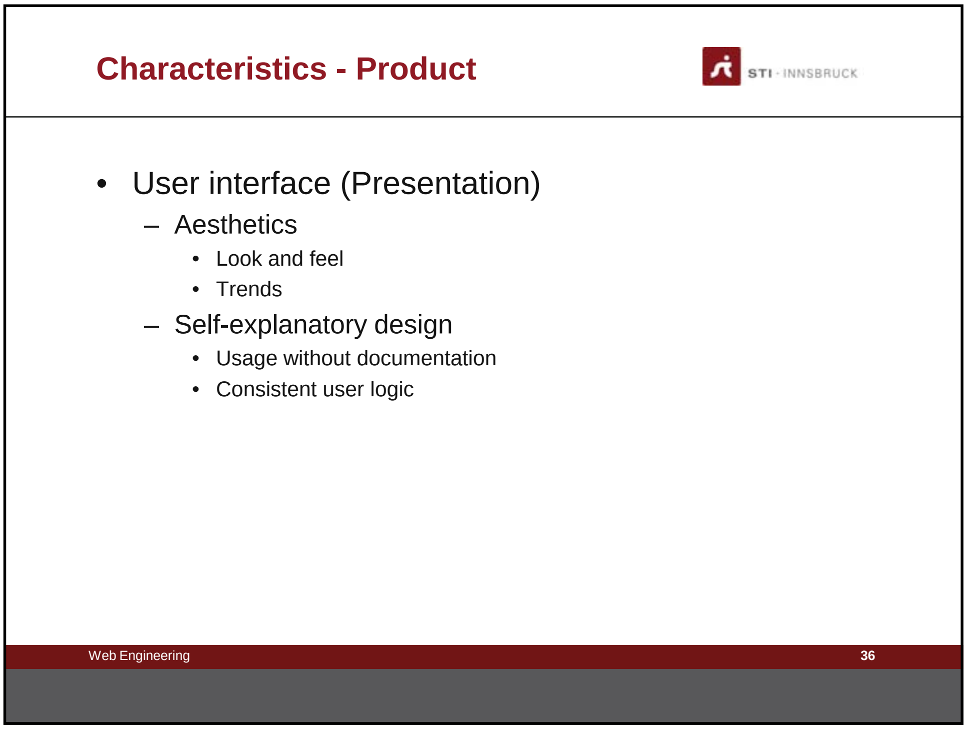
- Navigation Structure (Hypertext)
  - Non-linearity
    - Difference to traditional software: possibility of systematic reading (e.g. Guided tour)
    - Moving in information space depending on various factors, such as interests.
    - Challenge for authors!
  - Disorientation and cognitive overload
    - Disorientation: Loss of sense of direction and location in a non-linear document
    - Cognitive overload: Higher effort and concentration to maintain overview of various pathes



Characteristics - Product

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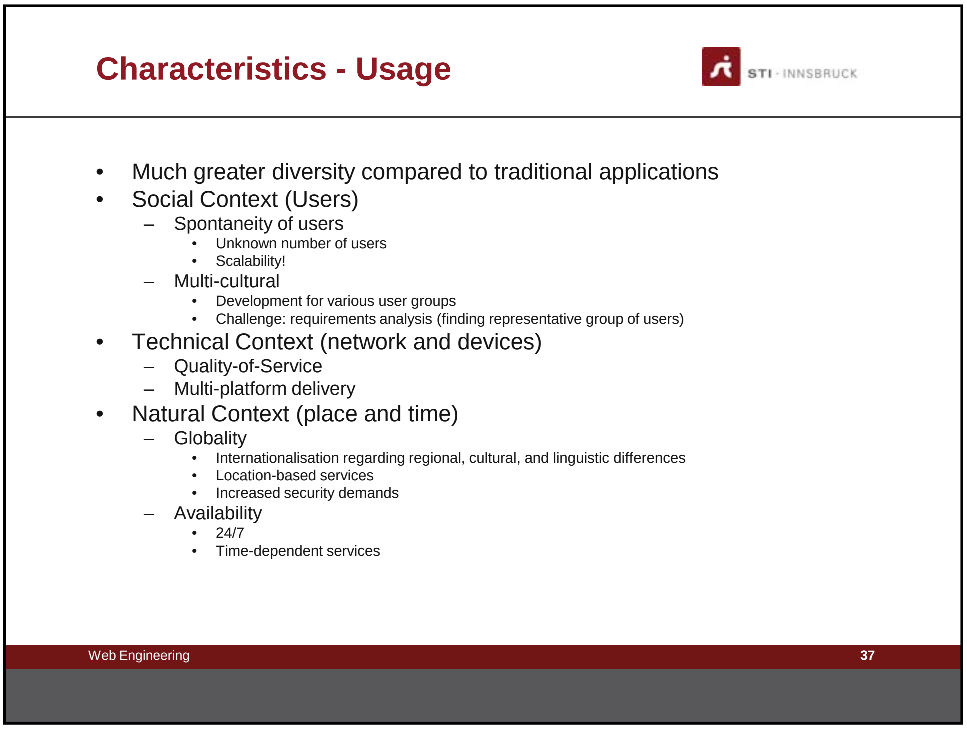
- User interface (Presentation)
  - Aesthetics
    - Look and feel
    - Trends
  - Self-explanatory design
    - Usage without documentation
    - Consistent user logic



Characteristics - Usage

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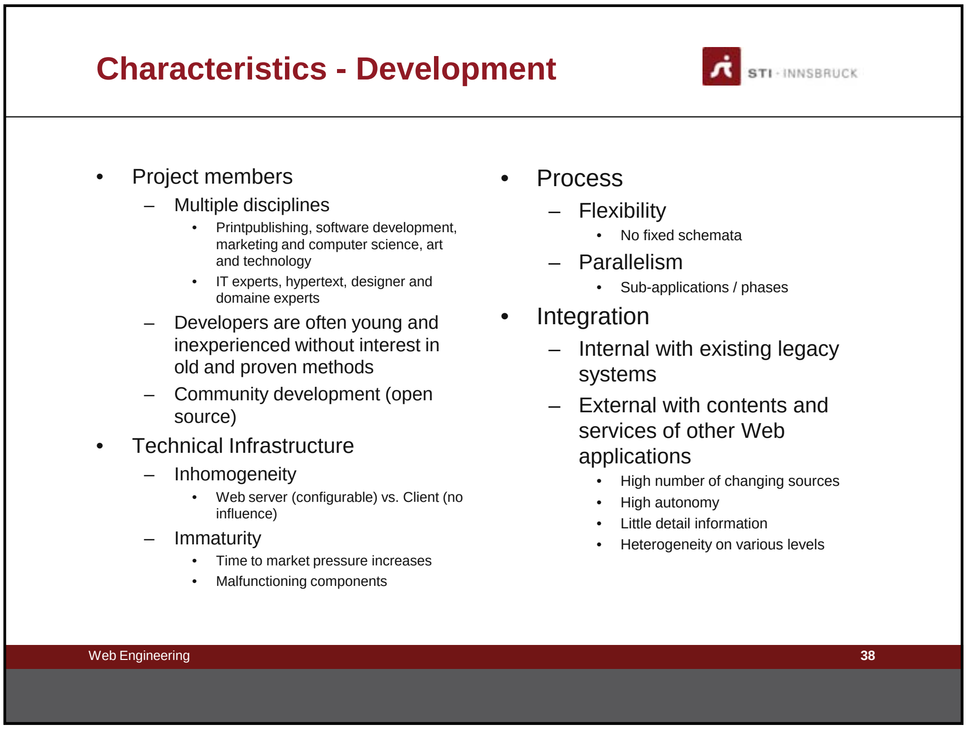
- Much greater diversity compared to traditional applications
- Social Context (Users)
  - – Spontaneity of users
    - Unknown number of users
    - Scalability!
  - – Multi-cultural
    - Development for various user groups
    - Challenge: requirements analysis (finding representative group of users)
- Technical Context (network and devices)
  - – Quality-of-Service
  - – Multi-platform delivery
- Natural Context (place and time)
  - – Globality
    - Internationalisation regarding regional, cultural, and linguistic differences
    - Location-based services
    - Increased security demands
  - – Availability
    - 24/7
    - Time-dependent services



Characteristics - Development

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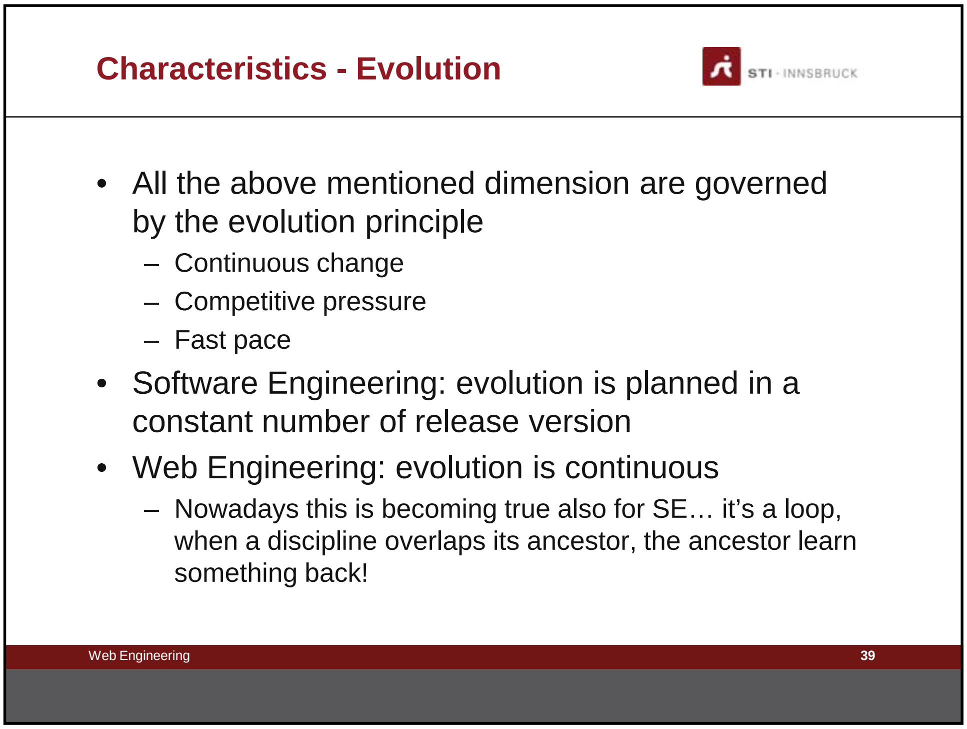
- Project members
  - – Multiple disciplines
    - Printpublishing, software development, marketing and computer science, art and technology
    - IT experts, hypertext, designer and domaine experts
  - – Developers are often young and inexperienced without interest in old and proven methods
  - – Community development (open source)
- Technical Infrastructure
  - – Inhomogeneity
    - Web server (configurable) vs. Client (no influence)
  - – Immaturity
    - Time to market pressure increases
    - Malfunctioning components
- Process
  - – Flexibility
    - No fixed schemata
  - – Parallelism
    - Sub-applications / phases
- Integration
  - – Internal with existing legacy systems
  - – External with contents and services of other Web applications
    - High number of changing sources
    - High autonomy
    - Little detail information
    - Heterogeneity on various levels



Characteristics - Evolution

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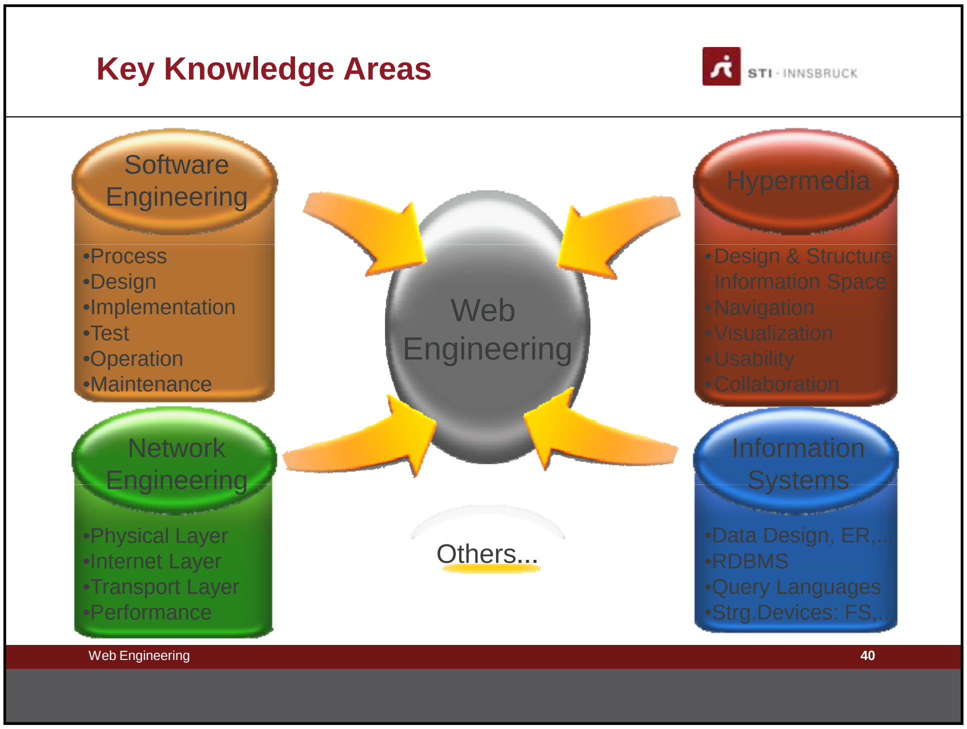
- All the above mentioned dimension are governed by the evolution principle
  - Continuous change
  - Competitive pressure
  - Fast pace
- Software Engineering: evolution is planned in a constant number of release version
- Web Engineering: evolution is continuous
  - Nowadays this is becoming true also for SE… it's a loop, when a discipline overlaps its ancestor, the ancestor learn something back!



Key Knowledge Areas

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

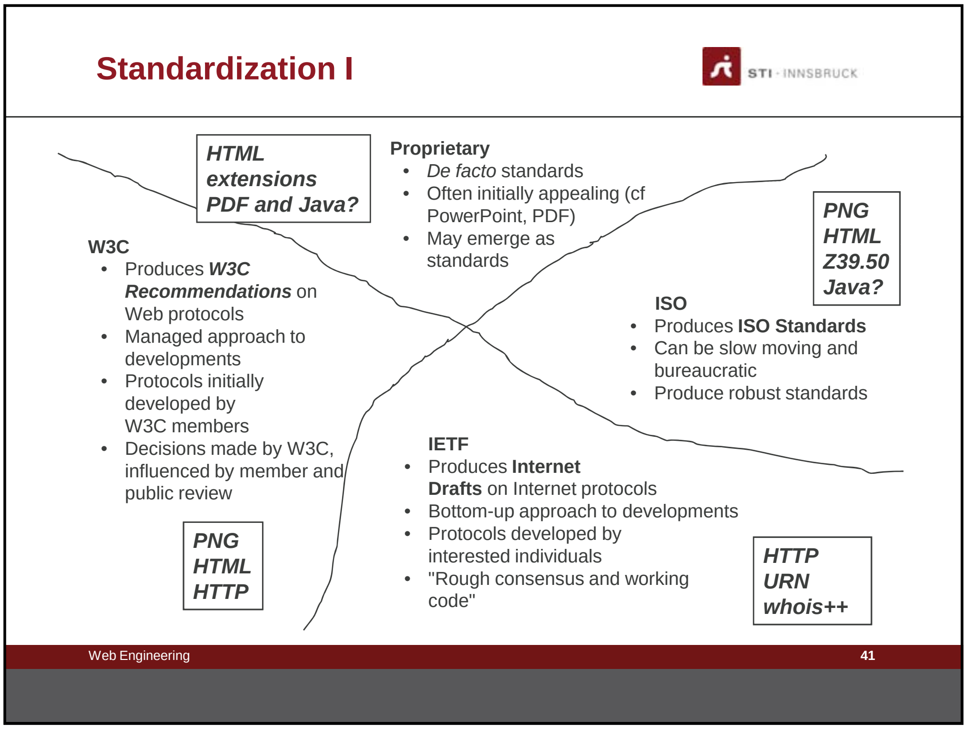
Hypermedia
- •Design & Structure Information Space
- •Navigation
- •Visualization
- •Usability
- •Collaboration

Web Engineering

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

Others...

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



Standardization I

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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

PNG HTML HTTP

HTML extensions PDF and Java?

Proprietary

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

ISO

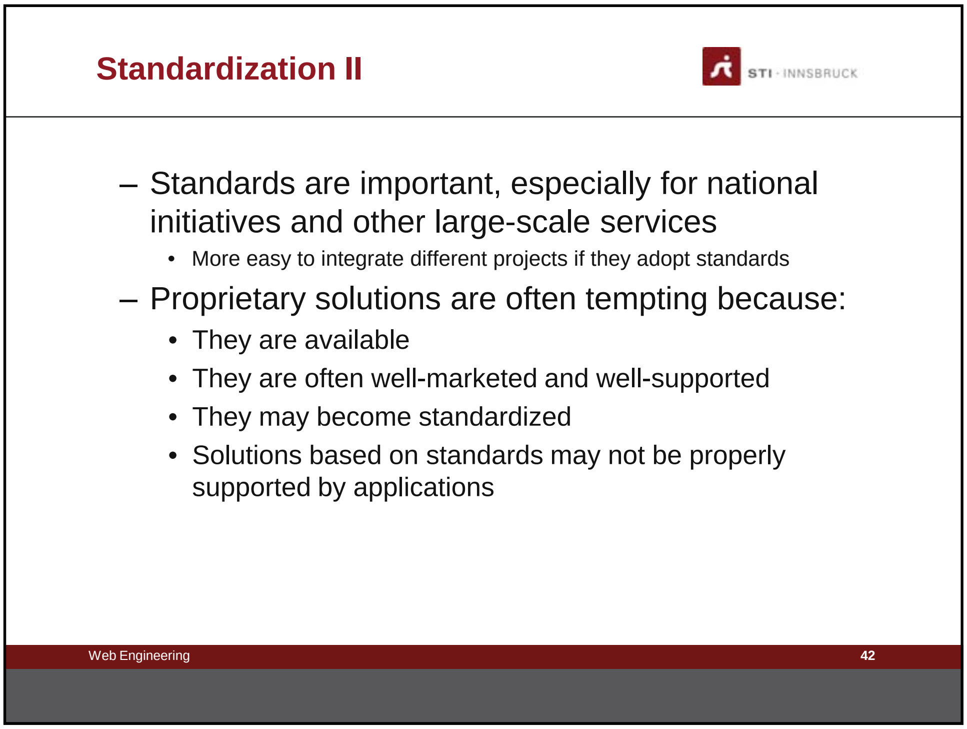
- Produces **ISO Standards**
- Can be slow moving and bureaucratic
- Produce robust standards

PNG HTML Z39.50 Java?

IETF

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

HTTP URN whois++



Standardization II

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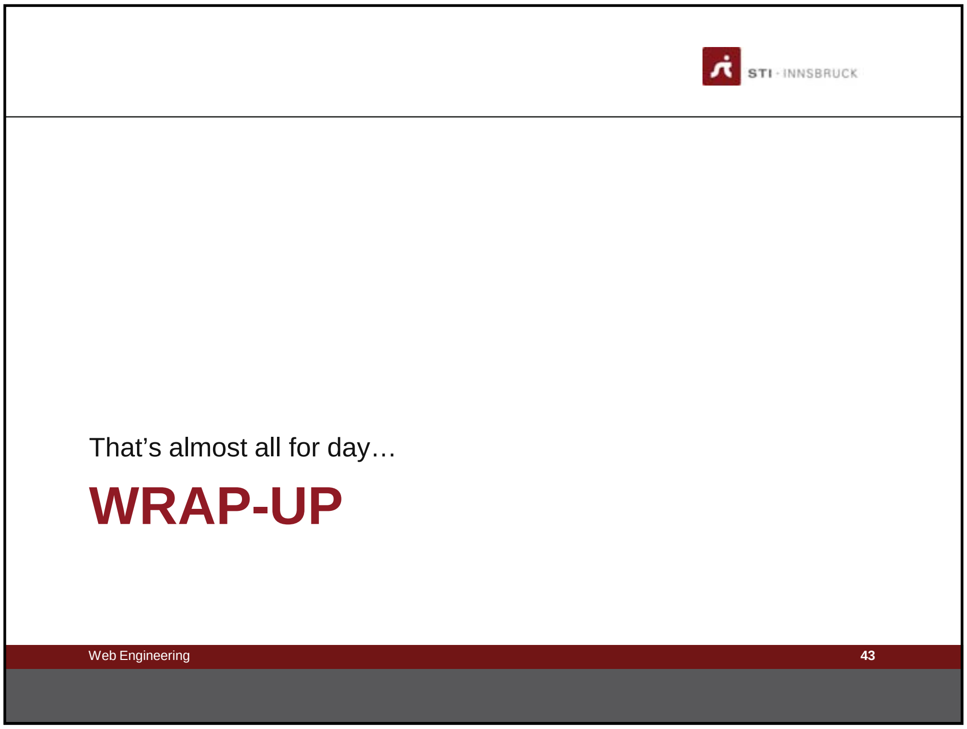
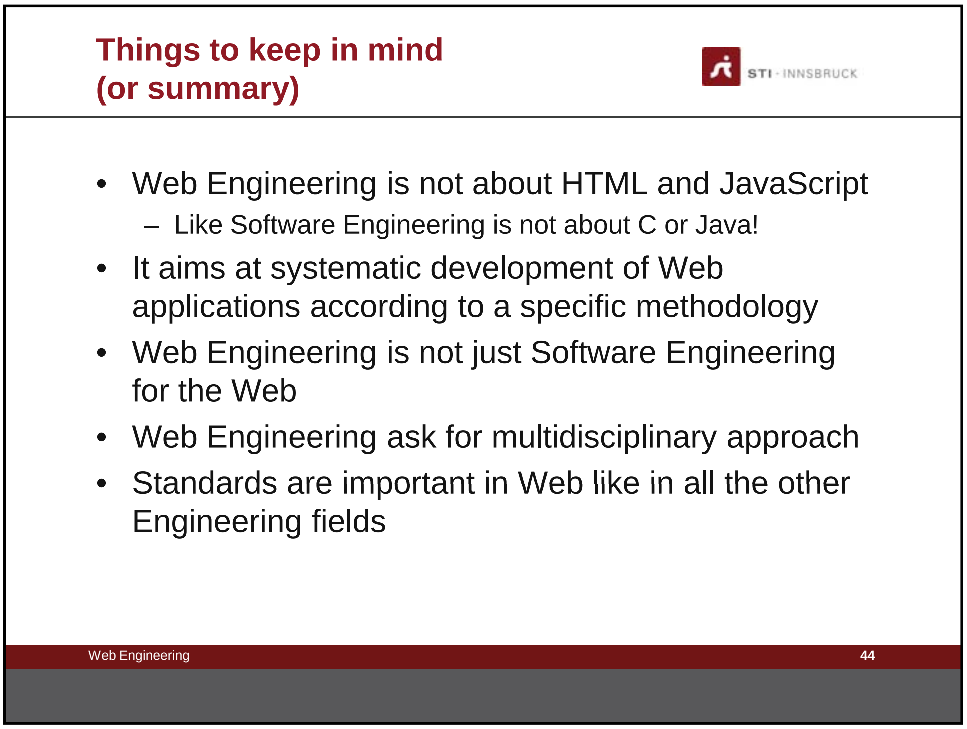
- Standards are important, especially for national initiatives and other large-scale services
  - More easy to integrate different projects if they adopt standards
- Proprietary solutions are often tempting because:
  - They are available
  - They are often well-marketed and well-supported
  - They may become standardized
  - Solutions based on standards may not be properly supported by applications



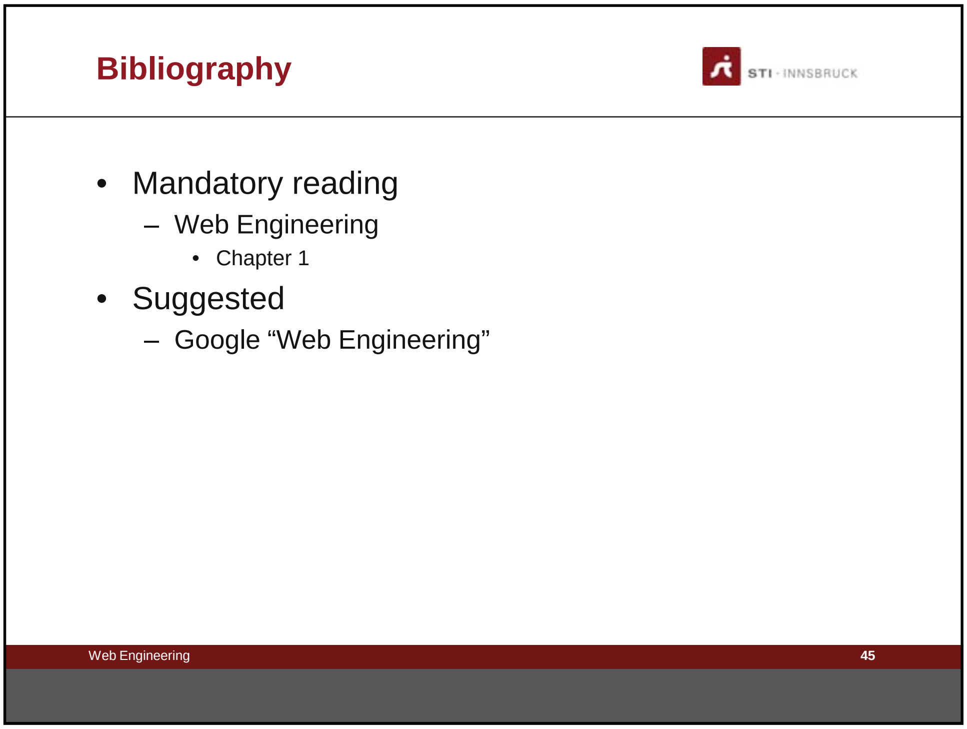
That’s almost all for day…

WRAP-UP



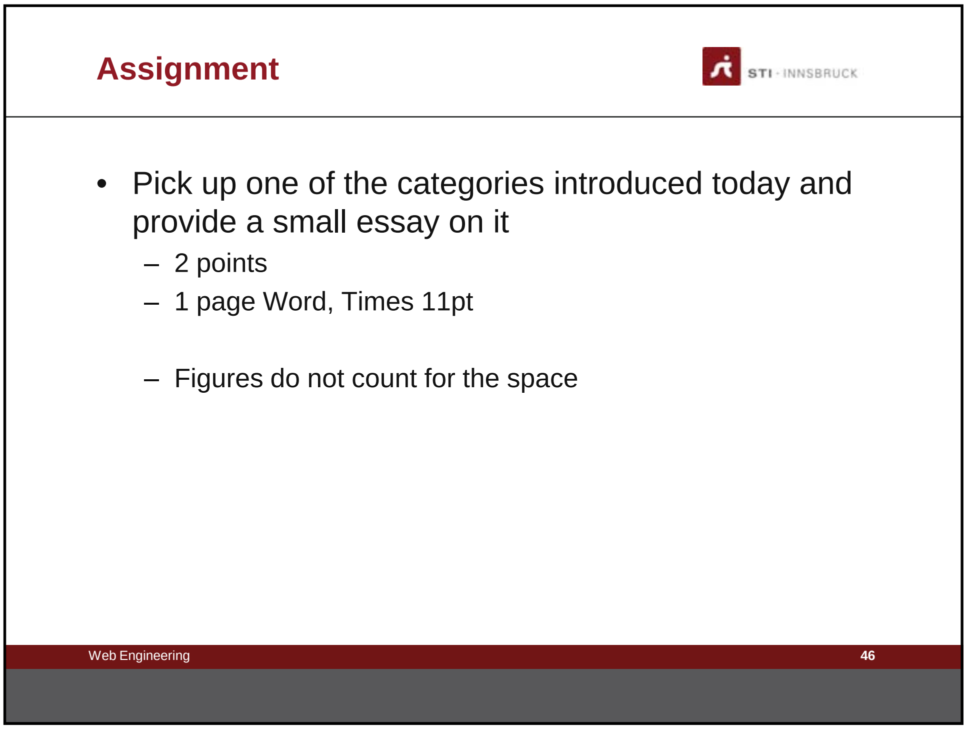
Things to keep in mind (or summary)

- 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 ask for multidisciplinary approach
- Standards are important in Web like in all the other Engineering fields



Bibliography

- Mandatory reading
  - Web Engineering
    - Chapter 1
- Suggested
  - Google “Web Engineering”



Assignment

- Pick up one of the categories introduced today and provide a small essay on it
  - 2 points
  - 1 page Word, Times 11pt
  - Figures do not count for the space

Questions?