



Web Engineering

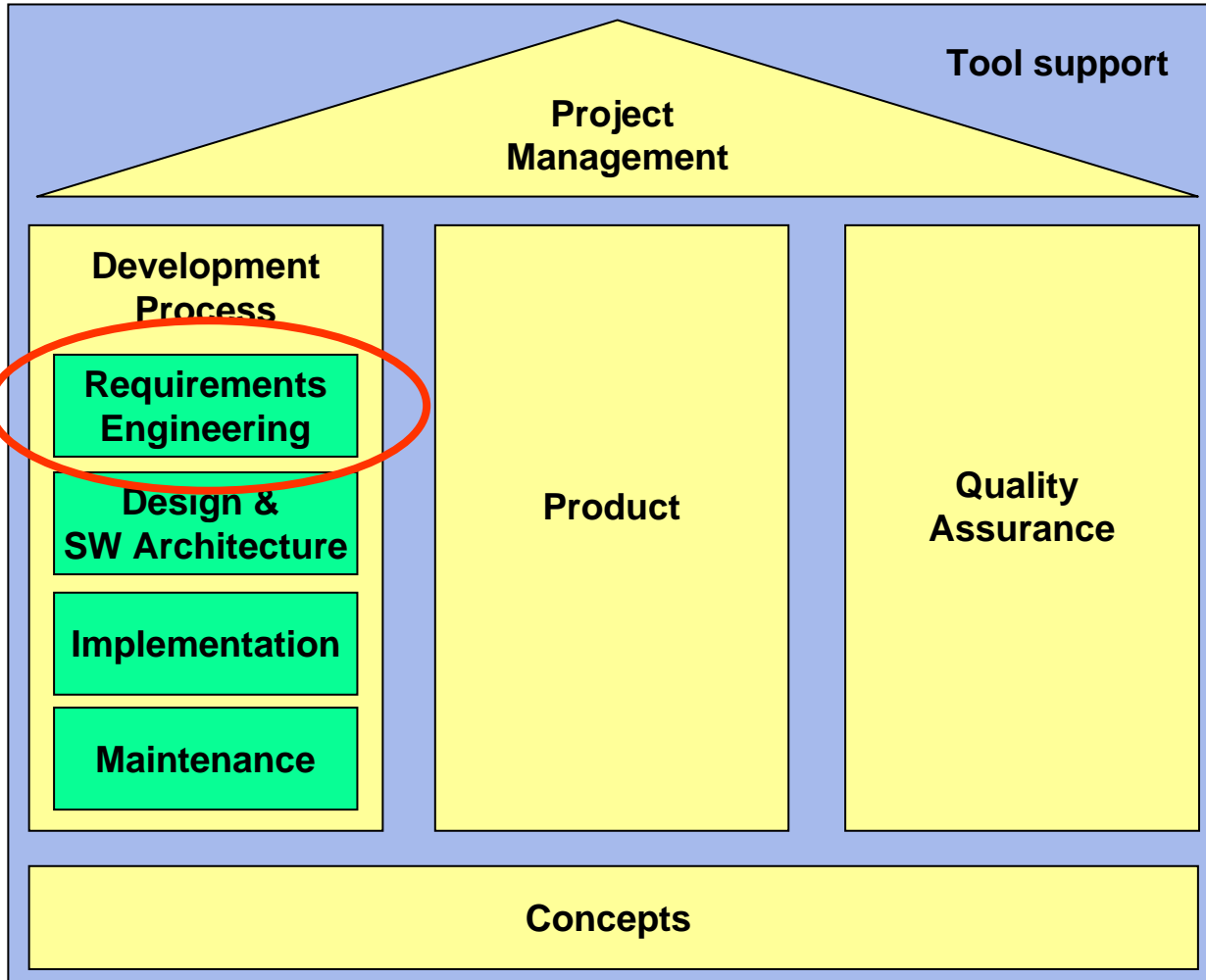
Requirements Analysis

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SS 07 (2) – 23.04.07

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(Web) software development implies also much effort in other activities rather than implementation

Requirements Engineering: Definition

- Requirements engineering (RE) is concerned with identifying the **purpose** of a software system, and the **contexts** in which it will be used.
- RE is a systematic approach
- RE acts as a bridge between
 - the real world needs of **users** and **customers**, and
 - the **stakeholders** involved in the development of the software system, and
 - capabilities and opportunities offered by software **technologies**

Contents Lecture 2

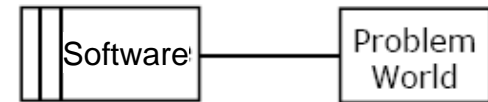
- Problem world and solution world
- Specifics of RE for Web systems
- RE process
- Techniques for RE
- Methods: NDT and UWE

Risk Factor: Requirements Analysis

- Risk that requirements are
 - unclearly specified
 - incorrect
 - incomplete
 - instable
 - containing bugs
- Consequences of poor requirements analysis
 - erroneous planning of budget and time
 - inadequate resources
 - low acceptance by users
- Industry has many problems due to
 - balance **technologies** and **business application** aspects
- Requirements role in the development of Web software is underestimated
 - customer satisfaction
 - quality of the Web application

*»Requirement definitions
are the prime sources
of project failures «
(Glass' law)*

- Provides solution to a **problem** of the real world, e.g.
 - to obtain tourist information
 - to perform bank transactions
 - to be assisted when travelling (booking flights, hotel reservation, maps & navigation)
- Requires existence of set of technologies enabling **solutions**, e.g.
 - HTML-forms allows for search mechanisms
 - Secure transfer makes online banking possible
 - AJAX technology allows for Google maps



- Characteristics
 - distinction between **problem world** and **solution world**
 - Web domain **driven by technologies**
- Separation of **business application** and **technologies** used to implement it
 - **new business ideas** require innovative technological support
 - **new technologies** allow for new type of business applications

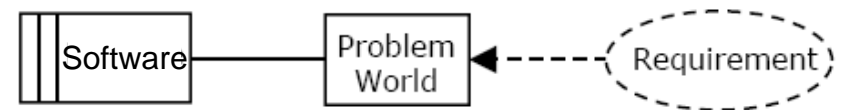
Problem World vs. Solution World

- Problems have
 - a real world
 - account, bank card (#), account owner, transactions
 - behaviour
 - money transfer, pin & tan check,
 - restrictions
 - transfer amount less or equal current money status of account + credit amount

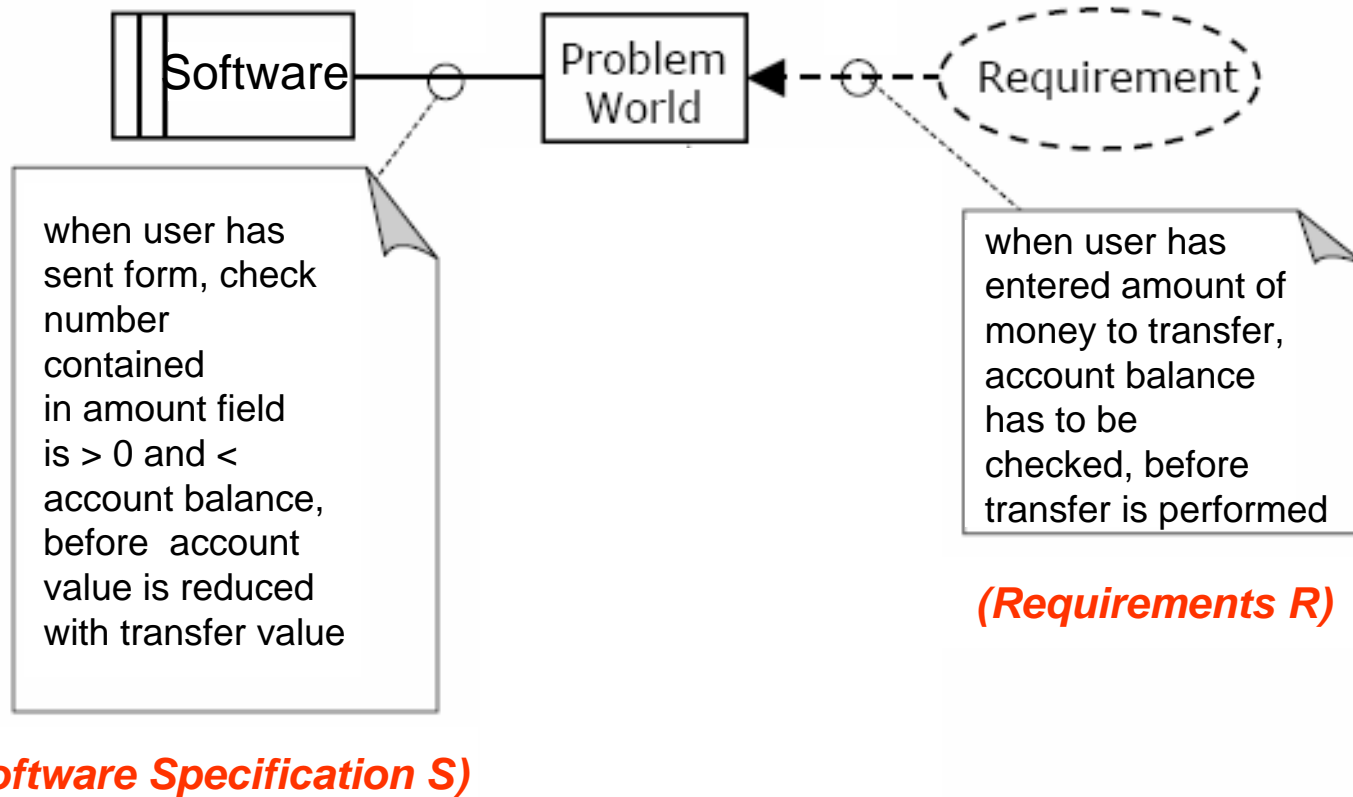


- Identification of customer's requirements
 - mainly conditions on the problem world not on the solution world!!
 - pin & tan has to be checked
 - account status has to be checked

- Developing a software for the problem means
 - identification of sub-problems
 - finding solutions for sub-problems
 - composition of these solutions



Requirements Specification vs. Software Specification



Differences for RE for the Web

- User Domain
 - user divorced from development
 - no traditional entry or exit point
 - technology more visible to the user
 - high reliance on user interface
 - non-functional requirements primacy
 - volatility in user requirements
- Developer Domain
 - multidisciplinary teams
 - aesthetic and cognitive differences
 - developer inexperience
 - uncertainty
 - rapidly changing technology
 - lack of useful methods
- Environment
 - tight linkage between business architecture and the technical design
 - impact of legacy systems
 - aggressive release demands
 - immaturity of Web development techniques
 - development changes the business model
 - highly competitive, market environment
 - fine grained evolution and maintenance

S. Jeary & K. Phalp 2004

Types of Requirements

■ Functional

- content
- hypertext structure
- user interface
- adaptivity/ubiquity
- mobility

■ Non-functional

- availability
- performance
- security of transactions
- reliability
- usability
 - understandability
 - learnability
- changeability
- portability
- ethic issues

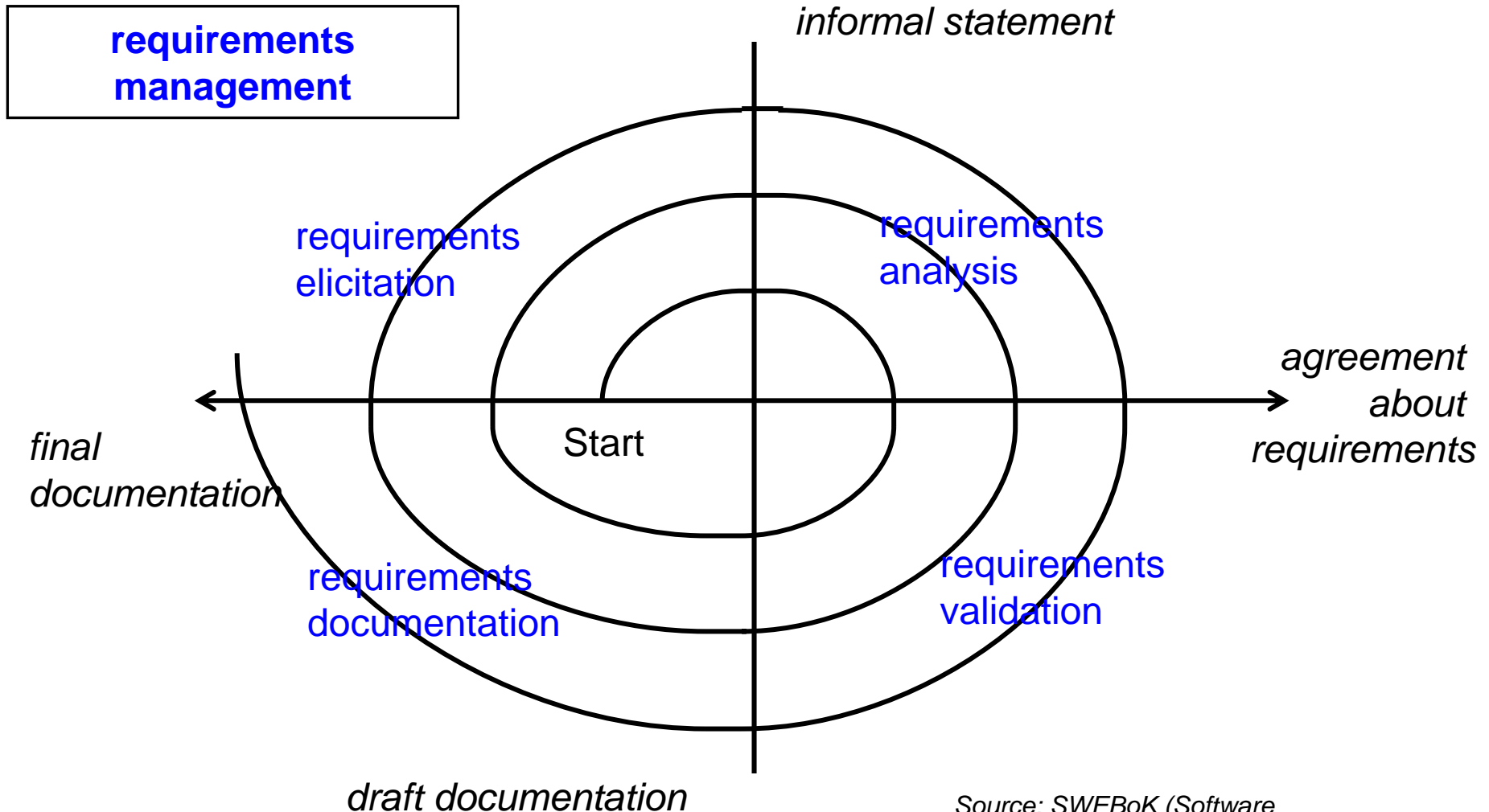
Functional Requirements

- Content
 - money transfer for different type of accounts
 - transfer history
- Hypertext structure
 - take categories of services into account
 - check of account status should be possible from everywhere
 - less than 5 steps to find a service or product
- Business processes
 - confirm selection of product (step 1), payment (step 2), invoice (step 3)
 - select software, select mirror, download
- Layout / Presentation
 - use corporate identity (CI) of the company for colours, fonts and shapes
 - appropriate for visually impaired (“barrier free internet”)

Non-functional Requirements

- Quality
 - Web application has to support 5000 simultaneous enquiries (performance)
 - secure transfer for all customer data
- Usability
 - arbitrary user shall be able to find a service in less than two minutes
 - shopping cart must be available (selectable) all the time
- Project management
 - Web application (solution) must be online on September 15th, 2007
- Technical environment
 - open source software
 - Web services should be implemented using JBoss technologies

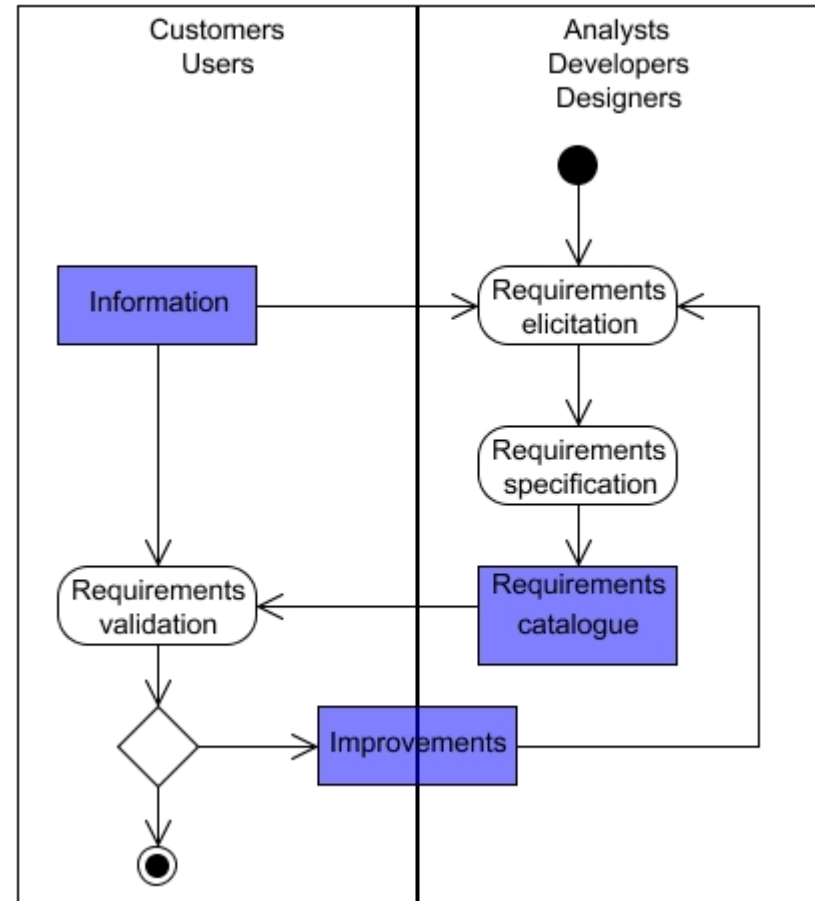
Requirements Engineering Process (1)



Source: SWEBoK (Software Engineering Body of Knowledge), IEEE project

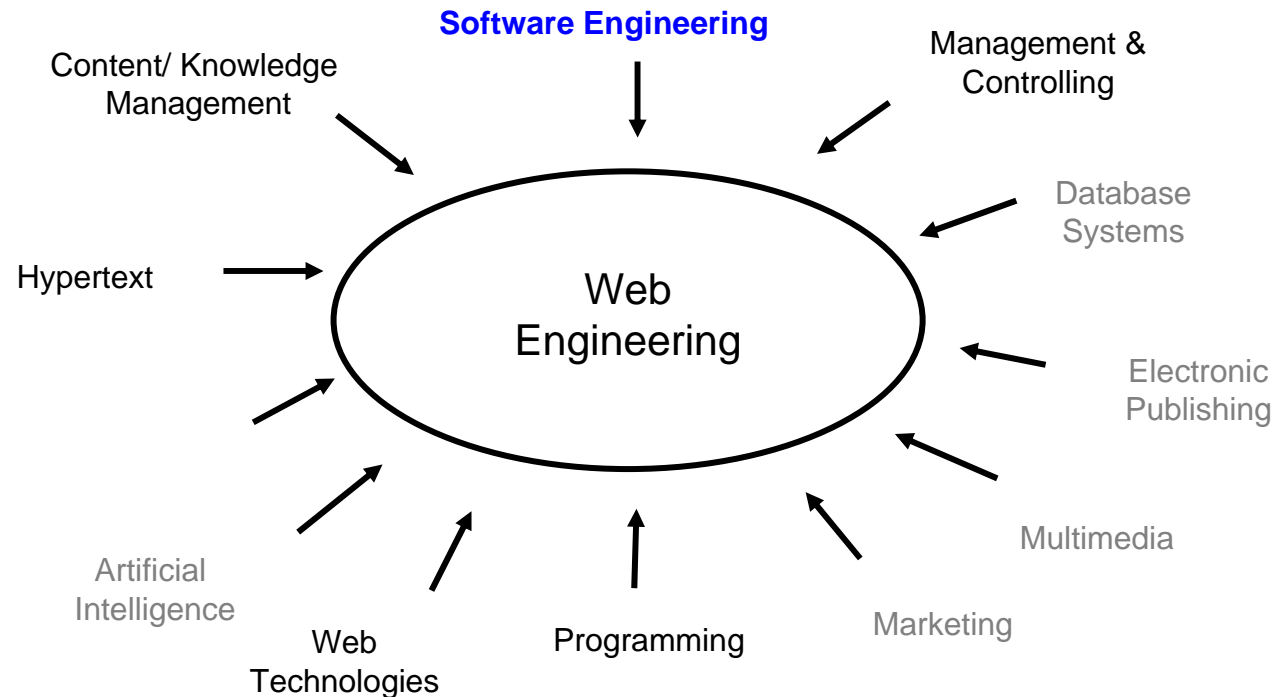
Requirements Engineering Process (2)

- Elicitation – capture
 - identification of functionalities the system has to fulfil
 - identification of non-functional characteristics
- Specification – documentation
 - textual and graphical description of captured requirements
- Validation
 - prove that the specification conforms the users/customers needs



- Most important
 - customer
 - user
 - developer

- More relevant by Web applications
 - content manager
 - marketing experts
 - usability experts
 - graphical designers
 -



Elicitation of Requirements

- Capture or elicitation
 - identification of functionalities the system has to fulfil
 - Web user groups
 - required content
 - navigation needs
 - business processes
 - presentation aspects, styles, corporate identity
 - identification of non-functional characteristics
 - performance, usability
- Techniques
 - interviews
 - questionnaires
 - checklists
 - concept mapping
 - brainstorming
 - sketching
 - storyboarding

Specification of Requirements

- Analysis, specification or documentation
 - description of captured requirements
 - graphical representation of requirements
- Techniques
 - informal description/representation
 - natural language
 - glossaries
 - ontologies
 - scenarios
 - user stories in XP
 - semi-formal
 - templates
 - visual models, e.g. UML use cases
 - formal
 - formal languages, e.g. specification in Z
 - prototypes

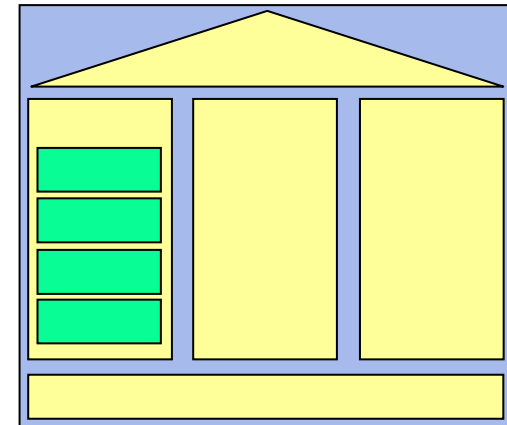
Validation of Requirements

- Validation
 - process with the goal to prove that the specification of the requirements defines the complete system that the user needs
- Techniques
 - reviews
 - walk-throughs or inspections
 - audits
 - traceability matrices
 - prototypes

Requirements Engineering Methods

(same as in Software Engineering)

- Each method comprises
 - tool support
 - development process establishing
 - steps
 - expected results
 - techniques for
 - construction
 - analysis
 - transformations
 - notation
 - syntax of documentation
 - types of diagrams
 - semantics
- Methods are based on
 - basic concepts
- Examples
 - NDT, UWE, OOHDM, W2000, ...



NDT: Navigation Development Techniques

- Method characteristics
 - focus mainly on requirements analysis (not on design)
 - lack of graphical representation
 - requires specific tool support: NDT-Tool
- Method specification
 - MOF Metamodel for each requirements type
- Pros
 - appropriated technique for customer-developer communication
- Cons
 - maintenance problems
- Extension
 - transformation to and from UML graphical notation (use cases and activity diagrams)

FR-01	Login	
Description		
Actors		
Normal sequence	Step	Action
	1	
	2	
	3	
	4	
	5	
Exceptions	Step	Action
	4a	
	5a	

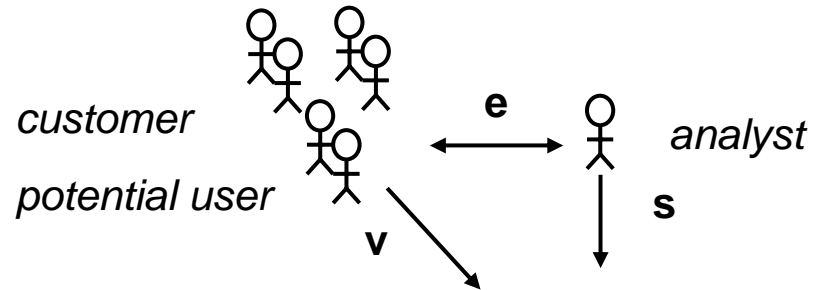
**NDT: M. J. Escalona
University of Sevilla, Spain, 2004*

Simple Music Portal Example

- inspired by www.mp3.com
- offers albums for downloading
- contains information about singer, composer, and publisher
- this information is available for free
- registered users can search albums and download them
- for downloading they need to have enough credit on their prepaid account
- accounts are rechargeable

NDT: Process, Techniques and Results

- Elicitation
 - mainly interviews
 - other techniques possible
- Specification
 - templates
 - cross references
 - use cases derived from templates
- Validation
 - review
 - traceability matrices



IR-02	Song request
Description	Application provides information to a song and download possibility
Actors	AC-01: User AC-02: Registered User
Entry parameters	The user indicates name or part of song name
Associated functionality	FR-01: Search by song name or song author
Information shown	SR-01 Album SR-02 Song SR-03 Author
Exit	IR-04
Entry	IR-01

NDT: Template-Based Specification

- Different types of templates for
 - actor requirements (user groups)
 - storage information requirements (content)
 - functional requirements
 - interaction requirements
 - visualization prototype (page layout)
 - non-functional requirements
 - traceability matrix

- Example
 - functional requirement (FR-01)
 - describes login process

FR-01		Login	
Description	Authentication to allow access to the checkout process		
Actors	Use case actor AC-01 Web User		
Normal sequence	Step	Action	
	1	System asks for userID and password	
	2	Input of UserID and password	
	3	Check of both	
	4	Storage of UserID and password	
	5	Access to checkout allowed	
Exceptions	Step	Action	
	4a	The user is not registered; the user executes FR-02	
	4b	UserID or password not valid, continue with step 2	

PROYECTO: PRO-00-Proyecto de difusión del patrimonio mueble

Proyectos Requisitos Diagrama conceptual Modelo Navegacional Modelo Interfaz Abstracta

Prototipos de visualización

Volver

Código	Nombre descriptivo
PV-01	Datos de identificación y localización del bien
PV-02	Datos de descripción del bien
PV-03	Datos de análisis del bien
PV-04	Datos del estado de protección del bien
PV-05	Datos del estado de conservación
PV-06	Datos de las intervenciones que se realizan sobre las piezas
PV-07	Datos de los museos

Datos del prototipo

código: nombre descriptivo:

PV-01 Datos de identificación y localización del bien

descripción:

El sistema deberá permitir la visualización de los datos concretos que se muestran a continuación y la navegación expresada y que representan los

precondición:

Tras ejecutar una de las frases anteriores se elegirá un bien mueble que será para el que se muestren los datos de identificación.

comentarios:

Nuevo

Recoger cambios

Eliminar

Datos básicos

Actores

Frases

Funcionalidad asociada

Información visualizada

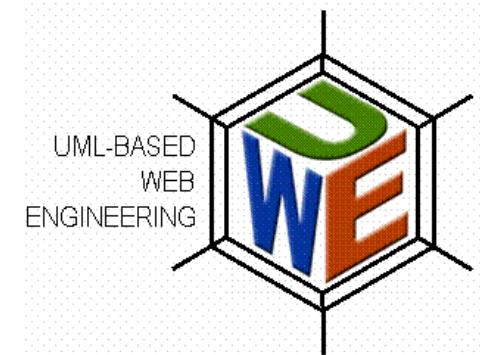
Prototipos relacionados

Autores

Fuentes

Avanzadas

- Method characteristics
 - semi-formal graphical specification
 - uses extension mechanisms provided by the UML stereotypes
 - e.g. «navigation» use case
 - OCL constraints
 - open source case tool support (ArgoUWE)
- Method specification
 - MOF Metamodel
- Advantage
 - use of OMG standards (UML, MOF, OCL, ...)
- Basis for Design
 - transformations to design model



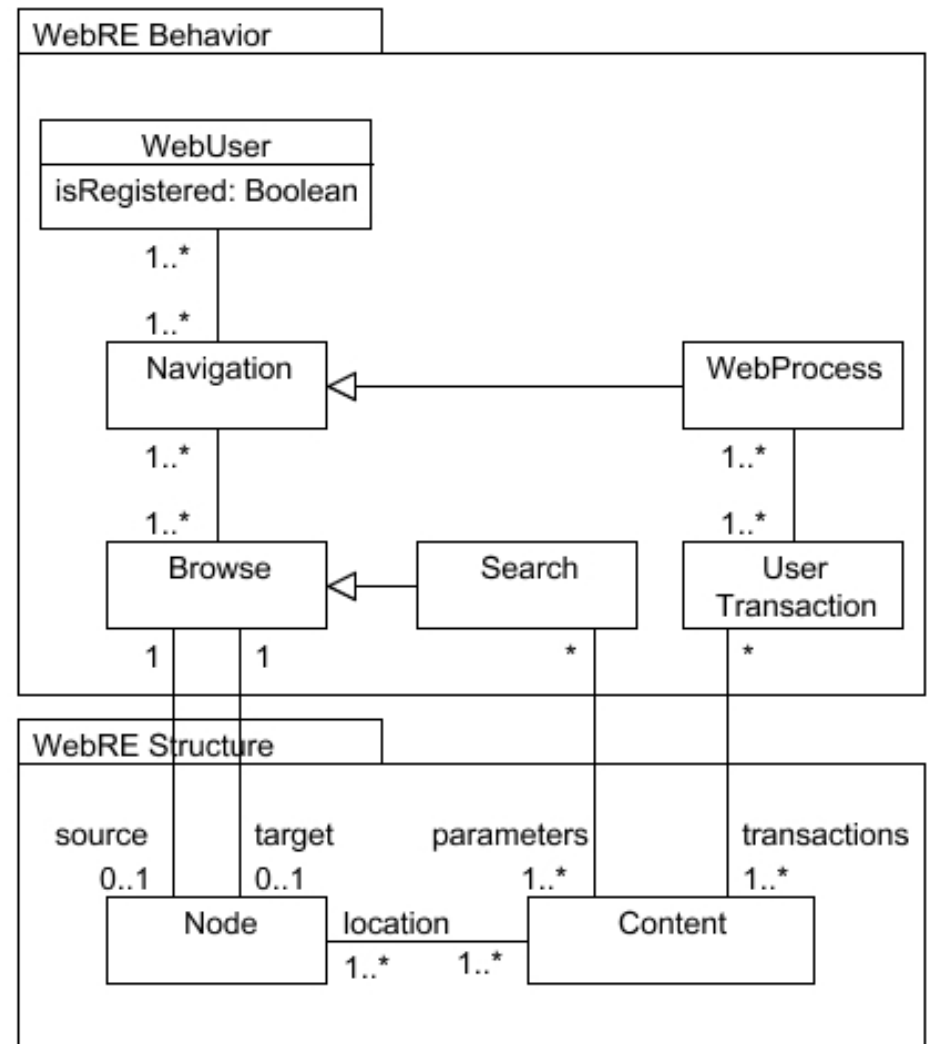
*UWE: Koch, Knapp, Zhang,
Baumeister, 2007*

- Structural elements
 - **Web users**: actors
 - **content**: information provided by the Web system
 - **node**: requirements on application structure
 - **Web user interface**: presentation relevant aspects
- Behavioral elements
 - **navigation** functionality and business **processes** on the Web
 - **browse** and **search** activities
 - **user transactions**, e.g. credit card payment

- Grouping elements in packages
- Define relationships among elements
 - inheritance (e.g. search defined as an extended browse)
 - associations (e.g. a browse requires a source and a target node)
- Define invariants (OCL constraints)

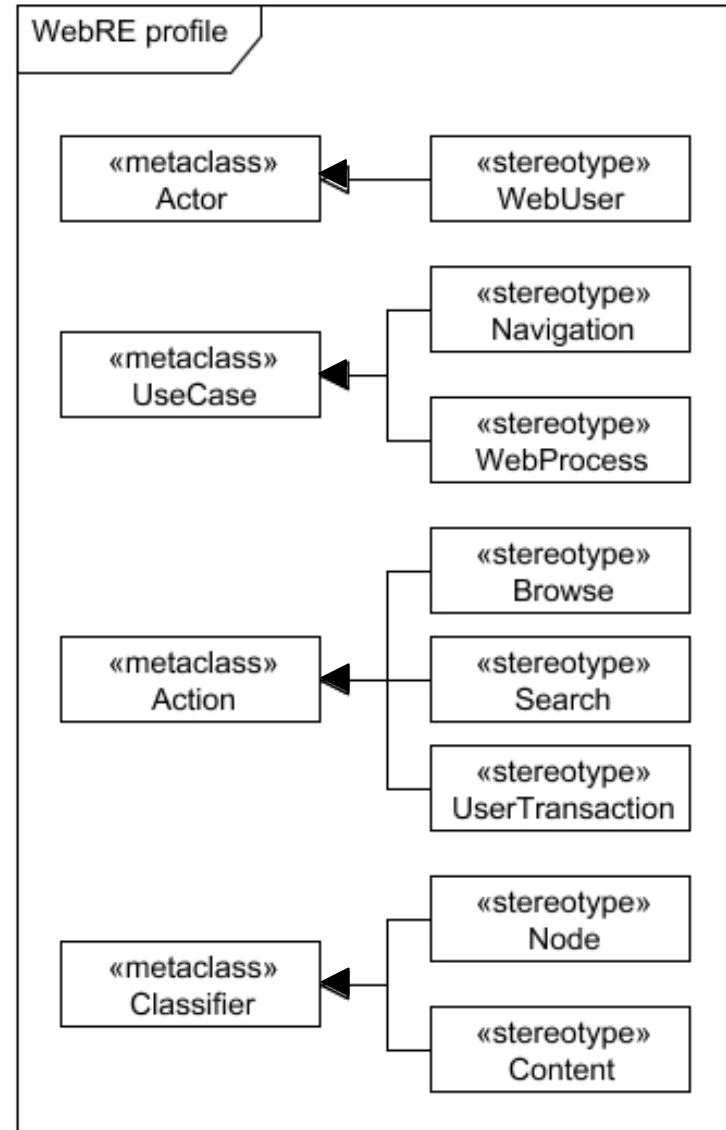
```

context Search
inv: self.parameters -> forAll
    (p | p.location ->
        includes
        (self.source))
    
```



UWE: Definition of an UML Profile

- UML stereotype for each Web requirements concept
- Extends relationship
- UML metaclass
- Advantages
 - no need to specify complete semantic of new modeling elements
 - use of all UML CASE-Tools



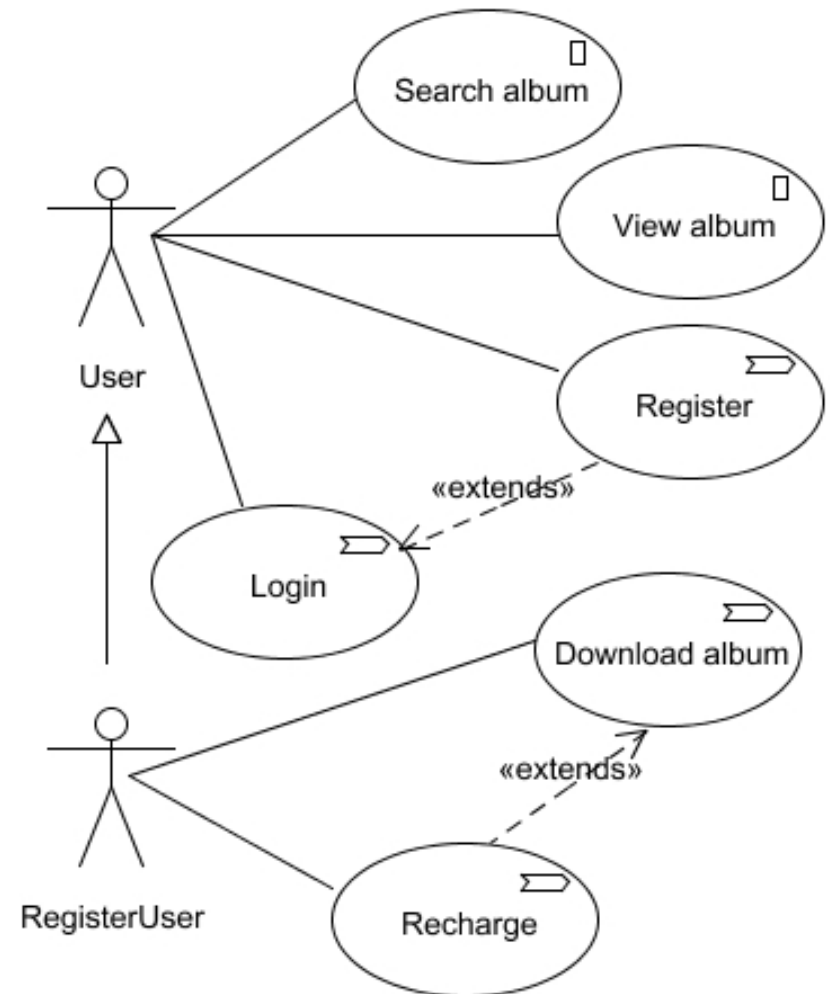
- Elicitation
 - interviews
 - brainstorming
 - ...
- Specification
 - UML use case diagrams
 - UML activity diagrams
 - invariants in OCL (Object Constraints Language)
- Validation
 - review
 - ...

UWE: Notation for Use Case Model Elements

- UML use case diagram
 - distinguished between process and navigation use cases
- Visual representation of Web modeling constructs
 - navigation

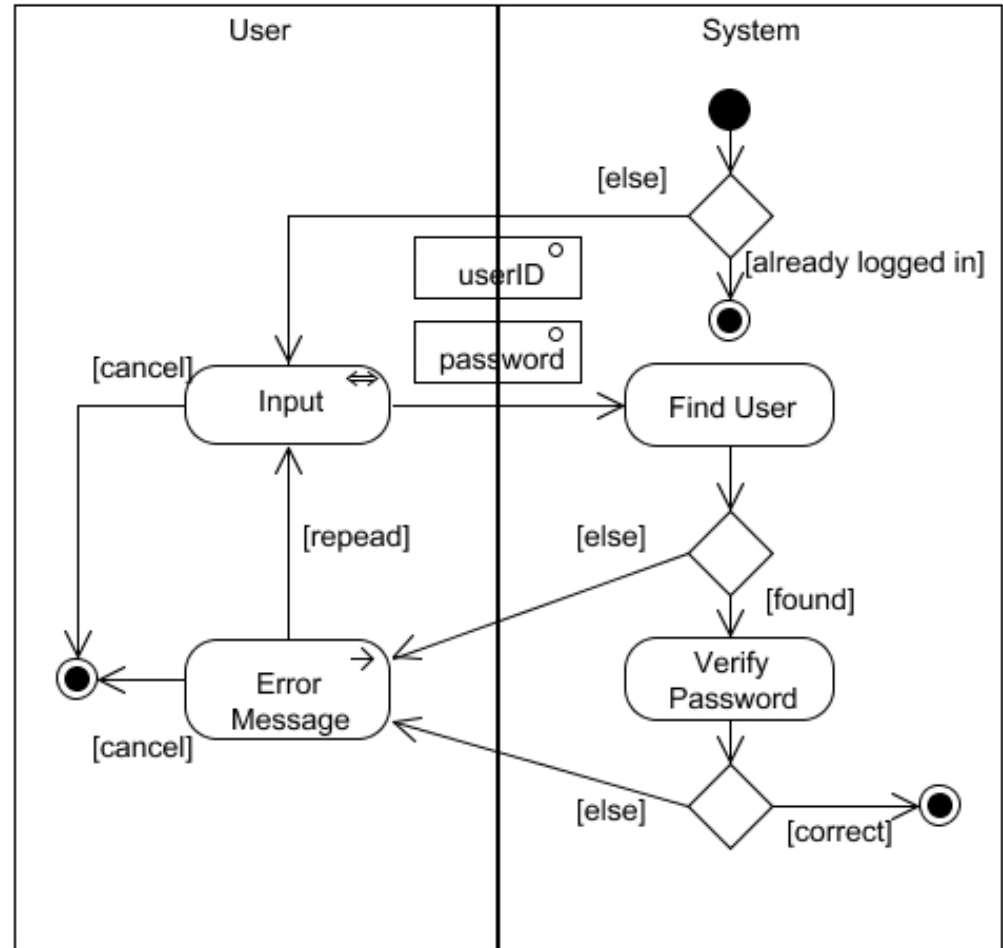


- «process»

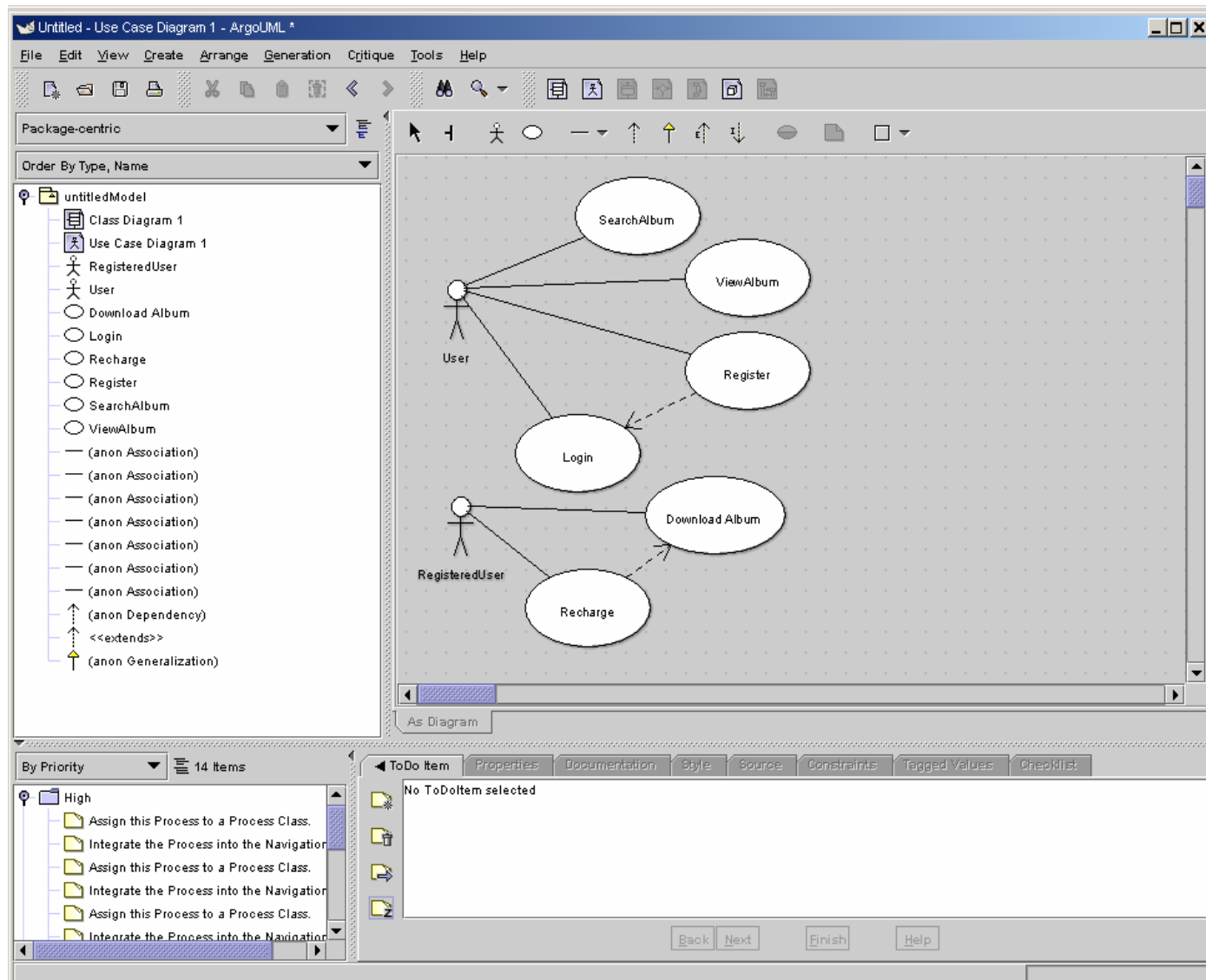


UWE: Notation for Activity Diagram Elements

RE Element	UML Metaclass	Icon
Browse	Activity	⇒
Search	Activity	?
User Transaction	Activity	↔
Content	Class	○
Node	Class	□
Web User Interface	Class	□ □



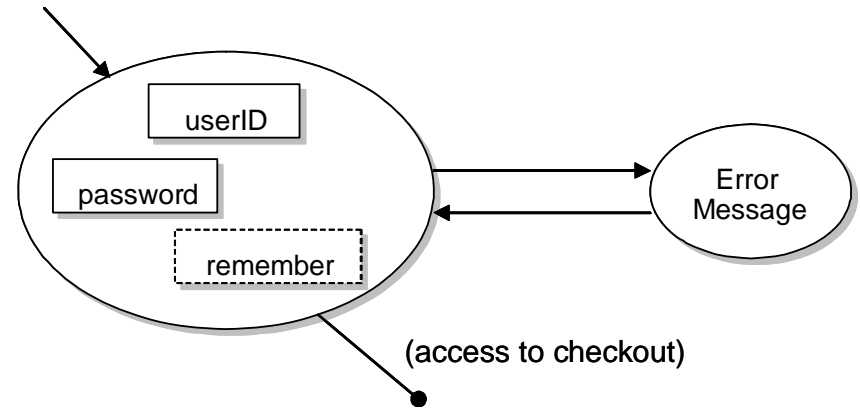
Tool Support: ArgoUWE



Other Modeling Approaches

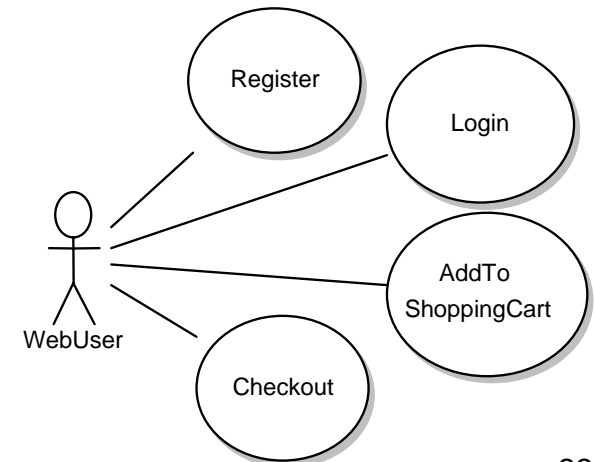
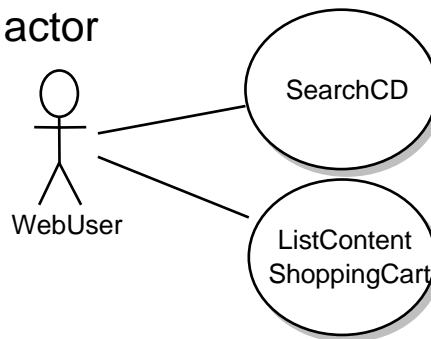
■ Object-Oriented Hypermedia Design Method (OOHDM)

- use cases model (standard UML)
- user interaction diagram (UID)
 - entry and exit points to UIDs
 - user input data
 - communication to other UIDs
- proprietary notation for UIDs visual representation



■ W2000

- use case diagrams
 - browsing activities
 - functional requirements
- separate models for each actor



Requirements Engineering: Summary

- Problem world and solution world
 - identification from the user (customer) point of view
- Specifics of RE for Web systems
 - relevance of user interface, rapidly changing technology, ...
- RE process
 - elicitation, analysis, validation
- Techniques for RE
 - template-based specification
 - visual representation of models
- Methods
 - NDT: Navigation Development Technique
 - UWE: UML-based Web Engineering

- Software Engineering: A Practitioner's Approach.
R. Pressman, McGraw-Hill, 6th edition (2005)

- Practical Software Engineering.
L. Maciaszek, B. Lee Liang, Addison Wesley (2005)

- Web Engineering: Systematic Development of Web Applications.
Gerti Kappel, Birgid Pröll, Siegfried Reich, Werner Retschitzegger (eds.)
dpunkt-verlag (German version), 2003
John Wiley & Sons (English version), 2006

- Web Engineering: Modelling and Implementing Web Applications.
G. Rossi, O. Pastor, D. Schwabe, L.Olsina (eds.), Springer (2007)

- Metamodelling the Requirements of Web Systems.
N. Koch, M.J. Escalona, Proc. 2nd International Conference on Web Information Systems and Technologies (WebIST'06), Setubal, Portugal, pages 310-317. INSTICC, 2006
www.pst.ifi.lmu.de/~kochn/escalona-koch-webist06.pdf