Introduction to E-Learning Technologies

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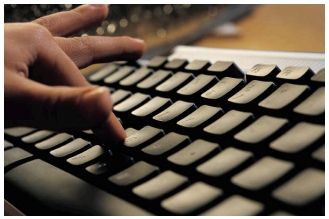
Technische Universiteit
Eindhoven
University of Technology

Where innovation starts

Presentation Outline

- ***What is*** **&** ***Why*** **E-learning?**



- **E-learning technologies: where?**

Worldwide

In NL

@ TU/e

@ Information Systems Section

of Mathematics & Computer Science Dpt. @ TU/e

TU/e Technische Universiteit Eindhoven University of Technology

About Me

Russia, Saint-Petersburg State Electro-Technical University, 1999

- **Engineer diploma**
  Development of the distance learning server for studying of artificial intelligence

Russia, Saint-Petersburg, 1999-2001

- **Projects**
  - **IDLE (Intelligent Distance Learning Environment)**
  - **Distance Learning Course on Business Planning**

About Me

The Netherlands, TU/e, 2007

- **PhD thesis**
  Incorporating Cognitive/Learning Styles in a General-Purpose Adaptive Hypermedia System

The Netherlands, TU/e, 2001 until now

- **Projects**
  - **AHA! (Adaptive Hypermedia for All)**
  - **GRAPPLE (Generic Responsive Adaptive Personal Learning Environment)**
  - **CHIP (Cultural Heritage Information Personalization)**

What is E-Learning?/ Some History Facts

- *Distance education* dates to at least as early as *1728*, when the Boston Gazette printed an advertisement from *Caleb Phillips*, teacher of the new method of *Short Hand*, that offered

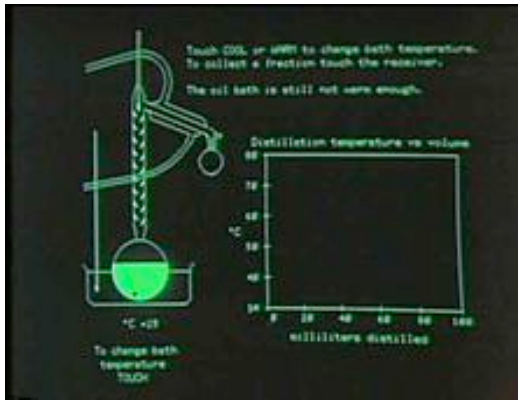
  "… any persons in the country desirous to learn this Art, may, by having the several lessons sent weekly to them, be as perfectly instructed as those that live in Boston."


THE
Boſton-
AND
COUNTRY
Gazette,
JOURNAL
Containing the freſheſt Advices, Foreign and Domeſtic.
Printed by BENJAMIN EDES, in Queen-Street, BOSTON.

What is E-Learning?/ Generations of Distance Education

- **1840s: Stenographic Short Hand by *Isaac Pitman*, through *written & print materials***

- **End of 1960s: Multimedia distance education through *print materials, radio and TV broadcasting, cassettes, computers e.g. PLATO (computer system)***



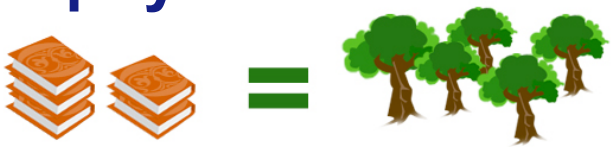
Q: What is missing in these forms of distance education?

What is E-Learning?/ Generations of Distance Education

- **1970s: Computer-mediated communication through *email, teleconferences, growing use of Internet***

Why E-Learning?/ Online Course vs Textbook

- physical



- local
- uniform

Why E-Learning?/ Online Course vs Textbook

- paperless
- global
- possibly adaptive

Popular Tools for E-Learning: Learning Management Systems

WebCT (Course Tools) or Blackboard Learning System, now owned by Blackboard Inc.

Blackboard

moodle

Sakai

Claroline

Dokeos

Universities Worldwide Offering E-Learning

Top universities offering e-learning:

- The Open University, UK
- University of British Columbia, Canada
- Pennsylvania State University, USA
- University of Florida, USA
- Walden University, USA
- to add more ...

Dutch Universities Offering E-Learning

- **Open University**
  http://www.ou.nl

- **Collaboration between**

Universiteit Utrecht

University Medical Center Utrecht

UNIVERSITY OF APPLIED SCIENCES UTRECHT

www.elevatehealth.eu

- **Fontys University of Applied Sciences**
  http://www.fontys.nl

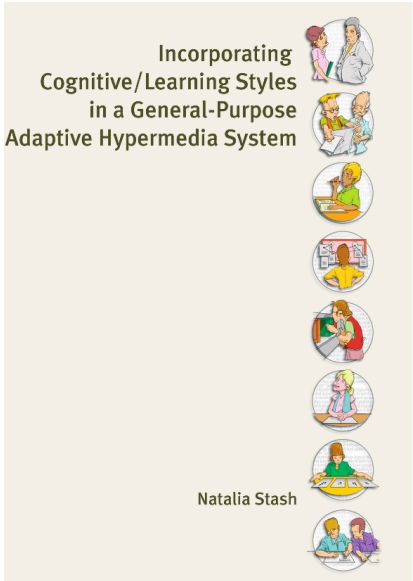
Fontys

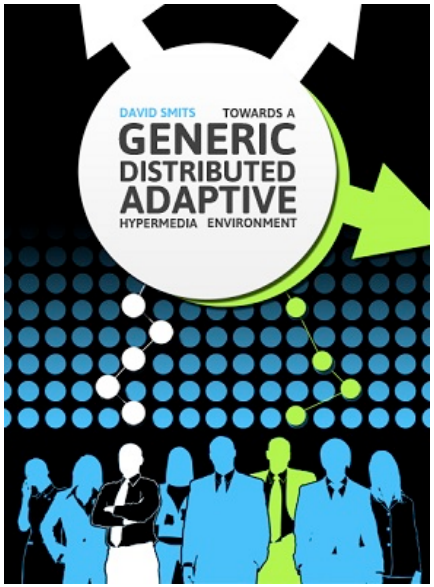
E-Learning @ TU/e

- CoffeeDregs: Visualizing programs
  http://wiki.netbeans.org/CoffeeDregs
- DiagNow - an interactive lecture-response system
- Escom-Method a multimedia guide through a knowledge area
- peach³ - for assignments evaluation
  peach3.nl

E-Learning @ Information Systems Section, Mathematics & CS Dpt., TU/e

- **Specialization in *Adaptive E-learning***
- ***Software for developing adaptive applications:***
  - **AHA! (Adaptive Hypermedia Architecture)**
  - **GALE (Generic Adaptive Learning Environment)**
    The first adaptive online thesis





Adaptive E-Learning & Adaptive Web-Based Applications in General @IS

- IS scope is not limited to e-learning:
  - AHA! and GALE are *general-purpose* tools for various types of adaptive applications
  - CHIP demonstrator - personalized *museum guide* based on *Semantic Web* Technologies

Ideal Adaptive Teaching

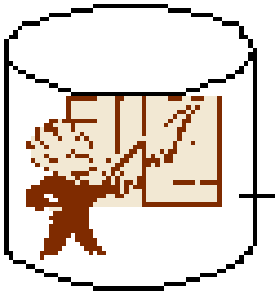
Master - Apprentice –>

Tutor - Student (Learner)

One Size Does Not Fit All

Adaptive E-Learning

- **Consider adaptation to:**



knowledge

goals & tasks

cognitive/learning styles

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Adaptive E-Learning

- **Most commonly used types of relationships between course topics:**
  - **knowledge propagation**
  - **prerequisites**

    A is a *prerequisite* for B, means:

    ***You should study A before B* or**
    You should study A before you can understand B

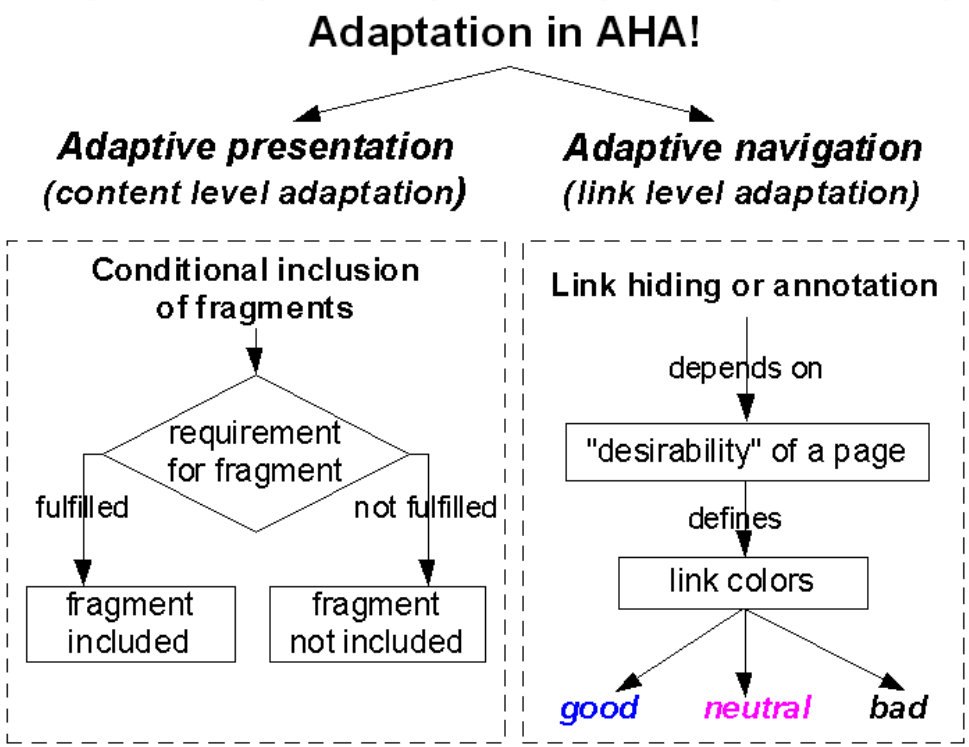
Example Created with AHA!: Presentation for Visual+Global Learner

- AHAtutorialLS8
  - readme
  - installation
    - ahacontext
    - firstconfig
  - architecture
    - adaptation
      - conditionalObjects
        - potentialProblems
          - objectInclusion
            - fragmentsObjectsXHTML
      - linkHidingAnnotation
        - linkTypes
      - pageProcessing
    - adaptationEngine
    - users
      - manager
      - author
        - pages
          - xhtml
          - headerfooter
          - fragments
        - DomainAdaptationModel
          - concepts
          - rules
        - tools
          - ConceptEditor
          - GraphAuthor
          - FormEditor
      - endUser
        - UMstructure

Anonymous user (no email address) has read 7 pages and still has 24 pages to read - list of read pages - pages still to be read

Changeable settings: link colors - knowledge of AHA! 3.0 tutorial LS - password - Form to change your preferences Log off

Adaptation performed by AHA!



see more textual information

Example Created with AHA!: Presentation for Verbal+Analytic Learner

- AHAtutorialLS8
  - readme
  - installation
    - ahacontext
    - firstconfig
  - architecture
    - adaptation
      - conditionalObjects
        - potentialProblems
          - objectInclusion
            - fragmentsObjectsXHTML
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      - manager
      - author
        - pages
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Adaptation performed by AHA!

- Regarding the content level adaptation fragments can have an associated *requirement*. This is a Boolean expression that decides whether the fragment should be included or not. In AHA! a fragment can be a part of an html or xhtml page. In that case the requirement is also part of the page, using an <if> tag. A fragment can also be an object, stored in a separate file. In that case the requirement is stored inside the combined domain and adaptation model, and the inclusion also triggers the adaptation engine to perform more user model updates.
- Regarding the link level adaptation AHA! checks a condition associated with the destination of a link in order to decide whether the link is "desirable". Depending on the status of the link destination the link anchor will be of the class "good", "neutral" or "bad". By default this results in the link anchor being blue, purple or black.

see more pictorial information

Example Created with AHA!: Inferring Preference for Image vs Text

- AHAtutorialLS
  - readme
  - installation
    - ahacontext
    - firstconfig
  - architecture
    - adaptation
      - conditionalObjects
        - potentialProblems
          - objectInclusion
            - fragmentsObjectsXHTML
      - linkHidingAnnotation
        - linkTypes
      - pageProcessing
    - adaptationEngine

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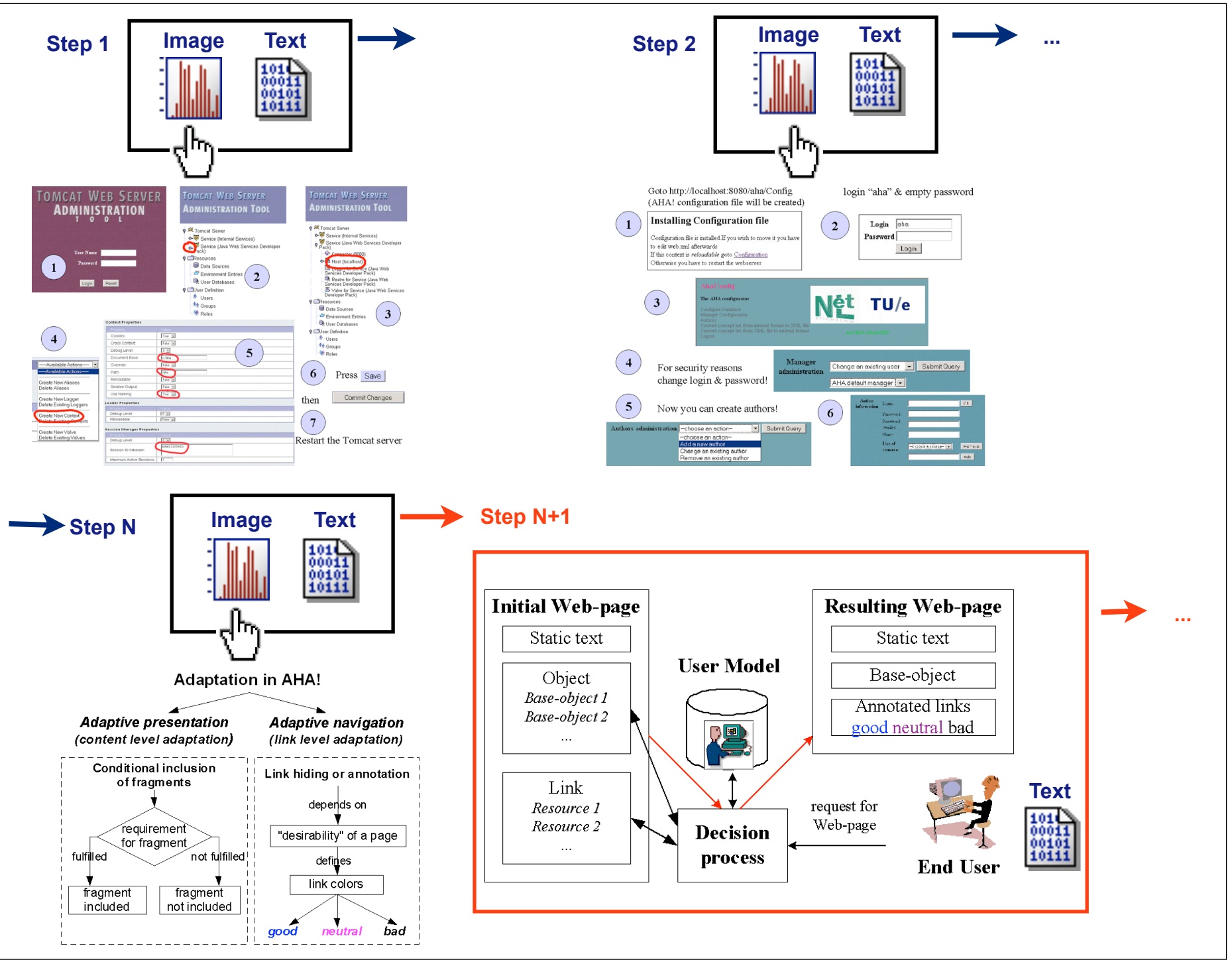
Adaptation performed by AHA!

more pictorial information

more textual information


Step 1
Image
Text
Step 2
Image
Text
...
Goto http://localhost:8080/aha/Config
(AHA! configuration file will be created)
Installing Configuration file
login "aha" & empty password
Login
Password
For security reasons
change login & password!
Now you can create authors!
Press
Save
then
Commit Changes
Restart the Tomcat server
Step N
Image
Text
Step N+1
Adaptation in AHA!
Adaptive presentation
(content level adaptation)
Adaptive navigation
(link level adaptation)
Conditional inclusion
of fragments
requirement
for fragment
fulfilled
not fulfilled
fragment
included
fragment
not included
Link hiding or annotation
depends on
"desirability" of a page
defines
link colors
good
neutral
bad
Initial Web-page
Static text
Object
Base-object 1
Base-object 2
...
Link
Resource 1
Resource 2
...
User Model
Decision
process
Resulting Web-page
Static text
Base-object
Annotated links
good neutral bad
request for
Web-page
End User
Text
...

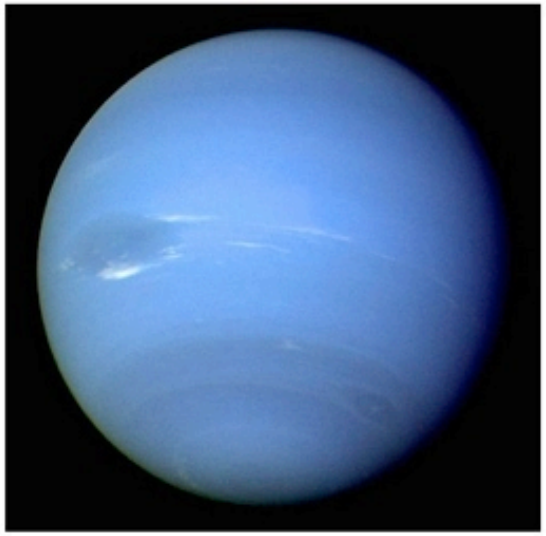
Example Created with GALE: Course about MilkyWay

- Milkyway
  - Nebula
  - Star
  - Planet
    - Mercury
    - Venus
    - Earth
    - Mars
    - Jupiter
    - Saturn
    - Uranus
    - Neptune
  - Moon

Natasha (nstash@win.tue.nl) has read 2 pages and still has 27 to read - list of read pages - pages still to be read
Options in stand-alone mode: change password logout

Planet

Image of Planet

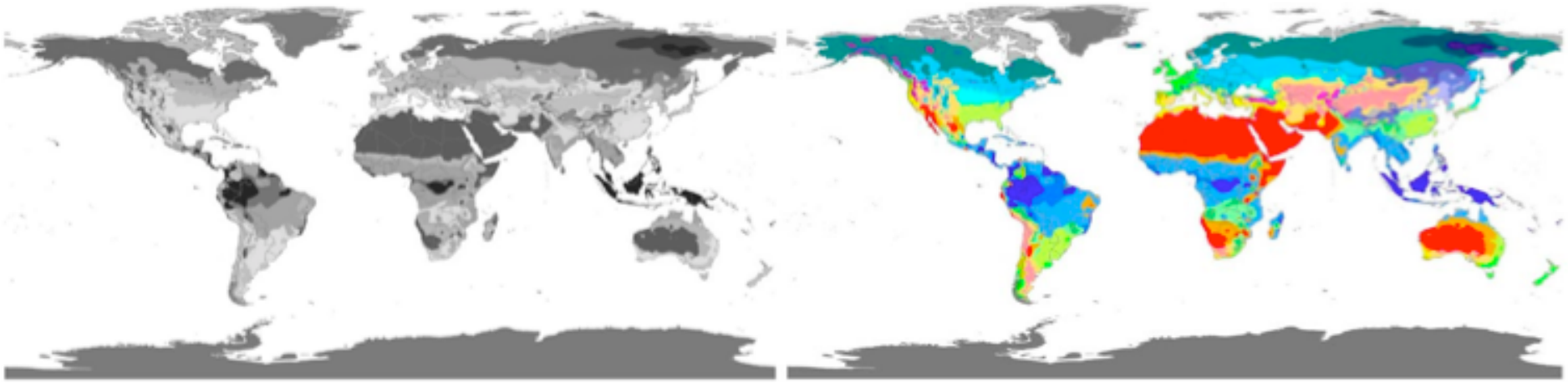


Information

A planet, as defined by the International Astronomical Union (IAU), is a celestial body orbiting a star or stellar remnant that is massive enough to be rounded by its own gravity, is not massive enough to cause thermonuclear fusion, and has cleared its neighbouring region of planetesimals. **Visited:** 1

Next suggested concept to study: Moon

Example Created with GALE: World of Biomes



Example Created with GALE: World of Biomes

Environment

▽Definition

The environment is the combined modeling of the physical environment and the biological life forms within the environment, and includes all variables, parameters as well as conditions and modes inside the Earth's biosphere. The environment can be divided into two categories: the natural environment and the built environment, with some overlap between the two. Following the industrial revolution, the built environment has become an increasingly significant part of the environment. The environment is the context describing the ambiance of any entity therein. As this described entity itself is part of the environment, the description is partially recursive.

▽Constituents

The scope of the environment is all that contained in the biosphere, which is that part of the Earth in which all life occurs. A environment is the complex of biotic, climatic, and edaphic factors that act upon an organism and determine its form and survival, and morphs itself in the process. Ecosystems, of which there are numerous types and are a defined part of the biosphere, collectively make up the whole of the biosphere. Within an ecosystem there are habitats in which an organism (including human beings) exists. At its most natural state, an environment would lack any effects of human activity, although the scale of this activity is such that all areas of the Earth have had at least some influence by humans. At the other end of the scale is the built environment and in some cases it has the biotic component that is virtually absent.

First visit

Environment

▽Definition

The environment is the combined modeling of the physical environment and the biological life forms within the environment, and includes all variables, parameters as well as conditions and modes inside the Earth's biosphere. The environment can be divided into two categories: the natural environment and the built environment, with some overlap between the two. Following the industrial revolution, the built environment has become an increasingly significant part of the environment. The environment is the context describing the ambiance of any entity therein. As this described entity itself is part of the environment, the description is partially recursive.

▷Constituents

After the first visit

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Example Created with GALE: World of Biomes

permanent ice caps and floats towards hotter watters and melt there gradually.

Big chunks of ice can float around for months before

Rich media content

hotter watters and melt there gradually.

[Image]

Big chunks of ice can float around for

No rich media content

Example Created with GALE: Latex Tutorial

- LaTeX
  - Introduction
  - **Basics**
    - Latex source
  - Document structure
  - Advanced formatting

Reset profile

Show progress-view

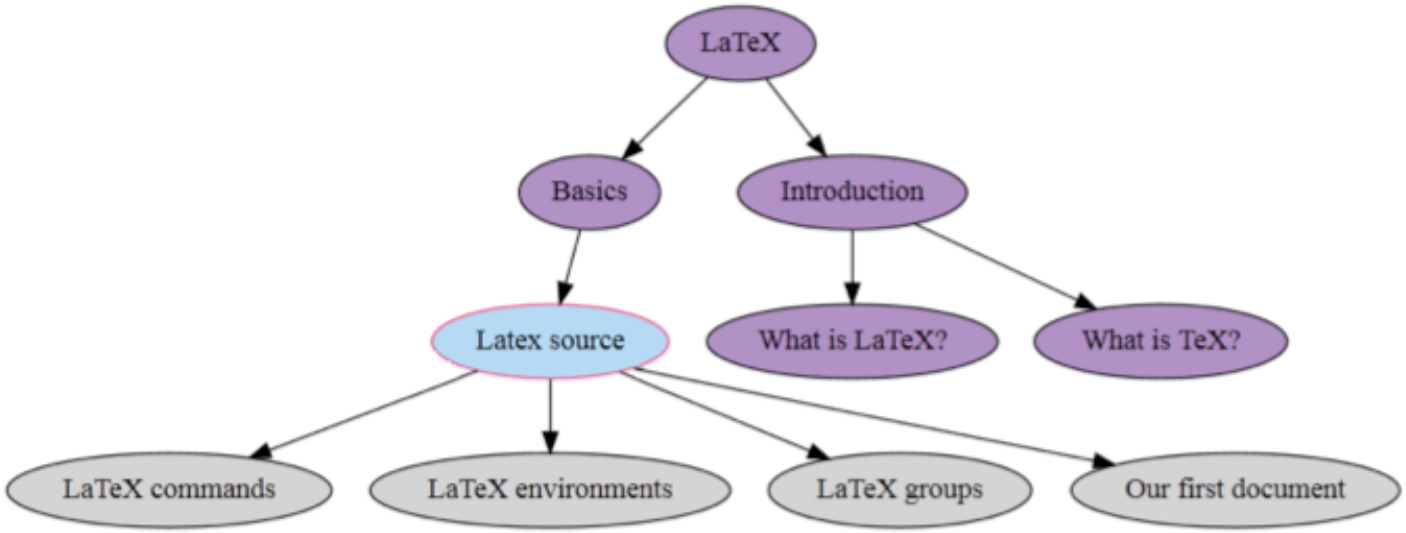
Chapter 2 - Basics

<< Previous chapter]] [[*Next chapter >>*

Next topic: Latex source

This tutorial is aimed at getting familiar with the bare bones of LaTeX.

Before starting, ensure you have LaTeX installed on your computer (see Installation for instructions of what you will need). We begin by creating the source LaTeX file, and then take you through how to feed this file through the LaTeX system to produce quality output, such as postscript or PDF.



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Example Created with GALE: Research Methods Book

Clients: You Can't Always Get What You ...

localhost:8080/gale/concept/http://localhost:8080/gale/DoingResearch/Part1/Clients_You_Cant_Always_Get_What_You_Want

- Doing Research
- Preface
- Introduction
- The Purpose of Research
- Design
- Reasons for Research
  - Choosing your Topic
  - Clients: You Can't Always Get What You Want
  - Data Collection
  - Glossary
  - Assignments
  - Multiple Choice Test
- Demarcating the Research Topic
- Fieldwork
- Analysis
- Assessment and Evaluation

Anonymous user (email unknown) has read 18 pages and still has 160 to read - list of read pages - pages still to be read
Options in stand-alone mode: logout

My interests:

Quantitative Research
Qualitative Research
Miscellaneous

Clients: You Can't Always Get What You Want

If you are invited to put forward a research proposal, then you are generally not alone. Clients often ask several firms to pitch for the job and then they choose the proposal that suits them best. This does not necessarily mean that they go for the cheapest, or that expensive is always 'good'. You normally have to do a lot of investigating and carry out an awful lot of leg and spade work before you're awarded a project and start your research,

what the client wants During the initial briefing with the client, you make a list of what it is they want. Often there's a problem or a question, an objective and a reason. The objective may be that the client wants to optimize their service. The question is: how can they best go about this?
Sometimes there's a hidden agenda, an ulterior motive. Behind the issue you are presented with lies a completely different goal to the one you may see on the surface. It's your job to get to the real objective and to formulate the relevant questions. This is crucial. If you launch into the project, without getting to the real objective of the research, you'll be talking at cross-purposes and the chances of you getting the job will be compromised. Apart from anything else, as the researcher you are supposed to be independent and objective. You are there to help solve a problem, you don't allow yourself to be used for any other purpose. Dealing with clients and what they want is sometimes difficult. You have to make the topic 'researchable', but at the same time you have to keep the client happy by doing what they want as far as possible.

Tips & tricks

- Make sure you know your client's organization and its profile.
- Be convincing.
- Listen carefully and ask questions: don't come up with 'the solution' at the drop of a hat.
- Make a note of how the first meeting went! Afterwards you can remind yourself of your first impressions.
- Don't argue the point, even if you're right.
- Don't get involved in the subject: be critical and objective.
- Know what the client expects of you.
- Know what you expect of the client.
- Make sure it is clear what is required (research objective).
- Use the right combination of what you've learned during your study and how to apply it in practice.
- During the briefing, make it very clear to the client what your intended procedure will be.
- Give serious thought to whether you can answer your client's question, and if so, how.
- Work on your proposal at home or in the office.

demarcating your subject Once you know what your client's issues and objectives are, then you can set about demarcating the subject. You check whether you are familiar with the subject, if you know something about it, or have read about it, whether research into the subject has already been done, or whether it's connected to projects you've done in the past. What problem will be solved by your research? The aim of this demarcation is to translate the client's question into a researchable question. This is also known as problem analysis.

possibilities and limitations Once you've established the main research question (more about this in Chapter 3 under formulating the central problem), you think of ways to address it. The answer depends on the nature of the question, but also on what is possible and the restrictions that the client may impose. The

The next suggested concept to study: Data Collection

Example:
C# Online Tutorial

- C# Online Tutorial
  - **Survey for Assessing Knowledge Level**

User Name: *user1*, **E-mail:**
Statistics: 2 read pages and **43** pages to read - Read Pages List - Remaining Pages List
Account Settings: Change Password Logout

---

7. In order for a class to use an interface, it must
   - Inherit the properties of the interface
   - Contain the same methods as the interface
   - All of them

8. A local variable
   - Represent a class object
   - Is declared within a method
   - Must accept a class

   Wrong Answer!

9. An instance variable
   - Is an object of a class
   - Represents an attribute of an object
   - Is a method of a class

   Wrong Answer!

10. A Constructor
    - All of them
    - Is used to create objects

    Wrong Answer!
    - Must have the same name as the class it is declared within

Your score is **0**.

There are **3 knowledge levels** in this tutorial.

You were evaluated as a **learner** who have **no** knowledge (Level 1).

Therefore, the tutorial will be adapted based on your knowledge in which you have to study **General**, **Programming Basics** and **Programming in C#** subjects.

Please click here to continue.

Example:
C# Online Tutorial

- C# Online Tutorial
  - General
  - Programming Basics
  - Programming in C#

User Name: *user1*, **E-mail:**
Statistics: 3 read pages and **42** pages to read - Read Pages List - Remaining Pages List
Account Settings: Change Password Logout

C# Online Tutorial

This online tutorial is aimed to introduce some basics and advanced concepts to **novice** learners related to the C# programming language.

Describes lots of different contents and topics related not only to the programming language itself, but to some used tools and technologies.

Example:
C# Online Tutorial

- C# Online Tutorial
  - Programming in C#
    - Syntax
      - Comments
      - Statements
      - Loops
      - Expressions
      - Exceptions
    - Some Examples
    - Some Features

User Name: *user2*, **E-mail:**
Statistics: 4 read pages and **41** pages to read - Read Pages List - Remaining Pages List
Account Settings: Change Password Logout

Syntax

A Simple C# Program

There are basic elements that all C# executable programs have and that's what we'll concentrate on for this first lesson, starting off with a simple C# program. The following list is an example of a C# program. to view this first program.

Warning: C# is case-sensitive.

A Simple Welcome Program: Welcome.cs

```
// Namespace Declaration
using System;

// Program start class
class WelcomeCSS
{
  // Main begins program execution.
  static void Main()
  {
    // Write to console
    Console.WriteLine("Welcome to the C# Station Tutorial!");
  }
}
```

Next suggested concept to study: Comments
Number of page visits: 1

Example:
Course About Tennis

TENNIS
- Pre-Test
- Introduction
- The Game
- Tennis Shots
- Tournaments
- Test Overall

nvs () has read 1 pages and still has 32 to read - list of read pages - pages still to be read
Options in stand-alone mode: change password - logout

Tennis

In the last several years Tennis has been growing, as both a participant and a spectator sport. Tennis has gained immense popularity as a participant sport because people have discovered that it not only is fun to play, but also provides good exercised in a short period of time. Today it is easier to have a rewarding career in tennis both as a player and as a teacher. More and more youngsters are choosing tennis over baseball, football, and other sports, a situation which means that there will be more and better players turning professional in the future. The sport of tennis has finally lost its "country club" image and is being enjoyed by an ever-increasing number of avid fans

Next suggested concept to study: Pre-Test

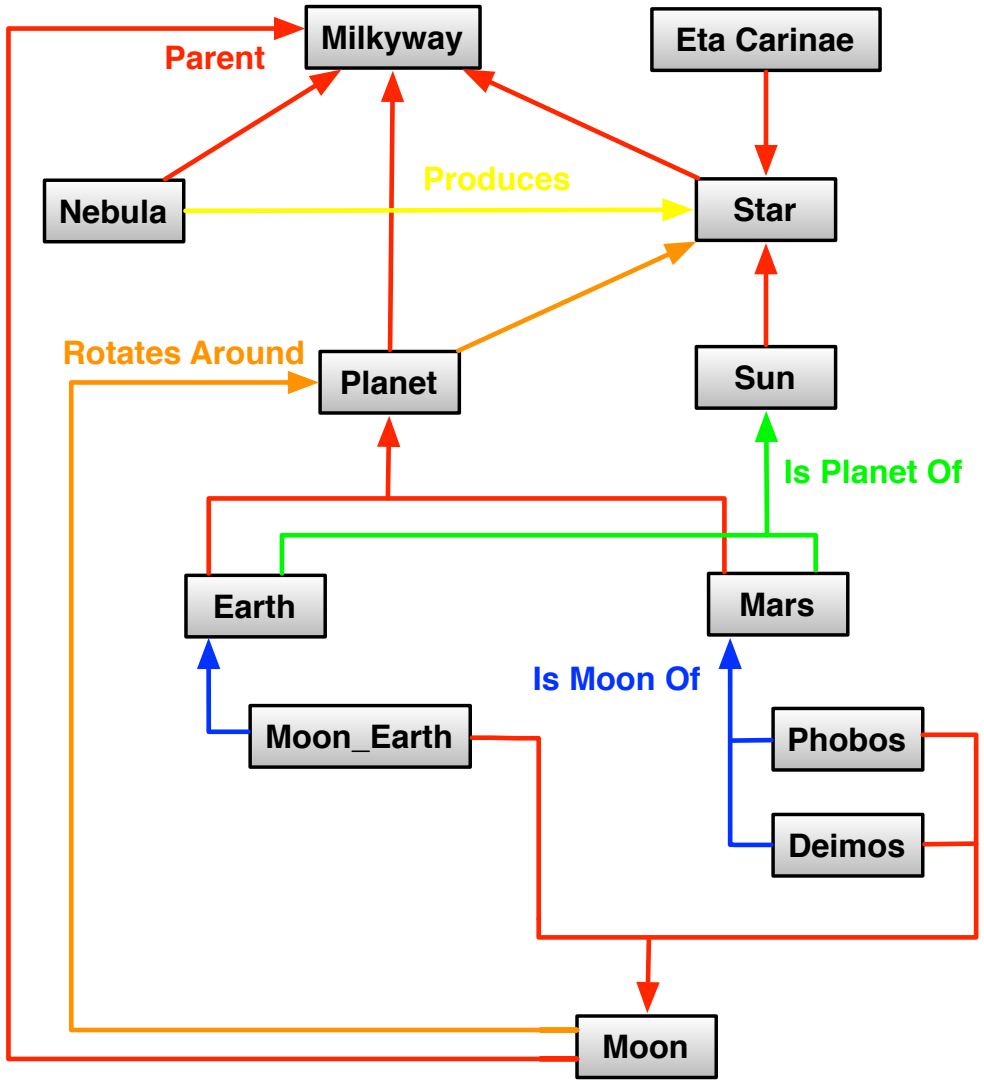
Designing an Online Adaptive Course

Consists of:

1. Designing *information structure* (domain model)
2. *Information* creation (application content)
3. Defining *navigation structure* (application content)
4. Defining *pedagogical structure* (adaptation model): Which navigation is desirable during learning?
   - An *adaptive* system such as AHA! or GALE should support navigation

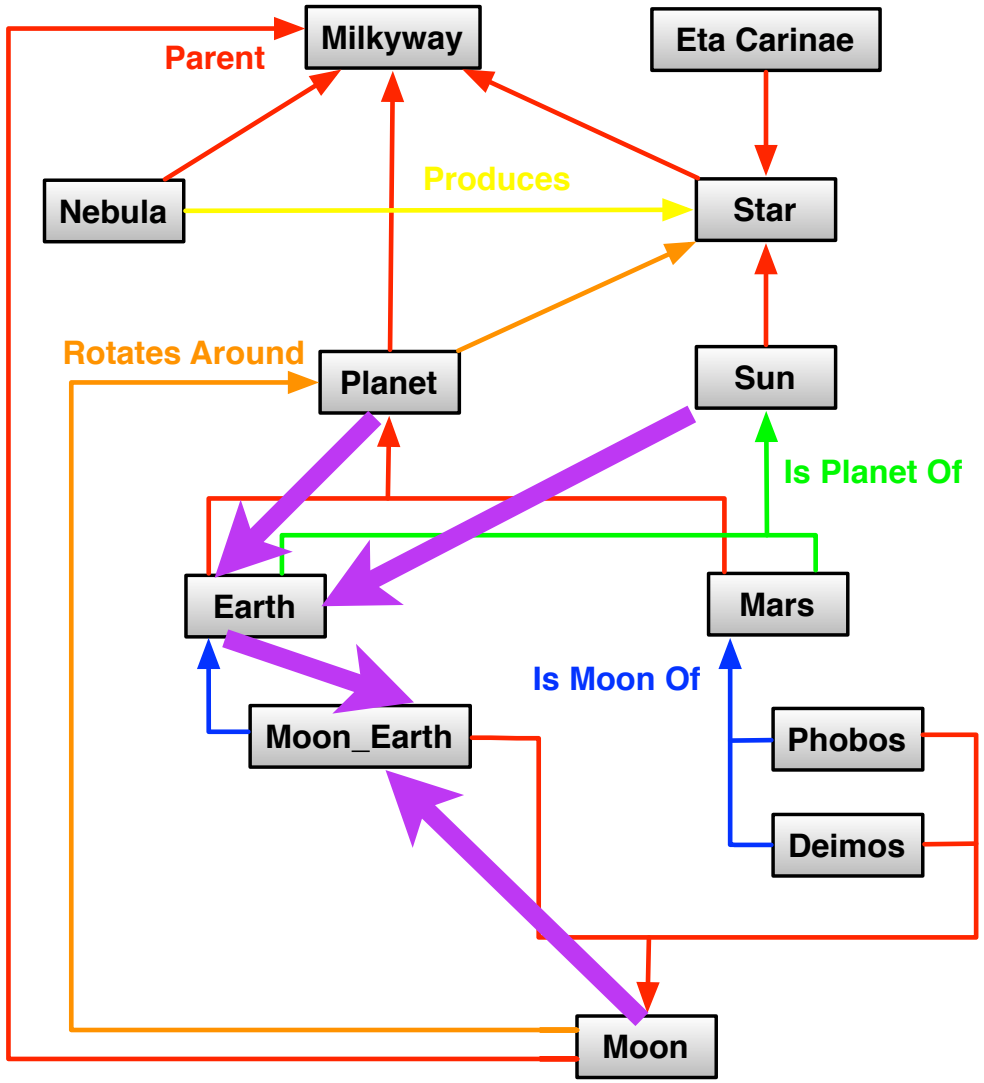
Example: Milkyway Information Structure

- The "logical" structure of Milkyway
- Different relationship types result in links in the application

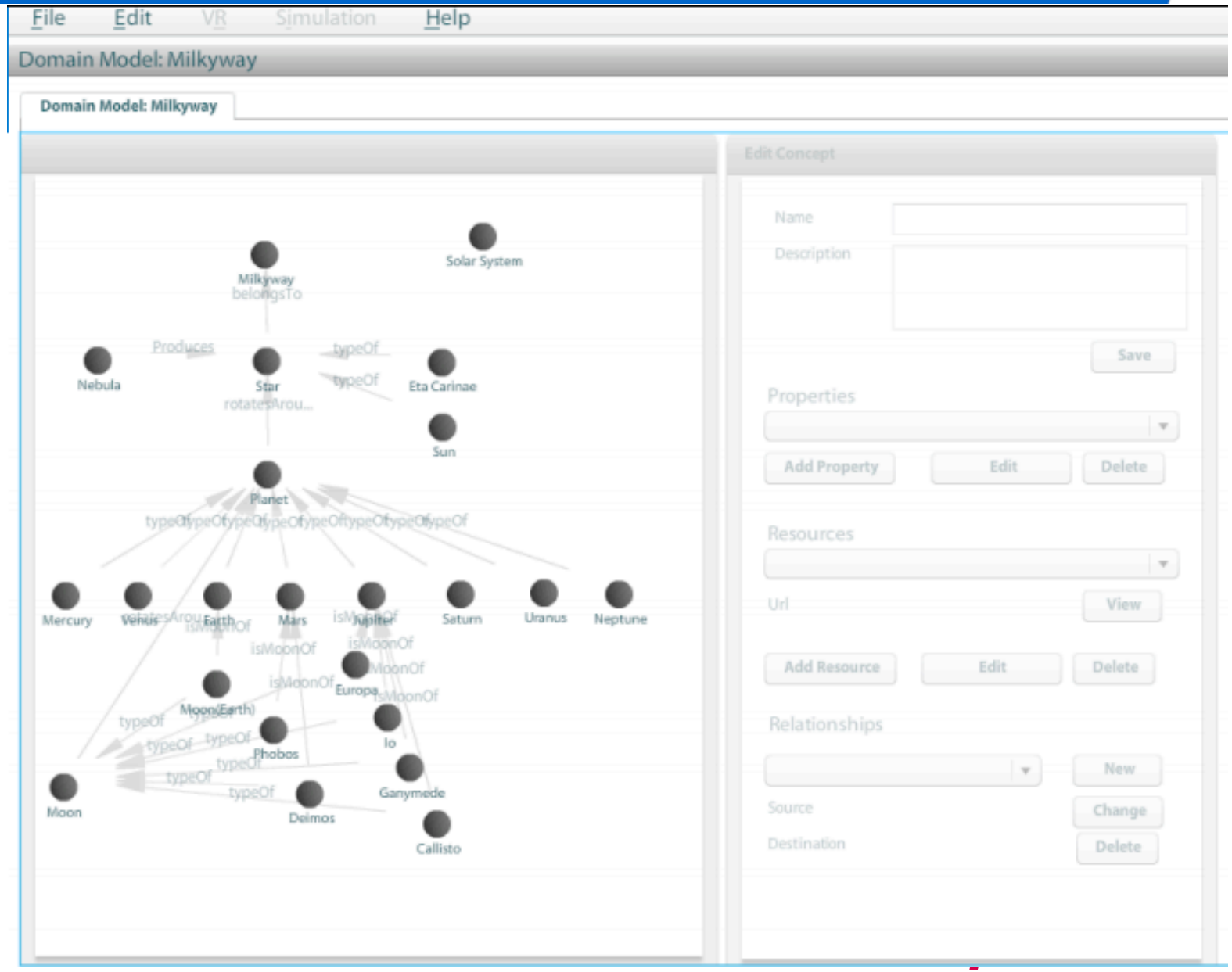


Example:
Milkyway Pedagogical Structure

- **Adaptation can be supported by Artificial Intelligence**



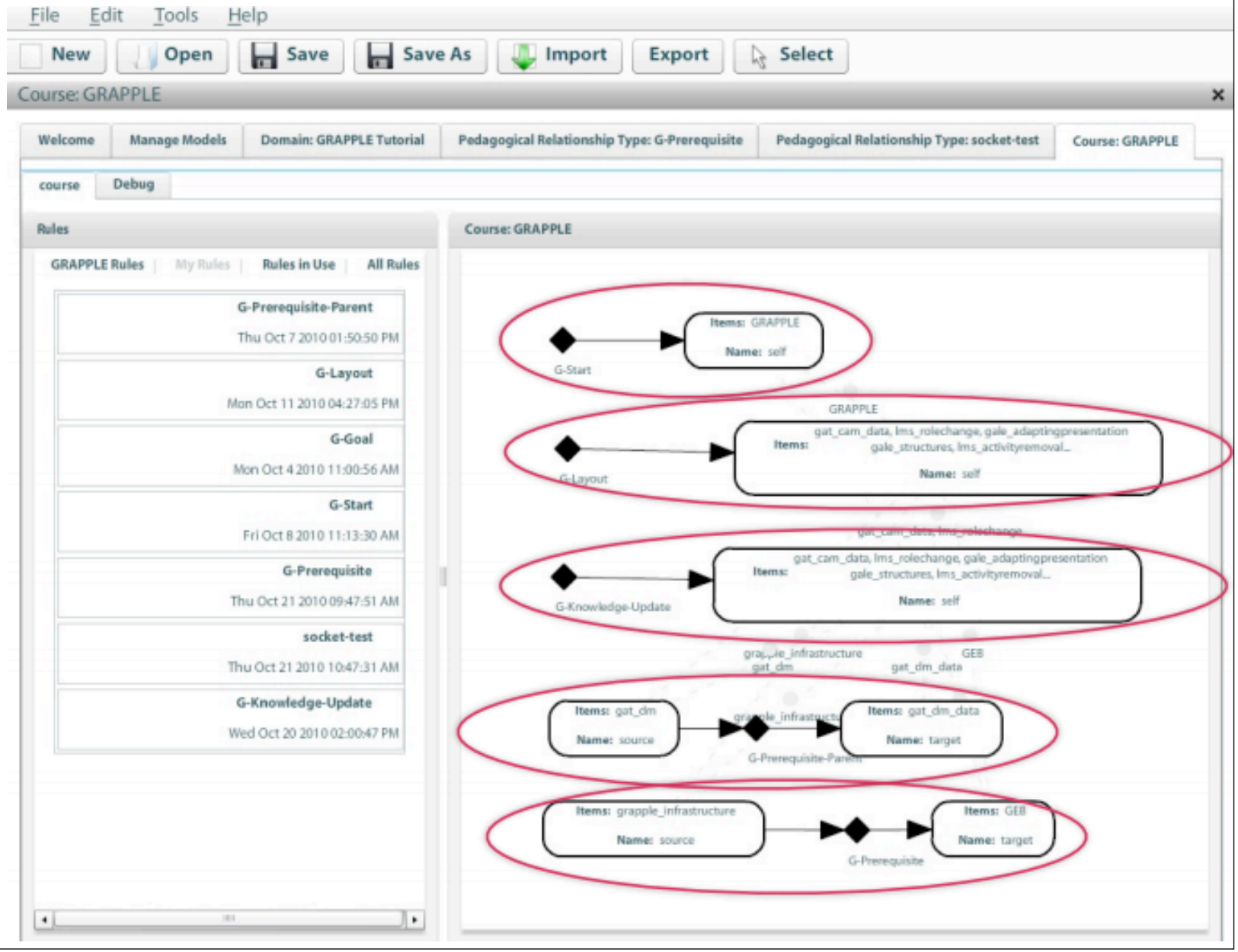
Authoring Adaptive Application: Domain Model



Authoring Adaptive Application: Application Content/XHTML Page Using GALE Syntax

```
<h2>Authoring AHA! Applications</h2>
<p>Creating AHA! applications involves four main steps:
    writing <gale:a href="pages">pages</gale:a>,
    creating a <gale:a href="domainmodel">conceptual
    structure</gale:a> of the application,
    defining the <gale:a href="rules">adaptation rules</gale:a>
   <gale:if expr="${rules#knowledge}&gt;50">
   <gale:block>
        <gale:a href="rules"> (event-condition-action rules)</gale:a>
   </gale:block>
  </gale:if>, and defining the <gale:a href="layout">look and
feel, or layout</gale:a> of the application.</p>
```

Authoring Adaptive Application: Adaptation Model



Prerequisites Structure

- **Different ways of creating prerequisites structure:**
  - **Top-down (deductive) approach**
    from abstract to concrete concepts
  - **Bottom-up (inductive) approach**
    from concrete to abstract concepts
- **Adaptive systems allow for the implementation of different prerequisites structures for one course to address individual learner's preferences**

How to *Realize* Prerequisites

- You should study A before B
  - "should": different adaptation techniques either *enforce* this or *give advice*
  - "study": this can be access or read or take a test; result is a knowledge value
  - how much knowledge is enough?
  - "before": this does not imply just before

Conclusions: Applications Developed With AHA! and GALE

- *Adaptation* to address *individual differences*
- Adaptation through *prerequisites*
- *Various* prerequisite structures are possible for the same course
- *Time estimation* for *authoring* an adaptive online course (TU/e master students who followed Adaptive Systems course) - *10 to 25 hours*

Use of Semantic Technologies in E-Learning

WIKIPEDIA
The Free Encyclopedia

- In **software**, ***semantic technology*** encodes meanings separately from data and content files, and separately from application code
- In computer science and information science, an ontology formally represents knowledge as a set of concepts within a domain, and the relationships among those concepts. It can be used to reason about the entities within that domain and may be used to describe the domain

Use of Semantic Technologies in E-Learning

- **Previous examples do not (yet) make use of *semantic* structures defined in *ontologies***

  ==> amount of reasoning over semantic structures is limited

- **Next, we will see how to make adaptive applications based on semantic structures from CHIP project**

  Although CHIP prototype is a recommender system, a personalized museum guide, it can also be seen as an e-learning application - teaching about Art

Use of Semantic Technologies in E-Learning: Ontologies Mapping

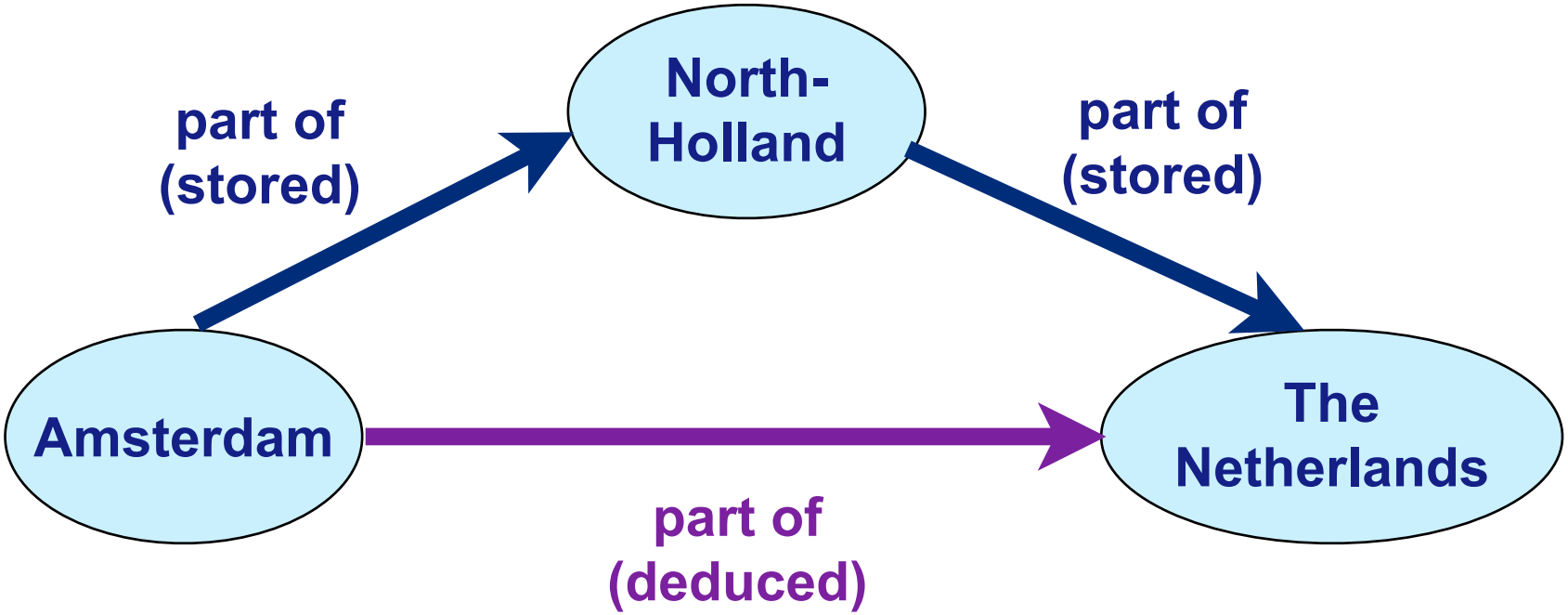
Ontology A:
#Rembrandt

Ontology B:
#Rembrandt van Rein

Ontology C:
#Rembrandt Harmensz. van Rein

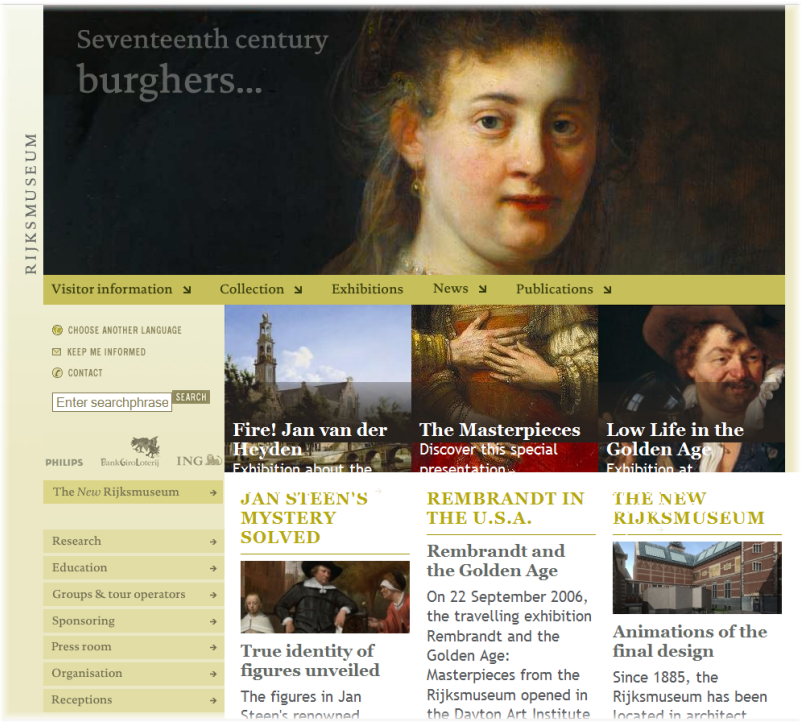
ULAN vocabulary
(Union List of Artists Names)
http://www.getty.edu/vocabularies/ulan#500011051

Use of Semantic Technologies in E-Learning: Reasoning Example

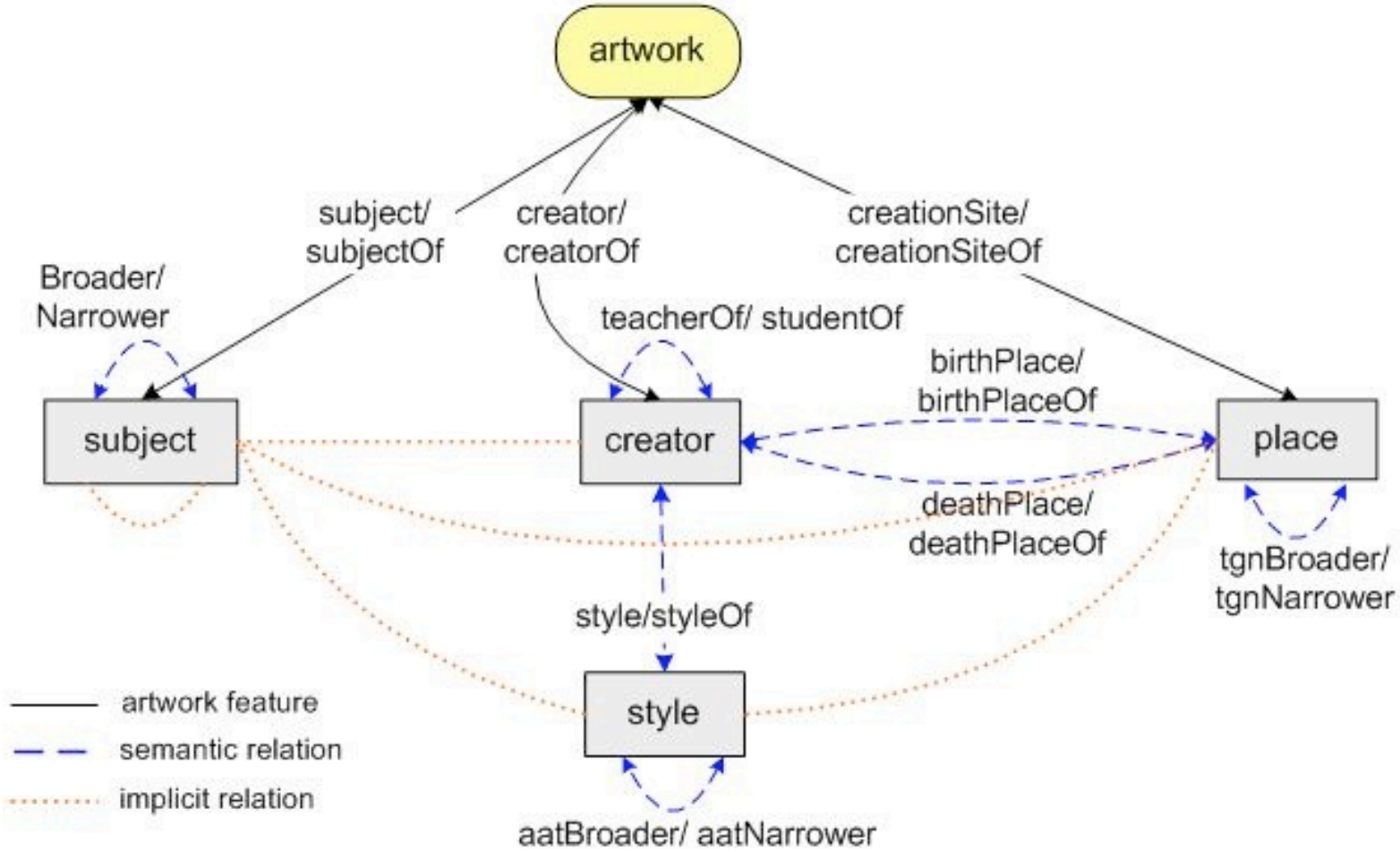


Cultural Heritage Information Personalization, CHIP: a Personalized Museum Guide

- Developed in collaboration between TU/e, Telematica Institute and Rijksmuseum
- Personalized access through multiple devices
  - PC, iPhone, etc.
- Recommendations are based on:
  - metadata about artworks & art topics
- http://www.chip-project.org

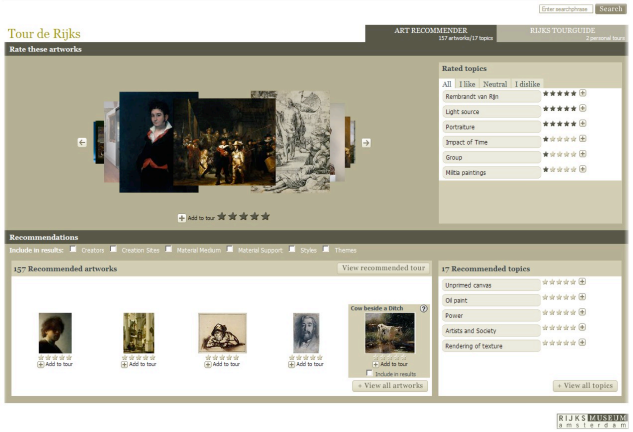


CHIP Data


artwork
subject/
subjectOf
creator/
creatorOf
creationSite/
creationSiteOf
Broader/
Narrower
teacherOf/ studentOf
birthPlace/
birthPlaceOf
subject
creator
place
deathPlace/
deathPlaceOf
tgnBroader/
tgnNarrower
style/styleOf
style
artwork feature
semantic relation
implicit relation
aatBroader/ aatNarrower

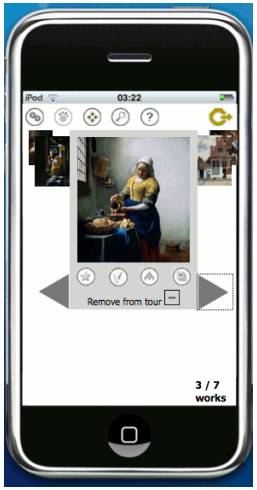
CHIP Web-Based Tools

Art Recommender



Tour Wizard

Mobile Museum Guide



Artworks and Concepts Recommendations

Managing and Visualizing Museum Tours

Guiding the user inside the museum

Interactive User Modeling