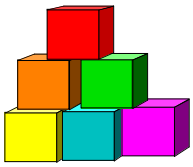
XXII. Website Design

The Web
Hypertext Data Independence
Data Models for Hypertext Documents
The Araneus Data Model (ADM)
The Navigational Conceptual Model (NCM)
The Araneus Methodology for Website Design



The Web

- The spread of World-Wide Web (hereafter "Web") technology is one of the most remarkable phenomena of the last few years in all areas of computing and communication.
- The Web (e.g., Web browsers) is becoming a standard interface for the general public to access and exchange information:
  - ✓ The protocol is very simple and public;
  - ✓ The interface is uniform;
  - ✓ The content is extremely rich (both in breadth and in depth);
- Moreover, the Web is becoming a standard interface for accessing many specialized services, specifically information systems and databases of every type.

Web Features and Open Problems

- The Web is a simple and powerful data integration tool.
- Two basic approaches to Web-based data integration:
  - ✓ Coarse-grain: pages of hypertext;
  - ✓ Fine-grain: unified interface for accessing different (usually similar) information systems available on the Web.
- The Web is built out of semi-structured (HTML/XML) documents, databases contain structured (I.e., tuple/record) data.
- Databases can be queried in a flexible way; hypertext documents are easy to access, but cannot be "queried".
- Web sites are often difficult to explore, use and monitor.
- Web sites are also difficult to design and maintain.

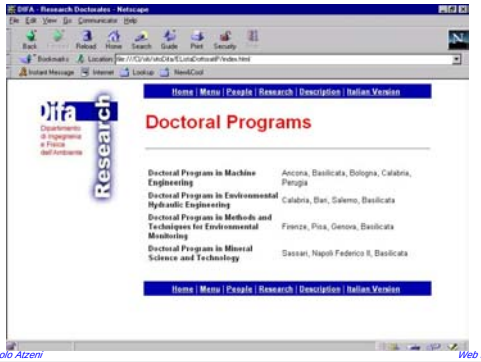
Problems with Large Websites

- Information is often poorly organized and difficult to access.
- It is often unclear what information is available on a given website.
- The access structure of many websites is casual and idiosyncratic, causing frequent dangling references.
- The style of presentation is often heterogeneous.
- Large websites are usually difficult to update, or change their structure.
- It is also difficult to change the presentation structure and/or details.

Data Independence for Hypertext Documents

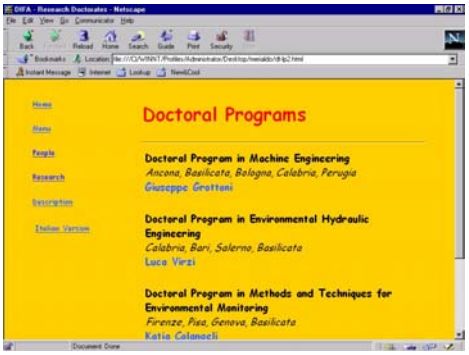
- You might say that there are three facets to the Web:
  - ✓ ***Data*** -- what information is offered through the site and what are the conceptual details and the logical organization;
  - ✓ ***Hypertext*** -- how data is arranged in pages and what navigation links correlate them;
  - ✓ ***Presentation*** -- the appearance of each piece of information on each pages.
- As much as possible, we'd like to decouple the three, so that changes to one affect minimally the other two facets of the Web.

An Example



...Another...

...and Another...



Design Issues

- ***Data*** -- *choose the content*
- ***Hypertext*** -- *choose navigation paths*
- ***Presentation*** -- *define layout and graphics*

Maintenance Issues

- ***Data*** -- changing the content
- ***Hypertext*** -- changing navigation paths
- ***Presentation*** -- changing layout and graphics

Components and Models

Data	***ER and Relational***
Hypertext	
Presentation	***HTML***

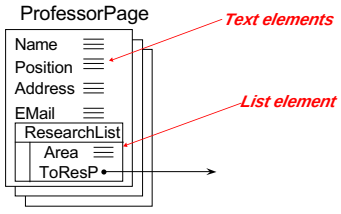
What is missing is a model for hypertexts!

Models for Hypertext Documents

- *In **data-intensive Websites** (and often in general) there are (many) pages with a similar (or even the same) structure.*
- *Forty years ago people realized that in an application it is often the case that there are many records **with the same structure**; files and file technology were invented to exploit this fact.*
- *Likewise, the notion of a **schema** for a database was later introduced as an overall description of the content of a database.*
- *We need something similar for the Web!*

A Web Page

A Page Schema: ProfessorPage

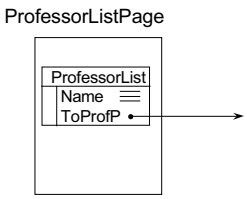


ADM (Araneus Data Model): A Logical Model for Hypertext Documents

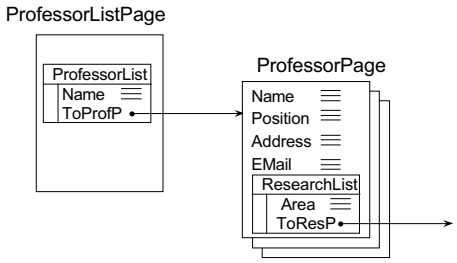
- Developed at the University of Rome III (Universita di Roma Tre) by Paolo Atzeni, Paolo Merialdo, Giansalvatore Mecca and colleagues.
- Its features include:
  - ✓ Page schemas
  - ✓ Simple attributes
    - ✓ text, images, ...
    - ✓ link (anchor, URL)
  - ✓ Complex attributes such as lists, possibly nested.
  - ✓ A heterogeneous union operation.
  - ✓ Forms as virtual lists over form fields and links to a result.

Another Web Page -- Containing a List of Links

A Page Schema for ProfessorListPage

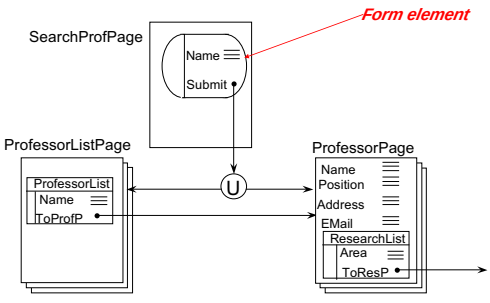


An ADM Schema

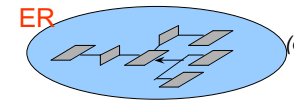


Heterogeneous Union and Forms

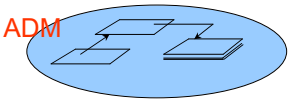
Heterogeneous Union and Forms



Data Models, Again



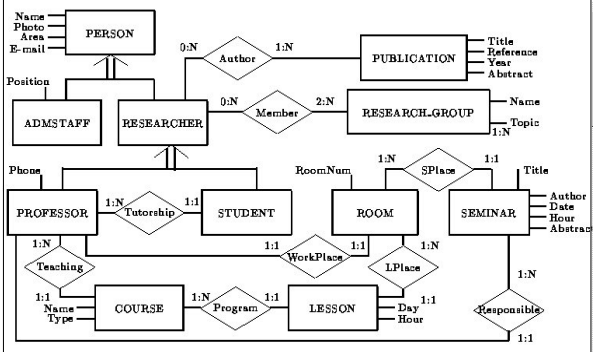
Database Conceptual Schema
(entities - relationships)



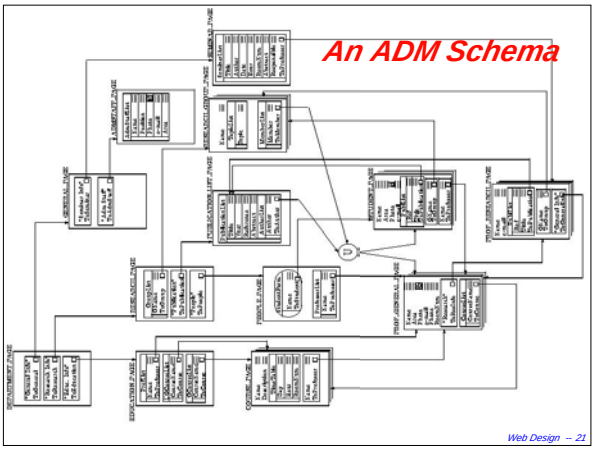
Hypertext Logical Schema
(page schemas, links)

There is considerable conceptual distance between the two!

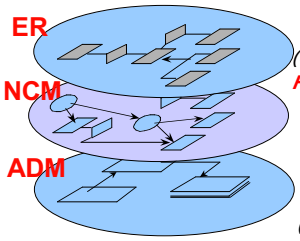
A Simple ER Schema



An ADM Schema



The Navigational Conceptual Model (NCM)



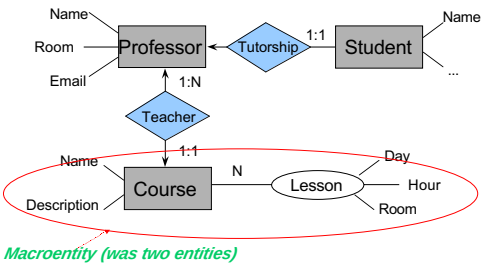
Database Conceptual Schema
(entities - relationships)

Hypertext Conceptual Schema
(macroentities, directed relationships, aggregations)

Hypertext Logical Schema
(page schemas, links)

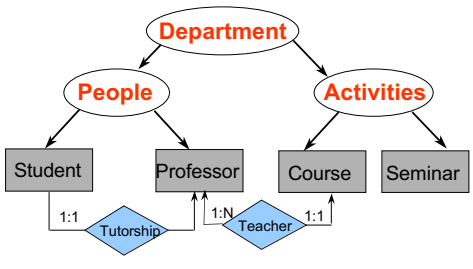
NCM fills the gap between the two

Macroentities and Directed Relationships

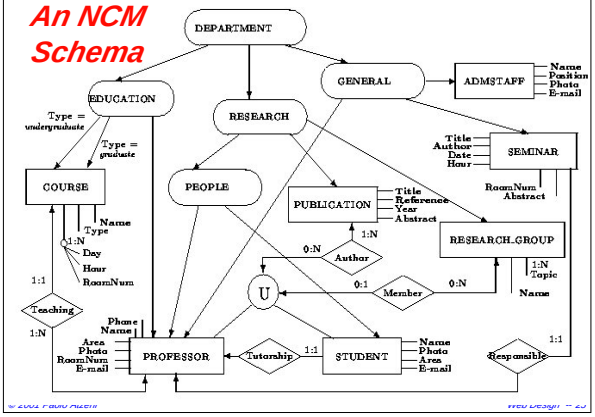


Macroentity (was two entities)

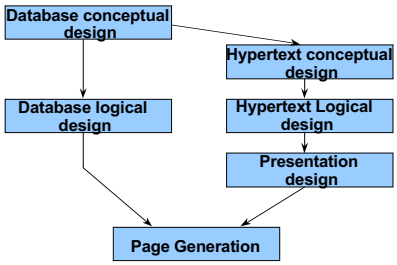
Aggregation Nodes



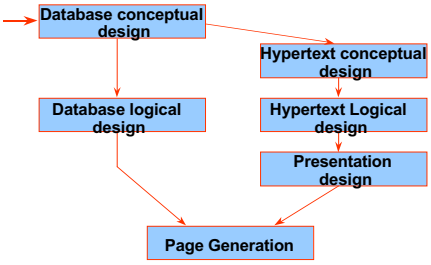
An NCM Schema



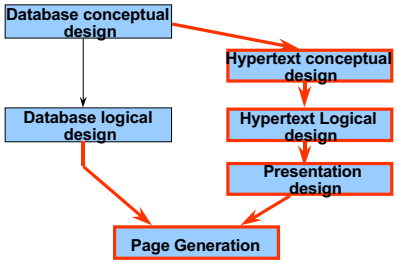
The Araneus Methodology



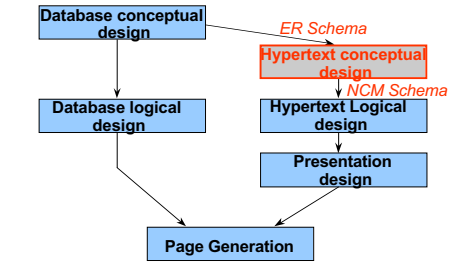
The Araneus Methodology: Design from Scratch



The Araneus Methodology: Design from an Existing Database

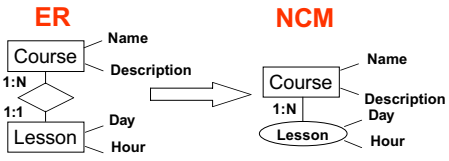


Hypertext Conceptual Design: From an ER schema to a NCM Schema



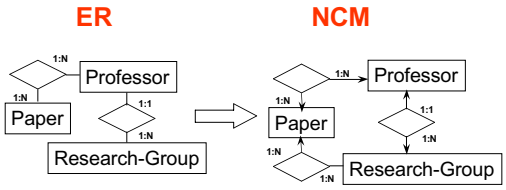
Hypertext Conceptual Design: Step 1

Choose and describe macroentities; design views over the input ER schema.



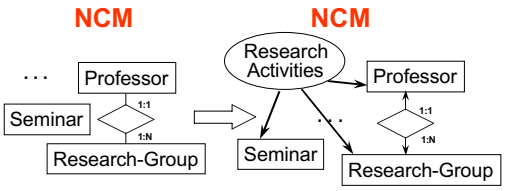
Hypertext Conceptual Design: Step 2

Choose navigation paths

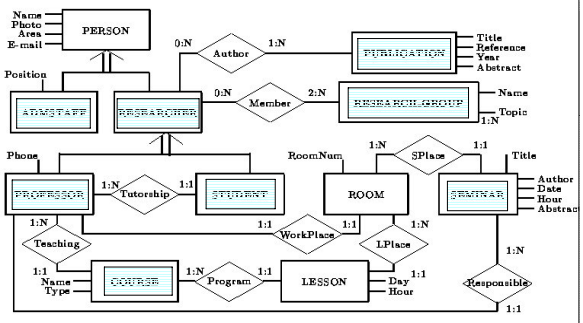


Hypertext Conceptual Design: Step 3

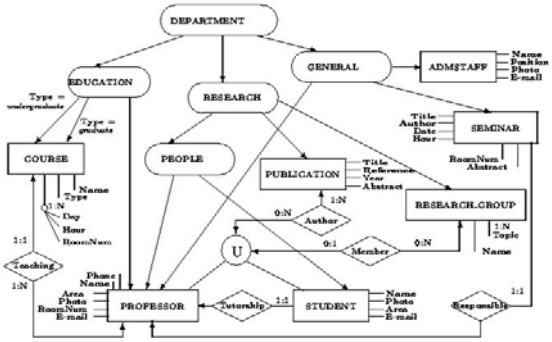
Shape the hypertext access structure



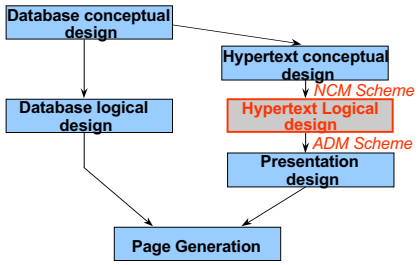
The Input ER Schema



The Output NCM Schema

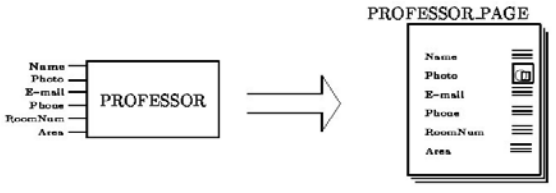


Hypertext Logical Design: From an NCM to an ADM Schema

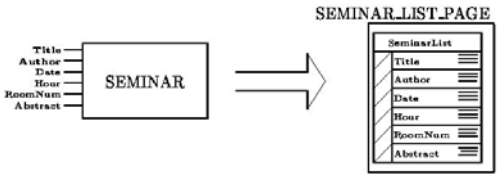


Hypertext Logical Design: Step 1

Map each macroentity into either a page schema or a list element inside a page schema



Another Example for Step 1



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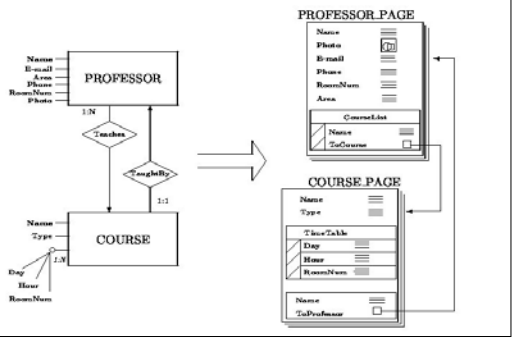
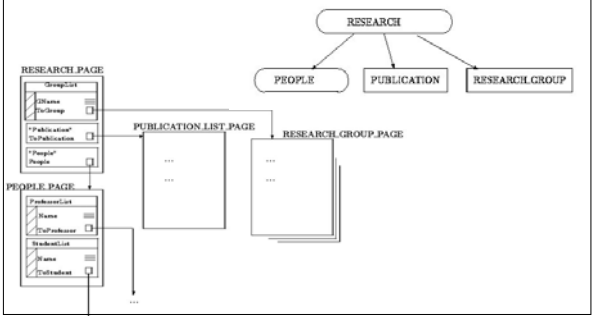
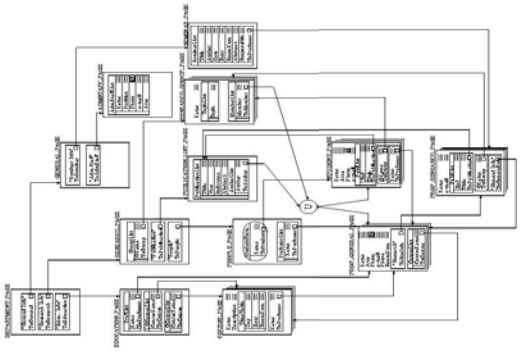
Hypertext Logical Design: Step 2

Map each directed relationship into a (list of) link attribute(s)



Hypertext Logical Design: Step 3

Map each aggregation into a unique page schema with link attributes to the target page schemas



Resulting ADM Schema ...Sideways...