Problems with many Web-sites

- design
  - information is often poorly organized and difficult to access
  - it is not even clear which pieces of information are available
  - the access structure is casual and many dangling references occur
  - the style of presentation is heterogeneous
- maintenance
  - difficulties in updating the content (type and values)
  - difficulties in changing the initially defined structure
  - difficulties in changing the presentation details
Esistono pagine con la stessa struttura

Indipendenza dei dati negli ipertesti: stessi dati, diversa struttura ipertestuale
Indipendenza dei dati negli ipertesti: stessi dati e stessa struttura ipertestuale, diversa presentazione

Hypertext data-independence

- **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 in pages”
### Design Issues

- **Data**
  - choosing the content
- **Hypertext**
  - choosing page organization and navigation paths
- **Presentation**
  - defining layout and graphics

### Maintenance Issues

- **Data**
  - changing the (type of) content
- **Hypertext**
  - changing page organization and navigation paths
- **Presentation**
  - changing layout and graphics

### Components and Models

- **data**
- **hypertext**
- **presentation**
- **ER and Relational**
- **HTML**

**What is missing is a model for hypertexts!**
Models for hypertexts

- in **data-intensive Web sites** (and often in general) there are (many) pages with a similar (or even the same) structure
- thirty or forty years ago people realized that in an application it is often the case that there are **records with the same structure**; files with a rather fixed structure were invented with this purpose
- the notion of **scheme** of the database was later introduced as an overall description of the content of a database

Pagine con la stessa struttura
Pagine con un'altra struttura

A Web page
A page-scheme: *ProfessorPage*

ADM (Araneus Data Model): a logical model for Web hypertexts

- page-schemes
- “unique” pages
- simple attributes
  - text, images, ...
  - link (anchor, URL)
- complex attributes: lists (possibly nested)
- heterogeneous union
- form (as virtual list over form fields and link to the result)
A Web page (containing a list of links)

![Web page screenshot](image)

A “unique” page-scheme: ProfessorListPage

```
ProfessorListPage

ProfessorList

Name ➔ ToProfP
```

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An ADM Scheme

Heterogeneous Union and Forms
Heterogeneous Union and Forms in ADM

ProfessorListPage

SearchProfPage

ProfessorPage

U

ProfessorList

ProfessorPage

Name

Submit

Name

Position

Address

EMail

ResearchList

Area

ToResP

ToProfP

Name

Submit

Name

Position

Address

EMail

ResearchList

Area

ToResP

ToProfP

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Data Models

There is a lot of ‘distance’ between the two!
A simple ER scheme
There is a lot of ‘distance’ between the two!

Data Models

- **ER** (Database Conceptual Scheme): (entities - relationships)
- **ADM** (Hypertext Logical Scheme): (page-schemes, links)

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Data Models

There is a lot of ‘distance’ between the two!

NCM fills the gap between the two
Navigation Conceptual Model (NCM)

Hypertext Conceptual Features

- Which concepts should be the hypertext nodes
- Which should be the navigation paths between nodes
- How nodes should be aggregated to build the hierarchical access structure

NCM Constructs

- Macroentity
- Directed Relationship
- Aggregation

NCM: Macroentities and directed relationships

[Diagram showing relationships between Professor, Student, Course, Tutorship, and Lesson with attributes like Name, Room, Email, etc.]
NCM: aggregation nodes

An NCM scheme
The Araneus Methodology

- Requirements analysis
- Database conceptual design
- Hypertext conceptual design
- Hypertext logical design
- Database logical design
- Hypertext logical design
- Presentation design
- Site generation

Design from scratch

- Requirements analysis
- Database conceptual design
- Hypertext conceptual design
- Hypertext logical design
- Database logical design
- Hypertext logical design
- Presentation design
- Site generation
**design from an existing database**
(with an ER scheme)

- Requirements analysis
- Database conceptual design
- Database logical design
- Hypertext conceptual design
- Hypertext logical design
- Presentation design
- Site generation

**design from an existing database**
(without an ER scheme)

- Requirements analysis
- Database conceptual design (reverse engineering)
- Database logical design
- Hypertext conceptual design
- Hypertext logical design
- Presentation design
- Site generation
Hypertext conceptual design: from ER to NCM

Requirements analysis

Database conceptual design

Hypertext conceptual design

Hypertext logical design

Database logical design

Presentation design

Site generation

Hypertext Conceptual Design

ER scheme \rightarrow NCM Scheme

• **step 1**
  
  choose and describe macroentities: design “views” over the input ER scheme

• **step 2**
  
  choose navigation paths

• **step 3**
  
  shape the hypertext access structure on the basis of (“bottom-up”) conceptual aggregation
Hypertext Conceptual Design
ER scheme → NCM Scheme

- **step 1** choose and describe macroentities:
  design “views” over the input ER scheme
-usually it corresponds to “de-normalize” the input ER scheme

ER scheme:
- **Course**
  - Name
  - Description
  - Day
  - Hour
- **Lesson**
  - 1:N
  - 1:1

NCM Scheme:
- **Course**
  - Name
  - Description
  - Day
  - Hour

**ER**

**NCM**

- **Professor**
  - 1:N
  - 1:1
  - 1:N

- **Paper**
  - 1:N
  - 1:1
  - 1:N

- **Research-Group**
  - 1:N
  - 1:N

- **Professor**
  - 1:N
  - 1:1
  - 1:N

- **Paper**
  - 1:N
  - 1:1
  - 1:N

- **Research-Group**
  - 1:N
  - 1:N
Hypertext Conceptual Design

ER scheme → NCM Scheme

- **step 3** shape the hypertext access structure
- it is based on “bottom-up” conceptual aggregations

### NCM

- Professor
- Research Activities
- Seminar
- Research-Group

### NCM

- Professor
- Research Activities
- Seminar
- Research-Group

The Input ER scheme
The resulting NCM scheme

Hypertext logical design: from NCM to ADM

Requirements analysis

Database conceptual design

Hypertext conceptual design

Database logical design

Hypertext logical design

Presentation design

Site generation
Hypertext Logical Design
NCM scheme  →  ADM Scheme

◆ step 1
  map each macroentity into either
  • a page-scheme or
  • a list inside a page-scheme

◆ step 2
  map each directed relationship into a (list of) link attribute(s)

◆ step 3
  map each aggregation into a unique page-scheme with link attributes to the target page-schemes

Hypertext Logical Design
Step 1 (example)
Hypertext Logical Design
Step 1 (example)

Hypertext Logical Design
Step 2 (example)
Hypertext Logical Design
Step 3 (example)
Maintenance

- The Schemes help designers to maintain the hypertext structure
- Maintenance activities correspond to apply scheme transformations:
  - introduce multilevel lists
  - introduce forms
  - split pages
  - ...

**Maintenance: example**

![Diagram showing maintenance example]