Web-Based Information Systems

Prof. dr. Paul De Bra
Eindhoven Univ. of Technology

Topics

- Motivation
- Web Technology
- Design of Web-Based Information Systems
- Automatic Generation of Web-Based Interfaces

Web-Based Information Systems

- The Web brings database information to the world. This offers huge market potential in B2C and efficiency gains in B2B electronic commerce.
- Web-based interfaces for databases need to be designed, because of multimedia objects.
- Heuristics and languages are needed to generate presentations of arbitrary query results.

Applications: electronic commerce

- **product selection**: the range of available products is taken from the production database.
- **pricing information**: presented prices are the same as in the accounting database.
- **on-line ordering**: orders are used to steer production and delivery directly.
- **production and delivery tracking**: customers can follow production and transportation.
- **after-sales support**: documentation (updates) and problem reports are handled through the Web.

Variants of Web database access

- A database can be made *accessible* to users who do not have a database interface. Server-side scripting is used to send queries to the database and translate answers to HTML.
  - Example: TUE phone book, always up to date
- A Web-site can be populated with data extracted from a database (e.g. at night).
  - Example: UIA phone book, not updated for several years.

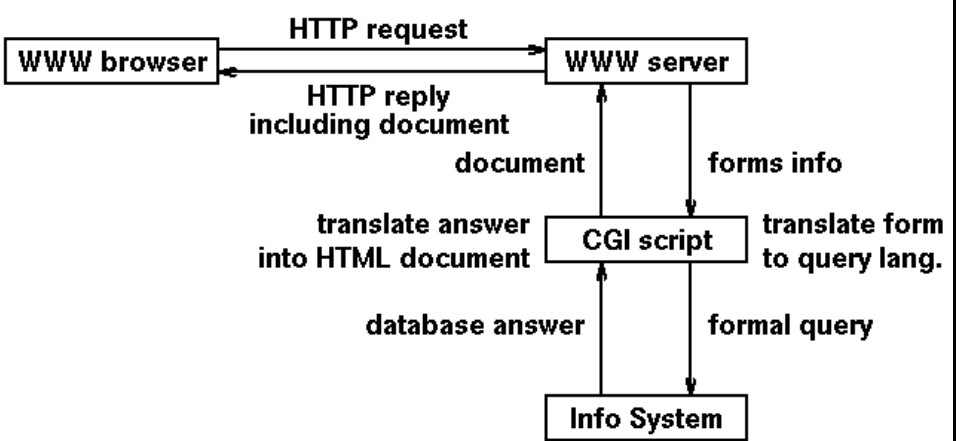
Basic Web Standards

- HyperText Transfer Protocol:
  - GET request for information requests;
  - POST request to provide additional information in a request; may have side effects;
  - PUT request to upload information to server.
- HyperText Markup Language
  - Links generate GET requests for other pages;
  - Imagemaps allow the selection of points or regions of images;
  - Forms send attribute/value pairs to the server.

Accessing Databases through www

- The server may forward requests to the database:
  - CGI scripts (Common Gateway Interface)
  - Server-side plug-ins (server dependent)
  - Servlets (Java code executed in the server)
- Browsers can access databases directly through Javascript, VBscript, Java Applets.
- Results are usually converted into HTML to be displayed by the browser.

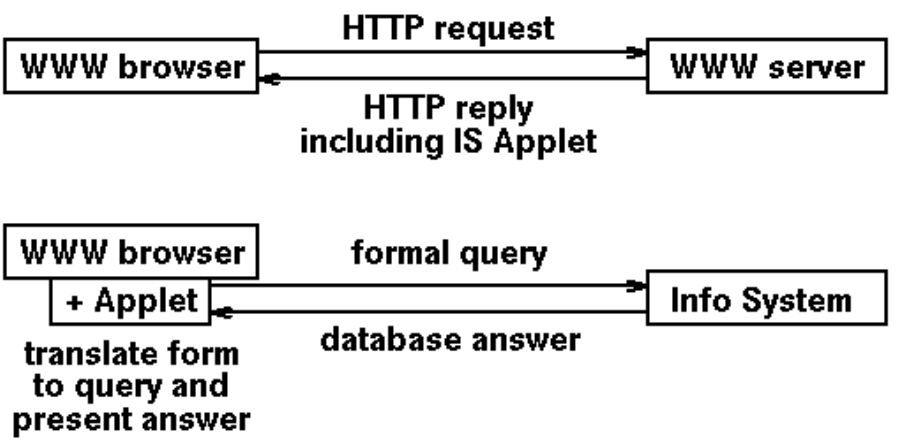
Architecture using CGI-scripts



Translations in WIS

- Web-server receives forms input, which must be translated into database operations (e.g. into SQL queries or updates).
  - Standards like ODBC and JDBC make it possible to do this in a portable way.
- Database produces results (in a DBMS-dependent format), which must be translated into HTML to send to the browser.
  - When databases can produce results in XML this translation can be done in a portable way.

Architecture with Applets



Presentation of data

- Traditionally tabular data.
- Multimedia data require other presentation:
  - The presentation of an object may require a designed *layout* for multi-media attributes;
  - Few objects fit on the screen; indirect access may be needed, through links or temporal relationships;
  - Some objects may be too large to fit on the screen; they may need to be split up.

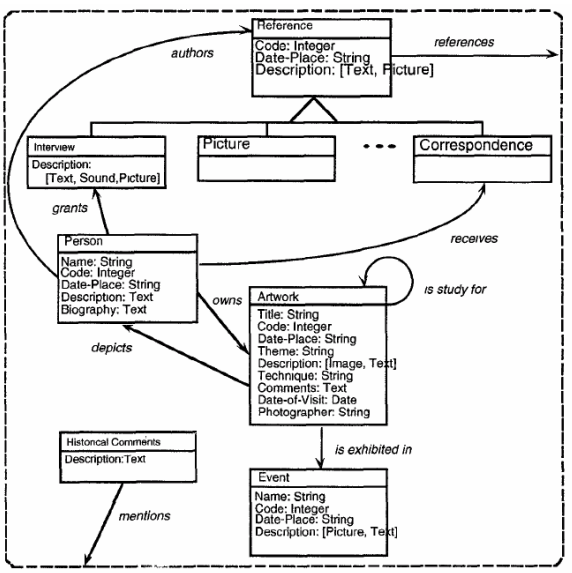
Navigation through data

- Databases consist of objects and relationships.
- Hypermedia applications consist of objects (nodes) and relationships (links).
  - Direct access to objects, as in tables, must be replaced by access through sets of links;
  - Access to different parts of objects must be provided by means of links;
  - Relationships between object types must be translated into link structures.

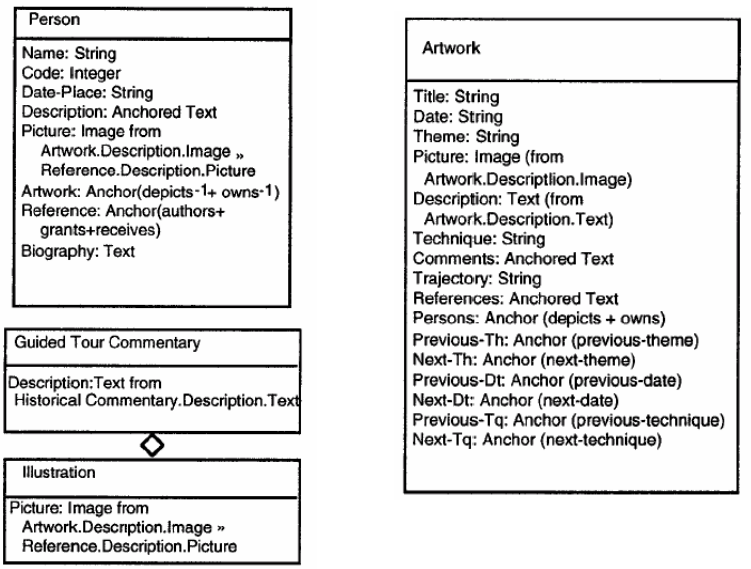
Design with OOHDM

- Conceptual design
  - Build a model of the application domain using OO modeling principles.
- Navigational design
  - Design how the user can navigate, using indexes and guided tours.
- Abstract interface design
  - Layout through Abstract Data Views (ADV)
- Implementation

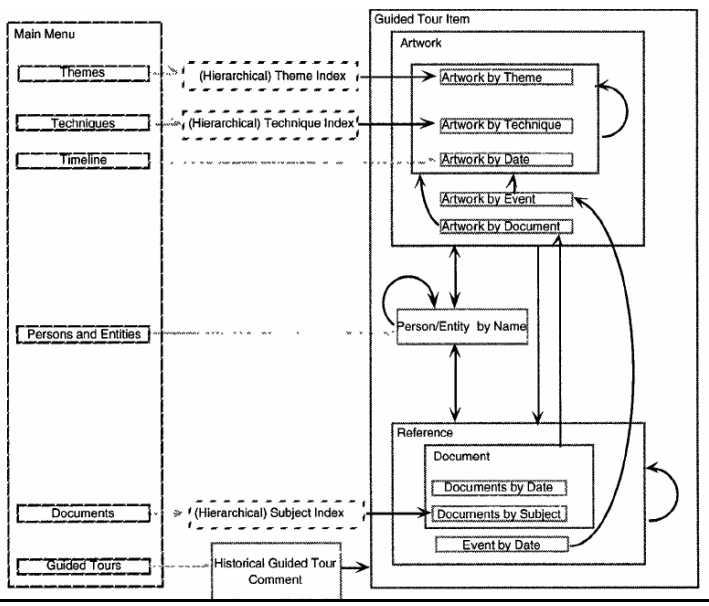
Example of conceptual schema



Example of navigational design



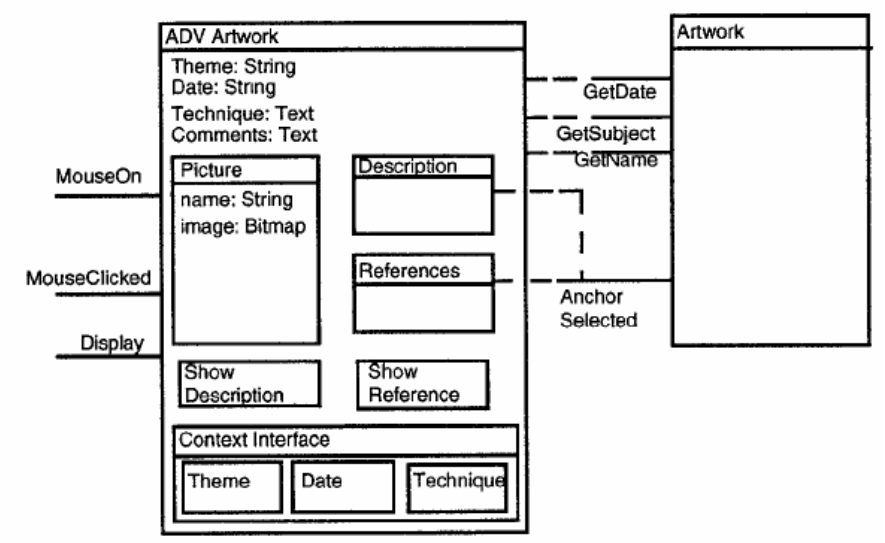
Navigational design (cont.)



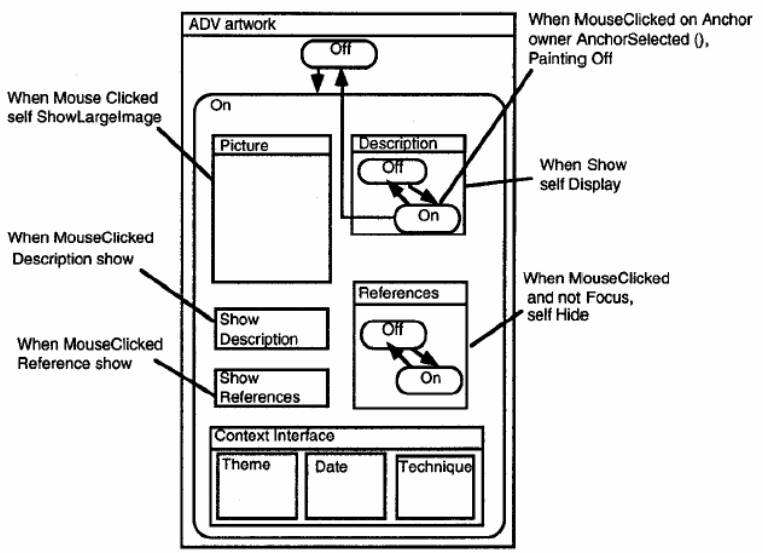
Abstract Interface Design

- An **abstract data view** is a formal, object oriented model of an interface object, showing:
  - the static layout structure, including interface appearance of navigational objects and other interface objects (menu bars, buttons).
  - the static relation to navigation objects.
  - how they behave when reacting to external events; in particular how they trigger navigation. (ADV-charts are a derivative of Statecharts)

Example Configuration Diagram



Example ADV



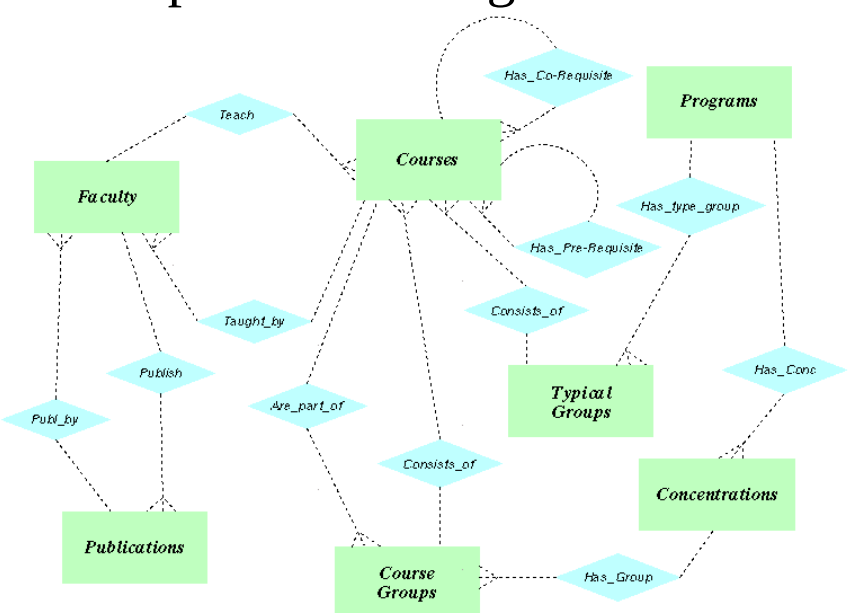
The Relationship Management Methodology (RMM)

- The name RMM is based on the view that hypermedia is a vehicle for managing **relationships** between information objects.
- The associated data model is RMDM: Relationship Management Data Model.
- Transformation of **data structure** into a **data and navigation structure**.
- RMDM enables to describe **information objects and navigation mechanisms** in hypermedia applications.

The Relationship Management Data Model (RMDM)

- RMDM's **domain primitives** model:
  - entity types;
  - attributes;
  - associative relationships.
- **Slices** are groups of attributes, used to split up large groups of diverse attributes into smaller groups of related attributes.
  - Example: a person's home page can be split up into a main slice, biography slice, publication slice, hobby slice.

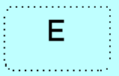
Example: E-R Design



RMDM Access Primitives

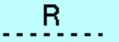
E-R Domain Primitives

Entities

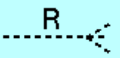


Attributes

One-One Associative Relationship



One-Many Associative Relationship



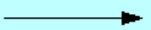
RMD Domain Primitives

Slices

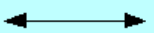
RMDM Access Primitives

Access Primitives

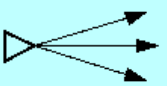
Unidirectional Link



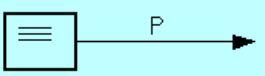
Bidirectional Link



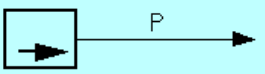
Grouping



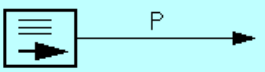
Conditional Index



Conditional Guided Tour



Conditional Indexed Guided Tour



Example: Slice Design

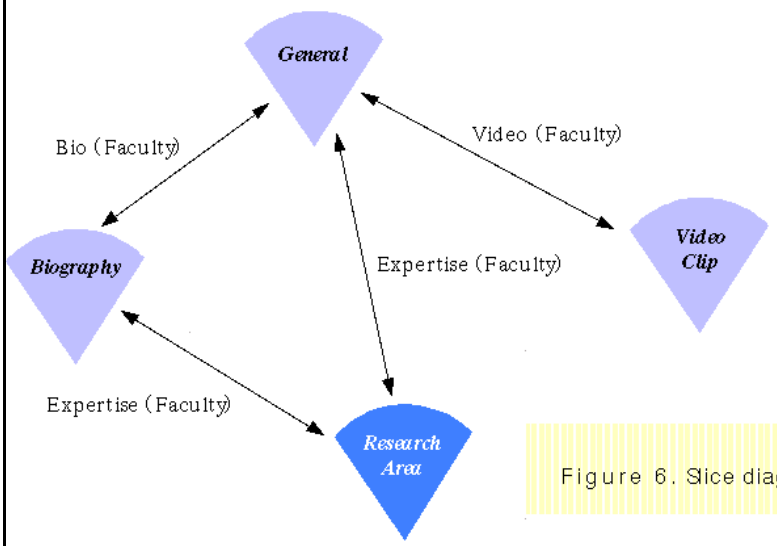
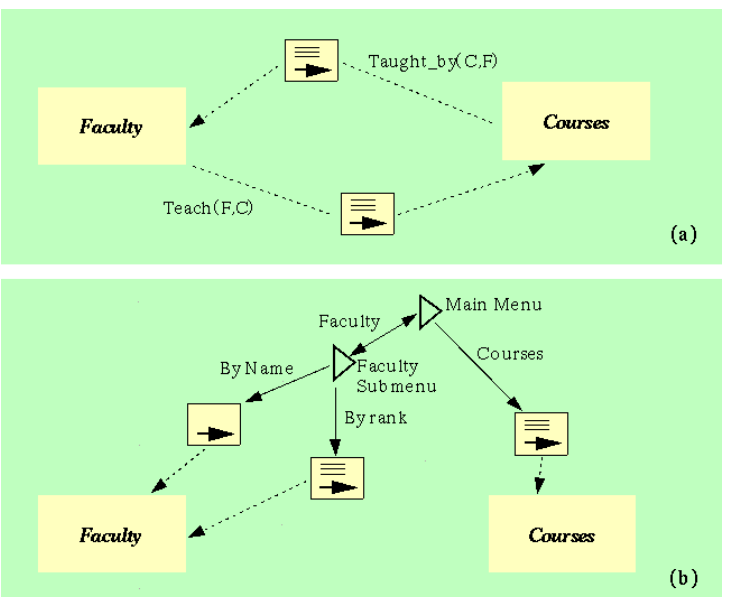
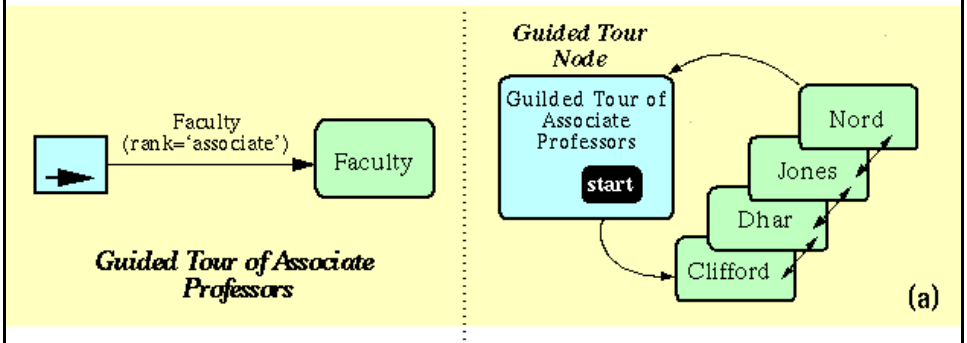


Figure 6. Slice diagram for faculty.

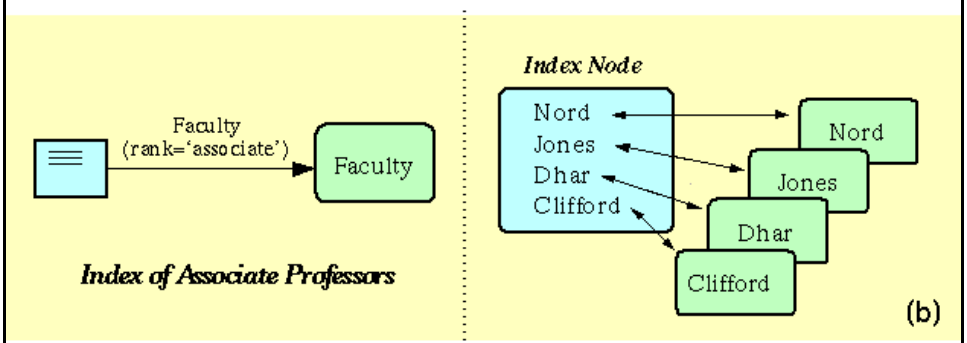
Example: E-R to RMDM conversion



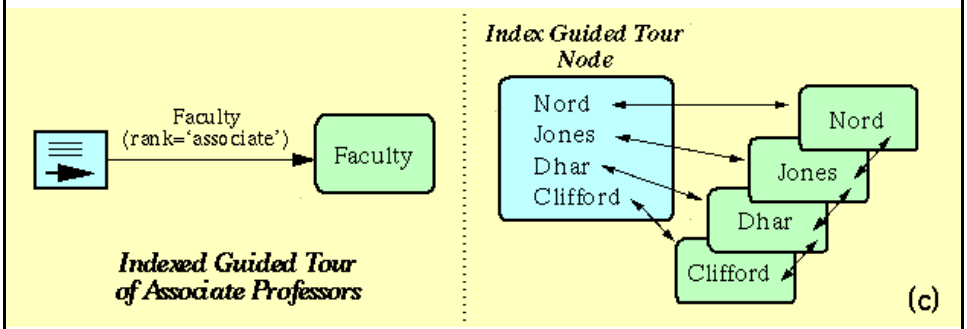
Example: RMDM Access Constructs



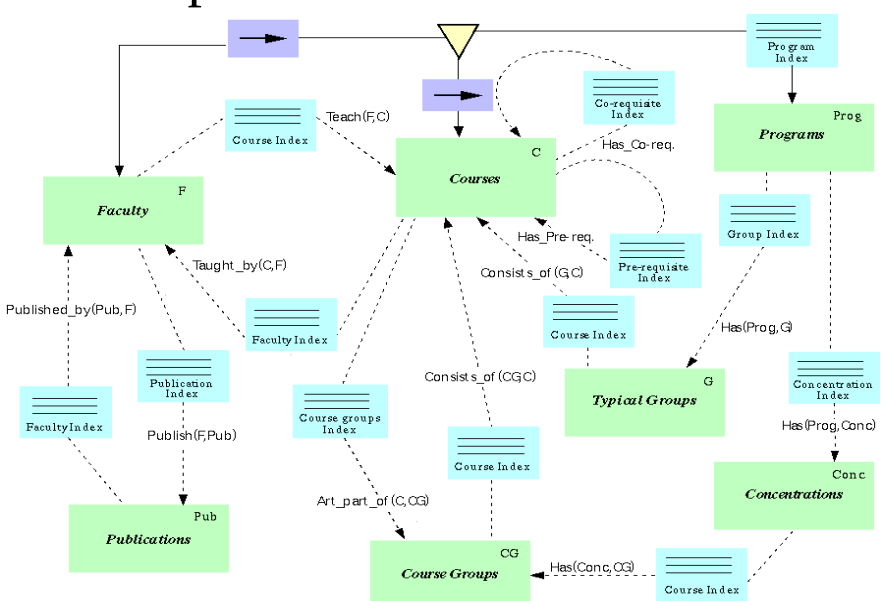
Example: RMDM Access Constructs



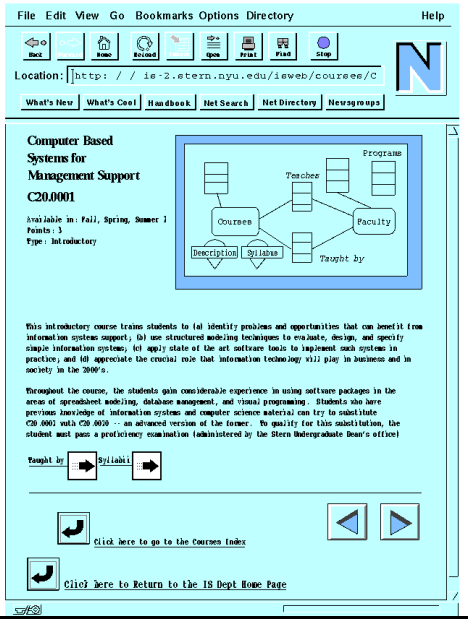
Example: RMDM Access Constructs



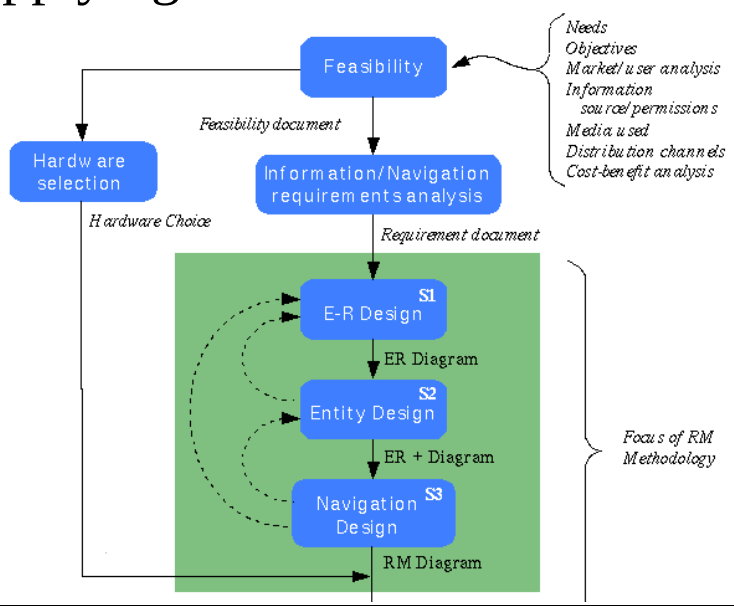
Example: RMDM Scheme



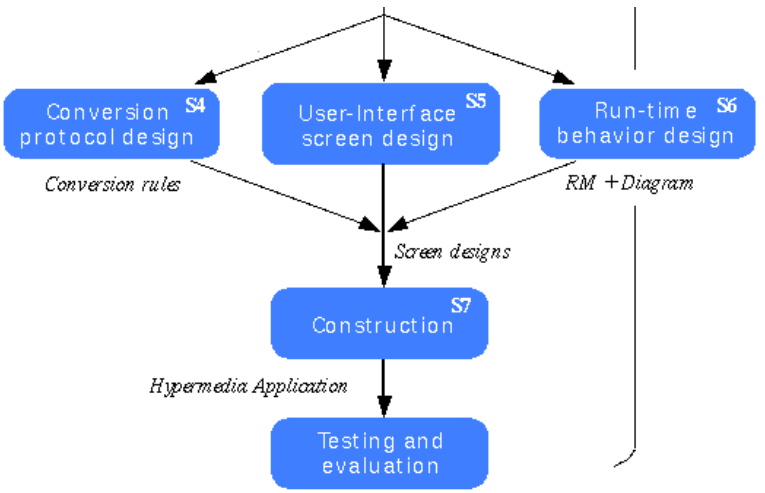
Example: Screen Layout



Applying RMM

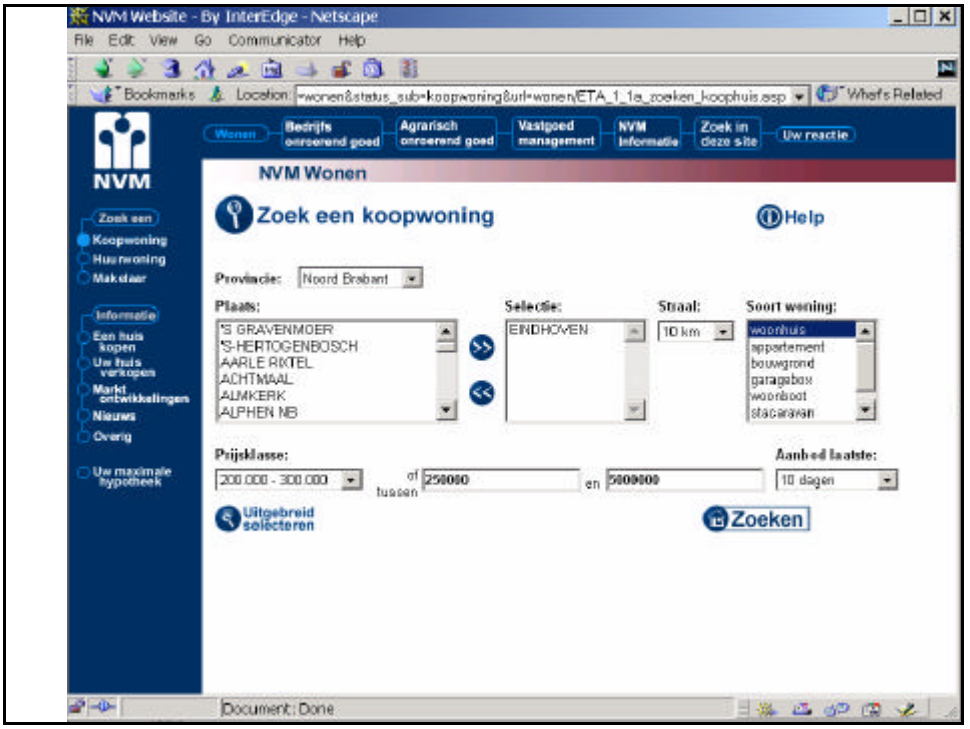


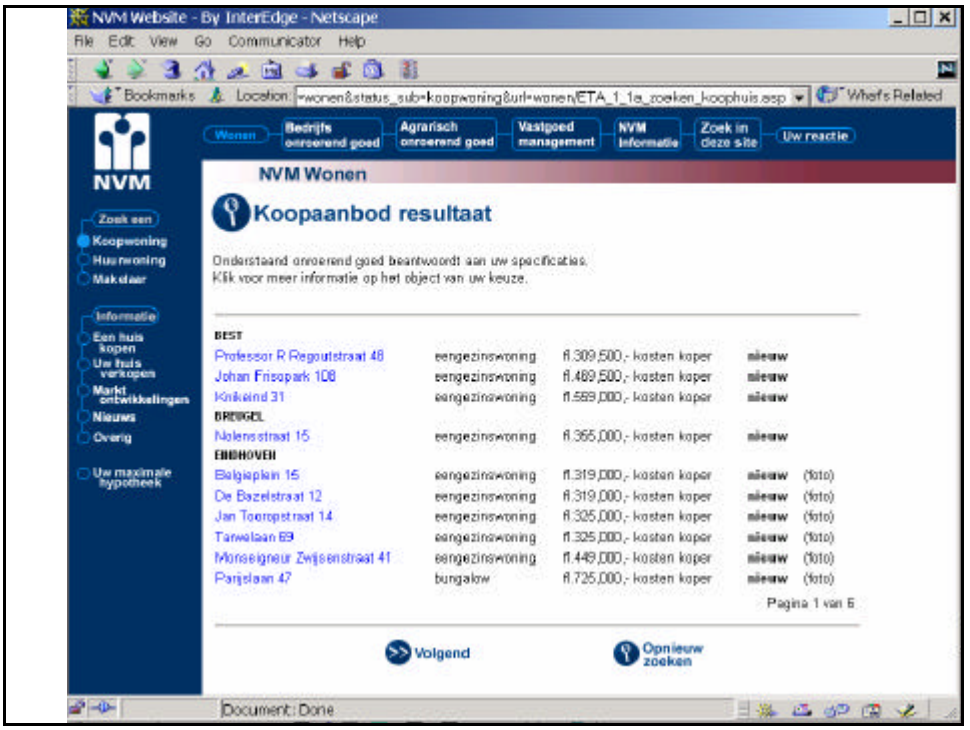
Applying RMM

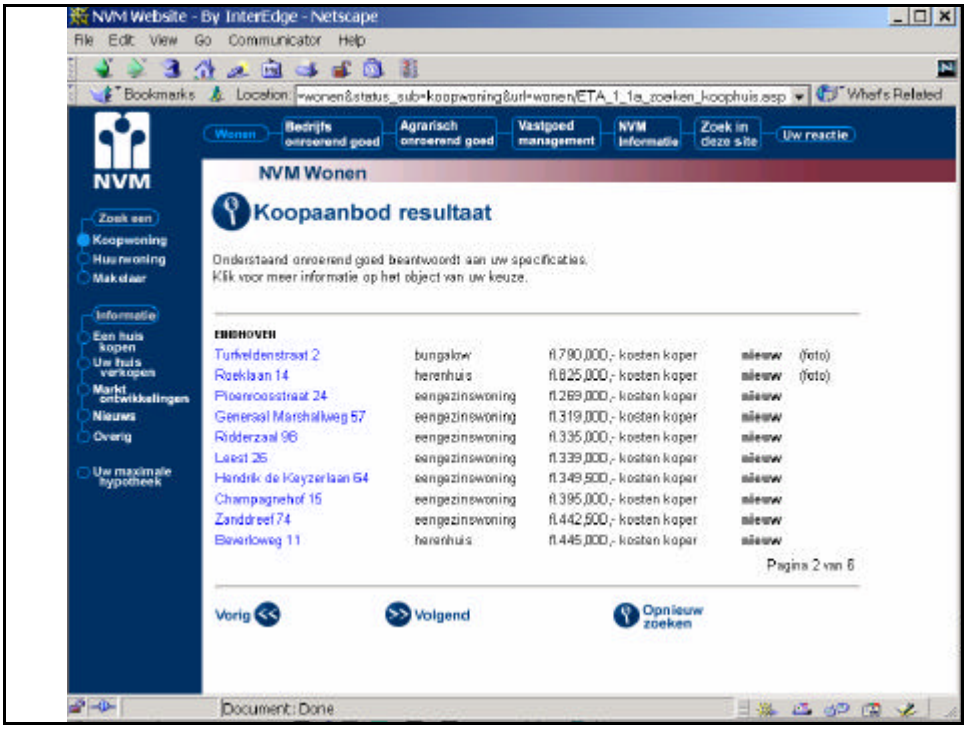


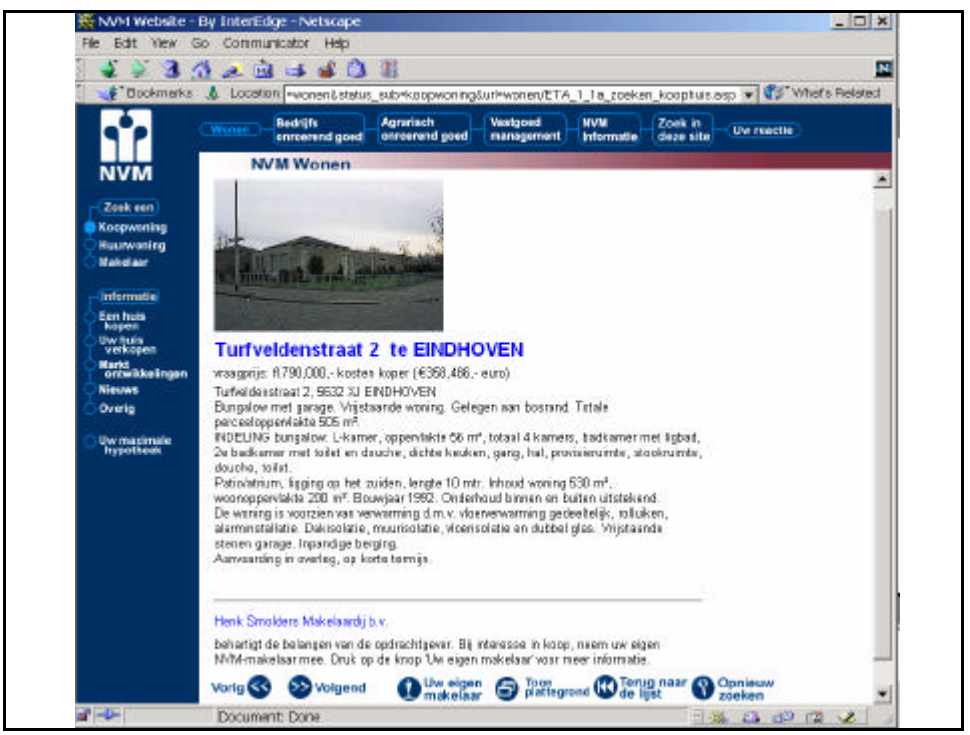
"Real World" Examples

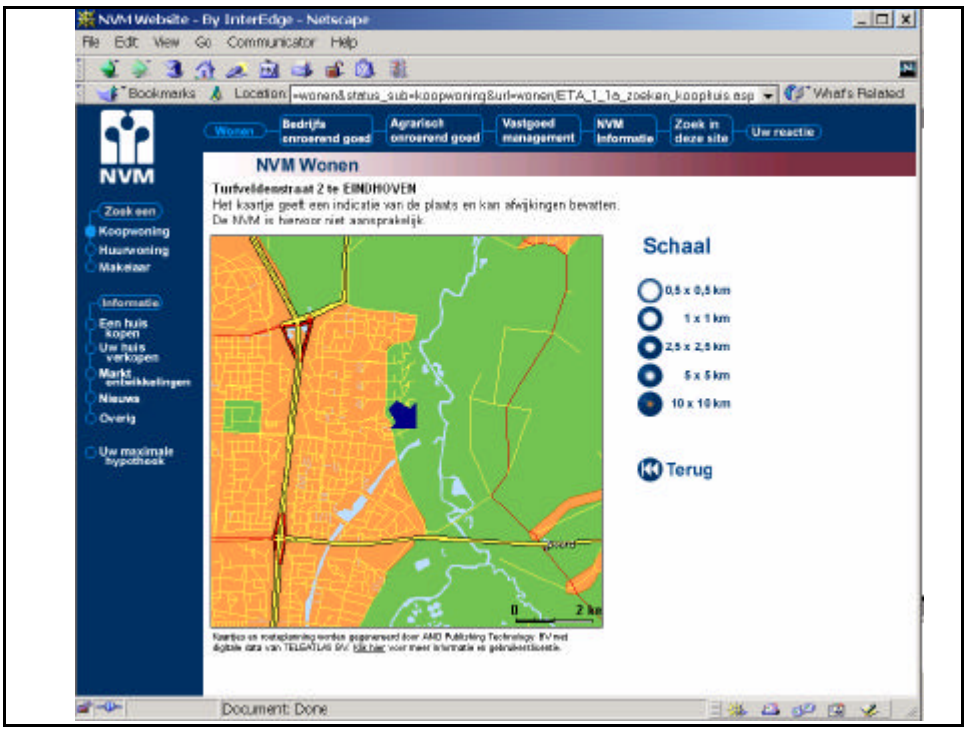
- A simple example with an **index** structure is the real-estate site of the LMV:
  http://www.lmv.nl/
- An example with **indexed guided tours** is the real-estate site of the NVM:
  http://www.nvm.nl/


NVM Website - By InterEdge - Netscape
File Edit View Go Communicator Help
Bookmarks Location: =wonen&status_sub=koopwoning&url=wonen/ETA_1_1a_zoeken_koophuis.asp What's Related
NVM
Wonen
Bedrijfs onroerend goed
Agrarisch onroerend goed
Vastgoed management
NVM informatie
Zoek in deze site
Uw reactie
NVM Wonen
Zoek een
Koopwoning
Huurwoning
Makelaar
Informatie
Een huis kopen
Uw huis verkopen
Markt ontwikkelingen
Nieuws
Overig
Uw maximale hypotheek
Zoek een koopwoning
Help
Provincie: Noord Brabant
Plaats:
'S GRAVENMOER
'S-HERTOGENBOSCH
AARLE RIXTEL
ACHTMAAL
ALMKERK
ALPHEN NB
Selectie:
EINDHOVEN
Straal:
10 km
Soort woning:
woonhuis
appartement
bouwgrond
garagebox
woonboot
stacaravan
Prijsklasse:
200.000 - 300.000
of tussen
250000
en
5000000
Aanbod laatste:
10 dagen
Uitgebreid selecteren
Zoeken
Document: Done


NVM Website - By InterEdge - Netscape
File Edit View Go Communicator Help
Bookmarks Location: =wonen&status_sub=koopwoning&url=wonen/ETA_1_1a_zoeken_koophuis.asp What's Related
NVM
Wonen
Bedrijfs onroerend goed
Agrarisch onroerend goed
Vastgoed management
NVM informatie
Zoek in deze site
Uw reactie
NVM Wonen
Koopaanbod resultaat
Onderstaand onroerend goed beantwoordt aan uw specificaties.
Klik voor meer informatie op het object van uw keuze.
BEST
Professor R Regoutstraat 48 eengezinswoning fl.309,500,- kosten koper nieuw
Johan Frisopark 108 eengezinswoning fl.469,500,- kosten koper nieuw
Kinkelend 31 eengezinswoning fl.569,000,- kosten koper nieuw
BREUGEL
Nolensstraat 15 eengezinswoning fl.365,000,- kosten koper nieuw
EINDHOVEN
Belgiaplein 15 eengezinswoning fl.319,000,- kosten koper nieuw (foto)
De Bazelstraat 12 eengezinswoning fl.319,000,- kosten koper nieuw (foto)
Jan Tooropstraat 14 eengezinswoning fl.325,000,- kosten koper nieuw (foto)
Tarwelaan 69 eengezinswoning fl.325,000,- kosten koper nieuw (foto)
Monseigneur Zwijsenstraat 41 eengezinswoning fl.449,000,- kosten koper nieuw (foto)
Panjelaan 47 bungalow fl.725,000,- kosten koper nieuw (foto)
Pagina 1 van 6
Volgend
Opnieuw zoeken
Document: Done


NVM Website - By InterEdge - Netscape
File Edit View Go Communicator Help
Bookmarks Location: =wonen&status_sub=koopwoning&url=wonen/ETA_1_1a_zoeken_koophuis.asp What's Related
NVM
Wonen
Bedrijfs onroerend goed
Agrarisch onroerend goed
Vastgoed management
NVM informatie
Zoek in deze site
Uw reactie
NVM Wonen
Zoek een
Koopwoning
Huurwoning
Makelaar
Informatie
Een huis kopen
Uw huis verkopen
Markt ontwikkelingen
Nieuws
Overig
Uw maximale hypotheek
Koopaanbod resultaat
Onderstaand onroerend goed beantwoordt aan uw specificaties.
Klik voor meer informatie op het object van uw keuze.
EINDHOVEN
Turfveldenstraat 2 bungalow fl.790,000,- kosten koper nieuw (foto)
Roeklaan 14 herenhuis fl.825,000,- kosten koper nieuw (foto)
Ploegossstraat 24 eengezinswoning fl.289,000,- kosten koper nieuw
Generaal Marshallweg 57 eengezinswoning fl.319,000,- kosten koper nieuw
Ridderzaal 98 eengezinswoning fl.335,000,- kosten koper nieuw
Leest 26 eengezinswoning fl.339,000,- kosten koper nieuw
Hendrik de Keyzerlaan 64 eengezinswoning fl.349,500,- kosten koper nieuw
Champagnehof 15 eengezinswoning fl.395,000,- kosten koper nieuw
Zanddreef 74 eengezinswoning fl.442,500,- kosten koper nieuw
Bewerloweg 11 herenhuis fl.445,000,- kosten koper nieuw
Pagina 2 van 6
Vorig
Volgend
Opnieuw zoeken
Document: Done


NVM Website - By InterEdge - Netscape
File Edit View Go Communicator Help
Bookmarks Location: =wonen&status_sub=koopwoning&url=wonen/ETA_1_1a_zoeken_koophuis.asp What's Related
NVM
Wonen
Bedrijfs onroerend goed
Agrarisch onroerend goed
Vastgoed management
NVM informatie
Zoek in deze site
Uw reactie
NVM Wonen
Zoek een
Koopwoning
Huurwoning
Makelaar
Informatie
Een huis kopen
Uw huis verkopen
Markt ontwikkelingen
Nieuws
Overig
Uw maximale hypotheek
Turfveldenstraat 2 te EINDHOVEN
vraagprijs: fl.790,000,- kosten koper (€358,486,- euro)
Turfveldenstraat 2, 5632 XJ EINDHOVEN
Bungalow met garage. Vrijstaande woning. Gelegen aan bosrand. Totale perceelsoppervlakte 505 m².
INDELING bungalow: L-kamer, oppervlakte 56 m², totaal 4 kamers, badkamer met ligbad, 2e badkamer met toilet en douche, dichte keuken, gang, hal, provisiekamer, strookruimte, douche, toilet.
Patiotuintuin, ligging op het zuiden, lengte 10 mtr. Inhoud woning 530 m³.
woonoppervlakte 200 m². Bouwjaar 1962. Onderhoud binnen en buiten uitstekend.
De woning is voorzien van verwarming d.m.v. vloerverwarming gedeeltelijk, rolluiken, alarminstallatie. Dakisolatie, muurisolatie, vloerisolatie en dubbel glas. Vrijstaande stenen garage. Inpandige berging.
Aanvaarding in overleg, op korte termijn.
Henk Smolders Makelaardij b.v.
behartigt de belangen van de opdrachtgever. Bij interesse in koop, neem uw eigen NVM-makelaar mee. Druk op de knop 'Uw eigen makelaar' voor meer informatie.
Vorig
Volgend
Uw eigen makelaar
Toon plattegrond
Terug naar de lijst
Opnieuw zoeken
Document: Done



Shortcomings of RMM

- For user-defined queries there is **no predefined structure** for which RMM produces a representation.
- An **extension** to RMM is needed to generate hypermedia representations and navigation structures for query results.
- The exact **query specification** needs to be considered as well. It is not feasible to design a presentation for every possible query.

Translation from SQL to RMDM

- Core of the approach is:
  1. Use heuristics to determine a *reasonable* navigation and presentation for query results.
  2. Offer extensions to SQL to allow users to specify alternative navigation and presentation.
- We distinguish three cases:
  - Query result is **single slice**.
  - Query result is **multiple slices** from a **single relation**.
  - Query result is **multiple slices** from **several relations.**

Single slice queries (1)

- Consider relation R with:
  - head slice with attributes ABCD
  - slice Y with EFG, forward link from head slice
  - slice Z with HIJK, forward link from head slice
- **select** A,B,C,D **from** R **where** C=0;
- Heuristics lead to:
  - inter-record navigation as for base relation;
  - intra-record navigation starts at slice "specified" in the select clause;
  - no new volatile slices are created.

Single slice queries (2)

- Extensions to SQL:
  - **select** (E,G) **asslice** X **newhead**
    from R;
- User can connect new slices through links:
  - **select** (E,G) **aslice** X **newhead**,
    links (X, **head**(R))
    from R;
  - **select** (H,K) **asslice** X, (I,J,K) **asslice** W,
    links (**head**(R),X), (X,W)
    from R;

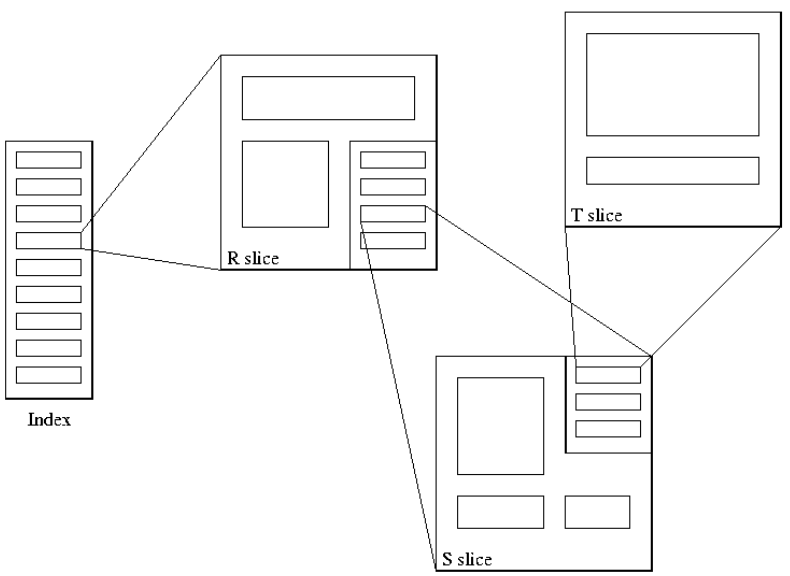
Multiple slice queries

- Consider same R with slices X and Y, with X and Y reachable from head through link.
- **select** A,B,I,J,K **from** R;
- Heuristics lead to:
  - inter-record navigation same as for base relation;
  - intra-record navigation starts at the head slice;
  - no new volatile slices are created

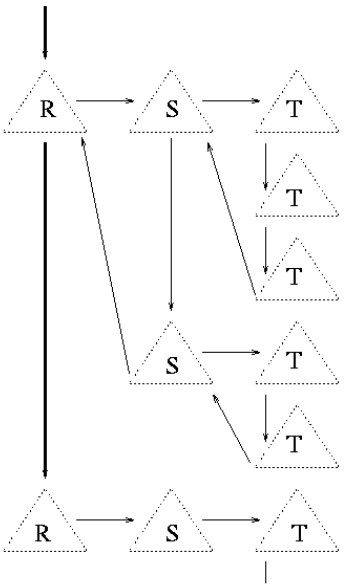
Multiple relation queries

- Heuristics lead to:
  - inter-record navigation for the resulting set of records is the same as for the first relation in the **from** clause;
  - intra-record navigation between base records uses **indexed guided tour** to connect associated base records;
  - intra-record navigation within base record starts at head slice;
  - no new volatile slices are created;

Join structures



Join structures



Example screen shot