Multi-representation in spatial databases using the MADS conceptual model

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ICA Workshop on Generalisation and Multiple representation – 20-21 August 2004 – Leicester

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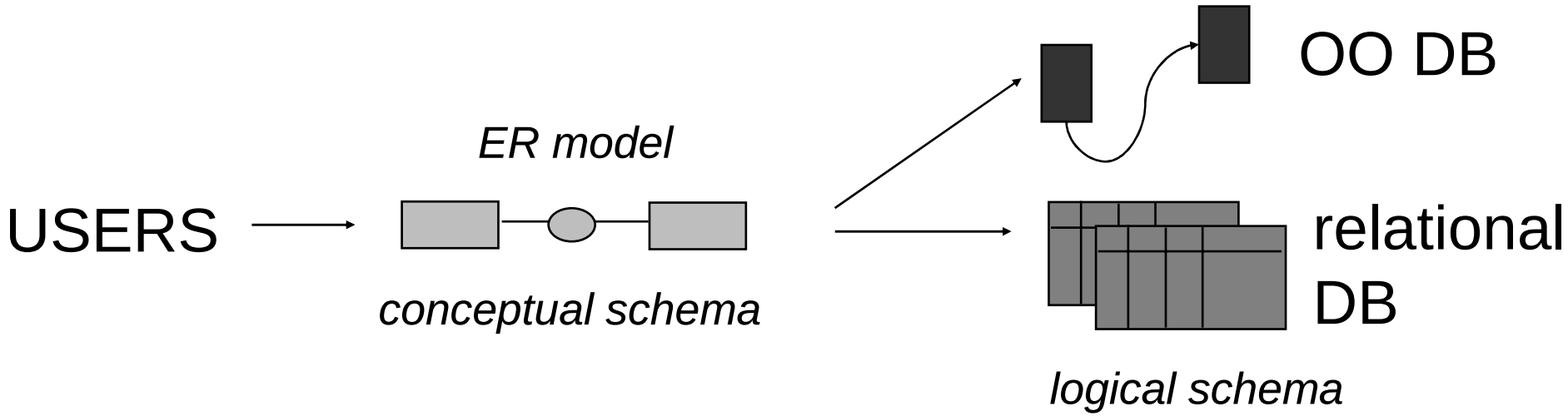
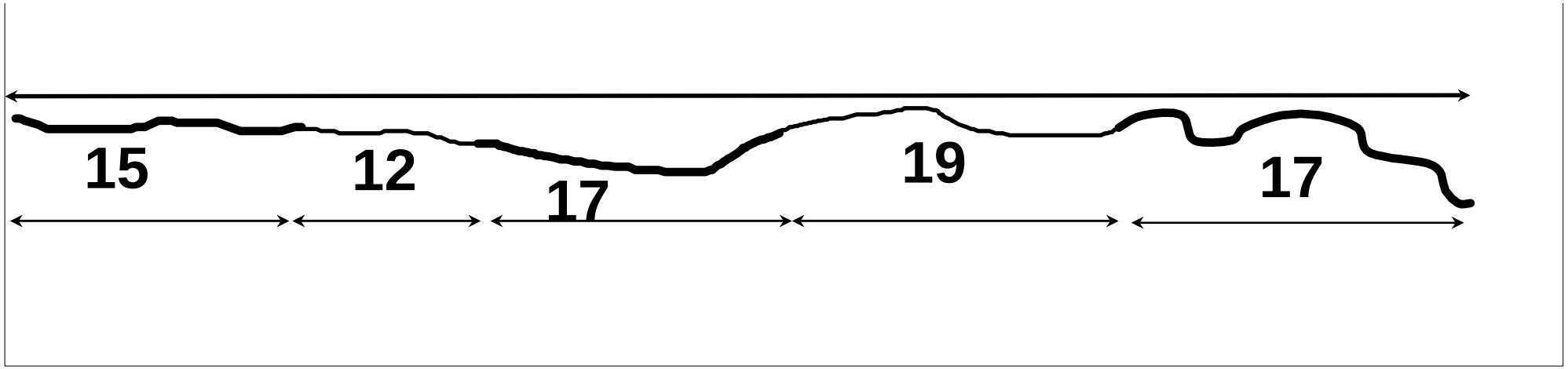
MADS is a conceptual model ...

- ER conceptual





life cycle

space varying attribute

spatial attribute

temperature f( )

tributary

Flows

River

spatial object type

main

quality f( )

name

reservoir

time varying attribute

topological semantics

R# name location

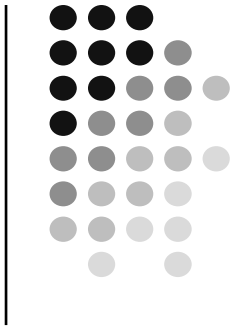
synchronisation semantics

spatial attribute

Big

Small

Objectives

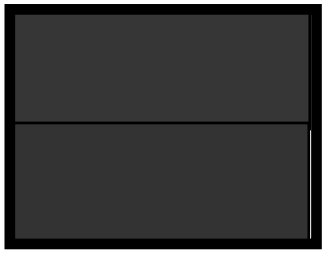


- Add Multi-representation facilities in the MADS conceptual model

- Considering the following facets:
  - Resolution
    - level of detail for spatial and thematic data
  - Viewpoint
    - user perception of real world

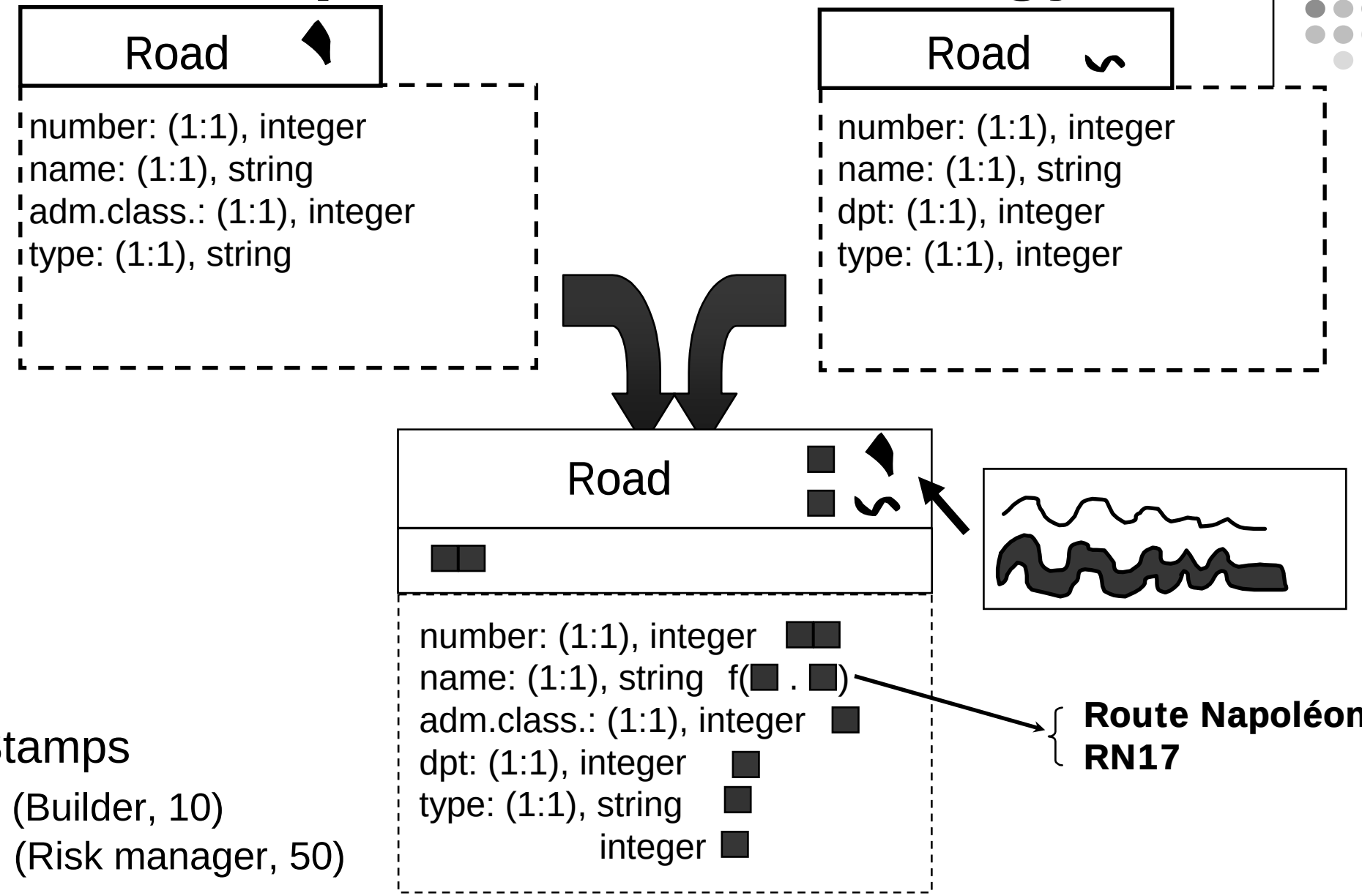
Multi-Representation Modeling

- Two strategies:
  - Multi-representation strategy
    - Integrate representations in a single data structure
  - Inter-representation strategy
    - Link representations with a link with an inter-representation semantics

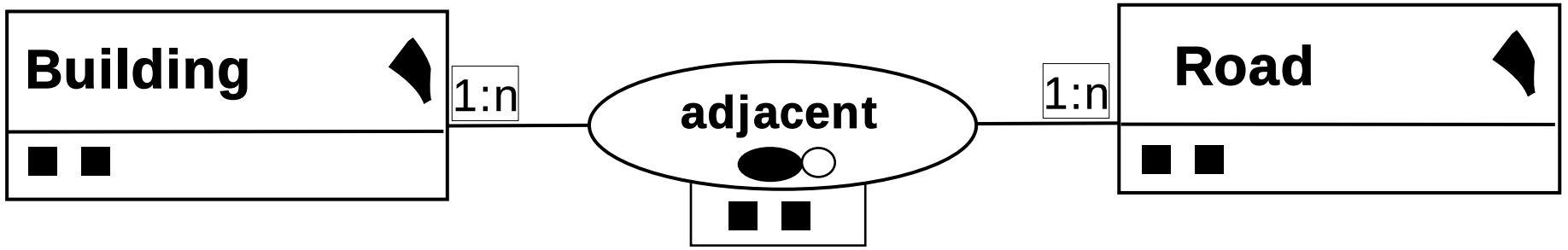


- Stamping
  - ■ (Builder, 10)
  - ■ (Risk manager, 50)

Multi-representation strategy

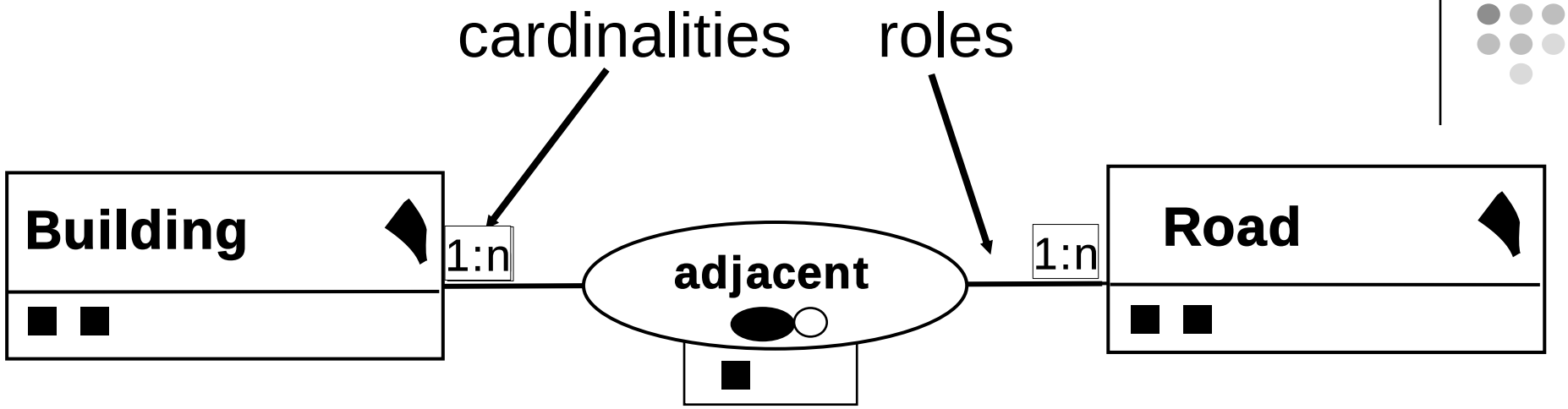


Multi-perception relationship



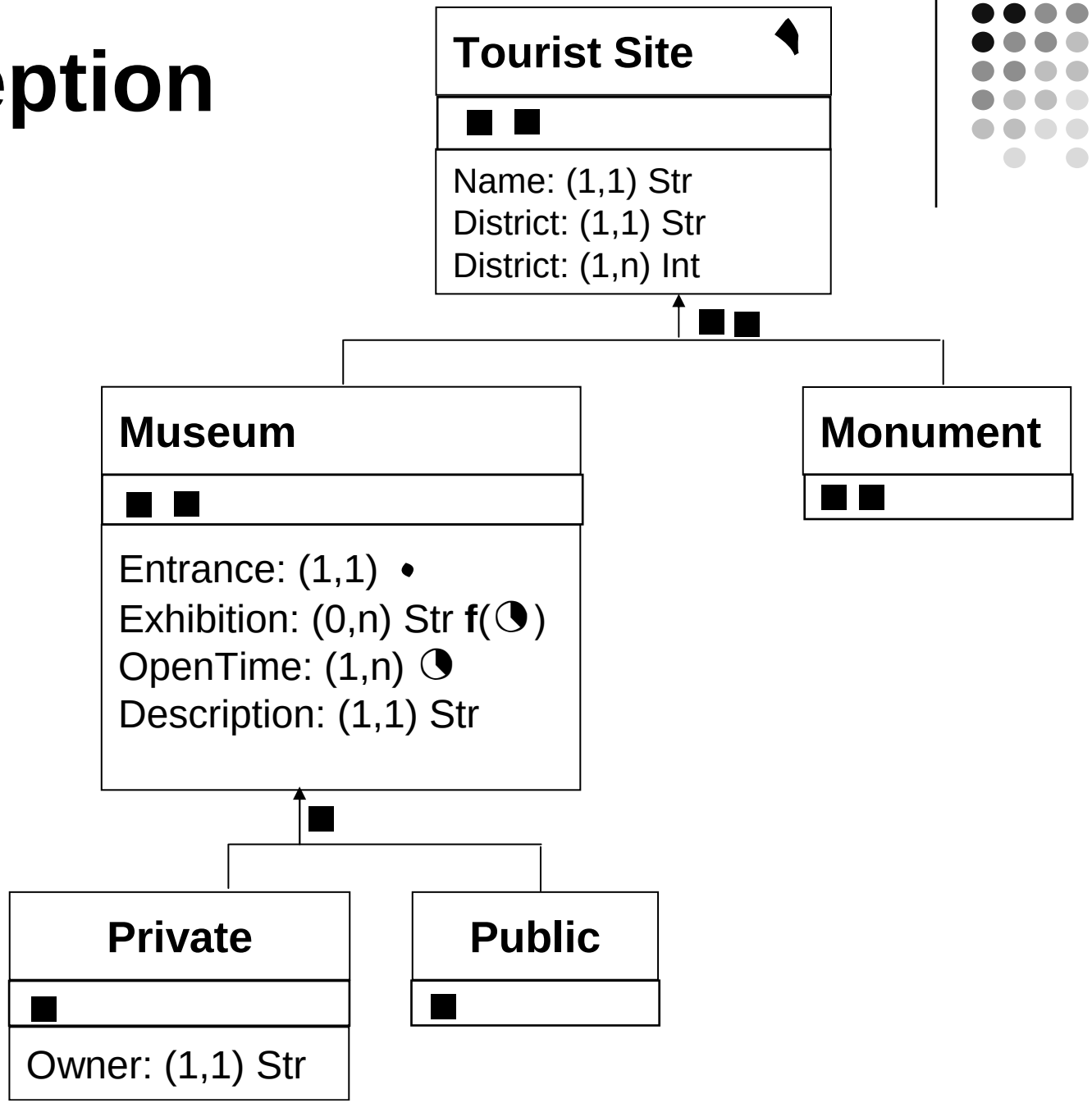
- Multi-perception relationship "*Adjacent*":
  - Adjacency of buildings and roads is described for red and blue stamps
  - *Adjacent* relationship may contain different sets of attributes according to stamps

Multi-perception relationship (2)

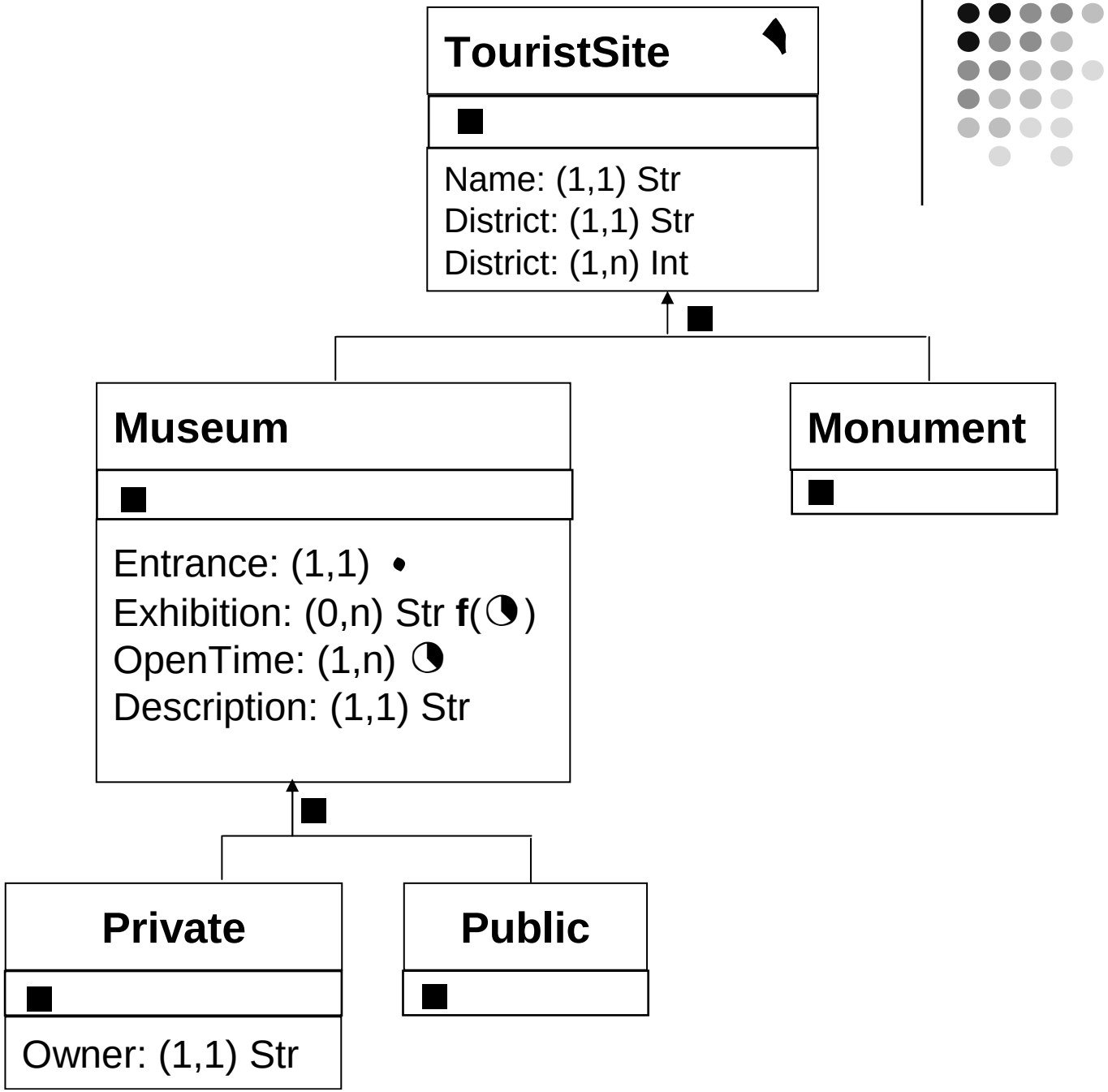


- Mono-perception relationship "*Adjacent*":
  - Adjacency of buildings and roads is described only for ■
  - Transactions having only the stamp ■ do not see which instances of Building are linked to which instances of Road

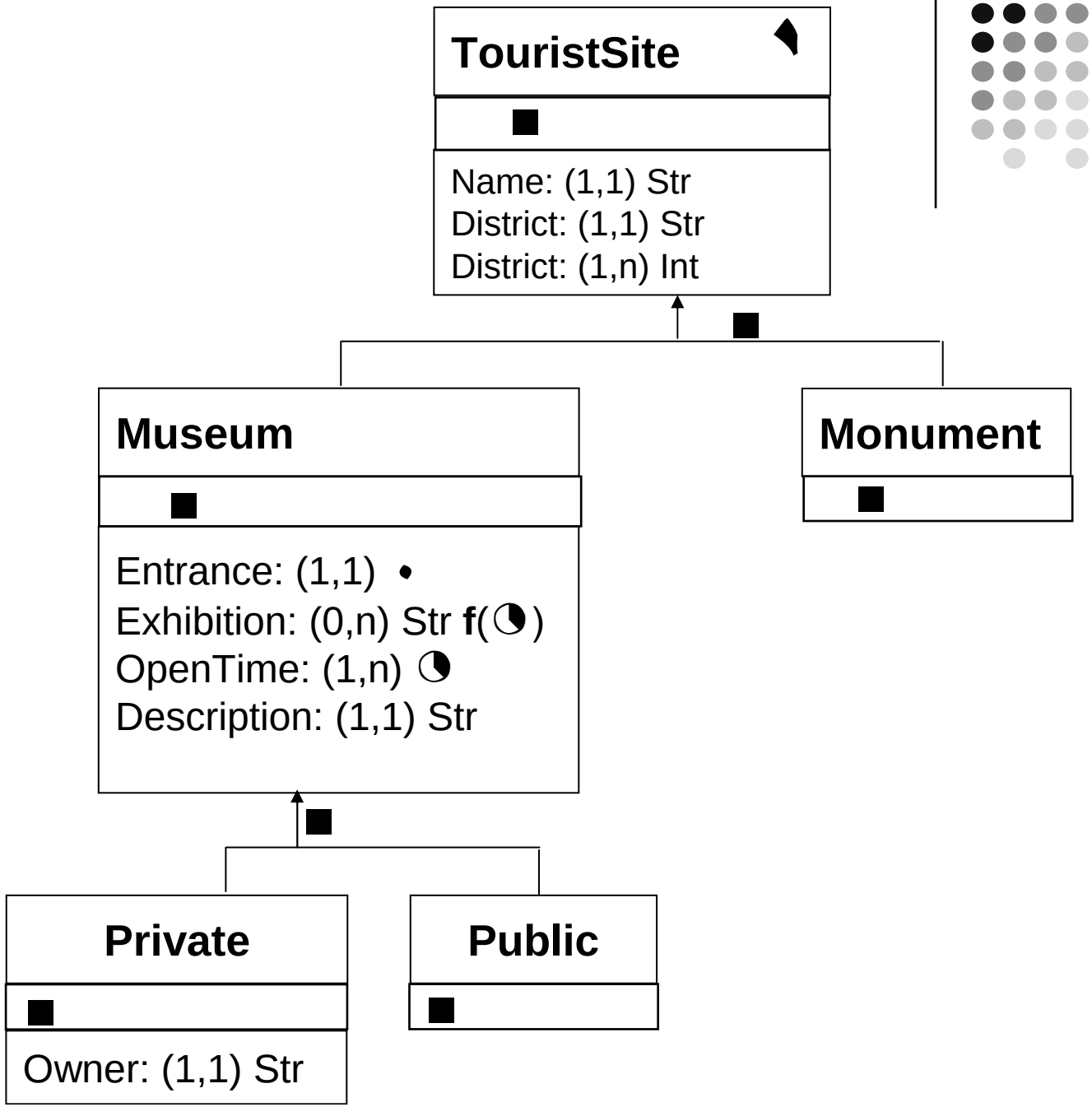
Multi-perception hierarchy



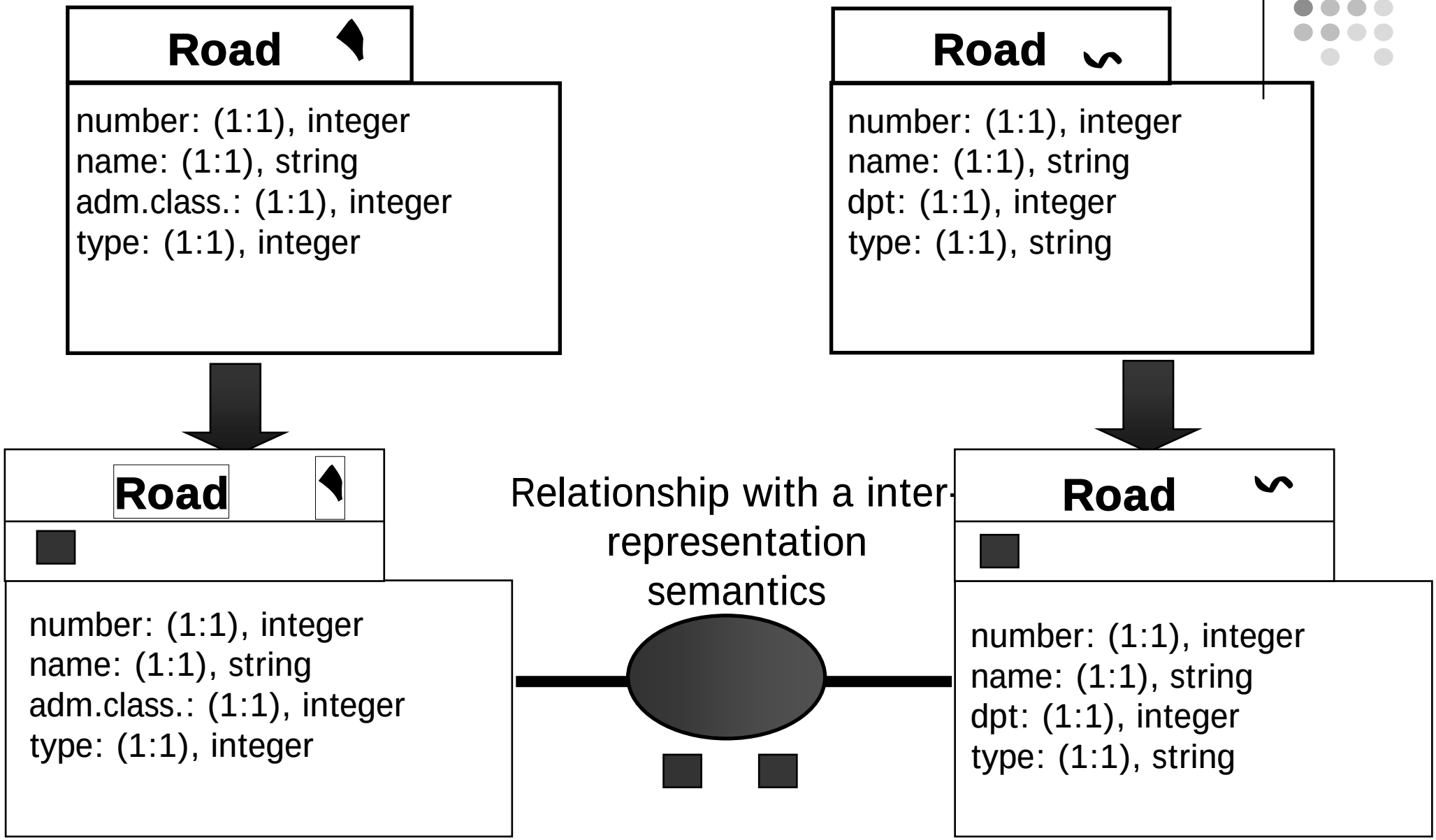
Multi-perception hierarchy



Multi-perception hierarchy

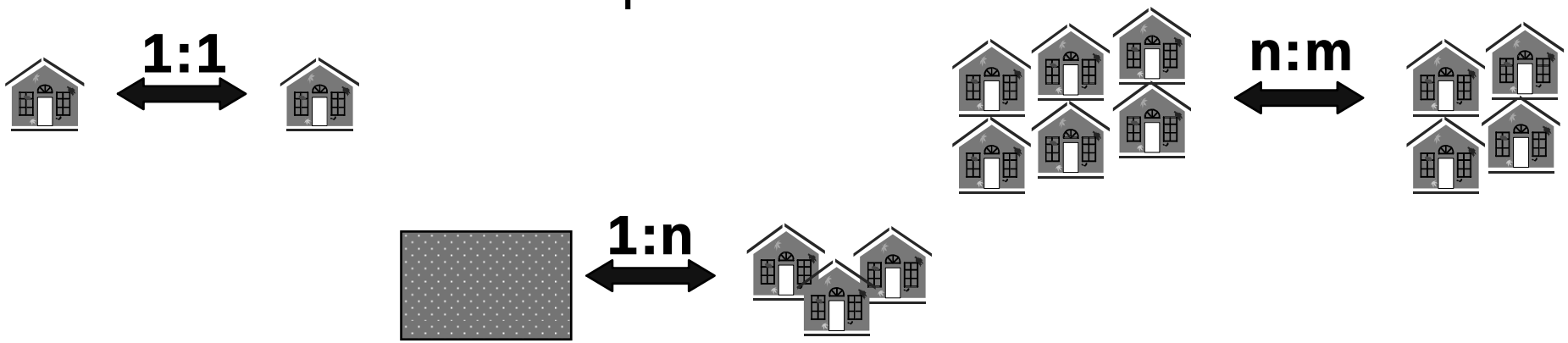


Inter-representation strategy



Inter-representation strategy

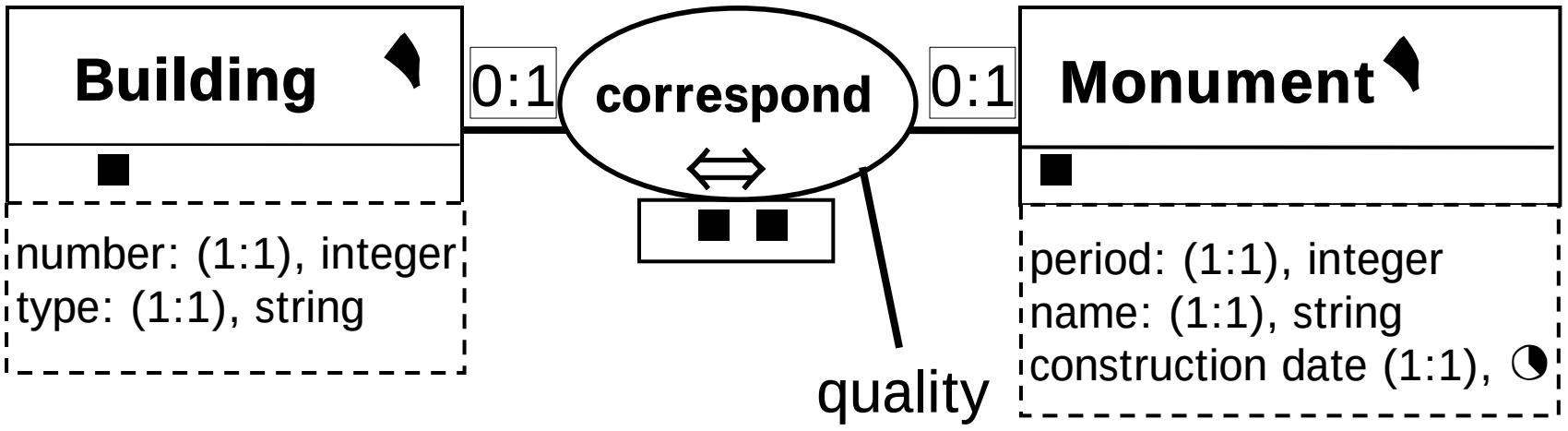
- Several kinds of correspondences:



- Adding a inter-representation semantics on relationships:
  - Binary relationship 1:1
  - Aggregation 1:n
  - Multi-associations n:m

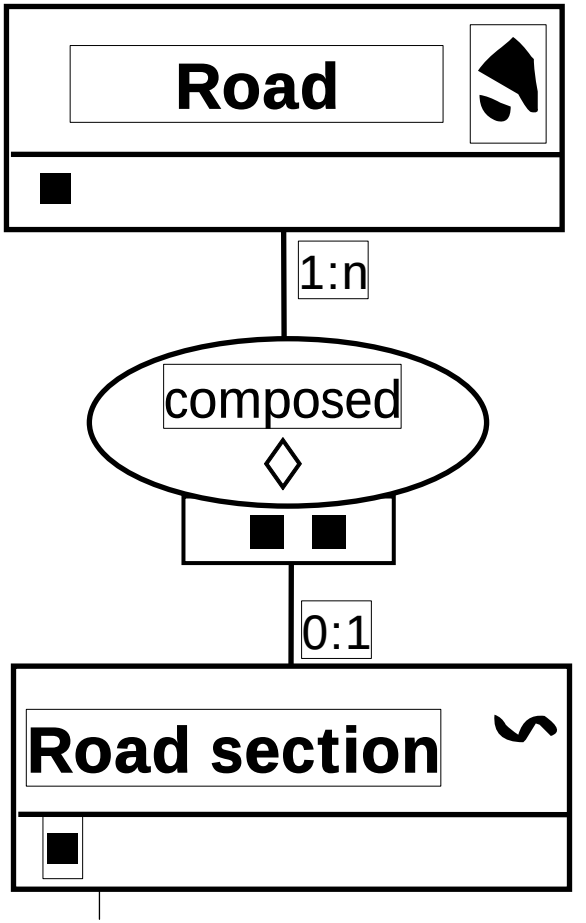
1:1 correspondence

- Binary relationship with inter-representation semantics
- Links 2 objects representing the same phenomenon in different perceptions



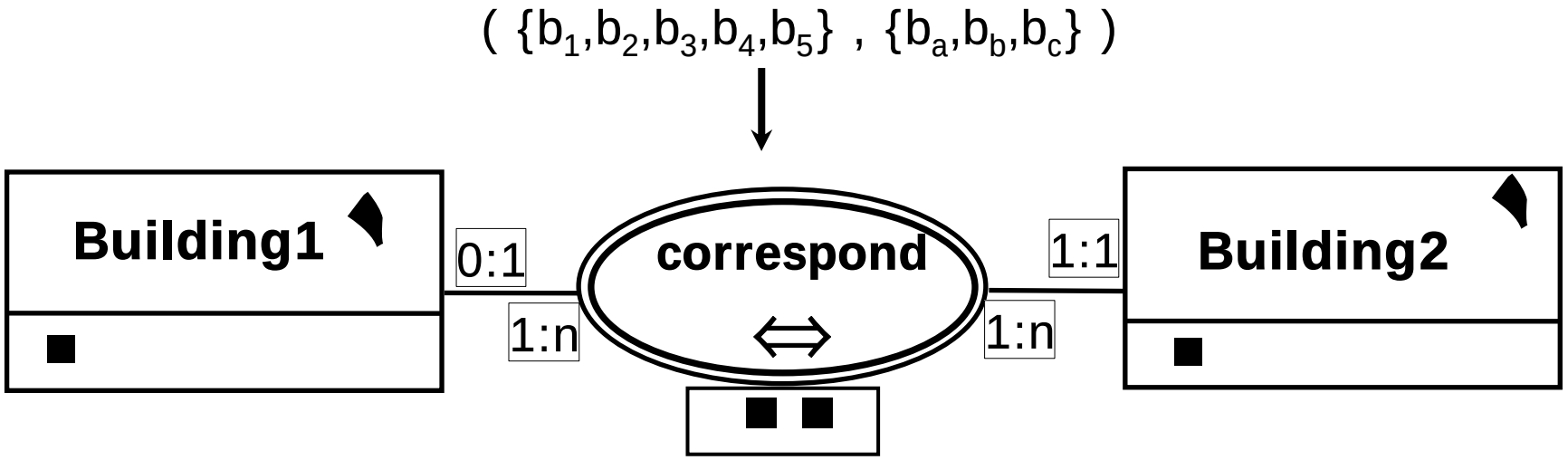
1:n correspondence

- Aggregation (intrinsic inter-representation semantics)



n:m correspondence

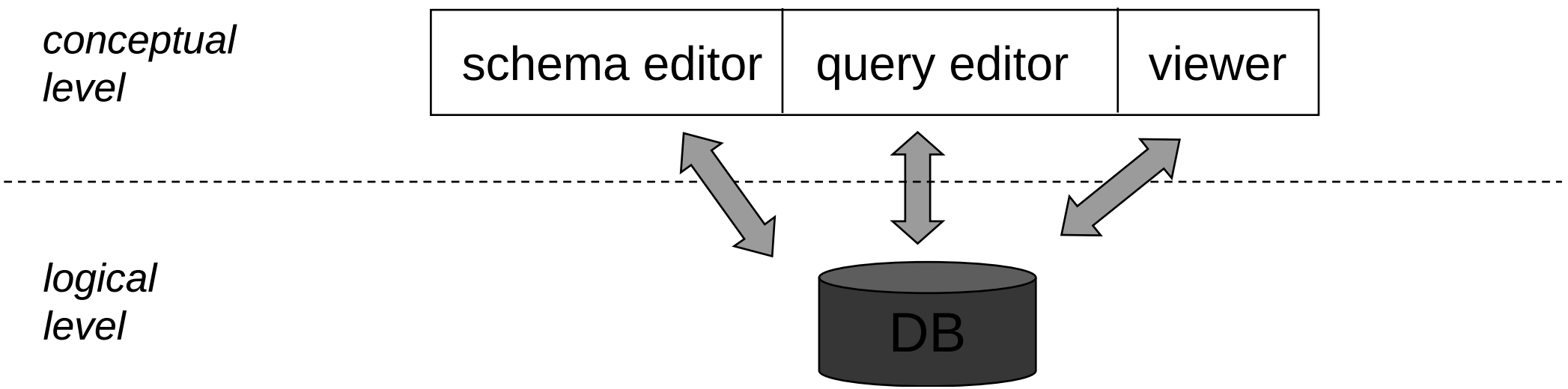
- Multi-Association with inter-representation semantics



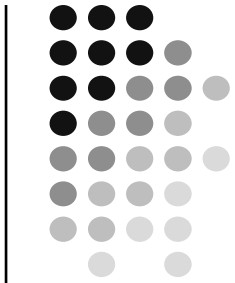
Linked Instances are two perceptions of the same real world phenomenon

Implementation

- MurMur Project (ULB, IGN, Cemagref, Star)
  - Software on top of a GIS (Oracle)
    - Schema editor MADS with multi-representation capabilities
    - Query editor multi-representation
    - Viewer



Future work



- Consistency, derivation between representations
  - Stating constraints between multiple-representations
  - Derivation rules
- Multi-representation in the continuous view of space
  - Space-varying attribute referring to a spatial attribute defined at various spatial resolutions
  - Space varying attribute for which the same value may be defined at different semantic resolution
- Describing the correspondences between the continuous and discrete representation of space.

Thank you

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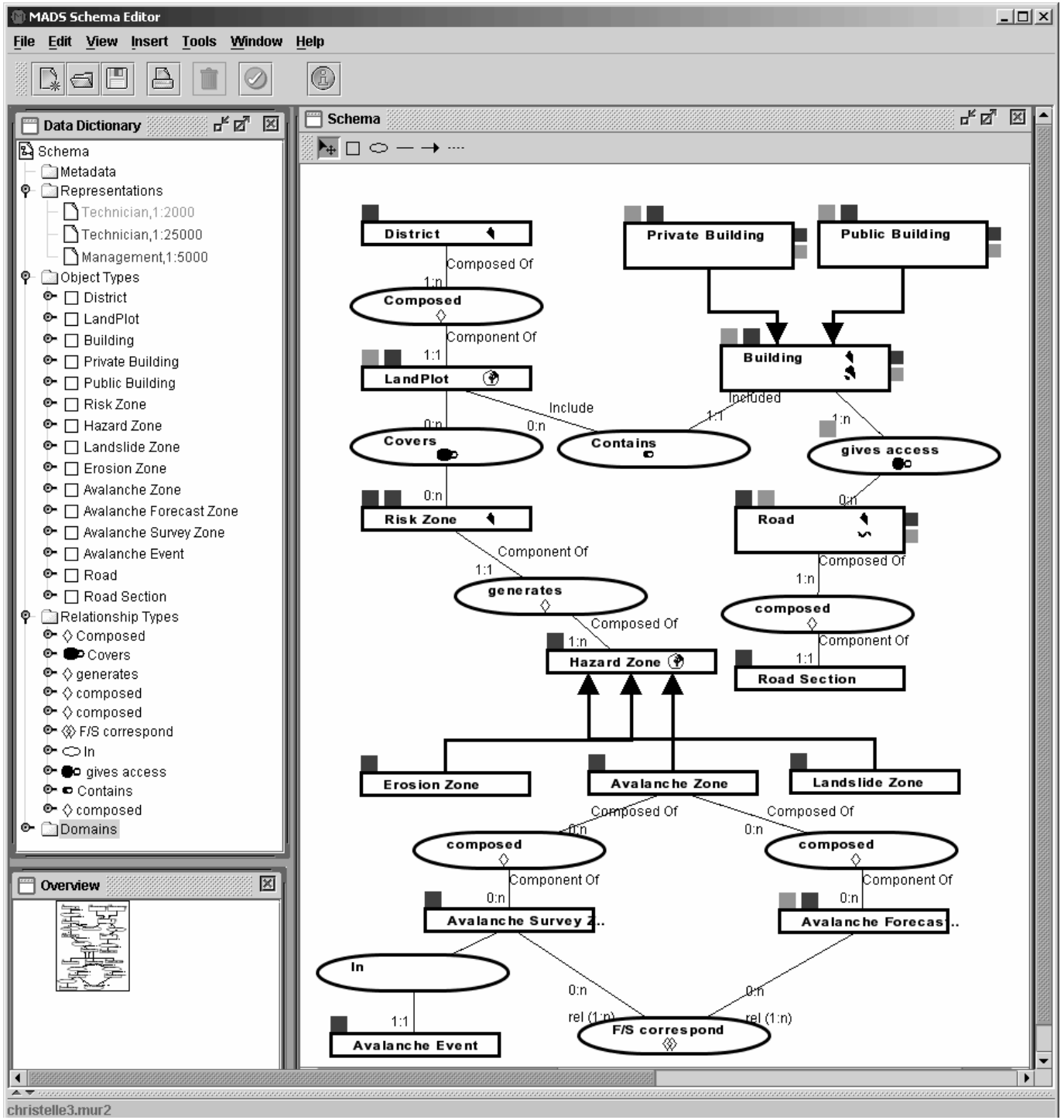
MADS Schema Editor
File Edit View Insert Tools Window Help
Data Dictionary
Schema
Metadata
Representations
Technician,1:2000
Technician,1:25000
Management,1:5000
Object Types
District
LandPlot
Building
Private Building
Public Building
Risk Zone
Hazard Zone
Landslide Zone
Erosion Zone
Avalanche Zone
Avalanche Forecast Zone
Avalanche Survey Zone
Avalanche Event
Road
Road Section
Relationship Types
Composed
Covers
generates
composed
composed
F/S correspond
In
gives access
Contains
composed
Domains
Overview
Schema
District
Composed Of
1:n
Composed
Component Of
1:1
LandPlot
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0:n
Covers
Contains
Private Building
Public Building
Building
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gives access
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Risk Zone
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generates
Composed Of
1:n
Hazard Zone
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1:n
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Road Section
Erosion Zone
Avalanche Zone
Landslide Zone
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rel (1:n)
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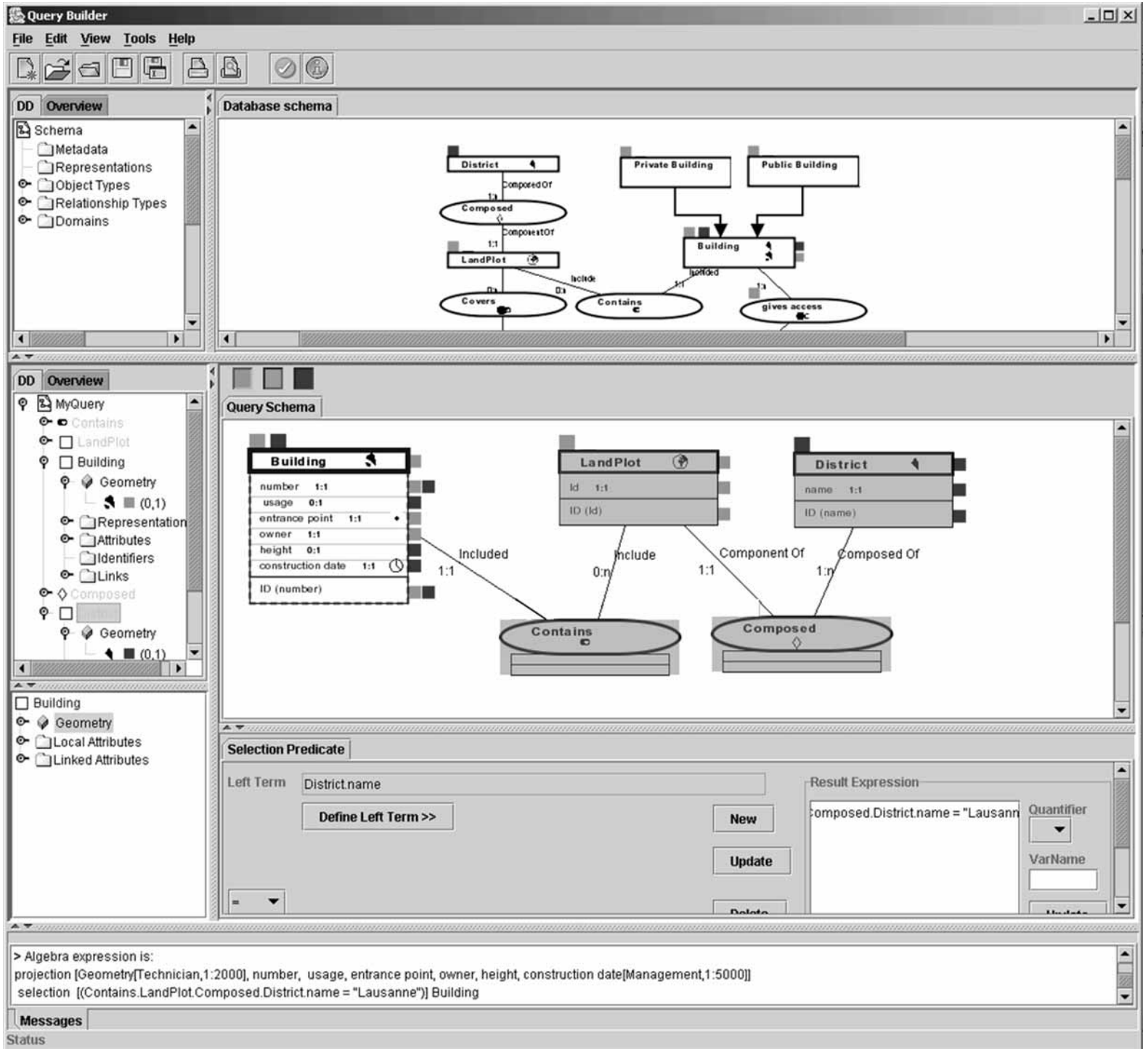
Query Builder
File Edit View Tools Help
DD Overview
Schema
Metadata
Representations
Object Types
Relationship Types
Domains
Database schema
District
ComposedOf
Composed
ComposesOf
LandPlot
Include
Covers
Contains
Private Building
Public Building
Building
Included
gives access
DD Overview
MyQuery
Contains
LandPlot
Building
Geometry
(0,1)
Representation
Attributes
Identifiers
Links
Composed
Geometry
(0,1)
Building
Geometry
Local Attributes
Linked Attributes
Query Schema
Building
number 1:1
usage 0:1
entrance point 1:1
owner 1:1
height 0:1
construction date 1:1
ID (number)
LandPlot
Id 1:1
ID (Id)
District
name 1:1
ID (name)
Included
1:1
Include
0:n
Component Of
1:1
Composed Of
1:n
Contains
Composed
Selection Predicate
Left Term
District.name
Define Left Term >>
New
Update
Result Expression
composed.District.name = "Lausann
Quantifier
VarName
> Algebra expression is:
projection [Geometry[Technician,1:2000], number, usage, entrance point, owner, height, construction date[Management,1:5000]]
selection [(Contains.LandPlot.Composed.District.name = "Lausanne")] Building
Messages
Status