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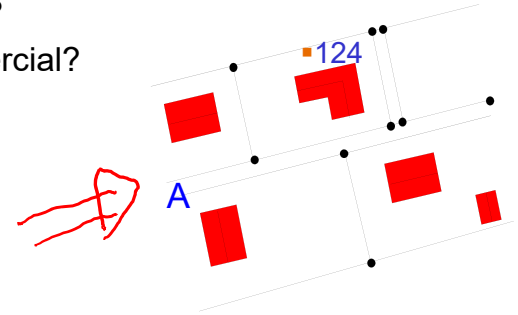
Thematic Modeling

- Thematic modeling is referred to the description, handling and storage of the thematic of spatial objects
- We use thematic layers and object hierarchies to combine objects with the same thematic
- Furthermore, thematic modeling describes attributes and (semantic) relations between objects
- Thematic models are represented with graphical modeling languages

Thematic Queries

- Who is the owner of the house 124?
- How many houses are used commercial?
- Can trucks drive on Road A?

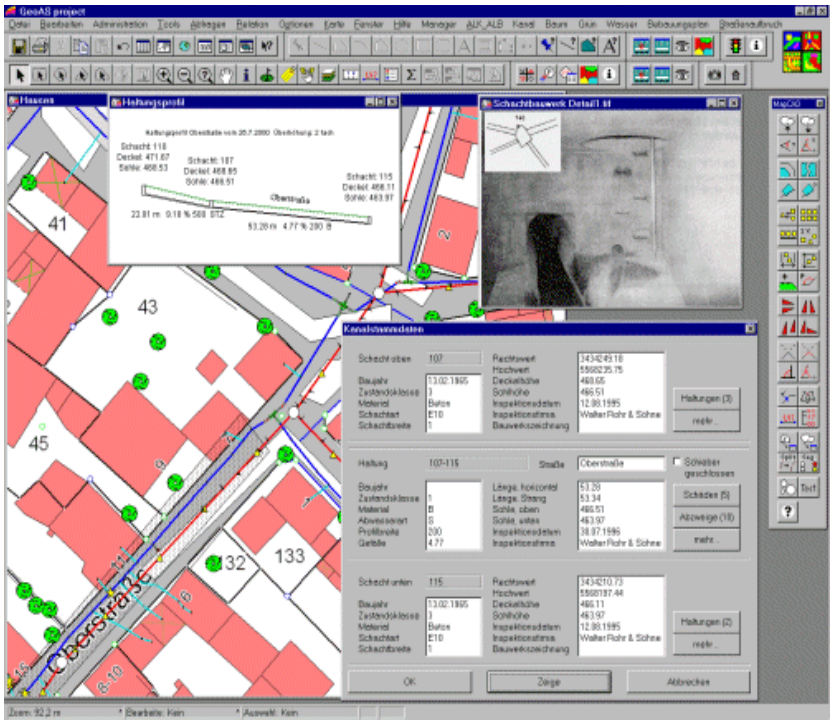


- Thematic information are independent from geometry and topology
- Thematic information can be coded additionally in the graphic representation of an object. Examples:
  - houses are represented by red polygons
  - parcels are filled with green colour
  - street names are oriented at the centre line of the street

Thematic Information

- Normally not all thematic information can be coded in the graphic representation
- Example: thematic information of a house
  - roof type
  - number of floors
  - area
  - owner
  - kind of use
  - etc.
- Thematic information are represented by alphanumerical symbols in the database
  - geometric information are represented by points, lines and areas (in 2D)
  - topologic information are represented by nodes, edges and meshes (in 2D)

Thematic Information in a Sewer Information System



GeoAs (AGIS GmbH, Frankfurt)

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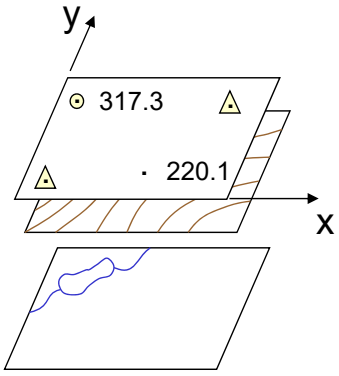
Layer principle

- The layer principle stores geometric data with different thematic meaning in different layers
- First used model but still widely used
- Developed by the 1:1 implementation of the analogue map production (use of transparencies). In order to produce different kinds of maps, the transparencies could be selected and combined - instead of drawing a new map each time



layer 1: fixed points

layer 2: height lines

layer n: water

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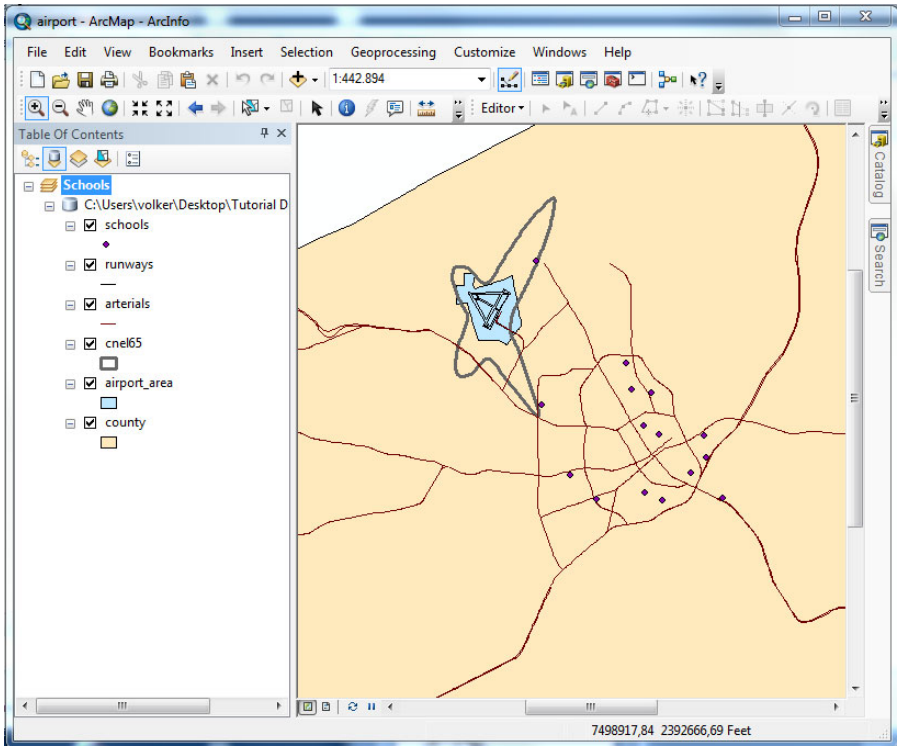
Layer principle in ArcGIS



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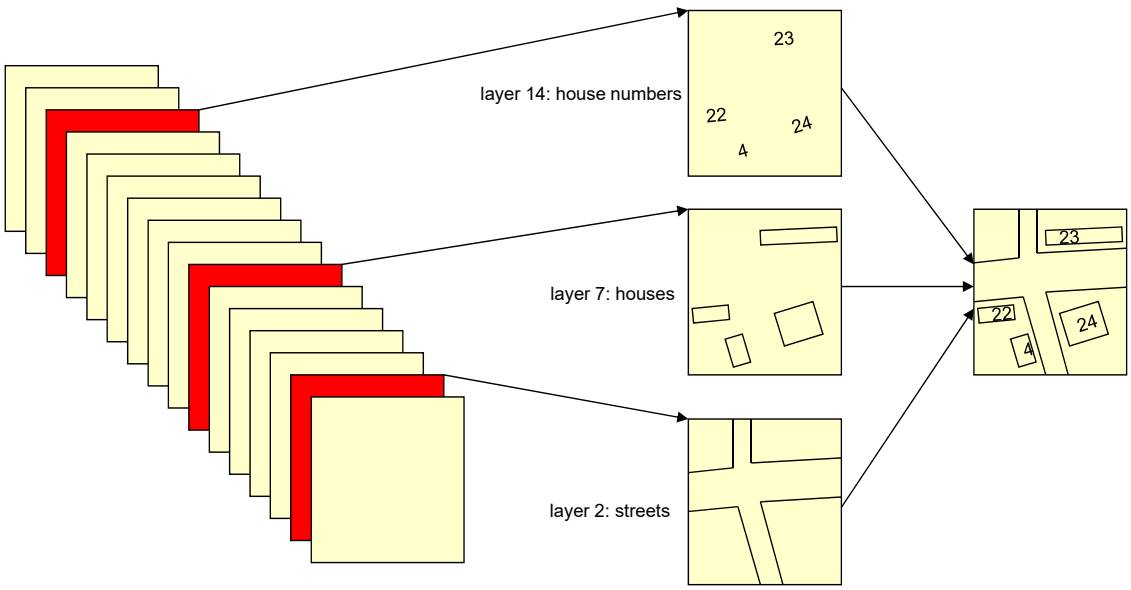
Layer principle

- Notice: all layers must be defined in the same coordinate system



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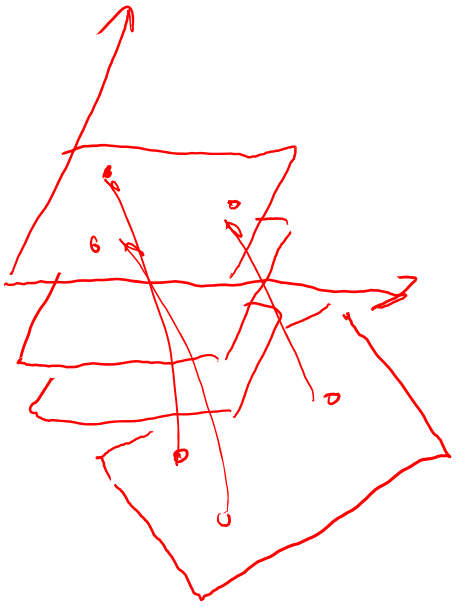

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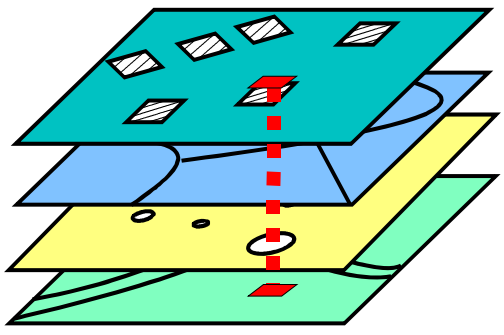
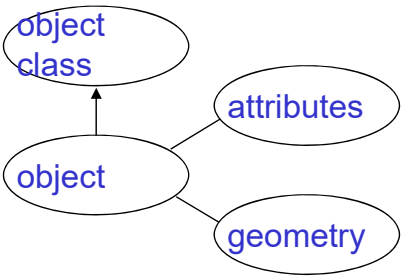
Layer principle

- Layer principle:
  - each layer contains different information
  - simple model; easy superimposition
  - no hierarchy - all layers are of equal priority
  - not flexible: all layers have to be of same size



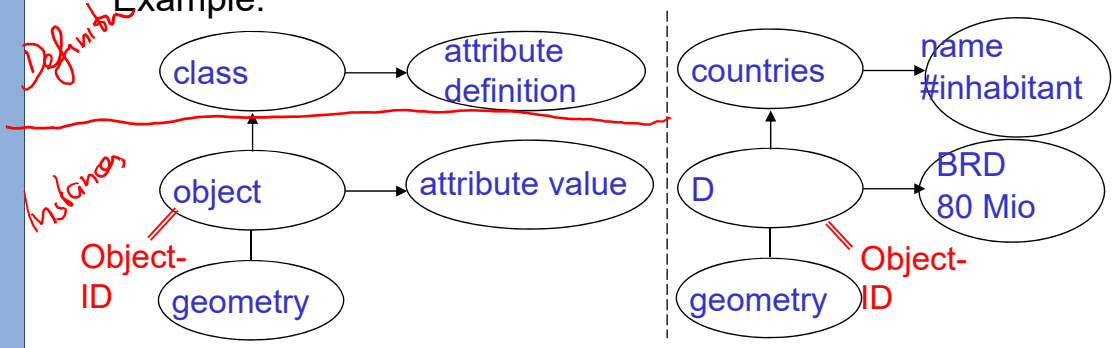
Object Class Principle

object class principle is the modern form of thematic modeling



object class principle is linked to object oriented programming paradigm

Example:



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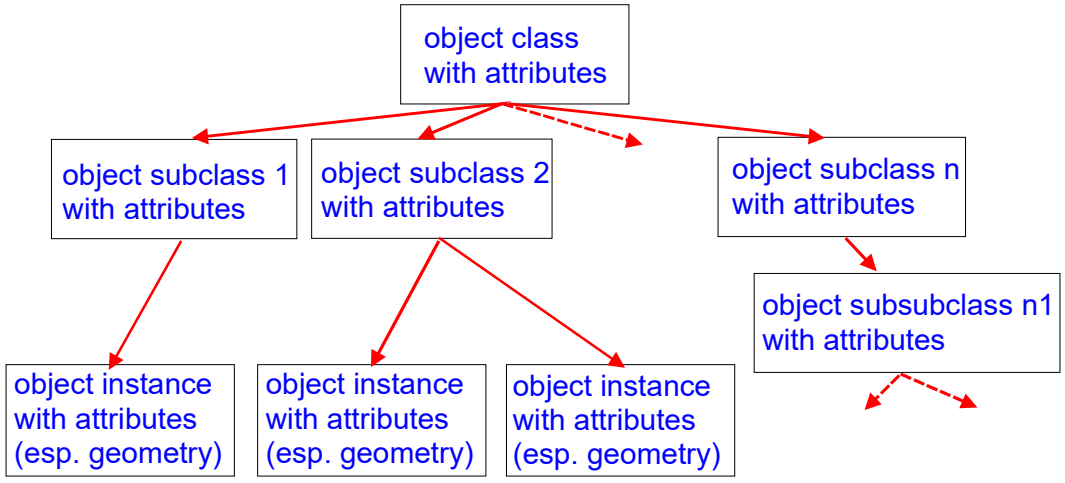
Hierarchical Organization of Object Classes

- Object classes can be subdivided in subclasses - subclasses in subsubclasses, ...
- A subclass inherit all attributes from their superclass
  - flexible model
  - hierarchical organization describes dependencies between objects



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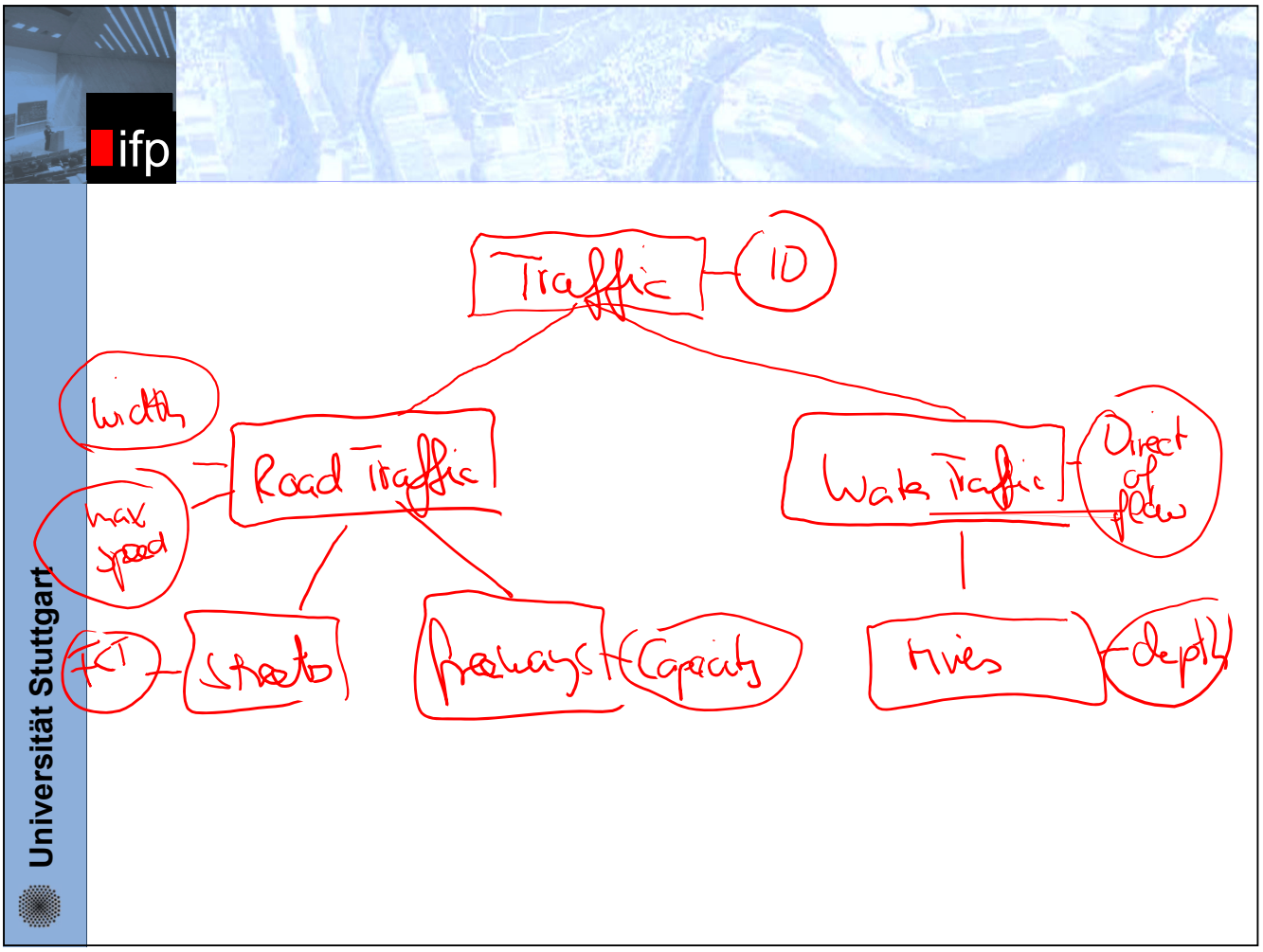

Object Catalogue ATKIS

Objektbereich 1000 Festpunkte	Objektbereich 2000 Siedlung	Objektbereich 3000 Verkehr	Objektbereich 4000 Vegetation	Objektbereich 5000 Gewässer	Objektbereich 6000 Relief	Objektbereich 7000 Gebiete

- Objektgruppe 3100 Straßenverkehr
- Objektgruppe 3200 Schienenverkehr
- ...

- Objektart 3101 Straße
- Objektart 3102 Weg

Objekt Straße

Attribute	Attributwerte
Breite der Fahrbahn	
Funktion	1301 Bundesautobahn 1302 Bundesstraße 1303 Landesstraße ...
Zustand	
Widmung	

Attribut Widmung

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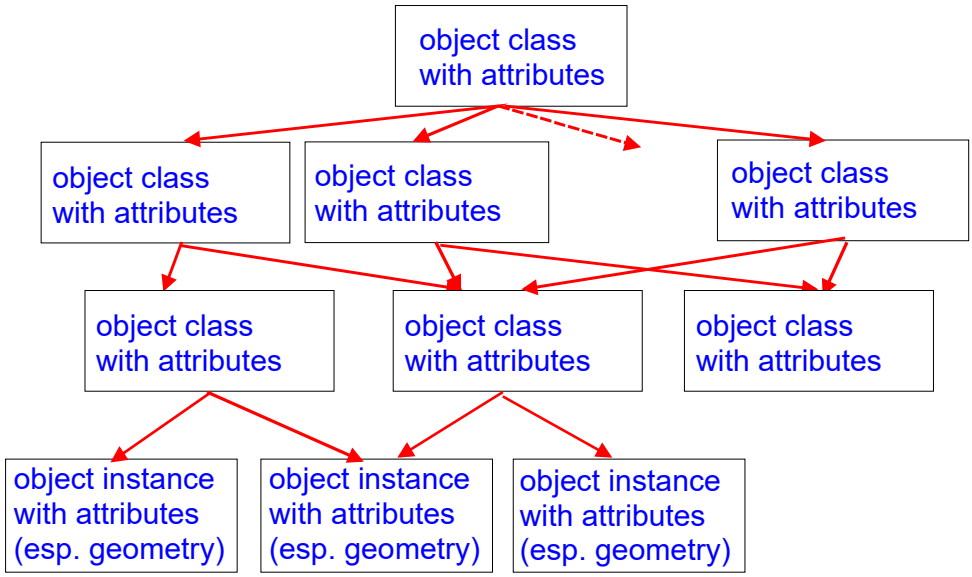
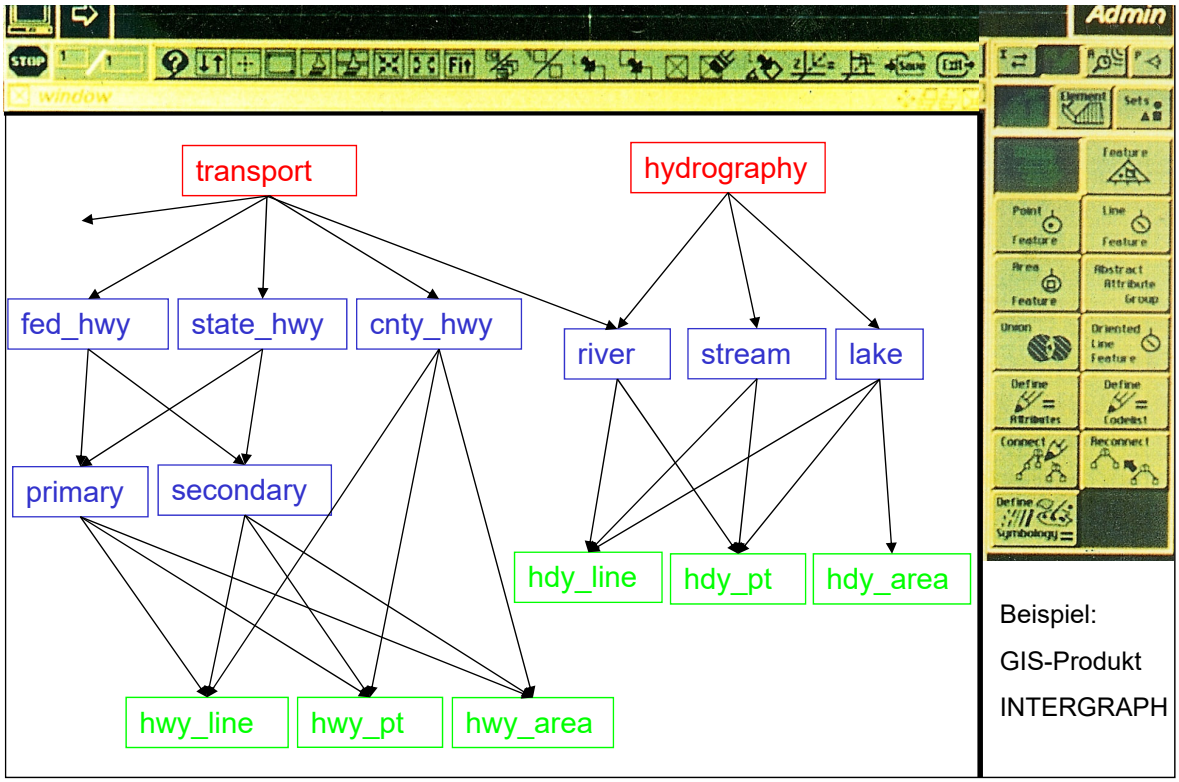
Semantic Network

- object-class-principle organized as semantic network: allows higher order relations (m:n) between object classes:
  - e.g. a river can be both a subclass of "waters" and of "traffic"





Beispiel:
GIS-Produkt
INTERGRAPH

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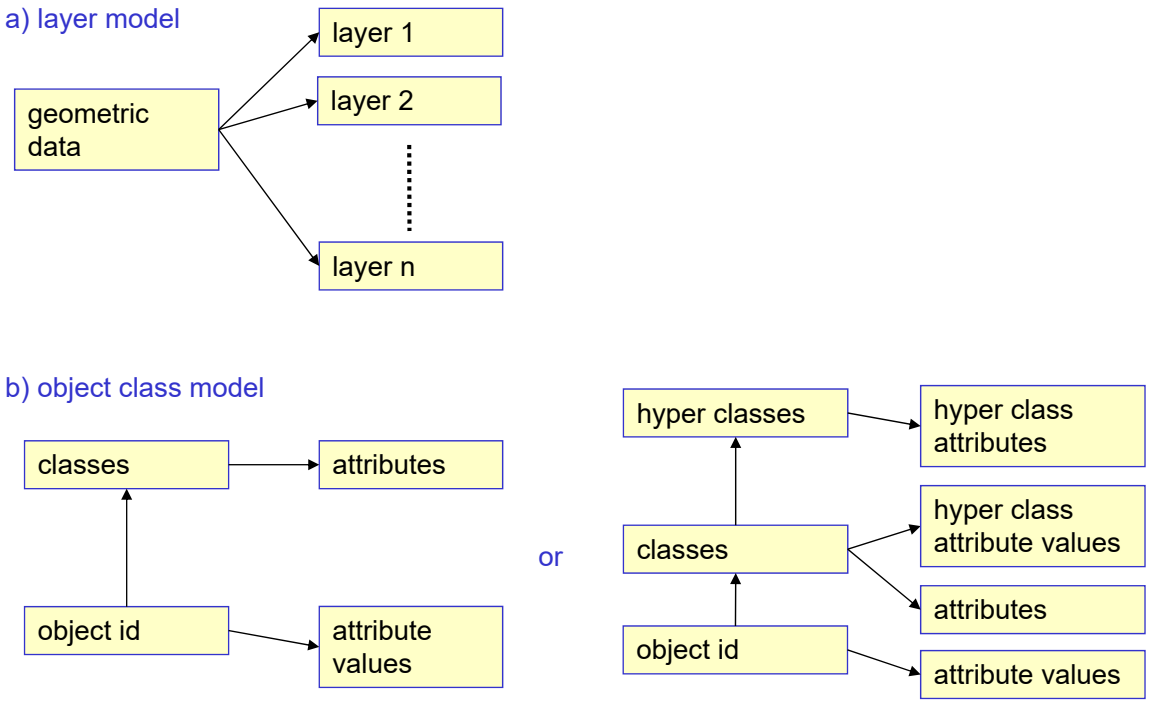
Thematic Modeling



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Thematic Modelling

- Objects can have relations to other objects:
  - parcel is owned by owner
  - student attends lecture
- Objects can have attributes:
  - house has house number
  - student has matriculation number
- Different modeling languages are available to describe this information in a formal way:
  - ER (Entity-Relationship-Model)
  - NIAM (Nijsen Information Analysis Method)
  - OMT (Object Modeling Technique)
  - UML (Unified Modeling Language)
  - …

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ER-Modeling (Crash Course)

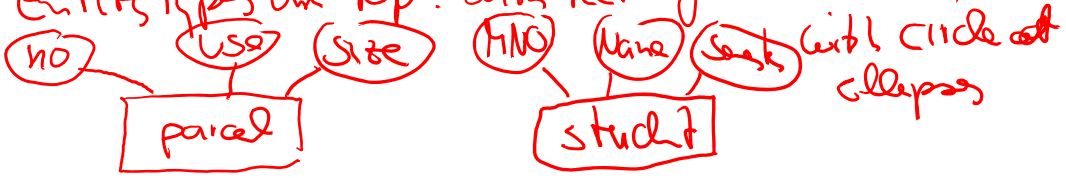
Entities are objects of the world
- parcel 12/32 student 1247-08, Bill no 128

Similar entities are grouped entity types
- Parcels Students Bills Cats

Entities can have attributes
- size, MNR, color

Attributes belong to a domain
- Integer, Float, String

Entity types are represented with rectangles and the attributes with circles or ellipses



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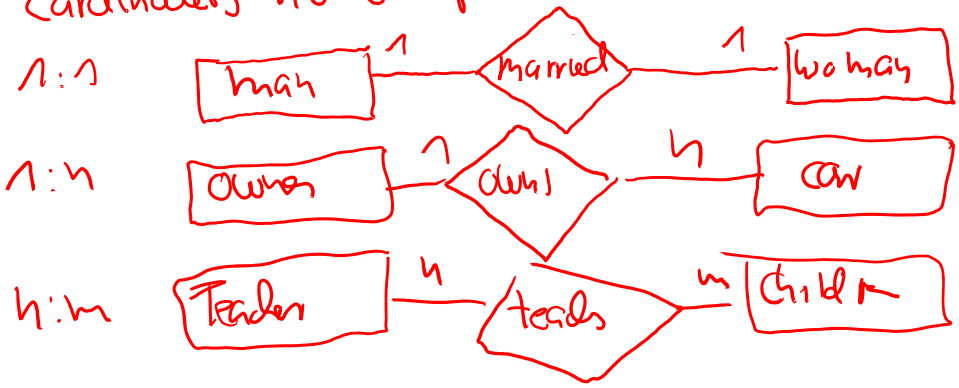
Entities can have relations to other entities
owner owns a parcel
student attends a lecture

Relationships are represented with a rhombus

Cardinalities number of involved entities



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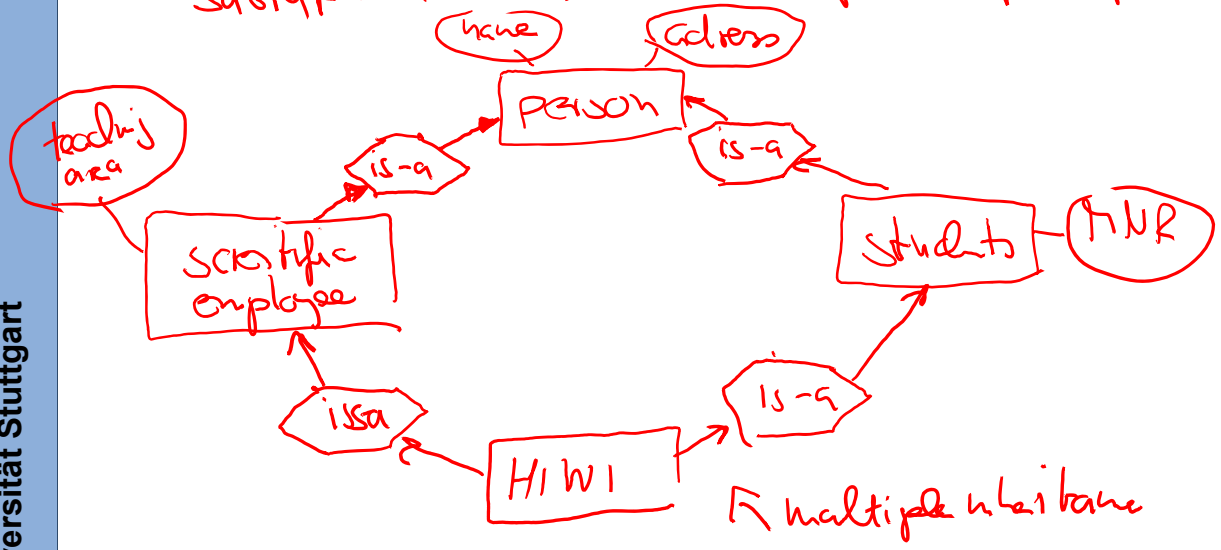
Similar entity types can be grouped together with is-a relation

Representation is with hexagon

subtypes inherit the attributes of the supertype



↖ multiple inheritance

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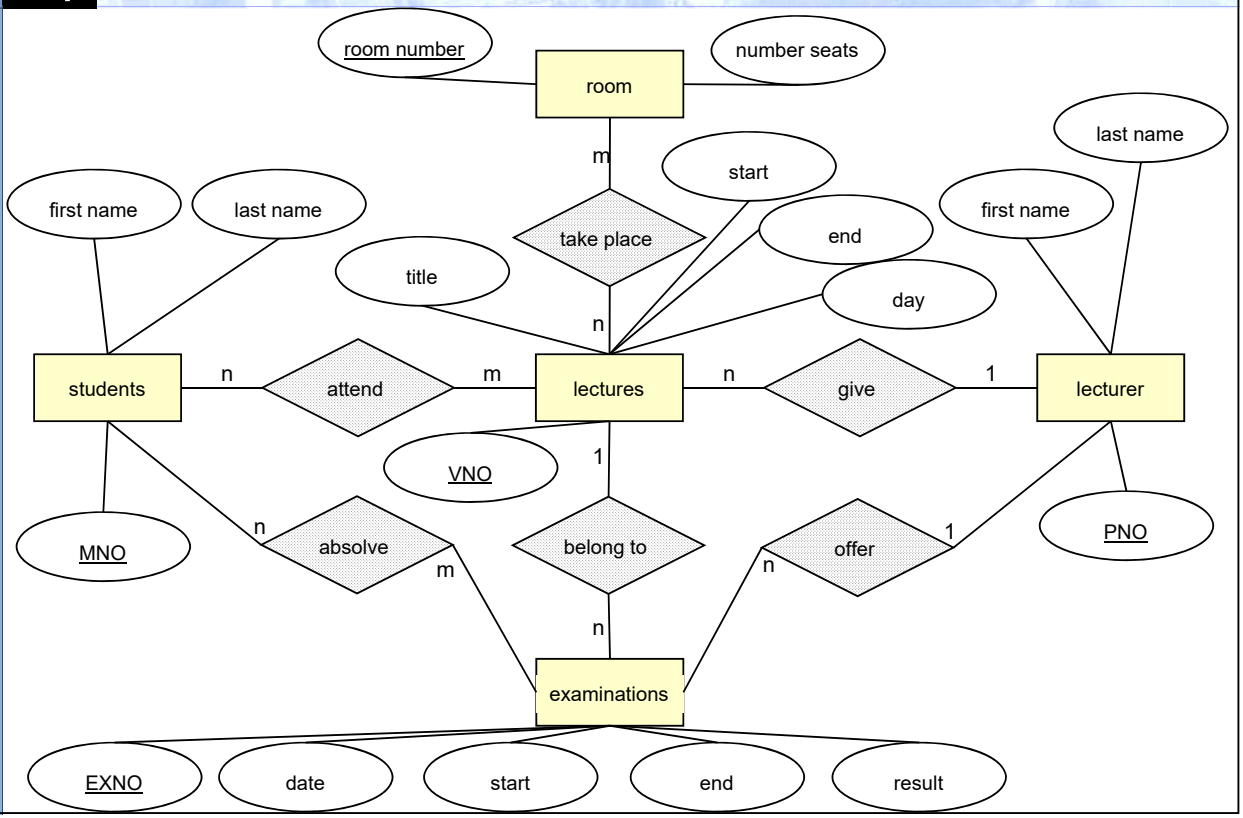
ER-Diagram



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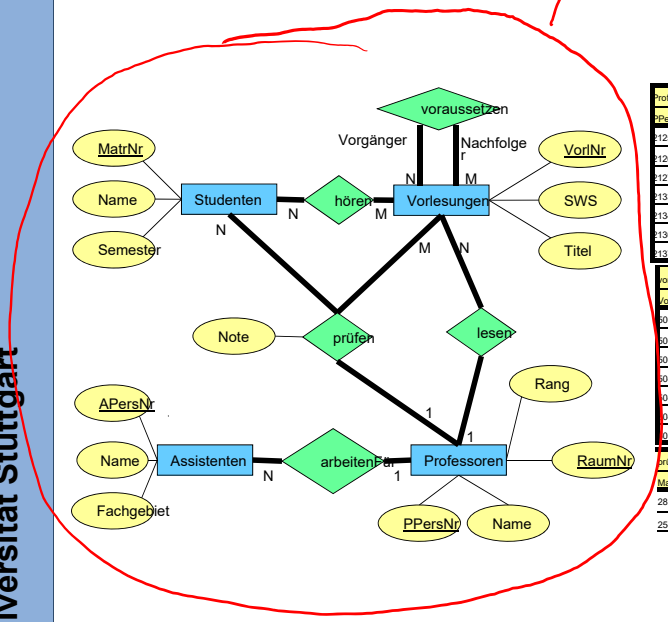
Datenstrukturen for Thematic Data: Tables

transfer



Professoren

PersNr	Name	Rang	Raum
2125	Sokrates	C4	226
2126	Russel	C4	232
2127	Kopernikus	C3	310
2133	Popper	C3	52
2134	Augustinus	C3	309
2136	Curie	C4	36
2137	Kant	C4	7

Studenten

MatrNr	Name	Semester
24002	Xenokrates	18
25403	Jonas	12
26120	Fichte	10
26830	Aristoxenos	8
27550	Schopenhauer	6
28106	Carnap	3
29120	Theophrastos	2
29555	Feuerbach	2

Vorlesungen

VorlNr	Titel	SWS	PersNr
5001	Grundzüge	4	2137
5041	Ethik	4	2125
5043	Erkenntnistheorie	3	2126
5049	Mäeutik	2	2125
4052	Logik	4	2125
5052	Wissenschaftstheorie	3	2126
5216	Bioethik	2	2126
5259	Der Wiener Kreis	2	2133
5022	Glaube und Wissen	2	2134
4630	Die 3 Kritiken	4	2137

voraussetzen

Vorgänger	Nachfolger
5001	5041
5001	5043
5001	5049
5041	5216
5043	5052
5041	5052
5052	5259

hören

MatrNr	VorlNr
26120	5001
27550	5001
27550	4052
28106	5041
28106	5052
28106	5216
28106	5259
29120	5001
29120	5041
29120	5049
29555	5022
25403	5022

Assistenten

Name	Fachgebiet	PersNr
Platon	Ideenlehre	2125
Aristoteles	Syllogistik	2125
Wittgenstein	Sprachtheorie	2126
Rhetikus	Planetenbewegung	2127
Newton	Keplersche Gesetze	2127
Spinoza	Gott und Natur	2126

prüfen

MatrNr	VorlNr	PPersNr	Note
28106	5001	2126	1
25403	5041	2125	2

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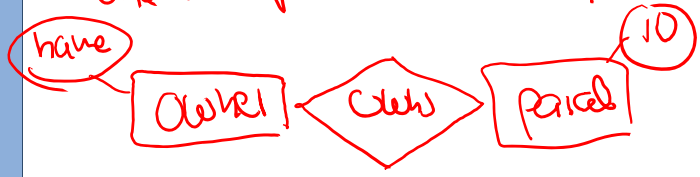
Examples

One table for each entity type

Parcel:

no	use	size
1	RES	100
2	IND	2050
3	...	...

One table for each relationship type



owns

name	ID
Smith	109
Mills	117
...	...

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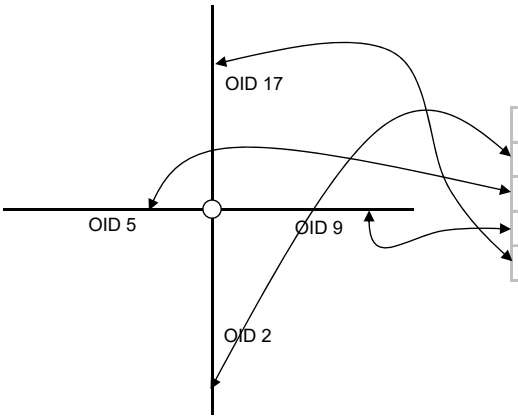
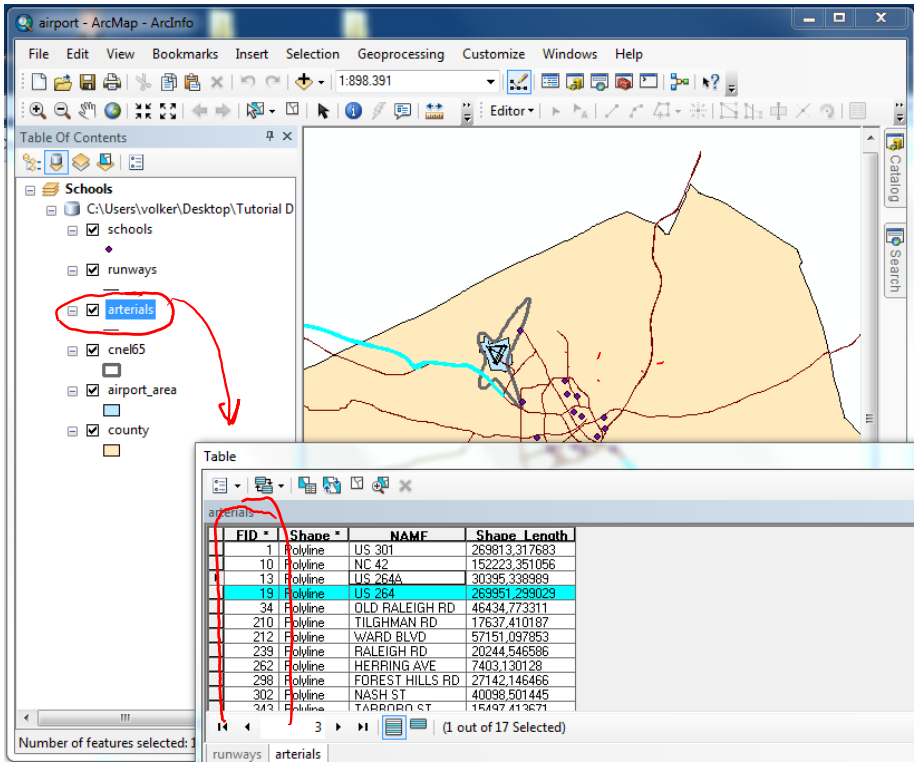
Link between Geometry and Thematic



OID	Name	Breite	MaxGeschw.
2	Keltenstr.	15	50
5	Oberstr.	12	50
9	Kanalstr.	20	50
17	Unterstr.	25	30

Link between Geometry and Thematic ArcGIS



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