Spatial Information Concepts
Data Modeling (1)

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Field sketches
Designing a GIS for garden maintenance

- Questions the system should answer
- Required geographical information
- Geo-Spatial description of garden (field inventory)
- Structuring acquired field data
  - geometric structure & coordinates
  - classification & class attributes
  - Finally: tables in database
From real world to GIS

Real World

Database
From real world to GIS

- The representation of geographical reality, its description and computer storage has been subject of scientific research and many papers in the field of GI-science.
- This debate has become quite complicated, with different views and opinions.
Spatial conceptions & 2D data models (1)

- Designing a GIS for garden maintenance
- Geo-Spatial data modelling in 4 steps
  - 1. Spatial perception
  - 2. Spatial description
  - 3. (Geometric) Data structure
  - 4. Tabular description (database)
    - geometric (coordinates)
    - thematic (attributes)
WWW: a description of reality

- Thematic description (what)
- Geometric description (where)
- Temporal description (when)
From real world to geo spatial data

Real World

Data Modelling

Database & application
by files and programmes

Data structure
geometric/thematic
by a data model

Spatial Perception

Spatial description
by an information model
Overview

- Geographical / Spatial Perception
- Geographical / Spatial Representation

- Geo Spatial Data Model
- Geo Database / Geo data set
Spatial perception

- Depends on personal competences (intentional drives, knowledge and research goal)
- Discrete view and continuous view
Discrete phenomena
Spatial perception (2)

... requires a disciplinary view on our world!

- One omnipresent phenomenon → continuous
- Several neighbouring phenomena → discrete
Continuous phenomena
Geographical perception

- Continuous
  - ‘Tangible’ phenomena
  - defined from a physical, constructive context

- Discrete
  - ‘Virtual’ phenomena
  - defined from an administrative, legislative context
Example ‘Virtual’ 1
Example ‘Virtual’ 2

http://geodata.prv.gelderland.nl/km/milieu/
Example ‘Tangible’
Continuous OR discrete phenomena
Spatial representation

Based on Goodchild et al. 2007:

- Continuous $\rightarrow$ Geo-field
- Discrete $\rightarrow$ Geo-objects
Relation between spatial representation and geometric data structure

Continuous (Fields)  
Raster

Discrete (Objects)  
Vector
Study area

Ecologic research
Field based or object based description

Field based

Object based
Data model = geometric structure

- A generalized view of data representing the real world
- Vector data model (Chapter 3 and Chapter 4, Chang)
- Raster data model (Chapter 5, Chang)
Objects in the object based (vector) data model

Geometry:
1) Position and orientation
2) Shape and size
3) Topology
Objects in the vector data model

- **Point**
  - 0 dimension
  - only location
  - (e.g. wells, pits, trees)

- **Line**
  - 1 dimension
  - location, length, shape
  - (e.g. roads, streams)

- **Area**
  - 2 dimensions
  - location, length, area, shape
  - (e.g. land parcels, water bodies)
Objects in the raster data model

Cell

Raster
(Rows, columns, cells)

Point  ->  single cell

Line  ->  sequence of neighboring cells

Area  ->  collection of contiguous cells
Fields in the raster data model
Fields in the vector data model
Geo Atom: the missing link?

Geo-Atom

- Continuous (Fields)
- Discrete (Objects)
- Raster
- Vector
Geo-Atom

- Paper by Mike Goodchild et al., (IJGIS, 2007)
- Geo-Atom < x, Z, z(x) >

- Z identifies a property
  eg Celsius Temperature

- x defines a point in space – time
  eg 120°W, 34°N at Mean Sea Level
    at local noon on 11 July 2005

- z(x) defines a particular value of the property at that point
  eg 20 °
geo-atoms aggregation

- Continuous Geo – fields: select for Z

- Discrete Geo – objects: \( z(x) = \text{identical} \)
  based on classification rules
  mainly homogeneous thematic classes
Spatial (Temporal) Description start: \( < x, Z, z(x) > \)

- **Thematic description** (what) \( Z, z(x) \)
- **Geometrical description** (where) \( x \)
- **Temporal description** (when) \( x \)
Example 1
Example CBS (Dutch Census Office)

- borders of residential areas, town districts and municipalities

- Geographical perception: discrete, virtual features
- Geographical representation: geo-object
- Data model: vector structure
- Data Structure: data eg *shapefile*
Example 2
Example LGN (Dutch Land Use Inventory)

- Landuse types
  - Geographical perception: discrete, tangible features
  - Geographical representation: geo-object
  - Data model: raster structure
  - Data structure: run length
Summary: How to describe the real world into geo data

From real world into geodata

- 4 phases

- spatial perception types
  [ tactile / real, virtual, continuous, discrete ]

- spatial representation
  [ atoms, fields (location based), objects (entity based) ]

- data model / structure – geometric structure
  [ raster (tessellation, cell based), vector ]

- data
  [ database, thematics and geometry tables ]
# Study material

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<thead>
<tr>
<th>Theory</th>
<th>Chang, 2006</th>
<th>2010</th>
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## Practical:
Exercise Module 1

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To be continued

- ........a Green Maintenance GIS......
Fig. 3.2 – Modeling process. The transformation of the real world into GIS products is achieved by means of simplification and models.