GEO-DATA INPUT AND CONVERSION

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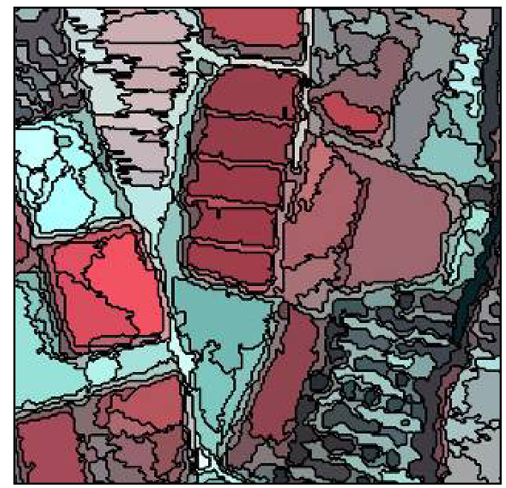

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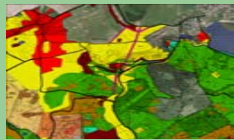

0. GEOGRAPHICAL ANALYSIS

GIS is based on the Science of Geographic Information and Analysis. When solving geographic problems (any problem with spatial reference)…

- Good knowledge of the scientific field is a prerequisite
- Problem analysis needs good mathematical approach
- Spatial statistics (multivariate statistics) is a necessary background
- Image analysis (qualitative and quantitative) has become a must
- GIS solutions (technical skills) is the question; modeling is an advanced approach for operational use
- Synthesis is the product

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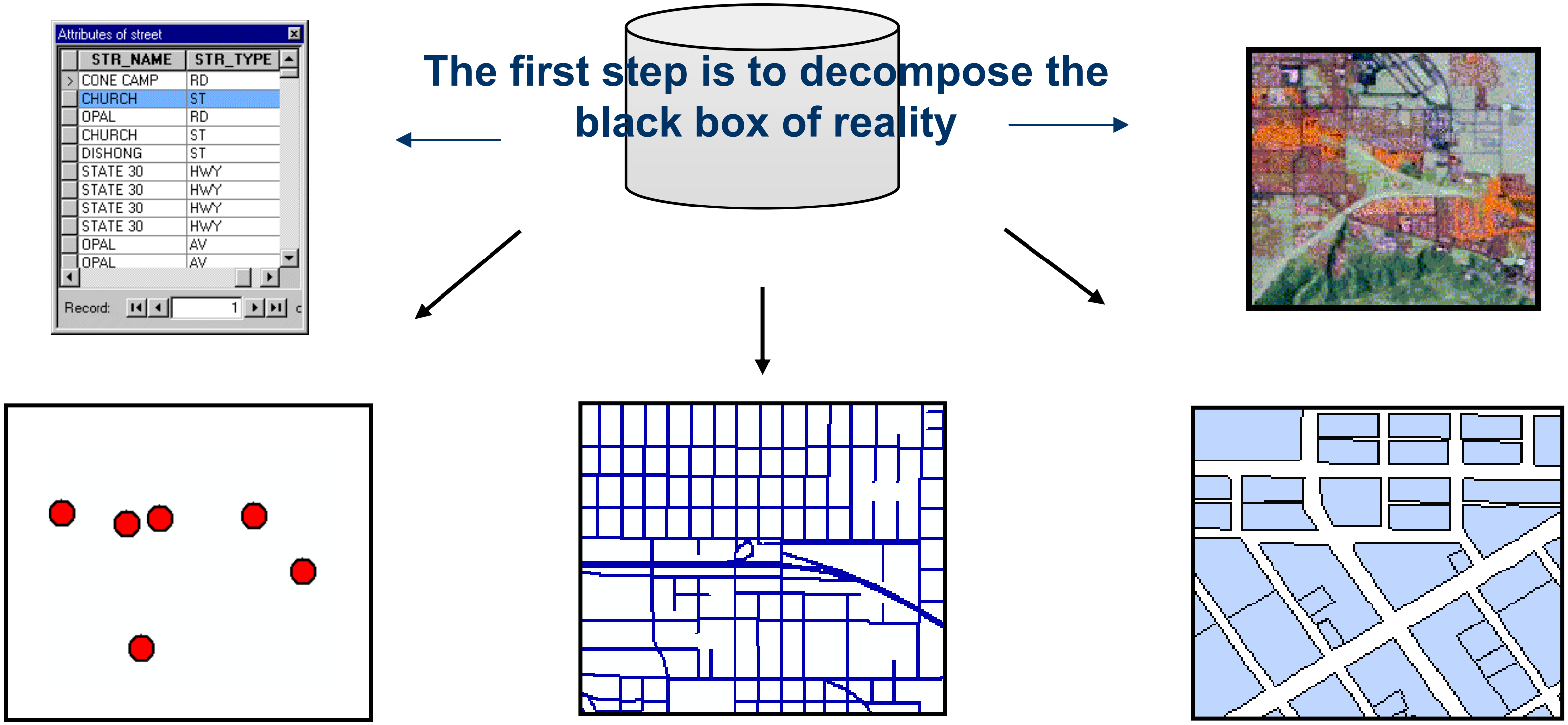
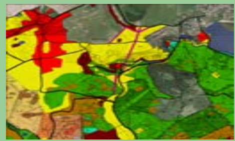
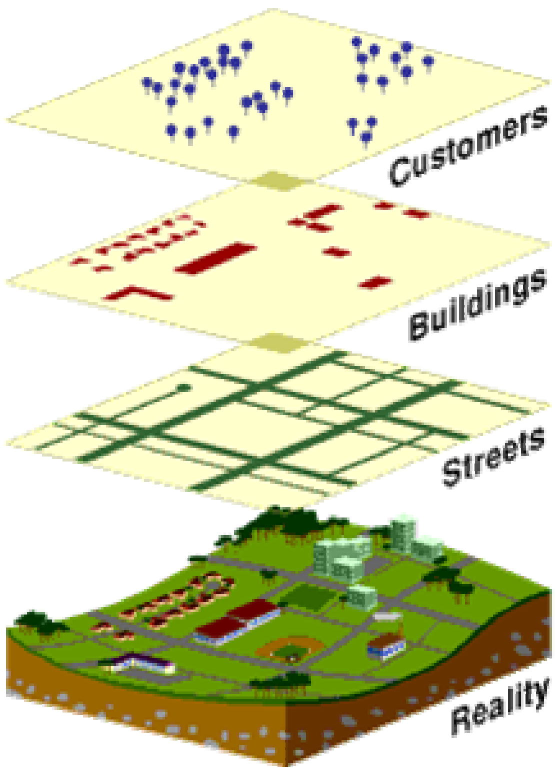
0.1 DECOMPOSITION OF REALITY

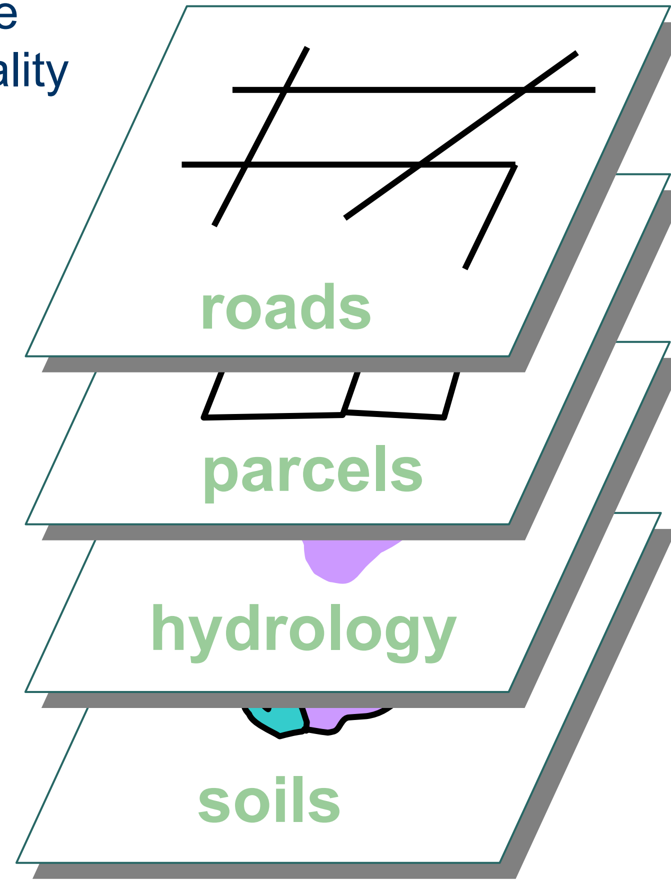




0.2 SYNTHESIS INTO GIS LAYERS

Then you must try, test and decide what layers will represent your reality





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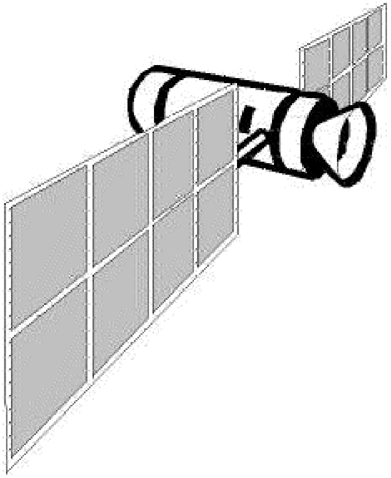
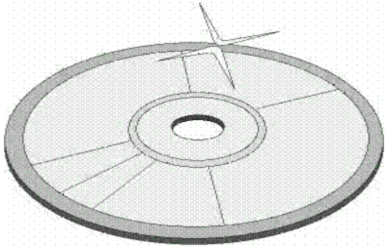
0.3 DATA INPUT



Then, what kind of data are available or can be obtained; moreover, what kind of data are appropriate for you study. Finally, how your dataset will enter your Geo-database



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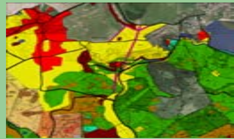

0.3-1 DATA INPUT

Quiz: connect the terms

DATA FORM

PAPER MAPS

PAPER ORTHOPHOTOS

DOQs

SATELLITE IMAGES

GPS MEASUREMENTS

TABLES

FUNCTION

DIGITIZING

SCANNING

INSERTING

LOADING

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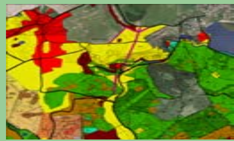


0.4 GEOGRAPHIC-DATABASES

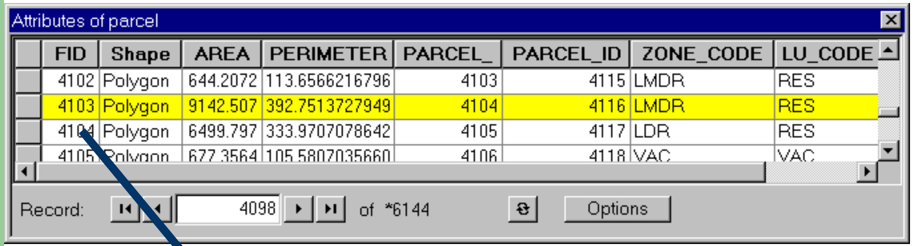
A geo-database is a Database (DB) with data having spatial reference, i.e. tables with x,y values.

In GIS, there are tow general models of building a geo-database:

- The Georelational data model: stores spatial data and attribute data separately
- The Object-oriented data model: combines spatial and attribute data into a single database

0.5 GEO-RELATIONAL MODEL

In the Geo-Relational Data Model (RDBM), spatial and attribute data is linked through the Feature ID

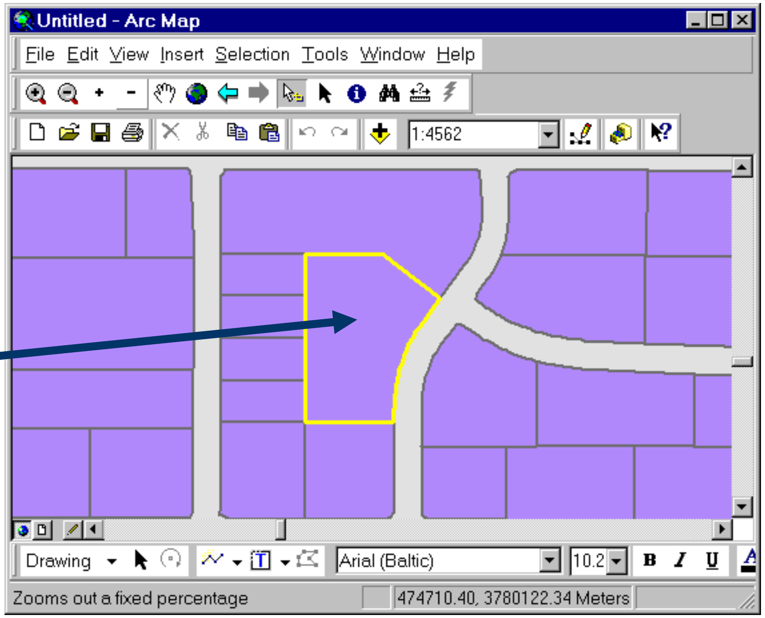

Attributes of parcel

FID	Shape	AREA	PERIMETER	PARCEL_	PARCEL_ID	ZONE_CODE	LU_CODE
4102	Polygon	644.2072	113.6566216796	4103	4115	LMDR	RES
4103	Polygon	9142.507	392.7513727949	4104	4116	LMDR	RES
4104	Polygon	6499.797	333.9707078642	4105	4117	LDR	RES
4105	Polygon	677.3564	105.5807035660	4106	4118	VAC	VAC

Record: 4098 of *6144 Options

FID = 4103

(element identity)



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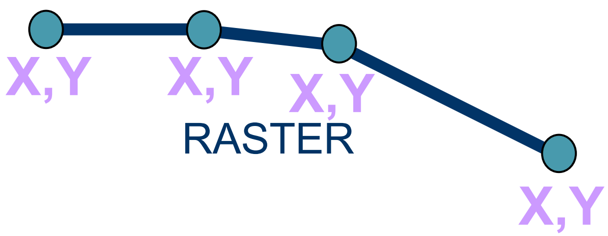
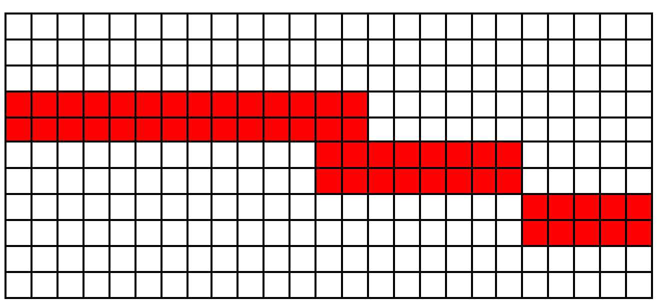
0.6 SPATIAL DATA TYPES

VECTOR



RASTER



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1. VECTOR DATA MODEL

1. STRUCTURE LEVELS
2. VECTOR DATA REPRESENTATION
3. TOPOLOGY
4. NON-TOPOLOGICAL VECTOR DATA
5. HIGHER-LEVEL OBJECTS
6. ACCURACY
7. VECTOR DATA INPUT
8. ATTRIBUTE DATA INPUT

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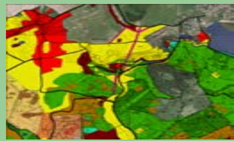

1.1 STRUCTURE LEVELS

The following vector structure levels are available, ascending in complexity and potentialities:

- Spatial features are represented as simple geometric objects of points, lines, and areas.
- The spatial relationship is expressed explicitly (topology is built up)
- A logical data structure of data files must be in place, so that the computer can efficiently process data for spatial features and their spatial relationships.

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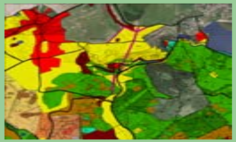

1.2 VEC. DATA REPRESENTATION

1. It uses x-,y- coordinates, simple geometric objects
2. Dimensionality and property distinguishes the three types of g.obj.

- POINT: dimension 0, only location, examples
- Node, vertex, 0-cell

- LINE: dimension 1, length, examples
- Edge, link, chain, 1-cell

- AREA: dimension 2, area, perimeter, examples
- Polygon, face, zone, 2-cell

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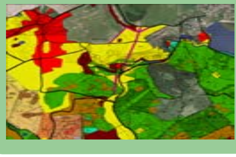
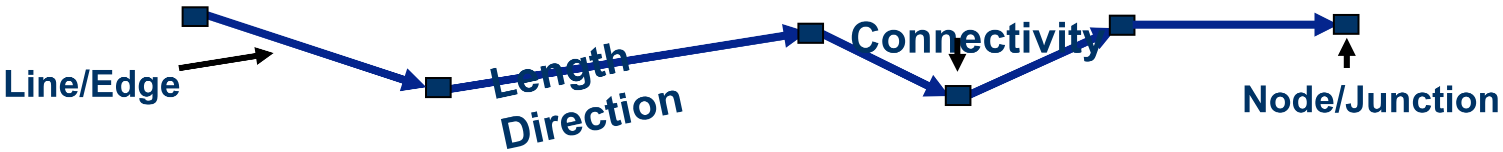
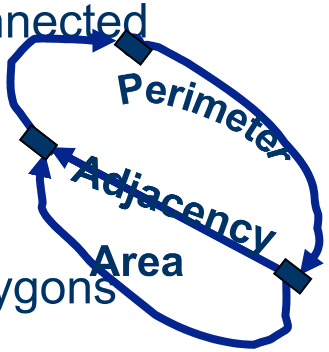


1.3 TOPOLOGY

1. Study of those properties of g.obj. that remain invariant under transformations, such as bending or stretching
2. Explained through graph theory
3. Topological data structure: arcs and nodes
4. The way that shared boundaries are handled, separates topological from non-topological data. Principles in topological structure:
   - CONNECTIVITY: Arcs connect to each other at nodes



   - AREA DEFINITION: An area is defined by a series of connected arcs
   - CONTIGUITY: Arcs have directions and left and right polygons



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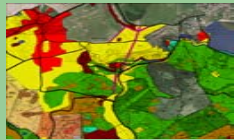


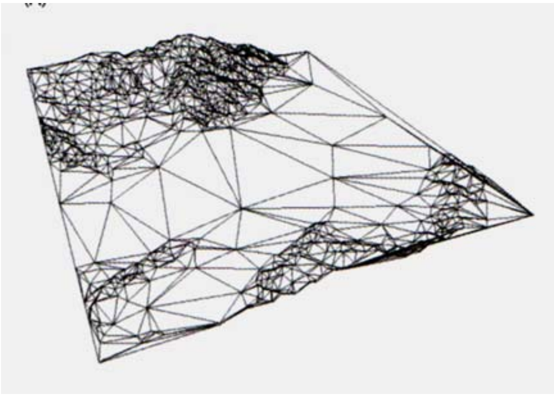
1.4 NON-TOPOLOGICAL VEC.DATA

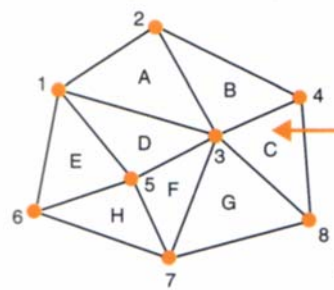
Principles of non-topological data:

- No spatial relationship
- May have duplicate arcs
- Can be converted to 'coverages' and vice versa
- 'shp' -> 'coverage' requires 'building' and 'cleaning' (ESRI terms)
- 'coverage' ->'shp' simpler

1.5 HIGHER LEVEL OBJECTS

1. Triangulated Irregular Network, for terrain mapping and analysis
   - Approximates surface with a set of non-overlapping triangles, as equiangular as possible
   - (x,y,z,slope,aspect) at the three corners of each triangle



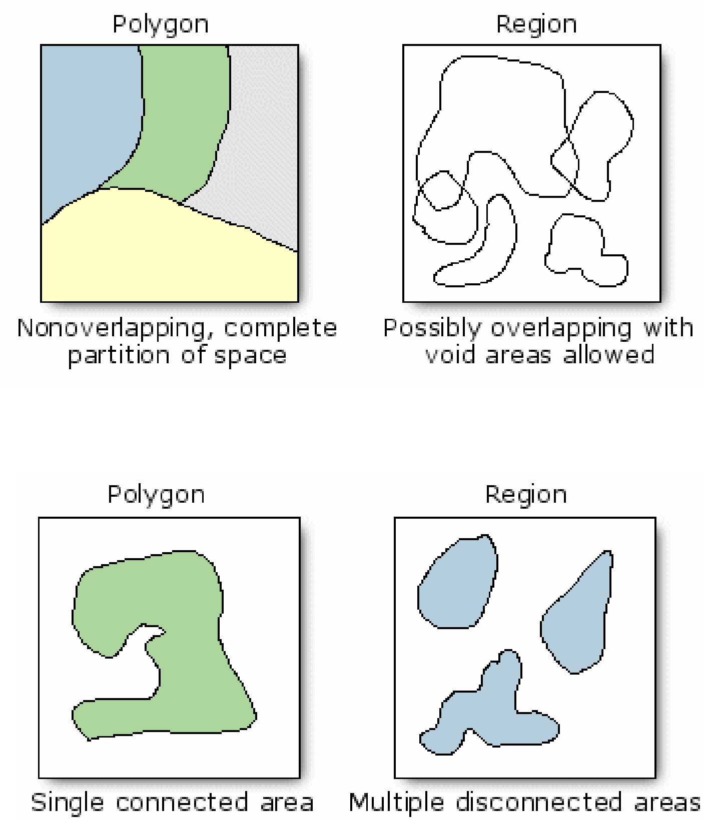


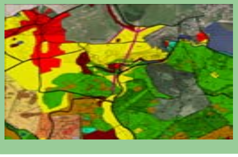
Triangle	Node list	Neighbours
A	1, 2, 3	-, B, D
B	2, 4, 3	-, C, A
C	4, 8, 3	-, G, B
D	1, 3, 5	A, F, E
E	1, 5, 6	D, H, -
F	3, 7, 5	G, H, D
G	3, 8, 7	C, -, F
H	5, 7, 6	F, -, E

1.5 HIGHER LEVEL OBJECTS

2. Regions

- Is made of regions of the same attribute
- Region layers may overlap or cover the same area
- May have disconnected or disjoint components

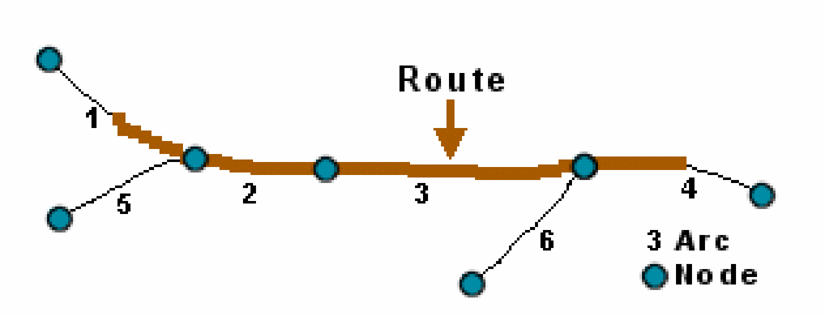




1.5 HIGHER LEVEL OBJECTS

3. Dynamic segmentation

- Comprises: Routes, Sections, Events
- Route systems usually define linear features with similar attributes and measure them. For example, a set of all bus routes in a county would be a route system.
- Can accurately model linear features without having to modify the underlying arc-node topology.



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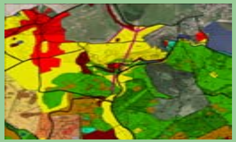
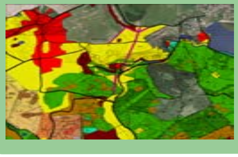


1.6 ACCURACY

1. Location accuracy
   - How close the apparent location of a map feature is to its true ground location
   - Example: map scale=reliability and detail of a map feature, rule of thumb)
   - RMS error: measure of goodness of control points (individually or totally)
2. Topological accuracy
   - How well spatial relationships are maintained
   - Depends on data entry, error detection and removal
3. Precision: how exactly a value (location included) is recorded

1.7 VECTOR DATA INPUT

1. DIRECT TRANSLATION OF VECTOR DATA
2. GPS DATA (field work, accuracy, principles, diff. GPS)
3. X,Y DATA
4. DIGITISATION (on-screen)
    - Manual on a background (QODs, satellite img)
    - New data
    - Update data
5. SCANNING (AND VECTORISATION)
    - Digitising method of an analogue map
    - Binary format (0-1)
    - Level of detail: dpi
    - Vectorisation of a scanned doc with ‘tracing’



1.8 ATTRIBUTE DATA INPUT

1. Feature attribute tables are organised in rows and columns
2. Types of attribute data:
   1. Categorical
      1. Nominal
      2. Ordinal
   2. Numerical
      1. Interval
      2. Ratio (meaningful or absolute 0)
3. Field definition and methods of entry
   1. Manual
   2. Data classification
   3. Data computation

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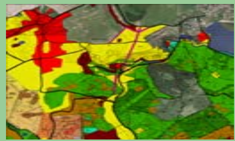


2 RASTER TYPE

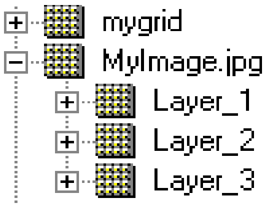
Raster data type comprises tow major kinds:

IMAGE RASTER

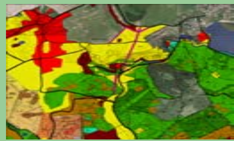
- SATELLITE IMAGES (SENSORS, LEVEL, M
- AERIAL PHOTOS (MS, PAN)
- ORTHOPHOTOS (DOQs)

GRID RASTER (it has an attribute table)

- THEMATIC MAP
- SURFACE COVER



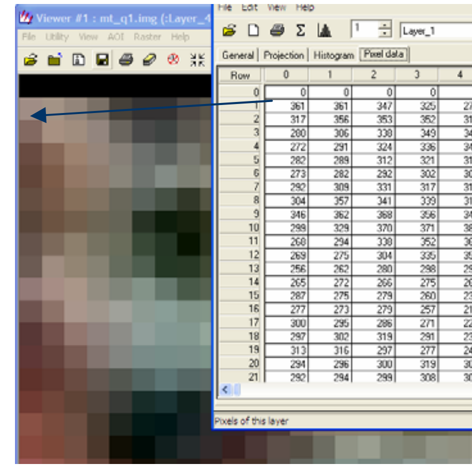
– REMOTE SENSING
– IMAGE PROCESSING AND ANALYSIS



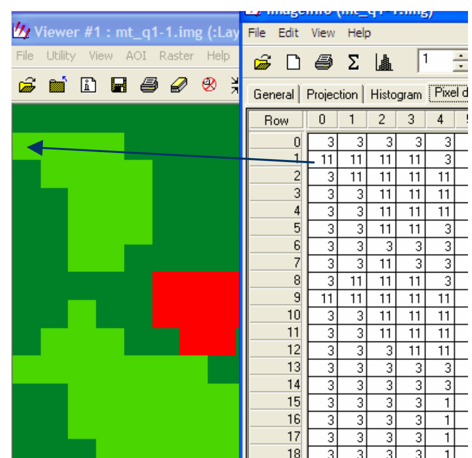
2.1 RASTER STRUCTURE

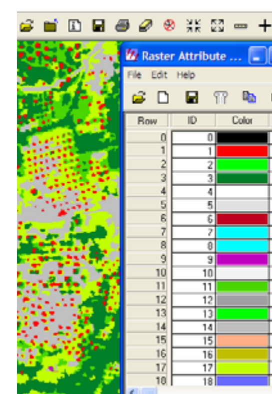
- Raster data STRUCTURE (rows, columns)
- GIS software-specific raster data
  - ‘GRID’
  - ‘Grass raster map’
  - ‘IDRISI image’
  - ‘PCI surface cover’
- Data COMPRESSION (MrSID, etc)

CONTINUOUS



THEMATIC





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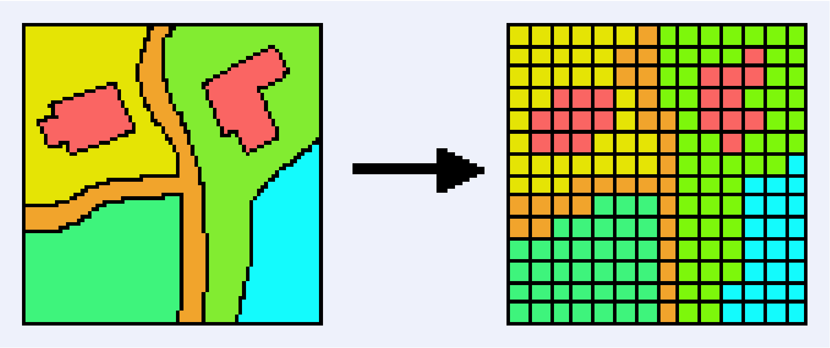
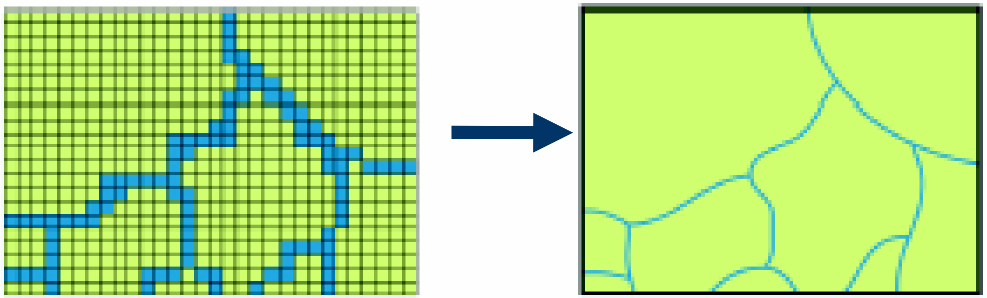
3. DATA CONVERSION

- RASTERISATION



Example: Land Use

- VECTORISATION



Example: Drainage network

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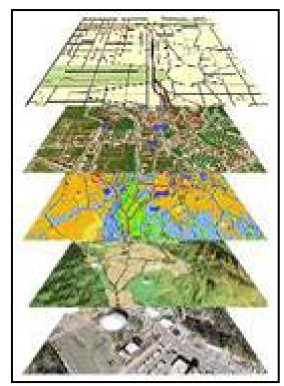
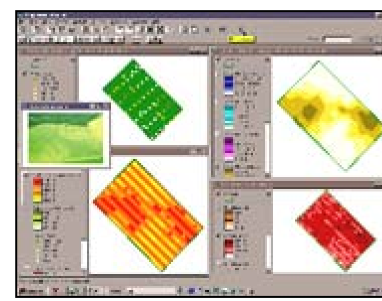
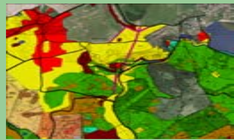
3.1 CONVERSION & INTEGRATION

- CONTINUOUS RASTER
  - THEMATIC RASTER
  - VECTOR (DIGITISATION)
- THEMATIC GRID (e.g. DEM)
  - THEMATIC GRID (e.g. SLOPE, ASPECT)
  - VECTOR (e.g. CONTOURS)
- VECTOR (e.g. CONTOURS)
  - VECTOR (e.g. TIN)
  - RASTER







Suggested literature

Basic

Burrough, P. A. (1986). Principles of Geographical Information Systems for Land Resources Assessment. New York, Oxford University Press.

Zeiler, M. (1999). Modeling our World - The ESRI Guide to Geodatabase Design. Redlands, CA, ESRI Press.

Atkinson, P. M. (1999). Spatial Statistics. Spatial Statistics for Remote Sensing. A. Stein, F. v. d. Meer και B. Gorte. Dordrecht, Kluwer Academic Publishers: 57-81.

Advanced

Molenaar, M. (1998). An Introduction to the Theory of Spatial Object Modelling for GIS. London, Bristol (PA), Taylor & Francis.