Introduction to ILWIS 3.11

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Contents of the lecture

- What is ILWIS?
- ILWIS Data types
- Spatial entities and data models
- How the spatial data types are represented in ILWIS
- Basic User-interface of ILWIS
- How to install ILWIS
What is ILWIS?

ILWIS: the Integrated Land and Water Information System

- PC-based integrated Geographical Information System (GIS) & Remote Sensing software
- Developed by ITC
- Originally designed in 1985 for a land use zoning and watershed management project in Sumatra
- Since 1989 ± 5000 systems installed in > 100 countries
- Used extensively in courses in and outside ITC, in research and projects
- Non-commercial
- Intended for training, research and small projects
- Complete package (GIS & Image processing)
- Easy to learn
- Many training materials available

What is ILWIS?

- PC-based GIS & Remote Sensing package
- Developed by ITC
- A complete package:
  - image processing
  - spatial analysis
  - digital mapping
- Easy to learn and use:
  - full on-line help
  - extensive tutorials for direct use in courses
  - 25 case studies of various disciplines
What can you do with ILWIS?

- Data input
- Data management
- Digital Image Processing
- Three dimensional image interpretation
- Attribute data analysis
- Data analyses (mostly raster)
- Data output

Hardware

- Digitizer
- Scanner
- Printer
- Plotter
- PC running Windows 3.1, 95, NT
ILWIS data types: *GIS*

Spatial data: where is it?  
Attribute data: what is it?

<table>
<thead>
<tr>
<th>Landuse</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A   Agriculture</td>
<td>500</td>
</tr>
<tr>
<td>F   Forest</td>
<td>300</td>
</tr>
<tr>
<td>G  Grassland</td>
<td>200</td>
</tr>
</tbody>
</table>

Geographic data in a GIS  
Combining spatial and attribute data

ILWIS data types: *Remote Sensing*

- Remote Sensing is the science of acquiring information about the earth without actually being in contact with it.
Spatial entities

- **Points:** single X and Y coordinate
  - rainfall stations, sampling points
- **Lines:** linear features; series of X and Y coordinates
  - drainage lines, contour lines
- **Area:** features occupy a certain area
  - landuse units, geological units

Data models - vector and raster
Spatial data in ILWIS: **Data Objects**

- **Point maps**: single X,Y coordinate
- **Segment maps**: series of X,Y coordinates
- **Polygon maps**: closed lines defining areas
- **Raster maps**: row/cols and pixels
- **Tables**: to store data in tabular format

Spatial data in ILWIS: **Service Objects**

- **Coordinate System**: describes map projection and coordinate system
- **Georeference**: defines relation between raster grid and map coordinates
- **Domain**: describes the type of data
- **Representation**: specifies how data is shown
### Spatial data in ILWIS: **Container objects**

<table>
<thead>
<tr>
<th>Icon</th>
<th>Object</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Map list" /></td>
<td>Map list</td>
<td>set of raster maps</td>
</tr>
<tr>
<td><img src="image" alt="Object Collections" /></td>
<td>Object Collections</td>
<td>subset of your data or result of import via Geogateway</td>
</tr>
<tr>
<td><img src="image" alt="Layouts" /></td>
<td>Layouts</td>
<td>map composition</td>
</tr>
<tr>
<td><img src="image" alt="Annotation text" /></td>
<td>Annotation text</td>
<td>text layers (e.g., labels of polygons)</td>
</tr>
<tr>
<td><img src="image" alt="Graphs" /></td>
<td>Graphs</td>
<td>graphical display of tabular data</td>
</tr>
<tr>
<td><img src="image" alt="Map Views" /></td>
<td>Map Views</td>
<td>display multiple map layers + annotation (grid, graticules, text etc)</td>
</tr>
</tbody>
</table>

### Spatial data in ILWIS: **Special Objects**

<table>
<thead>
<tr>
<th>Icon</th>
<th>Object</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Histogram" /></td>
<td>Histogram</td>
<td>table with frequencies of values in a map</td>
</tr>
<tr>
<td><img src="image" alt="Sample sets" /></td>
<td>Sample sets</td>
<td>training areas for multi-spectral classification</td>
</tr>
<tr>
<td><img src="image" alt="2-dim tables" /></td>
<td>2-dim tables</td>
<td>to combine 2 raster maps with class or ID domain</td>
</tr>
<tr>
<td><img src="image" alt="Matrices" /></td>
<td>Matrices</td>
<td>2-dim array of values</td>
</tr>
<tr>
<td><img src="image" alt="Filters" /></td>
<td>Filters</td>
<td>used to filter raster maps</td>
</tr>
<tr>
<td><img src="image" alt="Functions" /></td>
<td>Functions</td>
<td>user defined functions for MapCalc / TabCalc</td>
</tr>
<tr>
<td><img src="image" alt="Scripts" /></td>
<td>Scripts</td>
<td>sequence of ILWIS expressions</td>
</tr>
</tbody>
</table>
ILWIS Main Window

Navigator

Operation-Tree

Operation-List

ILWIS Main Window (2)
ILWIS Dialog boxes

Map Window
Table Window

On-line Help <F1>
Spatial data in ILWIS: Service Objects

- **Coordinate System**: describes map projection and coordinate system
- **Georeference**: defines relation between raster grid and map coordinates
- **Domain**: describes the type of data
- **Representation**: specifies how data is shown

**Coordinate system - geographic**

- Latitude ($\phi$)
- Longitude ($\lambda$)
- Equator
- Greenwich meridian

Diagram showing the relationship between latitude and longitude.
ILWIS 2.1 concepts

Coordinate system - Map projection

Cylindrical projections

Azimuthal projections

Conical projections

Georeference

A georeference stores the relation of the rows and columns of raster map(s) with ground-coordinates

Georef corners
**Georeference**

![Image](image.png)

**Domains**

- **Domain**: defines the possible content of a map, table or column.
  
  - In other words, what do these items in a map, table or column mean? Are they classes (such as land use classes), or values or something else?

- **Domain types**:
  
  - **Class domain**, list of class names (e.g. geological units)
  - **Identifier domain**, each element is unique (e.g. rainfall stations)
  - **Value domain**, measured, calculated or interpolated values (e.g. elevation)
  - **Image domain**, satellite images containing values between 0-255 (e.g. SPOT)
Representations

Representation contains information about how spatial data should be displayed (on screen or printout).

- **Representation Class:**
  - Each item in the domain has a color assigned to it
  - Maps with class domain need representation, otherwise it is impossible for ILWIS to know how to display

- **Representation Value**
  - Using actual values as limits
  - Using percentage values as limits
Representations

ILWIS 2.1 concepts

Domain value

Coordinate system

Point map
Segment map
Polygon map
Attribute table

Class Maps

Class domain
Representation

ID Maps

Identifier domain

Value Maps

Value domain
Representation Gradual or Value
ILWIS 2.1 concepts

Coordinate system

Georeference

Raster map

Attribute table

Class domain

Representation

ID Maps

Coordinate system

Georeference

Raster map

Attribute table

Identifier domain

Value Maps

Coordinate system

Georeference

Raster map

Attribute table

Value domain

Representation Gradual or Value

Spatial data

Point map

Segment map

Polygon map

Raster map

Attribute data

Attribute table

Column1

Column2

Column3

Identifier domain

Class domain

ID domain

Value domain

Class repr.

Class repr.

Value repr.
ILWIS 2.1 concepts

Reclassifying a map with attribute data

<table>
<thead>
<tr>
<th>Cityblock</th>
<th>Landuse</th>
</tr>
</thead>
<tbody>
<tr>
<td>001</td>
<td>Institutional</td>
</tr>
<tr>
<td>002</td>
<td>Commercial</td>
</tr>
<tr>
<td>003</td>
<td>Commercial</td>
</tr>
<tr>
<td>004</td>
<td>Residential</td>
</tr>
<tr>
<td>005</td>
<td>Residential</td>
</tr>
<tr>
<td>006</td>
<td>Residential</td>
</tr>
<tr>
<td>007</td>
<td>Industrial</td>
</tr>
<tr>
<td>008</td>
<td>Residential</td>
</tr>
<tr>
<td>009</td>
<td>Industrial</td>
</tr>
<tr>
<td>010</td>
<td>Industrial</td>
</tr>
<tr>
<td>011</td>
<td>Residential</td>
</tr>
<tr>
<td>012</td>
<td>Industrial</td>
</tr>
<tr>
<td>013</td>
<td>Residential</td>
</tr>
<tr>
<td>014</td>
<td>Residential</td>
</tr>
<tr>
<td>015</td>
<td>Residential</td>
</tr>
</tbody>
</table>

ILWIS Concept: Dependency link

¬ Dependency link: the link between data objects, derived from other data objects

¬ Maps, tables and columns, which are original are called source objects, and those that are made from them, are called dependent objects.

¬ Advantages:
  - Easy update
  - Minimum use of disk space
  - Data retrieval without actual calculation
  - Easy change of calculation formulas

¬ Object definition files store, amongst others, the expression by which the output object is created and contain a reference to the data file.
ILWIS Concept: *Dependency link*

- **Source objects**
  - Point map
  - Segment map
  - Polygon map
  - Raster map
  - Attribute table

- **ILWIS operations**
  - For example:
    - Polygon to Raster

- **Dependent objects**
  - Point map
  - Segment map
  - Polygon map
  - Raster map
  - Attribute table

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**Object Definition - *Properties***

- **Object definition files**
  - ILWIS objects have an ASCII object definition file which stores all information on the object:
    - name
    - creation time
    - relation to other required objects (domain, georeference, representation, etc)
    - the objects data files
    - dependent or not
    - up-to-date
  - Stores how dependent map, table or column was created.
  - In principle only the map's or table's object definition file is stored on disk. When the dependent map or table is displayed, the data file is automatically calculated and stored on disk.
  - All dependent data objects can be recalculated in case the input data have changed.
  - The contents of object definition files is shown in the Properties dialog box of an object.
ILWIS 2.1 concepts

Object Definition - Properties

Using “Map calculation” in ILWIS

Output map Logical or Arithmetic expression

New map on screen Combine existing maps with logical and arithmetic operators

SUM_Rain storm 1 + storm 2

Suitable iff(slope > 50, 1, iff(slope > 20, 2, 3))
ILWIS 2.1 concepts

**Domain: Landuse**

Input map: Landuse

Rocks $= \text{iff(landuse} = \"bare rocks\", \text{landuse}, \"?\")$

Output map: Rocks

Output map: Lands

**Domain: lands**

Output map: Pastarea

**Domain: bit**

Pastarea $= \text{landuse} = \"pasture\"$

Examples using the Map calculator

Using single and multiple RETRIEVAL selection criteria:

Grass $= \text{Landuse} = \"grassland\"$

Landwat $= \text{iff (landuse} = \"lake\") \text{ or (landuse} = \"riverbed\"), \text{ \"water\", \"land\"}$

Mainfault $:= (\text{faults} = \"fault\") \text{ and (length > 5000)}$

$= \text{dependent ilwis map}$

$:= \text{independent ilwis map}$
Examples using the Map calculator

Reclassification:

\[ \text{Demc1} = \text{if}(\text{dem} < 3000, \text{“low”}, \text{if}(\text{dem} < 4000, \text{“moderate”}, \text{“high”})) \]

Reclassification using a table (outmap = inmap . Table)

\[ \text{Landval} = \text{landuse} \cdot \text{Landvalue} \]

Reclassification using a domain (outmap = clfy ( inmap , domain)

\[ \text{Landvalc} = \text{clfy(landvalue , landvalc)} \]

What’s new in version 3? (1)

- 32-bit application
  - fully compatible with Windows 95/98/NT4 and 2000
  - memory allocation limitations are removed
  - long filenames are now supported

- Extended import/export capabilities
  - conversions through PCI’s GeoGateway®, supporting more than 100 map and table formats.

- Removal of limitations
  - new data structure for point, segment and polygon maps, resulting in more accurate positioning of vector data
  - maximum number of points per segment is removed
  - maximum number of segments and polygons per map removed
  - maximum number of columns in a raster map is removed
What’s new in version 3? (2)

- Modern User Interface
  - operation-list also available as tree view
  - layer management pane with a tree view in a map window, including legend
  - dockable windows
  - tabbed property sheets

What’s new in version 3? (3)

- Improved data management
  - multiple catalogs in the Main window
  - select, copy and delete multiple objects
  - object collection: container for related objects
  - sorting and details view
What’s new in version 3? (4)

- User-friendly wizards
  - digitizer setup
  - ASCII table import
  - join columns

- Map Layout for better output
  - WISIWYG map layout with multiple annotated map views on specified scale

ILWIS Stereoscopy tool

- Stereoscopy tools
  - Create stereo pairs from two aerial photographs
  - Create stereo pair from 1 image and a DEM
  - Stereo pairs can be viewed as anaglyph or using a stereoscope mounted to the monitor.
What’s new in version 3? (6)

- Improved help
  - HTML-Help
  - better contents, index and search capabilities

Downloading and installing ILWIS

- Download the program ILWIS 3.1 from:
  http://www.itc.nl/ilwis/downloads/1_ilwis_31/ilwis31.asp

- Run the program: ILWIS3.1Academic.exe

- Fill in the following information in the registration part:
  - Name: ASIA IT&C CASITA training course
  - Company/e-mail: ITC training course
  - Registration code: DE22541E-14D2D9D2-B1A4DF87-A464A392
  - Verification code: AEDC4646-C0FA8DC5-A5764332-3658D7DF

- This license is valid till April first

- Download the patch for ILWIS 3.11 from the same website and install it on your system.
ILWIS systems for CASITA participants

- Each partner University of the CASITA project will receive their own license for ILWIS, which can be used on many computers within the university.
- Please fill in the ILWIS registration form:
  - Project, Organisation, Contact person, e-mail, address.
- Hand in to Dr. Van Westen
- You will receive a CD with ILWIS 3.1
- Upgrading to 3.12 via ILWIS Website.
- You will also receive the CD: Introduction to GIS and Remote Sensing.

Please visit our web-site:

www.itc.nl/ilwis