RASTER AND VECTOR DATA

ADVANTAGES AND DISADVANTAGES

CONTENTS

RASTER AND VECTOR DATA

- Geographic features stored in a GIS can be considered as one of three types:
- **points:** no area at this scale (e.g. building, tower)
- **lines (arcs):** no width at this scale (e.g. river, road, administrative boundary)
- **areas (polygons):** line surrounding enclosed area (e.g. forest stand, census district)
- Spatial characteristics of features can be stored in a GIS in one of two ways:
  as *raster* data or as *vector* data.

- Thus geographically referenced data is stored in: -
  - Raster (grid or cellular-based) data structure.
  - x, y coordinate reference-based (vector) data structure.
- Raster data structure

- Grid or cellular-based

- Grid representation of a measured image property in which each grid cell (pixel) comprises a digital number. The larger the area represented the lower the resolution of the data. The smaller the area covered the greater the resolution and the more accurately features are represented.

- Vector data structure
- Arc-node model
- Arcs represent the shape of lines and are split at their intersections with other arcs, where nodes occur; nodes represent the beginning and ending vertex of each arc. Vector format- representation of features on the earth as lines, points, or polygons as a series or XY Cartesian coordinates

DEFINITIONS:

- *RASTER DATA MODEL*

  A spatial data model that uses a grid and cells to represent the spatial variation of a feature.

- *VECTOR DATA MODEL*

  A data model that uses points and their x-, y- coordinates to construct spatial features.

Characteristics Of Raster Data Model

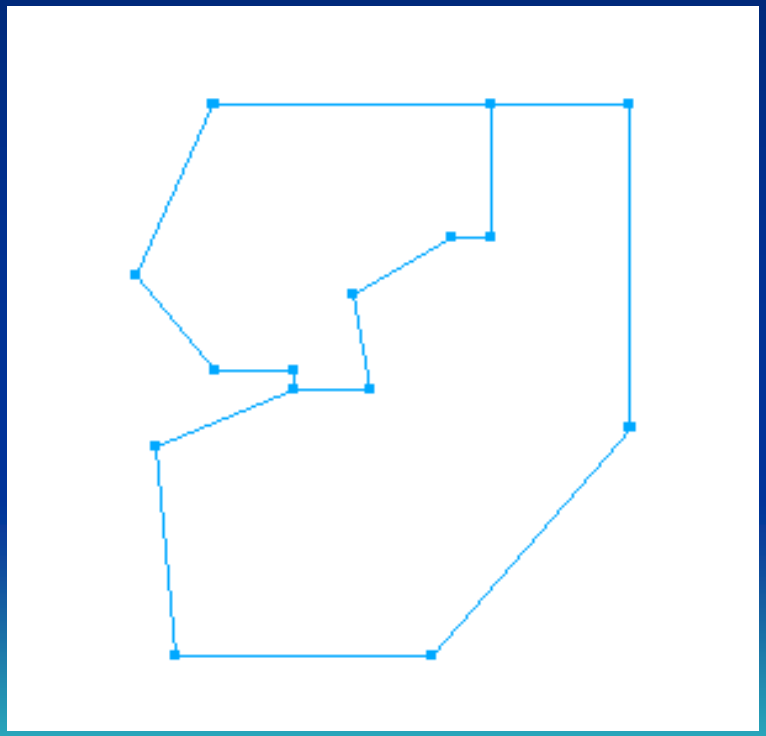
- Simple 'grid' structure of rows and columns.
- Based on cells or picture elements (pixels).
- Linear feature (e.g. a road) is a contiguous set of cells.
- Resolution based on size of grid (cell) the smaller the cell, the higher the resolution.
- Features are considered homogenous within a pixel.
- Storage increases with the square of the resolution.

Characteristics Of Vector Data Model

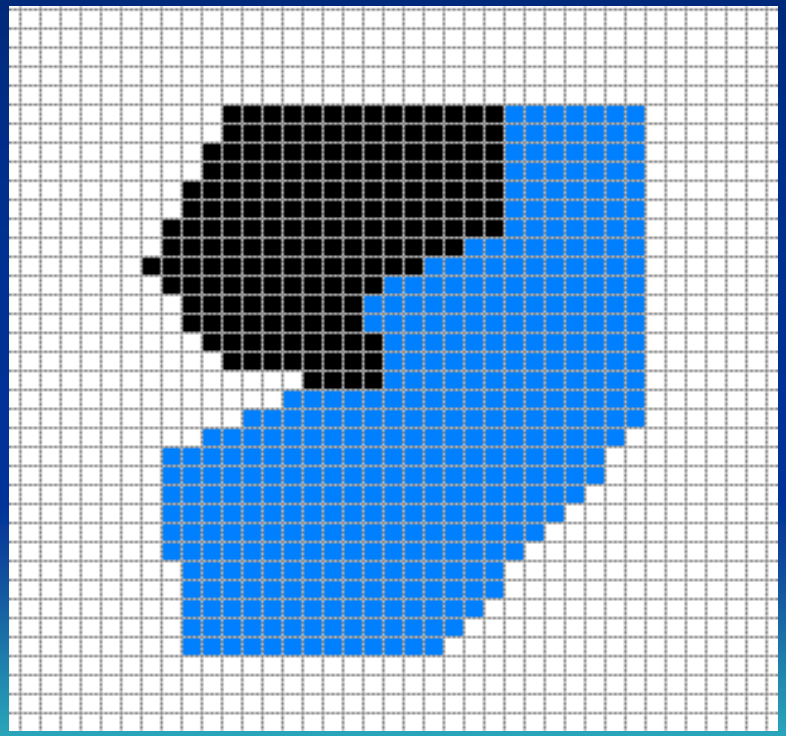
- Based on objects (points, lines, areas).
- Constructed using arcs, nodes and vertices.
- Resolution can be independent of detail.
- Every point has a unique location.

Figure 1:ILLUSTRATING RASTER and VECTOR DATA

(b) Vector Data



(a) Raster Data



Advantages of Raster Data Structures

- Simple data structures.
- Overlay and combination of maps and remote sensed images easy.
- Some spatial analysis methods simple to perform.
- Simulation easy, because cells have the same size and shape.
- Technology is cheap.
- Compatible with remote sensing.
- High spatial variability available which is efficiently represented (e.g. relief).
- Only raster can store image data (e.g. photos).

Advantages of Vector Data Structures

- Good representation of phenomenonology.
- Topology can be completely described and easy to maintain.
- Accurate graphics, retrieval, updating and generalization of graphics and attributes possible.
- Requires less disk storage.
- Graphical maps more closely represent hand-drawn.
- Compact data structure for homogenous areas.
- Better suited for map output.

Disadvantages of Raster Data Structures

- Crude raster maps are considerably less beautiful than line maps.
- Projection transformations are time consuming
- Requires more storage space.
- Boundaries has more blocky appearance.
- More difficult to represent topology.
- Data structure is not compact (though it can be modified).
- Topological relationships are harder to represent.
- Map output can appear 'blocky‘, less accurate maps.
- The use of large cells to reduce data volumes means that recognizable structures can be lost and there can be a serious loss of information (drop out).

Disadvantages of Vector Data Structures

- More complex Data Structures.
- Combination of several vector polygon maps or polygon and raster maps through overlay creates difficulties.
- Simulation is difficult because each unit has a different topological form.
- Display and plotting can be expensive, particularly for high quality, color and cross-hatching.
- Spatial analysis and filtering within polygons are impossible.
- Not as compatible with remote sensing as raster data.
- Overlay analysis more time-consuming than raster data.
- High spatial variability is less efficiently stored.
- Cannot store (continuously varying) image data.

COMPARISON OF RASTER AND VECTOR DATA MODELS

- The primary focus of the vector data model is the geographic feature; the primary focus of the raster data model is location.
- The vector data model is more suited to the question of "What do I know about this geographic feature? The raster data model answers the question, "What geographic phenomenon occurs at this location."
- The vector model uses x, y coordinates to represent geographic features, raster store rows and columns of cell values.
- The vector data model defines boundaries. There are no boundaries defined in the raster data model.

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- The vector data model represents location as x, y coordinates in a Cartesian coordinate systems. The raster model represents location as cells, also in a Cartesian coordinate system.

- The vector model represents feature shape accurately; the raster model represents rectangular areas and thus is more generalized and less accurate.

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- The vector model represents features with well-defined boundaries; the raster model represents a more generalized view. The raster model can also represent gradual transition between features and surfaces, such as soil classification and elevation

- The vector model is used for high-quality cartography and where accuracy and precision are important, such as for cadastral (property) applications. The raster data model is useful for image/picture storage and is well suited to many spatial modeling operations (as optimum corridor route selection, modeling surface storm runoff, and forest fire spread).

Figure 2: In a more complex example, this image shows both raster data (satellite image of UNBC and area) and vector data (Cranbrook Hill Greenway). This image is at normal size (no zoom).

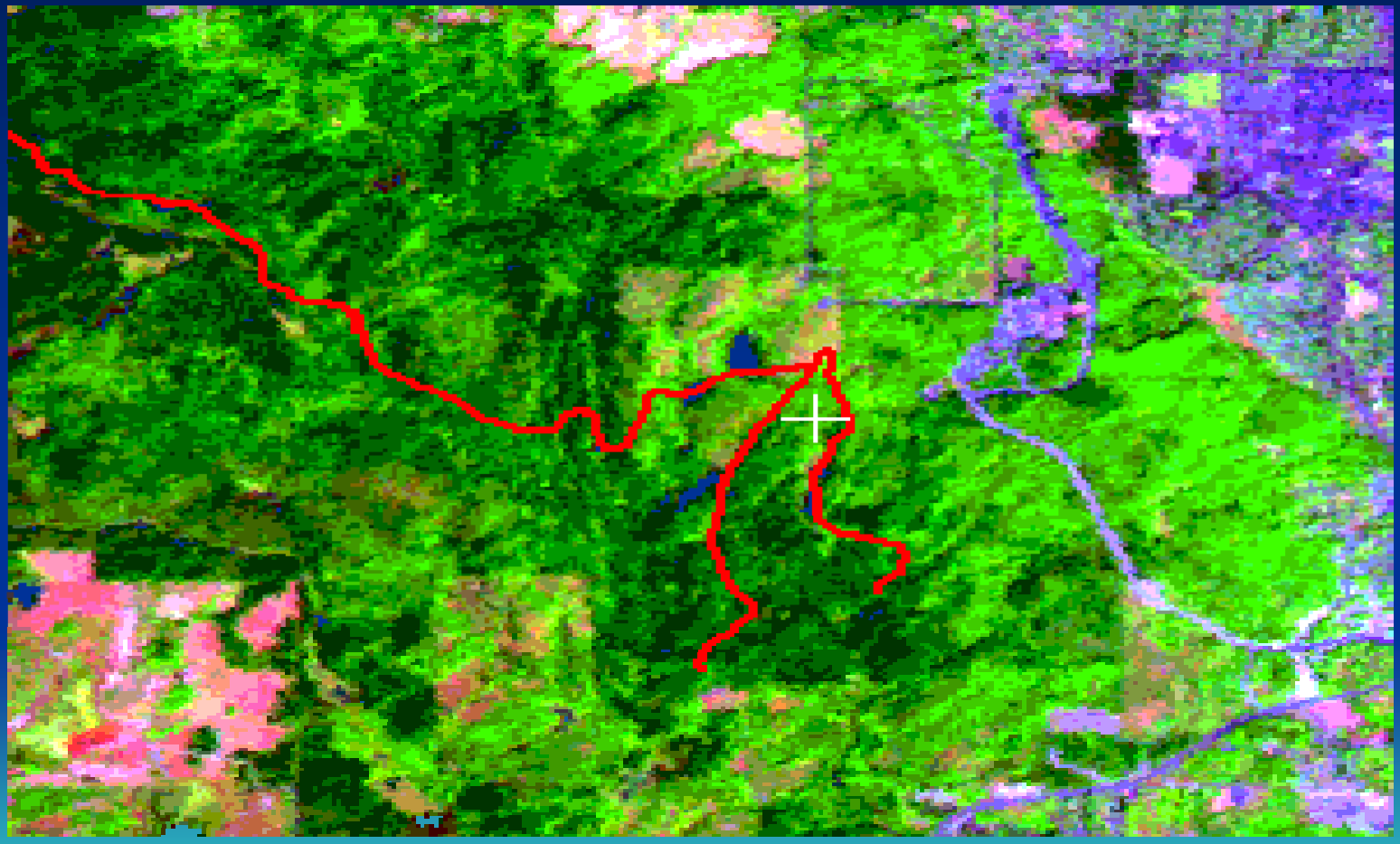


Figure 3: When we zoom in 16X from the previous image, the difference between raster and vector data becomes more apparent. The raster data is defined by an individual colour (representing a data value) for each grid cell. The vector data remains a solid red line with the same width.

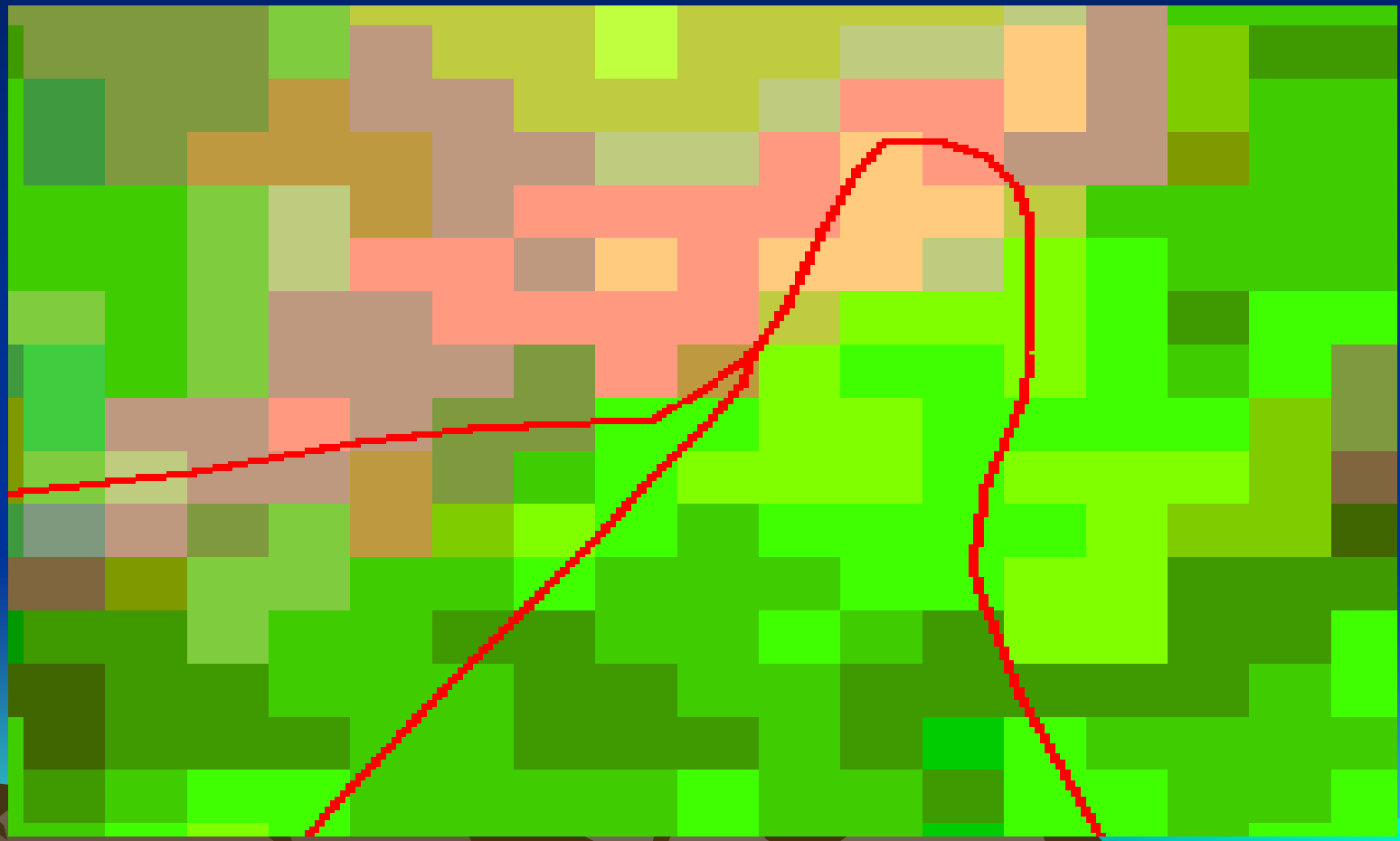


Figure 4: RASTER - AND VECTOR - VISUALISATION OF IDENTICAL SPATIAL OBJECT IN GIS

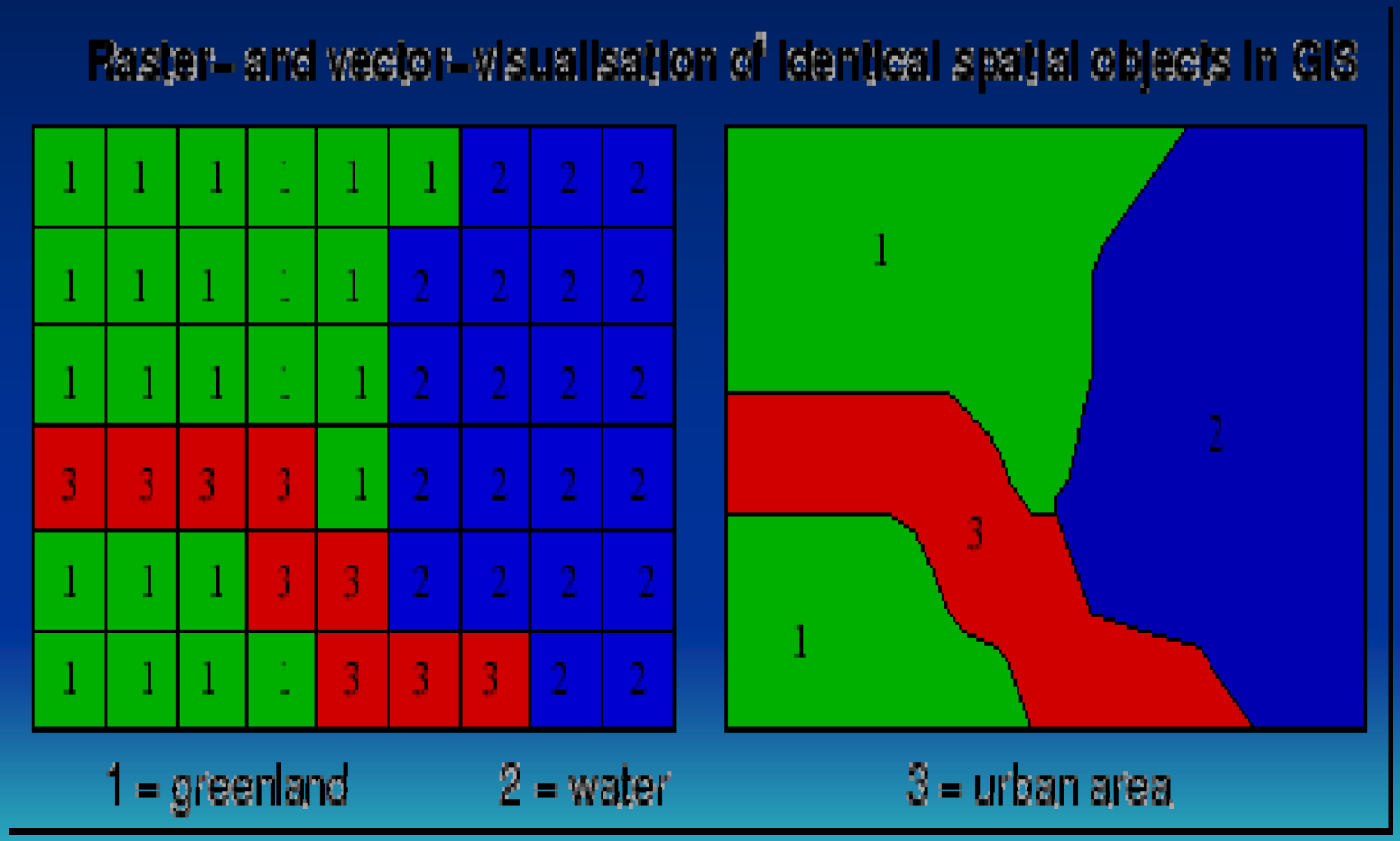
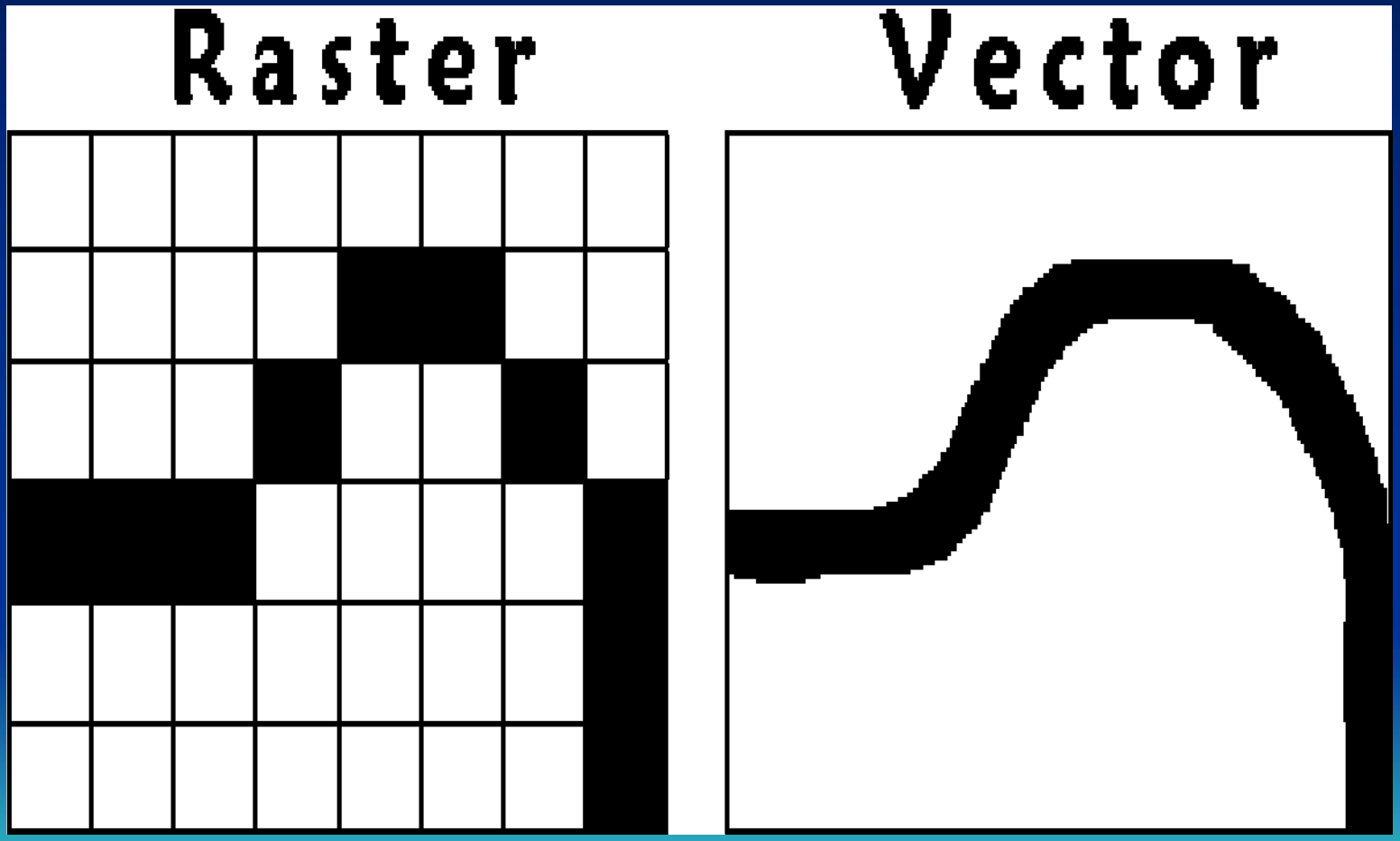


Figure 5 : A simplified example of the difference between raster data and vector data



Examples of vector and raster data

- Examples of vector data: DLGs (digital line graphs), TIGER files (U.S census data)
- Examples of raster data: DRGs, Remotely sensed data (imagery); DOQs (photos); DEMs (grids)

CONCLUSION

- **Raster data are data continuously spread in space, which are structured in a measured matrix of usually quadratic cells and cells with the same size. Each cell gets an attribute (property, attribute date), which represents an appropriate phenomenon.**

- **Vector data are used for the storage of line information and/or for the storage of homogeneous areas at closed lines (polygons). Each vector object can be assigned with none, one or several attributes (property).**