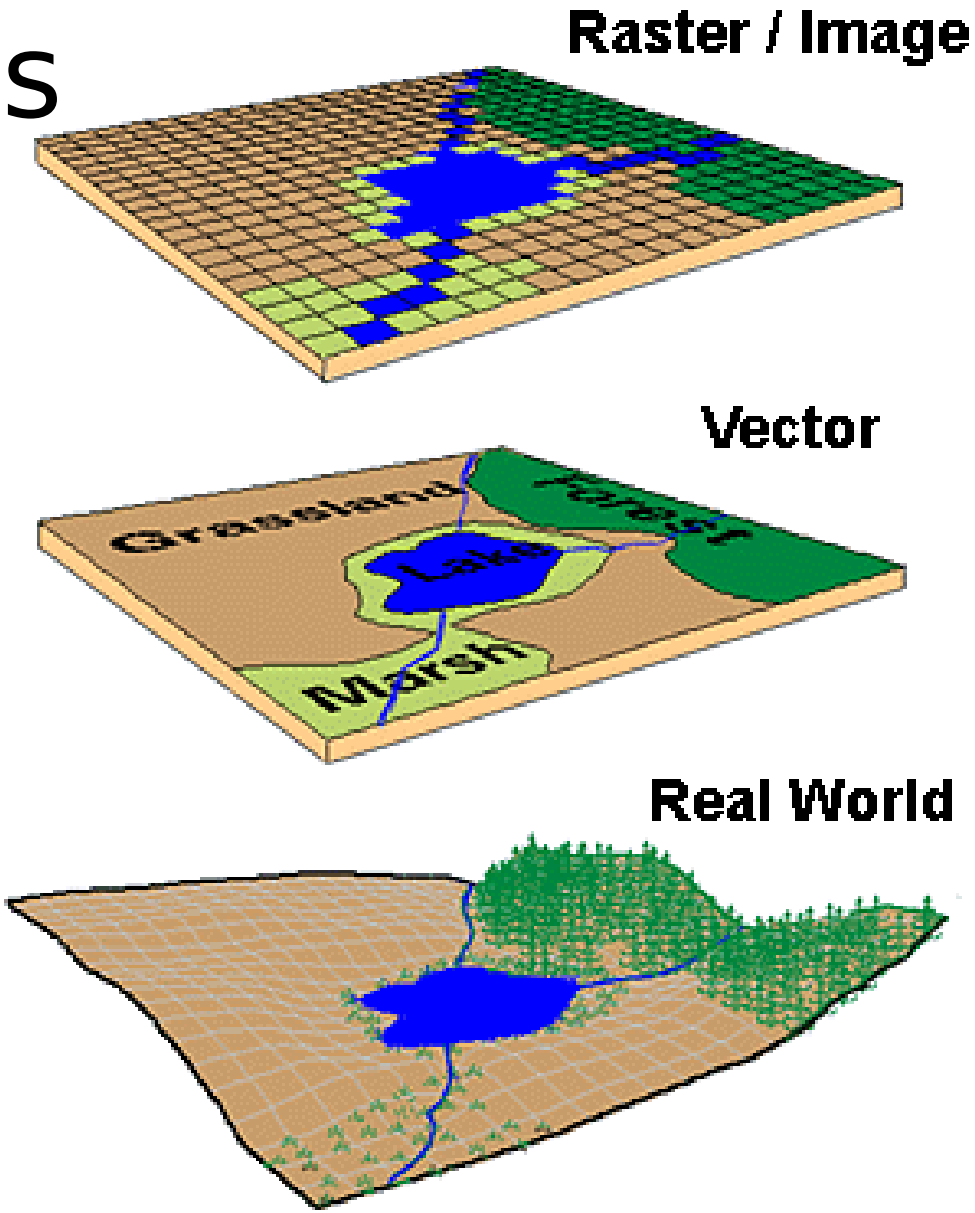
Basic Data Models

- **Vector Data Model (entities)**
- **Raster Data Model (fields)**



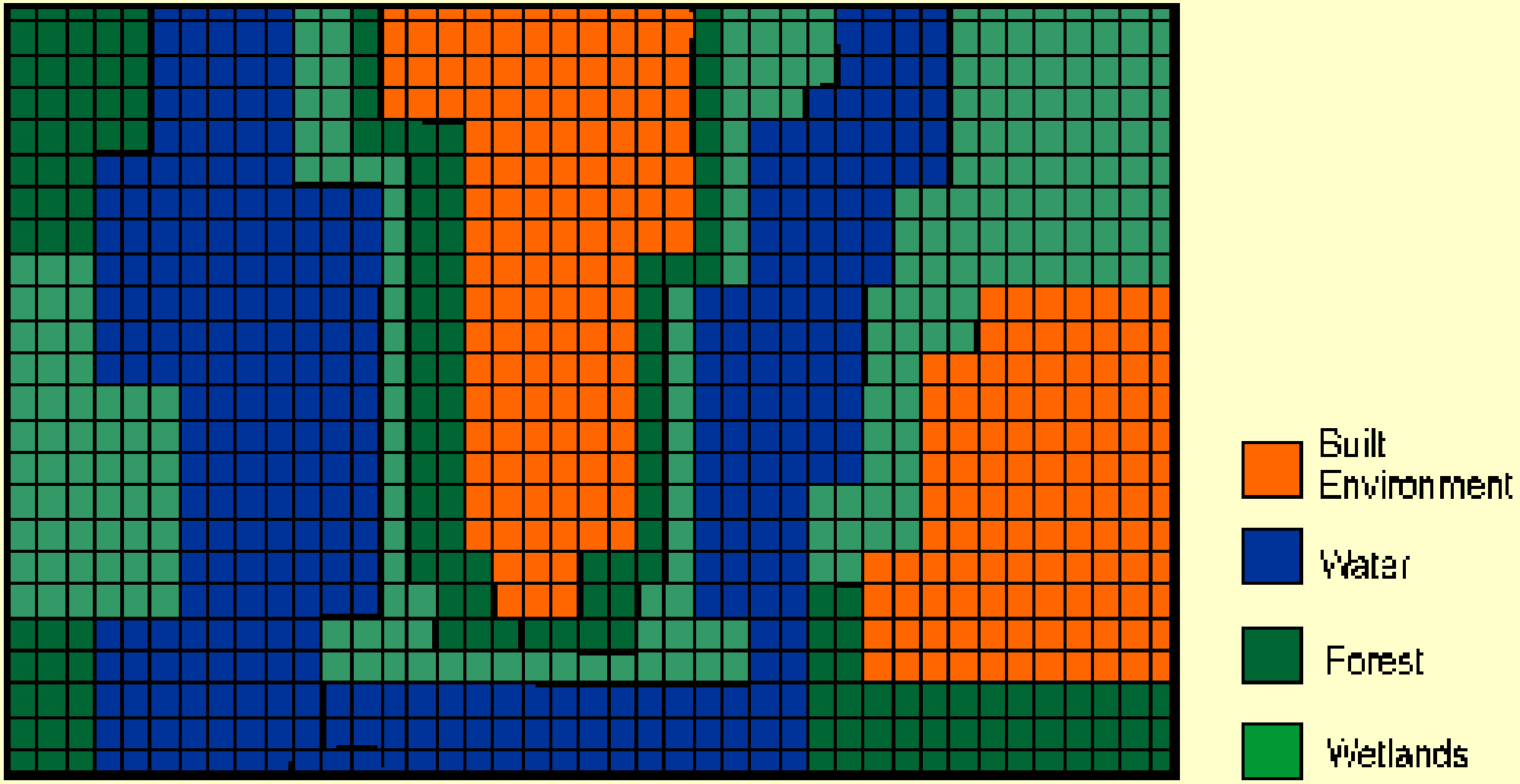
Raster Data Models

- **Establishes a pattern of similar grids or cells over a geographic area**
- **The location of each cell is defined by its row and column indices**
- **The value assigned to a cell either reflects the dominant feature (attribute) at that grid space or indicates the presence of a preferred feature in case where two or more features are present within a single grid space**

Raster Data Models

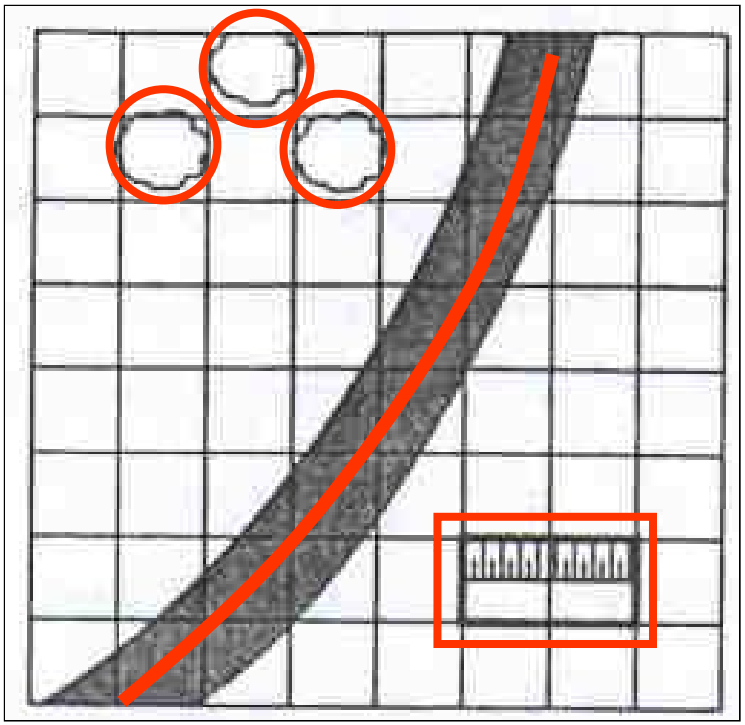
- **Basic unit in a raster is a cell (or grid or pixel)**
- **Analytically more powerful than the vector based GIS**

The Raster View of the World



The Raster GIS references phenomena by grid cell location in a matrix. The grid cell is the smallest unit of resolution and may vary from centimeters to kilometers depending on the application.

Raster Data Model

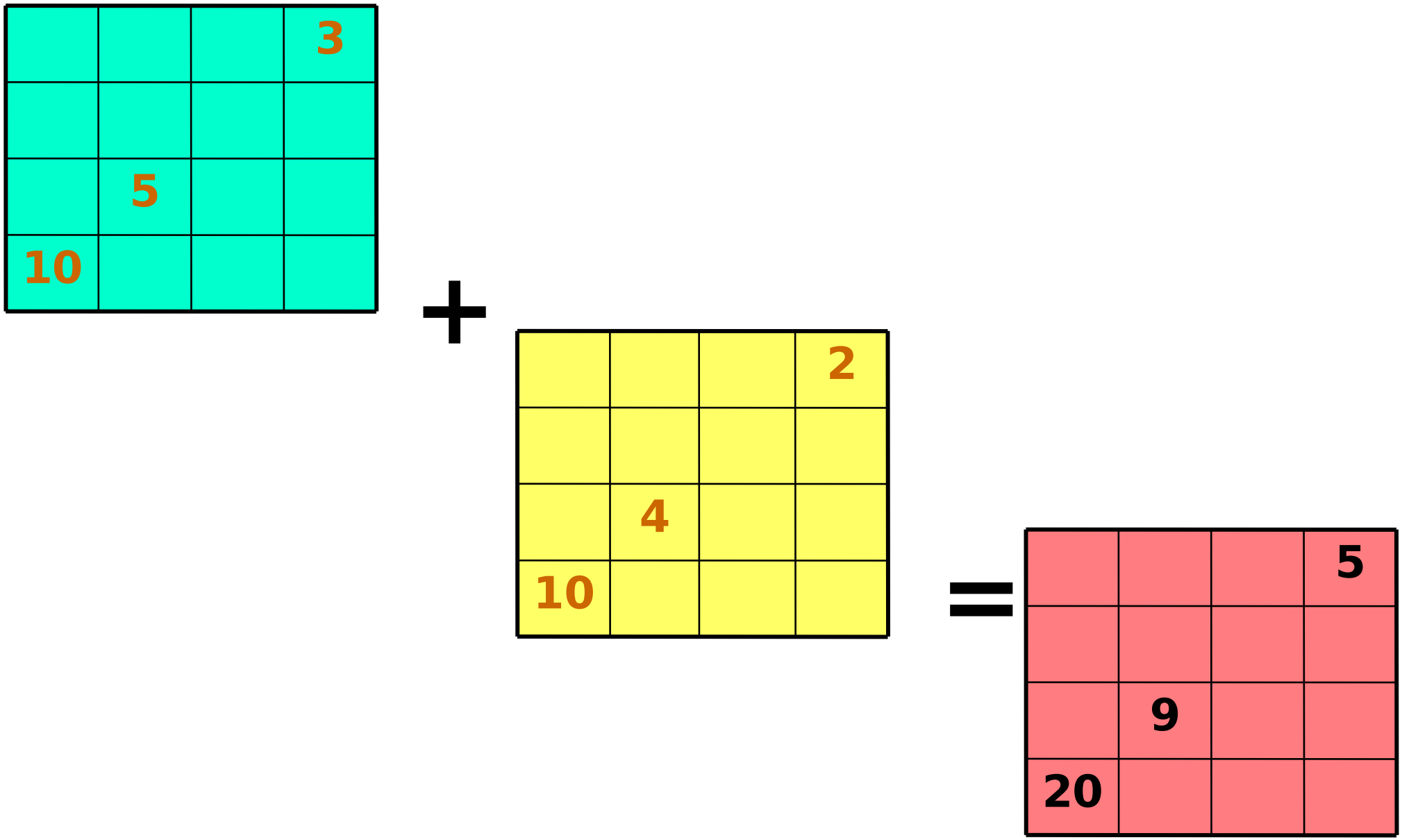


	0	1	2	3	4	5	6	7
0	0	0	1	0	0	2	0	0
1	0	1	0	1	2	2	0	0
2	0	0	0	0	2	2	0	0
3	0	0	0	0	2	0	0	0
4	0	0	0	2	2	0	0	0
5	0	0	2	2	0	0	0	0
6	0	2	2	0	0	3	3	0
7	2	2	0	0	0	0	0	0

Cell table

Cell no.	Cell value
00	0
01	0
02	1
03	0
04	0
05	2
06	0
.	0
65	3
66	3
67	0
.	.
70	2
71	2
.	.
.	.

Code list	
0	unmapped
1	forest
2	road
3	house



Direct calculations using raster layers

Comparison between raster and vector

	Raster	Vector
Data collection	**Rapid**	**Slow**
Data volume	**Large**	**Small**
Graphic treatment	**Average**	**Good**
Data structure	**Simple**	**Complex**
Geometrical accuracy	**Low**	**High**
Analysis in network	**Poor**	**Good**
Area analysis	**Good**	**Average**
Generalization	**Simple**	**Complex**

Attribute Data

Data Type	***Allowed Values***	***Allowed Operations***
Boolean	0 or 1	Logical and indicator operations: Truth versus Falsehood
Nominal	Any names	Logical operations, classification and identification
Ordinal	Numbers from 0 to ∞	Logical and ranking operations, comparisons of magnitude
Integer	Whole numbers from $-\infty$ to $+\infty$	Logical operations, integer arithmetic
Real	Real numbers (with decimals) from $-\infty$ to $+\infty$	All logical and numerical operations
Topological	Whole numbers	Indicate links between entities

Raster data formats

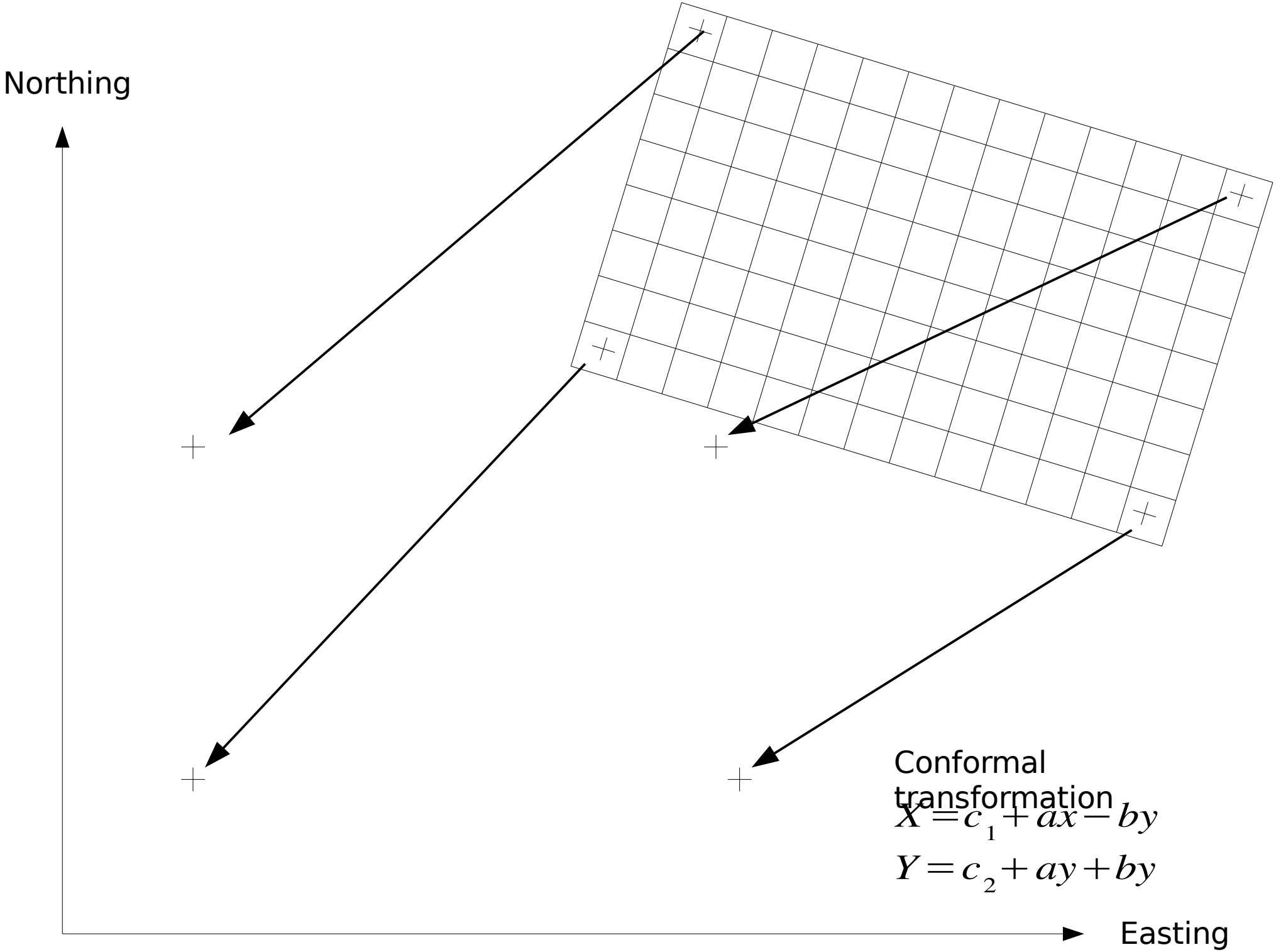
(http://www.gdal.org/formats_list.html)

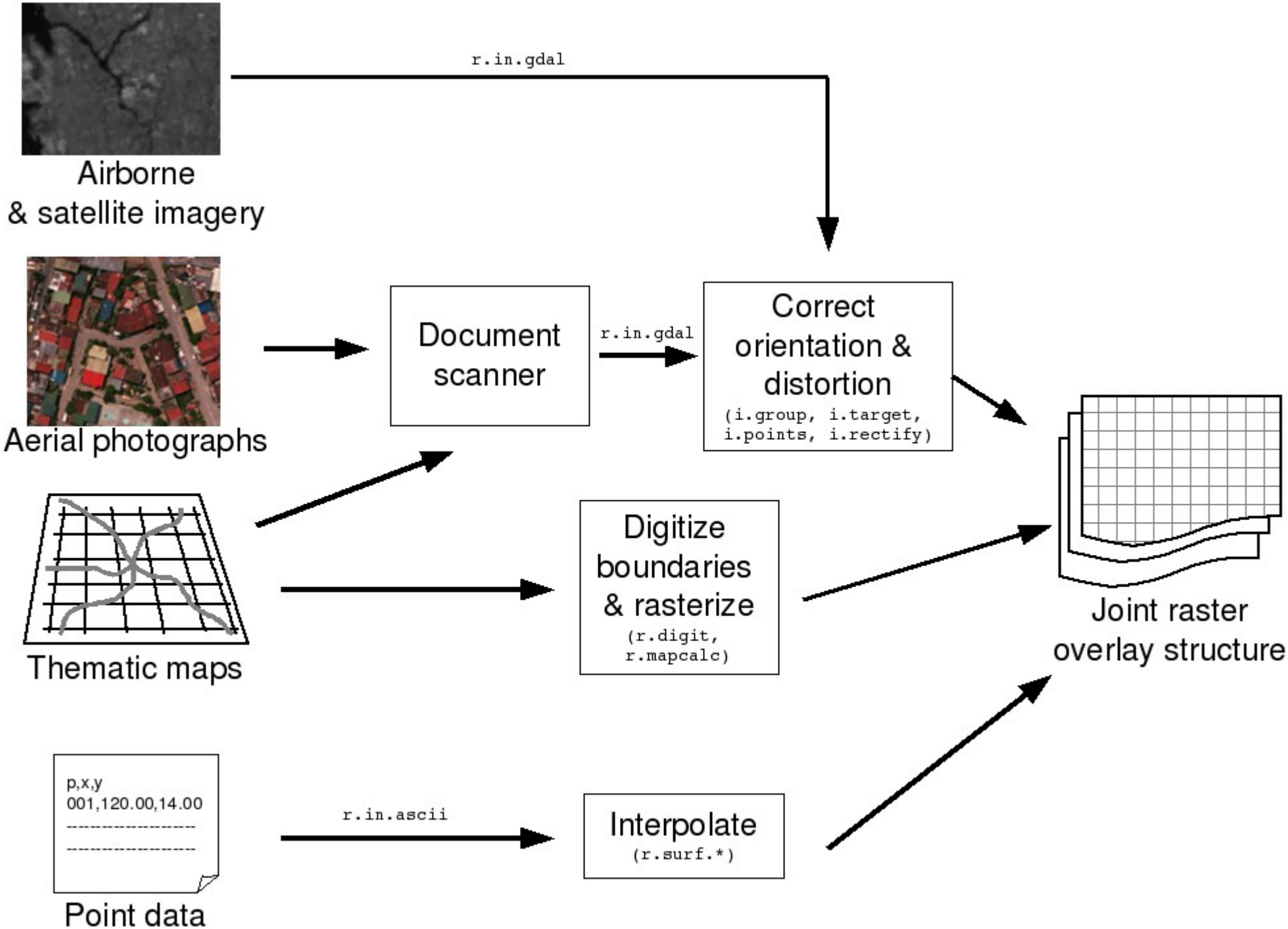
Arc/Info ASCII Grid , Arc/Info Binary Grid (.adf) , AIRSAR Polarimetric , Microsoft Windows Device Independent Bitmap (.bmp) , BSB Nautical Chart Format (.kap) , VTP Binary Terrain Format (.bt) , CEOS (Spot for instance), First Generation USGS DOQ (.doq) , DODS / OPeNDAP , New Labelled USGS DOQ (.doq) , Military Elevation Data (.dt0, .dt1) , **ERMapper Compressed Wavelets (.ecw) , ESRI .hdr Labelled , ENVI .hdr Labelled Raster** , Envisat Image Product (.n1) , EOSAT FAST Format , FITS (.fits) , Graphics Interchange Format (.gif) , Arc/Info Binary Grid (.adf) , **GRASS Rasters , TIFF / GeoTIFF (.tif) , Hierarchical Data Format Release 4 (HDF4)** , **Erdas Imagine (.img)** , Atlantis MFF2e , Image Display and Analysis (WinDisp) , ILWIS Raster Map (.mpr,.mpl) , Japanese DEM (.mem) , **JPEG JFIF (.jpg) , JPEG2000 (.jp2, .j2k) , JPEG2000 (.jp2, .j2k) , JPEG2000 (.jp2, .j2k) , NOAA Polar Orbiter Level 1b Data Set (AVHRR)** , Erdas 7.x .LAN and .GIS , In Memory Raster , Atlantis MFF , Multi-resolution Seamless Image Database , Meteosat Second Generation , NDF , NITF , NetCDF , OGDI Bridge , PCI .aux Labelled , PCI Geomatics Database File , Portable Network Graphics (.png) , PCRaster (.map) , Netpbm (.ppm,.pgm) , RadarSat2 XML (product.xml) , USGS SDTS DEM (*CATD.DDF) , Raster Matrix Format (*.rsw, .mtw) , SAR CEOS , USGS ASCII DEM (.dem) , X11 Pixmap (.xpm)

Creating digital datasets by manual input

Georeferencing

- all spatial data in a common frame of reference
- common coordinate system is plane, orthogonal cartesian coordinates
- referenced with ground and field surveys or GPS
- In GRASS
  - i.group, i.target, i.points, i.rectify


Northing
Easting
Conformal transformation
$X = c_1 + ax - by$
$Y = c_2 + ay + by$



from Burrough & McDonnell, 1998