Spatial data models & representations

Models vs representations

	Entity - based model (bjects that do not cover entire space – relative space)	Field-based model (modelled objects/phenomena fully cover space absolute space)
Raster representation (finite resolution arrays of grid cells)	Discrete raster representations of spatial objects	Continuous rasters: DEM grids, temperature data…
Vector representation (with linear interpolation between vertices)	Discrete geometries: Points, lines, polygons	e.g., regular (triangular) partitions of space (Voronoi polygons)

Relational model and spatial data

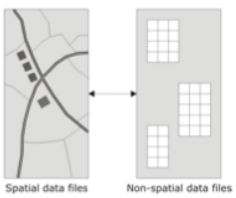
- **A complicated marriage:**
  - **Performance:** dealing with inherently multi-valued attributes (coordinates) would lead to endless joins – this, spatial data are a bad fit for tabular structures!
  - Spatial data are usually **multi-dimensional** (2D+, up to the dimensionality of the embedding space (2D, 3D)…
    - Can you think of 0D, 1D spatial data?
    - Can you think of a spatial analysis in a 1D *space*?
  - **Indexing:** no natural ordering of data in 2D(+) space leads to problems with indices (discussed in a few weeks)

To efficiently and correctly interpret, analyse and relate spatial data, more than their geometry is needed:

- **Spatial reference systems** (defined by origin, axes, units, etc)
- Efficiency is assured by spatial access structures (**indexes**)
- Optionally, **metadata** about the spatial features – data quality parameters (lineage, accuracy, semantics of attributes, units of measurements)

Options for Spatial data in DBMS

- **Hybrid model:**
  - maintains pointers (FK) to a separate storage solution
  - Typical for early integration with GIS
  - Makes maintaining integrity, security and reliability harder



- **Integrated model (Object-relational DBMS)**
  - **Extends the relational model** with special data types and spatial data definition, manipulation and query methods
  - Uses the capabilities of the DBMS to manage, query and secure the data

Spatial O-R DBMS (entity-based model)

- **Extended relational model:**
  - Tables with *n* non-spatial, and (usually) a column with a spatial data type
  - This data type is a (sub)class of the object data type Geometry
- **Spatially grounded entities: *Features***