# Spatial data models and dimensions of spatial entities

By NTUA

GEO-ACADEMY
GEO-Hub for teachers in Europe

Co-funded by the European Union

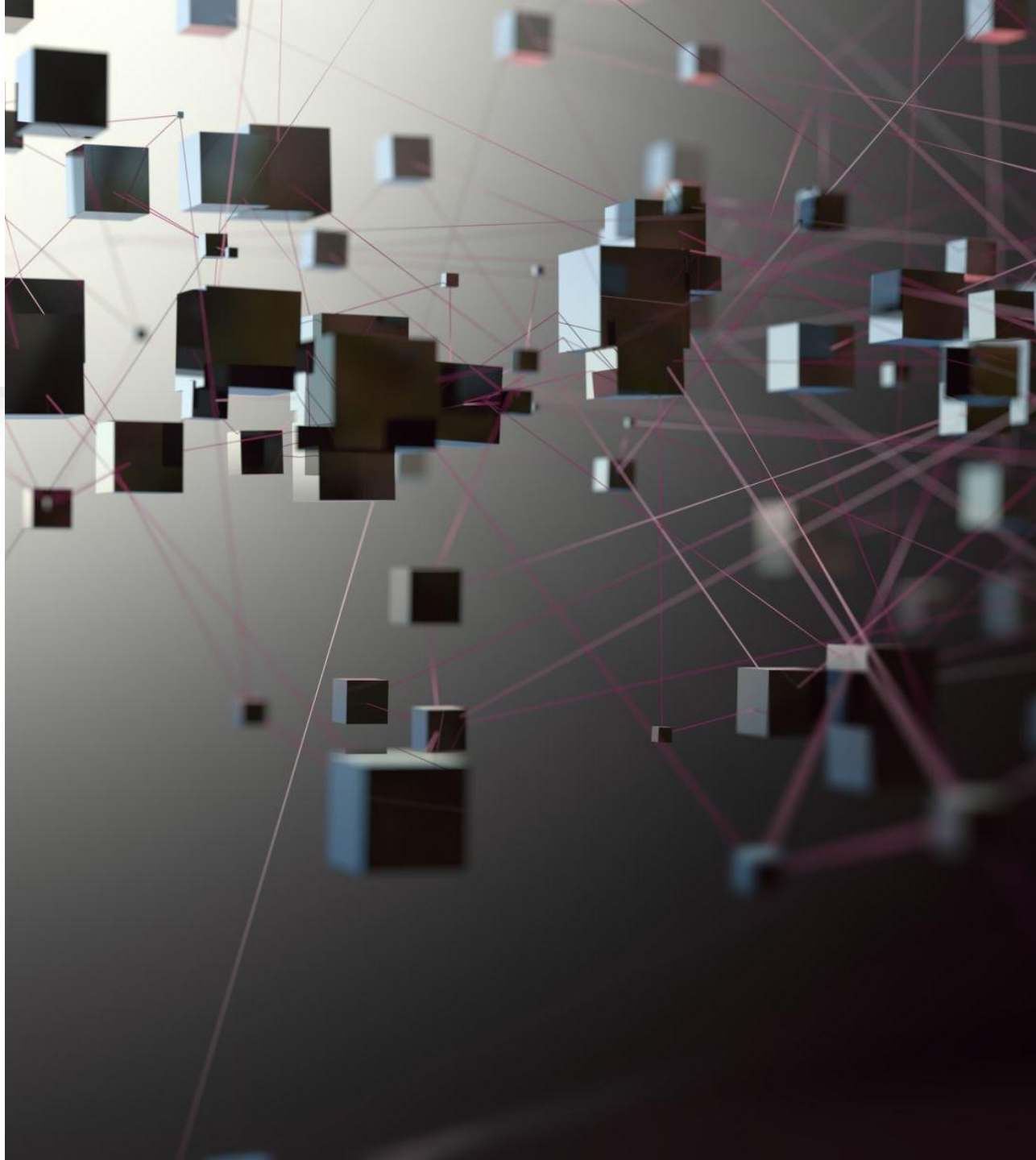
Project Ref: 101104693 — GEO-ACADEMY — ERASMUS-EDU-2022-PEX-TEACH-ACA

# Representation of spatial entities

- Geographic space is theoretically infinite, continuous and complex, while the space provided by a computer system is limited and digital.
- Thus, for the representation of spatial entities of the real world in the digital space, it is necessary to use a link between the two spaces.
- Data models and structures provide this link.

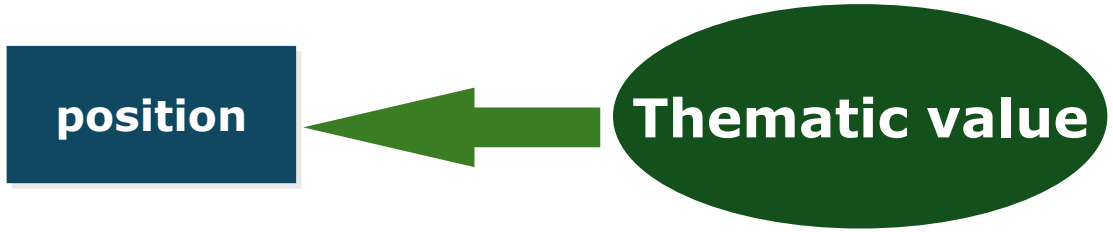
# Spatial data models

- Spatial data models are defined as conceptual schemes for representing geographic space
- Two basic spatial data models:
  - Field-based model
  - Object-based model
- The selection of one over the other depends on the type of geographic data



# Field-based model

- The field-based model approximates geographical space as a continuous and homogeneous spatial medium consisting of sub-areas, the fields.
- The phenomenon being considered takes a value at each position of the two-dimensional space.
- The field-based model is usually preferred to represent soil's constitution, humidity, terrain, etc., because these are phenomena whose values are changing continuously from location to location.

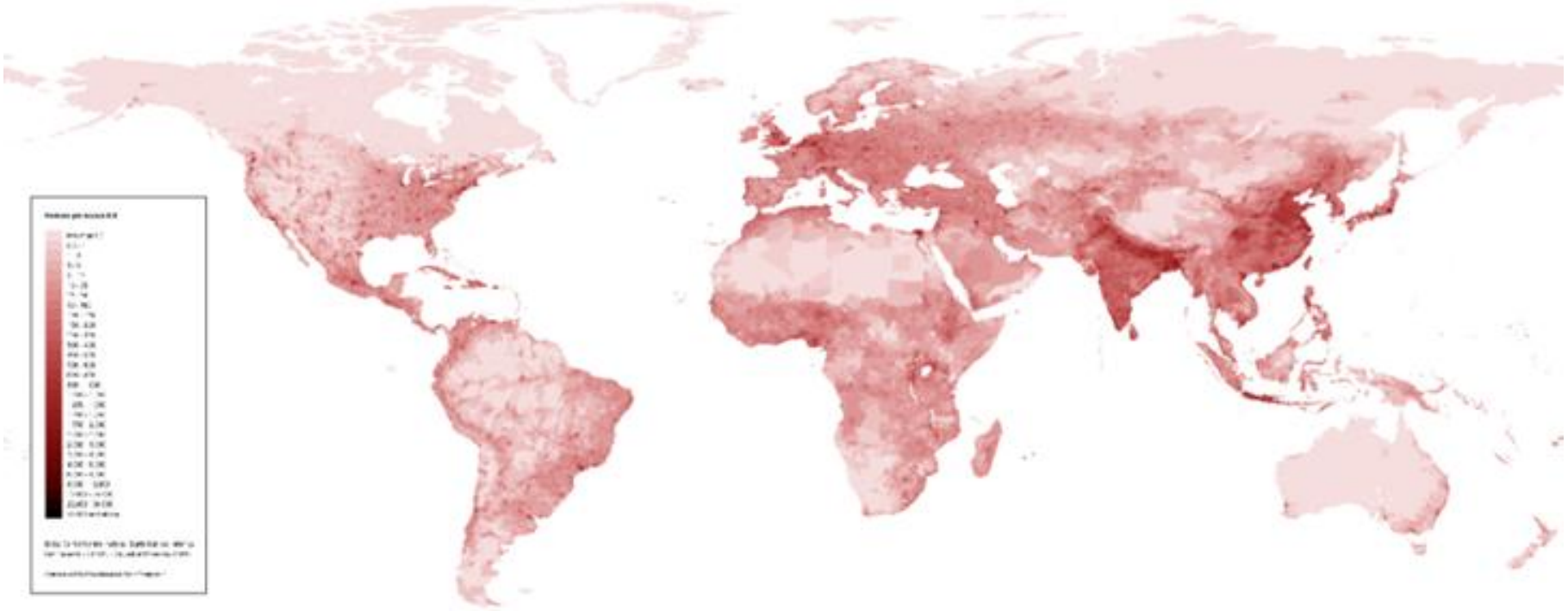


# Field-based model

- The representation of a field-based model on the computer requires the use of data structures that support the partition of the representation space into individual smaller areas, either points or finite cells in the form of a grid, so as each point or cell is assigned an attribute value.

# Field-based model

The Figure shows an example of the representation of world population density with the field-based model. The continents have been divided into individual small grid cells (1km$^2$) and population density values are assigned to each cell.



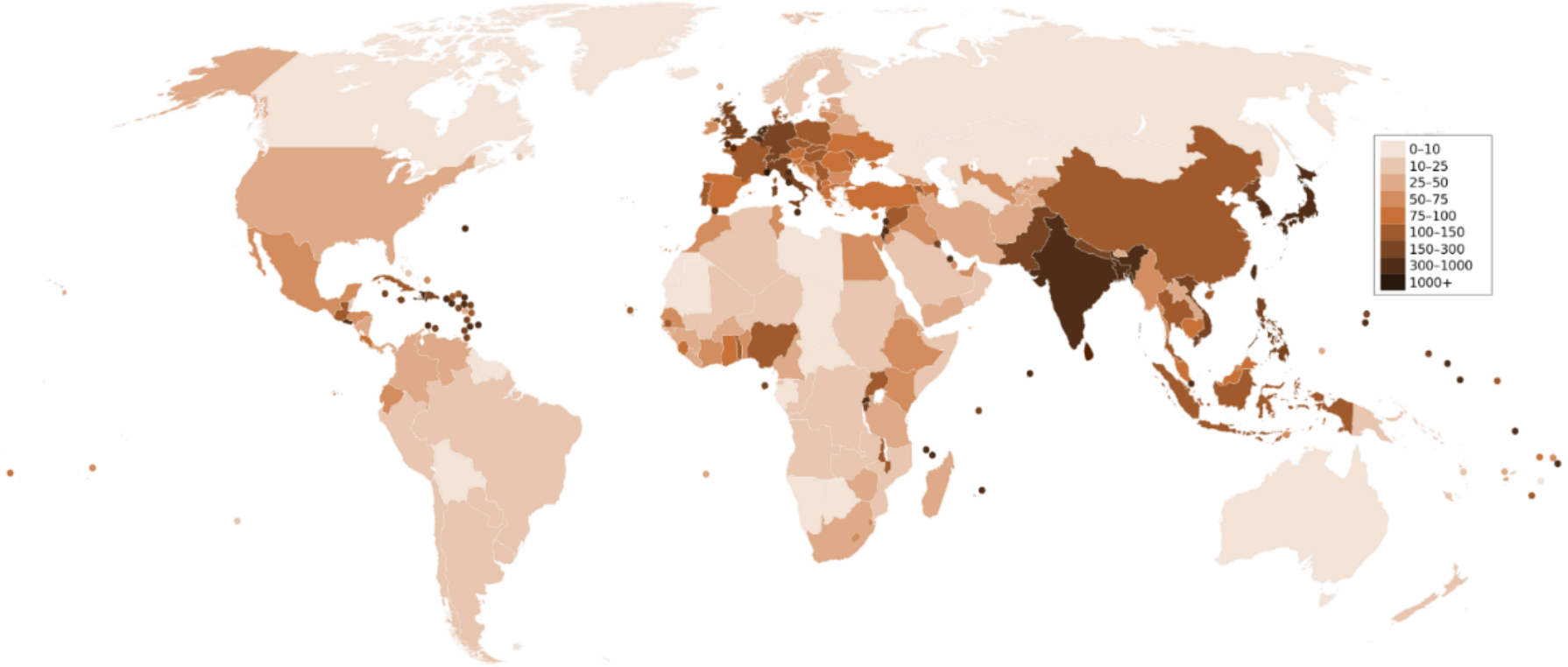
# Object-based model

- Represents geographic space as consisting of objects with well defined boundaries.
- The objects possess geometric characteristics (shape, position, etc.) and thematic characteristics.
- It is preferred over the field-based model for the representation of spatial entities with distinct boundaries, such as administrative divisions, hydrographic and road networks, land parcels, etc.

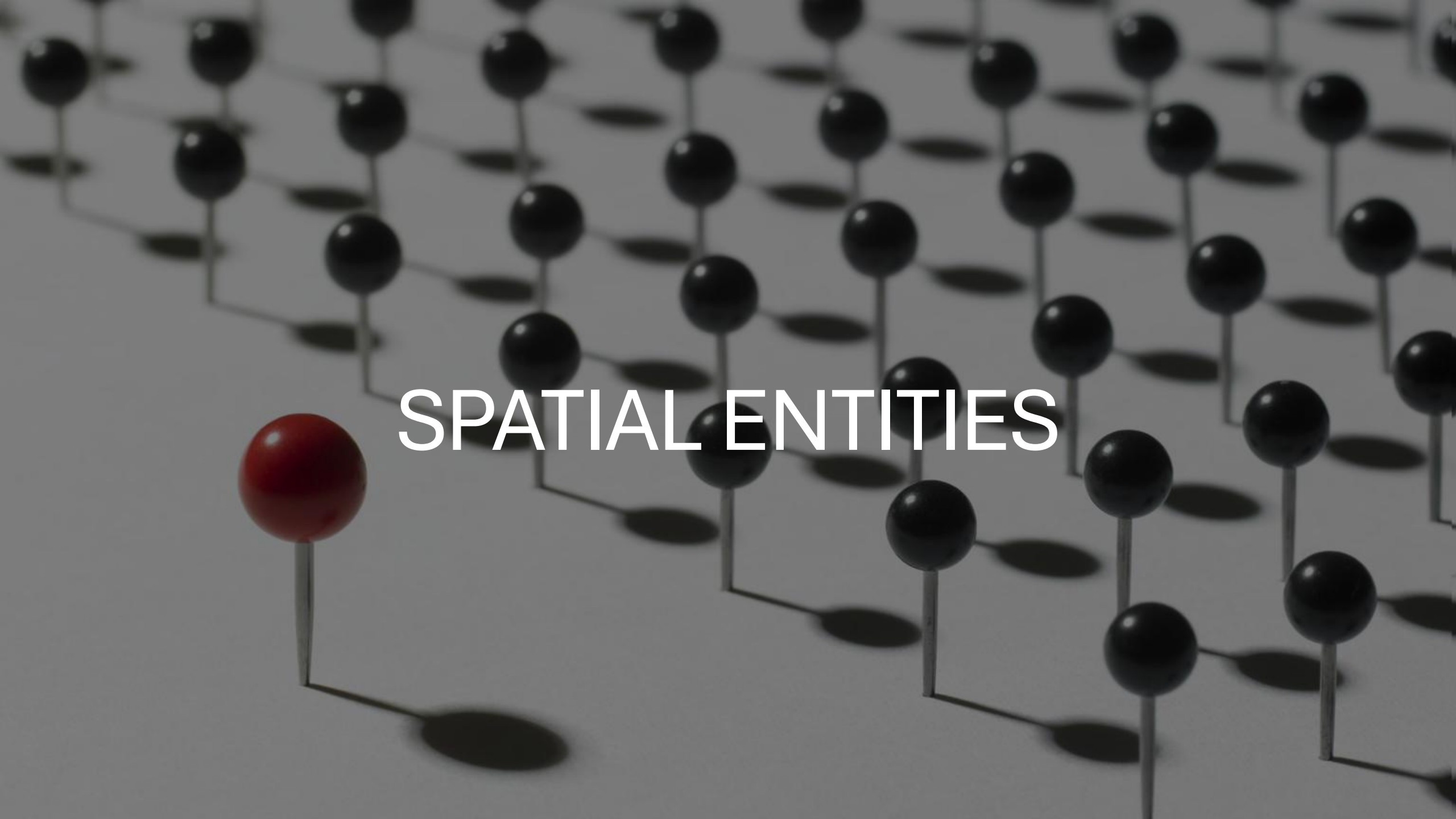
# Object-based model

- The representation of an object-based model on the computer requires the use of data structures that support the use of discrete objects with specific geometric (size, shape, etc.) and thematic information (attributes, properties, etc.).

# Object-based model

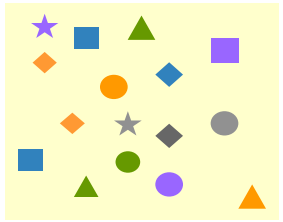



Representation of population density with the object-based model: population density is represented as thematic attribute of areal spatial entities with discrete boundaries (countries). (Countries by population density, licence CC0 1.0).

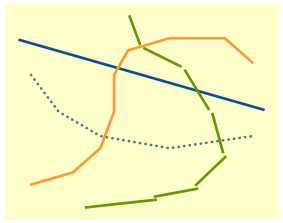


# SPATIAL ENTITIES

# Dimensions of spatial entities

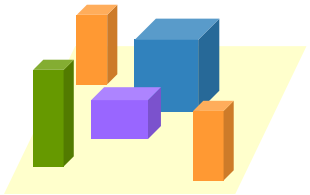


Point (0-D)



Linear (1-D)

Areal (2-D)



Volumetric (3-D)

Classic, still functioning telephone booth in La Crescent, Minnesota, https://commons.wikimedia.org/wiki/File:ClassicTelephoneBooth.jpg N9LXI, CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons

National Diet Building of Japan, https://commons.wikimedia.org/wiki/File:Diet_of_Japan_Kokkai_2009.jpg, Wiiii, CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons

The Nile, Cairo, Egypt, https://commons.wikimedia.org/wiki/File:Zad-Cairo.jpg, Zadokite at English Wikipedia, CC BY-SA 3.0 <http://creativecommons.org/licenses/by-sa/3.0/>, via Wikimedia Commons

Field ready for harvesting, https://commons.wikimedia.org/wiki/File:Wheat_Farm_in_Behbahan,_Iran.jpg, Photogir, CC BY-SA 4.0 <https://creativecommons.org/licenses/by-sa/4.0>, via Wikimedia Commons

Crater Lake, https://commons.wikimedia.org/wiki/File:Crater_Lake_3.jpg, Jan Tik from USA, CC BY 2.0 <https://creativecommons.org/licenses/by/2.0>, via Wikimedia Commons

View of the Northwest face of the Sandia Mountain near Albuquerque, https://commons.wikimedia.org/wiki/File:Northwest_face_Sandia_Mountain.JPG, Asaavedra32, CC BY-SA 3.0 <https://creativecommons.org/licenses/by-sa/3.0>, via Wikimedia Commons