Data Models for GIS

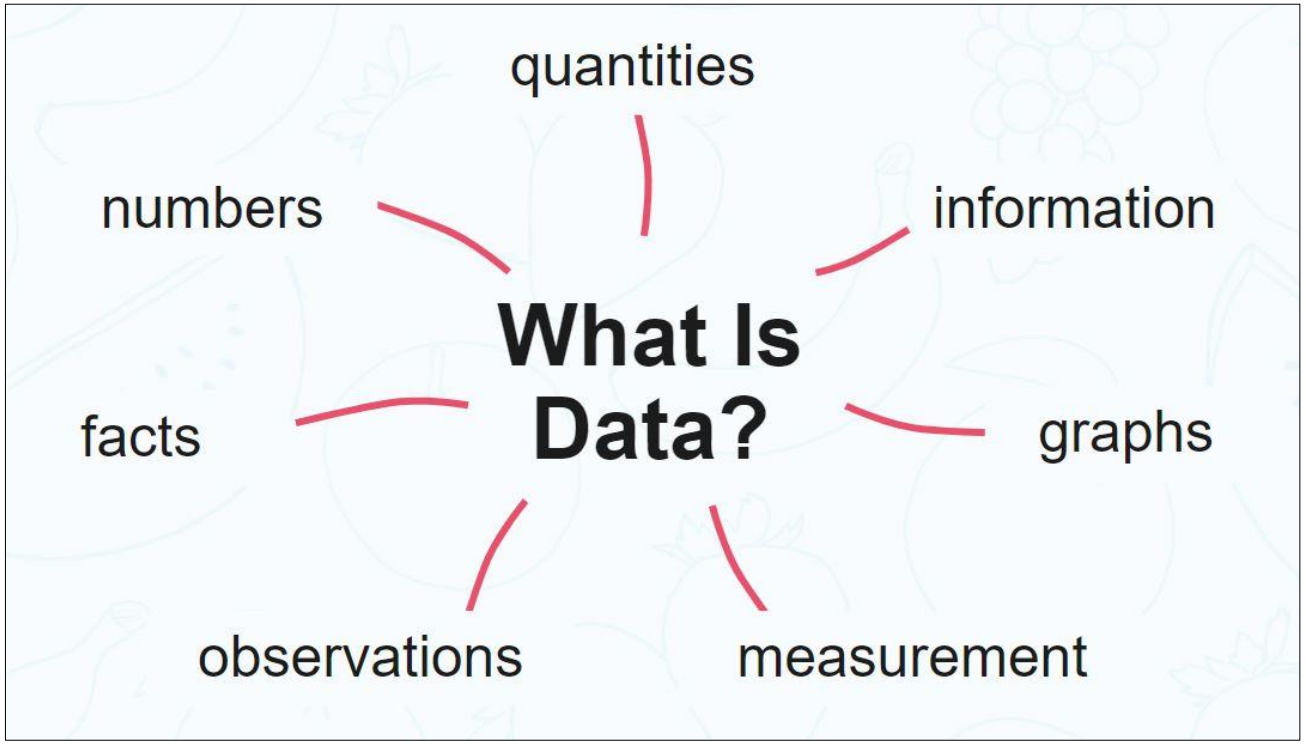
➢ **What exactly is DATA ?**

❖ We can collect **all kinds of data about all kinds of things.**

- The **length of rainbow** trout in a Colorado stream,
- The **number of vegetarians** in Alaska ,
- The **diameter of mahogany tree trunks** in the Brazilian rainforest,
- **Student scores** on the last GIS midterm,
- The **altitude of mountain peaks** in Nepal,
- The **depth of snow** in the Austrian alps,
- The **number of people who use public transportation** to get to work in London .

✓ Data refer to facts, **measurements, characteristics, or traits of an object of interest.**

✓ **Facts, measurements, and characteristics of something of interest.**



Data Models for GIS

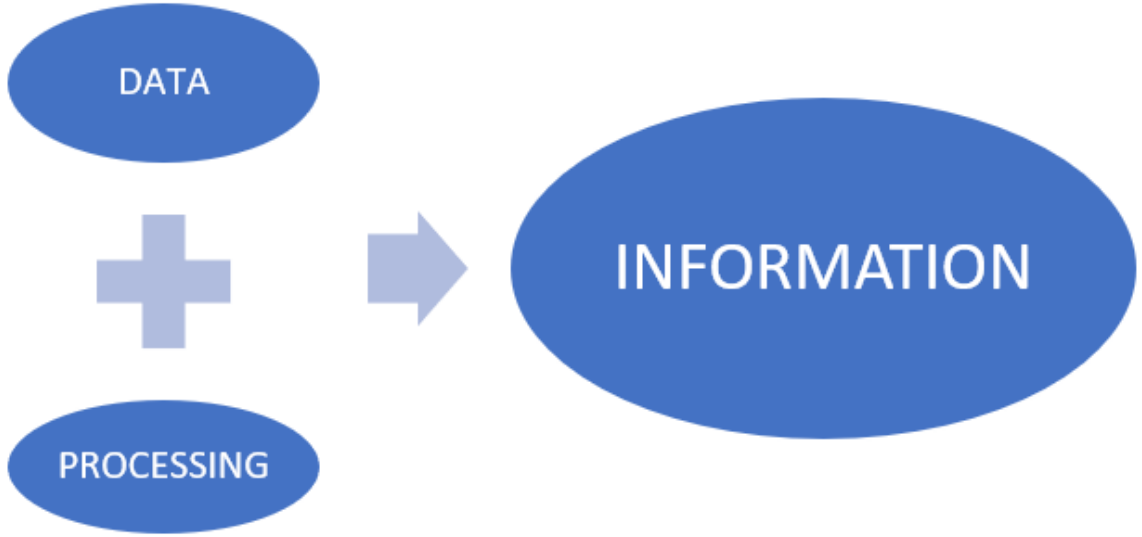
➢ **What exactly is INFORMATİON ?**

- Information simply refers to **the knowledge of value obtained through the collection, interpretation, and/or analysis of data.**

- Though a computer is not necessary to collect, record, manipulate, process, or visualize data, or to process it into information, information technology can be of great help.

- For instance, computers can automate repetitive tasks, store data efficiently in terms of space and cost, and provide a range of tools for analyzing data from spreadsheets to GISs, of course.

✓ **Knowledge and insights** that are acquired through the **analysis of data.**



Data Models for GIS

➢ DATA vs INFORMATİON ?

- Data is <u>RAW</u> !!
- Information is the <u>PROCESSED form of data</u> !!

Data Models for GIS

➢ Spatial Data

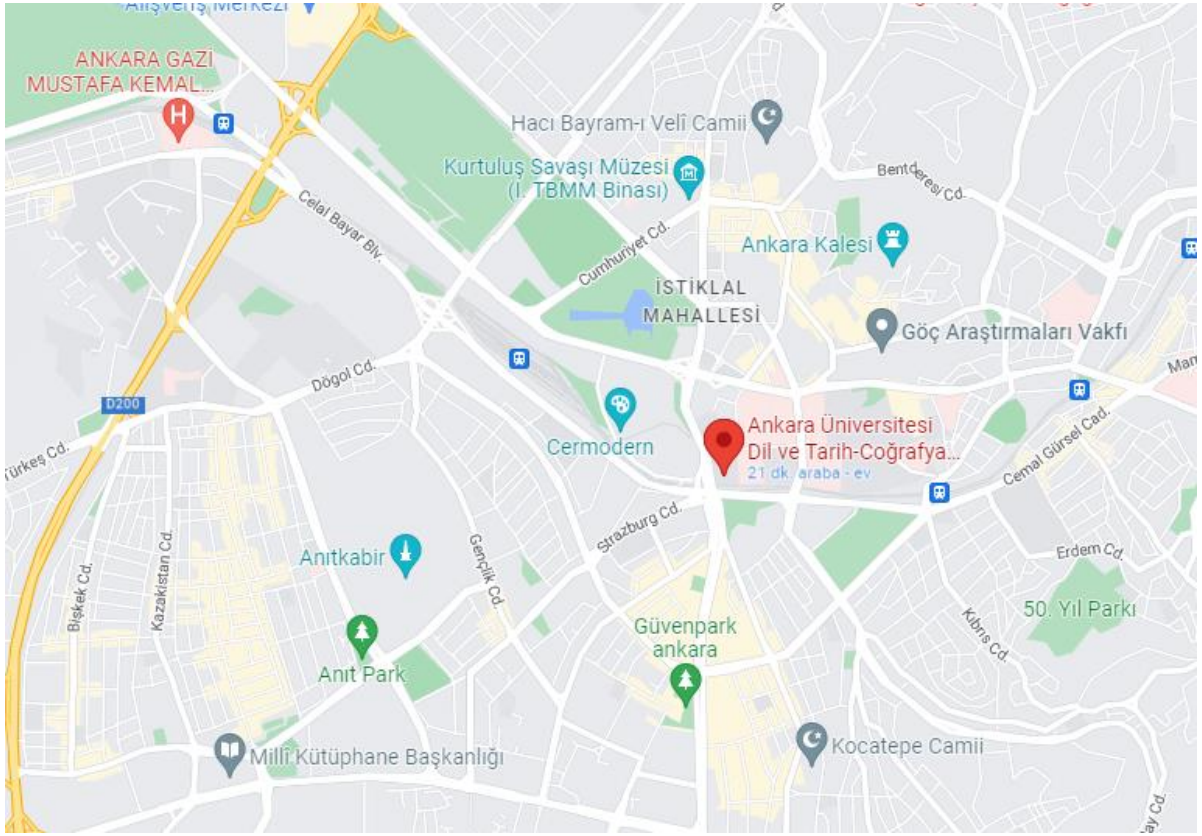
- **Geographic or spatial data** refer to geographic facts, measurements, or characteristics of an object that permit us to **define its location on the surface of the earth.**

- Such data include the **latitude and longitude coordinates of points of interest, street addresses, postal codes, political boundaries, and even the names of places of interest.**

- **Geographic data** are concerned with **defining the location** of an object of interest.

- **Attribute data** are concerned with its **nongeographic traits and characteristics.**

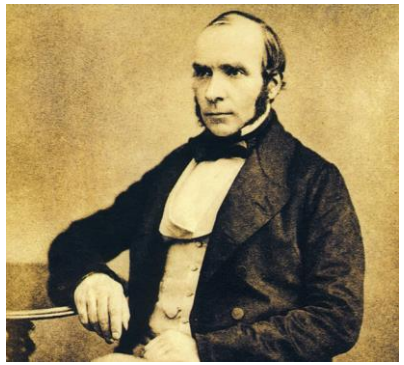
✓ Data that **describe the geographic and spatial aspects** of phenomena.



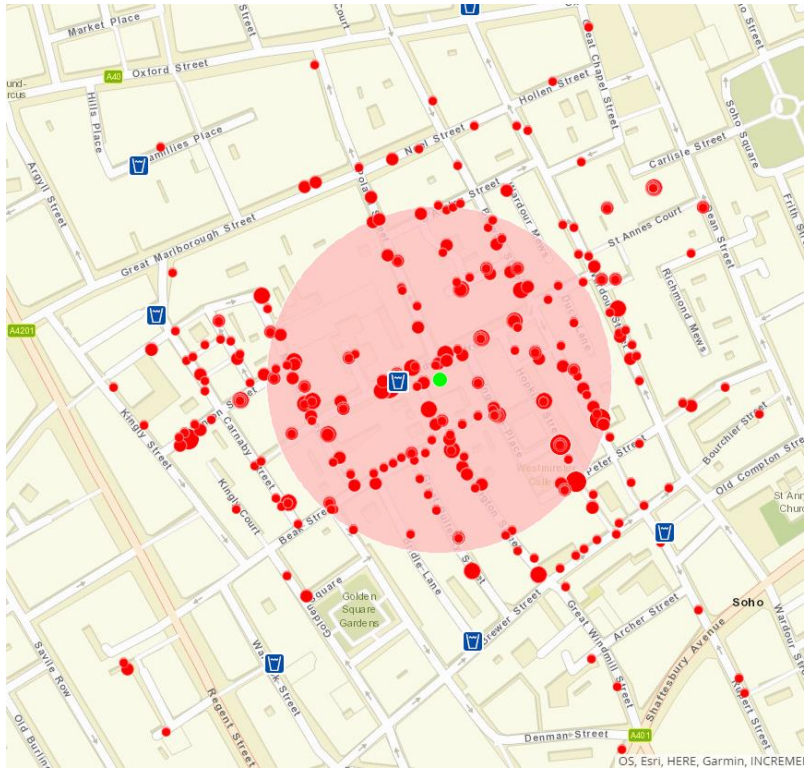
Data Models for GIS

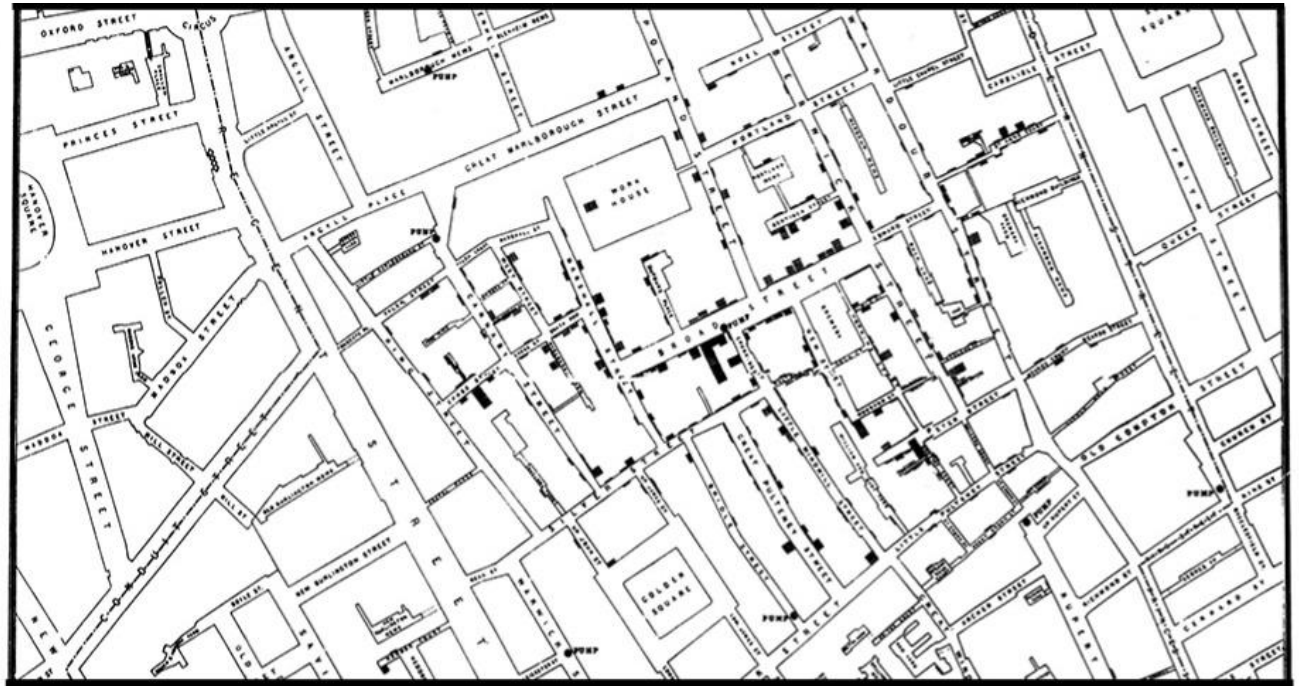
- **Spatial Data**
  - Geographic or spatial data

-1854 Broad Street cholera outbreak



Dr. John Snow

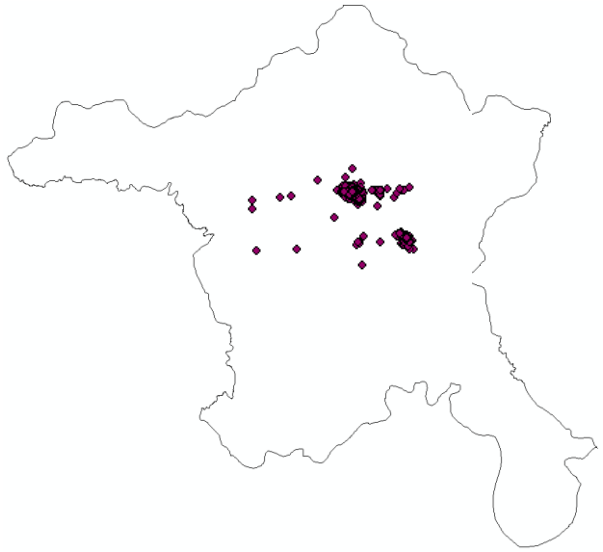


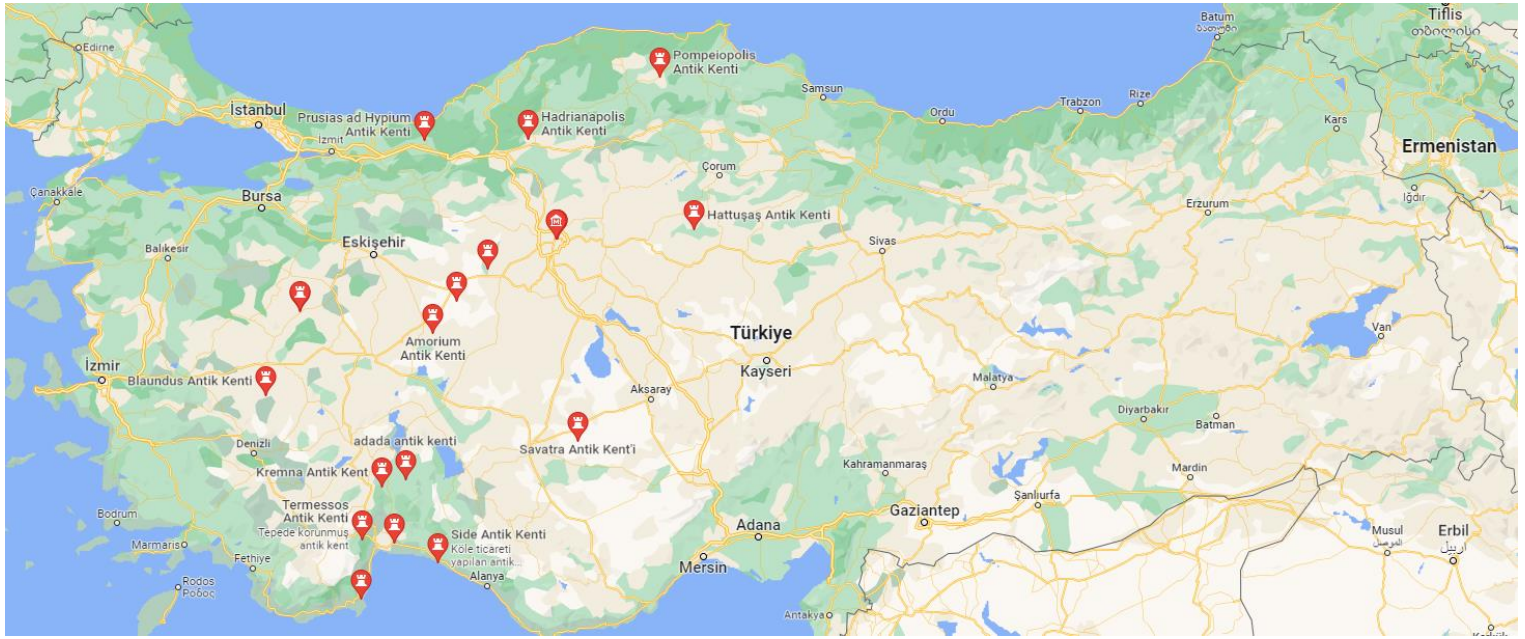


Data Models for GIS

➢ Spatial Data

❑ Attribute data





Table

trafik2

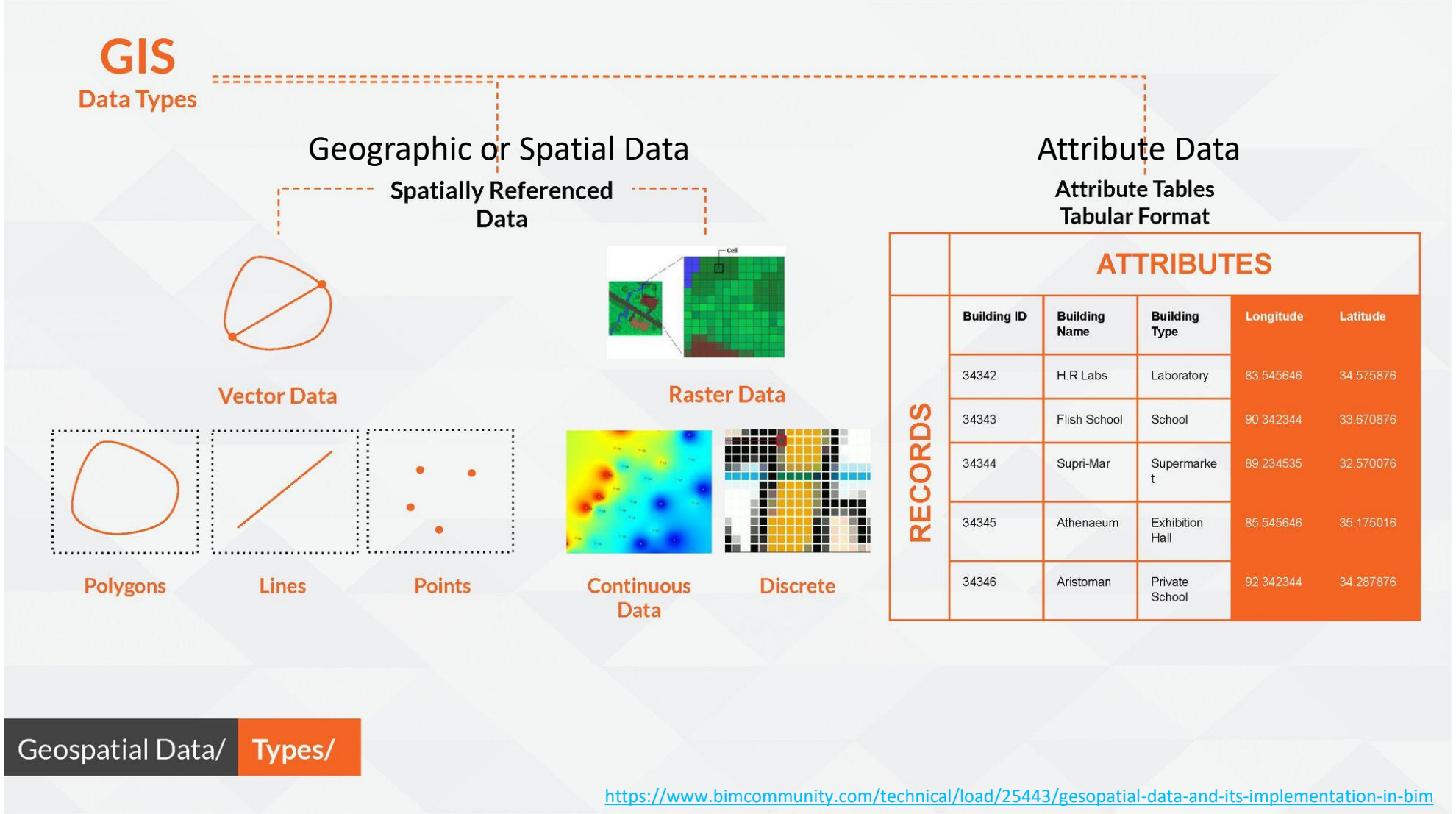
FID	Shape *	KazaYılı	Kaza_Ayı	Kaza_Gün	Kaza_SaatD	Kaza_İli	XKoordinat	YKoordinat	KazaTarihi	Kaza_İlç	Kaza_YerYe	YolunTipi	Kaplaması	YolunSın	Yoladı_Ke	GeoYatay	GeoDüşey	GeoKavşak	
0	Point	2013	8	30	22:35	6	32,81422	39,90237	20130830	ÇANKAYA	1-Yerl.Yeri	1-Bölünmüs Yol	1-Asfalt	Cadde	MEVLANA BLV.	1-Düz yol	1-Eğimsiz	8-Kavşak Yok	5-Geçit
1	Point	2013	6	6	23:05	6	32,81402	39,8999	20130606	ÇANKAYA	1-Yerl.Yeri	1-Bölünmüs Yol	1-Asfalt	Cadde	MEVLANA BLV.	1-Düz yol	1-Eğimsiz	6-Diger Kavsak Çesidi	5-Geçit
2	Point	2013	2	8	16:30	6	32,76051	39,90139	20130208	ÇANKAYA	1-Yerl.Yeri	1-Bölünmüs Yol	1-Asfalt	Diger	ATATÜRK EĞİTİM VE ARAŞTIRMA HASTANESİ	1-Düz yol	1-Eğimsiz	8-Kavşak Yok	5-Geçit
3	Point	2013	3	11	15:00	6	32,83328	39,96912	20130311	KEÇİÖREN	1-Yerl.Yeri	1-Bölünmüs Yol	1-Asfalt	Cadde	halil sezai erkut cad.	1-Düz yol	1-Eğimsiz	8-Kavşak Yok	5-Geçit
4	Point	2013	7	5	18:00	6	32,82891	39,96904	20130705	KEÇİÖREN	1-Yerl.Yeri	1-Bölünmüs Yol	1-Asfalt	Cadde	halil sezai erkut cad.	1-Düz yol	1-Eğimsiz	3-Dört Yönlü	5-Geçit
5	Point	2013	1	10	11:10	6	32,83455	39,96994	20130110	KEÇİÖREN	1-Yerl.Yeri	1-Bölünmüs Yol	1-Asfalt	Cadde	halil sezai erkut cad.	1-Düz yol	1-Eğimsiz	4-Dönel Kavsak	4-Yaya
6	Point	2013	9	7	14:58	6	32,80849	39,96982	20130907	YENİMAHALLE	1-Yerl.Yeri	1-Bölünmüs Yol	1-Asfalt	Cadde	KORDONBOYU CAD	1-Düz yol	2-Eğimli	6-Diger Kavsak Çesidi	5-Geçit
7	Point	2013	5	19	12:20	6	32,77449	39,97443	20130519	YENİMAHALLE	1-Yerl.Yeri	1-Bölünmüs Yol	1-Asfalt	Cadde	M AKİF ERSOY CAD	1-Düz yol	2-Eğimli	8-Kavşak Yok	5-Geçit
8	Point	2013	5	18	08:15	6	32,72187	39,97857	20130518	YENİMAHALLE	1-Yerl.Yeri	1-Bölünmüs Yol	1-Asfalt	Sokak	1969 SOK	1-Düz yol	1-Eğimsiz	3-Dört Yönlü	4-Yaya
9	Point	2013	3	29	08:30	6	32,71643	39,97614	20130329	YENİMAHALLE	1-Yerl.Yeri	1-Bölünmüs Yol	1-Asfalt	Sokak	1969 SOK	1-Düz yol	1-Eğimsiz	3-Dört Yönlü	5-Geçit
10	Point	2013	4	5	17:20	6	32,72301	39,97856	20130405	YENİMAHALLE	1-Yerl.Yeri	1-Bölünmüs Yol	1-Asfalt	Sokak	1969 SOK	2-Viraj	1-Eğimsiz	8-Kavşak Yok	5-Geçit
11	Point	2013	4	17	19:15	6	32,57424	39,99245	20130417	SİNCAN	1-Yerl.Yeri	1-Bölünmüs Yol	1-Asfalt	Cadde	414. CAD.	1-Düz yol	2-Eğimli	1-Üç Yönlü (T)	5-Geçit
12	Point	2013	2	19	17:15	6	32,81875	39,94451	20130219	YENİMAHALLE	1-Yerl.Yeri	3-Iki Yönlü Yol	1-Asfalt	Baglanti Yolu	alemdar sk ahududu sk kav.	1-Düz yol	1-Eğimsiz	8-Kavşak Yok	4-Yaya
13	Point	2013	3	5	13:00	6	32,84476	39,89196	20130305	ÇANKAYA	1-Yerl.Yeri	3-Iki Yönlü Yol	1-Asfalt	Sokak	SAİR NAZIM SOK	2-Viraj	1-Eğimsiz	8-Kavşak Yok	5-Geçit

1 (0 out of 86690 Selected)

trafik2

Data Models for GIS

➢ Types of GIS Data



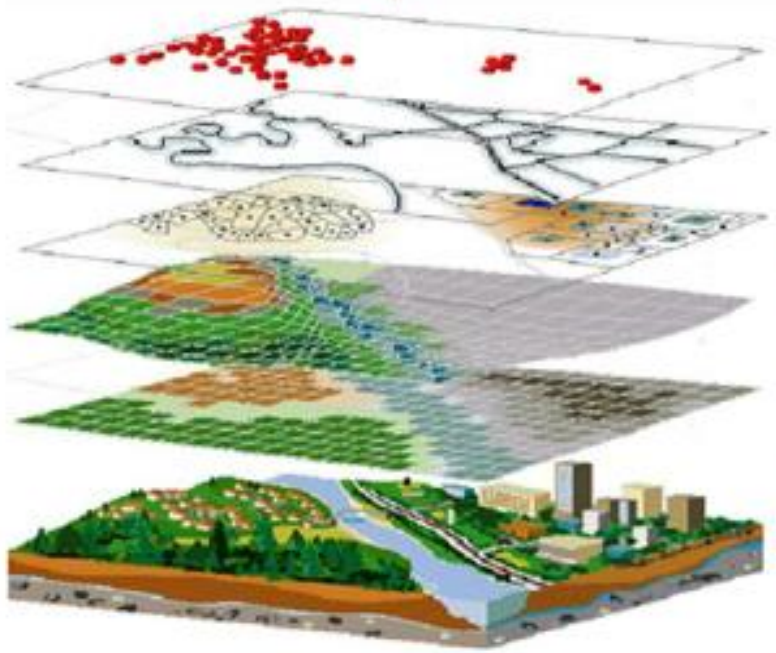
https://www.bimcommunity.com/technical/load/25443/gesopatial-data-and-its-implementation-in-bim

Data Models for GIS

➢ Types of GIS Data

DATA

Geographic Or Spatial Data



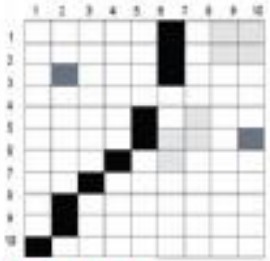
Vektör

(XY)

$(X_1Y_1), (X_2Y_2), \ldots\ldots (X_nY_n)$

$(X_1Y_1),(X_2Y_2),(X_3Y_3),\ldots\ldots,(X_1Y_1)$

Raster

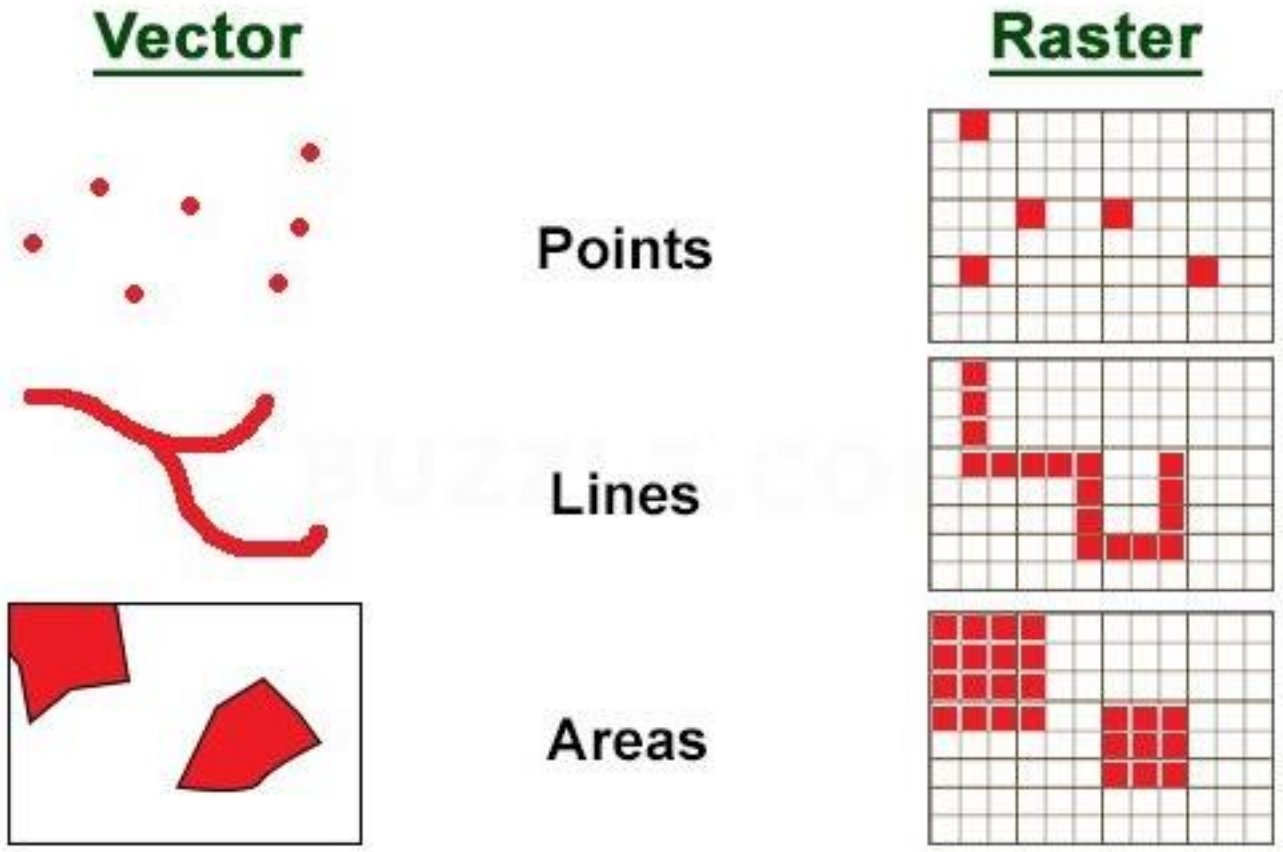


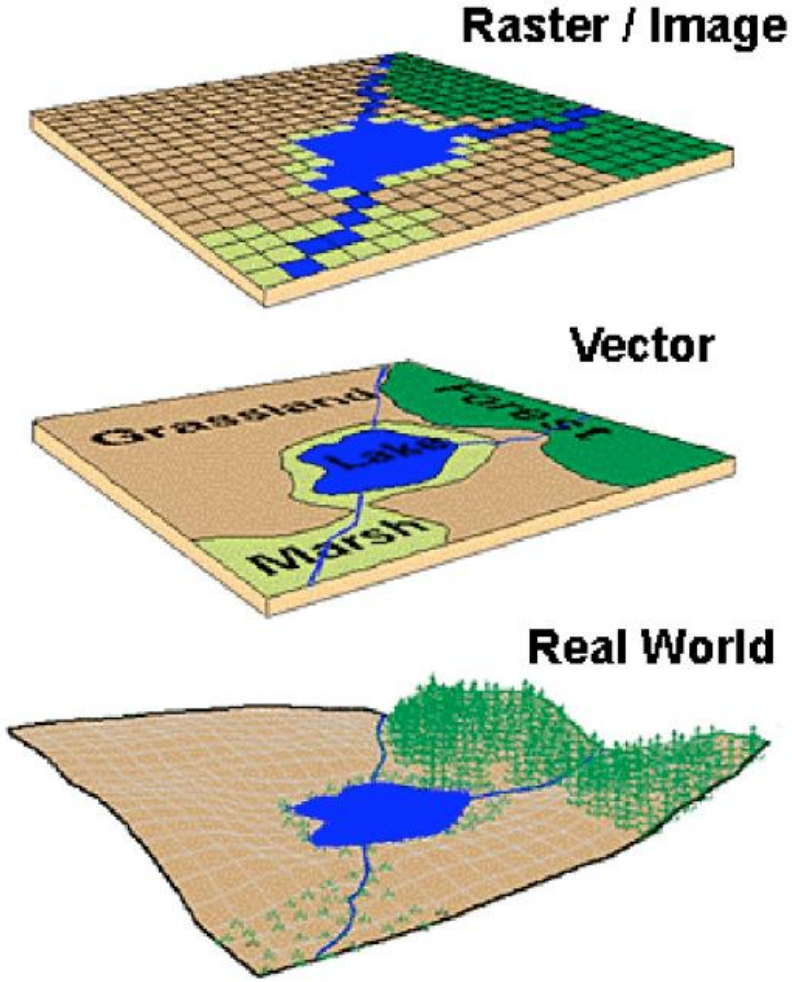
Gerçek Dünya

Attribute Data (Nonspatial Data)

Data Models for GIS

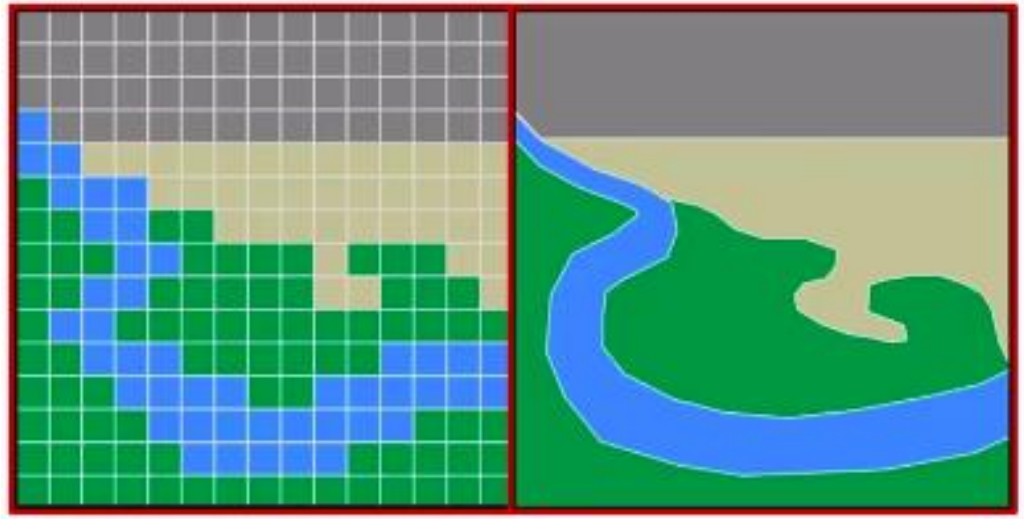
- **Geographic or Spatial Data**

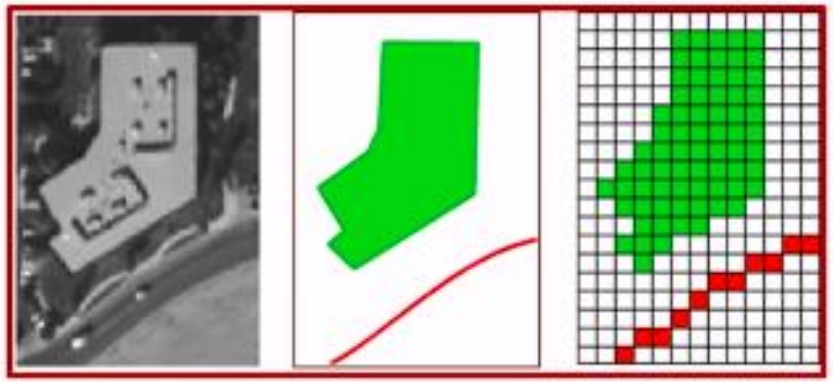


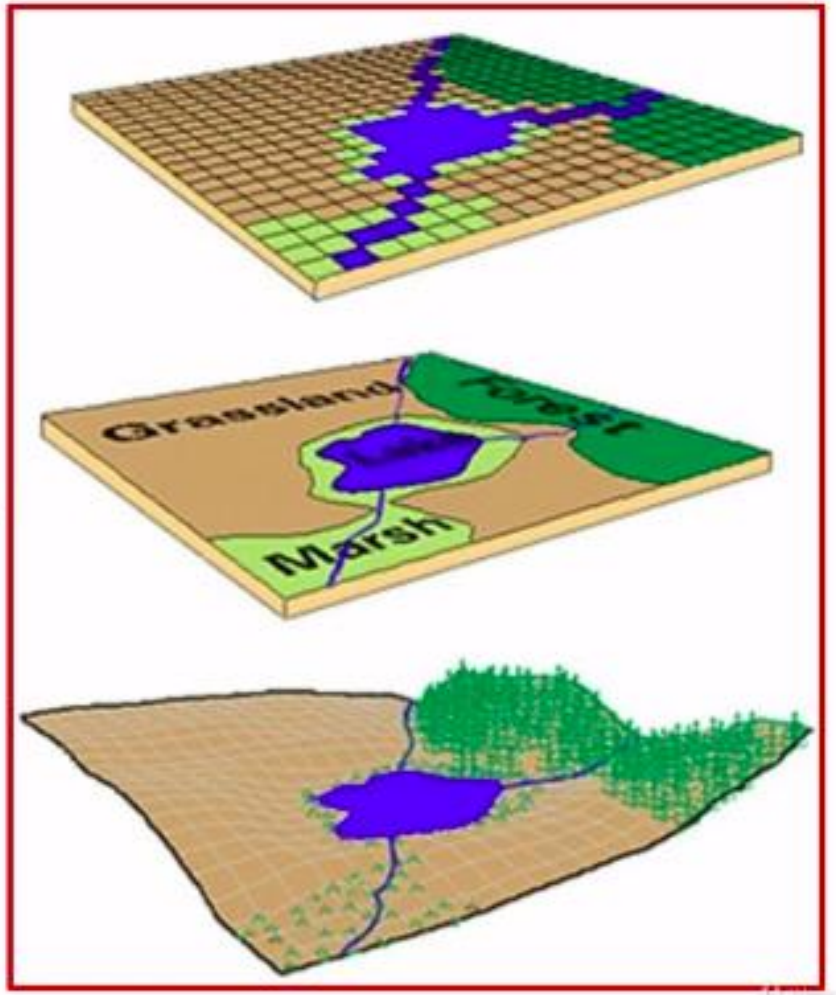


Data Models for GIS

- **Geographic or Spatial Data**

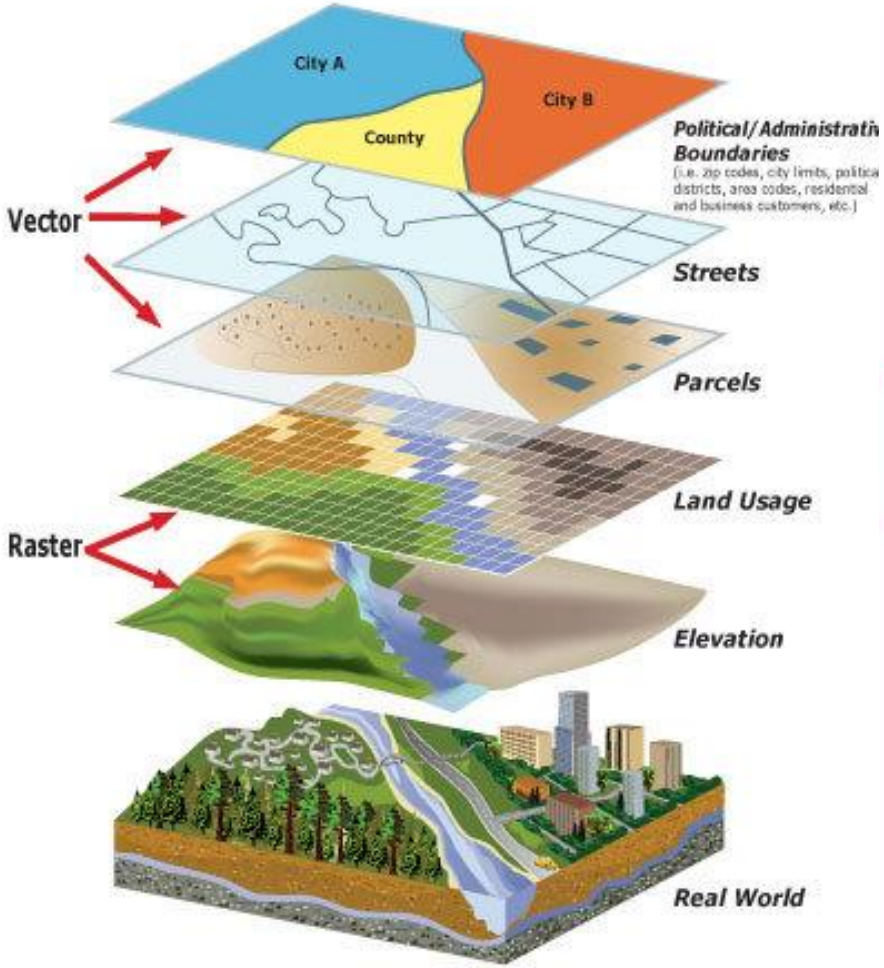


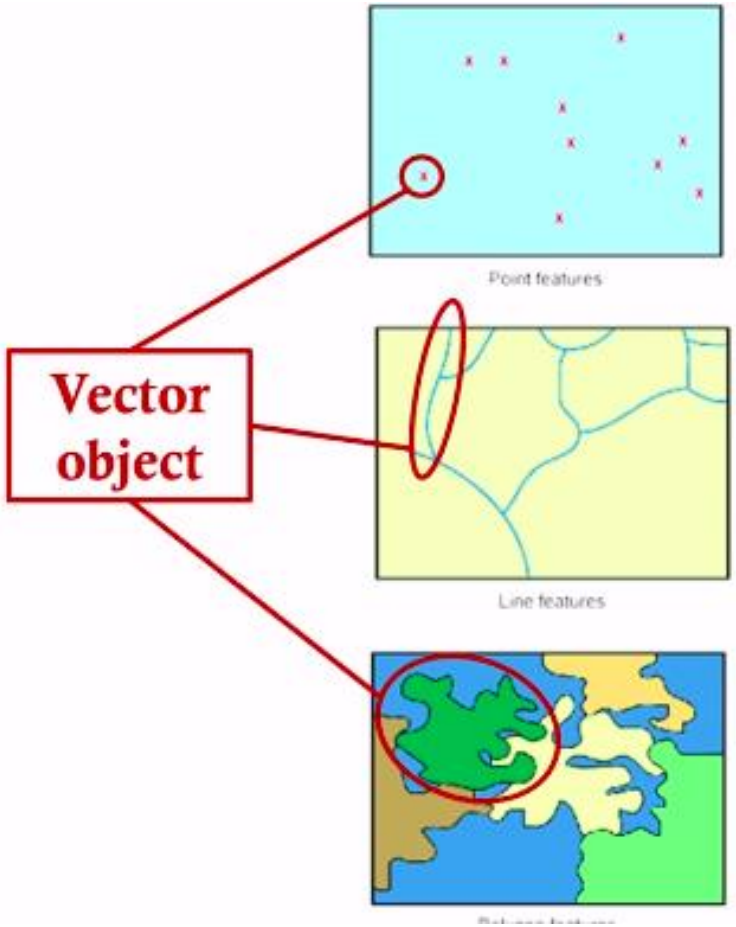


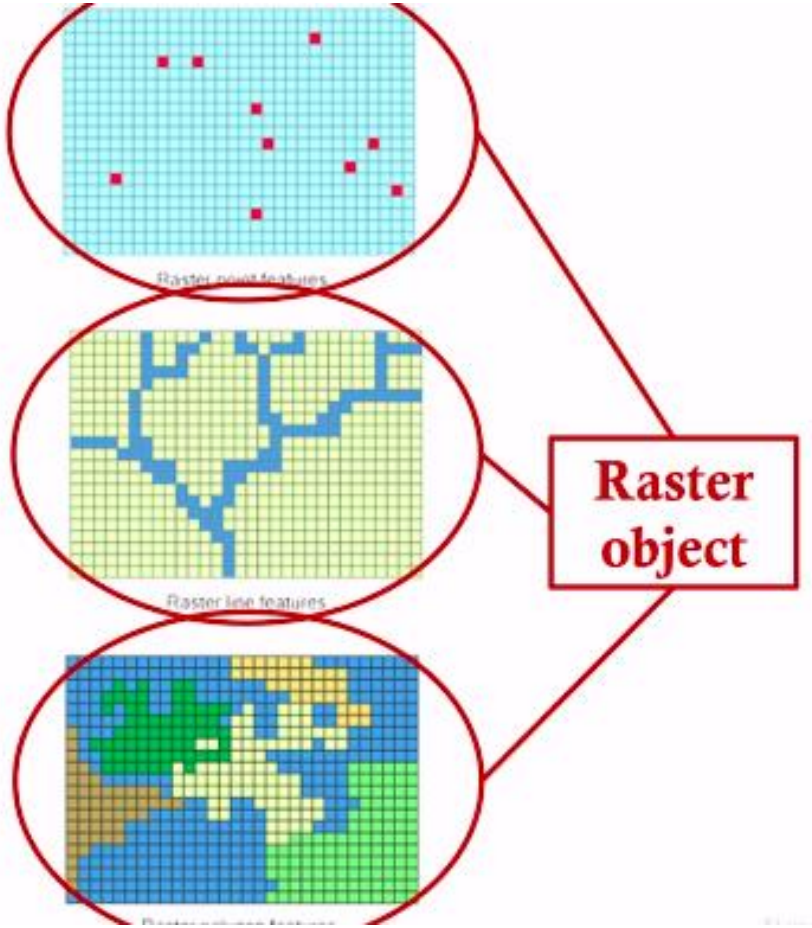


Data Models for GIS

- **Geographic or Spatial Data**





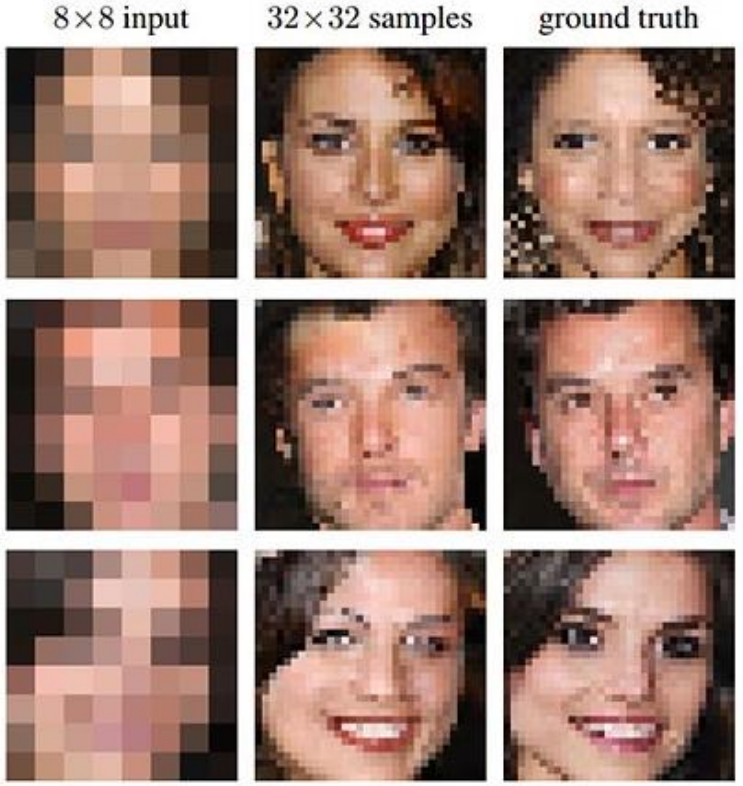


Data Models for GIS

➢ Geographic or Spatial Data

1. Raster Data Models

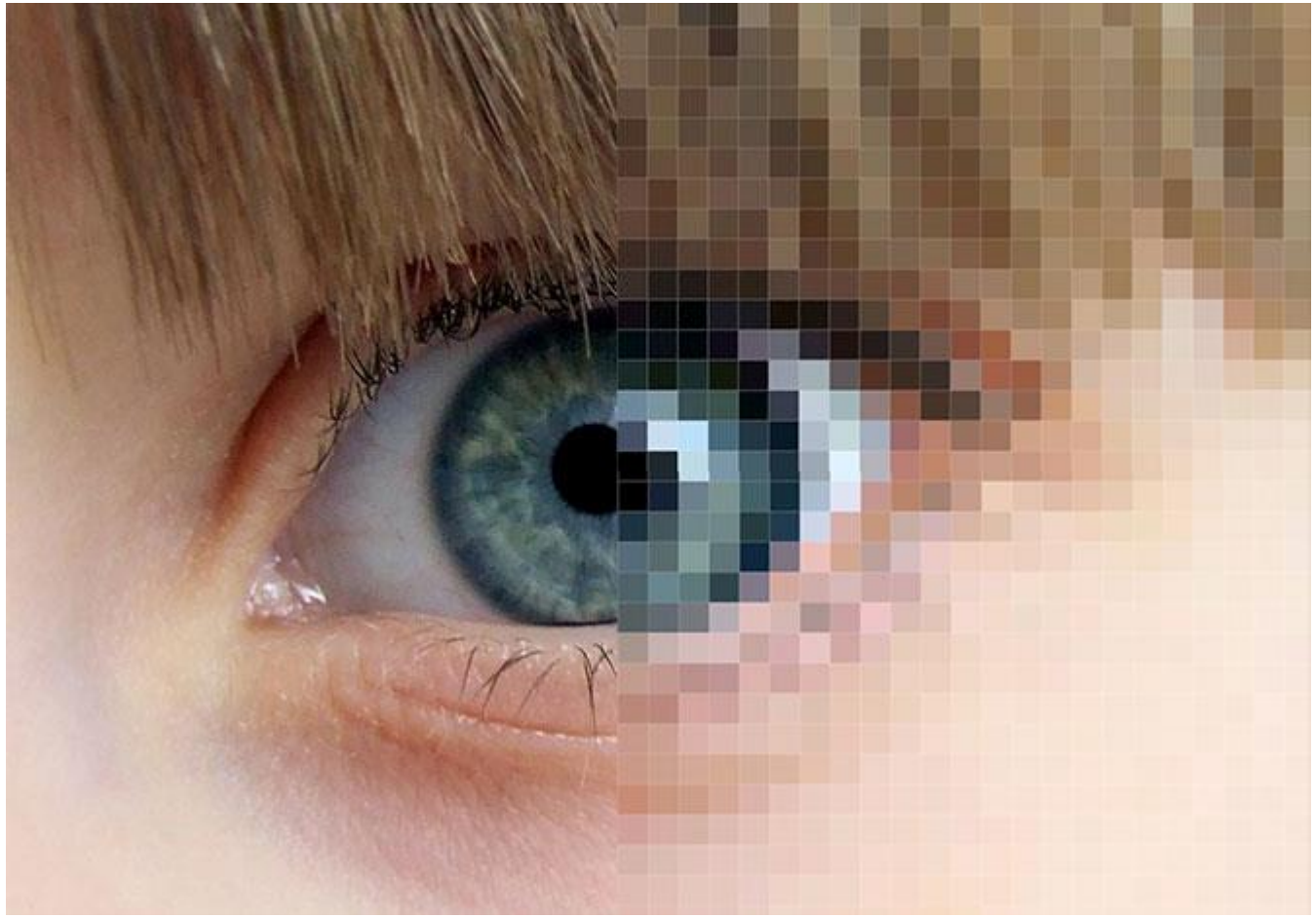
- The raster data model is **widely used** in applications ranging far beyond geographic information systems (GISs).
- Most likely, **you are already very familiar** with this data model if you have any experience with **digital photographs.**
- The ubiquitous **JPEG, PNG, and TIFF** file formats are based on the raster data model.
- Take a moment to view your favorite digital image. If **you zoom deeply into the image**, you will notice that it is composed of an array of tiny square pixels.
- **Each of these uniquely colored pixels, when viewed as a whole, combines to form a coherent image.**

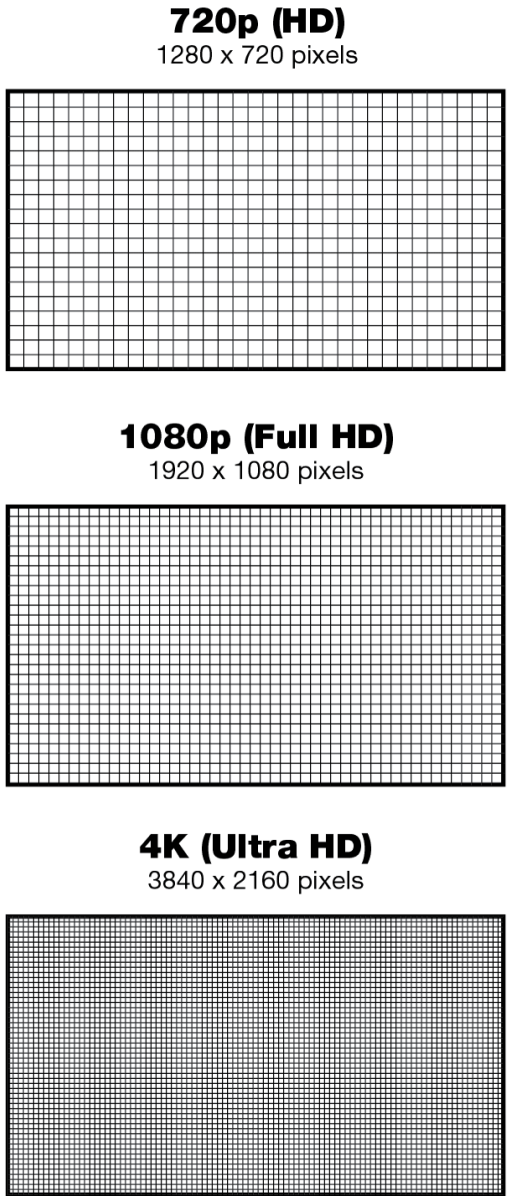


Data Models for GIS

- **Geographic or Spatial Data**

1. Raster Data Models



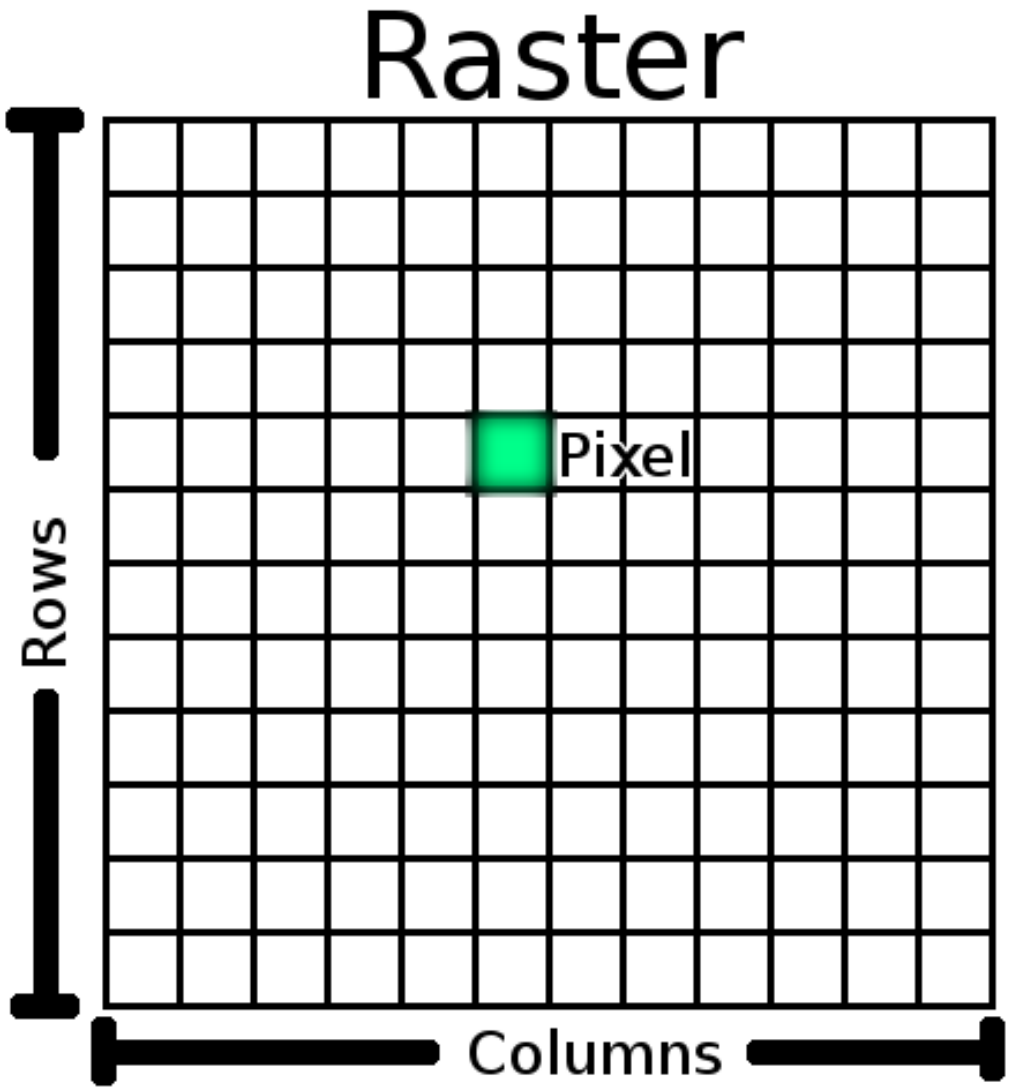


Data Models for GIS

➢ Geographic or Spatial Data

1. Raster Data Models

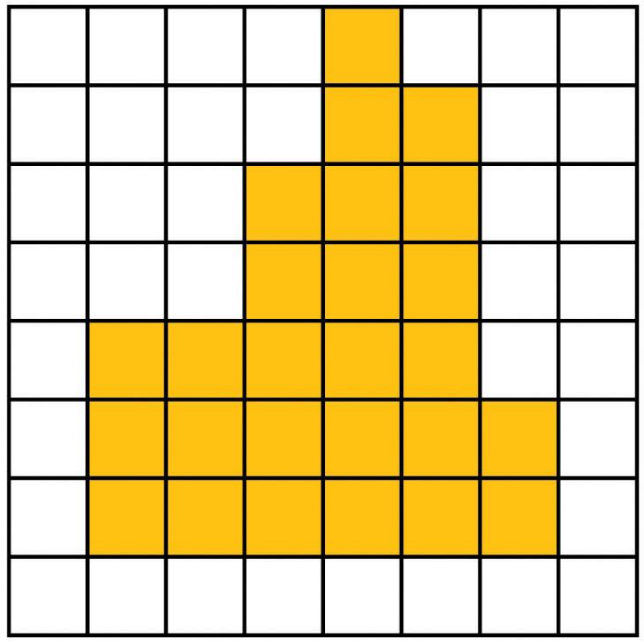
- The raster data model **consists of rows and columns of equally sized pixels** interconnected to form a planar surface.
- These pixels are used as building blocks for **creating points, lines, areas, networks, and surfaces.**
- Because of the reliance on a uniform series of square pixels, the raster data model is referred to **as a grid-based system.**



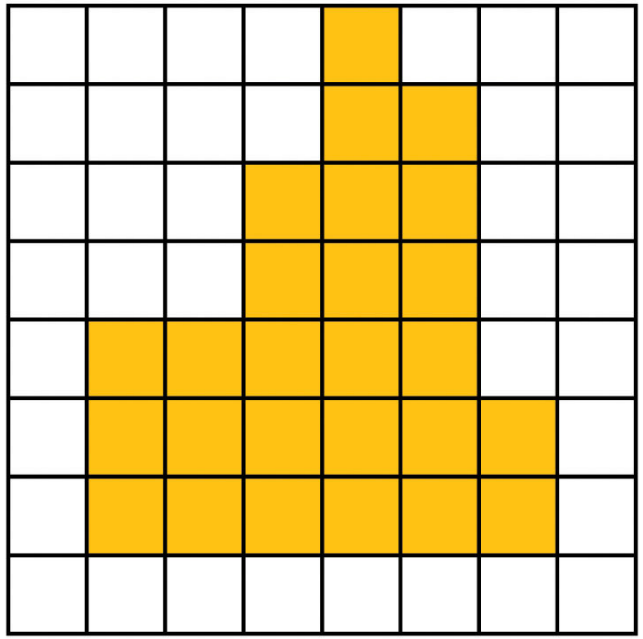
Data Models for GIS

➢ Geographic or Spatial Data

1. Raster Data Models



Row 1: 0 0 0 0 1 0 0 0
Row 2: 0 0 0 0 1 1 0 0
Row 3: 0 0 0 1 1 1 0 0
Row 4: 0 0 0 1 1 1 0 0
Row 5: 0 1 1 1 1 1 0 0
Row 6: 0 1 1 1 1 1 1 0
Row 7: 0 1 1 1 1 1 1 0
Row 8: 0 0 0 0 0 0 0 0



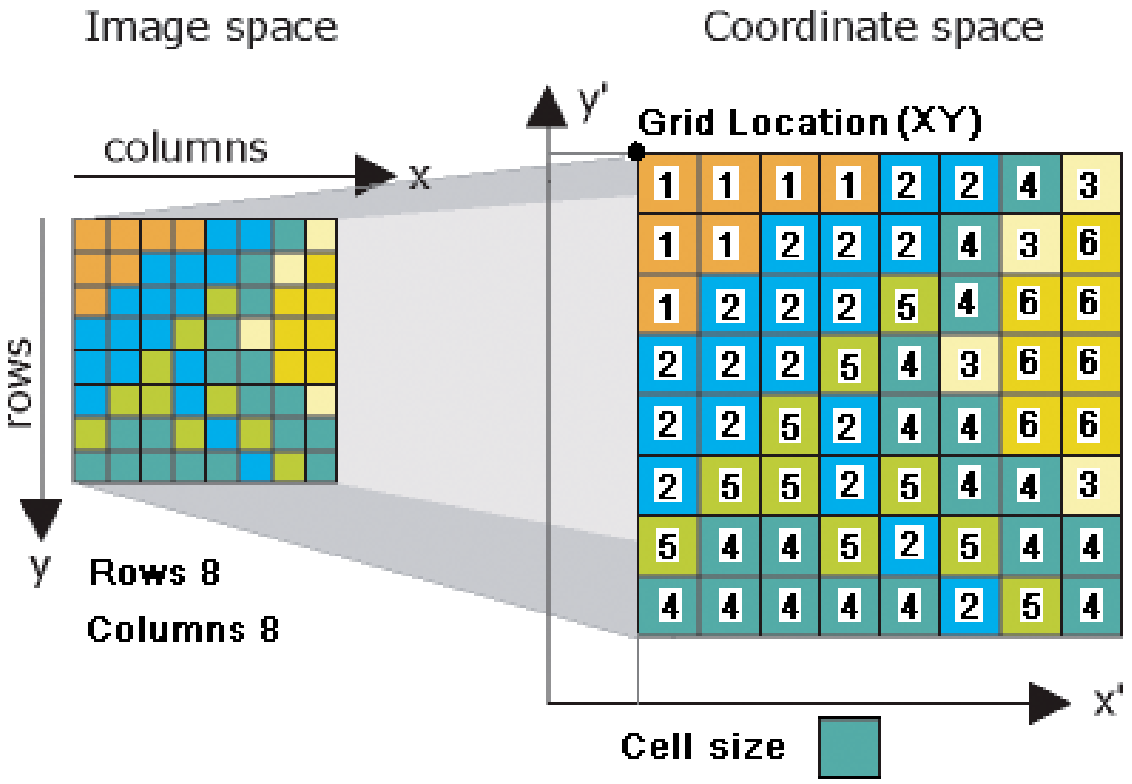
Row 1: 5
Row 2: 5 6
Row 3: 4 6
Row 4: 4 6
Row 5: 2 6
Row 6: 2 7
Row 7: 2 7

Data Models for GIS

➢ Geographic or Spatial Data

1. Raster Data Models

- **Each cell in a raster carries a single value**, which represents the characteristic of the spatial phenomenon at a location denoted by its row and column.
- The data type for that cell value can be **either integer or floating-point**.
- Alternatively, the raster graphic can reference a database management system wherein open-ended attribute tables can be used to associate multiple data values to each pixel.



List of cell values

[1111224311222436122254662225436622524466255254435445254444444254]

Data Models for GIS

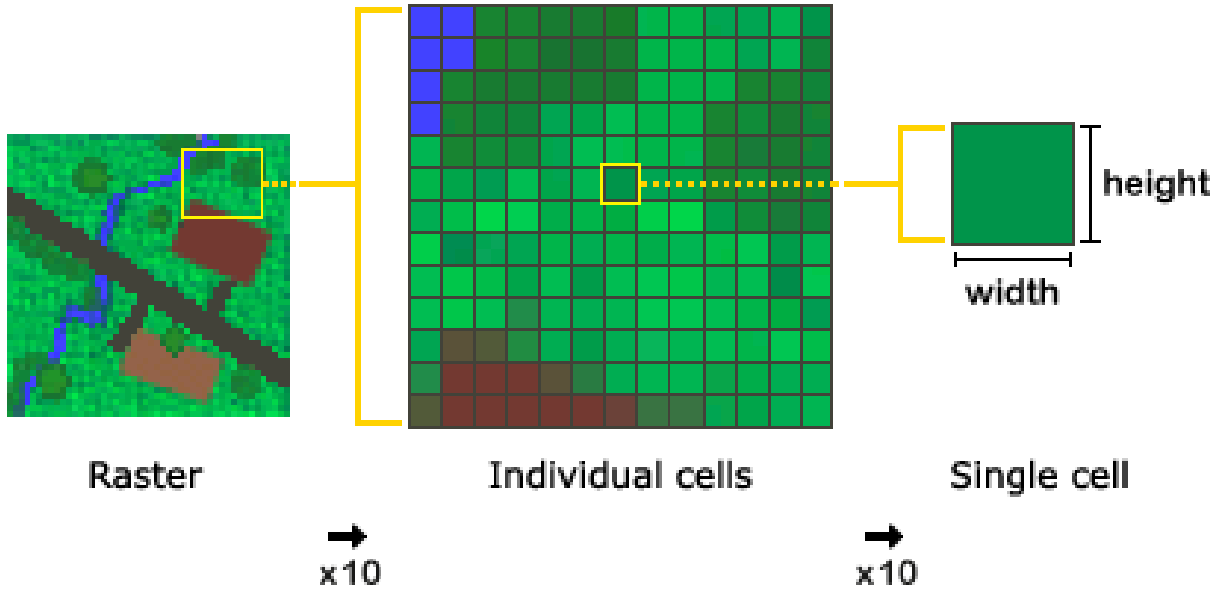
➢ Geographic or Spatial Data

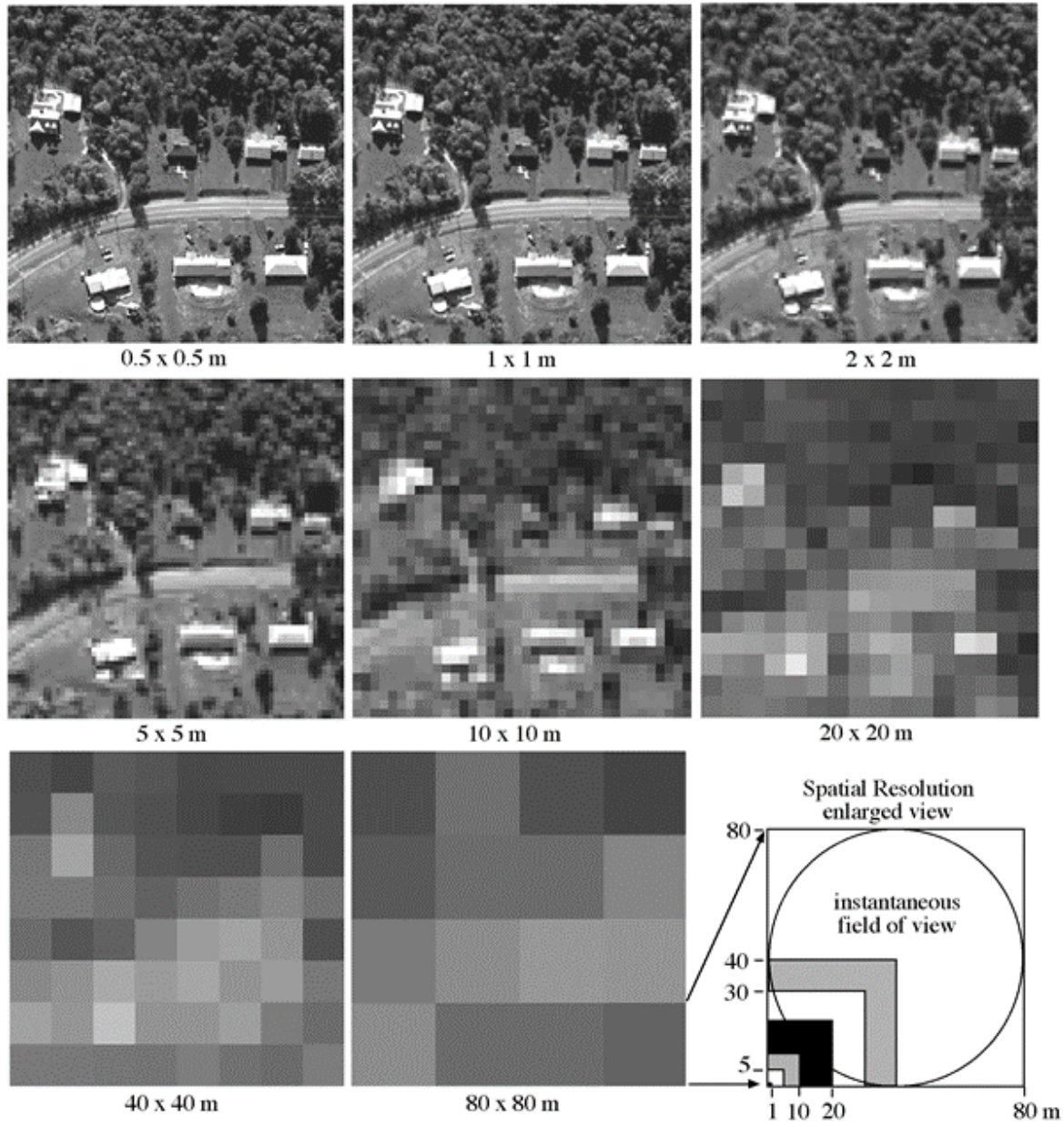
1. Raster Data Models

- The area covered by **each pixel determines the spatial resolution** of the raster model from which it is derived.

Spatial resolution:

- The smallest distance between two adjacent features that can be detected in an image.

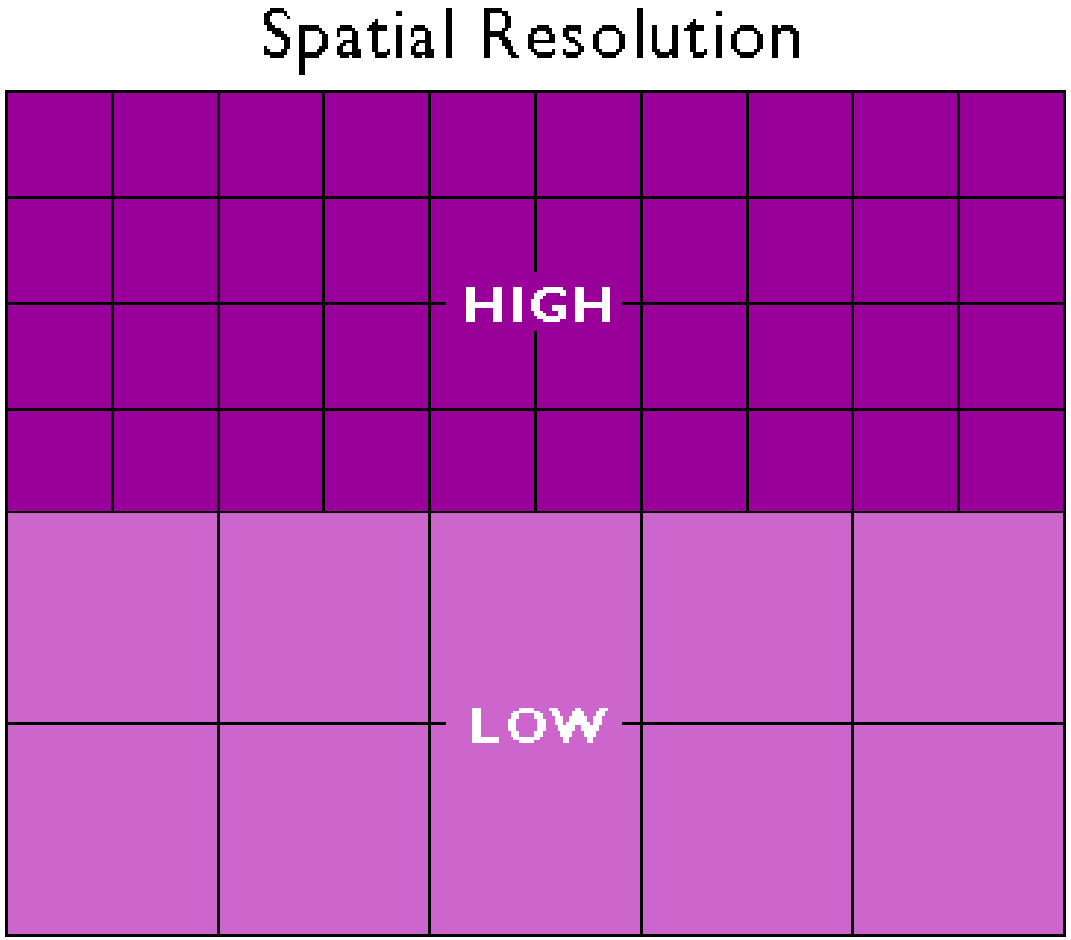


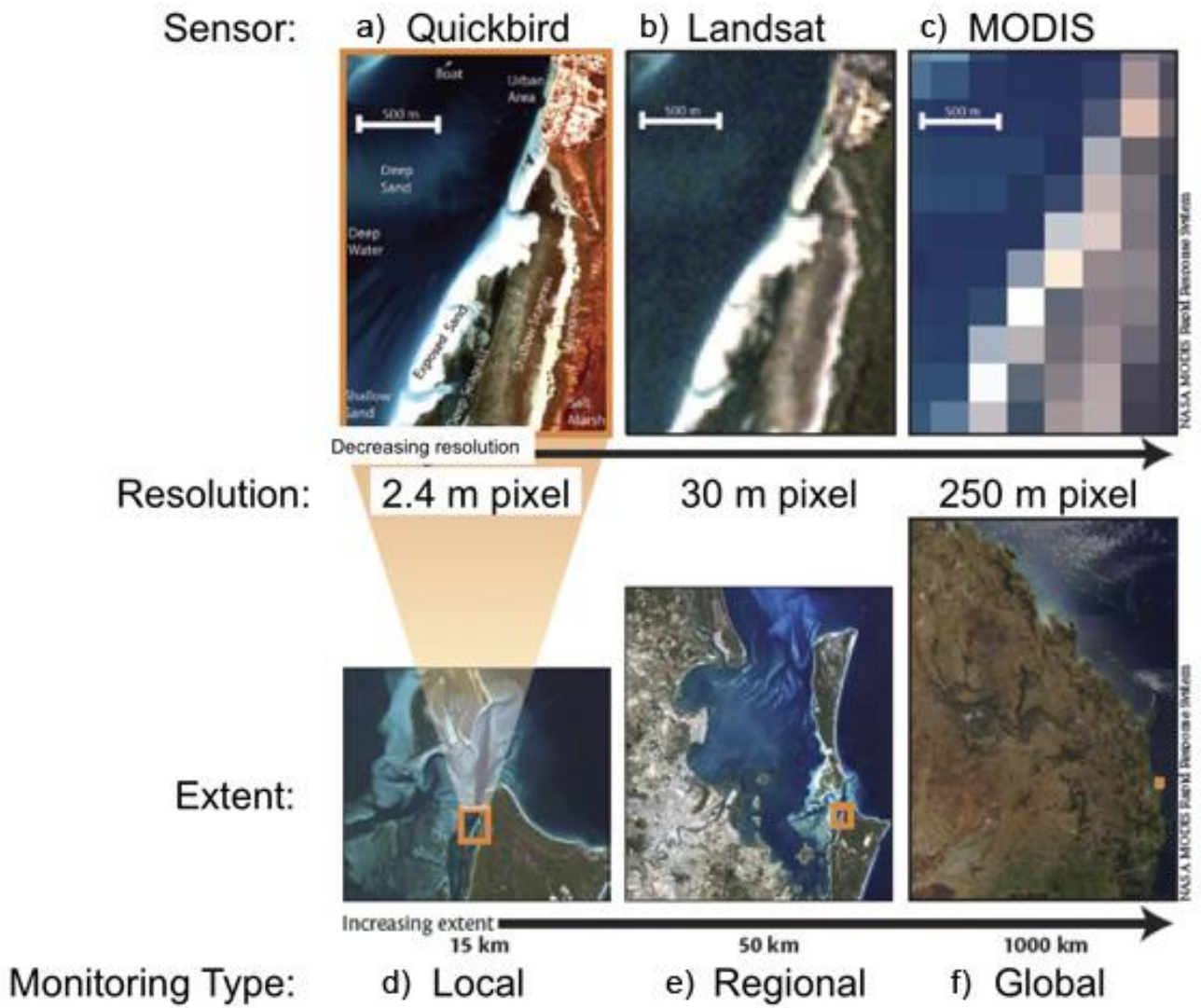


Data Models for GIS

- **Geographic or Spatial Data**

1. Raster Data Models





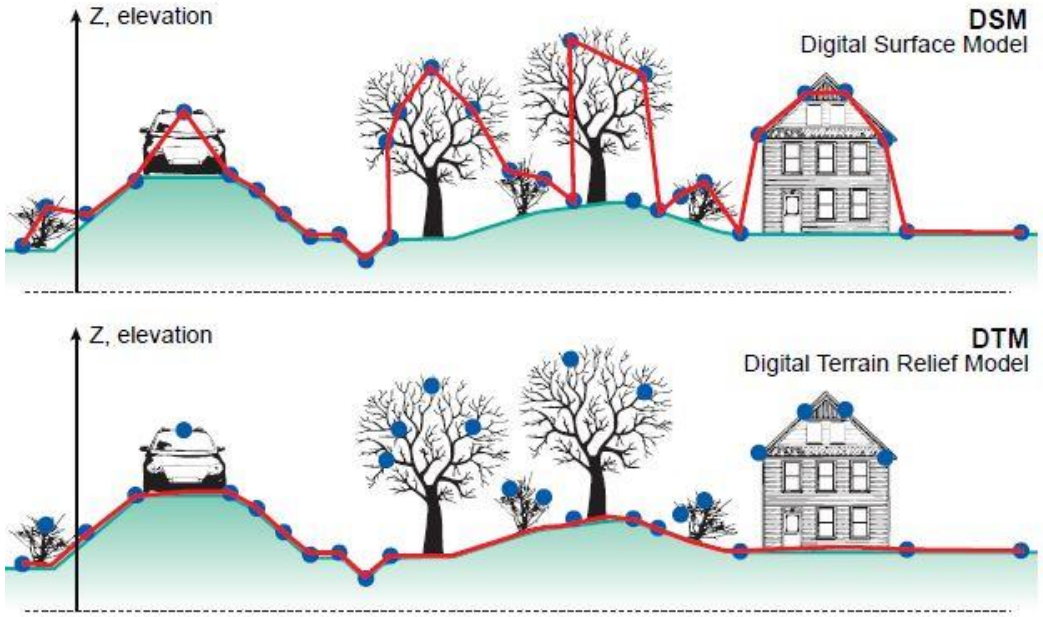
Data Models for GIS

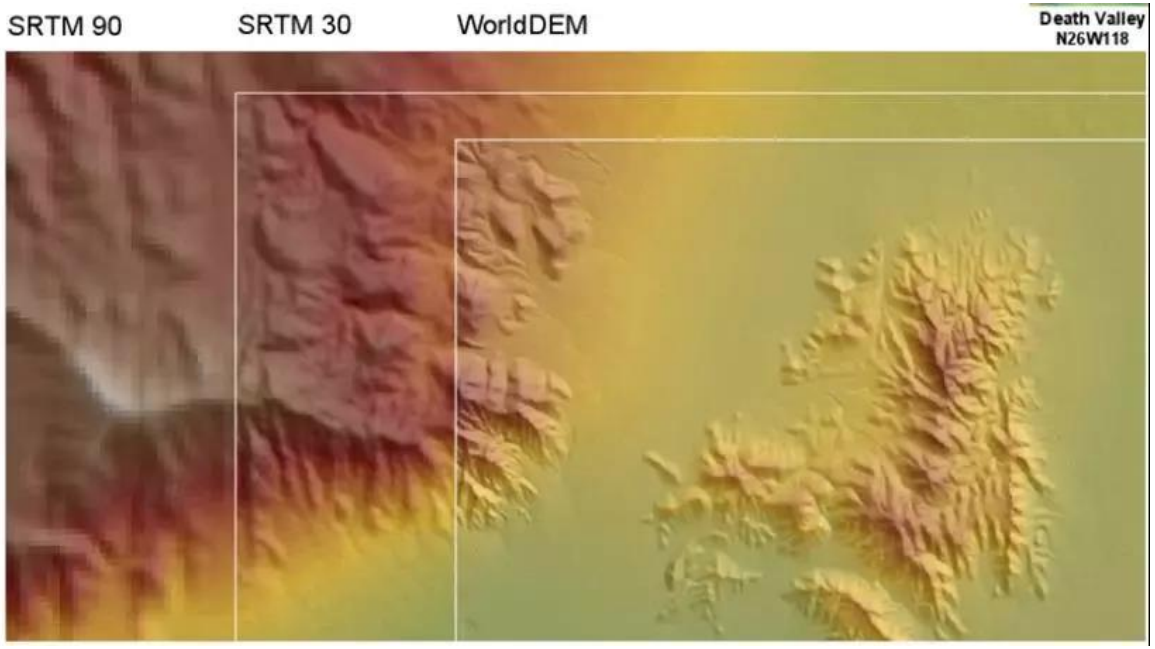
➢ Geographic or Spatial Data

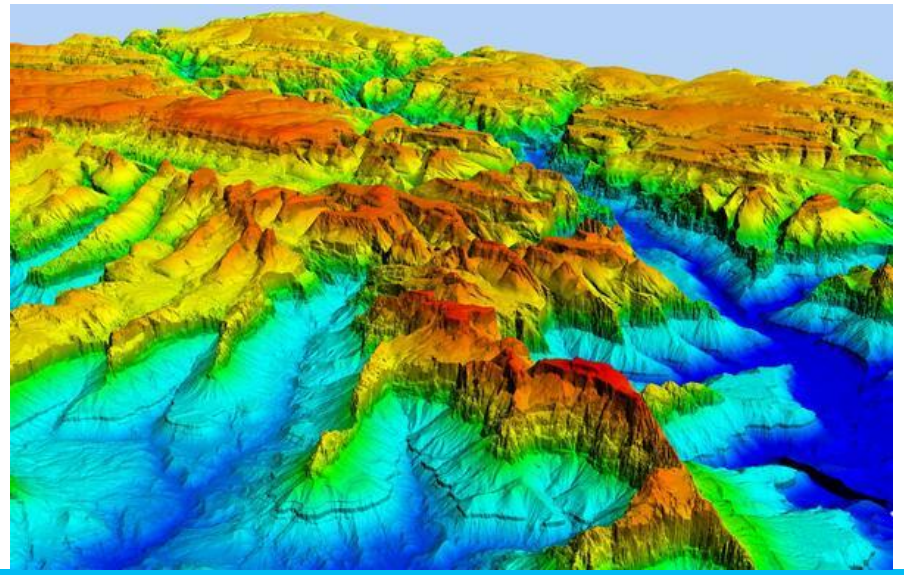
1. Raster Data Models

❑ What is a digital elevation model (DEM)?

- A Digital Elevation Model (DEM) is a **representation of the bare ground (bare earth) topographic surface** of the Earth excluding **trees, buildings, and any other surface objects.**



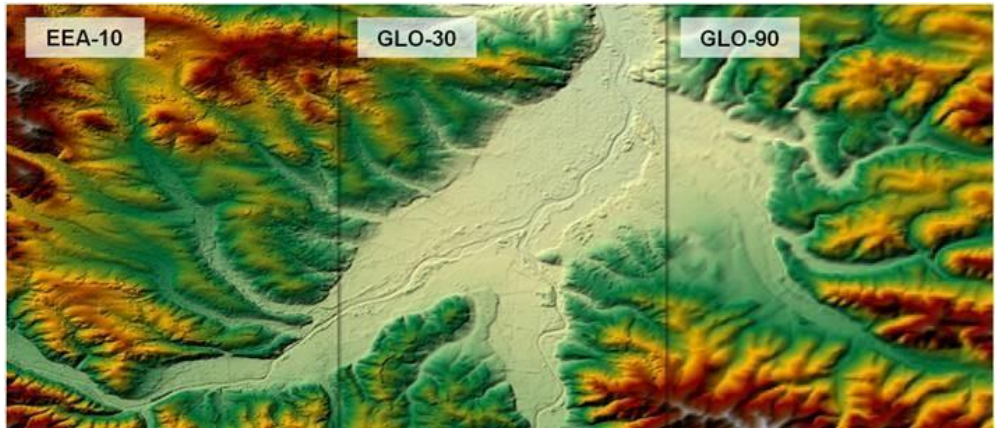


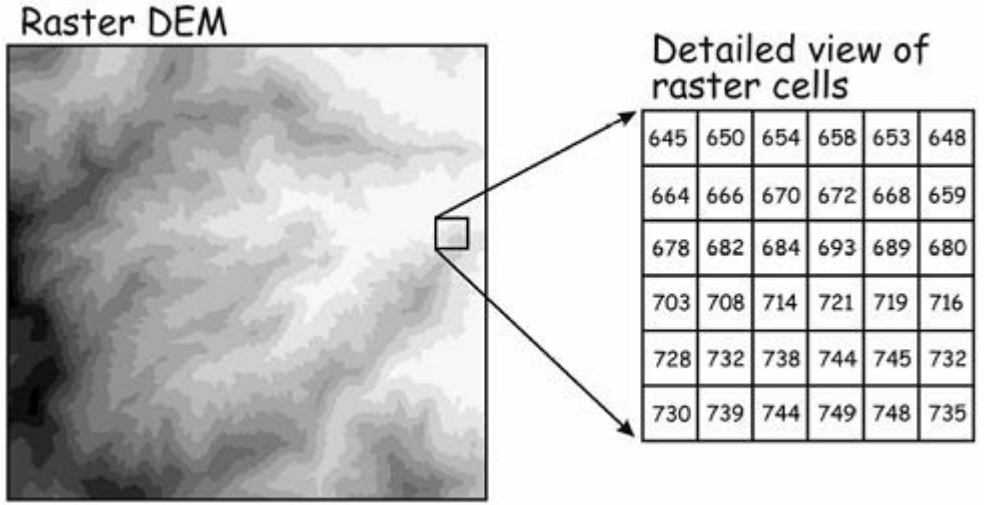


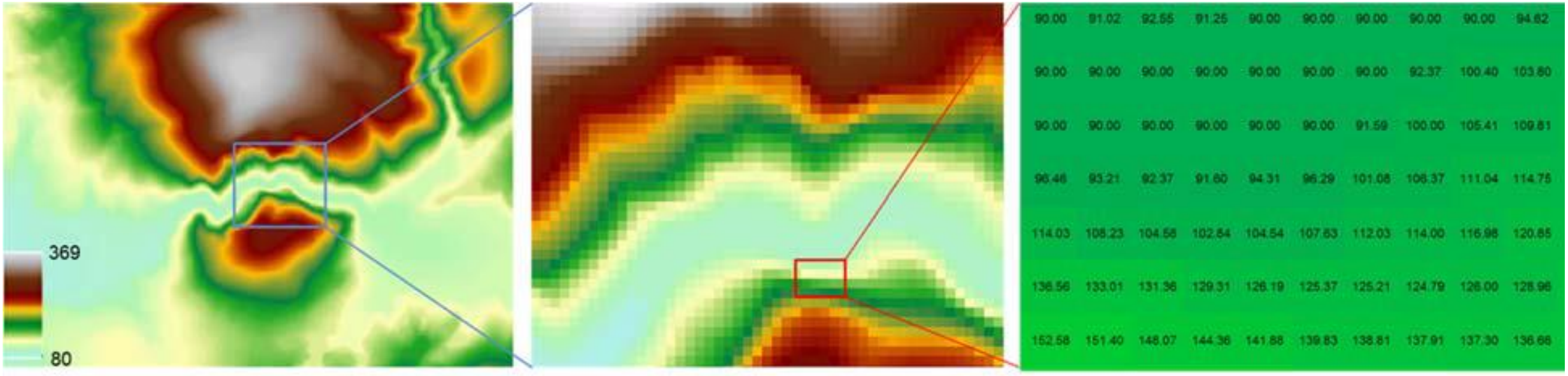
Data Models for GIS

➢ Geographic or Spatial Data

1. Raster Data Models





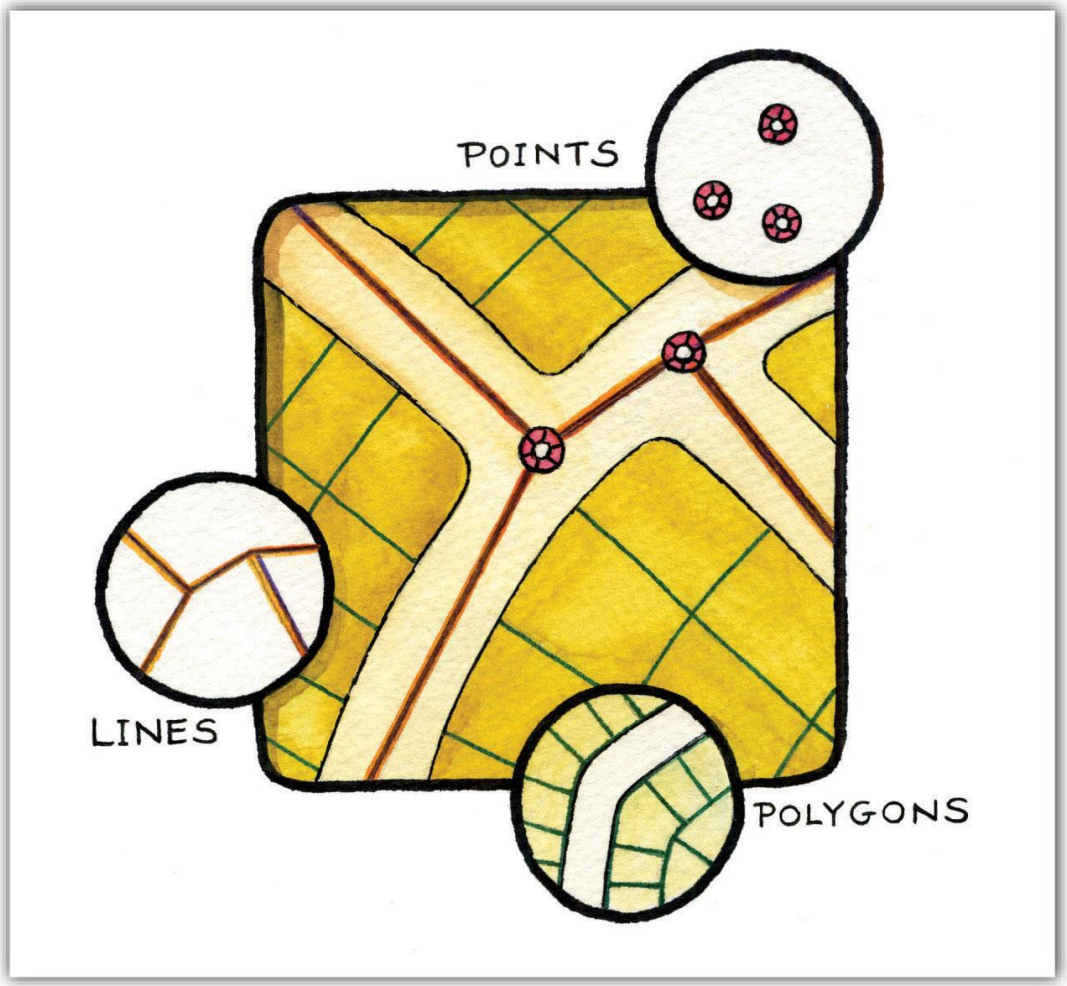


Data Models for GIS

➢ Geographic or Spatial Data

2. Vector Data Models

- In this model, **space is not quantized into discrete grid cells like the raster model.**
- Vector data models **use points and their associated X, Y coordinate pairs** to represent the vertices of spatial features, much as if they were being drawn on a map by hand.
- **The data attributes of these features are then stored in a separate database management system.**
- The spatial information and the attribute information for these models are **linked via a simple identification number** that is given to each feature in a map.



Data Models for GIS

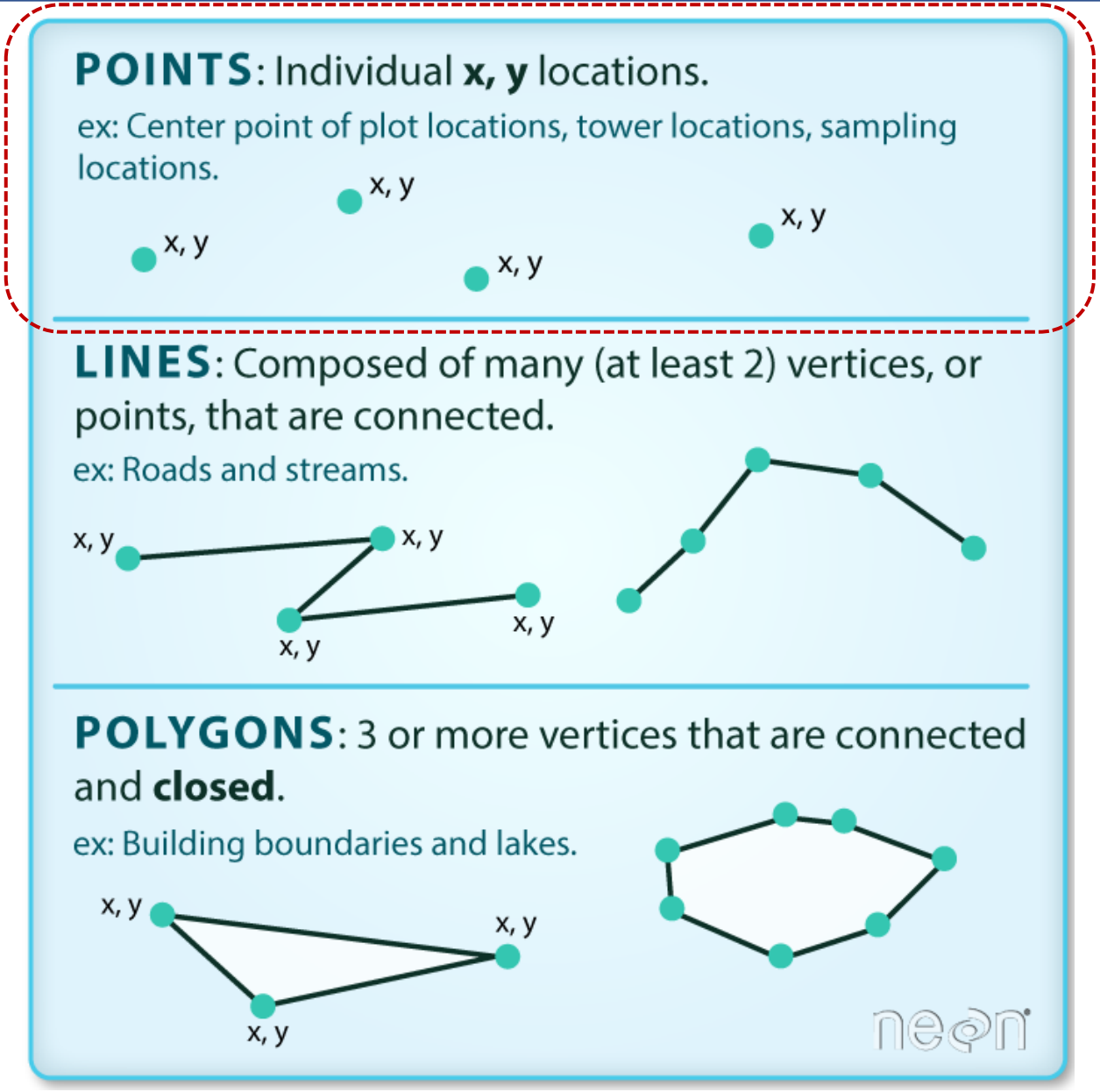
➢ Geographic or Spatial Data

2. Vector Data Models

- Three fundamental vector types exist in geographic information systems (GISs): **points, lines, and polygons.**

❑ Points

- Points are zero-dimensional objects that contain only a **single coordinate pair.**
- Points are typically used to model **singular, discrete features such as wells, power poles, sample locations, and so forth.**
- Points have **only the property of location.**



Data Models for GIS

➢ Geographic or Spatial Data

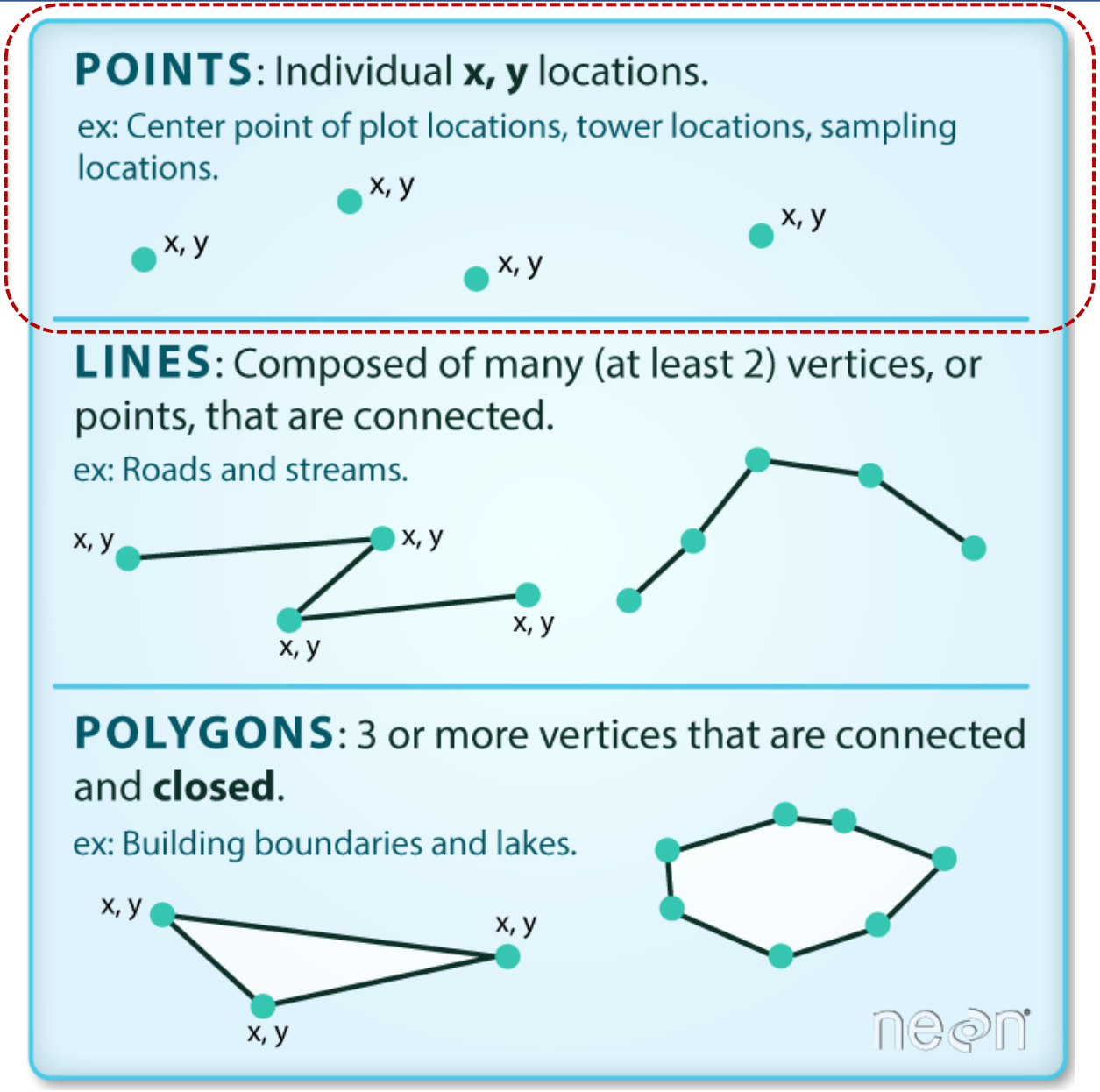
2. Vector Data Models

❑ Points

- Other types of point features include the **node** and the **vertex.**
- Specifically, a point is a stand-alone feature, while a **node is a topological junction representing a common X, Y coordinate pair** between intersecting lines and/or polygons.
- **Vertices** are defined **as each bend along a line or polygon feature** that is not the intersection of lines or polygons.

✓ **Node:** The intersection points where two or more arcs meet.

✓ **Vertices:** A corner or a point where lines meet.



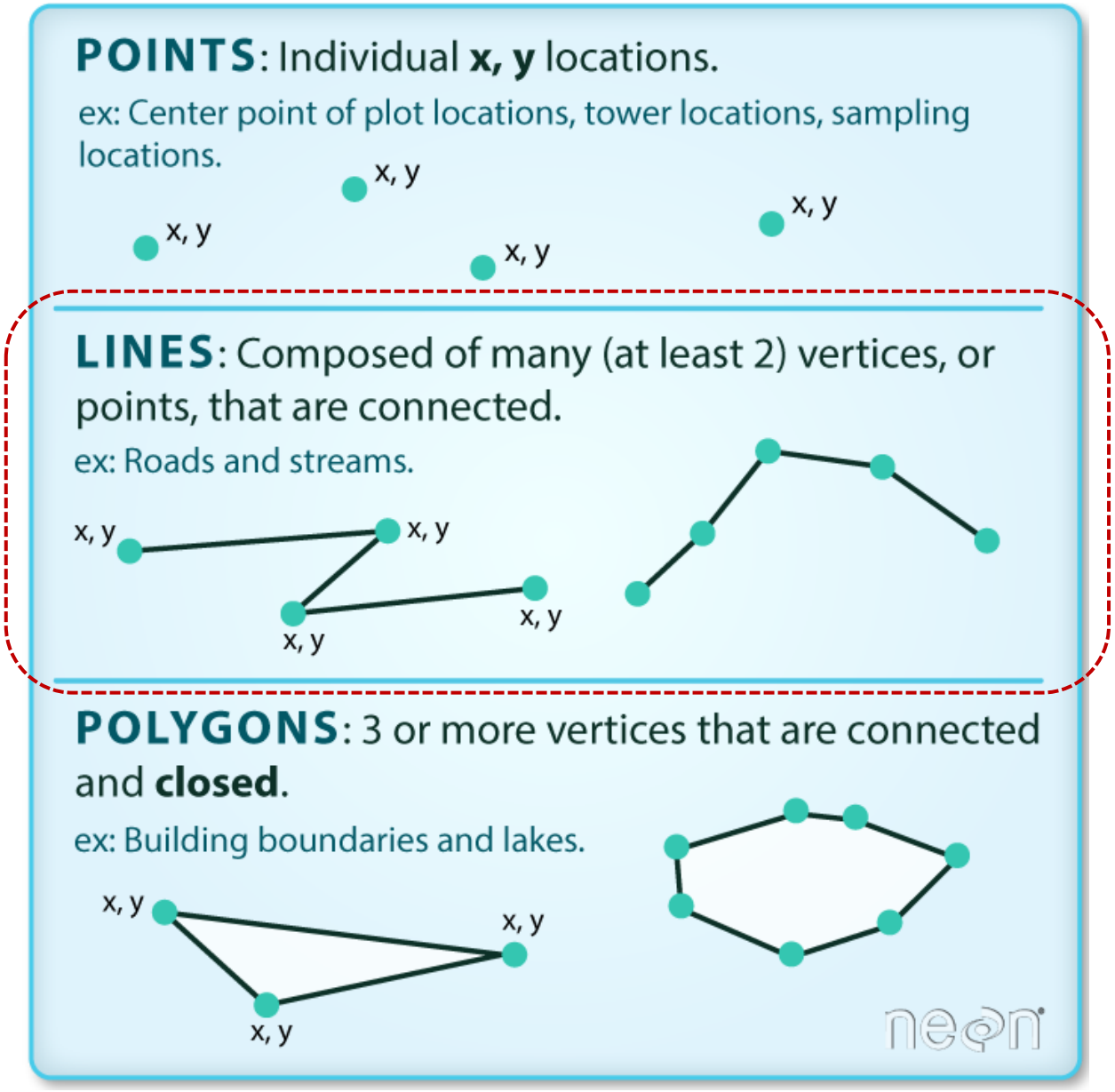
Data Models for GIS

➢ Geographic or Spatial Data

2. Vector Data Models

❑ Lines

- **Lines are onedimensional** features composed of **multiple, explicitly connected points.**
- Lines are used to represent linear features **such as roads, streams, faults, boundaries, and so forth.**
- **Lines have the property of length.**
- Lines that directly connect two nodes are sometimes referred to **as chains, edges, segments, or arcs.**



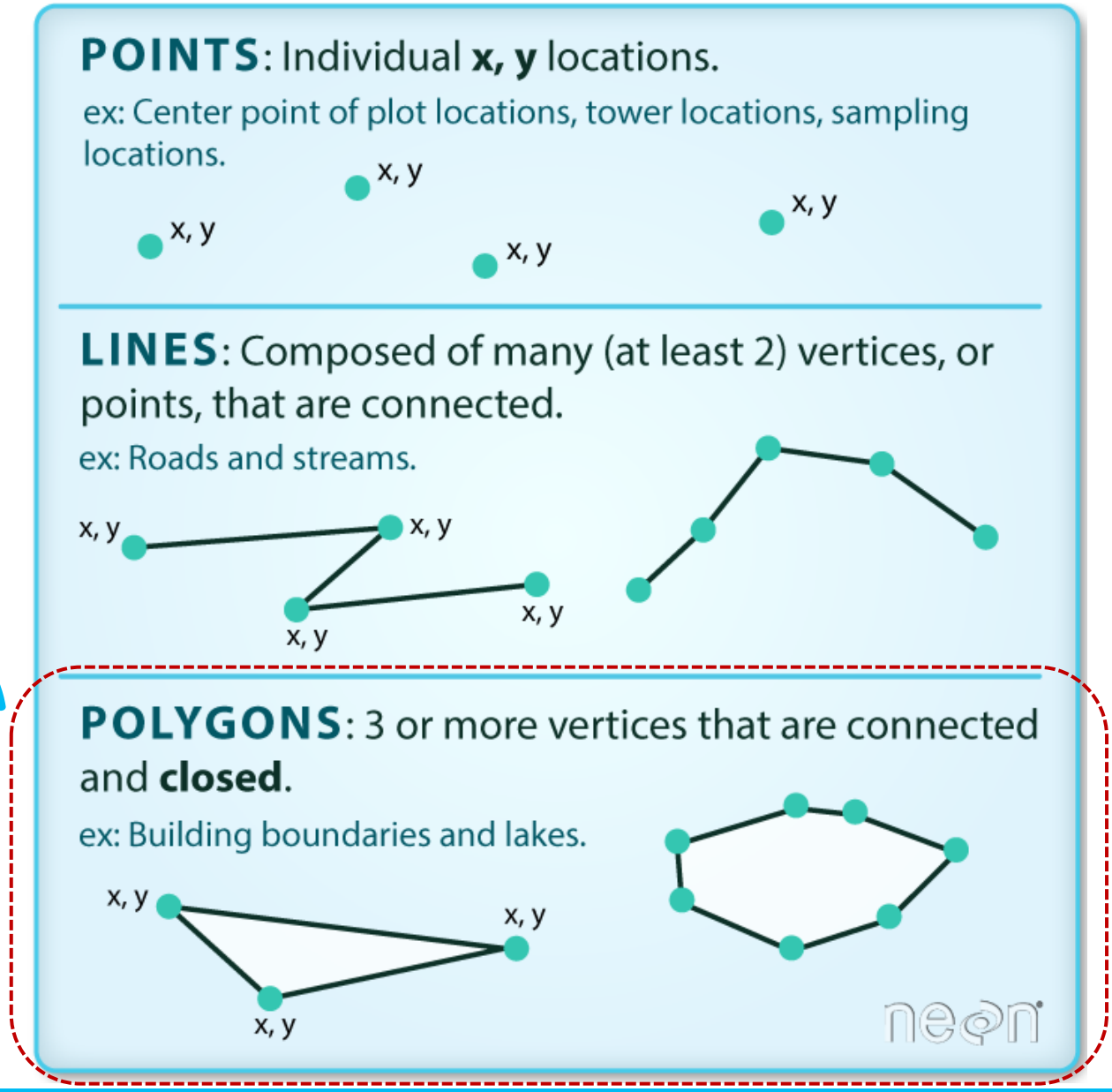
Data Models for GIS

➢ Geographic or Spatial Data

2. Vector Data Models

❑ Polygons

- Polygons are two-dimensional features created by **multiple lines** that loop back to create a **"closed" feature.**
- In the case of polygons, **the first coordinate pair (point) on the first line segment is the same as the last coordinate pair on the last line segment.**
- Polygons are used to represent features **such as city boundaries, geologic formations, lakes, soil associations, vegetation communities, and so forth.**
- Polygons have the **properties of area and perimeter.**
- Polygons are **also called areas.**



Data Models for GIS

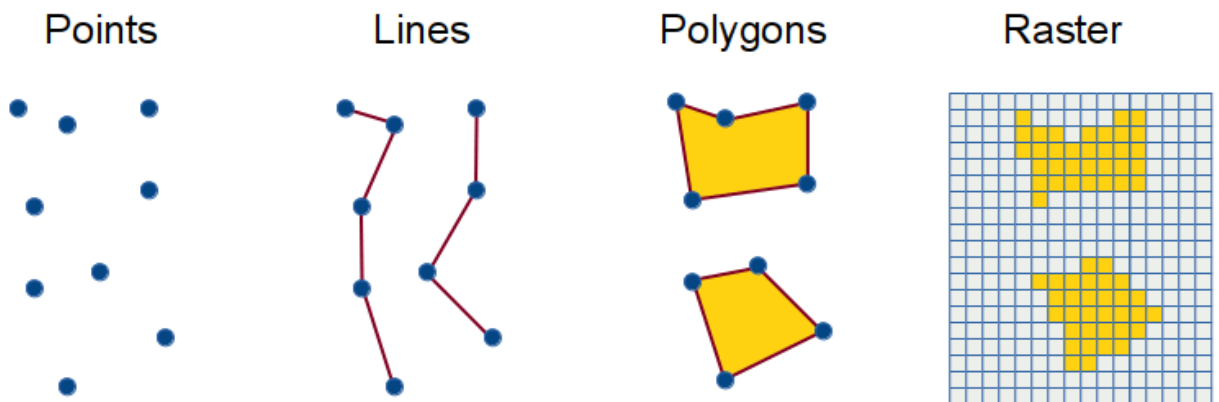
- **Geographic or Spatial Data**

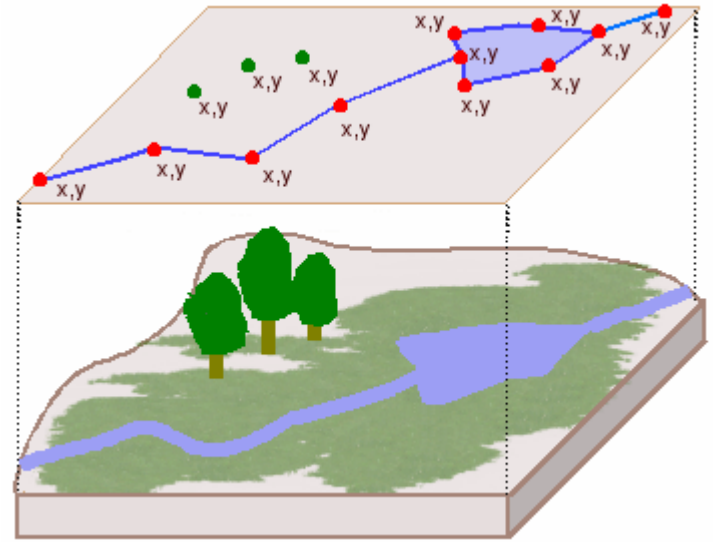
2. Vector Data Models

Data Models for GIS

➢ Geographic or Spatial Data

2. Vector Data Models

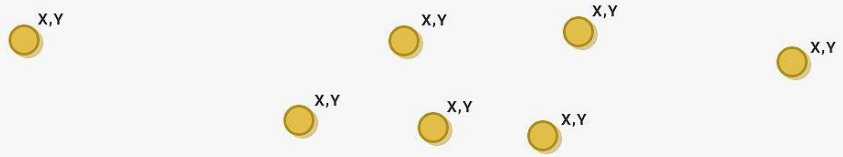




Point (node, vertex)

INDIVIDUAL X,Y LOCATIONS

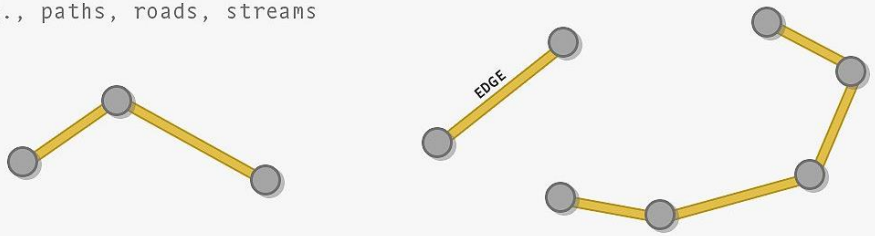
E.g., label, manhole, tower locations



Line (chain)

2 OR MORE POINTS THAT ARE CONNECTED*

E.g., paths, roads, streams



** 2 connected points also known as edge or arc.*

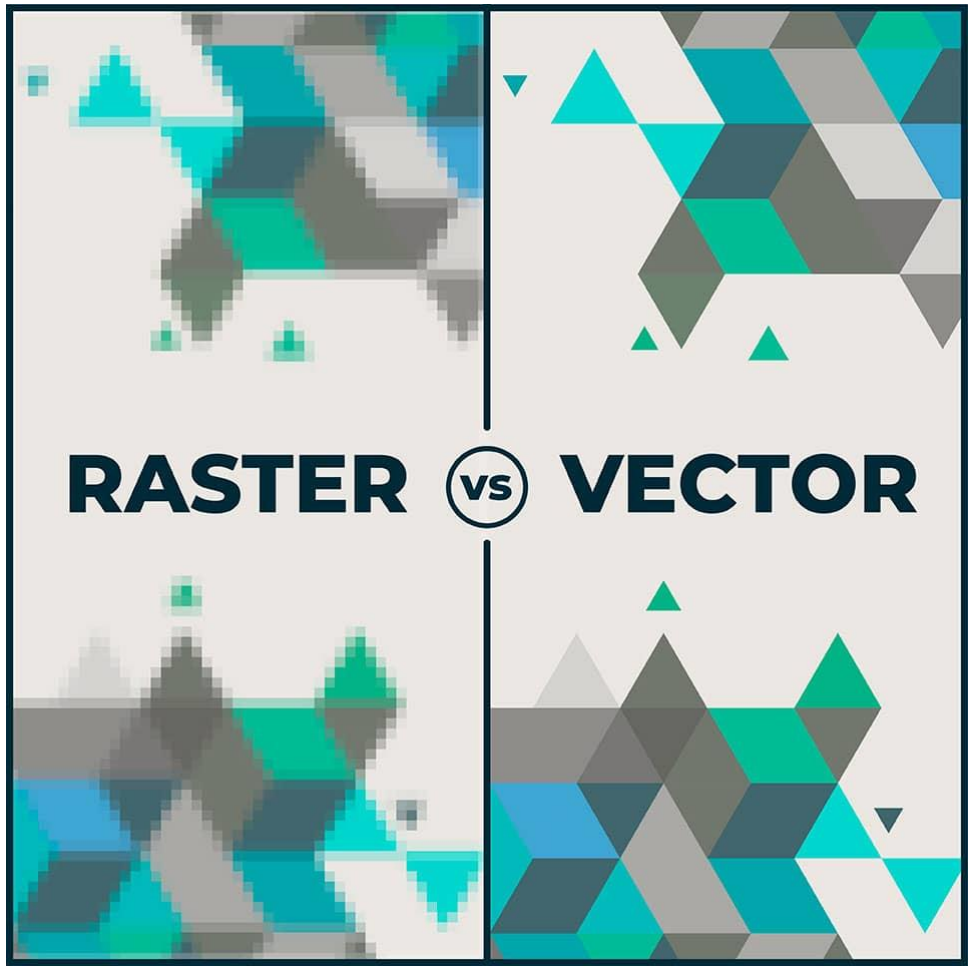
Polygon (area segment)

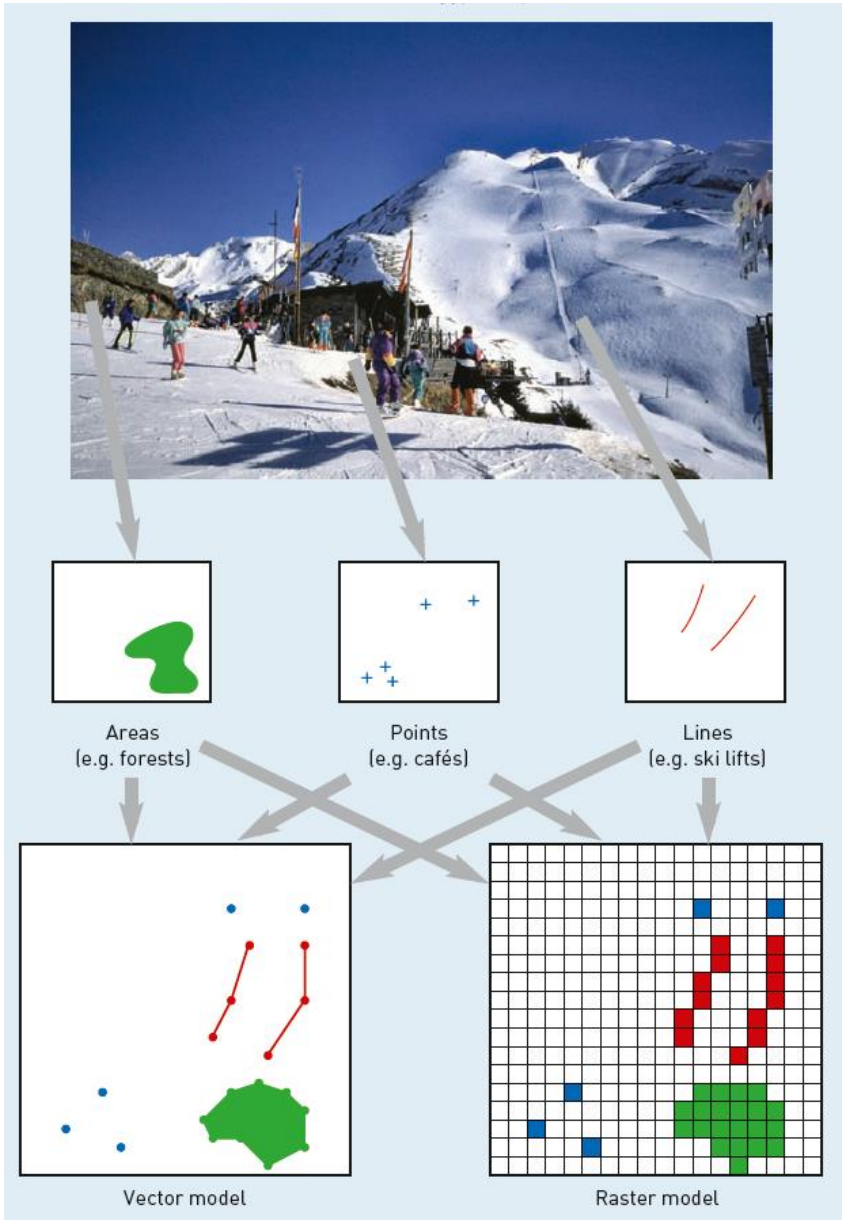
3 OR MORE VERTICES THAT ARE CONNECTED AND CLOSED

E.g., Land/water boundaries, buildings

Data Models for GIS

- **Geographic or Spatial Data**
  - **Raster vs Vector**



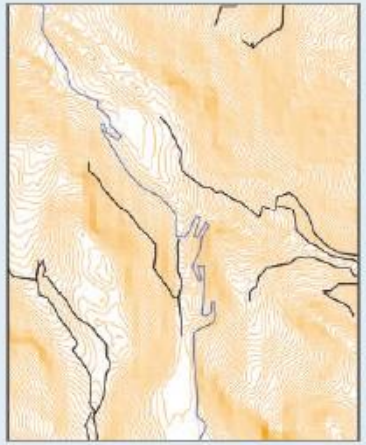


Data Models for GIS

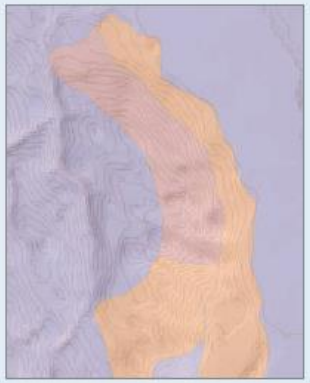
➢ Geographic or Spatial Data

❖ Raster vs Vector

(d) Digital colour aerial photograph

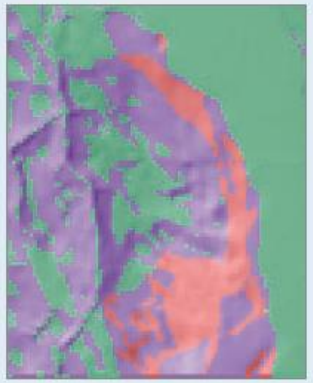


(e) Vector contours and roads

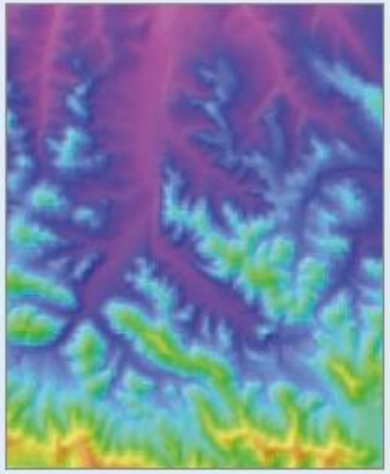


(a) Soil map display

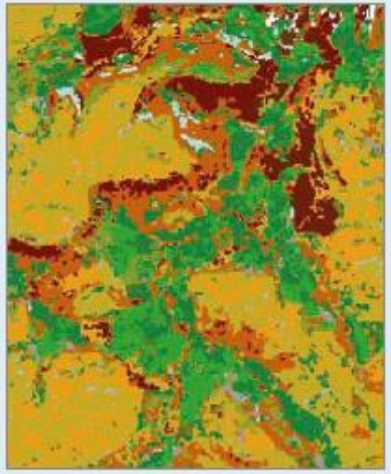
(b) Reselection of specific soil types



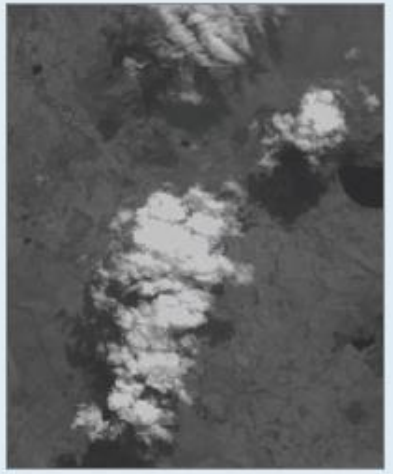
(c) Simple soil erosion model predictions



(a) Raster digital elevation model

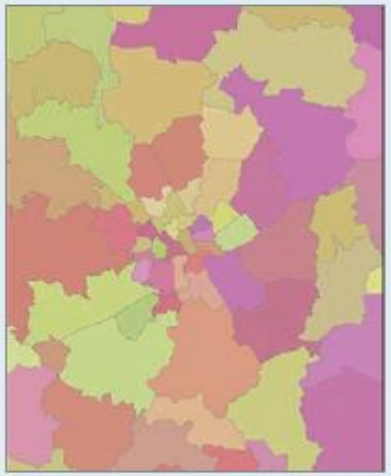


(b) Raster land cover data



(c) Satellite image

(f) Vector soil polygons

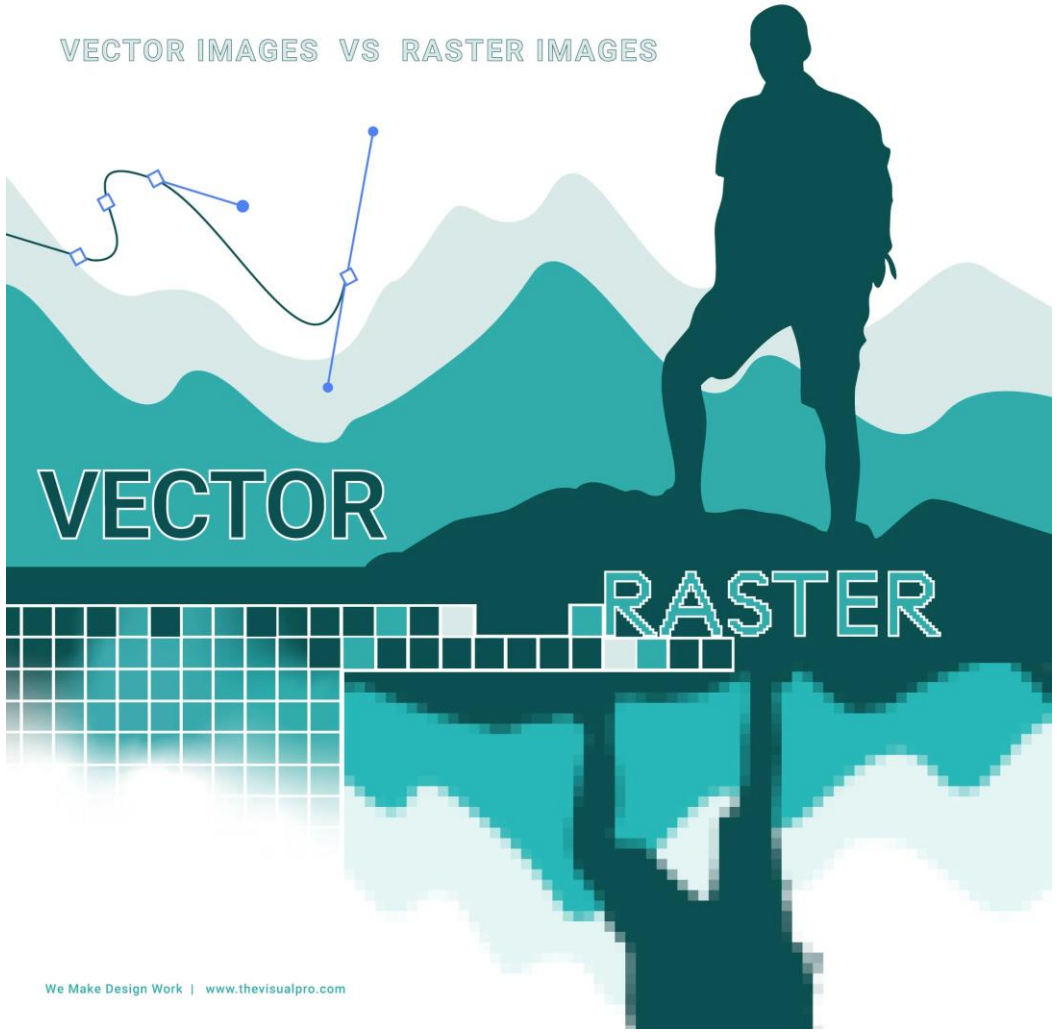


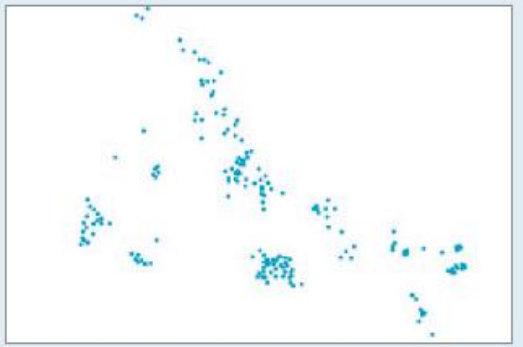
(g) Vector census polygon boundaries

(h) Vector land cover polygons

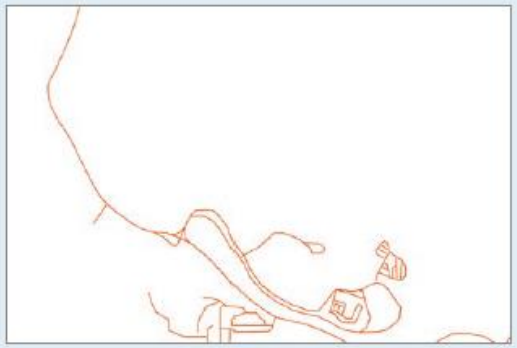
Data Models for GIS

- **Geographic or Spatial Data**
  - **Raster vs Vector**



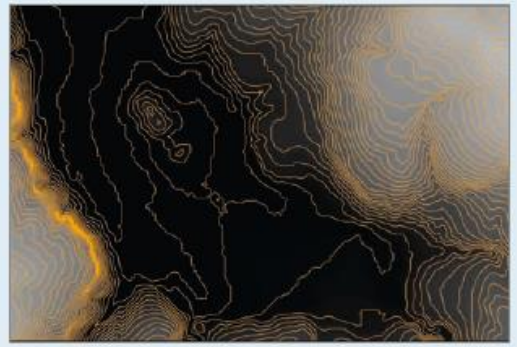


(a) Points (e.g. buildings)

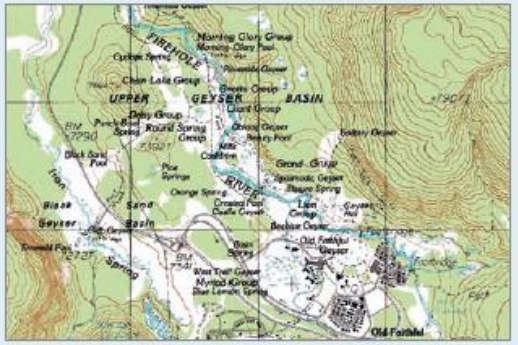


(b) Lines (e.g. roads)

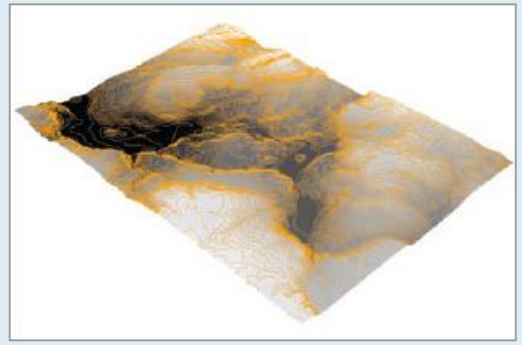
(c) Polygons (e.g. forests)



(d) Surface (e.g. terrain)



(e) Topographic map



(f) Digital terrain model

Data Models for GIS

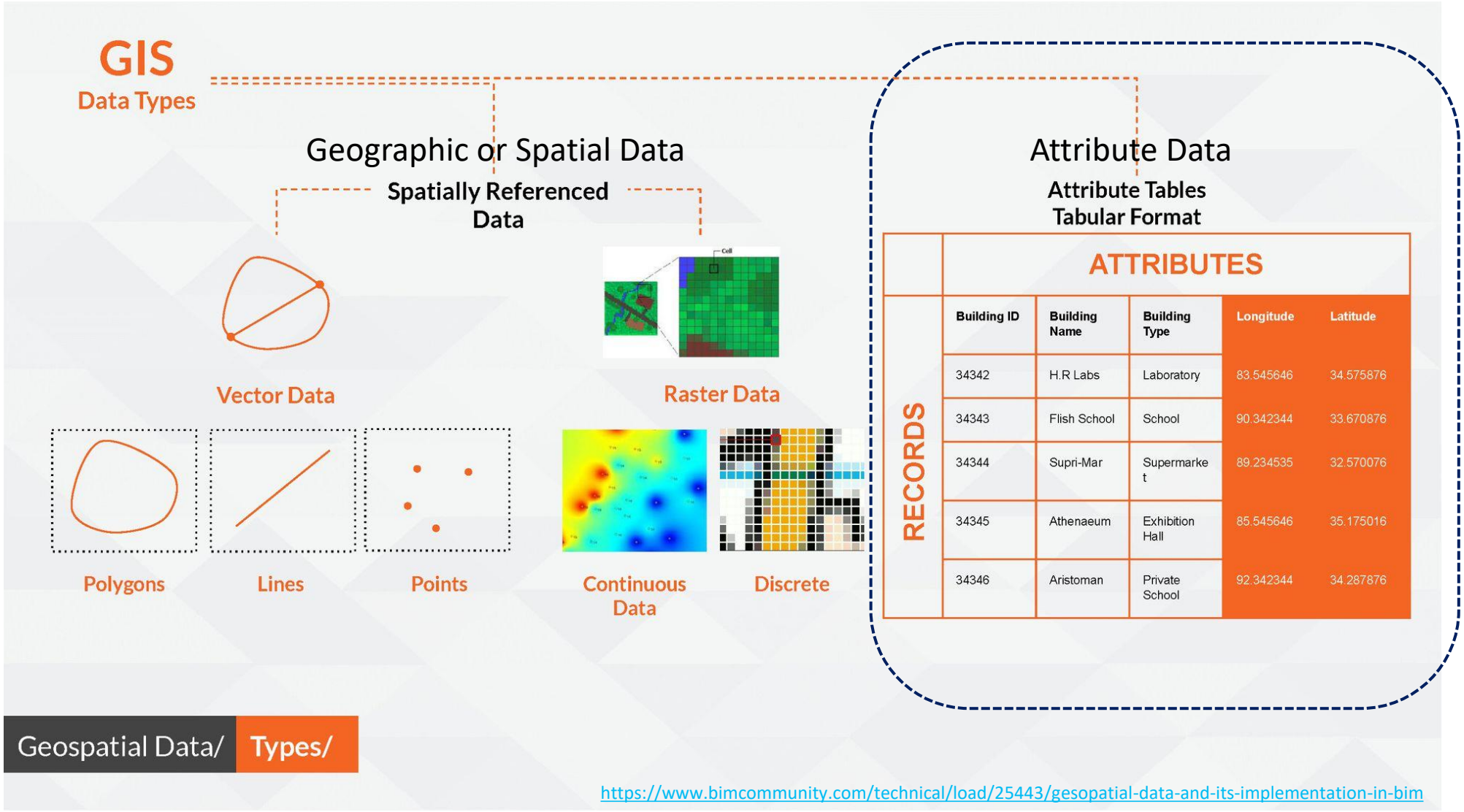
➢ Geographic or Spatial Data

❖ Raster vs Vector

Raster Graphics	Vector Graphics
They are composed of pixels.	They are composed of paths.
In Raster Graphics, refresh process is independent of the complexity of the image.	Vector displays flicker when the number of primitives in the image become too large.
Graphic primitives are specified in terms of end points and must be scan converted into corresponding pixels.	Scan conversion is not required.
Raster graphics can draw mathematical curves, polygons and boundaries of curved primitives only by pixel approximation.	Vector graphics draw continuous and smooth lines.
Raster graphics cost less.	Vector graphics cost more as compared to raster graphics.
They occupy more space which depends on image quality.	They occupy less space.
File extensions: .BMP, .TIF, .GIF, .JPG	File Extensions: .SVG, .EPS, .PDF, .AI, .DXF

Data Models for GIS

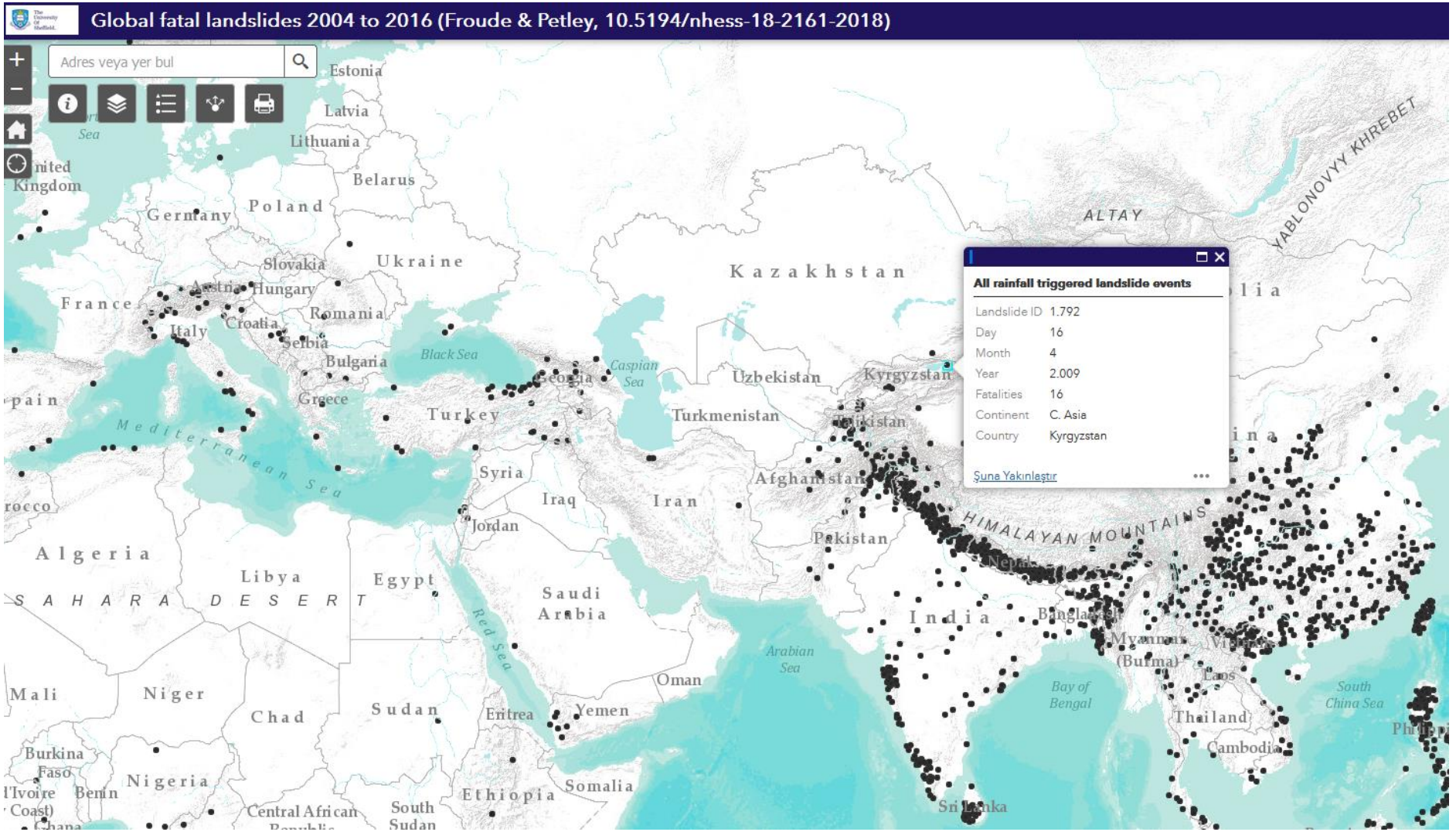
➢ Attribute Data



https://www.bimcommunity.com/technical/load/25443/gesopatial-data-and-its-implementation-in-bim

Data Models for GIS

- **Attribute Data**



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- https://www.bimcommunity.com/technical/load/25443/gesopatial-data-and-its-implementation-in-bim