

# Digital Cartography



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# What do we mean by Cartography?

It is the Art, Science and Technology of representing a geographical area in graphical form.

Basically it is a means of communication

# Necessity of Cartography

- Representing a geographical area in a mathematically accurate form through written communication is a gigantic task .
- It may take thousand of words and still may not be convincing.
- Cartography represents the area through signs and symbols in a comprehensive way.

# Challenges in Cartography and their Solutions

1. How to represent the vast area of earth on a tiny paper?

By choosing a proper scale.

2. How to represent the spherical surface of the earth on plane paper so that distortions and tearing may be minimum?

By technique called projection.

# Challenges in Cartography and their Solutions

3. How to depict accurately details in their correct relative position?

By choosing a coordinate system

4. How to depict large number of details without confusion

By proper symbolization

# History of Cartography

- Oldest known map discovered in Babylone. Estimated to be 4500 years old.
- Greek cartographer Ptolemy(90-168 A.D.) made the first map of the world .
- The science of Cartography suffered a setback during medieval times.
- It started recovering after 1500 A.D.

# History of Cartography

- The period after 1800 A.D. marks the setting up of Cartography on scientific footing.
- The period of colonial expansion witnessed an ever increasing demand for accurate maps and charts.
- Thus began the era of Modern Cartography.

# Process of Map Making

## Conventional Techniques

- Collection of raw materials.
- Mosaicing in correct geographical position
- Reduction/ Enlargement to required scale
- Preparation of positives or negatives



# Classification of Data

- Natural or Physical Features
- Man-made or cultural features

# Further Classification

- Hydrography
- Roads and Railways
- Buildings and other constructions
- Vegetations
- Boundaries
- Relief
- Geographical Names
- Utilities

# Digital Cartography

- It is the Computer assisted cartography.

# Digital Map

It is an organised set of cartographic data stored on computer readable media and representing a map image

# Digital Map

- In simple terms , it is computer compatible form of map to be displayed, manipulated, analysed and archived in computer.
- Information is stored in digital (binary or other system) form.

# Contents of a Digital map

- It Presents the Information available on the surface of the Earth in the form of Geographical Features.
- Features:
  - i. Natural
  - ii. Cultural

# What are the Map Contents?

- Features are represented by;
  - i. Point
  - ii. Line
  - iii. Area
  - iv. Text
- Two types of data are associated with these Features;
  - i. Positional / Spatial data
  - ii. Attribute / Non spatial data

# What is Positional Data

- It answers the question 'where it is' Means it indicates the location of a feature

How the location defined on the spherical surface of the Earth?

Defines by two types of geographic coordinate systems on a chosen reference surface

- i. Longitude, Latitude & Height
- ii. Geocentric X,Y,Z



# How the position is defined in 2D Paper Map

- Defined in a Cartesian X,Y Coordinates with reference to a scaled Map frame work

# Where do we get this X,Y

- The spherical surface projected on a two dimensional surface in a suitable manner to transform the geographic coordinate to Cartesian or rectangular X,Y coordinate
- Process of transformation is called Map Projection & X, Y is called Projected coordinate.

# How the features are defined?

- By 2D geometry - Point, Line or Area.
- Geometry depends on the theme of representation and scale of Map.

# How the elevation is represented?

By Linear contour/TIN/DEM/Hillshade

# What is Attribute data

It answers the question 'what it is'

Means it indicate the characteristic or class of a feature.

## How this data is presented in Paper Map?

Presented by Colour, Symbols or Description (Text) to a feature. A separate attribute table may also be made.

# How the Information is represented in Digital Map?

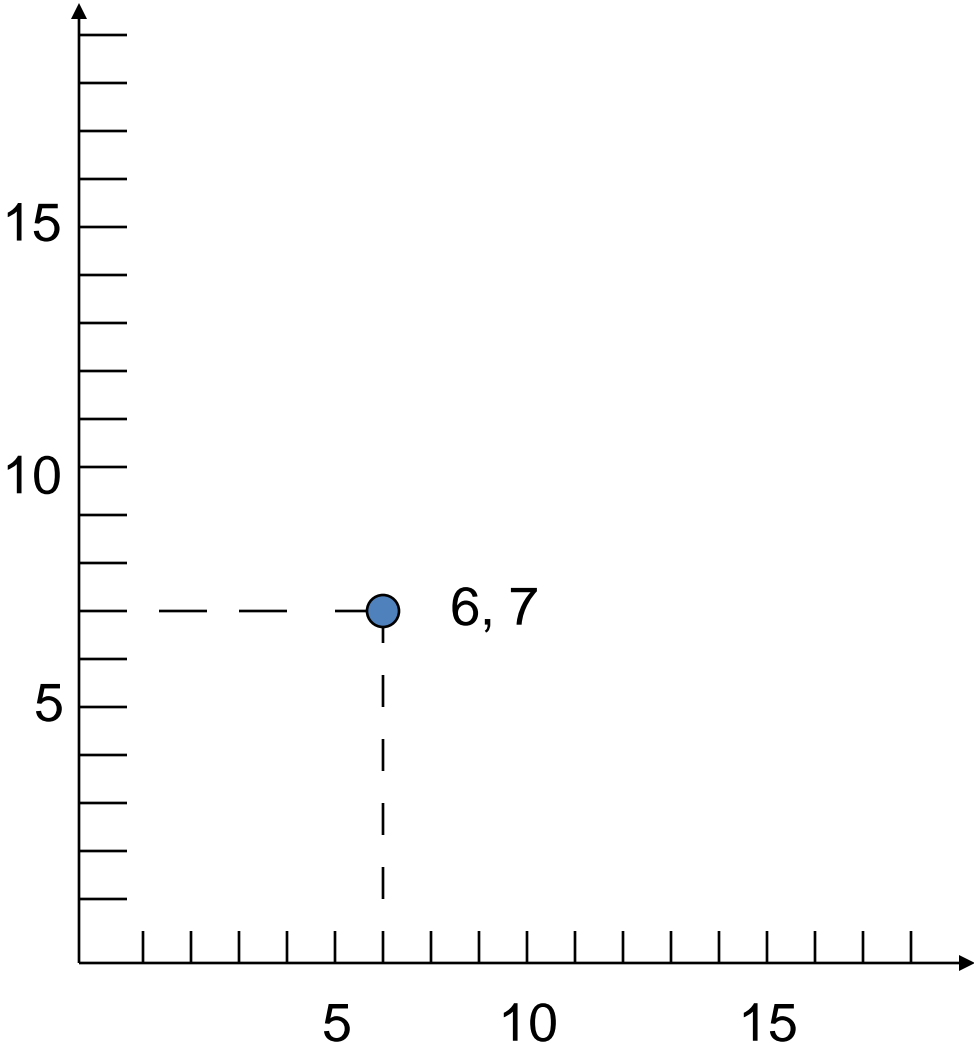
Represented in two modes or Systems

- i. Vector / Point mode
- ii. Raster / Cell mode

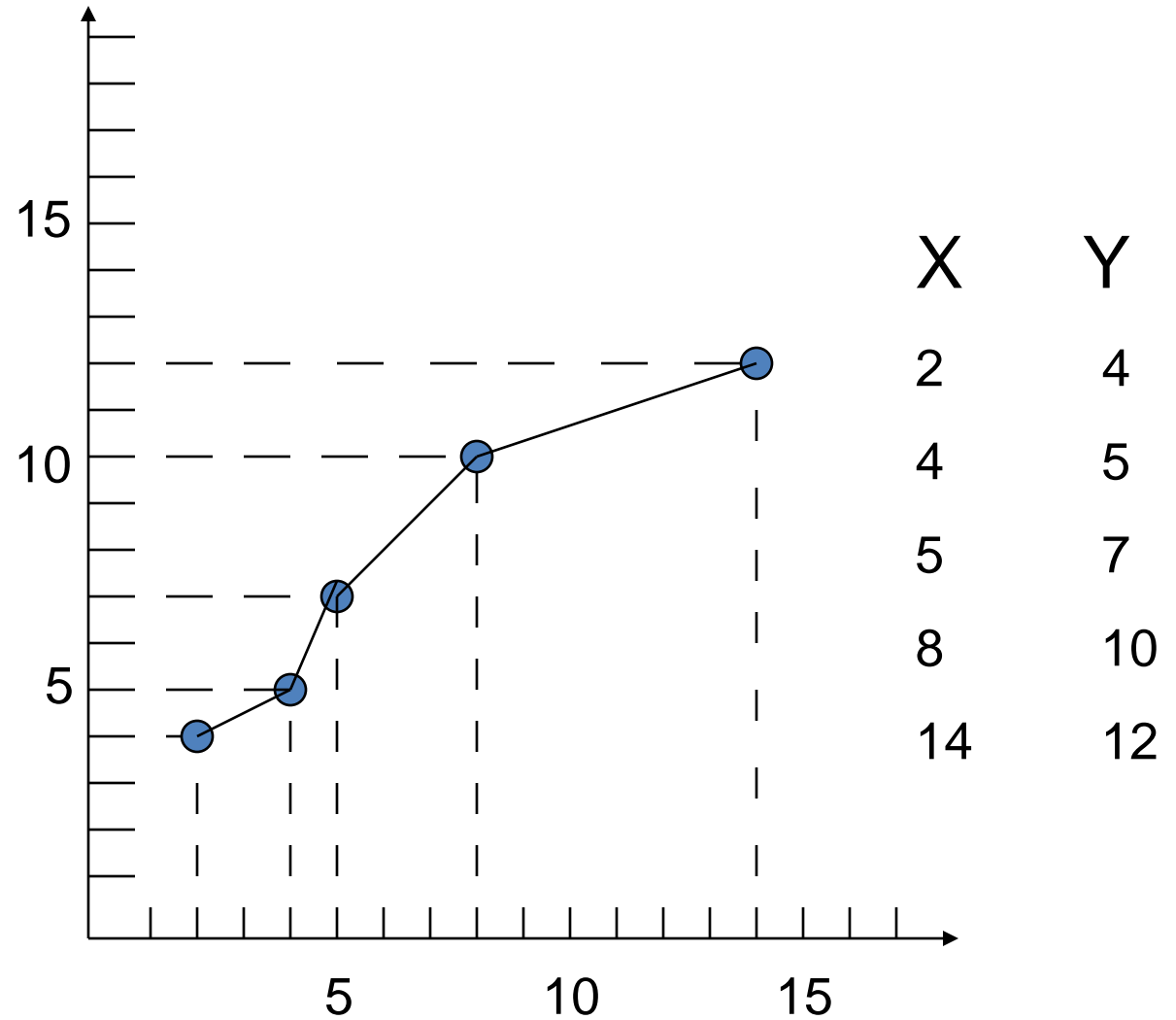
# What is vector?

- It is the representation of features using points and their  $x, y$  or  $x, y, z$  coordinates in a pre-defined Cartesian coordinate system
- Coordinates may be projected or geographic
- For point a single pair of  $x, y$ ,
- For line a sequence  $x, y$  pairs
- For area sequence of pairs of coordinates closing at the first point and start & end point recorded once

# DIGITAL REPRESENTATION OF A POINT

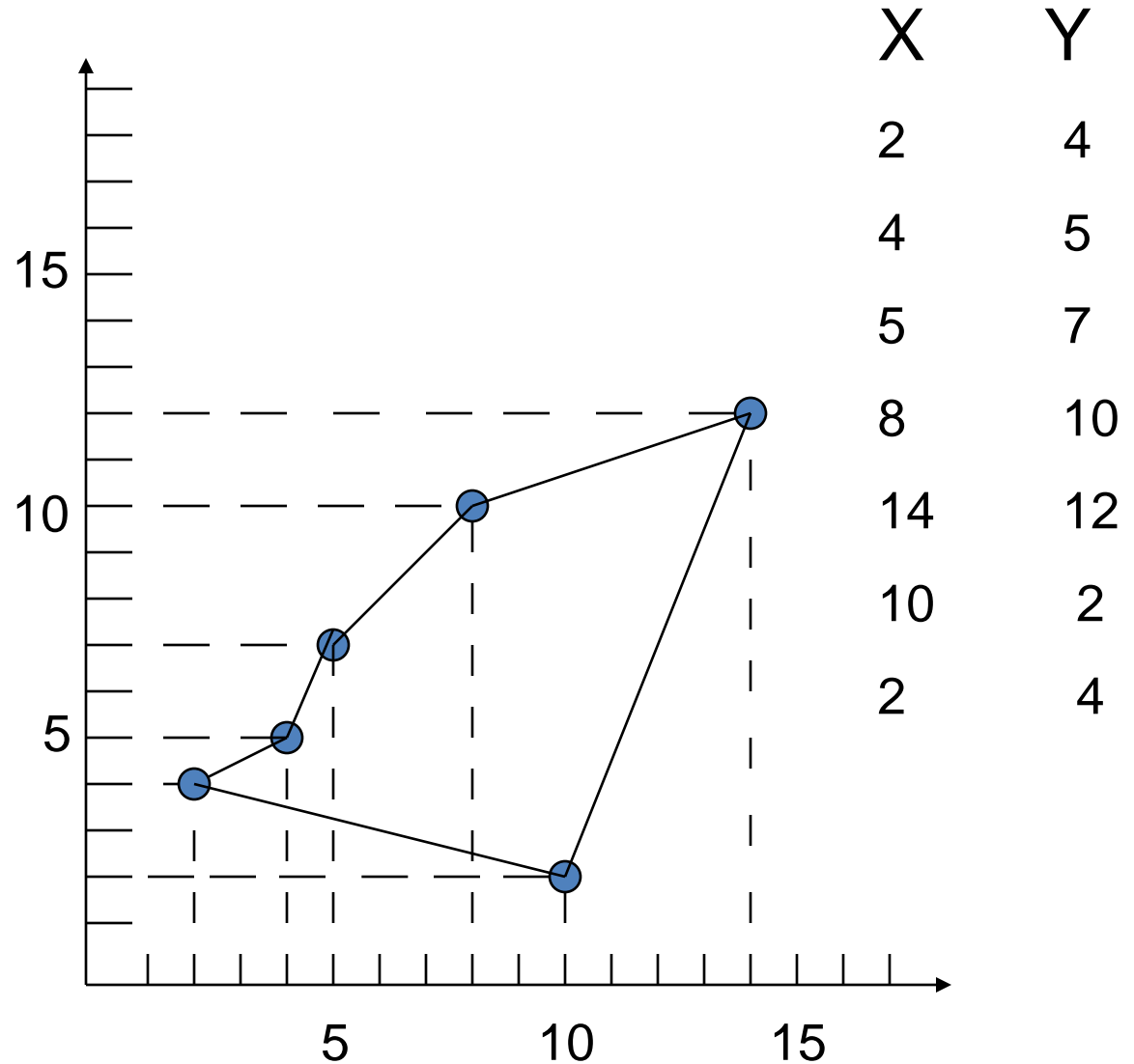


# DIGITAL REPRESENTATION OF A LINE





# DIGITAL REPRESENTATION OF AN AREA



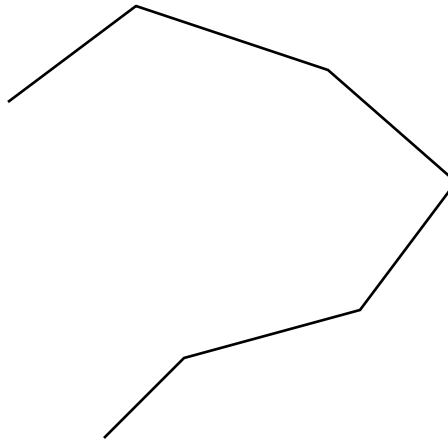
# Spatial Information in Vector

Point

Y

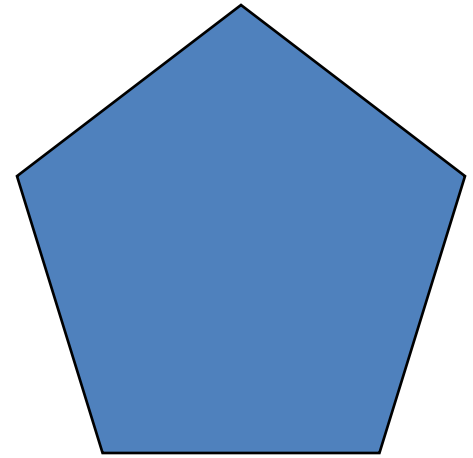


Line



Area

X



# How attribute is represented

- By a code to the geometry or data base with field values attached to it.

# What is Raster?

- It is the representation of features using cells or pixels (picture elements).
- The whole area is divided in to matrix of cells ( a Grid ) of definite cell size & no. of Row & Column.
- Cell size is called Spatial Resolution
- Position is defined by Column & Row address
- Attribute is defined by a value to the cell. That is the class value of the cell or Digital Number ( DN)

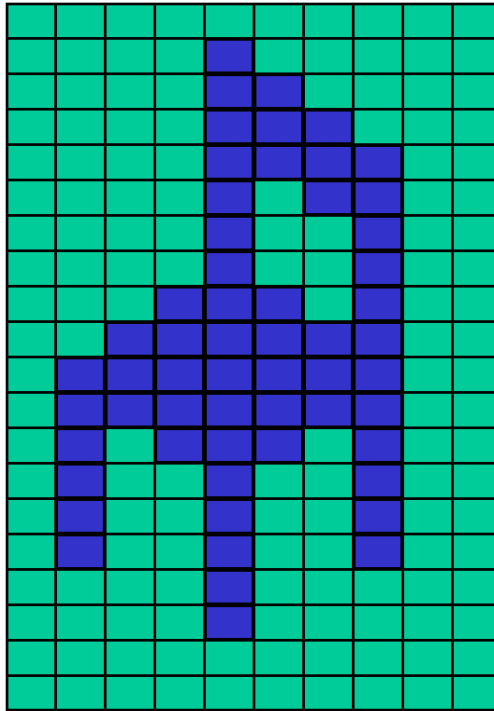
# How it is related with the position on the Earth surface?

- A relationship between raster position (Column & Row address) and with the corresponding geographic or projected coordinates.
- This process is called geo-referencing.

# How the geometry is represented?

- As such there is no concept of Point, Line or Area as each pixel is independent of its neighborhood and presented as an area.  
However interpreted as
- A point by single pixel with out common value in neighborhood
- A line by sequence similar cell in a linear alignment
- An area by a block similar cell

# A raster representation



Example of Raster data

Scanned output, Satellite Imageries,

Raster DEM, Classified Image

# Comparison

DATA	ANALOGUE	DIGITAL MAP	
		VECTOR	RASTER
Positional	Projected Cartesian X,Y coordinates with reference to a scaled map framework.	Cartesian X,Y (projected or Geographic) in 2D and X,Y,Z in 3D.	Row, Column Position of a cell.
Attribute	Colour, Symbology and Text Description	Code, Attribute values attached to the vector	Cell value



# How a Digital map is generated?

- It can be generated at any stages of map making process.

**OR**

- The already processed and Map presented in analogue form can be converted to Digital form

# Digital Cartography: process of Map making

**Three stages:**

## **1. Data acquisition :**

- **From Satellite Imageries**
- **From aerial photographs**
- **By GPS**
- **BY GPR**
- **By Total Stations**
- **By Palm Top equipped with GPS**
- **By LIDAR**
- **From existing Cartographic documents**

2. Data Manipulation : Includes georeferencing ,  
vectorization and proper symbolization of field  
data
3. Final printing through digital technology

# Stages of map making Contd.....

Data Stage as per DMS

Confirming to standards and formats  
(OGC compliance)

# Consideration before generating Digital Map;

- Extent of the area
- Coordinate System
- Selection of Features
- Organization of features in database
- Feature codes and attribute values or parameters for each features
- Symbology for presentation

# Basic Requirements;

- Hardware - Equipments
- Software – Application Soft ware
- Live ware – Skilled man power

# Why should we adopt Digital Technology?

- eliminate tedious repetitive manual work
- Speed up production
- increased productivity
- improve product quality
- allow new products to be developed
- flexibility in output, scale and design
- facilitate production process control
- enable the computer to analyze data

# continued.....

- update the data base easily and quickly
- perform value addition ( GIS Applications )
- easy and efficient archiving
- Selective (geographic extent or attribute wise)
- retrieval
- Facilitate Data integration and mosaicing



# Which mode should we adopt?

Raster Or Vector ?

Depends on the purpose

Still for Structured data for GIS mostly Vector is preferred

Therefore by Digitization it is meant Vectorisation

## Difference between Vector and Raster :

<b>Criteria</b>	<b>Raster</b>	<b>Vector</b>
Data Structure	Simple	Complex
Data Volume	Large	Small
Data Capture	Faster	Slower
Geometric Accuracy	Low	High
Feature wise organization	Scope limited	Scope wide
Individual Feature Selection, Extraction or Manipulation	Difficult	Easy
Symbolic presentation of features	Difficult	Easy

# What are the methods to vectorise?

- i. With the help of Digitiser tablet / Digitiser table
  - ii. Through scanning ( to get a Raster Image)
- With the help of digitiser tablet is completely manual, tedious, Time consuming
  - Thus gradually becoming obsolete

# Three ways of digitisation from raster;

- Complete Automatically
- Semi Automatically
- Manual Screen digitisation

# What are the phases?

For Creation of Database;

- Preparation
- Document Processing
- Georeferencing
- Digitising (Vectorising)
- Attribute Entry
- Editing
- Conversion to required or common Data Base format
- Archiving

## Symbolisation for presentation & Production

- Editing
- Archiving
- Plate making for production

**Thanks  
for  
your attention**