ArcMap 10.8.2 Learning Series

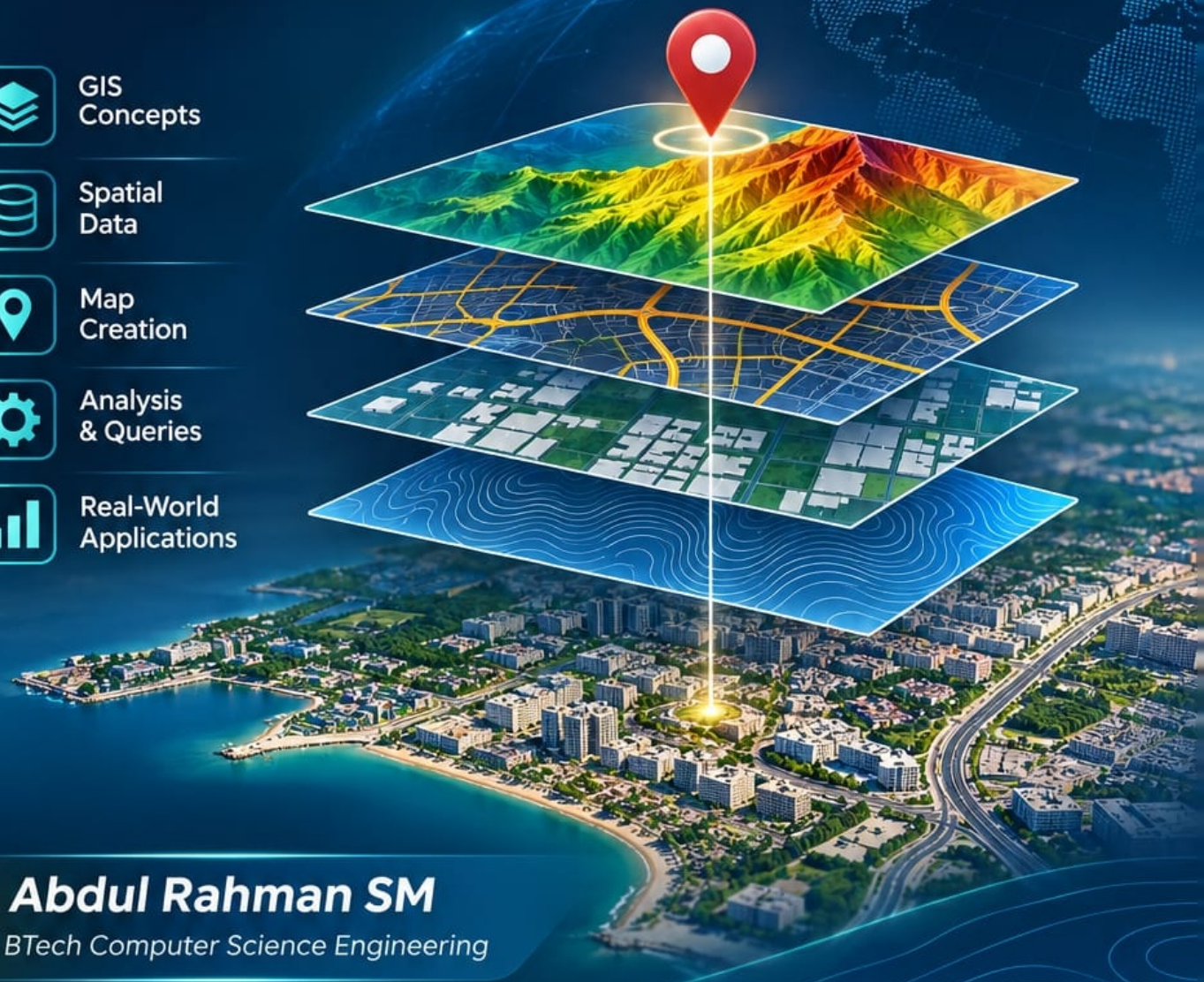
MODULE 1 | GIS FUNDAMENTALS

EBOOK 01
BEGINNER

Introduction to GIS

What GIS Is,
Why It Is Used, and
Real-World Applications

- GIS Concepts
- Spatial Data
- Map Creation
- Analysis & Queries
- Real-World Applications



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PREFACE

Maps are among the oldest tools people have used to make sense of the world. Geographic Information Systems carry that idea into the digital age.

A GIS helps us understand places, interpret spatial information and support decisions in fields such as surveying, urban planning, transportation, utilities and environmental management.

For someone meeting the subject for the first time, however, GIS can seem difficult. The terminology is new, concepts such as layers, features and attributes are unfamiliar, and software workflows can feel crowded with options before the ideas behind them are clear. A clear, organised introduction can make that first step easier and give readers a reliable foundation for everything that follows.

This eBook exists for that reason. Useful technical knowledge should be easy to reach for people who are beginning their learning journey. The material has been gathered from relevant sources, compiled, organised in a logical order and presented in a reader-friendly format. It builds on established GIS knowledge developed by many practitioners, educators and organisations, and the sources consulted are listed in the references at the end of the book. The aim is clarity, logical progression and practical relevance.

It is intended for students who are starting to study GIS, beginners exploring geospatial technologies, surveying and mapping learners, people interested in how GIS is applied, and anyone who prefers to build knowledge step by step.

Educational material is most useful when it is shared, and this eBook is offered for the benefit of those who want to learn. It is a starting point, not a complete course. Readers are encouraged to use it as a base for further study, for practice with real data and for wider reading. More information about this series is available at www.cadgistools.com.



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About This eBook

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ABOUT THE EXAMPLES	All maps, tables, coordinates and numbers in this eBook are invented for teaching unless a source is given. Do not use them as real geographic data or for real decisions. Pictures that look like software are schematic illustrations, not screenshots.
SERIES POSITION	Previous: none (this is the first eBook). Next: EBOOK 02, GIS Data Types.

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INTRODUCTION

Welcome to GIS

A first, friendly look at how we put information on a map and ask questions of it.

What you will learn

Almost everything around us has a location. A house, a road, a water pipe, a mobile tower, a school, a flood. When we know where things are, we can ask better questions. Where should we build? Which roads are near the river? Which areas have no clinic?

A **geographic information system**, or **GIS**, is the tool that helps us answer questions like these. This eBook explains what GIS is, how it works at a basic level, and where people use it in real work. You do not need to know anything about GIS before you start.

Why this topic matters

Every later eBook in this series builds on the ideas you meet here: layers, features, data and attributes. If you understand them well now, ArcMap will feel logical instead of confusing. Many beginners try to learn buttons and menus first. This eBook does the opposite. It builds the thinking first, because the thinking stays the same even when the software changes.

Where this knowledge is used

People use GIS in land surveying offices, city planning departments, road and transport agencies, water and power companies, telecommunications companies, environmental groups, emergency services, health departments, farms and shops. Chapter 8 gives a first tour of these fields.

Before you start

- You should know how to use a computer, open files and folders, and read a simple table.
- You need only simple arithmetic and a calculator that can do square roots. Every calculation is shown step by step.
- You do not need ArcMap to read this eBook. A short, optional hands-on exploration is in Section 7.4. You can skip it and come back later.
- You do not need any earlier GIS knowledge.

Learning objectives

When you finish this eBook, you will be able to:

1. Explain in your own words what a GIS is, using both a plain explanation and the formal definition.
2. Describe what the three words in “geographic information system” each add.

3. Tell the difference between a GIS and a paper map, a CAD drawing, a GPS receiver and a web map.
4. Explain the layer idea and show how layers are combined to answer a question.
5. Name the two main ways a GIS stores the shape of the world (vector and raster) and explain what an attribute table is for.
6. Calculate the straight-line distance between two points on a flat, metre-based grid, and explain when this method is valid.
7. List the five components of a GIS and describe a basic GIS workflow from question to decision.
8. Recognise five common kinds of questions that a GIS can answer.
9. Recognise the main parts of ArcMap 10.8.2 (map document, data frame, Table of Contents, layers, Data view and Layout view) and explain how they relate to ArcCatalog and the Catalog window.
10. Describe real problems that GIS helps to solve in at least five fields of work.
11. Avoid the most common beginner misunderstandings about GIS.

How to use this eBook

Read the chapters in order the first time. Each chapter starts with a short list of what it covers and ends with a summary. Boxes in the text use a fixed colour and label, so you always know what you are looking at.

TABLE I.1 The boxes used in this eBook

Box	What it tells you
KEY CONCEPT	An idea you must understand before moving on.
SIMPLE EXPLANATION	The same idea in everyday words.
REAL-WORLD EXAMPLE	How the idea appears in actual work. Examples are marked “illustrative” when they are invented.
IMPORTANT	A rule or warning that affects your results.
COMMON MISTAKE	A mistake beginners often make, and how to avoid it.
TECHNICAL NOTE	Extra detail for readers who want to go deeper. You may skip it on first reading.
STEP-BY-STEP	Numbered instructions to follow.
CHECK YOUR UNDERSTANDING	A few quick questions. Answers are in Appendix A.
PRACTICE TASK	An exercise to try on your own. Worked solutions are in Appendix A.

IMPORTANT Teaching data only

All maps and numbers in this eBook are invented for teaching, except the history in Chapter 3, which is based on the sources listed in Appendix C. Never use the examples as real data.

CHAPTER 1

Why Location Matters

Start with an everyday problem and see why “where” is the key to so many decisions.

IN THIS CHAPTER

- What “location” means in GIS
- How a GIS map differs from a paper map
- The difference between data and information

1.1 A problem that depends on where

Imagine that you work for a town council. The council wants to build a new health clinic. Many questions come up straight away:

- Where do most people live?
- Where are the existing clinics?
- Which roads can people use to reach a new clinic?
- Which land is safe from floods?

Every one of these questions has the word *where* hidden inside it. The answers are all tied to places on the Earth. A GIS is built to work with questions like these.

1.2 Everything happens somewhere

Location means the place where something is on the Earth’s surface. A house has a location. So does a road, a river, a mobile tower or a car accident.

Two words appear again and again in GIS: **geographic** and **spatial**. *Geographic* means “to do with places on the Earth”. *Spatial* means “to do with position in space”. In this series we use them almost as the same thing.

KEY CONCEPT Location is the link

Location links facts together. A road and a flood zone may look unrelated until you see that they share the same piece of ground. When two facts share a place, a GIS can combine them.

1.3 From paper maps to GIS maps

A paper map is a picture. Someone decided what to show, drew it once and printed it. It is useful, but it is fixed.

A GIS map is different. A computer draws it from data each time you look at it. Everything on the map is linked to information about that thing. So you can change what you see, ask questions and measure, without drawing the map again.

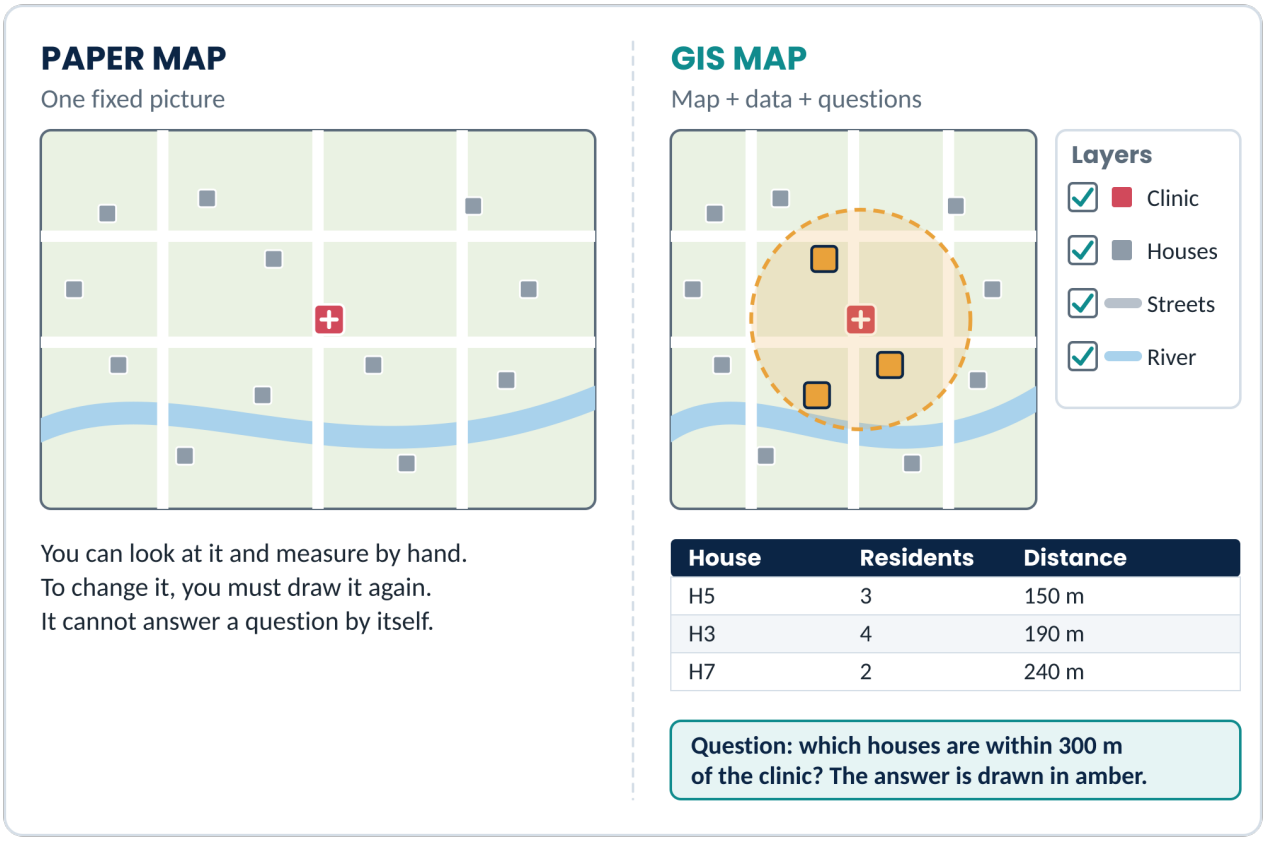


FIGURE 1.1 A paper map (left) and a GIS map (right) of the same invented town. In the GIS map, the three amber houses (H5, H3 and H7) are the answer to the question "which houses are within 300 m of the clinic?". The GIS measured the distances in the table from the map's coordinates.

Look at Figure 1.1. The left side is a paper map. You can look at it, but it cannot answer questions by itself. The right side shows the same town in a GIS. It has three extra parts. The **layer list** lets you switch themes on and off. The **table** holds facts about each house. The **question** at the bottom was answered by the computer, and the answer is drawn on the map.

TABLE 1.1 What you can do with a paper map and with a GIS map

Task	Paper map	GIS map
See an area	Yes, in one fixed style	Yes, and you can change the style
Measure a distance	By hand, with a ruler and the scale	The computer calculates it from coordinates
Find all houses near a clinic	Search by eye	Ask a question; the computer selects them
Add new information	Draw it again	Add a layer or a record
Update after a change	Print a new map	Edit the data; the map follows
Combine with other maps	Hard: trace or lay sheets over each other	Stack layers (Chapter 4)

1.4 Data and information

Data are facts or measurements on their own. For example, the number 412 is data. By itself it means very little. **Information** is data with meaning: “Hillview School has 412 students.”

In GIS we often talk about a **dataset**. A dataset is a collection of related data about one subject, such as all the road centrelines of a city or all the water-pipe records of a utility. When information is linked to a location, we can put it on a map and look for patterns.

SIMPLE EXPLANATION

Think of a GIS as three questions answered together: *Where is it? What is it? What is near it?* A paper map answers the first. A table answers the second. A GIS connects them and helps with the third.

CHECK YOUR UNDERSTANDING

1. Which of these have a location? (a) The street address of a school. (b) The number 412 on its own. (c) The position of a water pump. (d) The path of a river.
2. Name one thing a GIS map can do that a printed paper map cannot.

CHAPTER SUMMARY

- A **location** is a place on the Earth. Many decisions depend on it.
- **Geographic** and **spatial** both point to places and positions.
- A paper map is a fixed picture. A GIS map is drawn from data and can answer questions.
- **Data** are raw facts. **Information** is data with meaning. A **dataset** is a collection of related data.