Includes a trial copy of ArcGIS Desktop software

GETTING TO KNOW ArcGIS™ desktop




Basics of ArcView®, ArcEditor™, and ArcInfo™

Tim Ormsby | Eileen Napoleon | Robert Burke | Carolyn Groessl | Laura Feaster

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 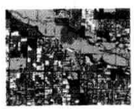 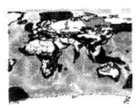 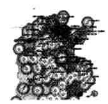

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INTRODUCTION

Getting to Know ArcGIS Desktop: Basics of ArcView, ArcEditor, and ArcInfo is the latest software workbook from ESRI. Like its predecessors, *Getting to Know ArcView GIS* and *Extending ArcView GIS*, this is a practical book that teaches how to use the software through exercises and color graphics. Concepts are explained at the beginning of each chapter and as needed throughout.

ArcGIS™ Desktop is the collective name for three products, ArcView® 8.x, ArcEditor™ 8.x, and ArcInfo™ 8.x. These products have the same interface and share much of their functionality. ArcEditor does everything ArcView does and goes beyond it; ArcInfo goes beyond ArcEditor. *Getting to Know ArcGIS Desktop* does not cover features unique to ArcEditor or ArcInfo, but because the three products have the same foundation, the book is an introduction to all three.

If you are new to ArcGIS Desktop software, and even if you have some experience, this book will be useful to you. If you are an ArcView 3 user, you will find some familiar elements in the new software, but a great deal that is different—beginning with the interface. ArcView 8 is not an updated version of ArcView 3, but a different product.

This book comes with two CDs. One has a fully functional copy of ArcView 8 software that expires 180 days after you install it; the other has exercise data. You need to install both CDs to do the exercises in the book. (If you already have a copy of ArcView, ArcEditor, or ArcInfo, you need only to install the data.) Appendix B tells you how to install the software and data.

Getting to Know ArcGIS Desktop is not a GIS textbook. If you have no GIS background, chapter 1 explains some concepts that will better prepare you for the exercises, but the book's purpose is to teach software, not theory. It is designed for practical uses, such as classroom lab work or on-the-job training.

The book has two introductory chapters and seventeen exercise chapters. Each exercise chapter contains two to four exercises that show you how to accomplish a particular GIS task in a realistic context. Many different tasks are covered, including symbolizing and labeling maps, classifying data, querying maps, analyzing spatial relationships, setting map projections, building spatial databases, editing data, geocoding addresses, and making map layouts. An online exercise teaches you how to use Geography Network℠, a Web site where you can bring maps and data from the Internet to ArcView.

You can save your work at the end of each exercise, but every new exercise is another starting point, with the maps and data you need already prepared for you. It is recommended that you follow the chapters in order—especially because tools and functions used frequently in early chapters may not be explained again in later ones. The exercises will work no matter which chapter you start with. We estimate it will take one to two hours to complete a chapter.

Getting to Know ArcGIS Desktop is an introductory book. While it doesn't teach you everything about ArcView 8, it teaches you much of what you'll need to know to complete your own GIS projects.

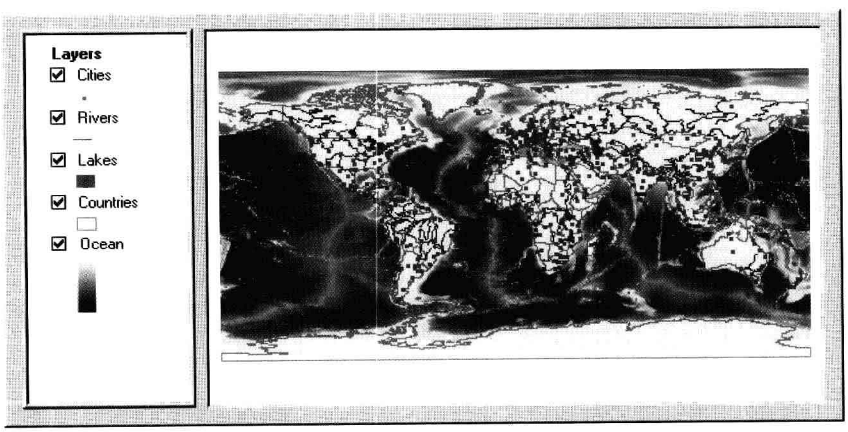
CONTENTS

Introducing GIS

For a long time, people have studied the world using models such as maps and globes. In the last thirty years or so, it has become possible to put these models inside computers—more sophisticated models into smaller computers every year. These computer models, along with the tools for analyzing them, make up a geographic information system (GIS).

In a GIS, you can study not just this map or that map, but every possible map. With the right data, you can see whatever you want—land, elevation, climate zones, forests, political boundaries, population density, per capita income, land use, energy consumption, mineral resources, and a thousand other things—in whatever part of the world interests you.

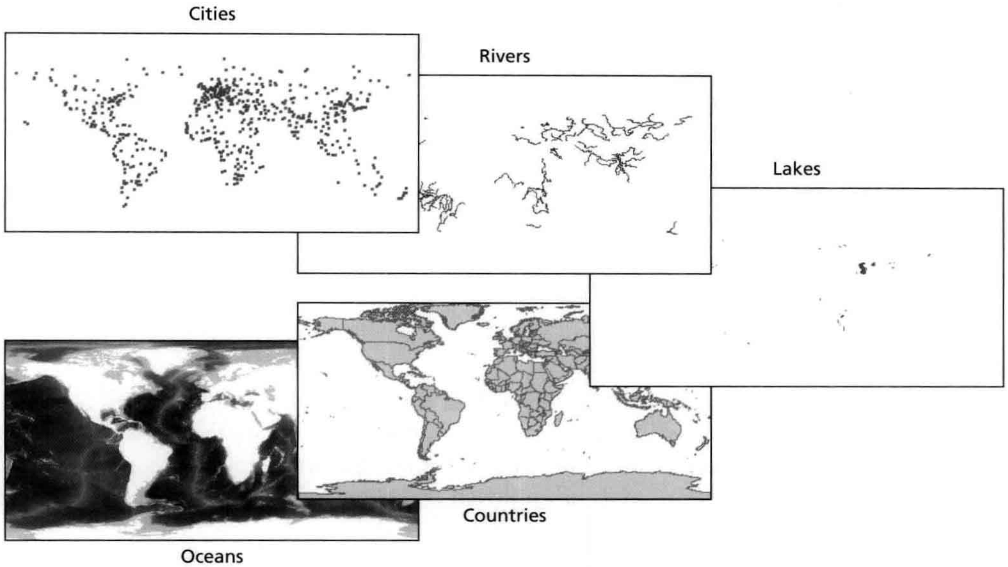
The map of the world, below, shows countries, cities, rivers, lakes, and the ocean.



The map has a legend (or table of contents) on the left and a display area on the right.

A GIS map contains layers

On a paper map, you can't peel cities away from countries, or countries away from the ocean, but on a GIS map you can. A GIS map is made up of *layers*, or collections of geographic objects that are alike. To make a map, you can add as many layers as you want.



This world map is made up of five layers. It could have many more.

Layers may contain features or surfaces

In this map, the Cities layer includes many different cities and the Rivers layer many different rivers. The same is true of the Lakes and Countries layers. Each geographic object in a layer—each city, river, lake, or country—is called a feature.

Not all layers contain features. The Oceans layer is not a collection of geographic objects the way the others are. It is a single, continuous expanse that changes from one location to another according to the depth of the water. A geographic expanse of this kind is called a surface.

Features have shape and size

Geographic objects have an endless variety of shapes. All of them, however, can be represented as one of three geometrical forms—a polygon, a line, or a point.

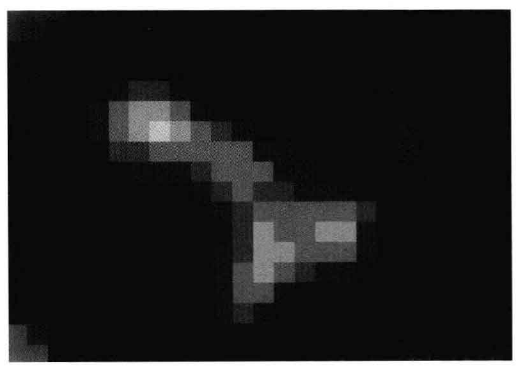
Polygons represent things large enough to have boundaries, such as countries, lakes, and tracts of land. Lines represent things too narrow to be polygons, such as rivers, roads, and pipelines. Points are used for things too small to be polygons, such as cities, schools, and fire hydrants. (The same object may be represented by a polygon in one layer and a line or a point in a different layer, depending on how large it is presented.)

Polygons, lines, and points collectively are called vector data.

Surfaces have numeric values rather than shapes

Unlike countries or rivers, things such as elevation, slope, temperature, rainfall, and wind speed have no distinct shape. What they have instead are measurable values for any particular location on the earth's surface. (Wherever you go, for instance, you are either at sea level or a number of meters above or below it.) Geographic phenomena like these are easier to represent as surfaces than as features.

The most common kind of surface is a raster, a matrix of identically sized square cells. Each cell represents a unit of surface area—for example, 10 square meters—and contains a measured or estimated value for that location.



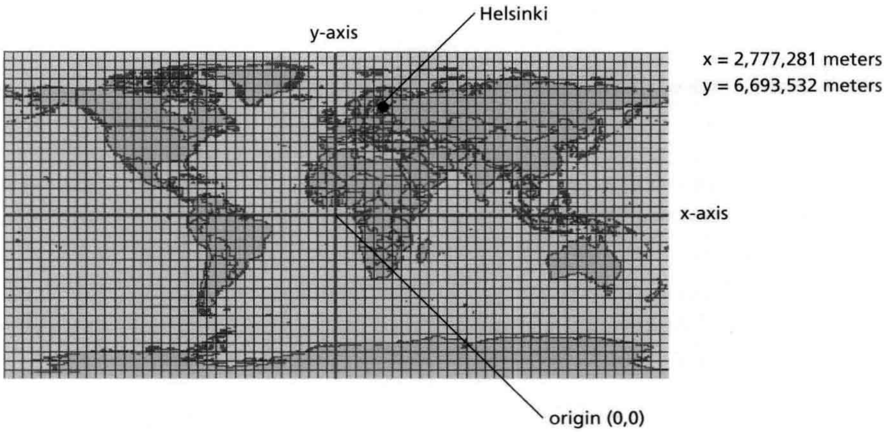
A close look at this raster of ocean depth shows that it is composed of square cells. Each cell holds a numeric value.

The world is not divided neatly into features and surfaces. Many things can be looked at either way. For example, polygons are often used to mark the boundaries of different vegetation types in a region, but this implies that the change from one type to another is more abrupt than it probably is. Vegetation can also be represented as a raster surface, where each cell value stands for the presence of a type of vegetation.

Features have locations

If you were asked to find Helsinki, Finland, on a map of the world, it probably wouldn't take you very long. But suppose Helsinki wasn't shown on the map. Could you make a pencil mark where it ought to go?

Now suppose you could lay a fine grid over the world map and you knew that Helsinki was a certain number of marks up from and to the right of a given starting point. It would be easy to put your pencil on the right spot. A grid of this kind is called a coordinate system, and it's what a GIS uses to put features in their proper places on a map.

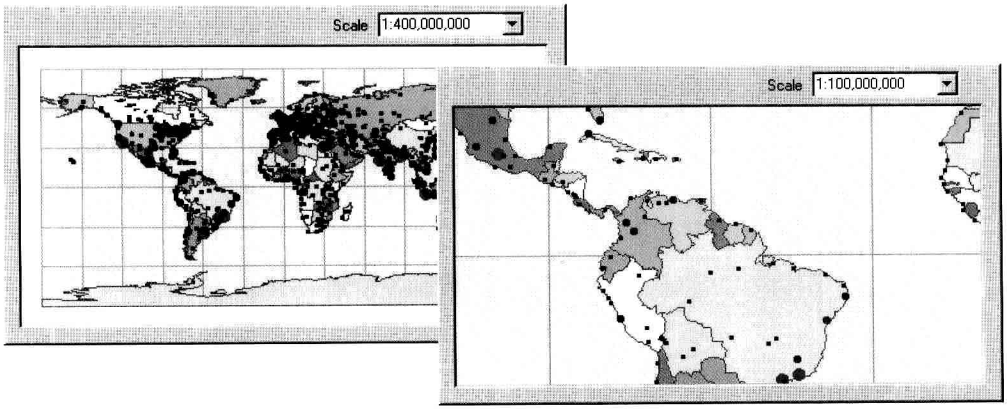


On a map, a coordinate system has an x-axis and a y-axis. The intersection of the axes is called the origin. Feature locations are specified by their distance from the origin in meters, feet, or a similar unit of measure.

The location of a point feature on a map is defined by a pair of x,y coordinates. A straight line needs two pairs of coordinates—one at the beginning and one at the end. If the line bends, like a river, there must be a pair of coordinates at every location where the line changes direction. The same holds true for a polygon, which is simply a line that returns to its starting point.

Features can be displayed at different sizes

On a GIS map, you can zoom in to see features at closer range. As you do so, the scale of the map changes.



Left: the scale is 1:400,000,000 and the entire world is shown. Right: the scale is 1:100,000,000 and you see part of South America and Central America.

Scale, commonly expressed as a ratio, is the relationship between the size of features on a map and the size of the corresponding places in the world. If the scale of a map is 1:100,000,000, it means that features on the map are one hundred million times smaller than their true size.

Zooming in gives you a closer view of features within a smaller area. The amount of detail in the features does not change, however. A river has the same bends, and a coastline the same crenulations, whether you are zoomed in and can discern them or are zoomed out and cannot.

How much detail features have depends on the layer you use. Just as a paper map of the world generalizes the shape of Brazil more than a map of South America does, so different GIS layers can contain more feature detail or less.

Features are linked to information

There is more to a feature than its shape and location. There is everything else that might happen to be known about it. For a country, this might include its population, capital, system of government, leading imports and exports, average rainfall, mineral resources, and many other things. For a road, it might be its speed limit, the number of lanes it has, whether it is paved or unpaved, and whether it is one-way or two-way. There is a great deal of information to be had about any feature, from a humble length of sewer pipe to an ocean.

Information about the features in a layer is stored in a table. The table has a record (row) for each feature in the layer and a field (column) for each category of information. These categories are called *attributes*.

Attributes of Countries

Shape	OID	NAME	ENERGY PERCAP	NET MIGRATION	URBAN PCT	GREENHOUSE
Polygon	186	Romania	84.12	-0.60	58.21	27.52
Polygon	189	Russia	179.76	1.02	77.68	405.04
Polygon	190	Rwanda	1.64	-2.46	6.16	0.20
Polygon	245	Samoa	11.93	-11.59	21.67	0.04
Polygon	200	San Marino	-99.00	11.62	96.30	-99.00
Polygon	221	Sao Tome and Principe	8.14	-3.62	46.26	0.02
Polygon	191	Saudi Arabia	206.86	1.36	85.74	63.82
Polygon	196	Senegal	5.92	0.00	47.00	1.02
Polygon	204	Serbia and Montenegro	67.32	6.26	59.86	15.25
Polygon	194	Seychelles	93.24	-6.30	58.44	0.14
Polygon	199	Sierra Leone	2.56	10.61	36.65	0.24
Polygon	201	Singapore	334.36	26.80	100.00	25.93
Polygon	132	Slovakia	135.18	0.53	61.11	11.60
Polygon	198	Slovenia	154.45	1.75	52.62	4.48
Polygon	28	Solomon Islands	5.69	0.00	19.59	0.04
Polygon	202	Somalia	1.21	0.00	27.49	0.16

Record: 0 Show: All Selected Records (0 out of 252 Selected.) Options

The attribute table for a layer of countries includes each feature's shape, ID number, and name, among other things.

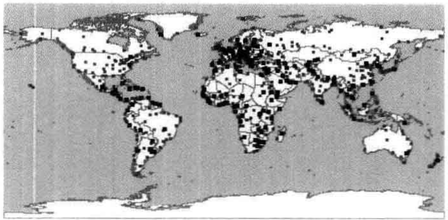
Features on a GIS map are linked to the information in their attribute table. If you highlight China on a map, you can bring up all the information stored about it in the attribute table for countries. If you highlight a record in the table, you see the corresponding feature on the map.

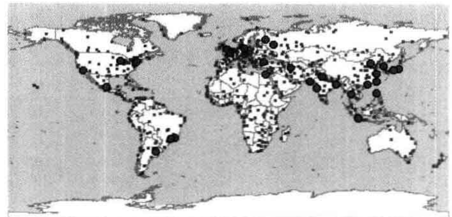
Attributes of Countries

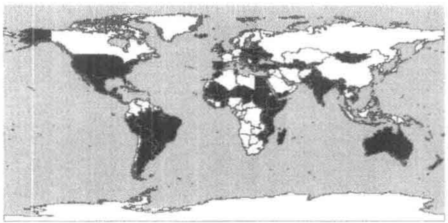
Shape	OID	NAME	ENERGY PERCAP	NET MIGRATION	URBAN PCT	GREENHOUS
Polygon	50	Central African Republic	1.48	-1.42	41.19	0.08
Polygon	37	Chad	0.34	0.00	23.79	0.05
Polygon	42	Chile	59.69	0.00	84.60	14.29
Polygon	41	China	29.46	-0.40	34.34	740.38
Polygon	124	Christmas Island	-99.00	-99.00	-99.00	-99.00
Polygon	44	Cocos (Keeling) Islands	-99.00	-99.00	-99.00	-99.00
Polygon	47	Colombia	31.30	-0.33	74.94	17.58
Polygon	46	Comoros	2.23	0.00	33.14	0.02
Polygon	40	Congo, Democratic Republic of	2.60	0.82	30.28	0.49
Polygon	39	Congo, Republic of	7.39	0.00	62.56	1.87

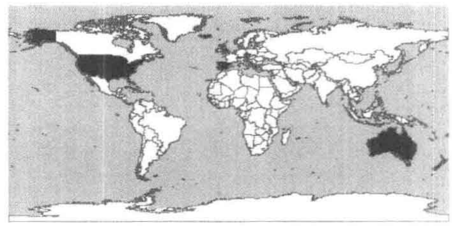
Record: 48 Show: All Selected Records (1 out of 252 Selected.) Options

The link between features and their attributes makes it possible to ask questions about the information in an attribute table and display the answer on the map.


Which cities are national capitals?

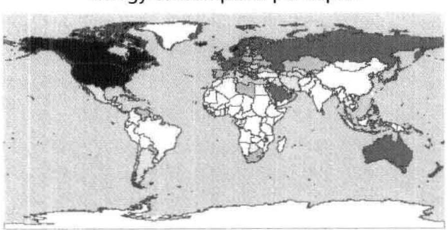

Which cities have populations over five million?


Which countries are net importers of goods?

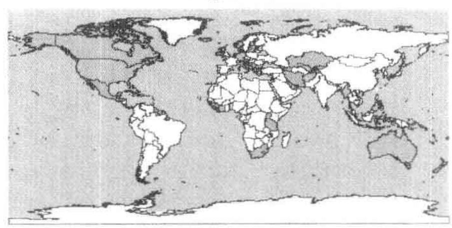

Which countries are net importers of goods and have per capita GDP of $10,000 or more?

Similarly, you can use attributes to create *thematic maps*, maps in which colors or other symbols are applied to features to indicate their attributes.

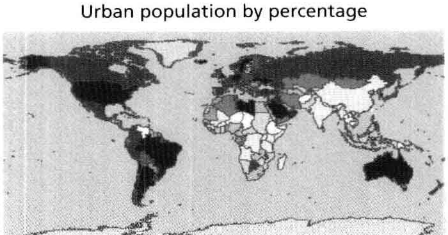
Energy consumption per capita


The darker the shade of brown, the more energy is used per person in each country.

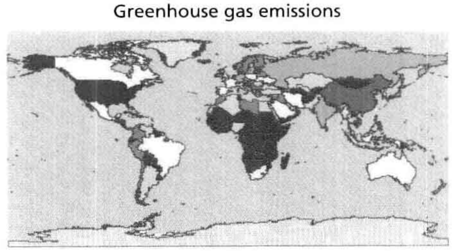
Migration


Red countries have net emigration, blue countries have net immigration. Yellow countries have little or no change.

Urban population by percentage


Darker shades of purple show countries where a higher percentage of the population lives in cities.

Greenhouse gas emissions


Greenhouse gas emissions are lowest in green countries, higher in yellow and orange countries, and highest in red countries.