Using Geographical Information

Are you going somewhere in the next few days?

Have you thought about how you are going to get there?

Have you thought about what might be there when you arrive?

Geographical information systems like Google Maps and Google Earth can answer these questions and, with a little work on your part, many more. They enable your computer to think about information in terms of a physical, real-world location and then associate data with that location.

Understanding Your Location

When you think about your current location — whether you're at home, at work, or even at the beach — do you realize how often you think about what is around you? If you were able to monitor your every thought, you'd probably be surprised at how often you consciously and subconsciously think about your environment.

Mapping a Location

Humans, on the whole, are very spatial creatures. We frequently think about and mentally map the information, places, and items around us — from the smaller things, such as curbs and sidewalks, to the larger components, such as the locations of mountains, buildings, and even entire towns and cities. But many humans take for granted the ability to locate and produce a mental map of where we are and where we want to go. (Some of us are better at this than others, mind you!)

Typically, the human brain collects information while simply walking or driving about. Subconsciously, and sometimes consciously, it's fairly common to think about the following:

- Locations of restrooms, police stations, information booths, and other useful places.

- Locations and names of restaurants or coffee bars.

- Interesting-looking buildings or places (such as castles, ruins, or statues).

- Routes to and from locations, including identifying whether a pathway meets up with a past location (somewhere you have been before).

You don't always, however, want to investigate an area and make a mental map of all this information. Suppose, for example, that you want to find a restaurant within a few blocks of your current location. Determining this information by walking about and collecting the data could take hours, by which time you would be much hungrier than when you started — and you still may not have found what you were looking for.

This is why Google Maps and Google Earth are so useful. At their core, they provide mapping (Google Maps) and aerial photography (Google Earth) of many areas of the planet. In addition, Google Maps connects the location information with data about businesses and other sites in the local area, allowing you to find all the restaurants or copy shops or any other type of business within a given area.

As a further expansion of the technology, Google Maps enables you to create applications that combine the mapping or earth information with your own set of data so that you can build customized views of information, all mapped to the geographical location of the items.

This technology can be used for a number of purposes, including (but not limited to) obtaining the following information:

- **Localized data:** You can find all of the restaurants (or any other type of business you choose) within a few miles of exactly where you are now.

- **Maps and routes:** You can find out where you are now and then how to get to other places.

- **Topographical views:** You can get an idea of exactly where you are in relation to other components, such as hills or ruins.

- **Relation of locations to photographs:** You can work out where you were standing and in which direction you were pointing the camera when you took a particular photograph.

- **Statistical data:** You can describe statistical data (such as population levels) by showing it graphically on a map, rather than by providing a basic list.

To make the best of this functionality, however, you need to change the way you think about your environment.

Defining a Location

You can describe your current location in several ways, usually depending on the level of civilization in your vicinity.

With an Address

Suppose you are interested in the National Maritime Museum in Greenwich, London. To write to the museum, you would use this simple address, along with the postal code SE10 9NF. (Postal codes are known by the post office and indicate a more specific location than just the town or city.)

But if you are on the ground and need to actually locate the building for a visit, you need something more specific; Greenwich is too large a district to have to search on foot. You need a street name (in this case, Park Row) in order to locate the museum's precise position. Having this information will help you find the correct street sign (if you already happen to be in the vicinity) or look up the street on a map.

Both of these address options — using just the postal code and using the full street address — have meaning only because the city of Greenwich has well-defined locations, identified in a format that humans can easily understand. They are useful only if you know where a location is in terms of other places (for example, the street name "Park Row" is useful only if you know it is the Park Row in Greenwich, London) and if you have a well-indexed map that shows you that location.

Without an Address

But what about areas that are neither subject to human habitation nor blanketed by roads, such as the Lake District in England or Yellowstone National Park in the United States?

In these situations, assigning an address is basically impossible. A much better solution is to use a map grid reference. Grid references give you a two-dimensional reference (horizontal and vertical) for a given location and are unique to the map you are using. Within the confines of a single local map, a reference like A6 or TQ 387 776 GB Grid (the Ordinance Survey grid reference for the museum) works quite well.

In a global environment, the grid reference is the combination of longitude and latitude. Longitude is the number of degrees, minutes, and seconds east or west of the prime meridian line. Latitude is the number of degrees, minutes, and seconds north or south of the equator. The combination of the two gives you a precise east/west and north/south location on the earth. Each half of the earth has 180 degrees.

The National Maritime Museum is on the prime meridian point, which is the home of Greenwich Mean Time and the reference point for longitude references and time differences between countries. Its longitude is, therefore, 0° 0' 0". Because the museum isn't on the equator, its latitude is 51° 28' 38".

Normally, however, you quote only degrees and minutes (not seconds) in the longitude and latitude references. Thus, the location of Greenwich is 51.28N 0E. For Washington, D.C., use 47.30N 120.30W; for Beijing, 39.55N 116.20E; and for Jakarta, 06.09S 106.49E.

Note Each of the references discussed in this section is useful in its own way, and you'll use all of them as a method for identifying information. Remember to consider them when you look at different data types and think about how you can map them to geographical locations. Also make sure to take into account the direction in which you are facing when you orient yourself on a map. Because your orientation affects what you can see, it becomes important when you build applications that can use this information.

Moving to Another Location

Once you know current location and the location of your destination, you need to work out the best route between them. Movement between locations is generally either direct (commonly referred to as "as the crow flies") or via roads. Once again, the environment will likely determine the route you choose.

If you are on foot or in the car and within a city, you will probably follow the road to your destination. The likelihood of being able to walk directly through a building (let alone drive through it!) is not great.

Within the countryside, especially if you are on foot, a more direct route (as opposed to traveling by road) will save you a lot of time. When traveling by plane, you'll probably use the direct route, as well.

Knowing how you are going to move between different locations is important when using geographical systems. You need this information not only to move between the areas, but also to gain information about your environment (for example, the distance between two points or the total area).

Thinking in Terms of Geographical Location

The first step in making use of geographical information is to change the way you think about the word "information" in general. You need to think about information in terms of how it relates to its geographical location, rather than as the simple data it may describe. To do this you must change the key you use to identify the information.

To Find Places

Imagine that you are stranded on the main street of a typical town, such as my hometown of Grantham. Although you know where you are, you are clueless about your surroundings. You do, however, have access to a computer.

The first rule of survival is to find something to eat, so you do a search on one of the various business directories on the Internet and find a list of restaurants easily enough. Table 1-1 shows a list of some of Grantham's restaurants and their addresses.

The list treats the information you've gained as simply a list of restaurants and their addresses. To make use of information in this format, you either need to know Grantham and its streets really well or you need a map in order to make heads or tails of the addresses. You would then need to use both the list and the map to work out in which direction you need to begin walking and when and where you need to turn left or right.

If you aren't familiar with Grantham, reordering the list by location — the most important piece of information — and combining that list with your map of Grantham would be much more useful, especially if you can show the location of the restaurants relative to your own.

Table 1-1: Restaurants in Grantham

Restaurant	Location
Manthorpe Road Fish & Chip Shop	25 Manthorpe Road
The Market Cross Fish Bar	9 Market Place
Sorrento's	11 Market Place
Catlins	11 High Street
Nicklebys Restaurant	41 The George Shopping Centre
China Inn	4 Avenue Road
Knightingales	Guildhall Court Guildhall Street
Hop Sing	Tudor House, 21 Westgate
Relax Fish Bar	71 Westgate
One on Wharf	1 Wharf Road

To Identify Photo Subjects

During a recent trip to New York City, my wife and I were amazed by how Manhattan doesn't feel like an island when you are on the ground. That perception has a number of effects, one of which is that you can walk for miles around the island, visiting different places, without ever getting a really good perspective on where you are in relation to other places you've visited.

The same can be true of photos: People tend to define the photographs they take in terms of the subject of the photo or the name of the site, and not by the relationship between that location and another one.

To illustrate the difference, I photographed the Brooklyn Bridge from two different locations. Figure 1-1 shows a photo I took of the bridge while standing on Manhattan Island.

If you aren't familiar with Grantham, reordering the list by location — the most important piece of information — and combining that list with your map of Grantham would be much more useful, especially if you can show the location of the restaurants relative to your own.

Figure 1-2 shows another photo I took of the bridge, this time from the Staten Island Ferry.

Both photos show the same object, and I could describe them as merely that: pictures of the Brooklyn Bridge. The problem is that, although both photos show something interesting, neither the generic description nor the photos themselves give you an idea of the relationship between the photos.

FIGURE 1-1: The Brooklyn Bridge from its base.

FIGURE 1-2: The Brooklyn Bridge from the Staten Island Ferry.

The same can be said of any set of photos that show the same subject. For example, photos of a property don't always give you an accurate impression of a house or building because you don't necessarily know from where the photo was taken, which direction the photographer was facing, or what the content of the photo is in relation to other photos that might be in the same file.

If you treat the photos as merely a record of your visit and describe them with meaningless terms (that is, a description of *what* the photo is, rather than *where* it is), you lose some of the most valuable information about the photo.

By thinking about photos in geographical terms (where they were taken, the direction you were facing) and combining this information with a map of the location (in this example, Manhattan), a vacation photo can become more than just a shot of a famous landmark.

To Understand Statistical Data

My wife and I arrived in New York City the weekend that Hurricane Katrina hit the Gulf Coast of the United States. The results of the hurricane were devastating. But hearing the results, or even seeing the interviews and reports "on the ground" about the effects of the hurricane on New Orleans and the surrounding areas, wasn't anywhere near as informative as the satellite images of New Orleans, taken before and after the hurricane hit. Through the Google Maps and Earth service, Google provided the images that showed these differences (see Figure 1-3).
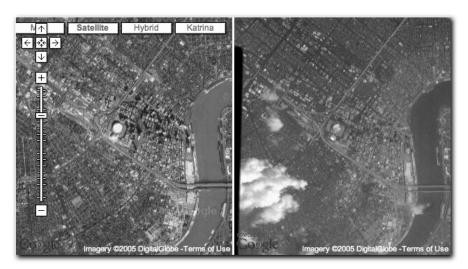
FIGURE 1-3: New Orleans before and after Hurricane Katrina.

Equally instructive were the maps showing the predicted route and, later, the actual route that the hurricane took. As successive hurricanes hit the Gulf Coast of the United States that fall, these maps became a vital method for individuals, companies, and government, emergency, and weather organizations to work out the probable location of landfall.

With a visual representation of the actual or predicted location of the storm, individuals could easily identify, at a glance, where the storm would be at a later time. This made the other information (number of miles off the coast, the towns and cities being affected, and so on) easier to understand.

A picture is worth a thousand words, which is why graphs and geographical data are combined in a variety of situations. Votes in elections, population data, plant and animal areas, even the migration routes and quantities of birds can all be described by marrying map data with the statistical information.

To Generate Data from Maps

While my wife and I were in New York City, we did a lot of walking — using the subway would have robbed us of the ability to view our surroundings and enjoy the city's architecture. On one particular day, we walked to Soho, from there to the Brooklyn Bridge, then around the bottom of Manhattan, across to the Staten Island Ferry, back again, and then back up to our hotel.

In the past, determining how far we'd walked would have been difficult without using a map, retracing our route, and then possibly using a piece of string and some quick math based on the map's scale to determine the distance. Using a Google Maps application, though, I was able to quickly determine exactly how far we had walked. I generated that data using information I'd gained from the map.

In this case, the translation of information into geographical representations is not what proved to be the most useful — the map data itself, in combination with some data points (the streets and places we visited), provided me with the information I needed.

Wrapping Up

Now you know several ways in which a location can be defined, as well as how important it is to think about information in relation to its geographical worth. To learn how to produce applications that convert information and portray it in geographical terms, read on!