Data Models, Queries, Evaluation

Storing data is not the main purpose of databases. The Internet is a data store but not a database. Library information systems are also data stores but not databases. Both Web browsers and library information systems can be queried using key words or phrases, but database queries are different. While Web browsers always return only existing webpages, database queries can create new information that is not stored in the database, although it is logically implied by the stored data. Retrieving stored data is relatively easy. To discover new knowledge is an enduring challenge. The main purpose of databases is to aid knowledge discovery. Even the simplest database system described in this book can aid in deriving new information that did not exist before.

Section 1.1 gives some example data that need to be stored in databases. Many details of the stored data are uninteresting for the users. Section 1.2 describes some essential features of database queries. Section 1.3 describes query evaluation within database systems.

1.1 Data Models

Many applications require the simultaneous use of several different types of data, such as the following:

Chart: Charts show continuous curves or discrete bars and are used to visually illustrate the relationship between two variables. For example, the chart in Figure 1.1 shows the relationship between total income on the $x$-axis and tax due on the $y$-axis.
Graph: Graphs are defined by nodes and edges between pairs of nodes. The nodes and the edges can be labeled or unlabeled. The edges can be directed or undirected. For example, the graph in Figure 6.6 represents the fastest possible travel times between pairs of cities in the midwest United States.

Map: The maps are commonly used to present geographic data, that is, data concerning phenomena occurring on the surface of the earth. Chapter 6 describes geographic databases.

Drawing: By drawings we mean simple black-and-white sketches of pictures. An example drawing of a bird is shown in Figure 1.1.

Video: For moving objects the best presentation is some form of video. This is especially important for spatio-temporal objects with a shape that is a spatial extent in either two or three dimensions and that keeps changing over time.

Sound: Sound is an important type of sensory information. Sound, such as human speech, frequently accompanies videos, but sound can be important in itself. For example, music is an especially sought after type of data.

The above list of different types of data can be continued without end. There are many specialized types of data that are important to particular