node and those existing in the system. Each node contains not only a text itself, but also its representation in the form of a semantic network. One of the advantages of semantic networks is the simplicity with which logic can be performed to answer questions. A query to the system is written in terms of a network fragment, and the semantic network is then searched for a pattern matching the query fragment. If a matching pattern is found, the answer may be explored by following arcs away from the matching pattern. Note that a search that uses a semantic net avoids the type of ambiguities that had sometimes occurred (as illustrated by the well-known example "Venetian blind" versus "blind Venetian"). Obviously, these statements will have different representations. The proposed search method has many other principally new features. First, it is possible and perhaps expedient to output a set of found text segments (commonly called hypertext) instead of the documents themselves that contain the found ideas. Second, while reading the hypertext, the user may arrive at a new IN, and the search can be readily continued.

However, real implementation of such a knowledge base is still a long way off. Today, many theoretical and practical problems connected with both semantic networks and their implementation await solution. As a matter of fact, this direction of AI research is in its early phase, and it is not yet time to consider its practical utilization in IR systems.

From the standpoint of the AI researchers, a direction of development commonly called neural network looks much more interesting and promising. *Neural networks* are physical cellular systems that can acquire, store, and utilize experiential knowledge (Zurada, 1992). The knowledge is in the form of stable states or mappings embedded in networks that can be recalled in response to the presentation of cues.

A neural network's ability to perform computations is based on the hope that we can reproduce some of the flexibility and power of the human brain by artificial means. Network computation is performed by a dense mesh of computing nodes and connections. They operate collectively and simultaneously on most or all data and inputs. The basic processing elements of neural networks are called *artificial neurons* or nodes. Neurons perform as summing and nonlinear mapping junctions. In some cases, they can be considered as threshold units that fire when their total input exceeds certain bias levels. Neurons usually operate in parallel and are configured in regular architectures. They are often organized in layers, and feedback connections both within the layer and toward adjacent layers are allowed. Each connection strength is expressed by a numerical value called *weight*, which can be modified.

One of the most attractive aspects of the utilization of neural networks is their ability to self-organize and self-learn, which has been examined in a number of publications (see, for example, Zurada, 1992). Furthermore, the search process itself in such networks can be very rapid. It was these features that first interested the researchers developing IR systems. As an example, we will examine an interesting approach developed by Kwok (1989).

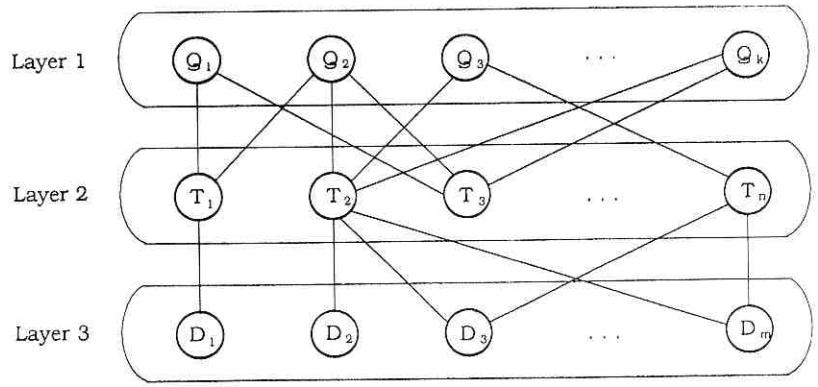

Figure 12.2
Three-layer network.

Kwok proposed utilizing, for information retrieval purposes, a three-layer network (Figure 12.2).

Nodes in Layer 1 are search requests, those in Layer 2 are descriptors, and those in Layer 3 are documents. The existence of connections is defined by the presence or absence of a descriptor in an item. Nodes of the search request and document layer serve both as input and output. In other words, in response to each search request relevant documents can be found, and for each document corresponding queries can be determined (for example, in systems performing SDI). This is precisely why query layer and document layer are bidirectionally connected with asymmetrical weights to the descriptor layer. To calculate weights, the author uses the probabilistic approach and expects to provide the users with a ranked output.

Basically, such a search arrangement is quite possible, and its drawbacks, which are mostly based on the probabilistic approach itself, are criticized in quite a number of well-known publications. In spite of this criticism, the first steps in the utilization of neural networks look quite promising.

In discussing the use of AI in developing IR systems, it is worthwhile to consider the attempts of applying to IR systems the typical methods and approaches of different AI fields, such as expert systems, machine learning, and automatic reasoning (see, for example, Daniels & Rissland, 1995; Kupiec, Pederson, & Chen, 1995; Yang, 1994; and Zahir & Chang, 1992). Most of the articles describing these attempts concentrate on the following two directions. One group of researchers is concerned with simplifying representation of the information found by the user (this was mentioned in Chapter 3), and the other group seeks to develop new automatic methods for conducting a search and to correct search during the process of feedback with the user.

The attempts to simplify the representation of information belong to the general direction of research that is often called the "intellectualization" of in-