

An Introduction to Expert Systems

By Michael Will, Picodoc Corporation

Human thought is undoubtedly one of the most complex and least understood processes in nature. Thinking about the world is the purview of art and science. Thinking about *thinking* is a somewhat stranger task, tackled by people ranging from psychologists and philosophers to engineers and designers. In computer science, attempts to describe, capture and apply such knowledge are generally grouped into that branch called artificial intelligence, or AI for short.

One of the more mature and successful applications of AI is the Expert System, in which a *knowledgebase* is stored on a computer, and then delivered back to a user through an *inference engine*. This allows one set of people to contribute to the knowledgebase, and a different set of people to use that knowledge. These two groups may be widely separated in time and location, making expert systems a natural application for Internet, wireless and mobile platforms. These technologies have allowed the sharing of information and collaboration between people, now they can be employed to assemble and distribute interactive, expert knowledge as well.

Development

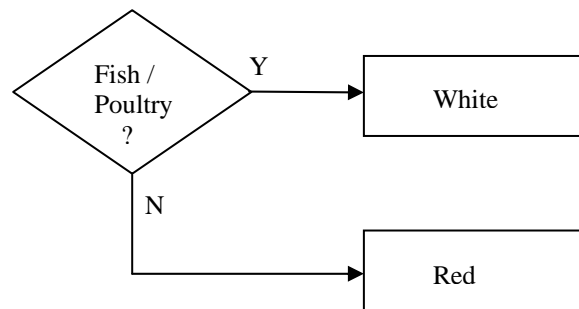
There are many ways to capture, store and retrieve human knowledge. They can range from simple text to sets of logical rules to actually mapping the brain itself as in some types of *neural networks*. An important trade-off must be considered when selecting a preferred approach, namely power versus usability. The more complex and detailed a knowledgebase development tool becomes, the fewer people will be able to use it.

To date, the vast majority of expert system tools have used a rule-based structure. Even with this middle-of-the-road design, however, most people still require extensive training and experience before they can use these tools productively. This fact has historically restricted real world applications to large, expensive projects and discouraged more general use.

Another consideration is collaborative development. Traditionally, expert systems have been built and maintained in monolithic fashion. This 'black box' design can make the results mysterious to users (and even subsequent developers) of the system. To fully exploit their potential, expert systems should be developed in a shared, collaborative environment, open to communication and review.

Rules

Let's take a deeper look at a rule-based expert system, i.e. one in which knowledge is represented as a set of logical rules. A rule consists of an *if-then* statement where a given set of conditions will lead to a specified set of results, or inferences. For example, a wine expert system might take the main course into account before recommending red or white. This expert knowledge is contained within a single, simple rule:



Of course, more intricate and tacit knowledge may require more complex rules, but a good expert system will allow simple rules to be chained together for such purposes. A rule can generally use the results (inferences) of other rules to assemble a list of prerequisites for its own execution. These conditions must all be in place before a rule can be triggered or *fired*.

Using the Expert System

The task of selecting and firing rules falls to the inference engine. This is a largely automatic process, which the user initiates to start an interactive session. The inference engine conducts a dialog with the user, where information flows both ways. At its simplest, this dialog resembles an interactive form, where the user is guided along a path to a solution of a problem or completion of a task. At its best, in a well-designed expert system, this dialog can feel like a conversation between two people.

Expert systems currently find success in areas such as science and engineering, finance, medicine, transportation, and communications. They are also now beginning to appear in corporate enterprise applications such as document management, workflow, help desk, and best-practices enforcement. Some new types of equipment such as photocopiers even include built-in diagnostic experts to save you the cost of a service call. The trend is clear and growing – expert systems are becoming an everyday part of our life.