EXPERT SYSTEMS and ARTIFICIAL INTELLIGENCE

Nathan Goldenthal

Expert Systems and Artificial Intelligence

by

Nathan Goldenthal

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Preface

The ever increasing accumulation of knowledge unfortunately leads to the need for specialization and the creation of "experts." I say unfortunately because a truthful definition of an expert is an individual who knows more and more about less and less. As a result information is lost or neglected that is essential for making a viable decision. The expert's field is too narrow and does not take into account other important facets that lie outside the area of expertise. The fault lies in our society, which demands specialists and is increasingly ignoring generalists. A readily available case in point is the increasing number of malpractice suits that are occurring in the field of medicine. The general practitioner is being forced into extinction by his or her own colleagues and a society that claims that specialization is essential in order to understand the ever increasing data base of medical knowledge. Children are delivered by obstetricians. They are cared for by pediatricians until age fourteen or sixteen, cared for by adolescent specialists until age eighteen and finally by internists thereafter. No longer does the generalist, the General Practitioner, deliver and take care of the individual from birth onward. But more importantly, no longer is there any continuity of care. Malpractice suits commonly occur when the cardiologist treats the patient for angina and forgets to ascertain if the pain may be due to gastric ulcers. The cardiologist's scope is too narrow, too specialized, too *expert.*

The knowledge required for many specialized areas tends to demand years of training or apprenticeship, and thus the expertise is a costly commodity to produce. The concept of an expert's ability being available on a computer, which can emulate an expert consultant, so that others can solve the same kind of problem has increased in popularity. Three factors have primarily lead to this new demand for expert systems:

1) A need to cut fee costs in the use of expert consultants along with the financial advantages available to industry in the direct use and commercial exploitation of such systems.

2) The availability of expert system programs now functioning in the United States and Great Britain described later in this book.

3) The interest that the Japanese have shown in using artificial intelligence and expert system concepts in their new fifth generation computers. Isn't competition wonderful?

The promotions are now everywhere. All homes will soon have expert systems to do the shopping and balance the budget. Human experts will be replaced as all human expertise will be placed into silicon chips. These claims are somewhat exaggerated. Expert systems, although they may hold a vast array of knowledge, do make mistakes and are far from infallible. These systems are sophisticated computer programs that manipulate facts to solve problems in a narrowly defined area. As with real human experts, these expert systems use symbolic logic and heuristics or rules of thumb to find solutions to problems. Unlike other computer programs, several of these expert systems are capable of learning from their mistakes.

This book is designed to meet the needs of those who want to understand the basic concepts of expert systems and actually create several working models. Examples will be given in Turbo Pascal or or Turbo Prolog.

In this book I will discuss several existing expert systems in use today as well as how expert systems are derived, their uses, their differences from other computer programs, the languages used for expert systems and the creation of several actual small expert systems using Turbo Prolog and Turbo Pascal from Borland International.

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Introduction

"Dave, will I dream?." This was the main concern of the Hal 9000 artificial intelligence computer in 2001: A Space Odyssey and in 2010, the sequel. This unique computer exhibited all the traits of what we would expect in a complete AI machine. That is, it had a personality, was able to think and express results in human terms, and had the ability to solve problems without being told how. In other words, Hal had the ability to work and function completely independent of a human operator. And of course these are the very ideals of which nightmares are made.

The Hal 9000 destroyed its crew of humans when it received conflicting information from a human government source. Within its database were the following facts:

1) The Hal 9000 was fully capable of carrying out its mission completely independent of all human interface.

2) The mission was top priority.

3) Orders from Washington directed that the crew must not be apprised of the mission.

4) All personnel, including the ship and Hal 9000 were expendable as long as data from the mission was reliably transmitted.

It was rule number 3 that caused the problem. The crew was to be kept ignorant of the mission; logically as the mission proceeded the crew would become knowledgeable of the facts. This had to be prevented. Rule 1 stated Hal could perform the mission alone and rule number 4 gave the solution to accomplish the goal in rule number 3. Thus Hal underwent an acute emotional trauma based on conflicting and incorrect facts provided by humans. The crew was to be terminated and by being terminated they would not become aware of the facts of the mission. The mission would succeed since Hal could operate independently. In 2010 the cause of the deaths was traced back to human instructions and not directly attributed to Hal. And there lies the problem and the fears. Humans are imperfect and their creations are necessarily imperfect.

Fact or fiction? As of this date still fiction. The Hal 9000 or even the Hal 2.5 is not even a reasonable concept. However, the fear and paranoia are quite real and in evidence. In 1972 the Lighthill Project and Report was closed down due to the with holding of funds when public outcry created fear of computers taking over the world. Science fiction books are full of machines taking over nuclear missile sites and launching their contents without conscience or regret because the human creators neglected certain safeguards in programming.

From its inception in the early 1950's, the concept of Artificial Intelligence has inspired the minds of scientists and brought fear to the minds of the public. A world where all important tasks could be run by the superior machine-mind would free man for the pursuit of greater endeavors such as unemployment. For better or worse AI programmers quickly learned just how difficult it really is to program computers to understand speech or operate an image recognition system that will differentiate between incoming ICBM missiles and a gaggle of geese.

At this point in time artificial intelligence is theoretically confined to the research laboratory with the occasional relevant application emerging. The concept of AI is however being stretched and generally used inappropriately. Industrial robots are programmed to perform a specific function. One cannot ask them to play chess during a lunch break and expect a reasonable game if any. However, one could ask a human worker, and should that worker be familiar with chess, then a good game may follow. Yet time and time again, the term of AI is applied to industrial robots. R2D2 or C3PO of Star Wars fame, they are not.

The concept of artificial intelligence was originally applied to the process of simulating human reasoning in a machine environment. As the realization of these goals was not forthcoming, the concept was continually adjusted until artificial intelligence is now applied to the performance of a task by a machine, where the task is considered to require intelligence. Traditionally, a major area of AI research has been in problem solving. This has generally satisfied the definition since one may argue that all intelligence involves problem solving. And thus today, multiple software packages are emerging, claiming artificial intelligence. These in fact are quite far from the truth. The more honest of these manufacturers will promote their products as expert systems.

The concept of expert systems is not new. Data key books used to abound on book shelves allowing the uninitiated to make an intelligent decision based on existing facts. Key books that allowed individuals to identify trees, or animals all followed a series of steps to reach the final goal. If a dead end was reached then appropriate information was given to allow the individual to backtrack to the correct path. In the tree keys one would follow a series of steps similar to the following:

Page 1
If leaf is green go to page 4
If leaf is red go to page 5

Page 4
If leaf is needle-like go to page 7
If leaf is board-leaf go to page 8

Adventure games are popular computer programs that follow the same format. If one looks closely, you will see an underlying tree structure starting at a base and continually branching out along different paths to reach the final goal.

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