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AN EXPERT SYSTEM FOR FINANCIAL PLANNERS

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ABSTRACT

Expert systems are computer programs which attempt to simulate the thought process of an expert in a particular field. In particular, the programs attempt to use the same rules of logic that an individual would. This paper describes an expert system for the financial planning field. First, characteristics of expert systems in general are discussed. Second, the specifics of this particular system are examined. Last, the pedagogical benefits of students' development of expert systems are investigated.

INTRODUCTION

Since the 1960s, computer software designers have promised to give machines an "artificial intelligence". With this characteristic, machines would have the ability to solve problems much as human beings do -- through a rational, reasoning process. Up to this point, the results have been more than a little disappointing. However, software developers have made enough progress in the last few years that a limited reasoning ability has been given to the machines. The greatest strides have been made in an area called expert systems.

An expert system is a computer program which simulates the reasoning process of an expert in a field, e.g. a doctor, a corporate treasurer, a geologist. Typically, a programmer spends several weeks or months with the expert, trying to determine how the expert arrives at decisions. After observing the expert's actions and asking hundreds of penetrating questions about the decisions made, the programmer designs a computer program which will hopefully arrive at the same decisions as the expert, when provided with the same information.

Expert systems are now beginning to be used in increasing numbers by industry. This paper demonstrates an application which has considerable pedagogical advantages for our students. The system also has the unusual feature of being compatible with Lotus 1-2-3, the most popular over-the-counter software used in business today.

GENERAL FEATURES

Most expert systems are "rule-based" in design --that is, they use decision rules to arrive at their recommendations. These rules may be laws of nature, rules of thumb, experience-based rules, or other types. Almost invariably, they are of the IF-THEN" variety. For example, a principle of finance states that there is an inverse relationship between interest rates and existing bond prices. Thus, a decision rule may take the form:

IF Interest rates are expected to rise,
THEN Prices of existing bonds are expected to fall.

By linking dozens of these decision rules together, a computer program can simulate the thought processes of an individual.

An expert mechanic, for example, might explain: "The first thing that I normally check for is an audible knock or noise in the engine. Over the past 30 years, I have learned to distinguish between the different sounds. If the sound is a dull- sounding thump, I suspect the problem is in the interior part of the engine. If the sound is a high-sounding ping, odds are about ninety percent that the problem is that the valves need adjusting. If the sound is . .

An expert system would ask the user (perhaps an apprentice mechanic) to respond to the question, "Does the engine make an unusual sound?" If the answer is yes, a second question is asked: "Which of the following sounds best describes the noise? A dull-sounding thump, a high-pitched pinging sound,..." If the user responds "a pinging sound", the computer would check its decision rules and find a rule which states:

IF The noise is a pinging sound
THEN The valves need adjusting.

If the sound was a dull thump, the user would be asked a series of further questions to narrow down the problem to a specific part of the engine. The IF-THEN rules would use answers to these questions to eliminate some of the possible problems in the engine. This would continue until only a very few engine problems fit the symptoms. Then the program's user could focus on these few possibilities in order to correct the problem.

Expert systems have three unique abilities relative to conventional quantitative programs:

(1) Expert systems have the ability to handle symbolic as well as quantitative data. Values such as "dull thump" and "ping" have more meaning to a mechanic who may not know what a decibel is, much less have a way to measure it.
(2) Expert systems have the ability to handle uncertainty in the data. It may be difficult to be absolutely certain that a noise is a "ping". Expert programs often provide a "certainty factor" associated with each value. Thus the mechanic might respond that he is 75%

certain that the noise is a "ping".

(3) Expert systems have the ability to handle missing data. In an IF-THEN rule, the condition is either true or false. If data is missing, the expert system may not be able to make a recommendation, but it will not cause the program to crash.

Although it is an oversimplification, it would not be totally inaccurate to think of an expert system as a decision tree which uses non-quantitative data (as well as quantitative). The system has the ability to travel down the tree, then "backtrack" or reverse its direction to search the upper part of the tree for relationships and other possible solutions.

Expert systems are typically constructed in one of two programming languages: either LISP or PROLOG. However, one does not have to be proficient in either of these languages to construct an expert system. Various software companies produce programs called "shells" which act as a translator between the English language and the programming language. Almost invariably, these shells are much easier to learn than the programming language itself and speed the construction process by a factor of several times.

The FINANCIAL ADVISOR

The Financial Advisor is an expert system which uses an "intelligent reasoning" process that determines a personal financial plan for an individual. The program was designed to assist personal financial planners in their evaluation process.

Typically personal financial planners will interview their clients to determine their goals, tolerance for risk, and level of income and expenses. The planner will then take this information back to the office and will run a quantitative analysis on the data. This is often accomplished with the help of an electronic worksheet (like Lotus 1-2-3). The worksheet will determine the individual's cash needs upon retirement, additional insurance needs, savings required for children's college expenses, and numerous other factors. This analysis eventually results in recommendations to the client regarding insurance policies, tax shelters, and other financial products.

However, much of a financial planner's job should be spent analyzing non-quantitative information. For example:

What are the goals of the client?
How much risk is the client willing to assume in his or her investment portfolio?
What tax strategies should the person be following?
What recommendations should be made in planning for the eventual transfer of the estate to the heirs?

Unfortunately, few financial planners are experienced enough to be experts in all of these areas. A recent survey indicates that almost 40% of all practicing financial planners have been in the business less than four years; 70¼ have been practicing less than seven years. Of these planners, 42% had prior experience in the insurance industry and another 18% worked as stockbrokers [11. These positions are primarily sales-oriented in nature and have not traditionally given training in a wide variety of financial planning skills. Thus, the typical planner needs help in assessing the non-quantitative segments of their business.

A primary advantage of an expert system like the Financial Advisor is that it can incorporate the knowledge of a wide range of experts in the field: tax specialists, investment personnel, insurance experts, etc. A second advantage is that it can be designed to communicate with a Lotus 1-2-3 type of worksheet, an area with which the planner is already very familiar. Thus, it offers both expertise and ease of use.

Financial Advisor has several sectors or divisions. Each sector (tax, investments, etc.) has its own set of goals. Figure I at the top of the next page may help you to visualize the overall system. The area enclosed in the dashed line comprises the expert system.

The first objective of the simulation is to gain all the relevant information from the client. Information is gathered through a series of questions which are crucial for planning the client's financial future: information on income, expenses, ages of children, and the like. This process is routine and simply progresses from one question to another.

Once this information is obtained, the information is entered into Lotus 1-2-3 in order to conduct the bulk of the quantitative analysis. The Lotus 1-2-3 worksheet automatically conducts the financial analysis, determines the client's financial needs, and returns the results to the expert system to be further evaluated.

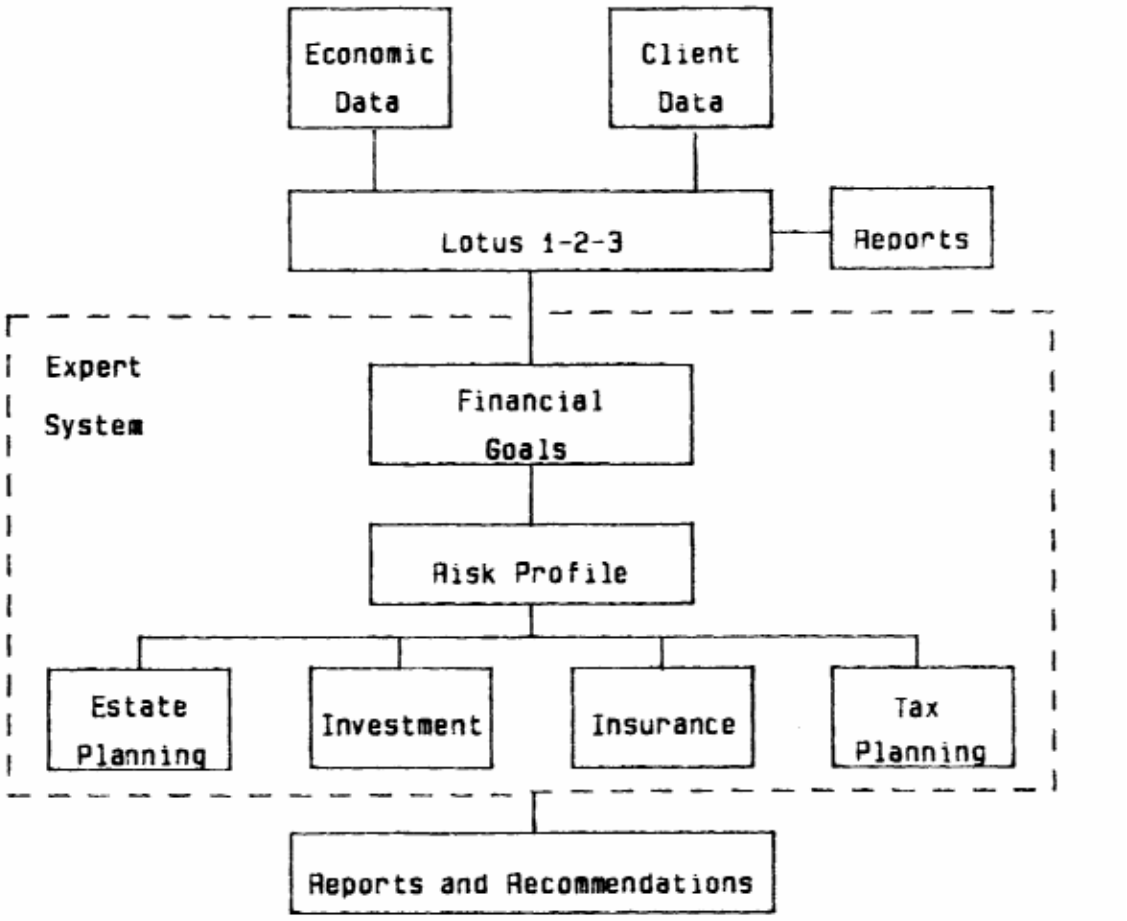
A risk profile is then generated for the client. The purpose of this question is to determine how aggressive or conservative the client is (in a financial sense). The client is asked a series of questions, such as:

> "You are at an auction. The auctioneer is auctioning off a sealed truck. He guarantees you that the contents of the trunk have a marketable value of no less than $100 but no more than $800. How much would you be willing to bid for the trunk?"

The client's answers to a series of questions such as this reveal whether the individual is risk- averse or financially aggressive. This profile is later used to screen potential investments for the client and to eliminate high-risk investments that the client would not feel comfortable with.

The program then progresses to the heart of the program. The user chooses the type of analysis to be conducted next. Assuming the Investment section is chosen, the expert system takes the information from the risk profile and also takes the financial data from the Lotus 1-2-3 analysis. The program then uses a series of decision rules to arrive at a

FIGURE I



recommendation. For example, some sample decision rules would be:

IF The client's current income needs are high,
THEN Consider a bond mutual fund as an investment.

IF The client's need for a liquid savings account is high AND Interest rates are currently rising
AND The client would like check- writing privileges on the savings account,
THEN Consider a money market mutual fund for a portion of the investable funds.

IF The client's tolerance for risk is low,
THEN Eliminate commodities as a potential investment.

The expert system evaluates dozens of rules such as these to narrow the list of suitable investments to those which are appropriate for the client. If the financial planner desires, the program will even make recommendations for specific products such as a particular mutual fund or a specific type of common stock.

As the program progresses down one branch of the tree, it may encounter a "dead end" and will not recommend the type of investment at the end of that branch. If so, it simply backs up, tries another branch, and continues searching until all suitable investments have been found. All recommended investments must help satisfy the client's need for income, ready access, tax goals, as well as having a degree of risk that the client is comfortable with.

The financial planner can then enter another branch of the program, perhaps the Estate Planning section. A search of the decision rules will be conducted to make sure that the client is following all desirable guidelines for wills, minimizing estate taxes, etc. If not, the program will identify those guidelines which are not met, and will make recommendations on the actions necessary to conform to the rules.

The expert system will then progress through the other major segments of the program: taxes and insurance. The client's financial goals are matched with his/her resources. The expert system evaluates these areas just as an expert financial planner would. Since the program is patterned on the expert's logic and thought processes, the program will arrive at the same result as the expert.

The end result of the program is a complete financial plan: one which recommends the monthly savings needed to meet retirement and education expenses, changes in provisions of the client's will, desirable tax strategies, and additional

insurance needed (along with the best type of policy). The client's goals, desires, and fears are taken into account in designing a plan which is tailor-made to the individual.

PEDAGOGICAL FEATURES

Although still in its infancy, expert systems are enjoying a period of rapid growth in business. Programs such as Financial Advisor are designed to be evolving programs, so that students can modify and improve them over time.

Since a formal class in expert systems will not be offered until next semester at our university, the immediate benefits are in the students' thought processes rather than mastery of a skill. In a Financial Seminar class, the students are asked to design a small portion of an expert system (perhaps similar to the part of the Estate Planning section having to do with wills). Their first step is to conduct an impressive amount of library research, learning all that they can about the topic in a short period of time. In essence, they are to become as "expert" as possible in this narrow area. We encourage them to segment the work and to "specialize" in a particular area, if they feel that will be productive.

The students then meet as a group to discuss the library research and to present their findings to the rest of the class. This presentation is primarily in written form but also requires an oral presentation of key findings.

Once the research has been disseminated, we ask that the students (1) identify all relevant questions to be asked, (2) that they reduce these to the crucial, key elements of the analysis, and (3) identify the data needed for the program to evaluate the client's responses to these questions.

Finally, the students are required to construct a series of IF-THEN statements (decision rules) which will handle the client's response to the questions. The students' goal is to have the program arrive at the same decision that an expert in the field would recommend.

There is a considerable pedagogical attraction here. By having to design the expert system's decision rules, the students have to clarify their own thought processes. Designing the rules requires that the students focus only on the key issues and that they discard interesting, but relatively useless, pieces of information in designing their system. They must make sure that they have identified all relevant variables and that this information is available somewhere in the program. (For example, the expert system should ask if there are any beneficiaries whose names have not been entered in the program already.) Finally, they must make sure that the decision rules cover all the possible solutions. (In other words, you want to make sure that the system has a recommendation for all possible outcomes.)

As in true in any "on-hands", active learning process, the students' understanding of the material is greatly enhanced, as opposed to using a more standard procedure of assigned readings, lecture, and testing.

Side benefits to the students include improved small-group communication skills and esprit-de- corp. Developing the simulation requires that a student work very closely with the other three members of the team. In turn, this team has to coordinate its work with the other teams in the class. Since employers consistently criticize college seniors' communication skills, this "side benefit" is not inconsequential.

CONCLUSION

The expert system has a number of advantages for our students.

First, the students gain experience in a technology that will become increasingly important in future years.

Second, the clarity of the students' understanding of the material increases markedly.

Third, the close coordination required for team members in designing the simulation leads to large gains in communication skills and the ability to work with others.

Fourth, a model is being developed which will constantly evolve and provide a role model for development of other expert systems in the future.

Expert systems have unlimited potential to assist businesses in the future. They can be used train new employees, to improve productivity, to conduct marketing research, and any number of other functions. However, they also offer considerable advantages to strengthening the analytical and communication skills of university students who attempt to design these systems.

REFERENCES

1. "Burgeoning Profession Faces Change", USA Today, October 15, 1986, p. B1.