ROLE OF EXPERT SYSTEMS

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INTRODUCTION

Our industry and economy, our health and safety, depend on experts, or more accurately, on knowledge. In knowledge lies power : power to inform, to decide and to control. There are now attempts being made to produce intelligent machines endowed with large amounts of knowledge, together with knowledge handling facilities. If knowledge is contained within computers, then it becomes a commodity which can be sold. The importance of knowledge as a resource, inspires people to build expert systems. An expert system could be defined as :

"An expert system is a programme which has a wide base of knowledge in a restricted domain and uses complex inferential reasoning to perform tasks which a human expert could do."

In a practical context, one of the important features of an expert system is the capability of explanation. In the same way that a human expert should be able to explain his conclusion and reasoning, an expert system should be capable of concise or detailed explanations. Apart from this being one of the characteristcs of experts, there are other reasons why explanation is important. The legal, ethical or moral aspects of decision making still remain with humans and so justification of an answer is an important part of a systems output. At the present time, expert systems are used to aid decision-making, and not to take the full responsibility for it. Perhaps in all domains, this seems desirable. Expert systems should, therefore, be viewed as tools, for use by humans.

Main Features of Expert Systems

The two main features of expert systems which distinguish them from ordinary computer programmes are that they :

i) use Heuristics
ii) are data driven, and not procedure driven.

Experts do not merely follow a set of rules. They have insight into problems and are able to use their professional judgement. Experts generally use heuristics rather than algorithms. In an algorithm, a goal is assumed, and a series of steps carried out which leads to that goal. Brain problems require a solution which is 'adequate' and not necessary the answer. Expertise includes the ability to choose a best path from various possibilities, using the best stimuli from several available. The process involves weighing up the potential outcome of

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effective teachers ?

(3) What is the nature of tasks of an engineering educator; whom are they training and for what tasks ?

(4) What level of competence does he/ she have in his/ her own speciality ?

(5) What are the teachers' own perceptions about the kind of professional training they need to be more effective in their role ?

Answers to these questions will provide a good basis for adequate curriculum design providing appropriate **knowledge, skills** and **attitudes** to the engineering teacher.

The other questions relate to the contents of the training programme and the modus operandi for conducting it. Some of these may be as follows (9).

1. Why is the training programme needed ?
2. What is the focus of the training ?
3. Who are to be trained ?
4. What will be the duration of training ?
5. How and where and by whom will the training be conducted ?
6. Why, how and by whom will the programme effectiveness be evaluated ?

Designing training for wholesome development of professional engineering teachers involves putting together sequences of learning experiences-training modules- in relation to the objectives of the programme.

Some of the elements of such a programme are given below. This list is neither ordered sequentially nor complete, but is based on author's own assessment of the need as an engineering teacher of long standing and as a trainer for Wholesome Development of People (WDP) in industry, Public Sector Organizations, and educational institutions, using principles of HRD and eastern paradigms (10).

-Basic Principles of teaching and learning. Andragogy. Learning as a life long process.

-Learning and Deeper Integrating Principle (DIP). Flow state teaching. Wholesome learning.

-Curriculum design

--Education technology

-Instructional design and method. Experiential techniques, media and materials development.

-Academic Leadership. Multi-disciplinary team project.

-Management of Professional Engineering Institutions. Competencies in Management. Research Management.

-Continuing engineering education; Wholesome professional development; Time Management; Self-Development; Stress Manage- ment and Meditation.

-Quality in Professional Education; values and vision. Infra- structure. How to assess quality ? The Excellent Teacher. Professional ethics.

-Management Development for Engineering Teachers. TQM; HRD; Team Building; interpersonal skills; communication skills; decision making etc.

-Creative thinking, Innovation and Research methodology.

-Human Management Skills. Dealing with student problems. Evaluating students. Entrepreneurship; Teacher/ Researcher as a Consultant and his role.

Presently there exists no

comprehensive educational programme to develop the engineering educator for the above mix of objectives. There is a dire need to set up a system of formal education in this area. Besides such formal education, continuing education and non-formal development will be needed to supplement teachers' own efforts. Self directed development is, what ultimately distinguishes the excellent, highly motivated teachers from the rest.

The formal programme could be a two- semester full- time courses conducted in a few chosen institutions like the T.T.T.I.'s, where the infrastructure has been built over the years for such work. Faculty should include resourse persons from the Industry, HRD professionals, and Professors from National Institutes of Eduction etc. The training programme has to be flexible so that it can develop creativity and innovation amongst participants who should be from different disciplines of engineering, and encouraged to work on a joint project during their formal training. A rigorous aptitude test of the participants is recommended before selection for formal training. It is desirable that only those with aptitude for teaching/ research be selected.

ACTION :

The All India Council of Technical Education (AICTE) ; the Institution of Engineers (India) and the Indian Society for Technical Education (ISTE) can make a beginning in instituting such a programme. In the meanwhile, it is open to others in the NGO sector to take up the challenge and begin a part time programme for motivated teachers who have a deep inner urge to develop themselves. This would go a long way to meet a deeply felt need.

CONCLUSION

A two semester programme for professional training of engineering teachers has been discussed in the paper. The objectives of such a programme and course contents have been spelt out . It is recommended that a part time training programme be instituted by a professional NGO for the benefit of teachers after discussion of this preliminary programme with them.

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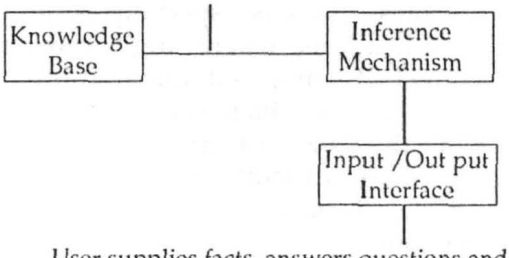
different paths and comparing them with the goal; those which seem to lead to states near the goal are considered to be worth pursuing. If a promising path leads to a dead- end then it may be necessary to go back, or back -track, and try a different alternative. Such



methods are inspired guesses, or rules of thumb, called heuristics.

STRUCTURE OF AN EXPERT SYSTEM

Knowledge from the Expert

The model of basic elements of an expert system comprises of the following :

1) The knowledge base, which contains a representation of the knowledge that is required.
2) The inference mechanism, which is the means by which this knowledge is handled.
3) The input/ output interface, which enables the user to supply facts and data, and enables the system to ask questions or supply advice and explanation.

APPLICATIONS OF EXPERT SYSTEM

Expert systems have been developed for the tasks like : interpretation of laws or rules, diagnosis of illness of fault diagnosis, debugging, corrosion analysis, design and planning. Some of the well known systems are given below :

1) **DENDRAL:** It interprets mass spectrographs, to determine a molecules structure and also its atomic constituents.
2) **MYCIN** : A very famous system which diagnosis meningitis and blood infections and recommends treatment.
3) **PROSPECTOR:** This is used in prospecting for mineral ore; it helps to identify probable sites for good deposites.
4) **PROGRAMMER'S APPRENTICE :** Assists programmers in the tasks of software construction and debugging.
5) **TAXMAN** : A system to interpret tax laws and suggest arrangements that can be chosen to meet financial objections.

PROBLEMS OF USING EXPERT SYSTEMS

The tone of this paper has been fairly optimistic about the potential of expert systems. However, there are number of areas which need consideration if a system is to be useful which include :

Choice of domain :

Some problems are too complex to be served by expert systems. If experts disagree, or a specialists in the domain s not available then the domain is unsuitable. Similarly, so too are problems which take a long time to solve, where there are many interactions or there is a lot of dependence on special relationships, procedures or commonsense concepts.

Acceptability :

Not everyone wants to rely on a

computer or even use one; some people have a resistance to their use and would prefer to deal with human experts. Even the experts are sometimes sceptical about expert systems. This is true even when the systems are performing well and in agreemet with the experts, since they feel that the programmes cannot be using the same sorts of reasoning as they do.

Uncertainty :

Much of data handled by experts is uncertain and data may be missing. The way in which expert systems handle uncertainty tends to be rather adhoc. In fact, this has resulted in severe criticism of the way in which probability theory has been used and the apparent dismissal of other well- established techniques.

Updating :

Domains where the knowledge is changing frequently are not well suited to expert system development. The knowledge base will need updating if the expert system is to retain its expertise. The facilities for updating knowledge bases could be improved.

Limitations :

A human expert knows his limitations. As yet expert systems do not perform very well in this respect. They tend always to produce an answer and thus there is a general tendency to over diagnose. This can be problematic and it should be stressed that they are most sensibly used as tools to assist rather than to replace.

Testing :

Many 'traditional ' computer system are put into operation without being fully tested. 'Bugs' are often found on site while the programmes are in operation. Testing an expert system presents real problems. Developers are not always sure about how systems should behave and so they cannot test them thoroughly. It is not easy to define the paths through an expert system programme, and it is very difficult to test for completeness or correctness. This is especially serious in applications where high risk is involved. Testing and maintaining a system becomes increasingly difficult when the size of the system is increasingly difficult when the size of the system is increased.

Behaviour :

Although the aim of an expert system is that it should imitate a human expert, there are very few which actually do this. Dialogues are usually directed by the programme and explanations can often be difficult to understand. Consultations tend to be programme driven and not user driven, and the user often has to suffer unnecessary explanation or output to obtain an answer.

Knowledge acquisition :

All the knowledge must be acquired before it can be represented, and it is this area which is restricting expert systems development at present.

ADVANTAGES OF USING EXPERT SYSTEMS

The various advantages of using expert systems are as under:

Availabilty

Experts are not born. They have to be trained and then practise. It generally takes over five years for someone to acquire expertise in a particular area. The facts given in books are only a skeleton for knowledge. The practitioner learns from years of experience of dealing with different cases and

learning patterns and principles which really are heuristics or guidelines. These are seldom documented. Declarative knowedge, or the facts is relatively easy to acquire; the procedural knowledge, or how to use those facts, is far more complex.

Consistency :

Even the best human expert can have an off day, wen he is not feeling well. He can make mistakes or may forgot an important point. With a good expert system, mistakes will be rare, but nonetheless they will occur. A programme is consistent. Provided that it is correctly formulated then it will be consistently correct. Apart from hardware failures, there is no reason why a programme should lose information or behave oddly. Once a programme is right, it is right consistently. The problem in developng expert systems is getting the problem 'right' and having the confidence that it is right and ready for use.

Comprehensiveness :

It is very difficult to get the joint opinion of more than one expert, and to get a group of experts to discuss a case and reach a concensus opinion, is almost impossible. An expert can only draw upon his own knowledge and experience. With a computer system, there is no reason why an expert system should not encapsulate the knowledge of more than one expert, so that its decision making is at least as good as any of the individual contributors.

Alternatively, expert systems could consult with each other and offer several options. Much of this remains in the future, and represents our optimistic view when compared with achievements to date, but some systems have been developed which contains knowledge from more than one source.

CONCLUSION :

Expert and other knowledge- based systems are usually composed of atleast a knowledge base, an inference engine and some form of user interface. The knowledge base, which is separate from the interface and control components, contains the expert kowledge coded in some form such as production rules, networks of frames or other representation scheme. The acquisition of expert knowledge for knowledge based systems remains one of the main bottlenecks in building them. This has led to a new discipline called knowledge engineering. Knowledge engineers build systems by eliciting knowledge from experts, coding that knowledge in an appropriate form, validating the knowledge and ultimately constructing a system using a variety of building tools.

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