AI BRIDGES AND DREAMS

Alan Bundy
Department of Artificial Intelligence, University of Edinburgh, Edinburgh, UK

Abstract
This paper is a modified version of my acceptance lecture for the 1986 SPL-Insight Award. It turned into something of a personal credo - describing my view of

- the nature of AI
- the potential social benefit of applied AI
- the importance of basic AI research
- the role of logic and the methodology of rational construction
- the interplay of applied and basic AI research, and
- the importance of funding basic AI.

These points are knitted together by an analogy between AI and structural engineering: in particular, between building expert systems and building bridges.

1 INTRODUCTION
Near my home in Edinburgh are the Forth Road Bridge and the Forth Rail Bridge: two of the great triumphs of the industrial revolution. The Rail Bridge has been in daily use since 1890 (Mackay 1985). 200 trains cross each day. Thousands of cars have crossed the Road Bridge each day since it was opened in 1964. The people in these trains and cars put their lives in the hands of the bridges' designers and builders - nor is this trust misplaced. It would not have been possible to build bridges of this size, nor to place trust in their robustness, were it not for both the art and science of structural engineering.

Today we are in the opening stages of a new revolution: one based on information technology rather than physical technology. I want to talk about one aspect of that revolution: the new discipline of artificial intelligence (AI) and its applications to expert systems.

AI is the building of computer programs which emulate human intelligence, i.e. the striving to create programs that equal or exceed human intelligence without necessarily achieving that intelligence in the same way as humans. In 1986 we are nowhere near achieving that goal, but we can build computer programs that rival human intelligence in narrow areas of expertise, for instance, medical diagnosis or mechanical trouble shooting. Such programs can be commercially useful in medicine, industry, education, defence etc. They are called expert systems.

Our current expert systems are mere footbridges across village streams. Useful for people who like to travel in style, but not essential if you are prepared to get your feet wet. Many disease diagnosis systems have been built, but they are usually for a narrow range of diseases and are not yet in widespread use in hospitals or consulting-rooms. Many companies have built fault diagnosis systems, but these are mostly for in-house use...
on a small piece of machinery. Similar remarks could be made about other kinds of expert systems.

Most of the interest in expert systems is not because of their proven capability, but because of their potential. Many people recognise the tremendous benefits that could be brought to industry, government, medicine, education, voluntary groups and ordinary people in their homes, by the easy and cheap availability of knowledge on a wide range of topics. Particularly so if a computer was available to help you find just the knowledge you wanted and then to help you apply it to your problem.

How many of our problems arise because we are ignorant, e.g. because we do not know how to cure our sickness, or how to become richer, or whether our rights are being infringed, or where to go for help? The information we require is known, but it is hidden from us in legal or medical tomes, or in the heads of professionals. A Third World farmer may have plants decimated by disease, but not know what the disease is nor how to cure it. This knowledge may not be available in the farmer’s village at all, or not at an affordable price. An expert system for diagnosing plant diseases could assist in identifying the disease and curing it for a reasonable cost. Some unemployed people do not have enough money to support themselves. Although they might be entitled to more benefits, they may not be claiming them because they lack access to independent advice.

An expert system on DHSS regulations might advise them on their rights and how to go about claiming them. A group of objectors to a planning application might feel lost in the maze of regulations that they have to cope with to phrase their objections. An expert system might help them locate the relevant parts of those regulations and then assist them in building their case. A small company designing a new widget might not be able to afford the investment in time and effort required to make the widget as efficient, and hence as competitive, as possible. An expert system might assist them in the design by interfacing to mathematical modelling packages, giving expert advice on the design choices etc. thus enabling them to make a competitive product.

It is not a coincidence that my examples all involve the small, the weak and the poor: I believe that these are the groups with most to gain from the provision of cheap information and advice. Expert systems could speed the provision of true equality and democracy. Of course, all new technological advances have the potential for both good and bad applications. I have emphasised the good applications, but the same technology could also be used to take power away from ordinary people and give it to an elite, or even lodge it with the computer systems themselves. We need to be aware of both the potential benefits and dangers of expert systems, and try to encourage the benefits and avoid the dangers. I am an optimist. I believe the good will outweigh the bad - at least in the long term.

Before the benefits of expert systems can be fully realised, more work is required to extend the range of their application, to improve their interface to the user, and to guarantee their reliability. What we need is not just expert systems like village footbridges, but expert systems like the Forth Bridges.

What made the building of the Forth Rail and Road Bridges possible was the development of structural engineering science. The techniques of current structural engineering include a lot of scientific knowledge about the properties of materials and about the way these properties are inherited by composite structures like bridges. This knowledge can be used reliably to predict the behaviour of a large structure without the need to build and test it. Hence it can be used to design a bridge to some specification. It