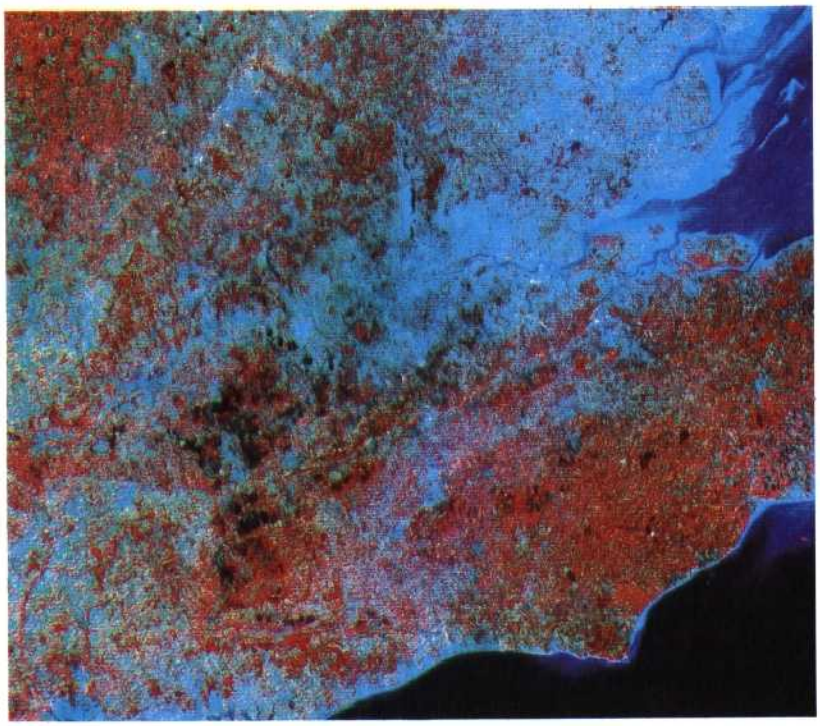
Consulting The Chip

Specialists will soon be freed from routine by 'Expert Systems': computers programmed to analyse complex data and answer questions about it

Artificial intelligence, the creation of computers that think and make decisions like their human creators, is still a science-fiction fantasy. Full understanding of the human brain and its working is a mammoth task and, although some advances are being made there is little prospect of a '2001-style' intelligent computer for many years.



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A View From Space
Landsat 4 was launched in July 1982 and is in an orbit that covers the whole surface of the world returning over the same spot every 20 days. All the data from the sensor is sent in digital form and by using computer techniques objects only 40 metres across can be resolved and geographical features interpreted. In the illustration the digital information has been photographically processed to show aspects of London and the southeast of England. Clear water is dark blue, shallow water with sediments is light blue, towns and ploughed fields are blue-grey, heathland red-brown, corn at harvest green and other vegetation is bright red

But if the task can be limited, if a computer only needs to seem 'intelligent' in a very restricted field of human activity, then reproducing at least the appearance of intelligence becomes much easier.

This is the theory behind expert systems. The idea is that an expert in a particular field, like a top geologist or surgeon, can feed expert knowledge and rules for dealing with it into a computer system. Then the computer program handling the knowledge and the rules is open to enquiry from unskilled people, who can type in questions about its specialist field and receive meaningful answers.

Expert systems could be useful in many ways. One program has already been developed to diagnose the cause of stomach pains by questioning patients about their symptoms. Another uses our knowledge of geology to pinpoint the most probable sites for finding molybdenum or other minerals. And a third deduces likely structures for organic molecules from masses of unstructured experimental data. All these tasks would normally be taken on by a highly and expensively-trained professional scientist. Thanks to the computers these valuable people can now get on with more original work.

But expert systems have something more to offer than simply replacing human experts. Once the specialist knowledge is being used by the program, the computer often throws up some unexpected facts. Sometimes the machine spots relationships between items of information that the humans have missed, and suggests new avenues that can be explored.

So it is generally agreed that expert systems are, or at least will be, an important development in computer applications. If the program in charge of the system works properly, the computer can act like an expert witness. And many computers can use the same program, turning the specialist knowledge of a single person into a large number of equally expert computers.

The obvious problem for the researchers is writing a program that *does* work properly: one that is as 'clever' as a human specialist.

Creating The Program

The first step is to think about how human experts make decisions about evidence and questions concerning their speciality. Human thinking is not particularly logical, certainly not when compared with the way computers work, and it depends very much on experience. If a new problem or question is put before a human expert, it is mentally compared with the large number of other situations the expert has encountered. Then, by comparing the new situation with those already in the memory, some tentative conclusions can be made and the appropriate action taken.

But representing the immensely detailed knowledge of an expert like, say, a doctor in these structures means that an enormous number of rules need to be stored and linked in very complex ways. And further modifications are also necessary if the computer is to mimic human behaviour. Human doctors are rarely certain about anything, and can only say that they are 'almost sure' or 'pretty confident' about an opinion. Based on just a couple of symptoms, our doctor might only be 30 per cent sure of a diagnosis.

So the rules in the computer model have to have probability values attached to their conclusions, ranging from 100 per cent where there is only one conclusion possible to 1 per cent