



Chapter 4

**The Use of Artificial Intelligence
Techniques and Applications
in the Medical Domain**

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In recent years we have witnessed sweeping developments in information technology. Currently, the most promising and interesting domain seemed to be the artificial intelligence. Within this field we see now a growing interest in the medical applications. The purpose of this article is to present a general review of the main areas of artificial intelligence and its applications to the medical domain. The review will focus on artificial intelligence applications to radiology, robotically-operated surgical procedures and different kinds of expert systems.

INTRODUCTION

The true challenge of artificial intelligence lies in the duplication of the mental capacities of ordinary people, such as vision and natural language (the language of speech as opposed to computer language). These actions may seem simple and natural to most of us, but in order to express them on the computer we will require the most complicated algorithms. “The fact that we are able to carry out the complicated act of vision at minimal effort, compared to complicated acts of multiplication, is almost an error of evolution” (Nilsen, 1990).

Indeed, research and development in the field of artificial intelligence mainly focus on the attempt to imitate “basic” human actions such as: speech recognition, vision, and various mechanical actions (assembly, analysis,

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dividing samples into petri dishes, storing professional knowledge and producing it when required expertise).

There are different definitions of artificial intelligence, Charniak's definition (Charniak, McDermott, 1989): "Artificial intelligence is studying mental capacities through the use of computerized models." It is easier to understand the potential value of artificial intelligence when we confront it with human intelligence. According to Kaplan (1994), artificial intelligence has a number of clear commercial advantages over natural intelligence:

- Artificial intelligence is more "steady," as it does not depend on workers' rotation, nor is it based on their memory. It ensures that as long as the software and hardware are in good shape the use we create will not change.
- Artificial intelligence ensures easy distribution and duplication. The process of transferring knowledge from one person to another is long and complicated, and it is almost impossible to duplicate human experts, unlike the duplication of computerized systems.
- As artificial intelligence is computerized technology, it is consequential and accurate (of course to the extent that the information fed into the database is consequential and accurate), compared to natural intelligence which is founded on the lack of stability of the human expert.
- The actions and decisions received from computerized systems are easy to document by following the stages of their receipt and therefore it is possible to study and examine them. On the other hand, the human expert is capable of drawing a conclusion, while at a later stage he will be unable to explain the sequence of deductions leading to this conclusion.

Compared to the advantages of artificial intelligence mentioned above, natural intelligence also has a few striking advantages:

- Natural intelligence is creative, compared to the rigidity characterizing artificial intelligence. Human beings possess the ability to acquire knowledge and draw conclusions, whereas artificial intelligence adapted to the requirements of the system, is generally fixed and well planned.
- Human beings are able to make immediate use of information received through the senses, whereas the computerized system requires symbolic signal processing.
- The most important advantage is the ability of human beings to integrate relevant knowledge from a number of fields and expertise and coordinate this in order to find the solution to a certain problem. Compared to this ability, the computerized systems are merely based on narrow, centralized information.

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