

## WHAT MAKES AN EXPERT?

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**Abstract:** *The study of notions such as knowledge and expert knowledge is aimed at acquiring new insights intended to be applied for more efficient use of the expert knowledge and conveying it in the development of intelligent systems capable to replace the human expert's knowledge. In order to be able to make systems useful in making decisions and replacing the brain work of human expert we must obtain the definition of terms knowledge and expert knowledge. After defining these two terms we must find out what is needed to secure an expert and how the expert solves the problems in the area of expert activities.*

**Key words:** *artificial intelligence, expert, knowledge, expert knowledge*

### 1. INTRODUCTION

The Oxford dictionary defines the knowledge as: "Good acquaintance gained by experiences; information owned by a person." Although the definitions impart many properties of the knowledge for technical needs, they are not enough precise. Processing of information works efficiently, when it makes correct and timely decisions. Such decisions can be made in two manners. According to the first manner, a similar state from among the saved states and the appropriate solution are found out. According to the second manner applied particularly when the identical saved state is not available the knowledge and the computation capability are used for determination of activities needed to reach objective. Distinction is made between (Anderson, 1978):

- Simple recognition and searching for solution
- Exacting use of knowledge and conscious calculation

The knowledge can be divided into two parts: it comprises the information about the problem as well as the information about the process of solving. If that was transformed into the computer knowledge, data and programs would be in question. The knowledge combines both of them. It is hard to put accurate limits between both types of information (Anderson, 1978). The difference can be found out by verifying the arguments: "I know it" and "I know how". Concerning the knowledge it can be claimed that the knowledge is the information transferred from the short term memory into long term memory in form of proper abstracts (Meystel & Albus, 2002).

### 2. EXPERT KNOWLEDGE

Until beginning to deal with the transfer of expert knowledge into artificial systems the definition of the notion "expert knowledge" was not required. The question arises: "What is expert knowledge?" Although the question seems to be quite simple it is soon found out that the description of this notion is very slipping and hard to include into a simple definition.

The expert knowledge can be defined in the following way (Chi & Glaser, 1988): "The expert knowledge is owned by the person who is continuously reaching excellent effect in a certain number of activities in an area; that that effect is not reached by the person not having expert knowledge." Such person is also called the expert. On this definition it can be

discerned that it refers to exceptional achievements in a well defined area and with well defined activities in comparison with the person not having that knowledge.

A further frequent but risky definition of the expert knowledge uses the quantity of experience gained as the criterion of expert knowledge (Anderson, 1978). The knowledge gained by active solving of problems is also called experience (Rohrbaugh & Shanteau, 1999). However, the quantity of the gained experience is a very unreliable estimate, since it does not imply the quality of gained experience. For the most part, the expert knowledge consists just of the gained experience. The definitions assumes that, for example professor has the expert knowledge because of the longer time of gathering of experience, whereas, the student do not have it because of the short time of their study.

Deliberate training aimed at improving the effect has proved to be the best technique of creation of experts (Ericsson & Charness, 1994). The type of training completely depends on the area of activities. For a man such activity represents a great effort, therefore, usually it may not last more then four hours per day (Chi & Glaser, 1988). It is a sad fact that experts cannot be created overnight. At least 10000 hours of deliberate training are necessary to reach the expert degree of top level (Anderson, 1978). It is impossible to create quickly an expert particularly when the expert knowledge requires much information and complex knowledge. Fortunately, gaining of expert knowledge does not take place linearly, but the quantity of the knowledge gained has the form of an exponential function depending on the time used (Meystel & Albus, 2002) as shown on Fig. 1. In the beginning the expert progresses quickly, afterwards the rate of gaining of the expert knowledge is slowed down.

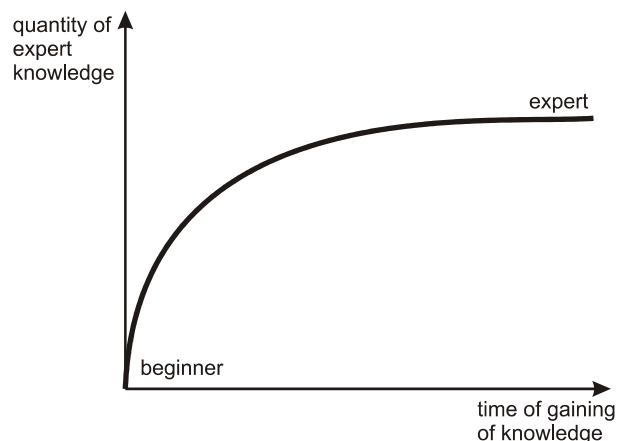


Fig. 1. Gained knowledge depending on time of gaining of knowledge

The expert knowledge differs mutually very much depending on the area it covered. The expert knowledge covers a very narrow area of expert's activity. Each area requires different skills which may mutually differ very much. In general the expert knowledge is defined by:

- Accurately determined and limited area of use

- Time of acquisition of that knowledge – if the expert knowledge does not depend on the time of acquisition, it is not the expert knowledge
- Effects achieved – the effects in the above mentioned area are above average

### 3. SEARCHING FOR KNOWLEDGE

If the human is compared with the computer it is found out that the computer surpasses the human in many respects. As far as the routine learning is concerned, the computer is much faster than the human. The man acquires and saves the information very slowly; the brain needs 5 to 10 seconds for memorizing each piece of information. Also the calculation is executed much slower, since it needs 40ms to compare two signs.

However, the human brain has a capability which the computer does not have. One of such properties is efficient recognition of patterns. Further, the brain is highly capable to organize the knowledge and to search for the knowledge needed by the current problem. In doing that it is capable to combine the searching for the knowledge with the capacity of recognition of patterns. If the brain capacity is compared with the computer in playing chess it can be established that the human and the computer use different techniques for problem solving.

The computer uses rough force and makes use of the capability of fast calculating by examining the solution space, whereas the human solves the problem by slow calculating but by fastly found needed knowledge (Fig. 2).

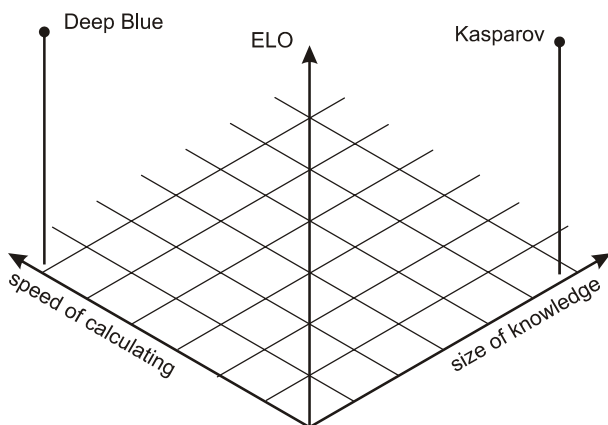


Fig. 2. Speed of calculating and examining the searching space and size of knowledge applied by grand champion and chess computer (ELO is unit of chess playing capability) (Rohrbaugh & Shanteau, 1999)

Selection of solution and its subsequent verification is one of the most universal techniques of problem solving, where the sequence of steps needed to arrive at the solution cannot be determined in advance. As it is not able itself to prescribe today's application of those steps, the programme use rough force to search for the solution.

### 4. METHODS OF REACHING SOLUTIONS

Like in other areas also during the brain work the human acts on the principle of least potential energy. Searching for solutions can be divided into three categories (Rasmussen, 1986):

- Searching for solution based on skill
- Searching for solution based on rules
- Searching for solution based on knowledge

In case of human struggles with a known problem he quickly finds the solution already existing in the memory. The time of finding, the solution depends particularly on the similarity of

the problem already solved to the current problem. Such searching for solution is based on the skill already acquired and is fast and very efficient. Such manner of problem solving could be also called the automatism (Meystel & Albus, 2002). The expert applies predominantly searching for solutions based on skill and less on rules, whereas he rarely applies solving of problems based on knowledge.

In addition to the gained experience the specialists have also quite a few individual innate or acquired properties assuring excellent results in solving of problems within an area.

The development of information sciences and artificial intelligence has caused a great increase of interest in the expert knowledge and its application in artificial systems. Researchers of this topic have agreed that the experts have the following properties (Schanck, 1990):

- Highly developed capacity of observation
- Capacity of simplifying complicated problems
- Creativity
- Capacity of conveying the expert knowledge to others
- Awareness of their capabilities
- Up-dated knowledge

### 5. CONCLUSION

After the expert knowledge and the expert have been defined we found out the following: the expert is an individual who is continuously reaching an excellent effect in a certain number of activities in an area; that that effect is not reached by the person not having expert knowledge. We find out that for formation of expert a person is needed who has the natural capabilities of reaching results above average in an area. However having such capabilities does not suffice future expert, in addition, must do at least 10 000 hours of training in the area where he will become the expert, which actually implies 5 years of activities. Further it can be found out that, since experts use mainly the skill-based searching for solution, it is possible nowadays already to replace the expert by the artificial intelligent system. The human expert possesses the information in the form of knowledge, but intelligent systems would be capable in certain uses to replace knowledge by a multitude of bare data and sophisticated searching algorithms. By using artificial intelligent systems it would be possible in some areas partly to avoid the need for experts and their training taking a long time.

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