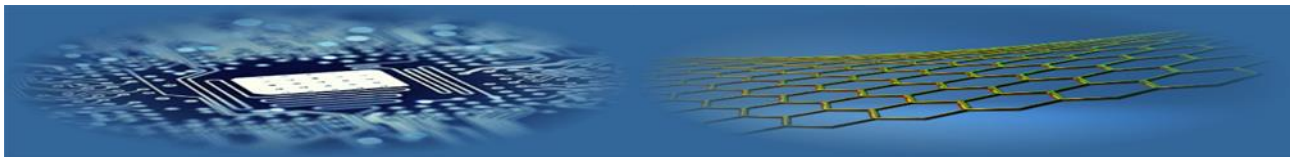

Some issues of expert systems in healthcare and education

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Abstract

A very significant and essential part of the development of an expert system is the creation of its knowledge base. The knowledge base includes not only the rules and the facts that form a part of the declarative knowledge, but also functions and procedures, which are responsible for the optimization of the algorithms used in the expert system. However, there is no clear and universal idea of creating knowledge base. This thesis will describe the attempt to develop ontology of the creation of knowledge base for different expert systems.

Keywords:

expert systems
knowledge base [KB]
medicine
education
future profession

1 Introduction

Today healthcare and education sectors are ones of the most developing spheres in Kazakhstan. The government has set the goal to improve the quality level of giving help to citizens and a significant improvement in existing services. All this is reflected in the letters of the president of Kazakhstan, in particular, the message called "Kazakhstan-2030" [1]. Therefore, we decided it would be very useful to develop expert systems in the spheres of healthcare and education. The thesis will describe the construction of knowledge base structure methods for these two systems.

2 Expert systems

An expert system is a software which uses expert knowledge for providing high-level solution of nonformal problems. The foundation of the expert system is a knowledge base in specific areas, which build during developing system.

Nowadays the value of information support of different medical technologies steadily increases. Use of the modern information technologies becomes a critical factor in the development of the majority of branches of knowledge and areas of practical activities. Therefore, development and deployment of information systems are one of the most actual tasks [2].

The system will identify the problems and give out the most probable disease. The system will define diseases based on rules which were set by experts.

Let's see the expert system for determining the future profession. Today a large percentage of high school graduates do not know who they want to be in the future, but even those who have already decided, and want to go in IT, do not clearly know the specifics of all specialties. There are tests to determine the future profession, but most of them give a very general answer without taking into account lots of implicit factors that may influence the choice. Hobby, zodiac sign or even enthusiasm of closest friends can influence the choice, and all these factors must be considered. So, this is how the idea of an expert system for determining the most suitable future profession for people who want to connect lives with IT appeared. So what makes this expert system different from the existing ones? First of all, it is narrowly specialized in the field of IT. All questions will be connected with information technologies and closely related aspects [3]. And in the end the answer will be clearly formulated within this sphere of activity. Again, the answer will be given very close to the reality.

3 Ontology

Perhaps the most important advantage is the fact which shows the ontology leading to creation of health systems able to support the integration of knowledge without replacement of data [7].

In this paper we consider the ontology that can cover cardio - vascular disease (CVD), as an object, and several classes as symptoms and diagnosis of treatment methods. Each class has its own parameters and terms (Figure 1).

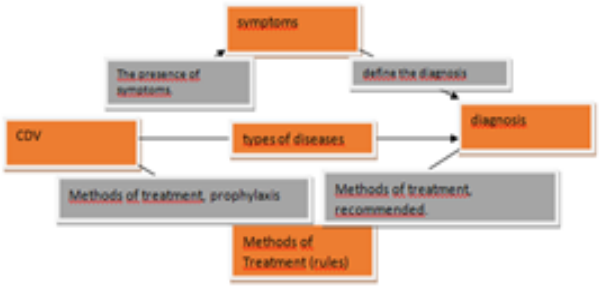

FIGURE 1

On the figure we can see some information about the ontology structure such as basic information about Symptoms (for example, shortness of breath on slight exertion or at rest, weakness, low endurance, heartbeat), Diagnosis (for instance, arrhythmia, cardiovascular failure, angina), Treatment (as an example - Complete blood count - specify the number of red blood cells and hemoglobin , as well as other cells for subsequent detection of diseases (leukemia , anemia , etc ECG or electrocardiogram, which is recorded using electrical impulses characteristic of the heart).

4 Construction ontology and knowledge base for Expert system determine future profession

If you have a problem or a challenge that you can not solve on your own - you refer to knowledgeable people, or to the experts, to those who have the knowledge.

Expert systems have appeared in studies on artificial intelligence (AI). In place of the search for a universal algorithm of thinking and solving problems the researchers got the idea to simulate specific knowledge experts. So in the US the first commercial systems based on the knowledge or expert systems appeared. These systems are the first intelligent systems on the right, and so far the only criterion is the presence of intelligence work with the knowledge of mechanisms.

The most widespread is the rule-based model of knowledge representation. The knowledge base in this type of model consists of a set of rules; and the program that controls the rules is called the output machine.

Expert systems are effective only in the specific "expert" areas where the empirical experience of experts is important.

One of the most important components of the expert system is a *knowledge base*. *The knowledge base* consists of rules of analysis of the information from the user on a particular issue. The expert system analyses the situation and, depending on the orientation expert system, make recommendations to resolve the problems.

As a rule, the expert system knowledge base contains facts (static information about the domain) and the rules – a set of instructions, which apply to the known facts, you can get new facts.

The most widespread is the rule-based model of knowledge representation. The knowledge base in this type of model consists of a set of rules; and the program that controls the rules is called the output machine.

The inference machine is a program that simulates the logical conclusions of experts, uses a given knowledge base for the interpretation of the data received by the system.

It usually has two functions:

- review of existing data (facts) of working memory (database) and the rules of the knowledge base and the addition (to the extent possible) in the working memory of new facts;
- determining the order of viewing and application of the rules. This mechanism controls the process of consultation, keeping the user information on the receipt of the opinion, and asks him for additional information when working memory has no sufficient data.

Also, the inference machine determines the order of application of the rules and should provide:

1) Matching- sample is compared with the existing rules of evidence.
2) Choice - if in a particular situation can be applied several rules, one of them, the most suitable for a given criterion (conflict resolution), is selected
3) Operate - if the sample by comparing the rules coincided with any of the working memory of the facts, the rule is triggered.
4) Action - working memory is subject to change by adding it to enter into the rule triggered. If the right side of the rule contains an indication of an action, then it is executed (for example, in information security systems).

The main factors affecting the viability and effectiveness of ES development (partly [Waterman, 1989]):

- Lack of specialists spent a lot of time to help others;
- A small task requires numerous team of specialists, because none of them has sufficient knowledge;
- Reduced performance because the task requires a complete analysis of a complex set of conditions, and one specialist is not able to see (in the allotted time) all of these conditions;
- Large discrepancy between the decisions of the nicest and the worst performers;
- Availability of experts ready to share their experiences. Suitable problem have the following characteristics:
  a) Can not be solved by traditional means of mathematical modeling;
  b) There is "noise" in the data - incorrect definitions, inaccurate, incomplete information;
- Are highly specialized;
- Do not depend heavily on universal knowledge or common sense.

Currently, there are several thousand industrial ES in the world to give advice:

- in the management of the complex control, for example, electricity distribution network;
- when making a medical diagnosis;
- in troubleshooting in electronic devices, diagnostics of failures of the equipment;
- in the design of integrated circuits;
- in the movement control;
- in forecast operations;
- in the formation of the investment portfolio, the evaluation of financial risks, taxation, and so on.

In general, the process of operation of the expert system can be represented as follows: A user who wishes to obtain information via the user interface sends a request to ES. Solver, using the knowledge base, generates and outputs an appropriate recommendation to the user, explaining the course of its reasoning with the help of explanation subsystem.

Today a large percentage of high school graduates do not know who they want to be in the future, but even those who have already decided, and want to go in IT, do not clearly know the specifics of all specialties. There are tests to determine the future profession, but most of them give a general answer without taking into account lots of implicit factors that may influence the choice. Next part will show the construction of expert system that considers different aspects of students' lives for determining the specialty the most suitable for students who want to continue getting education in IT sphere. It will help high school students to choose their future profession in the field of IT.

The implementation of the knowledge base for determining the future profession is based on building competent ontology.

Ontology is explicit formal specifications of the terms in the domain and relations among them (Gruber 1993).

Ontology, simply, is a description of the knowledge, made quite formally to be processed by computers. Ontology of the content of knowledge base in the expert system is needed to improve the quality of the search engine in the knowledge base.

While creating the knowledge base to determine the profession three main parameters were considered: IT

competence, specialty and skills.

IT competence: describes the quality of making people "potentially" competent in IT. IT competence can be divided into 2 parts: functional and behavioral, that constructs the personality of a person.

Skills can be represented asfunctional (the possibilities of people) and behavioral (characteristic).

Speciality: the most appropriate speciality for the person based on the IT competence and skills the student has.

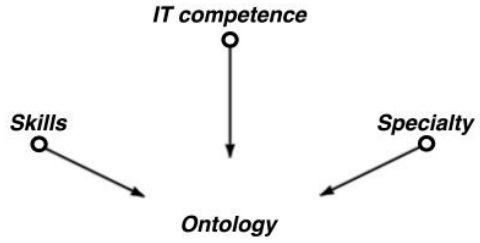

FIGURE 2 Simple ontology scheme for expert system for future profession

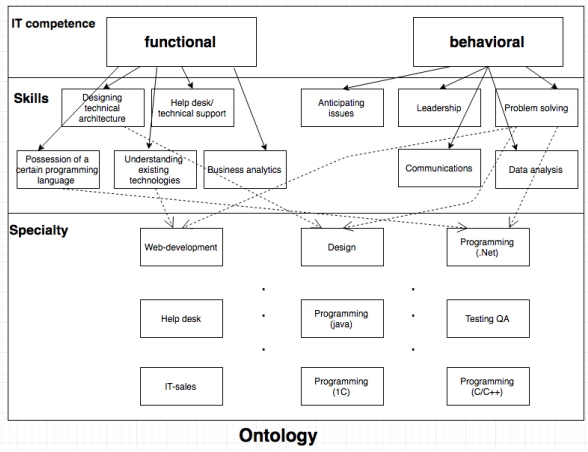

FIGURE 3 Ontology for expert system to determine the future profession

Questions are focused on the identification of potential future professional competence in a particular specialty with respect to skills that are necessary and skills that the person already has.

For example, the question "How much are you stable to stress?" can be answered as "Highly", "Low" and "Don't know". The level of stability to stress is a skill. On the basis of his reply specialties will be screened. If a person gives the answer "Low", the probability that he will be, for example, an IT-manager is reduced, because this specialty needs more resistant to stress people. Through the competent approach to ontology unnecessary specialties can be removed, leaving the person only the most suitable ones.

Using Mamdani inference system means that the information processed by the expert system is not entirely accurate, but is probabilistic in nature. The user does not need to be convinced of the absolute truth or falsity of the evidence; it can respond to requests from the system some degree of confidence. In turn, the system displays the results of the consultation in the form of occurrence probabilities of outcomes.

Example of the rule base of Mamdani inference system:

IF helpdesk is high AND communications is high THEN helpdesk_profession is highly possible.

IF designing_technical_architecture is high AND problem_solving is low THEN web_development is less possible.

The inference system gets data from two inputs that represent IT-competence in functional and behavioral ways. Then it constructs the rules for making the precise picture of student's skills. The result it the possible future profession.

5 Knowledge base

The knowledge base – is a set of the facts and inference rules allowing a logical output and intelligent information processing. The events are provided by depth (fundamental) knowledge of medicine, such as the hierarchy of diseases and hierarchy of parameters for the description of symptoms. Inference rules are surface (managing directors, practical) knowledge, such as rules of diagnosis of illness on symptoms and differentiation of disease [4].

There are a lot of method of elicitation knowledge, but for build our knowledge base we use two methods of elicitation knowledge from an expert. We use one of the active methods is Interview and the second one passive Document analysis. Why we chose two methods? In order to be sure that knowledge base consist truthful data. As this is medical expert system of course the main expert is a doctor. And document analysis method was chosen for the reinforcement of knowledge for this paper we interviewed tree doctors and in order have right results we prepare questions and ask doctor to give for every parameters (symptom) weight. For example for heart rate, we cannot exactly say that if rate less than 60 rate per one minute it is low or normal, because it depend on age, stay and individual characteristics of human, and in order to avoid *Table 1*. After we fill KB by if/then rules (Figure 4).

TABLE 1

Heart rate	Low	Normal	High	Hypertony
>60	80%	20%	0%	0%
60-80	5%	75%	20%	0%
80-100	0%	10%	85%	5%
100-140	0%	0%	5%	95%
140<	0%	0%	0%	100%

The implementation of the knowledge base for determining the future profession is based on building competent ontology. While creating the knowledge base to determine the profession three main parameters were considered: IT competence, specialty and skills.

Questions are focused on the identification of potential future professional competence in a particular specialty with respect to skills that are necessary and skills that the person already has. For example, the question "How much are you stable to stress?" can be answered as "Highly", "Low" and "Don't know". The level of stability to stress is a skill. On the basis of his reply specialties will be screened. If a person gives the answer "Low", the probability that he will be, for example, an IT-manager is reduced, because this specialty needs more resistant to stress people. Through the competent approach to ontology unnecessary specialties can be removed, leaving the person only the most suitable ones [6].

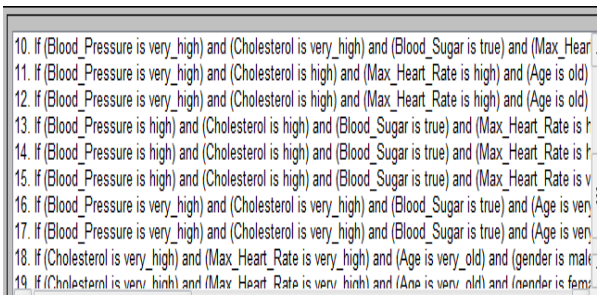

FIGURE 4 KB by if/then rules

4 Conclusion

The knowledge base is one of the most important components of an expert system. That's why the proper construction of knowledge base improves the efficiency and quality of the expert system. This thesis describes ways to build knowledge base for experts systems, particularly in healthcare and education areas, which are ones of the main issues in Kazakhstan.

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