Knowledge-based System for Antibiotics

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Abstract

Knowledge-based systems are systems based on the methods and techniques of artificial intelligence. Knowledge-based systems were designed primarily for the purpose of being able to apply knowledge automatically. Knowledge is the base of personal information, which is integrated in a fashion, which allows it to be used in further interpretation and analysis of data. The aim of this paper is to provide the user in order to diagnose the bacterial infections and know the knowledge of Antibiotics. This system makes decision for the diseases which the user suffers and represents knowledge about antibiotics for the user's disease. This paper presents a knowledge-based system that makes inference of bacterial infections and gives consistent Antibiotics by using Knowledge Acquisition, Knowledge Representation and Knowledge Manipulation methods. Antibiotic is medicine or chemical that can destroy harmful bacteria in the body of limit their growth. Knowledge Acquisition involves the acquisition of user's age and symptoms that the user suffers. The acquired age and symptoms are organized as a rule in the Knowledge-based system for representation of knowledge. In Knowledge Manipulation, this system matches the rule with the rules in Knowledge-based system. If matching, the system makes inference of bacterial infection disease name and provides knowledge of Antibiotics to the user for treatment.

Keywords: Knowledge-based System, Antibiotics

1. Introduction

Artificial intelligence is capable not merely of storing and manipulating data, but also of acquiring, representing, and manipulating knowledge. Knowledge is relation among sets of data (information) that is very often used for further information about behavior of abstract models of the world. Information acquired through experience or study. Types of Knowledge:

- Facts: Things to be accepted as true.
- Beliefs: Someone's opinion about what it true.
- Procedures: Accepted general strategy for accomplishing an objective.
- Relations: How things relate to each other?
- Heuristics: Experimental or judgmental outcome or "good guessing" usually held privately by experts.

Artificial intelligence systems aim to mimic intelligent problem solving. Problem-solving requires:

- Knowledge
- Inference (ability to manipulate, acquire and manage knowledge effectively and efficiently for recognition, reasoning, learning, etc).

There are two kinds of knowledge involved in automatically making inferences:

- The general knowledge of how to infer something (anything): general inference methods, and
- The specific knowledge about the something.

Knowledge provides power: power to inform, power to decide and power to control. In order for a knowledge based system to provide an acceptable level of support, it must have access to this power.

This system is intended to implement the methods of knowledge-based system. By using this system, users can easily diagnose the bacterial infections and can know the knowledge about the antibiotics.

2. Related Works

Morium Akter proposed "Diagnosis and Management of Diabetes Mellitus through a Knowledge-Based System**".** It presents to develop a low-cost automated knowledge-based system that helps in self-diagnosis and management of this chronic disease for patients as well as doctors. The knowledge-based system has an easy computer interface, which performs the diagnostic tasks using rules acquired from medical doctors on the basis of patient data. It contains 26 rules for diagnosis [6].

I.Hatzilygeroudis proposed “An Intelligent Medical System for Diagnosis of Bone Diseases”. It shows aspects of the design of an intelligent medical system for diagnosis of bone diseases that can be detected by scintigraphic images are presented. The system comprises three major parts: a user interface (UI), a database management system (DBMS), and an expert system (ES). The DBMS is used for manipulation of various patient data. A number of patient cases are selected as prototype and stored in a separate database. Knowledge is represented via an integrated formalism that combines production rules and a neural network. This results in better representation, and facilitates knowledge acquisition and maintenance [4].

3. Theory Background

Knowledge-based systems are systems based on the methods and techniques of Artificial Intelligence. Their core components are the knowledge base and the inference mechanisms.

3.1. Knowledge-based System

A knowledge-based system is a computerized system that uses domain knowledge to arrive at a solution to a problem within that domain. This solution is essentially the same as one concluded by a person knowledgeable about the domain, when confronted with the same problem.

The knowledge base contains knowledge necessary for understanding, formulating and solving problems. It includes two basic elements: facts, such as the problem situation and theory of the problem area and special heuristics, or rules that direct the use of knowledge to solve specific problem in a particular domain. The heuristics express the informal judgmental knowledge in an application area. Knowledge is the primary material of expert systems.

A Knowledge base is a set of representations of facts about the world. The goal is to facilitate intelligent interaction, in a user-oriented fashion, which is based on: the identification of the appropriate information, the effective utilization of the appropriate information, the user control of the appropriate without the ability to represent knowledge.

With a knowledge base and the ability to draw inferences from it, the computer can now be put to some practical use as a problem solver and decision maker. By searching the knowledge base for relevant facts and relationships, the computer can reach one or more alternative solutions to the given problem. The computer knowledge base and inferencing capability augment those of the user. The ability can be applied to different areas ranging from problem solving to the interpretation of languages and scenarios.

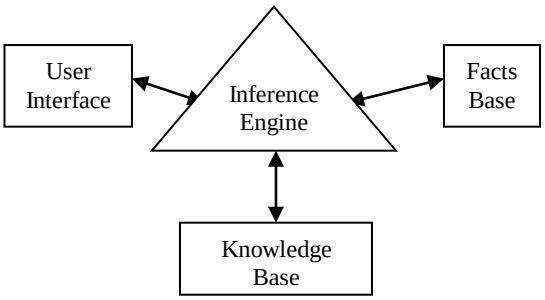

Figure1. Knowledge-based System Structure

3.2 Methods in Knowledge-based System (Knowledge Issues)

Knowledge issues confronting the designer of an AI system are

- Knowledge acquisition
- Knowledge representation, and
- Knowledge manipulation.

3.1.1. Knowledge Acquisition

Knowledge Acquisition is a structured way of developing knowledge-based systems. Knowledge Acquisition is the transfer and transformation of potential problem-solving expertise from some knowledge source to a program. Elicitation must carry out several operations, the most important of which are the following: extracting the knowledge by externalizing it, rendering it explicit by accumulating sufficient detail to make it clear, record it in a symbolic form, and verify it by checking the symbolic form against the original statement. End users often have a difficult time verbalizing all that goes on in performing their jobs better. Through observations and interactions in the working environments, data, information, and knowledge are needed for end-users to perform their jobs better. Knowledge Acquisition is the accumulation, transfer, and transformation of problem-solving expertise from some knowledge source to a computer program for constructing or expanding the knowledge base. Knowledge Acquisition can involve developing knowledge to solve the problem [3].

Acquiring knowledge from users is a complex task and frequently creates a bottleneck in

construction. The state of the art today requires a knowledge engineer to interact with one or more human experts in building the knowledge base. Typically, the knowledge engineer helps the user structure the problem area by interpreting and integrating user answers to questions.

3.1.2. Knowledge Representation

Knowledge Representation is probably the most important ingredient for developing an AI. A representation is a layer between information accessible from outside world and high-level thinking processes. Without Knowledge Representation, it is impossible to identify what thinking processes are mainly because representation itself is a substratum for a thought. The subject of Knowledge Representation has been "massaged" for a couple of decades already. But it has not been able to find literature where the subject is approached in the same manner as it is done here with the same technical suggestions [5].

The acquired knowledge is organized in an activity called Knowledge Representation. This activity involves preparation of a "knowledge map" and encoding the knowledge in the knowledge base. There are two general types of Knowledge Representation: those that support analysis and those that are used in actual coding. The working code of a knowledge-based system is usually represented either in the form of production rules or as frames. Knowledge Representation should be able to support the tasks of acquiring and retrieving knowledge as well as subsequent reasoning [3].

Knowledge Representation is very important for knowledge-based system. Popular knowledge representation schemes are rules, semantic nets, schema (frames, scripts), and logic. The selected knowledge representation scheme should have appropriate inference methods to allow reasoning.

Table1. Advantages and Disadvantages of Different Knowledge Representations

Scheme	Advantages	Disadvantages
Productio n rules	Simple syntax, easy to understand, simple interpreter, highly modular, flexible	Hard to follow hierarchies, inefficient for large systems, not all knowledge can be expressed as rules, poor at representing structured descriptive knowledge.

3.1.3. Knowledge Manipulation

Knowledge Manipulation is a field of study which seeks to compute information in a structured form, consistent with human cognitive processes as opposed to simple lists of data items.

Knowledge Manipulation programs link the generation of knowledge (e.g., from science, synthesis, or learning) with its use (e.g., policy, reporting, program management) as well as facilitating organizational learning and adaptation in a knowledge organization. Knowledge Manipulation transfers outputs (content, products, services, and solutions), in the form of knowledge services, to enable external use. Knowledge services support other organizational services, yield sector outcomes, and result in benefits for citizens in the context of knowledge markets.

Knowledge Manipulation in the fields of organizational development and organizational learning is the practical problem of transferring knowledge from one part of the organization to another (or all other) parts of the organization.

4. How does the Knowledge Base System functions?

A knowledge base system functions by filtering the available knowledge in the database in response to a question posed by a user. Most commonly this is done by using Structured Query Language (SQL) requests of the database. SQL queries are structured that they follow rules in which the parts of a query are combined. The Knowledge base system needs knowledge. It should have access to the combined relevant information and it seeks to serve. The knowledge base system also needs a way to serve the information to a user. It needs a database engine which will handle complex structured inquires. The knowledge base system needs a way to filter a user query to reduce the volume, and increase the relevance of the knowledge base system response. It needs an easily understood user interface where preliminary questions are posted to the user [1].

5. Rules for Diagnosis in Knowledge base

Table2. Sample Rule Table in the database

Disease Name	Rules	Age
Pneumonia	H2 and N1 and C9 and L9 and A6 or L9 or AB8 and NV and F and CG and CH	Child

Meningitis	H11and C9 and NV or F or CG or CH	Adult
Encephalitis	H19 and N6 and A6 or L9 or B1 or NV or F	Adult

Symptoms of nine features are used as main symptoms in this system. They are the symptoms for Head, Neck, Chest, Abdomen, Arm, Leg, Back, Skin, Pelvis features. Other four features: Fever, Nausea and Vomiting, Cough and Chills are also used as general symptoms in this system. There are 27 symptoms of Head (e.g.: Strong Headache, Hallucination, etc), 8 symptoms of Neck (e.g. Neck Pain, Swallowing, etc), 6 symptoms of Chest (e.g. Breathing Difficulty, Chest Pain etc), 11 symptoms of Arm (e.g. Hand Pain, Numbness or Tingling, etc), 10 symptoms of Leg (e.g. Fatigue, Foot Pain or Itch, etc), 1 symptoms of Back (Backache), 17 symptoms of Skin and 12 symptoms of Pelvis in the system.

There are 32 types of bacterial infection diseases can be diagnosed by using 80 rules in this system and gives Antibiotics for those diseases. Age type is classified in this system as three groups; Baby is for patients who are under two years, Child is for patients who are between two years and fourteen years and Adult is for patients who are above fourteen years.

5.1 Example

Rule 1:
IF Age = 12 (Child) **AND**
Head = H2 (Strong Headache) **AND**
Neck = N1 (Swallowing Difficulty) **AND**
Chest = C9 (Breathing Difficulty) **AND**
Arm = A6 (Numbness and Tingling) **OR**
Leg = L9 (Fatigue) **OR**
Abdomen = AB8(Diarrhea) **OR**
Nausea and Vomiting = Yes **AND**
Fever = Yes **AND**
Cough = Yes **AND**
Chills = Yes,
THEN Display "PNEUMONIA" and Antibiotics for PNEUMONIA.

Rule 2:
IF Age = 25 (Adult) **AND**
Head = H11 (Hallucination) **AND**
Chest = C9 (Breathing Difficulty) **AND**
Nausea and Vomiting = Yes **OR**
Fever = Yes **OR**
Cough = Yes,
THEN Display "MENIINGITIS" and Antibiotics for MENINGITIS.

Rule 3:
IF Age = 34 (Adult) **AND**
Head = H19 (Hallucination) **AND**
Neck = N 6 (Throat Pain) **AND**
Arm = A6 (Numbness and Tingling) **OR**
Leg = L9 (Fatigue) **OR**
Back = B1 (Backache) **OR**
Nausea and Vomiting = Yes **OR**
Fever = Yes
THEN Display "ENCEPHALITIS" and Antibiotics for ENCEPHALITIS.

Rule 4:
IF Age = 10 (Child) **AND**
Head = H23 (Long cough over 3 weeks) **AND**
Neck = N8 (Bloody Mucus) **AND**
Chest= C9 (Breathing Difficulty) **AND**
Leg = L9 (Fatigue) **AND**
Fever = Yes **AND**
Cough = Yes
THEN Display "TUBERCULOSIS" and Antibiotics for TUBERCULOSIS.

Rule 5:
IF Head = H26 (Mouth or Tongue Soreness) **AND**
Neck = N1 (Swallowing Difficulty) AND
Pelvis = P5 (Genital Sore) AND
Skin = S3 (Diaper Rash)
Nausea and Vomiting = Yes
Fever = Yes
THEN Display "THRUSH" and Antibiotics for THRUSH.

There are 80 rules for diagnosis of 32 types of bacterial infection diseases in this system. Since Admin user can modify (insert, update, delete) the rules in this Knowledge-based System, the numbers of rules is not unlimited.

5.2 System Flow of Knowledge-based System for Antibiotics

In this section, we describe system flow of KB system for Antibiotics. This system allows users to choose the symptoms and to provide decision and displays the Antibiotics for that decision. This system asks required symptoms for Head, Chest, Neck, Arm, Leg, Back, Abdomen, Pelvis, Skin. After selecting the symptoms which the users feel, this system checks the rules in the knowledge base with the user's symptoms. The system is making inference with rule-based approach and then makes a decision of bacterial infection disease for that input symptoms and displays the Antibiotics for that disease. Only Admin user who knows the

password correctly can modify the rules in the knowledge base. This system uses the knowledge base to diagnose the bacterial infection diseases and give suggestion the Antibiotics for that disease.

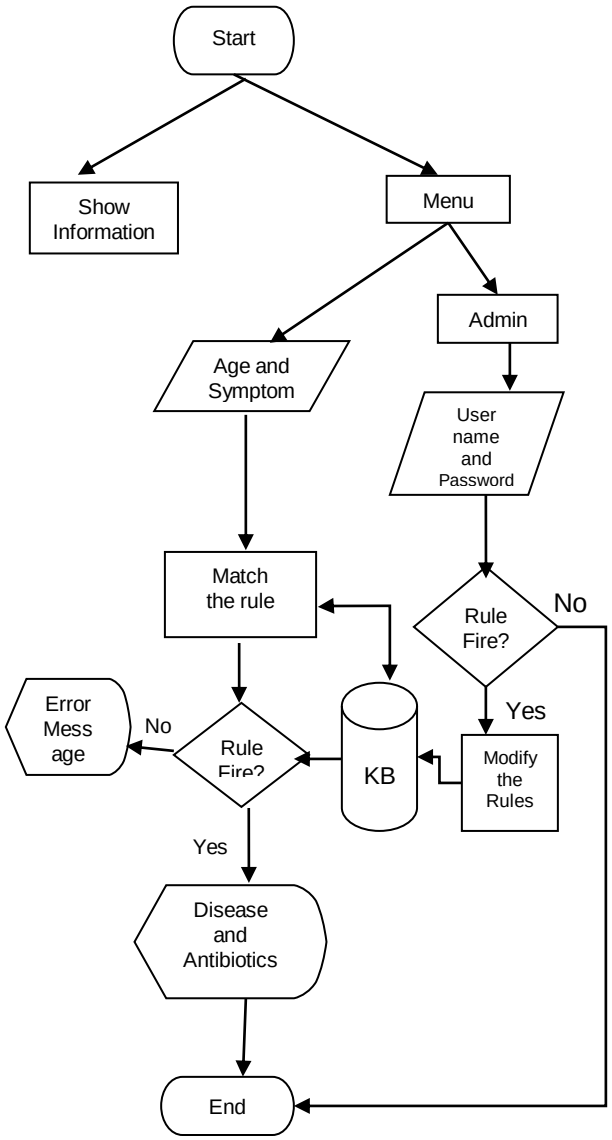

Figure2. System Flow Diagram of Knowledge-based System for Antibiotics

6. Conclusion and Further Extension

Knowledge-based system is a system that can undertake intelligent tasks in a specific domain that is normally performed by highly skilled people. Knowledge analysis techniques are usually used to support knowledge acquisition during scope establishment and initial knowledge gathering. Knowledge recorded in any of the analysis techniques can be easily translated into rules or frames. The inference engine is used in this system to fire the knowledge and rules in the database. The inference engine is a method of using the knowledge base, that is, reasoning with it to solve problem. The Knowledge-based system for Antibiotics will implement to acquire Knowledge, represents Knowledge and manipulates Knowledge. The systems match the input symptoms of the bacterial infections in the knowledge base and represent the knowledge about antibiotics for that bacterial infection. It can produce the necessary information accurately and timely.

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