Defining Tuberculosis and Related Diseases Using Brute-Force Algorithm

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Abstract

Tuberculosis (TB) is a contagious and potentially fatal disease that can affect almost any part of the body but manifests mainly as an infection of the lungs. It is caused by a bacterial microorganism, the tubercle bacillus or Mycobacterium tuberculosis. Tuberculosis (TB) infection can either be acute and short-lived or chronic and long-term.

Because of Tuberculosis (TB) is a top priority recognition disease of Myanmar, this system will help something by providing the information about the Tuberculosis (TB) as an Expert. So, users of the system will notice their disease symptoms whether need to care or not about Tuberculosis (TB). This system is implemented of a Rule-Based Expert System. The Inference Engine of the system is implemented by using Brute-Force Algorithm.

1. Introduction

Tuberculosis (TB) is a potentially fatal contagious disease that can affect almost any part of the body but is mainly an infection of the lungs. It is caused by a bacterial microorganism, the tubercle bacillus or Mycobacterium tuberculosis. Although TB can be treated, cured, and can be prevented if persons at risk take certain drugs, scientists have never come close to wiping it out. Few diseases have caused so much distressing illness for centuries and claimed so many lives.

Tuberculosis (TB) is a contagious and potentially fatal disease that can affect almost any part of the body but manifests mainly as an infection of the lungs. It is caused by a bacterial microorganism, the tubercle bacillus or Mycobacterium tuberculosis. TB infection can either be acute and short-lived or chronic and long-term.

With a strong national health infrastructure and government recognition of TB as a top priority, the country is now within sight of becoming the second of the current group of Home based care (HBC) to reach the global targets for DOTS implementation (after Viet Nam).

Myanmar has made these commendable achievements with little external donor support. This situation will change radically with a massive increase in funding, mainly from the Global Fund to Fight AIDS, Tuberculosis and Malaria (GFATM). When they become accessible, these funds will provide major opportunities for capital investment in infrastructure as well as important improvements in staffing at all levels and in the quality of laboratory services.

A national TB prevalence survey would provide a more accurate estimation of incidence and a baseline for assessing the impact of DOTS services on the TB epidemic.

Three other areas where programmed performance needs to be improved are diagnostic and laboratory services, TB/HIV coordination and links with other health-care providers.

This system covers the awareness and diagnosis of TB and related diseases for patients. This system is developed as an rule-based expert system. The system accepts symptoms of patients and diagnosis based on the inputted symptoms whether the symptoms are caused by TB or not.

This system is developed based on the data collected from Monywa Government Hospital especially from TB ward.

Brute force algorithm is a step-by-step recipe for solving a problem. A brute force algorithm is one that proceeds in a simple and obvious way, but will require a huge number of steps to complete. A brute force algorithm is often the least desirable choice because of the number of steps that will be involved, often, looking for underlying patterns, regularities or organizational tricks will help me discover algorithms that are cleverer, more subtle and more efficient.

List all possible Hamilton circuits (leaving out the exact reversals, if you wish), find the weight of each, choose (the) one with the smallest weight.

The brute force algorithm consists in checking, at all positions in the text between 0 and n-m, whether an occurrence of the pattern starts there or not. Then, after each attempt, it shifts the pattern by exactly one position to the right.

The brute force algorithm requires no preprocessing phase, and a constant extra space in addition to the pattern and the text. During the searching phase the text character comparisons can be done in any order. The time complexity of this

searching phase is O (mn). The expected number of text character comparisons is 2n.

In computer science, brute-force search or exhaustive search, also known as generate and test, is a trivial but very general problem-solving technique that consists of systematically enumerating all possible candidates for the solution and checking whether each candidate satisfies the problem's statement.

2. Expert System

An expert system is a computer program that enables a computer to make an unstructured decision normally made by humans with special expertise. These systems store facts and rules that are used in reaching a judgment in a particular case [1].

An expert system is able to store and manipulate knowledge to help the user solve a problem or make a decision. Typically, the system runs by understanding and applying rules. Systems have been developed for medical diagnosis where symptoms can be entered and an illness is diagnosed.

A system which employs human expertise captured in a CBIS to solve problems which usually require human expertise. An expert system either supports or automates decision making in an area of which experts perform better than non experts. It is also known as “Expert Computing System”, or “Knowledge Based Systems”. Expert Systems also work as a style of database, very much like a Tree Structure [2].

An expert system is software that attempts to reproduce the performance of one or more human experts, most commonly in a specific problem domain, and is a traditional application and/or subfield of artificial intelligence.

Expert systems may or may not have learning components but a third common element is that once the system is developed it is proven by being placed in the same real world problem solving situation as the human Subject Matter Expert (SME), typically as an aid to human workers or a supplement to some information system [3].

There are considerable advantages in reaching an accurate answer quickly.

3.1 Characteristics of Rule-Based Expert System

An expert system is built to perform at a human expert level in a narrow, specialised domain. Thus, the most important characteristic of an expert system is its high-quality performance. No matter how fast the system can solve a problem; the user will not be satisfied if the result is wrong.

On the other hand, the speed of reaching a solution is very important. Even the most accurate decision or diagnosis may not be useful if it is too late to apply, for instance, in an emergency, when a patient dies or a nuclear power plant explodes.

Expert systems apply heuristics to guide the reasoning and thus reduce the search area for a solution [4].

A unique feature of an expert system is its explanation capability. It enables the expert system to review its own reasoning and explain its decisions.

Expert systems employ symbolic reasoning when solving a problem. Symbols are used to represent different types of knowledge such as facts, concepts and rules [5].

3.2 Advantages of Rule Based Expert System

Natural knowledge representation. An expert usually explains the problem-solving procedure with such expressions as this: “In such-and-such situation, I do so-and-so”. These expressions can be represented quite naturally as IF-THEN production rules.

Uniform structure. Production rules have the uniform IF-THEN structure. Each rule is an independent piece of knowledge. The very syntax of production rules enables them to be self-documented

Separation of knowledge from its processing. The structure of a rule-based expert system provides an effective separation of the knowledge base from the inference engine. This makes it possible to develop different applications using the same expert system shell.

Dealing with incomplete and uncertain knowledge. Most rule-based expert systems are capable of representing and reasoning with incomplete and uncertain knowledge.

''Table 1. Two general categories of expert systems''

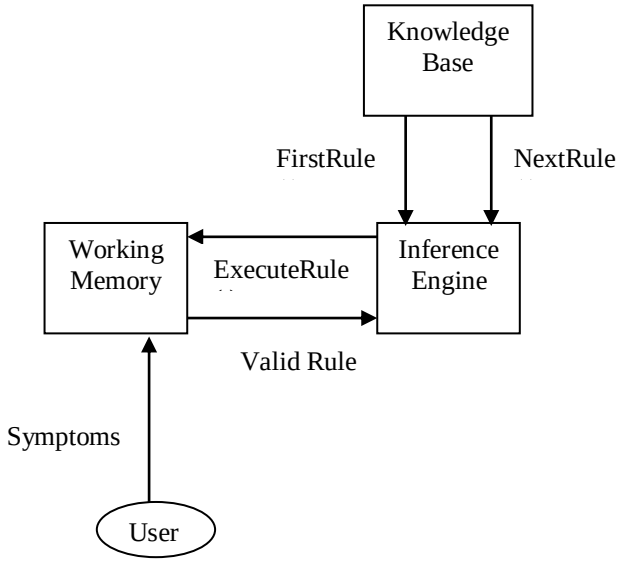
For Decision Support	For Decision Making
• To remind a human expert of issues to consider,alternatives to explore, etc. that the human expert may have missed in his decision making. • This type of Expert System is commonly found in the area of medicine.	• To aid a person in problem solving an area that he/she is unfamiliar in, or is inexperienced in. • This type of expert system is commonly found in industrial systems.

''Table 2. Human Experts and Expert Systems''

Human Experts	Expert Systems
• Skills and knowledge can deteriorate over time • Training human experts is an expensive and lengthy process that may not even guarantee good results • Susceptible to emotional and psychological factors that can impair decision making • Scarce and typically command high salaries	• Provides permanent expertise • Artificial expertise available from expert systems is easily reproduced and transferred, simply by duplicating the computer program • Provides consistent and reproducible results • Expert Systems are relatively cheap to operate and maintain

3.3 Brute-Force Algorithm of the System

When user enters the Disease Symptoms, these are stored in Working Memory. After then, Inference Engine call First Rule ( ) procedure to get first rule of the knowledge base. Then, Valid Rule ( ) procedure is invoked to validate the first rule with the current situation of the working memory. If Valid Rule ( ) return True, inference engine invoke Execute Rule ( ) to update the working memory with the consequence portion of the rule. Then, Inference Engine invoke Next Rule ( ) procedure to get next rule of the knowledge base. If Next Rule ( ) procedure return the another rule, inference engine invoke Valid Rule ( ) to validate the rule against with working memory. If Valid Rule ( ) return True, inference engine invoke Execute Rule ( ) to update the working memory with the consequence portion of the rule. This loop is done until Next Rule ( ) return null that is there is no rule in knowledge base to validate against with the working memory. After then Inference Engine display results of the Diagnosis Process.



''Figure 1. Brute-Force Algorithms for the System''

3.4 Data Set

Many people who become infected with Tuberclosis (TB) don't realize they have been exposed to the infection because their immune system successfully fights it off. When this happens, the bacteria become coated in tiny tubercles (round lesions), usually in the lungs. These can sometimes be seen on a chest X-ray. The bacteria are still in the body, but there are no symptoms and it can't be passed on to other people. This is called latent TB.

Depending on how effectively your immune system fights the infection, you may have: no symptoms at all , minor symptoms for a few weeks, which then go as you fight the infection off ,no symptoms at first, but symptoms and active TB develop in the following weeks or months

If my immune system successfully fights the infection, I will be immune to TB.

Sometimes latent tuberculosis becomes active years later. This is known as post-primary TB, and is more likely to happen if my immune system is weakened by other problems such as HIV, poorly controlled diabetes, or if you are underweight. About one in 10 people infected with TB bacteria go on to develop active TB at some point in their life.

Active TB bacteria aren't contained in tubercles, and a person with active TB will have symptoms, which may include:

A persistent cough - there may also be lots of phlegm, sometimes containing blood , fever , swollen glands, especially in the neck , tiredness , loss of appetite , weight loss , night sweats ,chest pain when you breathe in, caused by inflammation of the membranes lining your lungs (pleurisy)

At first, a TB infection normally affects the lungs. This is called pulmonary TB. However, TB often spreads to the lymph nodes (glands throughout my body that are part of my immune system). It can also affect our bones, joints and kidneys, as well as cause meningitis.

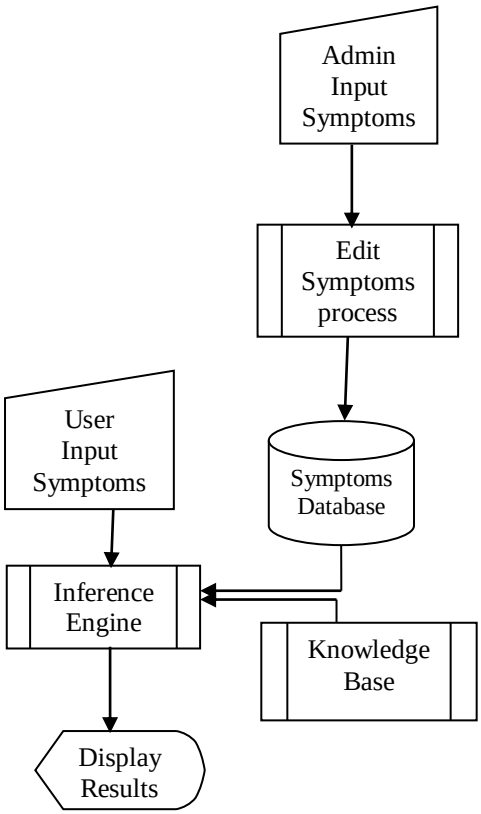
3.5 System Flow Diagram

When the system is invoked, Admin must enter disease Symptoms about input data entry and then must edit symptoms process.

Database gets these edited symptoms process and invoked Inference Engine.

After the user's symptoms data entry completed, Inference Engine is invoked to diagnosis symptoms database. Inference gets each rule of the knowledge base and validated each rule against with the symptoms database.

When there is no rule in knowledge base to validate, inference engine generate diagnosis result message to display on the user interface.



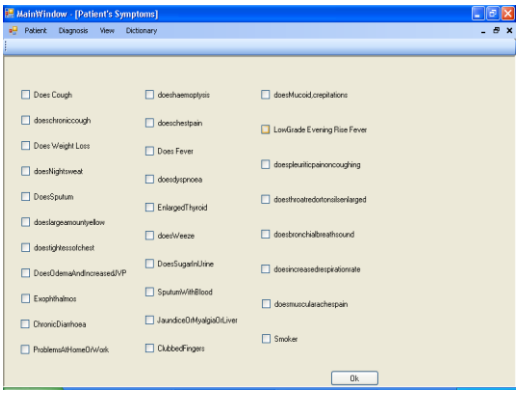
''Figure 2. System Flow Diagrams''

4. Result

If patient inputs the symptoms which are related to TB diseases and then the system's diagnosis process would generate the patients may be suffered TB disease.

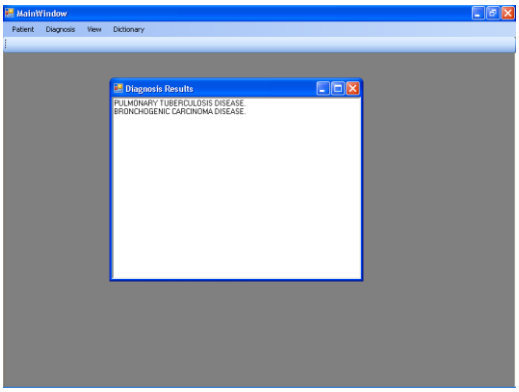
If patient inputs the symptoms which are not related to TB diseases and then the system's diagnosis process would generate the patients may be suffered some diseases which have common symptoms with TB disease.

If result has duplicate messages then there is more probabilities to suffer this disease described in the message.



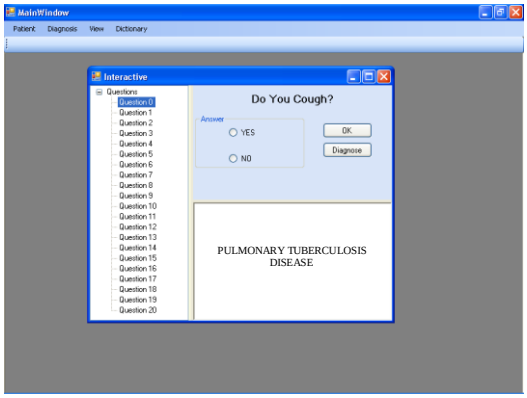
''Figure 3. Patient's Symptoms''

This figure is used to input patient's Disease Symptoms into Working Memory. After choosing symptoms checkboxes, click OK button to add these symptoms into working memory.



''Figure 4. Diagnosis Results menu''

Start Diagnosis menu is used to diagnose the patient's symptoms and display the diagnostic results with a result window.



''Figure 3. Interactive Diagnosis Windows''

This figure is used to diagnose the given symptoms to determine what disease occurred with interactive style. The patient must answer the questions that are generated by the system.

5. Conclusion

This system is implemented as an Expert System field of Artificial Intelligence Domain. And AI field is very interesting area of the computer science subject. In abbreviation, the system used Brute Force Algorithm for Reasoning. It is the data driven algorithm. Many medical Expert system use data-driven reasoning for implementation of Expert System.

6. References

[1] Giarratano "*Expert Systems: Principles and Programming*" PWS Publishing Company, Boston, MA, ISBN 0 534 95053-1, 1998

[2] C.J.Giarratano and G.Riley, "*Expert Systems, Principles and Programming*", ISBN 0-534-38447-1, 2005

[3] P.Jackson, "*Introduction to Expert Systems*", ISBN 0-201-87686-8, 1998

[4] I.James, "*Introduction to Expert Systems*", ISBN 0-07-909785-5, 1991

[5] L.G.Stephen, "*Connectionist Expert ystems*", Comb of the ACM, Feb 1998