PROCESSING OF LOOSELY STRUCTURED DATA IN THE CREATION OF A KNOWLEDGE BASE OF EXPERT SYSTEMS IN THE MEDICAL FIELD

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Annotation. This research involved designing a prototype expert system that helps patients in diagnosing their diseases and offering them the proper advice; furthermore, the knowledge management used in the expert system is discussed. One of the main objectives of this research was to find a proper language for representing patient's medical history and current situation into a knowledge base for the expert systems to be able to carry out the consultation effectively. Production rules were used to capture the knowledge.

Keywords: Knowledge Management, Expert System, CLIPS, Production System, Medical System

Introduction. An expert system solves problems by simulating the human reasoning process and applying specific knowledge and interfaces [5, 7, 8]. Expert systems also use human knowledge to solve problems that normally would require human intelligence. These expert systems represent the expertise knowledge as data or rules within the computer. These rules and data can be called upon when needed to solve problems. Books and manual guides have a tremendous amount of knowledge but a human has to read and interpret the knowledge for it to be used. A computer program designed to model the problem solving ability of a human expert. Experts systems and Artificial intelligence encompasses such diverse activities as game playing, automated reasoning, natural language, automatic programming, machine learning, robotics and vision, software tools, modelling human performance, and expert systems for complex decisions. Complex Medical decisions are central in each phase and our system help to solve this field of expert system [2,6, 15]. There are many medical diagnostic expert systems in the literature: like MYCIN, EasyDiagnosis, PERFEX, INTERNIST-I, ONCOCIN, DXplain, and PUFF. MYCIN was the first well known medical expert system

developed by Shortliffe at Stanford University [9] to help doctors, not expert in antimicrobial drugs, prescribe such drugs for blood infections. The limitation of MYCIN was: its knowledge base is incomplete, since it does not cover anything like the full spectrum of infectious diseases. Running it would have required more computing power than most hospitals could afford at that time (1976). Doctors do not relish typing at the terminal and require a much better user interface than that provided one. EasyDiagnosis is an expert system software that provides a list and clinical description of the most likely conditions based on an analysis of your particular symptoms [17]. EasyDiagnosis focuses on the most common medical complaints that account for the majority of physician visits and hospitalizations. EasyDiagnoses has a poorly designed user-interface, the user is required to answer a large number of questions without any notion that gives him the feeling that his data is accepted and will be diagnosed. PERFEX is a medical expert system that support solving problems clinicians currently have in evaluating perfusion studies. The heart of the PERFEX system is the knowledge-base, containing over 250 rules. They were formulated using the expertise of clinicians and researchers at Emory University Hospital. PERFEX limitation resides in its output. It is mostly numerical. INTERNIST-I is a rule-based expert system designed at the University of Pittsburgh in 1974 for the diagnosis of complex problems in general internal medicine [19]. ONCOCIN is a rule-based medical expert system for oncology protocol management developed at Stanford University [20]. Oncocin was designed to assist physicians with the treatment of cancer patients receiving chemotherapy. DXplain is a decision support system which uses a set of clinical findings (signs, symptoms, laboratory data) to produce a ranked list of diagnoses which might explain (or be associated with) the clinical manifestations. DXplain provides justification for why each of these diseases might be considered, suggests what further clinical information would be useful to collect for each disease, and lists what clinical manifestations, if any, would be unusual or a typical for each of the specific diseases. PUFF is an expert system for the interpretation of pulmonary function tests for patients with lung disease . PUFF was probably the first AI

system to have been used in clinical practice.

Knowledge Management in ESMDA. In the past few years, the appearance of knowledge management has facilitated the improvement for the knowledge demander in searching for knowledge efficiently and effectively [1, 3].The activity of knowledge management is wide and complex. It can be the management of person knowledge or the operation of venture knowledge. It also includes activities that form the communication of tacit knowledge to the integration of explicit knowledge. The basic activities of knowledge management are knowledge collection, creation, sharing/diffusion, and utilization [12]. There are a diversity of technologies that have been applied to support these activities, such as e-mail, database and data warehouse, group decision software, intranet and extranet, expert system, intelligent agent, data mining etc. [1, 3, 4, 10, 11]. Knowledge management in expert systems means how the knowledge is collected (knowledge acquisition), stored (knowledge representation) and retrieved (reasoning). ESMDA covers Six area of diseases: Cold and Flu, cough, fever, Ear and Eye problems (See figure 1).

Knowledge Acquisition. Basic information about the Cold and Flu, cough, fever, Ear and Eye problems, symptoms and treatment where collected from experts (physicians) and books. Knowledge elicitation was performed through interviews with the human experts.

Knowledge Representation. The environment of the system may affect its reliability. The use of some Expert System programming languages makes the system limited in specific features. The Expert System language chosen must be rulebased, portable, and use CLIPS rules. CLIPS (C Language integrated production System) was developed by Ernest Friedmanhill of Sandia National Labs [5, 14]. CLIPS is a rule based expert system shell that is suitable for our expert system. CLIPS is a productive development and delivery expert system tool which provides a complete environment for the construction of rule and/or object oriented based expert systems with python Class JClips. Class JClips is the Python part of the software bridge between CLIPS and Python. This class contains the methods to set up and control the CLIPS environment. JESS (Python Expert System Shell) was

chosen to meet these needs. JESS is rule-based, with a syntax that is a superset of CLIPS. It is also implemented in Python, and is portable to any platform with a Python 2 compatible JVM. While JESS is not open source, it is free for educational use. Since JESS is implemented in Python, it is possible to work with the JESS inference engine directly from Medical Diagnostics Systems Interface. JESS manipulates data stored in the knowledge base via a set of defined rules. All of the rule sets used in System are loosely based on Knowledge.clp. The following rule is an example of how knowledge is represented in ESMDA using CLIPS:

```
(defrule SINUSITIS
(Cough_Style (dry_cough yes) )
(Pain (around_eyes yes) ;;or
        (around_cheeks yes) ;;or
        (around_nose yes) ;;or
       (around_forehead yes) )
(Symptoms (swelling yes)
        (Headache yes)
        (discharge_nose yes)
        )       ;;end symptoms
=>
(printout t "You may be developing SINUSITIS" crlf) )
```

ESMDA help in diagnostic the following type of Diseases:

a) Cold and Flu problems The rule set of cold & flu contains knowledge about diagnoses, the symptoms of the cold or the flu and how to know when to see a doctor. The knowledge base of Cold and Flu covers the following diagnosis(see table 1):

b) Cough problems The rule set contains knowledge about how to diagnose and treat the symptoms of Cough (see Table2). A cough is an annoying symptom that can have many causes. Our Expert system can help patients identify the problem and find suggestions for treatment.

c) Ear Problems The rule set contains knowledge about Ear problems, Ear

problems are often caused by an infection. However, other conditions may also cause ear pain or discomfort. Table3 shows the diagnosis and symptoms of possible Ear problems.

d) Eye Problems This rule set contains knowledge about Eye problems, Eye pain or redness and changes in one's vision may be signs of a problem that requires medical attention. The possible list of diagnosis and symptoms of the Eye problems is in Table

e) **Fever** ESMDA has a rule set that contains knowledge about how to diagnose and treat the symptoms of fever. A fever is defined as a temperature 1° or more above the normal 98.6°. Minor infections may cause mild or short-term temperature elevations. Temperatures of 103° and above are considered high and can signal a potentially dangerous infection. Table 5 shows the diagnosis and symptoms of Fever.

f) Cystinosis ESMDA has a rule set that contains knowledge about how to diagnose and treat the symptoms of Cystinosis. Cystinosis is a rare genetic disorder that causes an accumulation of the amino acid cystine within cells, forming crystals that can build up and damage the cells. These crystals negatively affect many systems in the body, especially the kidneys and eyes. The accumulation is caused by abnormal transport of cystine from lysosomes, resulting in a massive intra-lysosomal cystine accumulation in tissues. Via an as yet unknown mechanism, lysosomal cystine appears to amplify and alter apoptosis in such a way that cells die inappropriately, leading to loss of renal epithelial cells. This results in renal Fanconi syndrome, and similar loss in other tissues can account for the short stature, retinopathy, and other features of the disease.

Symptoms There are three distinct types of cystinosis each with slightly different symptoms: nephropathic cystinosis, intermediate cystinosis, and non-nephropathic or ocular cystinosis.

- Infants affected by nephropathic cystinosis initially exhibit poor growth and particular kidney problems (sometimes called renal Fanconi syndrome). The kidney problems lead to the loss of important minerals, salts, fluids, and other nutrients.

The loss of nutrients not only impairs growth, but may result in soft, bowed bones (hypophosphatemic rickets), especially in the legs. The nutrient imbalances in the body lead to increased urination, thirst, dehydration, and abnormally acidic blood (acidosis). By about age two, cystine crystals may also be present in the cornea. The buildup of these crystals in the eye causes an increased sensitivity to light (photophobia). Without treatment, children with cystinosis are likely to experience complete kidney failure by about age ten. Other signs and symptoms that may occur in untreated patients include muscle deterioration, blindness, inability to swallow, diabetes, and thyroid and nervous system problems.

- The signs and symptoms of intermediate cystinosis are the same as nephropathic cystinosis, but they occur at a later age. Intermediate cystinosis typically begins to affect individuals around age twelve to fifteen. Malfunctioning kidneys and corneal crystals are the main initial features of this disorder. If intermediate cystinosis is left untreated, complete kidney failure will occur, but usually not until the late teens to mid twenties.
- People with non-nephropathic or ocular cystinosis do not usually experience growth impairment or kidney malfunction. The only symptom is photophobia due to cystine crystals in the cornea.

Conclusion

This paper has provided a brief introduction about knowledge management and the design of a prototype to ESMDA: Expert Systems for Medical Diagnostic Assistant. ESMDA helps patients in diagnosing their diseases and offering them the proper advice. CLIPS with Python language interface was used for representing patient's medical history and current situation into a knowledge base for the expert systems to be able to carry out the consultation effectively.

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