LOVELY PROFESSIONAL UNIVERSITY

ARTIFICIAL INTELLIGENCE REPORT

(REPORT)

AI IN HEALTHCARE

Artificial Intelligence (INT 404)

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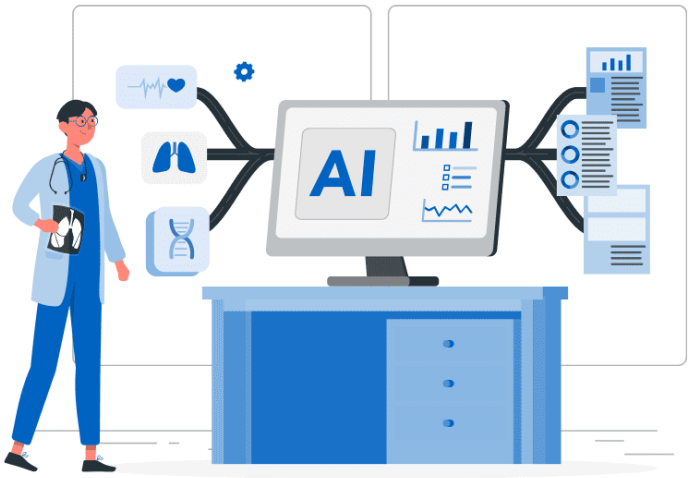
ARTIFICIAL INTELLIGENCE IN HEALTHCARE

ABSTRACT

Artificial intelligence is not one technology, but rather a collection of them. Most of these technologies have immediate relevance to the healthcare field, but the specific processes and tasks they support vary widely. Some AI technologies of high importance to healthcare are defined and described below.

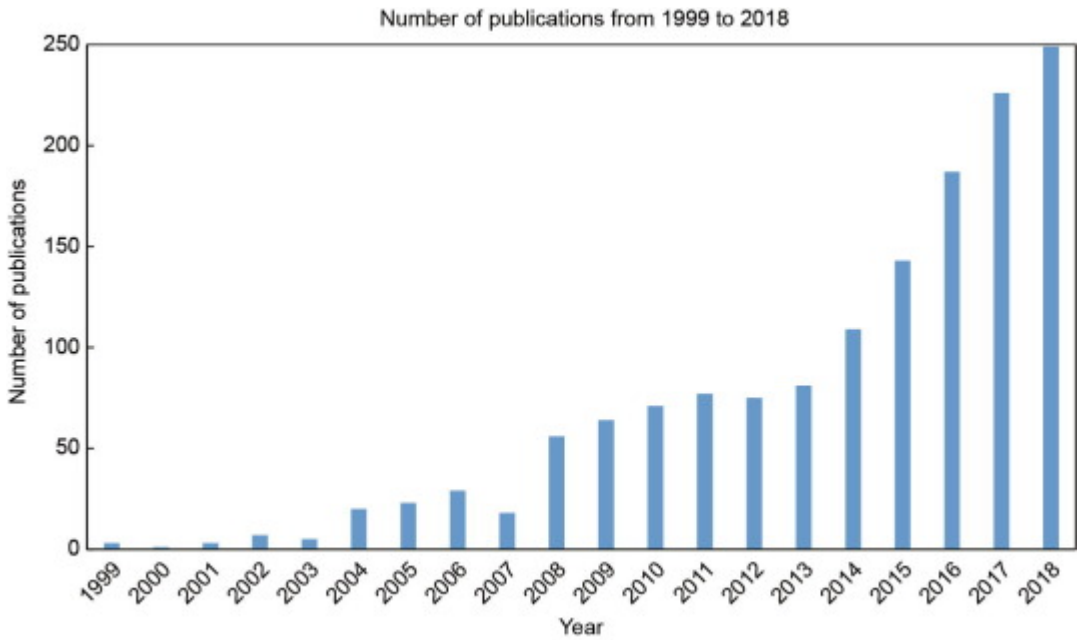


The current population of the world stands at nearly 8 billion, which is a huge number to deal with when it comes to data. The complexity and rise of data in healthcare has made it very difficult to handle manually hence comes AI (artificial intelligence) into the picture.Several types of AI are already being employed by payers and providers of care, and life sciences companies.

INTRODUCTION TO AI IN HEALTHCARE

There are already a number of research studies suggesting that AI can perform as well as or better than humans at key healthcare tasks, such as diagnosing disease. Today, algorithms are already outperforming radiologists at spotting malignant tumours, and guiding researchers in how to construct cohorts for costly clinical trials. However, for a variety of reasons, we believe that it will be many years before AI replaces humans for broad medical process domains. In this article, we describe both the potential that AI offers to automate aspects of care and some of the barriers to rapid implementation of AI in healthcare.

The goal for healthcare is to become more personal, predictive, preventative, and participatory, and AI can make major contributions in these directions. From an overview of the progress made, we estimate that AI will continue its momentum to develop and mature as a powerful tool for biomedicine.



Most interestingly, researchers in the biomedical fields have been actively trying to apply AI to help improve analysis and treatment outcomes and, consequently, increase the efficacy of the overall healthcare industry, below graph shows the

number of publications in this area in the last 20 years, from 1999 to 2018. The growth of interest is obvious, especially in the last five years, and continued growth in future can be forecast. The benefits that AI can offer to biomedicine were envisioned a couple of decades earlier. In fact, reviews have been published on the role of AI in biomedical engineering . More recently, new progress has been made in AI and its applications in biomedicine.

INTRODUCTION TO EXPERT BASED SYSTEM

Expert systems are a rapidly growing technology that use human expert knowledge to solve complex problems in many fields. They are computer programs that emulate the behaviour of a human expert and represent knowledge as data or production rules. This paper gives an overview of this technology and discusses a survey on many papers done in health using an expert system.

- Knowledge based system
- Part of artificial intelligence field
- Computer programs that contain some subject-specific knowledge of one or more human experts
- Made up of a set of rules that analyse user supplied information about a specific class of problems
- System that utilise reasoning capabilities and draw conclusions.

:-DENDRAL(1967) determine molecule structure based on mass spectrograms

:-MYCIN(1976) diagnosis & therapy recommendation for blood disease

:-PROSPECTOR(1978) mineral exploration (found a $100M ore deposit)

:-XCON(1984) configure VAX and PDP-11 series computer systems (saved DEC $70M per year)

CHARACTERISTICS OF EXPERT SYSTEM

- High Performance: The expert system provides high performance for solving any type of complex problem of a specific domain with high efficiency and accuracy.

- Understandable: It responds in a way that can be easily understandable by the user. It can take input in human language and provides the output in the same way.

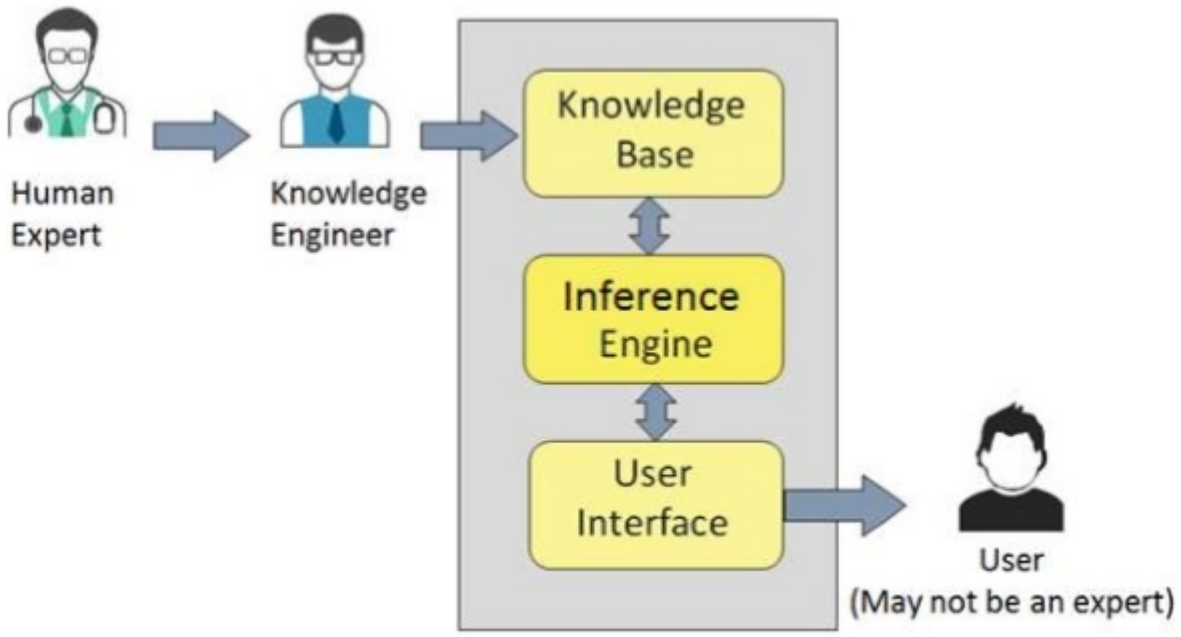
- Reliable: It is very reliable for generating an efficient and accurate output.

- Highly responsive: ES provides the result for any complex query within a very short period of time.

SYSTEM ARCHITECTURE

Usually, expert system are rule based extract expert knowledge in the form of facts & rule

1.User interface



2.Inference Engine (Rule of Engines)

Two types • Deterministic inference engine.

The conclusions drawn from this type of inference engine are assumed to be true. It is based on facts and rules.

• probabilistic Inference engine.

This type of interface engine contains uncertainty in conclusions,and based on the probability.

3.Knowledge base

Component of knowledge based:

Factual Knowledge: The knowledge which is based on facts and accepted by knowledge engineers comes under factual knowledge.

Algorithms used for implementing expert based systems.

Interface engine used below modes to derive the solution.

- Forward Chaining: It starts from the known facts and rules, and applies the inference rules to add their conclusion to the known facts.

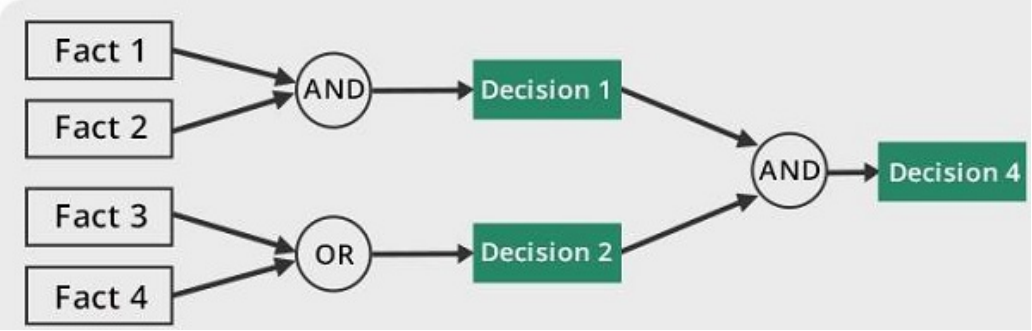


Diagram representing forward Chaining

- Backward Chaining: It is a backward reasoning method that starts from the goal and works backward to prove the known facts.

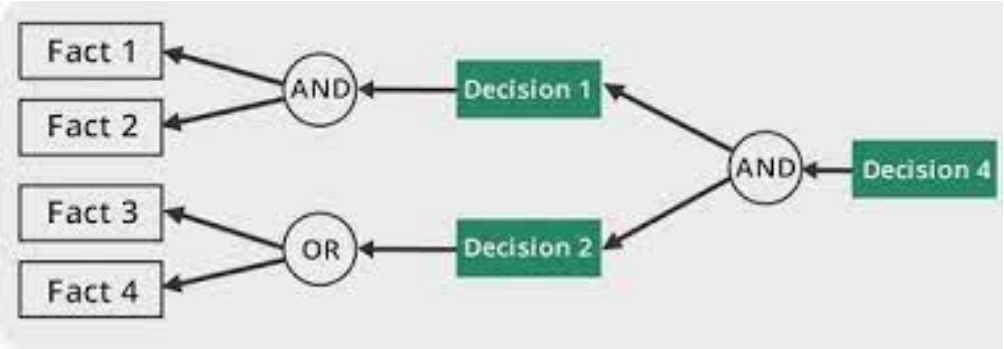


Diagram representing backward Chaining.

REAL WORLD APPLICATION OF EXPERT BASED SYSTEM :- MYCIN

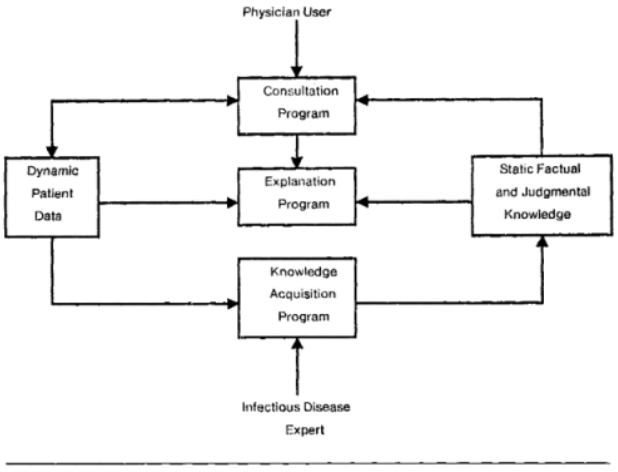
Introduction:

MYCIN was an early backward chaining expert system that used artificial intelligence to identify bacteria causing severe infections and to recommend antibiotics, with the dosage adjusted for the patient's body weight.

- MYCIN was developed over five or six years in the early 1970s at Stanford University.
- It was written in Lisp
- MYCIN operated using fairly simple inference engine, and a knowledge base of approximately 600 rules.

MYCIN is a computer program designed to provide attending physicians with advice comparable to that which they would otherwise get from a consulting physician specialising in bacteremia and meningitis infections. To use MYCIN, the attending physician must sit in front of a computer terminal that is connected to a DEC-20 (one of Digital Equipment Corporation's mainframe computers) where the MYCIN program is stored. When the MYCIN program is evoked, it initiates a dialogue. The physician types answers in response to various questions. Eventually MYCIN provides a diagnosis and a detailed drug therapy recommendation.

Structure of Mycin Program



WHY EXPERT BASED SYSTEM ?

CAPABILITIES OF EXPERT SYSTEM

1. Advising
2. Provide decision-making capabilities
3. Demonstrate a device
4. Problem-solving
5. Explaining a problem
6. Interpreting the input
7. Predicting results
8. Diagnosis

ADVANTAGES OF EXPERT SYSTEM

These systems are highly reproducible.

1. They can be used for risky places where the human presence is not safe.
2. Error possibilities are less if the KB contains correct knowledge.
3. The performance of these systems remains steady as it is not affected by emotions, tension, or fatigue.
4. They provide a very high speed to respond to a particular query.

DISADVANTAGES OF EXPERT SYSTEM

1. The response of the expert system may get wrong if the knowledge base contains the wrong information.

2. Like a human being, it cannot produce a creative output for different scenarios.

3. Its maintenance and development costs are very high.

4. Knowledge acquisition for designing is very difficult.

5. For each domain, we require a specific ES, which is one of the big limitations.

6. It cannot learn from itself and hence requires manual updates.

USE CASE OF AI IN HEALTHCARE

- Analysis of medical images

As a result of medical examinations, huge amounts of information are created. They contain a lot of graphical data that needs to be analysed. These are MRI images, ultrasound results, cardiograms, and CT scan findings.

The process of analysing and grouping medical images is time-consuming and labour-intensive. With the help of AI, the results of these graphic studies can be analysed. AI technologies optimise visual information and help cardiologists and radiologists:

- provide all the advantages of an automated system for recording medical documents.
- focus on important factors in severe cases.
- help to make a more accurate diagnosis.
- minimise the chance of errors.

- **Applications for diagnosis and treatment**

Telemedicine is the trend of AI in healthcare 2023. Remote consultations increase the number of patients who can receive medical services. This is important for remote settlements and villages with few inhabitants.

Here, medical assistance is especially needed. In such applications, general practitioners can provide real-time recommendations for the treatment of diseases that are not life-threatening.

Many large companies are working on telemedicine software. Applications use artificial intelligence to capture and recognize symptoms. Then the program makes a preliminary diagnosis. Afterwards, it recommends a specialised specialist to the patient. This reduces the number of working hours that doctors are forced to spend

on non-core patients. Some remote healthcare applications use AI with speech processing. Therefore, the patient asks questions at ease – as in a normal conversation at a doctor's appointment.

- **Patient data**

There was a shortage of medical professionals around the world even before the COVID-19 pandemic. According to the World Health Organization, for all the people of the globe to receive medical services, another 20 million top, and middle managers are needed. These figures are valid until 2030. In subsequent years, the situation will worsen for the following reasons:

These factors will certainly increase the need for highly qualified medical workers. The number of people who will have access to healthcare services will also decrease. Therefore, the latest developments should be based on artificial intelligence and medical knowledge bases. Such software will free physicians from daily simple work that takes a lot of time:

- issuance of statements;
- filling out medical records;
- analysis of information;
- answers to basic patient questions.

- **Remote patient assistance**

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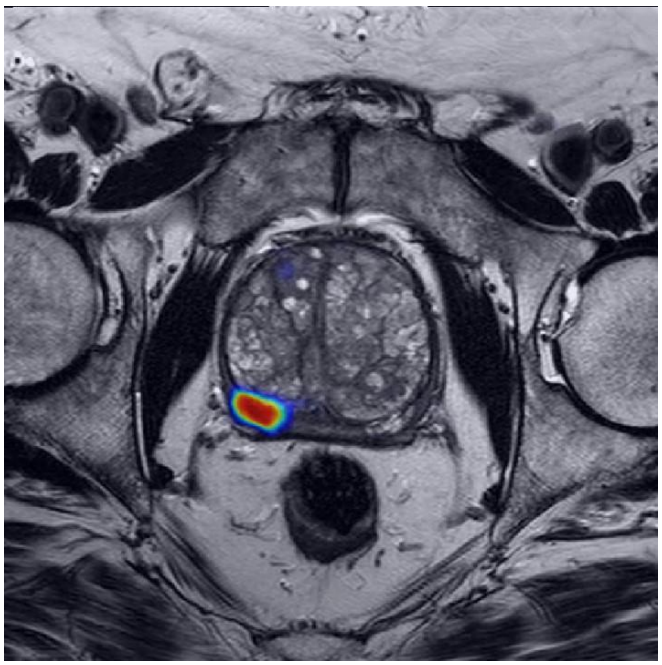
Accurate Cancer Diagnosis

AI has also shown the potential to improve cancer detection in people who have symptoms. The AI model developed by Dr. Turkbey and his colleagues in NCI's, for instance, could make it easier for radiologists to pick out potentially aggressive prostate cancer on a relatively new kind of prostate MRI scan, called multiparametric MRI.



On a multiparametric MRI scan of a patient's prostate, a cancer-suspicious area (red) is highlighted by an AI model developed by Dr. Turkbey.

Credit: Courtesy of Stephanie Harmon, Ph.D.

Although multiparametric MRI generates a more detailed picture of the prostate than a regular MRI, radiologists typically need years of practice to

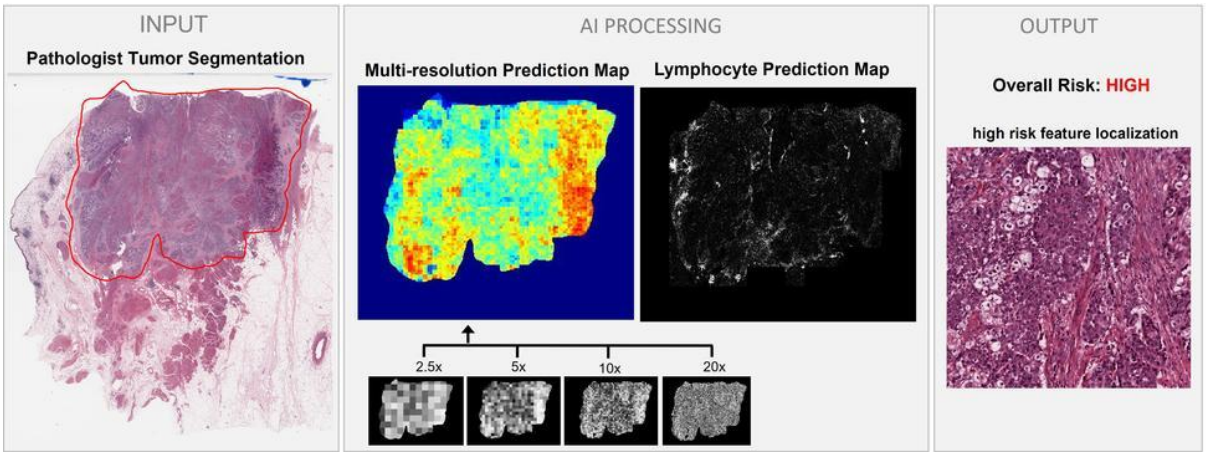
read these scans accurately, leading to disagreements between radiologists looking at the same scan.

The NCI team's AI model "can make [the learning] curve easier for practising radiologists and can minimise the error rate," Dr. Turkbey said. The AI model could serve as "a virtual expert" to guide less-experienced radiologists learning to use multiparametric MRI, he added.

For lung cancer, several deep learning AI models have been developed to help doctors find lung cancer on CT scans. Some noncancerous changes in the lungs look a lot like cancer on CT scans, leading to a high rate of false-positive test results that indicate a person has lung cancer when they really don't.

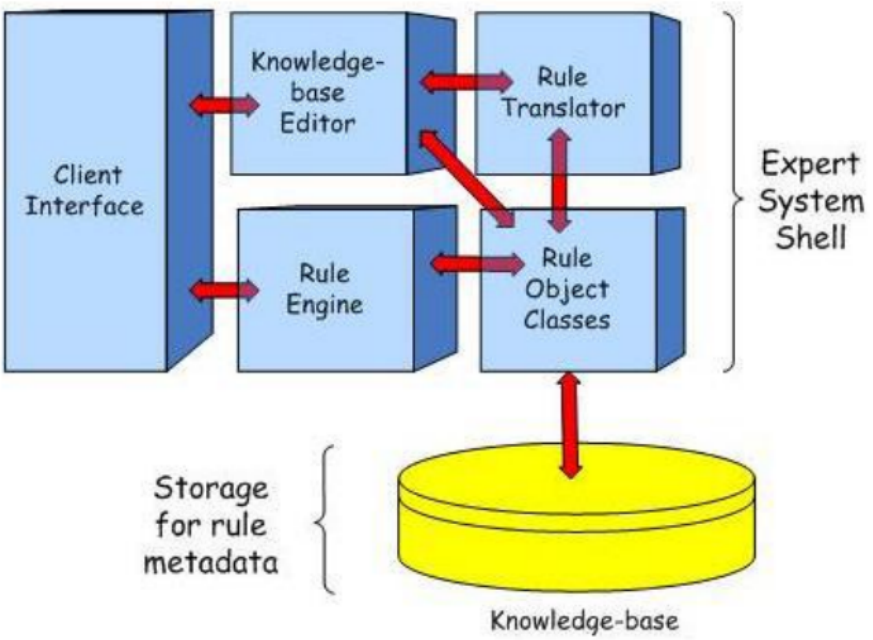
Experts think that AI may better distinguish lung cancer from noncancerous changes on CT scans, potentially cutting the number of false positives and sparing some people from unneeded stress, follow-up tests, and procedures.

For example, a team of researchers trained a deep learning algorithm to find lung cancer and to specifically avoid other changes that look like cancer. In lab tests, the algorithm was very good at ignoring noncancerous changes that look like cancer and good at finding cancer.



Cancer occurs when normal cells undergo a transformation and grow and multiply without normal controls, as the cells multiply, they form a mass called a tumour. Tumours are cancerous only if they are malignant, This means that they encroach on and invade neighbouring tissues (especially lymph nodes) because of their uncontrolled growth.Tumours may also travel to remote organs via the bloodstream. This process of invading and spreading to other organs is called metastasis. Tumours overwhelm surrounding tissues by invading their space and taking the oxygen and nutrients they need to survive.

Diagnosis of skin cancer diseases is very important. So they need a skin physician with wide experience of skin cancer diseases. For all the aforementioned reasons, we have developed this expert system to help skin physicians in diagnosing many of the skin cancer diseases, in order to prescribe the appropriate treatment. Expert System is a computer application of Artificial Intelligence (AI); which contains a knowledge base and an inference engine.



This smart program takes the rules learned from human experience and use them in the form of the “IF conditions Then results” methods of derivation and reasoning to extract and conclude results, and the resulting match of these conditions with the condition or the facts of what is specific to the problem, which is intended to find a solution. The design of expert systems vary depending on programmers based design, according to the purpose of its creation, however, there are broad lines of the existing terms of components systems that agree that the expert system consists of three main parts.

Knowledge Base.

Where the reasoning property alone is not enough to give the computer recipe of intelligence, man Intelligence is capable of reasoning and deducting of his extensive background information, so was the knowledge base is an important part of the expert system, and knowledge can be represented in expert systems in different ways but the most common one is production rules. Here we must not confuse the data and rules of knowledge in an expert system, as the first step is to retrieve stored information while the expert system is thinking and second to use the laws of logic to reach the final results.

Inference Engine

The Inference Engine machine determines when and how to use the facts or rules in the knowledge base. It specifies which rule will be fired and determines whether the solution of the problem is reached or not. It can use knowledge bases of different expert systems .

User Interface

Through the user interface, the end user can communicate with the expert system, and enables the user to answer questions and inquiries about the problem easily. Thus the expert system provides solutions and recommendations to the user in a clear and complete way .

Even though there are many expert systems that are developed for diagnosing human problems; there is no specialised expert system for diagnosing Skin Cancer diseases available free. The proposed expert system was designed and developed specifically to aid doctors in diagnosing Skin Cancer diseases.

We used the SL5 Object syntax (Rules, facts rules and objects) for representing the collected knowledge of skin cancer diseases. Here is an example of the representing knowledge:

RULE R5
IF The patient suffer from any change in size or colour or shape or texture of a mole or other skin growth
AND The patient suffer from an open or inflamed skin wound that won't heal
AND The patient suffer from a change in an existing mole
AND The patient suffer from a small dark multi coloured spot with irregular borders either elevated or flat that may bleed and form a scab
THEN ASK The patient suffer from a cluster of shiny firm dark bumps

EXPERT SYSTEM SOURCE CODE !

ATTRIBUTE start SIMPLE

ATTRIBUTE The patient suffer from any change in size or colour or shape or texture of a mole or other skin growth SIMPLE

ATTRIBUTE The patient suffer from an open or inflamed skin wound that won't heal SIMPLE

ATTRIBUTE The patient suffer from a change in an existing mole SIMPLE ATTRIBUTE The patient suffer from a small dark multi coloured spot with irregular borders either elevated or flat that may bleed and form a scab SIMPLE

ATTRIBUTE The patient suffer from a cluster of shiny firm dark bumps SIMPLE ATTRIBUTE The patient suffer from a mole larger than a pencil eraser SIMPLE

INSTANCE the domain ISA domain WITH start := TRUE

INSTANCE the application ISA application
WITH title display := introduction
WITH conclusion display := Conc

INSTANCE introduction ISA display
WITH wait := TRUE
WITH delay changes := FALSE
WITH items [1] := textbox 1

INSTANCE textbox 1 ISA textbox
WITH location := 10,10,800,350
WITH pen colour := 0,0,0
WITH fill colour := 153,255,255
WITH justify IS left
WITH font := "Arial"
WITH font style IS bold
WITH font size := 14
WITH text "=:

This Expert System diagnoses Skin Cancer Problems through a dialogue between the System and the End User. The Conclusion of the finding is Skin Cancer and Advice is given for the End User to solve the problem".

```
 INSTANCE Conc ISA display
 WITH wait := TRUE
 WITH delay changes := FALSE
 WITH items [1] := title textbox
 WITH items [2 ] := problem textbox
WITH items [3 ] := advise textbox
 INSTANCE title textbox ISA textbox
WITH location := 20,10,800,70
 WITH pen colour := 0,0,0
 WITH fill colour := 102,255,179
WITH justify IS centre
 WITH font := "Arial"
WITH font style IS bold
 WITH font size := 14
WITH text := " The Conclusion of the Skin Cancer Diagnosis Expert System"

INSTANCE problem textbox ISA textbox
WITH location := 20,110,800,130
 WITH pen colour := 0,0,0
WITH fill colour := 179,255,179
WITH justify IS left
WITH font := "Arial"
WITH font size := 14
 WITH text"--===-- "=:

 INSTANCE advise textbox ISA textbox
WITH location := 20,280,800,130
WITH pen colour := 0,0,0
WITH fill colour := 179,255,179
 WITH justify IS left
WITH font := "Arial"
 WITH font size := 14
 WITH text"--===-- "=:
```

RULE R1
IF start
THEN ASK The patient suffers from any change in size or colour or shape or texture of a mole or other skin growth.

RULE R2
IF The patient suffer from any change in size or colour or shape or texture of a mole or other skin growth
THEN ASK The patient suffer from an open or inflamed skin wound that won't heal

RULE R3
IF The patient suffer from any change in size or colour or shape or texture of a mole or other skin growth
AND The patient suffer from an open or inflamed skin wound that won't heal
THEN ASK The patient suffer from a change in an existing mole

RULE R4
IF The patient suffer from any change in size or colour or shape or texture of a mole or other skin growth
AND The patient suffer from an open or inflamed skin wound that won't heal
AND The patient suffer from a change in an existing mole
THEN ASK The patient suffer from a small dark multi coloured spot with irregular borders either elevated or flat that may bleed and form a scab

RULE R5
IF The patient suffer from any change in size or colour or shape or texture of a mole or other skin growth
AND The patient suffer from an open or inflamed skin wound that won't heal
AND The patient suffer from a change in an existing mole

AND The patient suffer from a small dark multi coloured spot with irregular borders either elevated or flat that may bleed and form a scab
THEN ASK The patient suffer from a cluster of shiny firm dark bumps

RULE R6
IF The patient suffer from any change in size or colour or shape or texture of a mole or other skin growth
AND The patient suffer from an open or inflamed skin wound that won't heal
AND The patient suffer from a change in an existing mole
AND The patient suffer from a small dark multi coloured spot with irregular borders either elevated or flat that may bleed and form a scab
AND The patient suffer from a cluster of shiny firm dark bumps
THEN ASK The patient suffer from a mole larger than a pencil eraser

RULE R7
IF The patient suffer from any change in size or colour or shape or texture of a mole or other skin growth
AND The patient suffer from an open or inflamed skin wound that won't heal AND The patient suffer from a change in an existing mole
AND The patient suffer from a small dark multi coloured spot with irregular borders either elevated or flat that may bleed and form a scab
AND The patient suffer from a cluster of shiny firm dark bumps
AND The patient suffer from a mole larger than a pencil eraser
THEN text OF problem textbox := "The patient suffers from skin cancer".
AND text OF advise textbox := "The Advice: Go to your doctor for the treatment CF 100%"
ELSE text OF problem textbox := "The patient does not suffer from skin cancer".
AND text OF advise textbox := "The Advice: Keep the good health"

END

CONCLUSION

We can summarise this discussion of certainty factors and rule-based systems as follows. The approach makes strong independence assumptions that make it relatively easy to use; at the same time assumptions create dangers if rules are not written carefully so that important dependencies are captured. The approach can serve as the basis of practical application programs. These systems use a knowledge base of medical information and algorithms to provide diagnoses, treatment recommendations, and other medical advice. They are particularly useful for routine tasks such as triaging patients, diagnosing common conditions, and monitoring vital signs. Rule-based expert systems have the potential to reduce errors, improve efficiency, and lower costs in healthcare. However, they are limited by their reliance on predetermined rules and may not always be able to adapt to new information or unique patient situations.