

Lower Back Pain Expert System Using CLIPS

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Abstract: Background : A Low back pain is a major burden to society. Many people will experience an episode of low back pain during their life. Some people develop chronic low back pain, which can be very disabling. Low back pain is associated with high direct and indirect costs. Recent epidemiological data suggest that there is a need to revise our views regarding the course of low back pain. Low back pain is not simply either acute or chronic but fluctuates over time with frequent recurrences or exacerbations. Also, low back pain may frequently be part of a widespread pain problem instead of being isolated, regional pain. Although epidemiological studies have identified many individual, psychosocial and occupational risk factors for the onset of low back pain, their independent prognostic value is usually low. Similarly, a number of factors have now been identified that may increase the risk of chronic disability but no single factor seems to have a strong impact. Consequently, it is still unclear what the most efficient strategy is for primary and secondary prevention. In general, multi-modal preventative approaches seem better able to reflect the clinical reality than single-modal interventions. **Objectives:** This paper will solve the problems of treatment of Low back pain through correct diagnosis and treatment. **Methods:** In this research, we provide an expert system for the diagnosis of Low back pain which will help doctors to explore everything related to the problems of Low back pain. We look forward to providing simplified answers to Low back pain(1).

Keywords: Artificial Intelligence, Expert Systems, Lower Back pain problem, clips ,low back pain ,epidemiology.

i. INTRODUCTION:

Back pain is very common and usually improves within a few weeks or months. Pain in the lower back (lumbago) is particularly common, although it can be felt anywhere along the spine, from the neck down to the hips. In most cases the pain is not caused by anything serious and will usually get better over time. There are things you can do to help relieve it. But sometimes the pain can last a long time or keep coming back.

Range of Lower Back Pain Symptoms Low back pain can incorporate a wide variety of symptoms. It can be mild and merely annoying or it can be severe and debilitating. Low back pain may start suddenly, or it could start slowly—possibly coming and going—and gradually get worse over time.

Depending on the underlying cause of the pain, symptoms can be experienced in a variety of ways. For example:

- Pain that is dull or achy, contained to the low back
- Stinging, burning pain that moves from the low back to the backs of the thighs, sometimes into the lower legs or feet; can include numbness or tingling (sciatica)
- Muscle spasms and tightness in the low back, pelvis, and hips
- Pain that worsens after prolonged sitting or standing
- Difficulty standing up straight, walking, or going from standing to sitting

In addition, symptoms of lower back pain are usually described by type of onset and duration:

- **Acute pain.** This type of pain typically comes on suddenly and lasts for a few days or weeks, and is considered a normal response of the body to injury or tissue damage. The pain gradually subsides as the body heals.
- **Subacute low back pain.** Lasting between 6 weeks and 3 months, this type of pain is usually mechanical in nature (such as a muscle strain or joint pain) but is prolonged. At this point, a medical workup may be considered, and is advisable if the pain is severe and limits one's ability to participate in activities of daily living, sleeping, and working.
- **Chronic back pain.** Usually defined as lower back pain that lasts over 3 months, this type of pain is usually severe, does not respond to initial treatments, and requires a thorough medical workup to determine the exact source of the pain(2).

Types of Low Back Pain:

There are many ways to categorize low back pain – two common types include:

- **Mechanical pain.** By far the most common cause of lower back pain, mechanical pain (axial pain) is pain primarily from the muscles, ligaments, joints (facet joints, sacroiliac joints), or bones in and around the spine. This type of pain tends to be localized to the lower back, buttocks, and sometimes the top of the legs. It is usually influenced by loading the spine and may feel different based on motion (forward/backward/twisting), activity, standing, sitting, or resting.
- **Radicular pain.** This type of pain can occur if a spinal nerve root becomes impinged or inflamed. Radicular pain may follow a nerve root pattern or dermatome down into the buttock and/or leg. Its specific sensation is sharp, electric, burning-type pain and can be associated with numbness or weakness (sciatica). It is typically felt on only one side of the body(3).

ii. **EXPERT SYSTEM:**

An expert system is computer software that attempts to act like a human expert on a particular subject area. Expert systems are often used to advise non-experts in situations where a human expert is unavailable (for example it may be too expensive to employ a human expert, or it might be difficult to reach location).

How Do Expert Systems Work?

An expert system is made up of three parts:

- A user interface - This is the system that allows a non-expert user to query (question) the expert system, and to receive advice. The user-interface is designed to be as simple to use as possible.
- A knowledge base - This is a collection of facts and rules. The knowledge base is created from information provided by human experts
- An inference engine - These acts rather like a search engine, examining the knowledge base for information that matches the user's query [4].

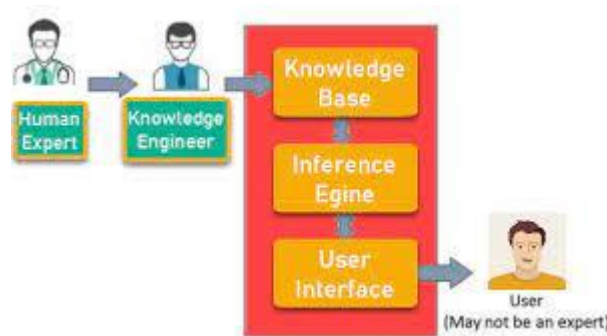


Figure 1: Expert Systems Work

iii. **LITERATURE REVIEW**

There is a lot of Expert System that were designed to diagnose human and Plant Diseases [5-56] such as Problems of Teeth and Gums, Skin Diseases, lower back pain and other types of Illness.. But there is no specialized expert system for diagnosis of lower back pain diseases available free and Use a language CLIPS. This expert system was characterized to be easy to use by specialists and users concerned. This is due to the coordinated application interface. we have built up this expert system to help specialists doctors in diagnosing lower back pain so as to prescribe the suitable treatment. Symptoms of a lower back pain disease can vary depending on the cause.

An expert system is a computer application of Artificial Intelligence (AI) [5].

iv. **MATERIALS AND METHODS**

The target expert system performs diagnosis for lower back pain diseases by presenting all symptoms. and will ask the user to choose the type of symptoms. At the end expert system provides diagnosis ,illness and recommendations for the user.

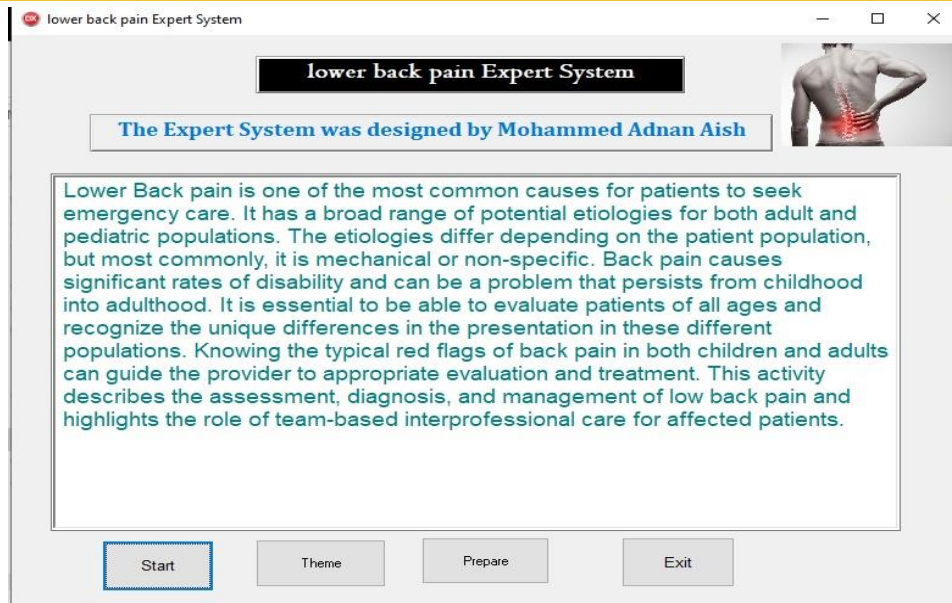


Figure 2: shows the main interface of the system

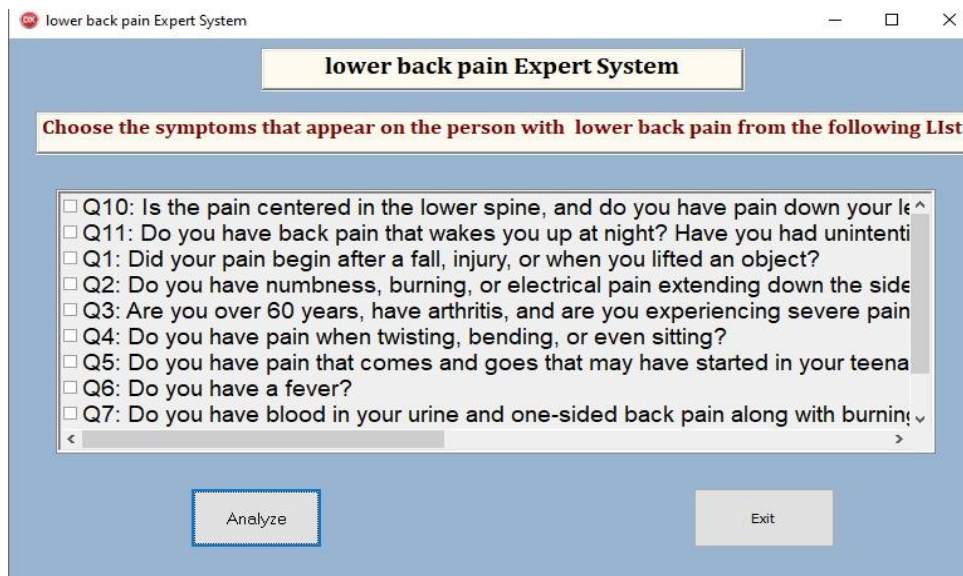


Figure 3: Dialogue between the expert system and the user

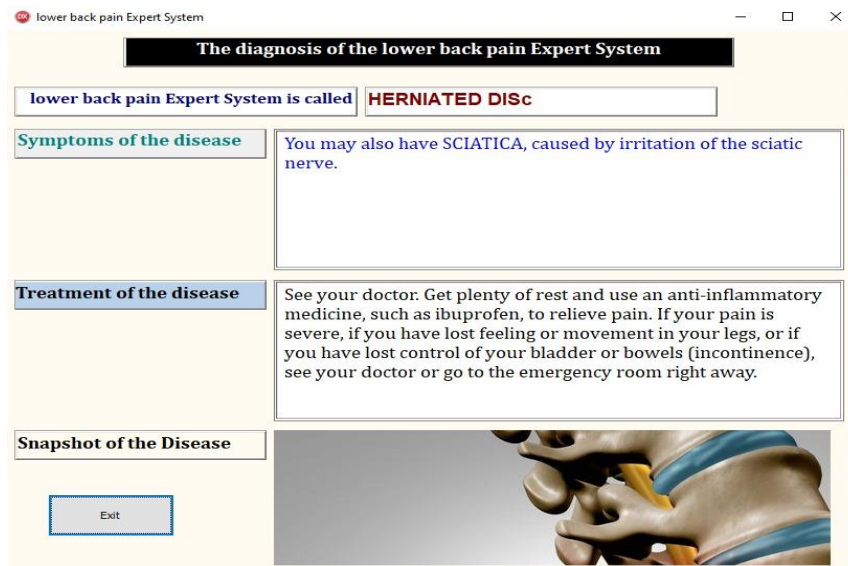


Figure 4:Diagnosis and recommendation

v. What Is a Knowledge Representation?

1. What is knowledge?

First, observe that when we say something like “John knows that ...,” we fill in the blank with a simple declarative sentence. So we might say, “John knows that Mary will come to the party,” or “John knows that Abraham Lincoln was assassinated.” This suggests that, among other things, knowledge is a relation between a knower, like John, and a proposition, that is, the idea expressed by a simple declarative sentence, like “Mary will come to the party.” Part of the mystery surrounding knowledge is due to the nature of propositions. What can we say about them? As far as we are concerned, what matters about propositions is that they are abstract entities that can be true or false, right or wrong.¹ When we say, “John knows that p,” we can just as well say, “John knows that it is true that p.” Either way, to say that John knows something is to say that John has formed a judgment of some sort, and has come to realize that the world is one way and not another. In talking about this judgment, we use propositions to classify the two cases. A similar story can be told about a sentence like “John hopes that Mary will come to the party.” The same proposition is involved, but the relationship John has to it is different.

2. What is Representation :

The concept of representation is as philosophically vexing as that of knowledge. Very roughly speaking, representation is a relationship between two domains, where the first is meant to “stand for” or take the place of the second. Usually, the first domain, the representor, is more concrete, immediate, or accessible in some way than the second. For example, a drawing of a milkshake and a hamburger on a sign might stand for a less immediately visible fast food restaurant; the drawing of a circle with a plus below it might stand for the much more abstract concept of womanhood; an elected legislator might stand for his or her constituency.

Knowledge representation, then, is the field of study concerned with using formal symbols to represent a collection of propositions believed by some putative agent. As we will see, however, we do not want to insist that these symbols must represent all the propositions believed by the agent. There may very well be an infinite number of propositions believed, only a finite number of which are ever represented. It will be the role of reasoning to bridge the gap between what is represented and what is believed.

3. what is reasoning?

In general, it is the formal manipulation of the symbols representing a collection of believed propositions to produce representations of new ones. It is here that we use the fact that symbols are more accessible than the propositions they represent: They must be concrete enough that we can manipulate them (move them around,

take them apart, copy them, string them together) in such a way as to construct representations of new propositions.

✓ **Why Knowledge Representation?**

- We can add new tasks and easily make them depend on previous knowledge. In our PROLOG program example, we can add the task of enumerating all objects of a given color, or even of painting a picture, by making use of the already specified KB to determine the colors.
- We can extend the existing behavior by adding new beliefs. For example, by adding a clause saying that canaries are yellow, we automatically propagate this information to any routine that needs it.
- We can debug faulty behavior by locating the erroneous beliefs of the system. In the PROLOG example, by changing the clause for the color of the sky, we automatically correct any routine that uses color information.
- We can concisely explain and justify the behavior of the system. Why did the program say that grass was green? It was because it believed that grass is a form of vegetation and that vegetation is green. We are justified in saying “because” here, since if we removed either of the two relevant clauses the behavior would indeed change(57)

✓ **Following are the kind of knowledge which needs to be represented in AI systems:**

- **Object:** All the facts about objects in our world domain. E.g., Guitars contains strings, trumpets are brass instruments.
- **Events:** Events are the actions which occur in our world.
- **Performance:** It describe behavior which involves knowledge about how to do things.
- **Meta-knowledge:** It is knowledge about what we know.
- **Facts:** Facts are the truths about the real world and what we represent.
- **Knowledge-Base:** The central component of the knowledge-based agents is the knowledge base. It is represented as KB. The Knowledgebase is a group of the Sentences (Here, sentences are used as a technical term and not identical with the English language)

✓ **AI knowledge cycle:**

An Artificial intelligence system has the following components for displaying intelligent behavior:

- Perception
- Learning
- Knowledge Representation and Reasoning
- Planning
- Execuion(58).

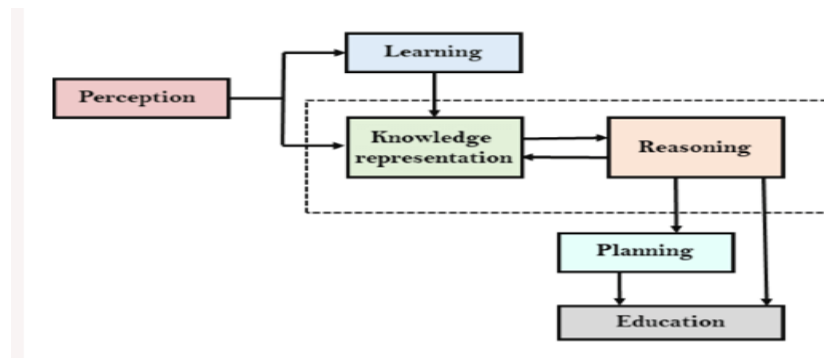


Figure 5: AI knowledge cycle

Here some overview about above DIAGNOSIS :

a. **HERNIATED DISC** : is a painful medical condition that occurs in your spine (backbone). Your spine is made up of 26 bones called vertebrae. In between each of these vertebrae are soft discs. These discs act like cushions and keep the bones of the spine in place. They also let your backbone move so you can bend and stretch. When part of a disc presses on a nerve, it can cause pain. Often the pain occurs on one side of your body. Where the pain is located depends on where the herniated disc is located.

A slipped disc in the cervical section of your spine can cause pain in your neck and arms. You could experience:

- Pain when moving your neck.
- Pain near the shoulder blade.
- Shooting pain down the arm and into the fingers.
- Numbness in the shoulder, elbow, forearm, or fingers.

A slipped disc in the lumbar part of your spine can cause pain in the back and legs. It is often referred to as sciatica. This is because the disc pushes on the sciatic nerve, which runs down your leg. Symptoms include:

- Pain in the leg, hip, or buttocks.
- Numbness in these areas.
- Pain or numbness in the back of the calf or sole of the foot.
- Weakness in one leg.

b. **VERTEBROPLASTY FRACTURED SPINE:** Vertebroplasty is an outpatient procedure that is done to treat compression spine fractures. In these types of fractures, the bone collapses and breaks. The procedure injects cement into the bone. This holds the bone in place and keeps it from collapsing or breaking more. It's also called percutaneous vertebroplasty. The bone cement used to secure the broken bone is safe.

Patients with tumors on the spine may be at slightly higher risk of complications.

Complications could include:

- Allergic reaction to the medicines.
- How long will the procedure take?
- Will I receive local or general anesthesia?
- Nerve injuries.
- Leakage of the bone cement into surrounding areas.

These complications are rare. You should always discuss the risks of any procedure with your doctor.

c. **KIDNEY STONES,**

Healthy kidneys remove waste products from your blood. These waste products leave your body in the urine your kidneys make. When the waste products don't properly leave your kidneys, it can result in kidney stones.

A kidney stone is a hard, solid lump that forms in your kidney. The lump can be as small as a tiny pebble or it can be much bigger. It's made out of the waste products in your urine.

Symptoms:

- Nausea and vomiting
- Cloudy or bloody urine
- Fever
- Feeling like you need to go to the bathroom more often than usual

Causes:

There are four types of kidney stones:

- **Calcium stone:** This is the most common type of kidney stone. Calcium that isn't used by your bones and muscles goes to your kidneys. Usually, the kidneys will get rid of the extra calcium through the urine. Calcium stones occur when some of the calcium remains in the kidneys and collects over time.
- **Struvite stone:** A struvite stone is more common in women. It usually forms after a chronic urinary tract infection. These stones are usually made of ammonia.
- **Uric acid stone:** A uric acid stone forms when there is too much uric acid in the urine. You may be at risk for this type of stone if you eat a high-protein diet or if you've received chemotherapy.
- **Cystine stone:** A cystine stone isn't very common. The disease that causes cystine stones to form runs in families and is called cystinuria.

d. Cancer:

Cancer is a collection of many diseases that all involve growth of abnormal cells. The body is made up of many types of cells. Normally, cells grow, divide, and then die. Sometimes, cells mutate (change). They begin to grow and divide more quickly than normal cells. Rather than dying, these abnormal cells clump together to form tumors.

Symptoms:

- **Unexplained weight loss.**
- **Fatigue.**
- **Not feeling "right."**
- **Blood in the stool or urine.**
- **Lumps anywhere on the body.**
- **Changes in skin appearance, texture, or color anywhere on the body.**

Causes:

- **smoking**
- **radiation**
- **viruses**
- **carcinogens (chemicals that cause cancer)**
- **hormones**
- **chronic inflammation**

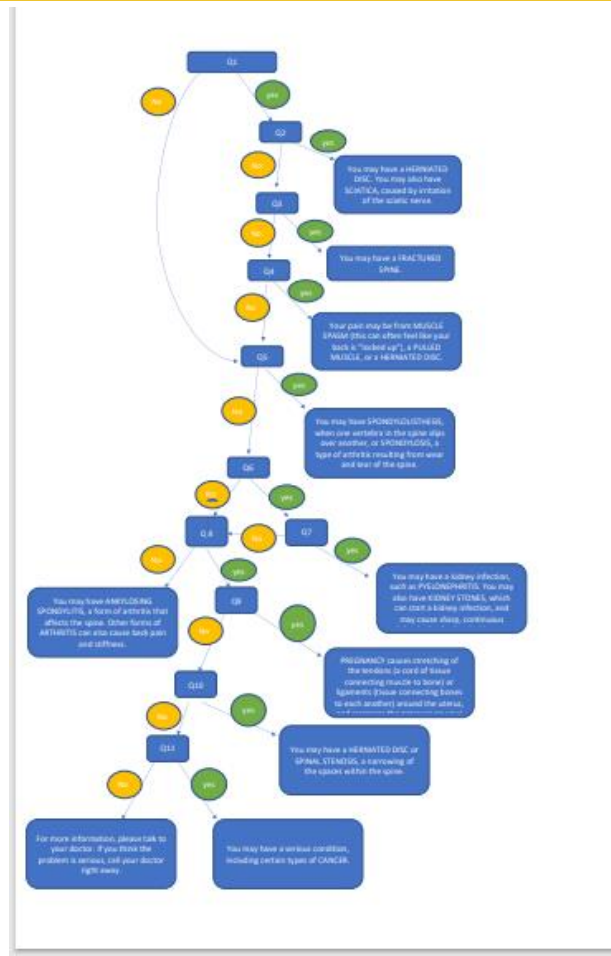


Figure 6: Decision Tree

1- Did your pain begin after a fall, injury, or when you lifted an object?
2- Do you have numbness, burning, or electrical pain extending down the side of back of your leg?
3- Are you over 60 years, have arthritis, and are you experiencing severe pain with any movement?
4- Do you have pain when twisting, bending, or even sitting?
5- Do you have pain that comes and goes that may have started in your teenage years?
6- Do you have a fever?
7- Do you have blood in your urine and one-sided back pain along with burning during urination?
8- Is your back stiff and sore in the morning and are other joints stiff, sore, swollen, or red?
9- Are you pregnant?
10- Is the pain centered in the lower spine, and do you have pain down your leg? Does bending forward while walking seem to make it feel better?

11- Do you have back pain that wakes you up at night? Have you had unintentional weight loss?

Table 1: Questions that were used in the expert system

vi. FUNCTION OF THE SYSTEM

The proposed system performs many functions. It will conclude the Low back pain problems diagnosis based on answers of the user to specific question that the system asks the user. The questions provide the system for explanation for the symptoms of the patient that helps the expert system for diagnosis the disease by inference engine. It stores the facts and the conclusion of the inference of the system, and the user, for each case, in data base. It processes the data base in order to extract rules, which complete the knowledge base.

vii. LIMITATIONS

There were 11 questions, and every question for Low back pain only through which the patient was diagnosed, and one of the following diseases was decided herniated disc , Vertebroplasty FRACTURED SPINE., KIDNEY STONES, Cancer.

viii. CONCLUSION

In this paper, a proposed expert system is presented to help doctor and people with Low back pain problems to diagnose the problem with eleven different possible questions of Low back pain problems. This system enables the user to obtain a diagnosis quickly and more accurately than a traditional diagnosis. It is also easy to use and does not require any training before use.

It was developed using clips Expert System language. An initial evaluation of the expert system was carried out and a positive feedback was received from the users. As future work we will constitute the expert system to cover all Low back pain problems.

ix. EXPERT SYSTEM SOURCE CODE

```

(defrule disease1
(Q1: Did your pain begin after a fall, injury, or when you lifted an object?)
(Q2: Do you have numbness, burning, or electrical pain extending down the side of back of your leg?)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "1" crlf ))
(defrule disease2
(Q3: Are you over 60 years, have arthritis, and are you experiencing severe pain with any movement?)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "2" crlf ))
(defrule disease3
(Q4: Do you have pain when twisting, bending, or even sitting?)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "3" crlf ))
(defrule disease4
(Q5: Do you have pain that comes and goes that may have started in your teenage years?)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "4" crlf ))
(defrule disease5
(Q6: Do you have a fever?)
(Q7: Do you have blood in your urine and one-sided back pain along with burning during urination?)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "5" crlf ))
(defrule disease6
(Q8: Is your back stiff and sore in the morning and are other joints stiff, sore, swollen, or red?)

```

```
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "6" crlf )
(defrule disease7
(Q9: Are you pregnant?)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "7" crlf ))
(defrule disease8
(Q10: Is the pain centered in the lower spine, and do you have pain down your leg? )
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "8" crlf ))
(defrule disease9
(Q11: Do you have back pain that wakes you up at night? Have you had unintentional weight loss?)
(not (disease identified))
=>
(assert (disease identified))
(printout fdatao "9" crlf ))
(defrule endline
(disease identified)
=>
(close fdatao))
(defrule readdata
(declare (salience 1000))
(initial-fact)
?fx <- (initial-fact)
=>
(retract ?fx)
(open "data.txt" fdata "r")
(open "result.txt" fdatao "w")
(bind ?symptom1 (readline fdata))
(bind ?symptom2 (readline fdata))
(bind ?symptom3 (readline fdata))
(bind ?symptom4 (readline fdata))
(bind ?symptom5 (readline fdata))
(bind ?symptom6 (readline fdata))
(bind ?symptom7 (readline fdata))
(bind ?symptom8 (readline fdata))
(bind ?symptom9 (readline fdata))
(bind ?symptom10 (readline fdata))
(assert-string (str-cat "(" ?symptom1 "))")
(assert-string (str-cat "(" ?symptom2 "))")
(assert-string (str-cat "(" ?symptom3 "))")
(assert-string (str-cat "(" ?symptom4 "))")
(assert-string (str-cat "(" ?symptom5 "))")
(assert-string (str-cat "(" ?symptom6 "))")
(assert-string (str-cat "(" ?symptom7 "))")
(assert-string (str-cat "(" ?symptom8 "))")
(assert-string (str-cat "(" ?symptom9 "))")
(assert-string (str-cat "(" ?symptom10 "))")

(close fdata)
)
```

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