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Expert System For Diagnosing Urination Problems Using Python

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***Abstract**: a problem or injury in urination is one of the most common diseases, and it has many causes, and its symptoms are bothersome and painful. These symptoms can be slight or very serious, since the patient feels almost the same symptoms. The proposed expert system was designed to assist people with problems passing urine and urinary tract infections in early detection of the disease, taking preventive and curative measures and visiting a doctor if necessary. The language used in programming the proposed system is Python.*

Keywords: *Expert Systems, Experta, Python, urination problems*

1. INTRODUCTION

The urinary system cleans the body from impurities, harmful substances and excess fluid and removes it from the body. The urinary system works around the clock non-stop even in the hours of deep sleep, and any impairment in kidney function may cause difficult diseases that may be fatal at times, and from here we must pay attention and maintain our health and every member of the body. Including the urinary system for health, strength and vitality.
The organs of the urinary system include the kidneys, renal pelvis, ureters, bladder and urethra.

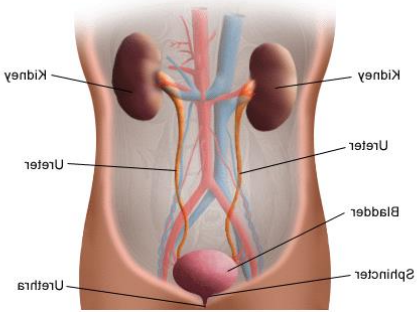

Figure 1: Front view of urinery tract [1]

The kidneys are an essential organ of the urinary system, which filters blood, removes excreta and excreta in the urine.[1]
The ureter is a small tube about 25 cm long, carrying urine from the renal pelvis to the urinary bladder.
The urinary bladder is a part of the urinary system that performs an important function in the human body, s a temporary storage reservoir for urine, It is located in the pelvic cavity, posterior to the symphysis pubis, and below the parietal peritoneum. [2]

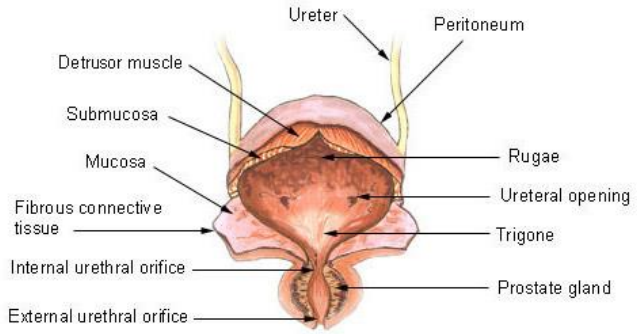

Figure 2: Urinary Bladder

The urethra is a thin-walled tube that transports urine from the floor of the urinary bladder to the outside. The urethra responsible for removing urine from the bladder out of the body.
Urinary bladder problems
1- Urinary Incontinence
It is a problem of involuntary urination, and it usually occurs from coughing, sneezing or laughing, and sometimes you may feel an urgent need to urinate immediately without warning.
There are several reasons that can cause incontinence, the most important of which are:

- Eat some types of food and drinks
- Constipation
- Pregnancy
- Birth
- An enlarged prostate.

2- Overactive bladder
Feeling the need to urinate gradually with a full bladder, but in case of overactive bladder, bladder muscles begin to shrink before the right time, which makes you feel the need to urinate.
This sudden feeling of urination can be severe and lead to some urination even though it is not desired, and it may cause you to

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wake up several times during the night, because your visits to the toilet during the day are many.

3- Urinary Tract Infection

In some cases, bacteria can enter the urethra, causing inflammation in the urinary tract, which leads to cystitis, swelling, and pain when urinating.

4- Cystitis

Cystitis usually results from urinary tract infection, and products that women use may increase their risk of this infection.

5- Bladder cancer

Doctors with bladder cancer patients are advised to remove as much of the tumor as possible, followed by chemotherapy or radiotherapy to kill the remaining cancer cells.

In some cases, the entire bladder is removed with the goal of getting rid of the cancer and preventing it again.

Experta is a Python library for building expert systems strongly inspired by CLIPS.[3]

For all the reasons mentioned above, the proposed expert system is designed to help people with problems urinating in the urinary tract and urinary tract infections in early detection of the disease, take preventive and curative measures and see a doctor if necessary.

The Expert System (ES) is a computer application that has the intelligence to make decisions in solving problems just as a skilled human expert does, it uses the specialized skills and information that some specialists provide to provide it as a computerized consulting service. The basic components of any expert system are shown in the figure below Figure 3

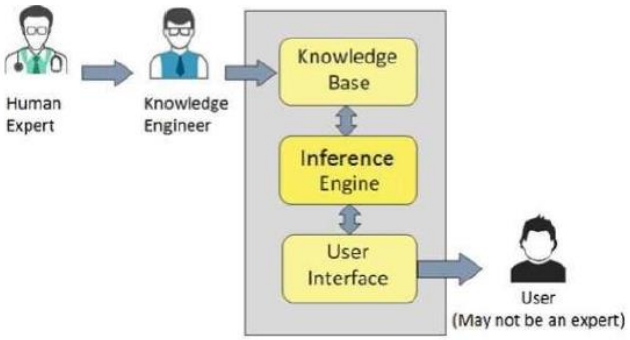

Figure3 : Main Components of Expert System

2. LITERATURE REVIEW

Many expert systems have been used in many fields such as medicine, chemistry, geology, law, politics, and economics. In the field of medicine, they are designed to diagnose human diseases [5 - 63]. However, there is no expert system for diagnosing urination problems available free of charge in Python, and this expert system is easy to use by professionals and interested persons.

3. MATERIALS AND METHODS

The proposed expert system will ask the user to answer questions about the patient's symptoms and end up with the diagnosis, personal care methods, and how to deal with the problem and recommendations for that. Figure 4 and 5 shows the expert system. Figure 5: The figure shows the decision tree of the expert system for diagnosing the urination problems.

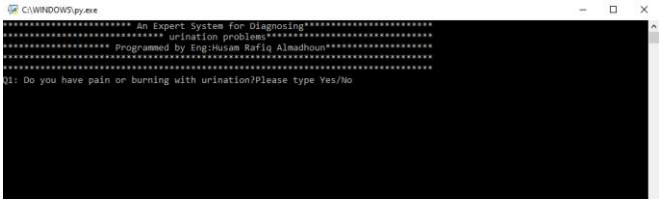

Figure4:Expert system for diagnosing the uniration problems

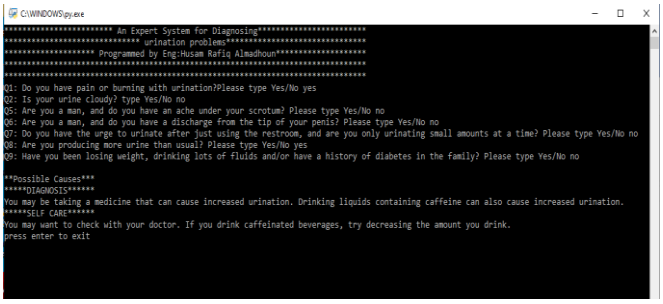

Figure5: Shows symptoms urination problems

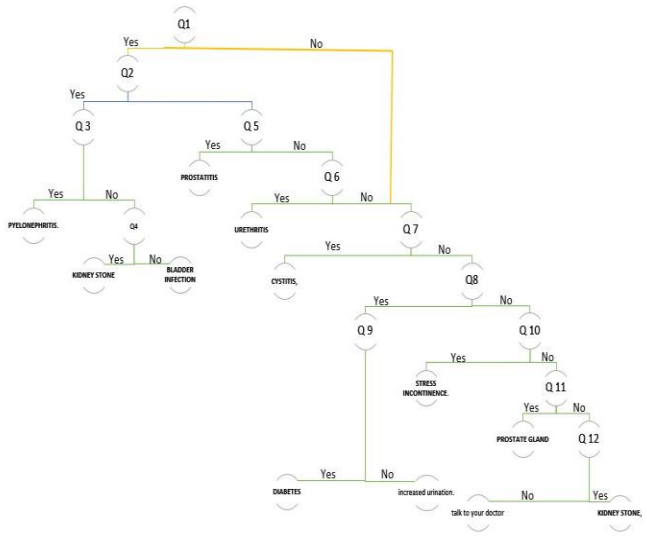

Figure 6: Diagnosis tree.

4. KNOWLEDGE REPRESENTATION

The main sources of knowledge in this expert system are urination problems, and this knowledge was used to construct facts and rules using the Python programming language and the Experta library used in building specialized systems.

The proposed expert system will diagnose the 12 urination problems by employing the knowledge obtained from a

specialized site that will ask the user to answer questions and through it the proposed expert system will provide the diagnosis and recommendations to the user, The proposed expert system contains 37 rules, Below we present the rules and expert system code for urination problems.

```
from experta import *
class Loads(KnowledgeEngine):
   @DefFacts()
   def _initial_action(self):
      yield Fact(Problem="urination")
      print(" An Expert System for Diagnosing".center(80, "*"))
      print(" urination problems".center(80, "*"))
      print(" Programmed by Eng:Husam Rafiq Almadhoun".center(80, "*"))
      print("".center(80, "*"))
      print("".center(80, "*"))


   #Rule 1
   @Rule(Fact(Problem='urination'), NOT(Fact(Q1=W())))
   def ask_id(self):
      self.declare(
         Fact(Q1=input("Q1: Do you have pain or burning with urination?Please type Yes/No ")))
   #Rule 2
   @Rule(Fact(Problem='urination'), (Fact(Q1='yes')))
   def ask_1(self):
      self.declare(
         Fact(Q2=input("Q2: Is your urine cloudy? type Yes/No ")))


  #Rule 3

@Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'),(Fact(Q2='yes')))))
   def ask_2(self):
      self.declare(
         Fact(Q3=input("Q3: Do you have a fever and/or backache? Please type Yes/No ")))


   #Rule 4

@Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'),Fact(Q2='no'))))
   def ask_3(self):
      self.declare(
         Fact(Q5=input("Q5: Are you a man, and do you have an ache under your scrotum? Please type Yes/No ")))
   #Rule 5
   @Rule(Fact(Problem='urination'), (AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'))))
   def ask_4(self):
      self.declare(
         Fact(Q6=input("Q6: Are you a man, and do you have a discharge from the tip of your penis? Please type Yes/No ")))


   #Rule 6
   @Rule(Fact(Problem='urination'), (AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'))))
   def ask_5(self):
      self.declare(
         Fact(Q7=input("Q7: Do you have the urge to urinate after just using the restroom, and are you only urinating small amounts at a time? Please type Yes/No ")))
   #Rule 7
   @Rule(Fact(Problem='urination'), (AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'), Fact(Q7='no'))))
   def ask_6(self):
      self.declare(
         Fact(Q8=input("Q8: Are you producing more urine than usual? Please type Yes/No ")))

   #Rule 8
   @Rule(Fact(Problem='urination'), (AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'), Fact(Q7='no'), Fact(Q8='yes'))))
   def ask_7(self):
      self.declare(
         Fact(Q9=input("Q9: Have you been losing weight, drinking lots of fluids and/or have a history of diabetes in the family? Please type Yes/No ")))

  #Rule 9
   @Rule(Fact(Problem='urination'), (AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'), Fact(Q7='no'), Fact(Q8='no'))))
   def ask_8(self):
      self.declare(
         Fact(Q10=input("Q10: Are you a woman, and do you leak urine when you cough or sneeze?")))


   #Rule 10
   @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'), Fact(Q7='no'), Fact(Q8='no'), Fact(Q10='no'))))
   def ask_9(self):
      self.declare(
         Fact(Q11=input("Q11: Are you a man, and do you leak or dribble urine after you urinate, or do you have problems starting the urine stream, or do you wake many times at night to urinate? Please type Yes/No ")))


   #Rule 11
   @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'), Fact(Q7='no'), Fact(Q8='no'), Fact(Q10='no'), Fact(Q11='no'))))
```

```
    def ask_10(self):
        self.declare(
            Fact(Q12=input("Q12: Do you have blood in your urine?")))


    #Rule 12
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='yes'), Fact(Q3='no'))))
    def ask_11(self):
        self.declare(
            Fact(Q4=input("Q4: Do you have sharp, knife-like, intense pains in your back or groin? Please type Yes/No ")))


    #Rule 13
    @Rule(Fact(Problem='urination'),(Fact(Q1='no')))
    def ask_12(self):
        self.declare(
            Fact(Q7=input("Q7: Do you have the urge to urinate after just using the restroom, and are you only urinating small amounts at a time? Please type Yes/No ")))


    #Rule 14
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='no'), Fact(Q7='no'))))
    def ask_13(self):
        self.declare(
            Fact(Q8=input("Q8: Are you producing more urine than usual? Please type Yes/No")))

    #Rule 15
    @Rule(Fact(Problem='urination'), (AND(Fact(Q1='no'), Fact(Q7='no'), Fact(Q8='yes'))))
    def ask_14(self):
        self.declare(
            Fact(Q9=input("Q9: Have you been losing weight, drinking lots of fluids and/or have a history of diabetes in the family? Please type Yes/No ")))

    #Rule 16
    @Rule(Fact(Problem='urination'), (AND(Fact(Q1='no'), Fact(Q7='no'), Fact(Q8='no'))))
    def ask_15(self):
        self.declare(
            Fact(Q10=input("Q10: Are you a woman, and do you leak urine when you cough or sneeze? Please type Yes/No ")))

    #Rule 17
    @Rule(Fact(Problem='urination'), (AND(Fact(Q1='no'), Fact(Q7='no'), Fact(Q8='no'), Fact(Q10='no'))))
    def ask_16(self):
        self.declare(
            Fact(Q11=input("Q11: Are you a man, and do you leak or dribble urine after you urinate, or do you have problems starting the urine stream, or do you wake many times at night to urinate? Please type Yes/No ")))

    #Rule 18
    @Rule(Fact(Problem='urination'), (AND(Fact(Q1='no'), Fact(Q7='no'), Fact(Q8='no'), Fact(Q10='no'), Fact(Q11='no'))))
    def ask_17(self):
        self.declare(
            Fact(Q12=input("Q12:Do you have blood in your urine?")))
    ############################## output ##############################

    #Rule 19
    @Rule(Fact(Problem='urination'), (AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='yes'))))
    def diagnosis_1(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print("You may have PROSTATITIS, an infection of the prostate gland.")
        print("SELF CARE".center(20, "*"))
        print("See your doctor.")

    #Rule 20
    @Rule(Fact(Problem='urination'), (AND(Fact(Q1='yes'), Fact(Q2='yes'), Fact(Q3='yes'))))
    def diagnosis_2(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print("Pain and fever may be caused by an infection of the kidneys called PYELONEPHRITIS.")
        print("SELF CARE".center(20, "*"))
        print("See your doctor right away.")

    #Rule 21
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='yes'))))
    def diagnosis_3(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print("These may be symptoms of an INFECTION such as URETHRITIS or a SEXUALLY TRANSMITTED INFECTION, such as GONORRHEA.")
        print("SELF CARE".center(20, "*"))
        print("See your doctor right away.")


    #Rule 22
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'), Fact(Q7='yes'))))
    def diagnosis_4(self):
        print("")
```

```
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print("Your symptoms may be caused by an infection in the bladder, called CYSTITIS, or from an irritation of the bladder, called INTERSTITIAL CYSTITIS, or from a KIDNEY STONE stuck in the bladder, or a chemical in the urine.")
        print("SELF CARE".center(20, "*"))
        print("See your doctor right away.")
    #Rule 23
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='yes'), Fact(Q3='no'), Fact(Q4='yes'))))
    def diagnosis_5(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print(" You may have a KIDNEY STONE or another serious problem.")
        print("SELF CARE".center(20, "*"))
        print("")
        print("EMERGENCY".center(30, "*"))
        print("See your doctor or go to the emergency room right away.")

    #Rule 24
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='yes'), Fact(Q3='no'), Fact(Q4='no'))))
    def diagnosis_6(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print("You may have a BLADDER INFECTION or a more serious problem with the KIDNEYS.")
        print("SELF CARE".center(20, "*"))
        print("See your doctor right away. Left untreated, problems with your kidneys may cause blood poisoning.")
    #Rule 25
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'), Fact(Q7='no'), Fact(Q8='yes'), Fact(Q9='yes'))))
    def diagnosis_7(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print(" You may have DIABETES, a condition in which your body lacks insulin or doesn’t use it in the right way.")
        print("SELF CARE".center(20, "*"))
        print("See your doctor.")
    #Rule 26
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'), Fact(Q7='no'), Fact(Q8='yes'), Fact(Q9='no'))))
    def diagnosis_8(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print("You may be taking a medicine that can cause increased urination. Drinking liquids containing caffeine can also cause increased urination.")
        print("SELF CARE".center(20, "*"))
        print("You may want to check with your doctor. If you drink caffeinated beverages, try decreasing the amount you drink.")
    #Rule 27
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'), Fact(Q7='no'), Fact(Q8='no'), Fact(Q10='yes'))))
    def diagnosis_9(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print(" Your symptoms may be from a weakness in the bladder due to childbirth or aging. This weakness causes STRESS INCONTINENCE.")
        print("SELF CARE".center(20, "*"))
        print("Absorbent protection may be helpful. Kegel exercises may help strengthen muscles that support the bladder. See your doctor.")
    #Rule 28
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'), Fact(Q7='no'), Fact(Q8='no'), Fact(Q10='no'), Fact(Q11='yes'))))
    def diagnosis_10(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print(" You may have a problem with your PROSTATE GLAND. Your symptoms may be caused by a benign (non-cancerous) ENLARGEMENT or a more serious condition such as INFECTION or CANCER.")
        print("SELF CARE".center(20, "*"))
        print("See your doctor.")
    #Rule 29
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'), Fact(Q7='no'), Fact(Q8='no'), Fact(Q10='no'), Fact(Q11='no'), Fact(Q12='yes'))))
    def diagnosis_11(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print(" You may have a KIDNEY STONE, a TUMOR in the kidney or bladder, a BLADDER INFECTION, TRAUMA to your kidney, or possibly a BLEEDING DISORDER.")
        print("SELF CARE".center(20, "*"))
        print("See your doctor right away.")

    #Rule 30
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='yes'), Fact(Q2='no'), Fact(Q5='no'), Fact(Q6='no'), Fact(Q7='no'), Fact(Q8='no'), Fact(Q10='no'), Fact(Q11='no'), Fact(Q12='no'))))
```

```
    def diagnosis_12(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("".center(80, "*"))
        print("SELF CARE".center(20, "*"))
        print("For more information, please talk to your doctor. If you think the problem is serious, call your doctor right away.")
    #Rule 31
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='no'), Fact(Q7='yes'))))
    def diagnosis_13(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print("Your symptoms may be caused by an infection in the bladder, called CYSTITIS, or from an irritation of the bladder, called INTERSTITIAL CYSTITIS, or from a KIDNEY STONE stuck in the bladder, or a chemical in the urine.")
        print("SELF CARE".center(20, "*"))
        print("See your doctor right away.")
     #Rule 32
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='no'), Fact(Q7='no'), Fact(Q8='yes'), Fact(Q9='yes'))))
    def diagnosis_14(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print(" You may have DIABETES, a condition in which your body lacks insulin or doesn't use it in the right way.")
        print("SELF CARE".center(20, "*"))
        print("See your doctor.")
    #Rule 33
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='no'), Fact(Q7='no'), Fact(Q8='yes'), Fact(Q9='no'))))
    def diagnosis_15(self):
        print("".center(80, "*"))
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print("You may be taking a medicine that can cause increased urination. Drinking liquids containing caffeine can also cause increased urination.")
        print("SELF CARE".center(20, "*"))
        print("You may want to check with your doctor. If you drink caffeinated beverages, try decreasing the amount you drink.")
    #Rule 34
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='no'), Fact(Q7='no'), Fact(Q8='no'), Fact(Q10='yes'))))
    def diagnosis_16(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print(" Your symptoms may be from a weakness in the bladder due to childbirth or aging. This weakness causes STRESS INCONTINENCE.")
        print("SELF CARE".center(20, "*"))
        print("Absorbent protection may be helpful. Kegel exercises may help strengthen muscles that support the bladder. See your doctor.")
        #Rule 35
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='no'), Fact(Q7='no'), Fact(Q8='no'), Fact(Q10='no'), Fact(Q11='yes'))))
    def diagnosis_17(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print("You may have a problem with your PROSTATE GLAND. Your symptoms may be caused by a benign (non-cancerous) ENLARGEMENT or a more serious condition such as INFECTION or CANCER.")
        print("SELF CARE".center(20, "*"))
        print("See your doctor.")
    #Rule 36
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='no'), Fact(Q7='no'), Fact(Q8='no'), Fact(Q10='no'), Fact(Q11='no'), Fact(Q12='yes'))))
    def diagnosis_18(self):
        print("")
        print("Possible Causes".center(20, "*"))
        print("DIAGNOSIS".center(20, "*"))
        print(" You may have a KIDNEY STONE, a TUMOR in the kidney or bladder, a BLADDER INFECTION, TRAUMA to your kidney, or possibly a BLEEDING DISORDER.")
        print("SELF CARE".center(20, "*"))
        print("See your doctor right away.")
    #Rule 37
    @Rule(Fact(Problem='urination'),(AND(Fact(Q1='no'), Fact(Q7='no'), Fact(Q8='no'), Fact(Q10='no'), Fact(Q11='no'), Fact(Q12='no'))))
    def diagnosis_19(self):
        print("".center(80, "*"))
        print("Possible Causes".center(20, "*"))
        print("".center(80, "*"))
        print("SELF CARE".center(20, "*"))
        print("For more information, please talk to your doctor. If you think the problem is serious, call your doctor right away.")
engine = Loads()
engine.reset()
engine.run()
input('press enter to exit')
```

5. CONCLUSION

Using an expert medical system is very interesting. The proposed expert system can assist specialists and patients in providing support for decision-making. This expert system does not require extensive training to use it; It is easy to use.

It was developed using the Python and Experta library of an expert system. As a preliminary evaluation an expert system was implemented and received positive feedback from users. As a future work, we will upgrade the system to include a graphical interface.

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