CODENAME: Zaemon
PROJECT: Eye-Diseases Diagnosing Expert System Using JESS

1. Abstract

In this project, we are implementing a rule-based expert system for diagnosing eye-diseases. The proposed system is implemented in JESS for the diagnosis of eye-diseases like Cataracts, Eye Floaters, Uveitis, CMV Retinitis, Color Blindness etc. In this system, the symptoms of the patients are presented to the system based on which the disease of the patient is diagnosed. The system can help the patients suffering from any kind of eye-diseases to identify it. This system can be used to assist eye professionals in their work and by patients for self-diagnosis. The system was evaluated with many test cases. The result of the evaluation was accurate.

2. Features

Eye-Diseases Diagnosing Expert System developed using Java Expert System Shell (JESS), is an expert system that uses facts and rules. The system makes use of backward chaining for the inference engine and uses the RETE algorithm to search the knowledge base. Based on the symptoms of the patient given to the system, the RETE algorithm searches the knowledge base for possible pattern matches. If there is a rule in the knowledge base which matches the symptoms of the patient, the system shows the possible diagnosis by firing that rule. Rules of the Expert System are designed in Boolean logic that processes the facts provided to it and produces the required output. The system takes the patient's symptoms and age parameters as input and processes them to do the correct diagnosis. It also provides them with the possible treatment options for treating that disease.

3. Rules and Description

The system makes use of backward chaining method to produce the desired output. Suppose, if a patient has the symptoms: blurred vision, hazy vision, night blindness and age > 70, then the rule for Low Vision disease is fired. On firing this rule, Low Vision disease gets added in the knowledge-base, and the rule with the treatment options for Low vision is fired. The expert system uses the RETE algorithm to search the knowledge-base for matching the patterns of the symptoms of the disease along with the age of the patient. It is possible that the symptoms match more than one rule, firing rules for diagnosis of all possible diseases and provides treatment options for all those diseases.

Sr no.	Rule	Description
1.	AMD	This rule will be fired on matching the following symptoms: -retina-disturbance -distortion of straight lines

		-blurred vision -age>60
2.	Bulging Eyes	This rule will be fired on matching the following symptoms: -Protruding-eyes -Excessive dryness
3.	Cataracts	This rule will be fired on matching the following symptoms: -blurred vision -double vision -opaque-lens -age>65
4.	Crossed Eyes (Strabismus)	This rule will be fired on matching the following symptoms: Misaligned-eyes
5.	DME (Diabetic Macular Edema)	This rule will be fired on matching the following symptoms: -Wavy-vision -blurred-vision -changes-viewing-colors -age>60
6.	Eye Floaters	This rule will be fired on matching the following symptoms: clouds-across-field-of-vision
7.	Glaucoma	This rule will be fired on matching the following symptoms: -blurred vision -headache -nausea -vomiting -age>65
8.	Keratoconus	This rule will be fired on matching the following symptoms: Cone-shaped-cornea
9.	Lazy Eye	This rule will be fired on matching the following symptoms: poor-vision-in-one-eye
10.	Low Vision	This rule will be fired on matching the following symptoms: -blurred-vision -hazy vision -night blindness -age>70

11.	Ocular Hypertension	This rule will be fired on matching the following symptoms: increased-pressure-in-eye
12.	CMV Retinitis	This rule will be fired on matching the following symptoms: -eye floaters -blurred vision
13.	Uveitis	This rule will be fired on matching the following symptoms: -eye-inflammation -eye floaters
14.	Color Blindness	This rule will be fired on matching the following symptoms: difficult-to-distinguish-colors
15.	Retinal Detachment	This rule will be fired on matching the following symptoms: -increase in eye floaters -sudden decrease in vision
16.	Eyelid Twitching	This rule will be fired on matching the following symptoms: -eye irritation -excessive blinking -involuntary-eye-moment
17.	EF	This rule will be fired on matching the following symptoms: -eye floaters -blurred vision
	Disease	Treatment
18.	CMV1	Medication (oral, injected or intravenous) or Laser Surgery.
19.	AMD1	Currently no treatment. Use Magnifiers.
20.	BulgingEyes1	Use eye-drops for lubrication and consult an eye professional.
21.	Cataracts1	Cataract Surgery
22.	CE1	Eyeglasses or contact lenses or Medication (eye drops) or Surgery or Patching or covering the better-seeing eye.
23.	DME1	Medication or Laser surgery.

24.	EF1	Consult an eye professional.
25.	G1	Prescription eye drops or glaucoma surgery.
26.	K1	Contact lenses or eyeglasses or eye surgery.
27.	LE	Patching or covering the strong eye; or contact lenses or eyeglasses or eye surgery.
28.	LV	Use tinted eyewear or magnifiers.
29.	OH1	Medication (eye drops).
30.	RT	Laser surgery.
31.	ET	Facial injections or surgery.
32.	Uv	Prescription eye drops in combination with anti-inflammatory medications.
33.	CB1	There is no known cure for color blindness. Contact lenses and glasses are available with filters to help color deficiencies, if needed.

4. Usage Manual

1) Assuming you have JESS running in eclipse 3.X or higher, extract the zip file in eclipse workspace.

2) Run the <filename>.clp file.

3) The input facts are supplied by deffacts construct. Three templates are created “Patient,” “Symptoms” and “Disease.”

4) You can change the value of parameters in the deffacts constructs to test other cases.

5. Output Samples

Test case 1:

```
(deffacts cases (Patient(name Melisa Brown)(age 22)(sex female) )
   (Symptoms (blurredVision yes)(EyeFloaters yes)(EyeInflammation yes)))
```

Output 1:

```
Jess, the Rule Engine for the Java Platform
Copyright (C) 2008 Sandia Corporation
Jess Version 7.1p2 11/5/2008

This copy of Jess will expire in 1813 day(s).
Melisa Brown has Uveitis.
Treatment for Uveitis: Prescription eye drops in combination with anti-
inflammatory medications or Surgery.
Melisa Brown has CMV Retinitis.
Treatment for CMV: Medication (oral, injected or intravenous) or Laser
Surgery.
```

Test Case 2:

```
(deffacts cases (Patient(name Richard Harrison)(age 71)(sex male) )
(Symptoms (poor-vision-in-one-eye yes)))
```

Output 2:

```
Jess, the Rule Engine for the Java Platform
Copyright (C) 2008 Sandia Corporation
Jess Version 7.1p2 11/5/2008

This copy of Jess will expire in 1813 day(s).
Richard Harrison has Lazy Eye.
Treatment for LazyEye: Patching or covering the strong eye;
or contact lenses or eyeglasses; or eye surgery.
```