CS 514 Applied Artificial Intelligence Project 2 report

A BLOOD SUGAR DETERMINING EXPERT SYSTEM

FUZZY DIABETES DIAGNOSER

INDEX

|  |  |
| --- | --- |
| Topic | Page number |
| Abstract | 3 |
| Features | 3 |
| Rules and Descriptions | 4 |
| Fuzzification Of The Data | 6 |
| Usage Manual | 6 |
| Sample runs | 7 |

***Note:*** *Suitable links have been provided for additional information wherever necessary in RULES and DESCRIPTION.*

# Abstract:

Diabetes Diagnoser is a rule based expert system built on JESS that is designed to take certain biochemistry related parameters from the user’s blood test and infer certain vital parameters to diagnose diabetes and makes recommendations to the user of the system. The system advices user on workout and food intake plans based on the various components in the person’s biochemistry. The system is also capable of recommending any further tests required by the user based on the ratio of glucose, electrolytes and lipid profiles . To determine blood sugar level the system considers the Fasting blood glucose and Post prandial blood glucose.

# Features:

1. The system requires the patient’s blood test details like the Fasting blood glucose, Post prandial blood glucose, Electrolytes and Lipid profiles.
2. The system considers the result of every biochemical component and advises the user if further steps are required.
3. The system first analyses the blood glucose level before as well as after the intake of food.
4. It then checks the various electrolyte levels like sodium, potassium, chlorides and creatinine. Then it advices the user on further steps to be taken if these components are found to be either high or low.
5. The system also analyses the lipid profiles present in the user’s bio chemistry.
6. The lipid profiles include Cholesterol, HDL Cholesterol, Triglycerides, non-HDL Cholesterol, VLDL Cholesterol. Except, HDL Cholesterol all other Cholesterol are dangerous for health. If there is an increase in the level of these cholesterols above the normal range then the system advices the user on the necessary actions to be taken.
7. The system is also capable of identifying that the high levels of HDL cholesterol is beneficial for health and encourages it.
8. The system advices the user to undergo BUN test if the urea in the blood is high as this might cause kidney problems.
9. The system recommends regular exercise, if the user has high cholesterol.
10. The system determines if the user has high sugar, low sugar or no sugar based on the Fasting blood glucose and Post prandial blood glucose levels.
11. All the attributes considered in biochemistry are independent. Hence, will not have any influence on each other.

# Rules and descriptions:

There are 2 templates described in the code:

**Biochemistry**

(deftemplate biochemistry

(slot fasting\_blood\_glucose(type float))

(slot post\_prandial\_blood\_glucose(type float))

(slot serum\_sodium(type float))

(slot serum\_potassium(type float))

(slot serum\_chloride(type float))

(slot HbAlc(type float))

(slot blood\_urea(type float))

(slot serum\_creatinine(type float))

(slot cholestrol(type float))

(slot HDL\_Cholestrol(type float))

(slot direct\_LDL(type float))

(slot S\_Triglycerides(type float))

(slot Non\_HDL\_Cholestrol (type float))

(slot VLDL\_Cholestrol (type float))

(slot sample (type integer))

)

**Patient**

(deftemplate patient

(slot name)

(slot age(type integer))

(slot sex)

(slot diabetes\_in\_family)

**Fuzzy Template**

(deftemplate fasting\_blood\_glucose\_data

"Auto-generated"

(declare (ordered TRUE)))

(deftemplate post\_prandial\_blood\_glucose\_data

"Auto-generated"

(declare (ordered TRUE)))

(deftemplate Age\_data

"Auto-generated"

(declare (ordered TRUE)))

(deftemplate Cholesterol\_data

"Auto-generated"

(declare (ordered TRUE)))

(deftemplate Sample\_data

"Auto-generated"

(declare (ordered TRUE)))

(deftemplate chol\_sample

"Auto-generated"

(declare (ordered TRUE)))

(deftemplate age\_sample

"Auto-generated"

(declare (ordered TRUE)))

(deftemplate Triglycerides

    "Auto-generated"

    (declare (ordered TRUE))

    )

(deftemplate Triglycerides\_sample

    "Auto-generated"

    (declare (ordered TRUE))

    )

(deftemplate Physical\_Activity\_Mins

    "Auto-generated"

    (declare (ordered TRUE))

    )

(deftemplate Physical\_Activity\_Mins\_sample

    "Auto-generated"

    (declare (ordered TRUE))

    )

(deftemplate Blood\_Pressure

    "Auto-generated"

    (declare (ordered TRUE))

    )

(deftemplate Blood\_Pressure\_sample

    "Auto-generated"

    (declare (ordered TRUE))

    )

(deftemplate Blood\_Urea

    "Auto-generated"

    (declare (ordered TRUE))

    )

(deftemplate Blood\_Urea\_sample

    "Auto-generated"

    (declare (ordered TRUE))

    )

There are total 31 rules in the program:

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Rule Name** | **Description** | **References and detailed explanations** |
| 1 | initial | Prints all the information in the test report. |  |
| 2 | defrule Low\_Sugar | Checks if both the fasting and post prandial glucose is low. | [0-70](https://en.wikipedia.org/wiki/Body_mass_index) mg/dl  0-65 mg/dl |
| 3 | defrule High\_Sugar | Checks if both the fasting and post prandial glucose is high. | [80-190](https://en.wikipedia.org/wiki/Body_mass_index) mg/dl  115-300 mg/dl |
| 4 | defrule Medium\_Sugar | Checks if both the fasting and post prandial glucose is medium. | [55-110](https://en.wikipedia.org/wiki/Body_mass_index) mg/dl  50-155 mg/dl |
| 5 | defrule Low\_High\_Sugar | Checks if the fasting glucose is low and post prandial glucose is high. | [0-70](https://en.wikipedia.org/wiki/Body_mass_index) mg/dl  115-300 mg/dl |
| 6 | defrule High\_Low\_Sugar | Checks if the fasting glucose is high and post prandial glucose is low. | [80-190](https://en.wikipedia.org/wiki/Body_mass_index) mg/dl  0-65 mg/dl |
| 7 | defrule Low\_Medium\_Sugar | Checks if the fasting glucose is low and post prandial glucose is medium. | [0-70](https://en.wikipedia.org/wiki/Body_mass_index) mg/dl  50-155 mg/dl |
| 8 | defrule Medium\_Low\_Sugar | Checks if the fasting glucose is medium and post prandial glucose is low. | [55-110](https://en.wikipedia.org/wiki/Body_mass_index) mg/dl  0-65 mg/dl |
| 9 | Defrule High\_Medium\_Sugar | Checks if the fasting glucose is high and post prandial glucose is medium. | [80-190](https://en.wikipedia.org/wiki/Body_mass_index) mg/dl  50-155 mg/dl |
| 10 | defrule Medium\_High\_Sugar | Checks if the fasting glucose is medium and post prandial glucose is high. | [55-110](https://en.wikipedia.org/wiki/Body_mass_index) mg/dl  115-300 mg/dl |
| 11 | defrule Low\_Cholesterol | Checks if the Cholesterol levels are low | 0-65mg/dl |
| 12 | defrule High\_Cholesterol | Checks if the Cholesterol levels are high. | 50-155mg/dl |
| 13 | defrule Medium\_Cholesterol | Checks if the Cholesterol levels are medium. | 115-300mg/dl |
| 14 | defrule Low\_Age | Checks if the patient is young. | 0-25 years |
| 15 | defrule Medium\_Age | Checks if the patient is middle aged. | 20-70 years |
| 16 | defrule High\_Age | Checks if the patient is Old. | 55-100 years |
| 17 | defrule Low\_Triglycerides | Check if Triglycerides levels are low | >150 mg/dl |
| 18 | defrule Med\_Triglycerides | Check if Triglycerides levels are Medium | 150 – 199 mg/dL |
| 19 | defrule high\_Triglycerides | Check if Triglycerides levels are High | 200-499 mb/dL |
| 20 | defrule Low\_Physical\_Activity | Check if Physical activity levels are low | 0-10 minutes |
| 21 | defrule Med\_Physical\_Activity | Check if Physical activity levels are Medium | 10-40 minutes |
| 22 | defrule high\_Physical\_Activity | Check if Physical activity levels are High | 40-120 minutes |
| 23 | defrule Low\_Blood\_Pressure | Check if Blood Pressure levels are low | >80 |
| 24 | defrule Med\_Blood\_Pressure | Check if Blood Pressure levels are Medium | 80-120 |
| 25 | defrule high\_Blood\_Pressure | Check if Blood Pressure levels are High | <120 |
| 26 | defrule Low\_Blood\_Urea | Check if Blood Urea levels are low | >7 mg/dL |
| 27 | defrule Med\_Blood\_Urea | Check if Blood Urea levels are Medium | 7-20 mg/dL |
| 28 | defrule high\_Blood\_Urea | Check if Blood Urea levels are High | <7 mg/dL |
| 29 | defrule diagnose | To determine if the person has diabetes based on the data provided. |  |
| 30 | defrule printFacts | To print all the facts |  |
| 31 | defrule init | Initialize the values for the patient and his biochemistry |  |
|  |  |  |  |
|  |  |  |  |

# Fuzzification Of The Data :

# The MAIN:: init - Fuzzy variables rule is used to divide the Fasting blood glucose, Post prandial blood glucose, Cholesterol and Age into desirable fuzzy categories with the following template:

(?\*fasting\_blood\_glucose\_Var\* addTerm "low" (new ZFuzzySet 10.0 70.0))

(?\*fasting\_blood\_glucose\_Var\* addTerm "medium" (new TrapezoidFuzzySet 55.0 70.0 85.0 110.0))

(?\*fasting\_blood\_glucose\_Var\* addTerm "High" (new SFuzzySet 80.0 190.0))

# Once the fuzzification is complete, the user defined values for the applicant template are passed into the rule so that they are categorized accordingly and used further ahead. This process is done using:

(assert (fasting\_blood\_glucose\_data (new FuzzyValue ?\*fasting\_blood\_glucose\_Var\* (new SingletonFuzzySet ?biochemistry.fasting\_blood\_glucose))))

# Finally, the rule that was defined for Boolean logic in project 1 can now be divided into all possible sub categories that deal with all the fuzzy sets accordingly.

# Usage Manual:

## Instructions:

Copy the file diabetes\_diagnosis.clp to the BIN folder under the JESS directory.

Open JESS and execute the below commands:

(batch AI\_Blood\_Sugar1.clp)

# Sample runs:

## Run #1

Condition where the user do not have diabetes or any other risks.

(assert (biochemistry(fasting\_blood\_glucose 55.0)

(post\_prandial\_blood\_glucose 115.0)

(serum\_sodium 50.0)

(serum\_potassium 2.0)

(serum\_chloride 80)

(HbAlc 5)

(blood\_urea 10)

(serum\_creatinine 0.5)

(cholestrol 150)

(HDL\_Cholestrol 30)

(direct\_LDL 70)

(S\_Triglycerides 50)

(Non\_HDL\_Cholestrol 80)

(VLDL\_Cholestrol 25)

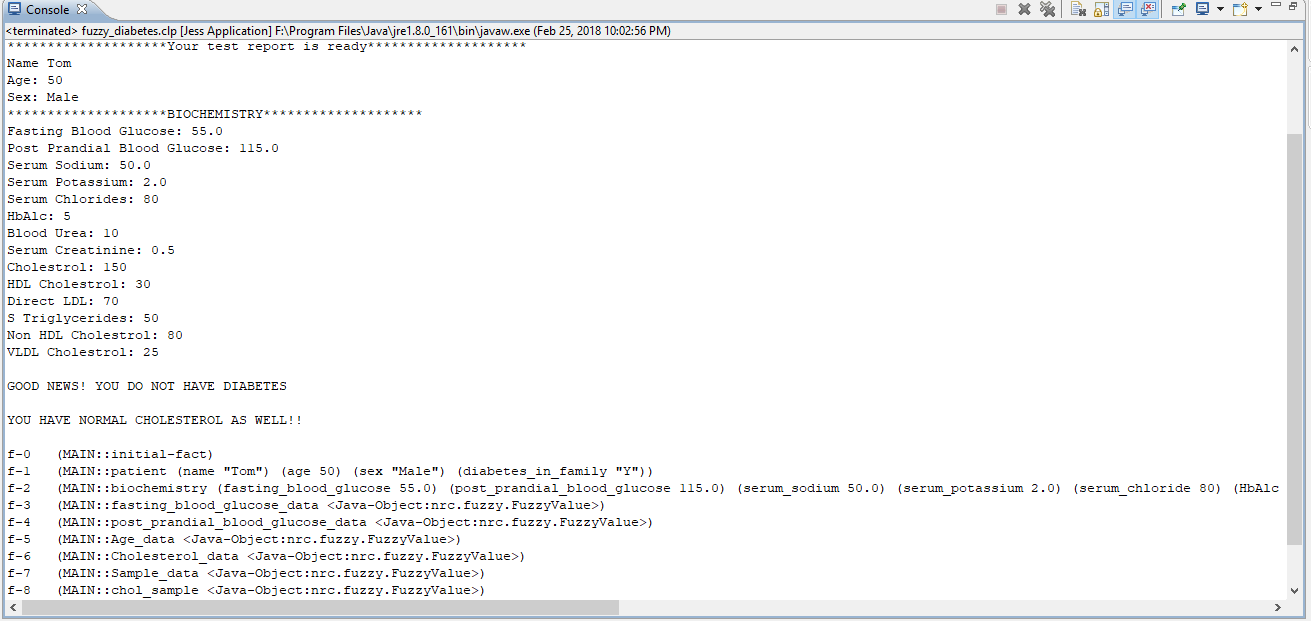
))

(assert (patient (name "Mark")

(age 45)

(sex "Male")

(diabetes\_in\_family "Y")))



## Run #2

Condition where the user has high diabetes and other risks.

(assert (biochemistry(fasting\_blood\_glucose 150.0)

(post\_prandial\_blood\_glucose 250.0)

(serum\_sodium 50.0)

(serum\_potassium 2.0)

(serum\_chloride 80)

(HbAlc 5)

(blood\_urea 10)

(serum\_creatinine 0.5)

(cholestrol 150)

(HDL\_Cholestrol 30)

(direct\_LDL 70)

(S\_Triglycerides 220)

(Non\_HDL\_Cholestrol 80)

(VLDL\_Cholestrol 25)

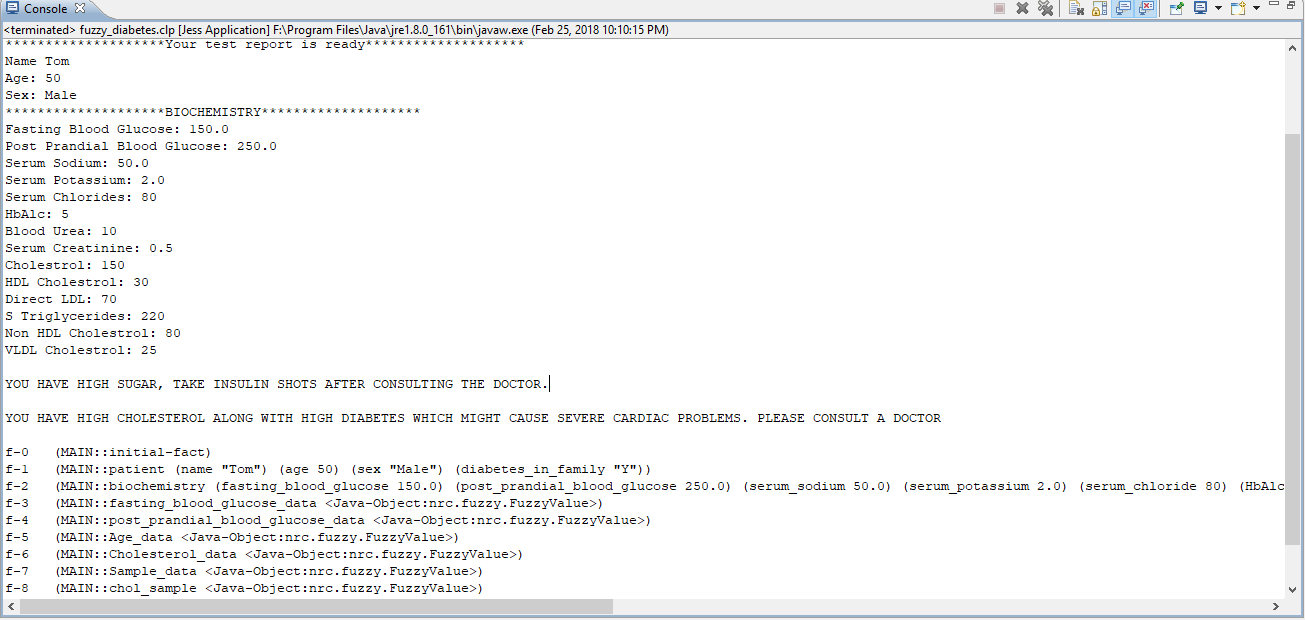
)))

(assert (patient (name "Mark")

(age 45)

(sex "Male")

(diabetes\_in\_family "Y")))



## Run #3

Condition where the user has low blood sugar and other risks.

(assert (biochemistry(fasting\_blood\_glucose 50.0)

(post\_prandial\_blood\_glucose 45.0)

(serum\_sodium 50.0)

(serum\_potassium 2.0)

(serum\_chloride 80)

(HbAlc 5)

(blood\_urea 10)

(serum\_creatinine 0.5)

(cholestrol 150)

(HDL\_Cholestrol 30)

(direct\_LDL 70)

(S\_Triglycerides 250)

(Non\_HDL\_Cholestrol 80)

(VLDL\_Cholestrol 25)

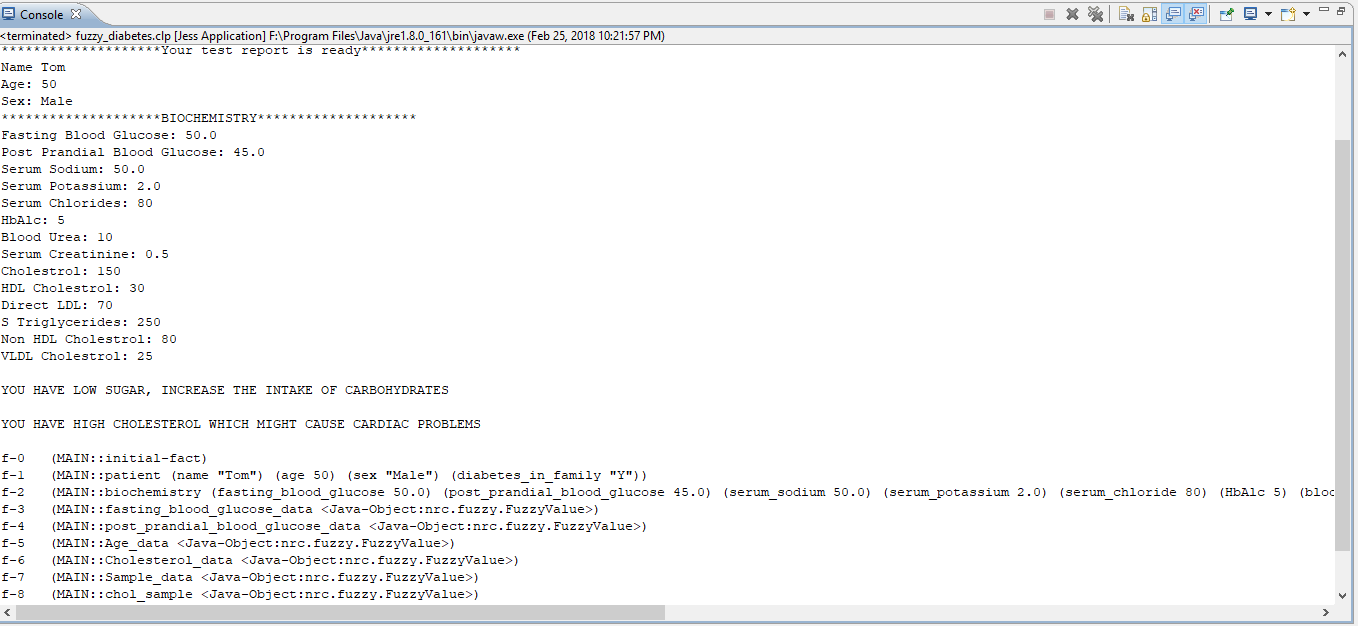
))

(assert (patient (name "Mark")

(age 45)

(sex "Male")

(diabetes\_in\_family "Y")))



## Run #4

Condition where the user is prediabetic and has other problems.

(assert (biochemistry(fasting\_blood\_glucose 75.0)

(post\_prandial\_blood\_glucose 110.0)

(serum\_sodium 50.0)

(serum\_potassium 2.0)

(serum\_chloride 80)

(HbAlc 5)

(blood\_urea 10)

(serum\_creatinine 0.5)

(cholestrol 150)

(HDL\_Cholestrol 30)

(direct\_LDL 70)

(S\_Triglycerides 250)

(Non\_HDL\_Cholestrol 80)

(VLDL\_Cholestrol 25)))

(assert (patient (name "Mark")

(age 45)

(sex "Male")

(diabetes\_in\_family "Y")))

