

# HEART DISEASE RISK PREDICTION SYSTEM

(Predicts risk for heart disease in the next 10 years based  
on user health data)

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

## **ABSTRACT**

Heart Disease Prediction System is a fuzzy based system built on FuzzyJ that is designed to take certain health related parameters from the user and infer certain vital parameters and makes recommendations to the user of the system. The system determines whether user is at risk for developing a heart disease in the next 10 years based on the patient's health information like height, weight, blood pressure and sleep and tension parameters.

## **FEATURES**

1. The system can calculate parameters like Body Mass Index (BMI) based on height and weight.
2. The system can classify the individual into different obesity fitness levels.
3. The system is also capable to identifying stress based on hypertension symptoms and sleep patterns.
4. Based on obesity indices and stress levels the system also estimates risk of heart attack.
5. The system infers the chances of diabetes.
6. In case the system finds users with extreme symptoms, the system recommends the user to consult a physician immediately.

## RULES AND DESCRIPTION

There are 12 templates described in the code

```
• (deftemplate patient
  (slot name)
  (slot weight (type INTEGER))
  (slot height (type INTEGER))
)

• (deftemplate patient_bmi
  "Auto-generated"
  (declare (ordered TRUE))
)

• (deftemplate patient_sleep
  "Auto-generated"
  (declare (ordered TRUE))
)

• (deftemplate patient_bp_sys
  "Auto-generated"
  (declare (ordered TRUE))
)

• (deftemplate patient_bp_dias
  "Auto-generated"
  (declare (ordered TRUE))
)

• (deftemplate patient_workout-p
  "Auto-generated"
  (declare (ordered TRUE))
)

• (deftemplate patient_stress-level
  "Auto-generated"
  (declare (ordered TRUE))
)

• (deftemplate patient_chd-risk
  "Auto-generated"
  (declare (ordered TRUE))
)

• (deftemplate patient_sugar-level
  (slot level (type INTEGER))
)

• (deftemplate patient_diabeticCondition
  "Auto-generated"
  (declare (ordered TRUE))
)
```

```
)

• (deftemplate patient_water-int
  "Auto-generated"
  (declare (ordered TRUE)))

)

• (deftemplate patient_cal-int
  "Auto-generated"
  (declare (ordered TRUE)))

)
```

There are 11 rules in the program:

Rule Number	Rule Name	Description
1	<code>defrule welcome-user</code>	Rule for the application that prints the Welcome message
2	<code>defrule MAIN::init-FuzzyVariables</code>	Initializing Global Variables
3	<code>defrule init</code>	Initializing patient values Starting point of execution. This rule will create all the basic facts in the working memory.
4	<code>defrule fuzzify_bmi</code>	Compute the BMI and fuzzify outputs Based on the height and the weight of the user, calculate the BMI and fuzzify it. The inputs are crisp set and the output is a fuzzy set as well.
5	<code>defrule mod_workout_required</code>	Recommend various workout based on the BMI Moderate for normal people Based on the BMI recommend workout type. For people with “normal” BMI will have moderate workout routine. The

		inputs are fuzzy and the output is a fuzzy set as well.
6	<code>defrule extrm_workout_required</code>	Recommend various workout based on the BMI Intense for obese people Based on the BMI recommend workout type. For people categorized as “overweight” will have an intense workout routine. The inputs are fuzzy and the output is a fuzzy set as well.
7	<code>defrule stress_lvls_high</code>	Compute the stress levels on the basis of poor sleep patterns and hypertension. Based on user input about the sleep patterns, diastolic and systolic blood pressures, infer stress of the individual. The inputs are fuzzy and the output is a fuzzy set as well.
8	<code>defrule chd_risks_high</code>	Compute the risk for coronary heart diseases based on stress level and BMI. A person with high stress and who is overweight is prone to heart attack. The inputs are fuzzy and the output is a fuzzy set as well.
9	<code>defrule chd_risks_mod</code>	Compute the risk for coronary heart diseases based on stress level and BMI A person with “more or less high” stress

		levels and is not over weight will have “moderate” chances of heart attack. The inputs are fuzzy and the output is a fuzzy set as well.
10	<code>defrule diabetes_chck</code>	Compute the chances of diabetes based on sugar levels. Calculate chances of diabetes based on the sugar level that is taken as an input from the user. The inputs are crisp sets and the output is a fuzzy set as well.
11	<code>defrule disImmediateDiagnosisHeartCondn</code>	In case of high risk for Heart Disease, advise for immediate attention. For users who have both high chances of heart conditions as well as high chances of diabetes, the system recommends consulting a specialist as soon as possible. The inputs are fuzzy and the output is a fuzzy set as well.

# USAGE MANUAL

## INSTRUCTIONS:

1. Create a new Java project in eclipse. Make sure you include the JAR file “fuzzyJ-2.0.jar” under New Project > Libraries.
2. Copy the contents of the files “FUZZY\_predict\_heart\_disease.clp” into a new text file under the newly created Java project. Save the file with extension “.clp”.
3. Run the project after setting up the correct run configurations.

In case you run into errors, make sure that the run as configuration is pointing to the right .main class.

By default, the main class will be jess.main. For the fuzzy parts to execute it should point to nrc.fuzzy.jess.FuzzyMain

**In case the grader wants to change inputs and test new inputs please only make changes to the rule “init”**

## *Allowed input values in the init rule:*

patient:::

name: <any valid string>

height: <height of the patient in meters>

weight: <weight of the patient in Kg>

sleep: <poor, normal>

bp\_sys: <low, hypertension, ideal>

bp\_dias: <low, hypertension, ideal>

sugar-level : <any valid positive float value in the range 30-200>

## *Format of the input for the init rule:*

```
(assert (patient (name Patient1)(height 1.6256)(weight 90))) ;
```

```
(assert (sleep (new nrc.fuzzy.FuzzyValue ?*sleepVar* "poor")))
```

```
(assert (bp_sys (new nrc.fuzzy.FuzzyValue ?*bloodPressSVar* "hypertension")))
```

```
(assert (bp_dias (new nrc.fuzzy.FuzzyValue ?*bloodPressDVar* "hypertension")))
```

```
(assert (sugar-level (level 100)))
```



# SAMPLE RUNS

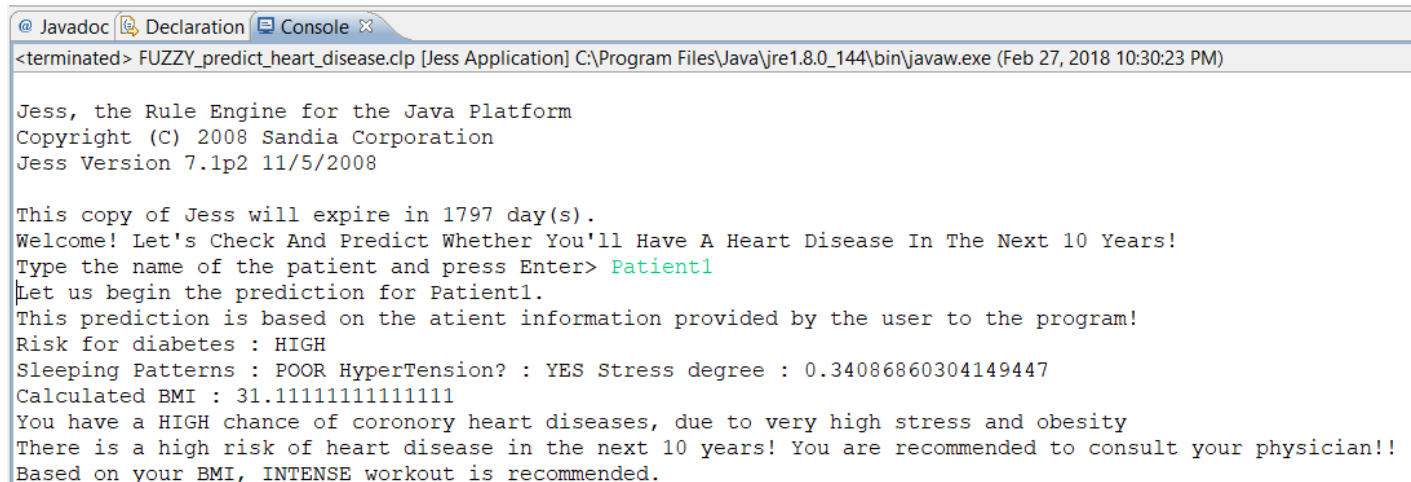
## RUN #1

According to below screenshot, the user gives the following input after the program runs:

```
(assert (patient (name Patient1) (height 1.5) (weight 70))) ;
(assert (patient_sleep (new nrc.fuzzy.FuzzyValue ?*sleepVar* "poor")))
(assert (patient_bp_sys (new nrc.fuzzy.FuzzyValue ?*bloodPressSVar*
"ideal")))
(assert (patient_bp_dias (new nrc.fuzzy.FuzzyValue ?*bloodPressDVar*
"hypertension")))
(assert (patient_sugar-level (level 100)))

;Initializing patient values
(=defrule init
  (declare (salience 50))
  =>
  (assert (patient (name Patient1) (height 1.5) (weight 70))) ;
  (assert (patient_sleep (new nrc.fuzzy.FuzzyValue ?*sleepVar* "poor")))
  (assert (patient_bp_sys (new nrc.fuzzy.FuzzyValue ?*bloodPressSVar* "ideal")))
  (assert (patient_bp_dias (new nrc.fuzzy.FuzzyValue ?*bloodPressDVar* "hypertension")))
  (assert (patient_sugar-level (level 100)))
)
```

## Output for SampleRunPatient1:



```
<terminated> FUZZY_predict_heart_disease.clp [Jess Application] C:\Program Files\Java\jre1.8.0_144\bin\javaw.exe (Feb 27, 2018 10:30:23 PM)

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 1797 day(s).
Welcome! Let's Check And Predict Whether You'll Have A Heart Disease In The Next 10 Years!
Type the name of the patient and press Enter> Patient1
Let us begin the prediction for Patient1.
This prediction is based on the atient information provided by the user to the program!
Risk for diabetes : HIGH
Sleeping Patterns : POOR HyperTension? : YES Stress degree : 0.34086860304149447
Calculated BMI : 31.11111111111111
You have a HIGH chance of coronary heart diseases, due to very high stress and obesity
There is a high risk of heart disease in the next 10 years! You are recommended to consult your physician!!
Based on your BMI, INTENSE workout is recommended.
```

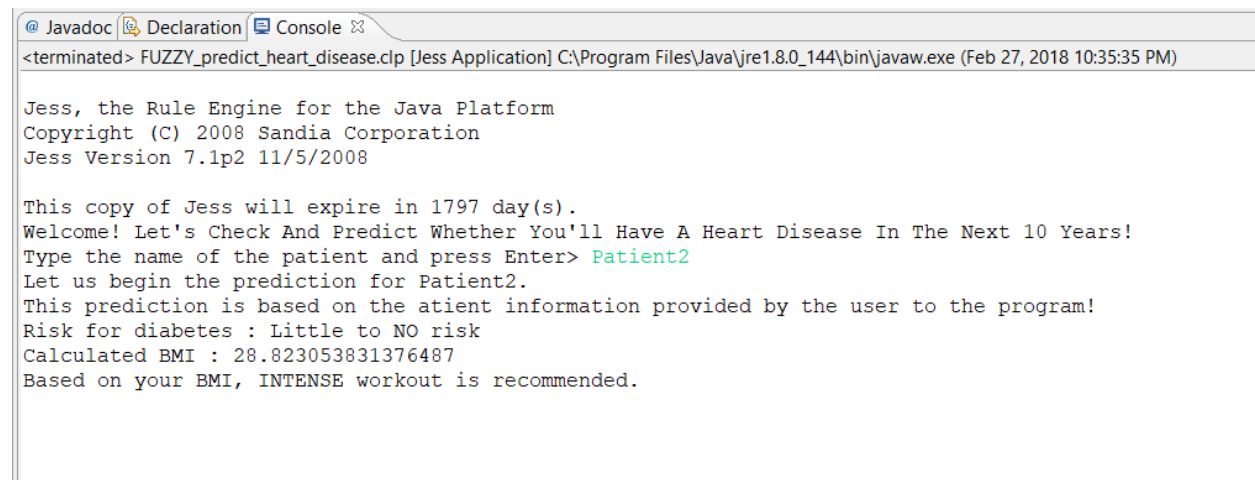
## RUN #2

According to below screenshot, the user gives the following input after the program runs:

```
(assert (patient (name Patient2) (height 1.666) (weight 80))) ;  
(assert (patient_sleep (new nrc.fuzzy.FuzzyValue ?*sleepVar* "normal")))  
(assert (patient_bp_sys (new nrc.fuzzy.FuzzyValue ?*bloodPressSVar*  
"hypertension")))  
(assert (patient_bp_dias (new nrc.fuzzy.FuzzyValue ?*bloodPressDVar*  
"hypertension")))  
(assert (patient_sugar-level (level 70)))
```

```
(assert (patient (name Patient2) (height 1.666) (weight 80))) ;  
(assert (patient_sleep (new nrc.fuzzy.FuzzyValue ?*sleepVar* "normal")))  
(assert (patient_bp_sys (new nrc.fuzzy.FuzzyValue ?*bloodPressSVar* "hypertension")))  
(assert (patient_bp_dias (new nrc.fuzzy.FuzzyValue ?*bloodPressDVar* "hypertension")))  
(assert (patient_sugar-level (level 70)))
```

### Output for SampleRunPatient2:



```
@ Javadoc Declaration Console  
<terminated> FUZZY_predict_heart_disease.clp [Jess Application] C:\Program Files\Java\jre1.8.0_144\bin\javaw.exe (Feb 27, 2018 10:35:35 PM)  
  
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 1797 day(s).  
Welcome! Let's Check And Predict Whether You'll Have A Heart Disease In The Next 10 Years!  
Type the name of the patient and press Enter> Patient2  
Let us begin the prediction for Patient2.  
This prediction is based on the atient information provided by the user to the program!  
Risk for diabetes : Little to NO risk  
Calculated BMI : 28.823053831376487  
Based on your BMI, INTENSE workout is recommended.
```