

# **DIABETES RISK EVALUATION ENGINE**

**(Evaluates the risk of having diabetes)**

## Abstract:

Diabetes Risk Evaluation Engine is a fuzzy based expert 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 is a prototype which classifies the user as underweight, normal or overweight. The system diagnoses diabetes, chances of a heart risk, recommends workout and also the stress levels.

## Features:

1. The system can calculate parameters like Body Mass Index on the basis of 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 descriptions:

Rule #	Rule Name	Description
1.	init-FuzzyVariables	Initialize all the fuzzy variables for the expert system to reason
2.	init	Starting point of execution. This rule will create all the basic facts in the working memory.
3.	fuzzify_bmi	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.
4.	mod_workout_required	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.
5.	extrm_workout_required	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.
6.	stress_lvls_high	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.

7.	heart_risks_high	A person with high stress and who is over weight is prone to heart attack. The inputs are fuzzy and the output is a fuzzy set as well.
8.	heart_risks_mod	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.
9.	diabetes_chck	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.
10.	disImmediateDiagnosisHeartCondn	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 “diabetes2.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”**

Format of the input for the init rule:::

```
(assert (patient (name Daniel)(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)))
```

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>

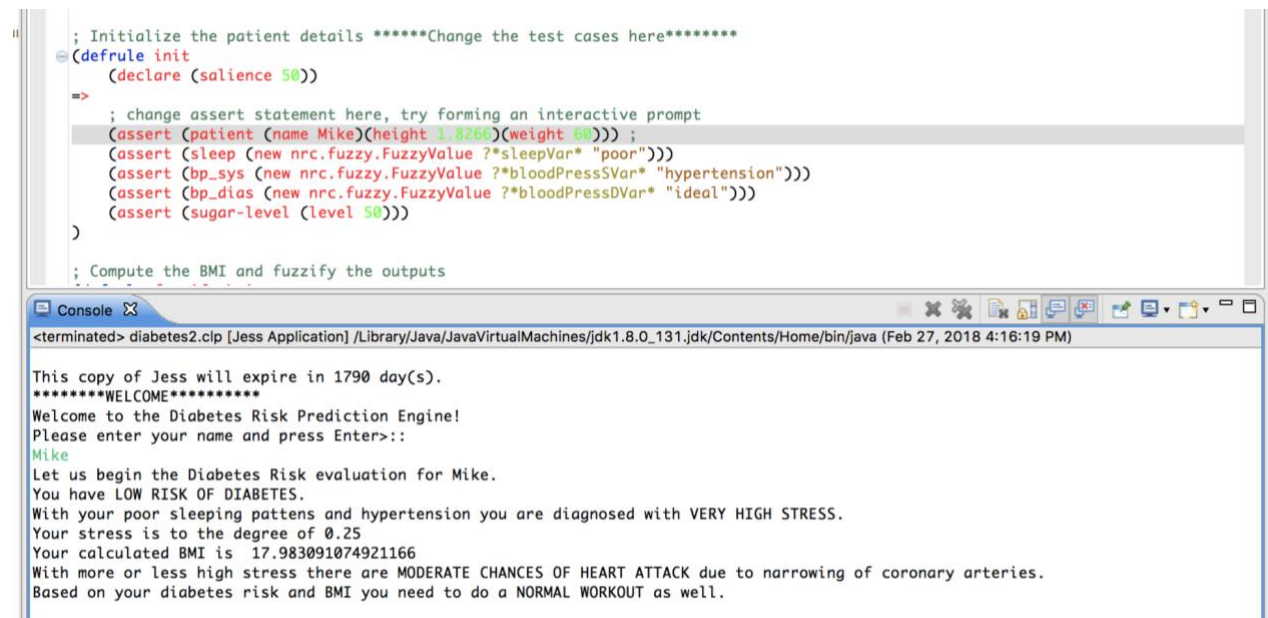
bp\_sys: <low, hypertension, ideal>

bp\_dias: <low, hypertension, ideal>

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

## Sample runs:

### Run #1



```
; Initialize the patient details *****Change the test cases here*****
(defrule init
  (declare (salience 50))
  =>
  ; change assert statement here, try forming an interactive prompt
  (assert (patient (name Mike)(height 1.8266)(weight 60))) ;
  (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* "ideal")))
  (assert (sugar-level (level 50)))
)

; Compute the BMI and fuzzify the outputs
```

<terminated> diabetes2.clp [Jess Application] /Library/Java/JavaVirtualMachines/jdk1.8.0\_131.jdk/Contents/Home/bin/java (Feb 27, 2018 4:16:19 PM)

This copy of Jess will expire in 1790 day(s).  
\*\*\*\*\*WELCOME\*\*\*\*\*  
Welcome to the Diabetes Risk Prediction Engine!  
Please enter your name and press Enter>:  
Mike  
Let us begin the Diabetes Risk evaluation for Mike.  
You have LOW RISK OF DIABETES.  
With your poor sleeping patterns and hypertension you are diagnosed with VERY HIGH STRESS.  
Your stress is to the degree of 0.25  
Your calculated BMI is 17.983091074921166  
With more or less high stress there are MODERATE CHANCES OF HEART ATTACK due to narrowing of coronary arteries.  
Based on your diabetes risk and BMI you need to do a NORMAL WORKOUT as well.

## Run #2

```
; Initialize the patient details *****Change the test cases here*****
(defrule init
  (declare (salience 50))
=>
  ; change assert statement here, try forming an interactive prompt
  (assert (patient (name Allen)(height 1.5266)(weight 50))) ;
  (assert (sleep (new nrc.fuzzy.FuzzyValue ?*sleepVar* "normal")))
  (assert (bp_sys (new nrc.fuzzy.FuzzyValue ?*bloodPressSVar* "ideal")))
  (assert (bp_dias (new nrc.fuzzy.FuzzyValue ?*bloodPressDVar* "hypertension")))
  (assert (sugar-level (level 70)))
)

; Compute the BMI and fuzzify the outputs
(defrule fuzzify_bmi
  ?p <- (patient (name ?name))
=>
  (bind ?bm (/ ?p.weight (* ?p.height ?p.height)))
  (printout t "Your calculated BMI is " ?bm crlf)
  (assert (bmi (new nrc.fuzzy.FuzzyValue ?*bmiVar* (new SingletonFuzzySet ?bm))))
)
```

<terminated> diabetes2.clp [Jess Application] /Library/Java/JavaVirtualMachines/jdk1.8.0\_131.jdk/Contents/Home/bin/java (Feb 27, 2018 4:25:10 PM)

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

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\*\*\*\*\*WELCOME\*\*\*\*\*

Welcome to the Diabetes Risk Prediction Engine!  
Please enter your name and press Enter::  
allen

Let us begin the Diabetes Risk evaluation for allen.  
You have VERY LOW/NO RISK OF DIABETES.  
Your calculated BMI is 21.45455387409256  
Based on your diabetes risk and BMI you need to do a NORMAL WORKOUT as well.

## Run #3

```
; Initialize the patient details *****Change the test cases here*****
(defrule init
  (declare (salience 50))
=>
  ; change assert statement here, try forming an interactive prompt
  (assert (patient (name Daniel)(height 1.6256)(weight 90))) ;
  (assert (sleep (new nrc.fuzzy.FuzzyValue ?*sleepVar* "poor")))
  (assert (bp_sys (new nrc.fuzzy.FuzzyValue ?*bloodPressSVar* "ideal")))
  (assert (bp_dias (new nrc.fuzzy.FuzzyValue ?*bloodPressDVar* "low")))
  (assert (sugar-level (level 200)))
)

; Compute the BMI and fuzzify the outputs
(defrule fuzzify_bmi
  ?p <- (patient (name ?name))
=>
  (bind ?bm (/ ?p.weight (* ?p.height ?p.height)))
  (printout t "Your calculated BMI is " ?bm crlf)
  (assert (bmi (new nrc.fuzzy.FuzzyValue ?*bmiVar* (new SingletonFuzzySet ?bm))))
)

; Recommend workout based on the BMI, moderate for normal people
```

<terminated> diabetes2.clp [Jess Application] /Library/Java/JavaVirtualMachines/jdk1.8.0\_131.jdk/Contents/Home/bin/java (Feb 27, 2018 3:58:39 PM)

Welcome to the Diabetes Risk Prediction Engine!  
Please enter your name and press Enter::  
daniel

Let us begin the Diabetes Risk evaluation for daniel.  
You have EXTREMELY HIGH RISK OF DIABETES.  
With your poor sleeping patterns and hypertension you are diagnosed with VERY HIGH STRESS.  
Your stress is to the degree of 0.34086860304149447  
Your calculated BMI is 34.05768530287061  
With very high stress and obesity there are HIGH CHANCES OF HEART ATTACK due to narrowing of coronary arteries.  
With such high chances of both diabetes and heart attack  
I recommend you to CONSULT A DOCTOR IMMEDIATELY in order to get a proper medication if required.

Based on your diabetes risk and BMI you need to do an INTENSE WORKOUT as well.

## Test cases:

Please use only one test case at a time in the init rule:

### Test case #1:

```
(assert (patient (name Mike)(height 1.8266)(weight 60))) ;  
(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* "ideal")))  
(assert (sugar-level (level 50)))
```

### Test case #2:

```
(assert (patient (name Allen)(height 1.5266)(weight 50))) ;  
(assert (sleep (new nrc.fuzzy.FuzzyValue ?*sleepVar* "normal")))  
(assert (bp_sys (new nrc.fuzzy.FuzzyValue ?*bloodPressSVar* "ideal")))  
(assert (bp_dias (new nrc.fuzzy.FuzzyValue ?*bloodPressDVar* "hypertension")))  
(assert (sugar-level (level 70)))
```

### Test case #3:

```
(assert (patient (name Daniel)(height 1.6256)(weight 90))) ;  
(assert (sleep (new nrc.fuzzy.FuzzyValue ?*sleepVar* "poor")))  
(assert (bp_sys (new nrc.fuzzy.FuzzyValue ?*bloodPressSVar* "ideal")))  
(assert (bp_dias (new nrc.fuzzy.FuzzyValue ?*bloodPressDVar* "low")))  
(assert (sugar-level (level 200)))
```