Diabetes Diagnosis Expert System Using Fuzzy Inference Methods

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- Template Based Approach
- Neuro Fuzzy Approach
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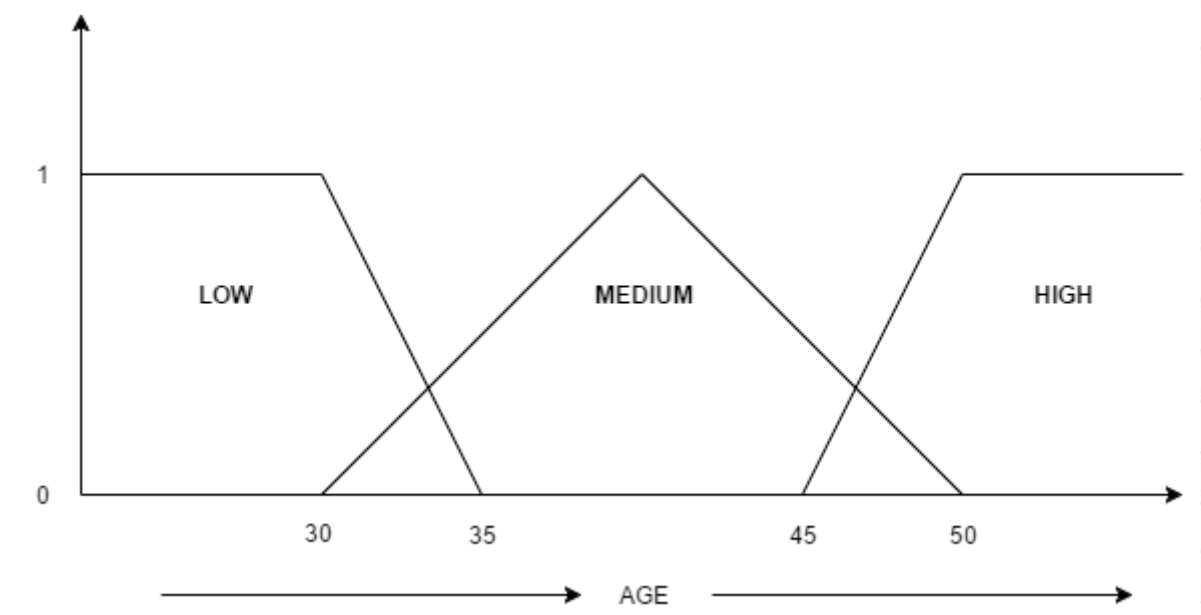
Introduction

- ***Diabetes*** has affected millions of people in the world, and hundreds of thousands of people across the globe die every year.
- The manual diagnosis cannot be much relied on, hence there is a need of an efficient automated system.
- In this project we have tried to study and implement ***Fuzzy Inference Mechanisms*** for diabetes diagnosis.
- We implement three fuzzy inference mechanisms:
  - **Template Based Approach**
  - **Neuro-Fuzzy Approach**
  - **Fuzzy C-Means clustering**
- We used PIMA Indian Diabetes Dataset [9] for implementation of all 3 approaches.

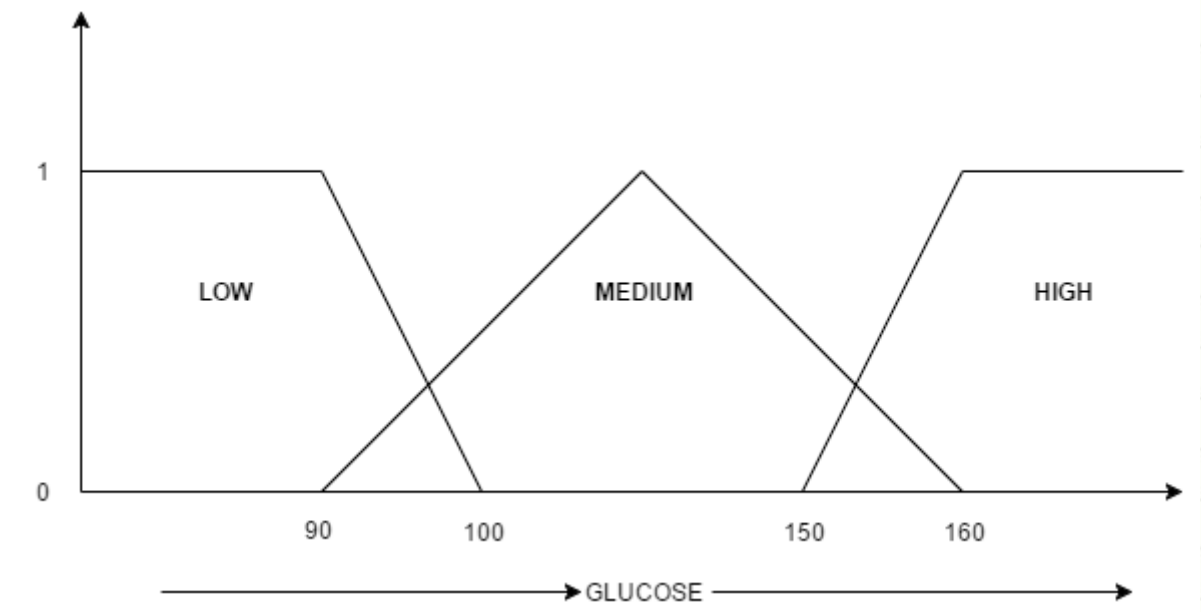
Dataset Description

- We have used ***PIMA Indian Diabetes Data Set*** for our experiments.
- Features Used are :
  - Plasma Glucose Concentration a 2 hrs in OGTT
  - Diastolic blood pressure (in mm Hg)
  - Two hours serum insulin (in mu U/ml)
  - Body mass index (kg per meter square)
  - Diabetes Pedigree Function
  - Age

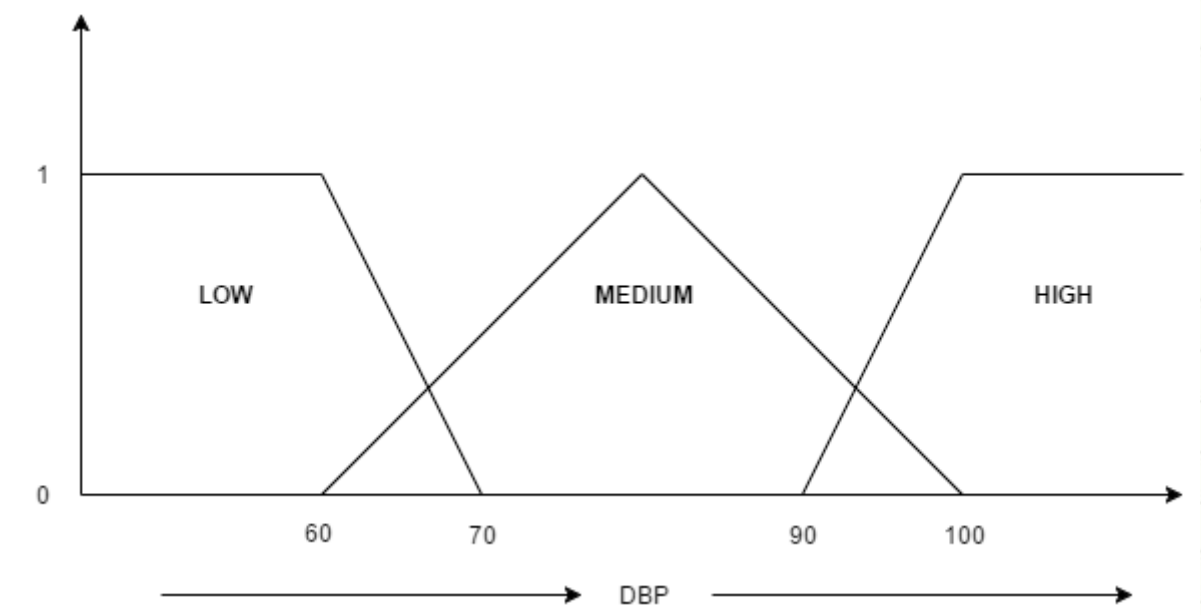
AGE



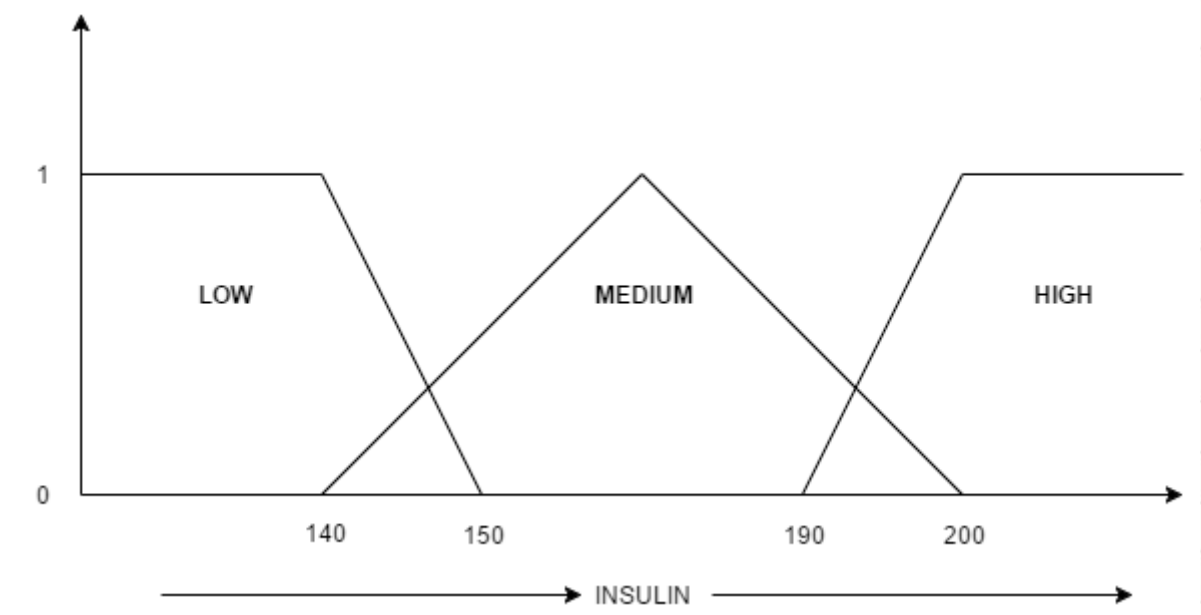
PLASMA GLUCOSE CONCENTRATION



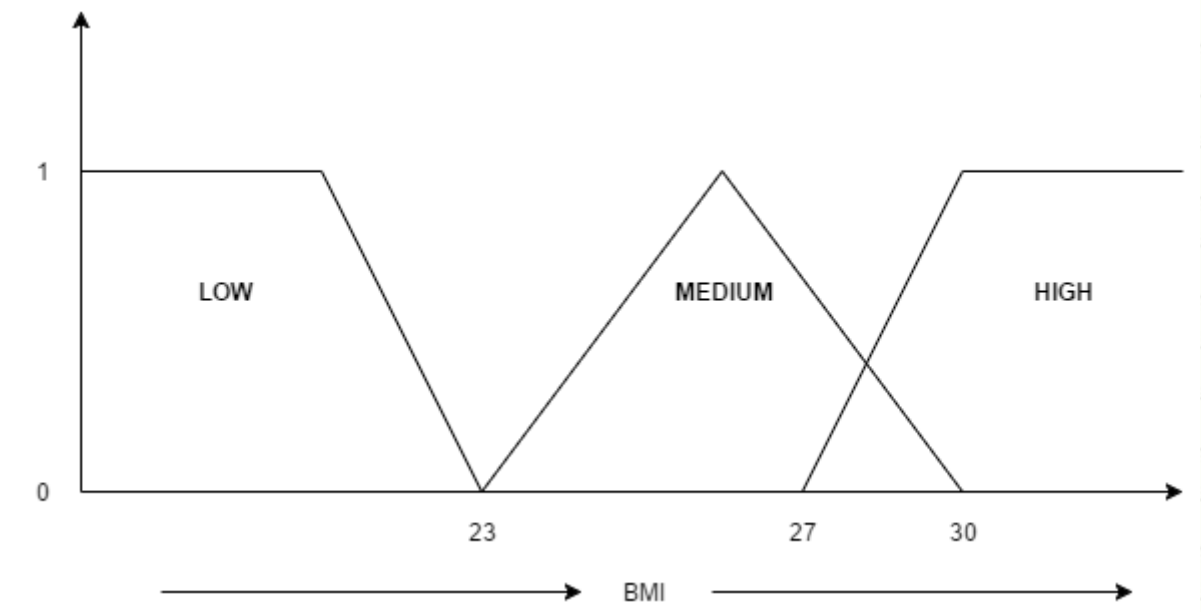
DIASTOLIC BLOOD PRESSURE



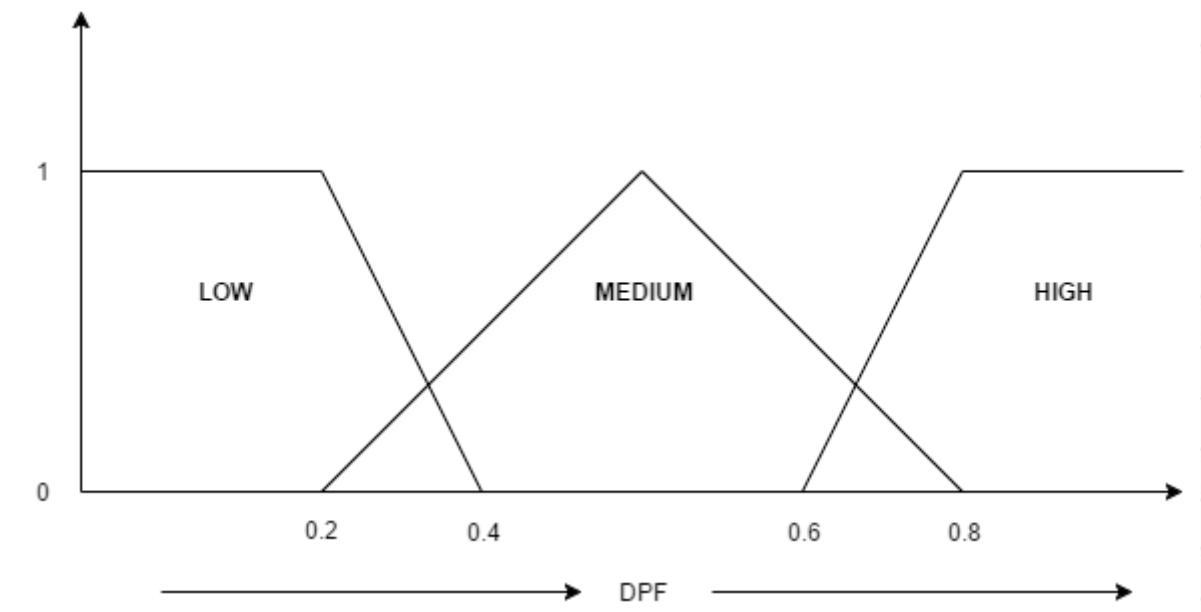
INSULIN



BODY MASS INDEX



DIABETES PEDIGREE FUNCTION



TEMPLATE BASED APPROACH

- Partition the input and output parameters into fuzzy sets

  fuzzySets(low, med,high, val)

- Generate Primary rule set

  generateRules()

- Assign degree to each rule

  Calculate_degree_of_rule(rule)

- Obtain the final set of rules

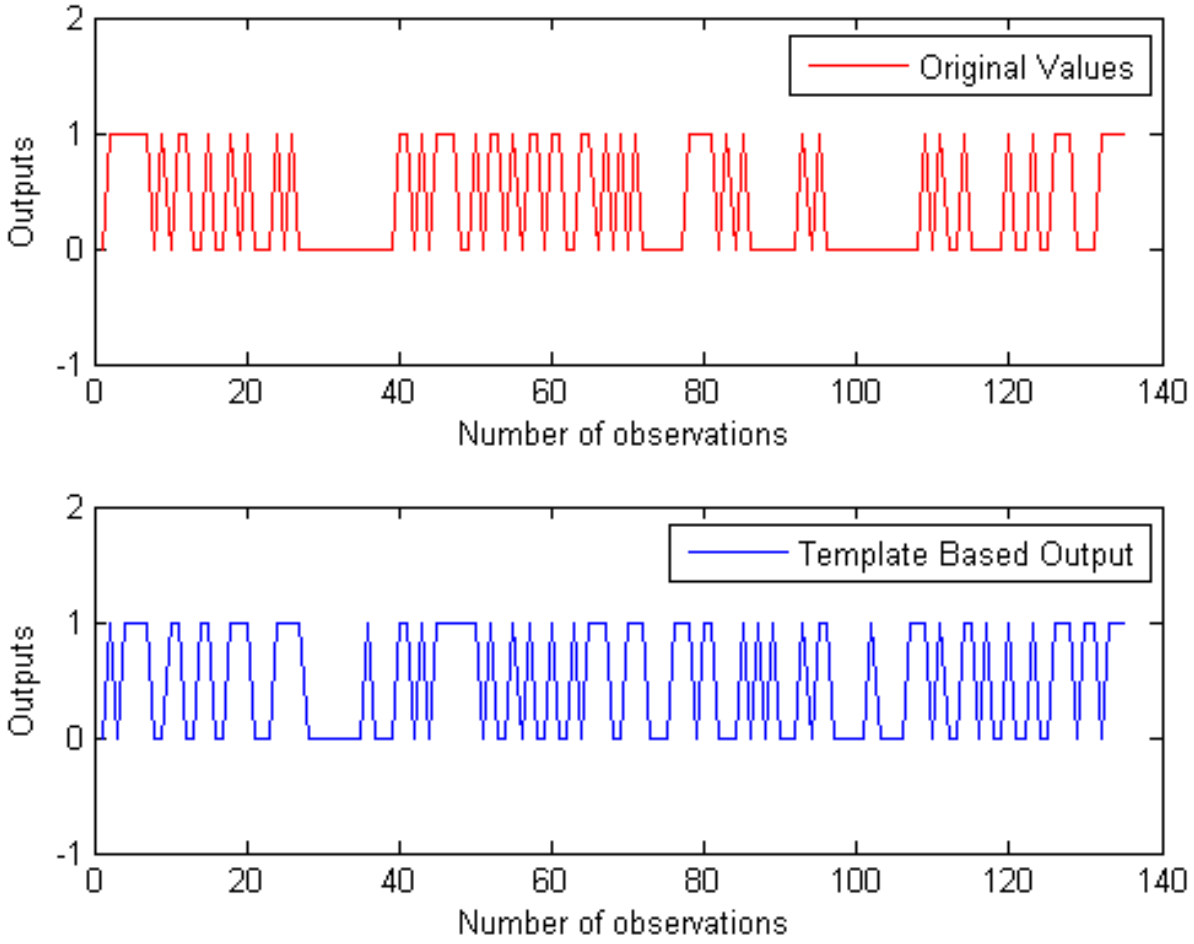
  Check_conflict(rules_list)

  Conflict_resolve(rule1, rule2)

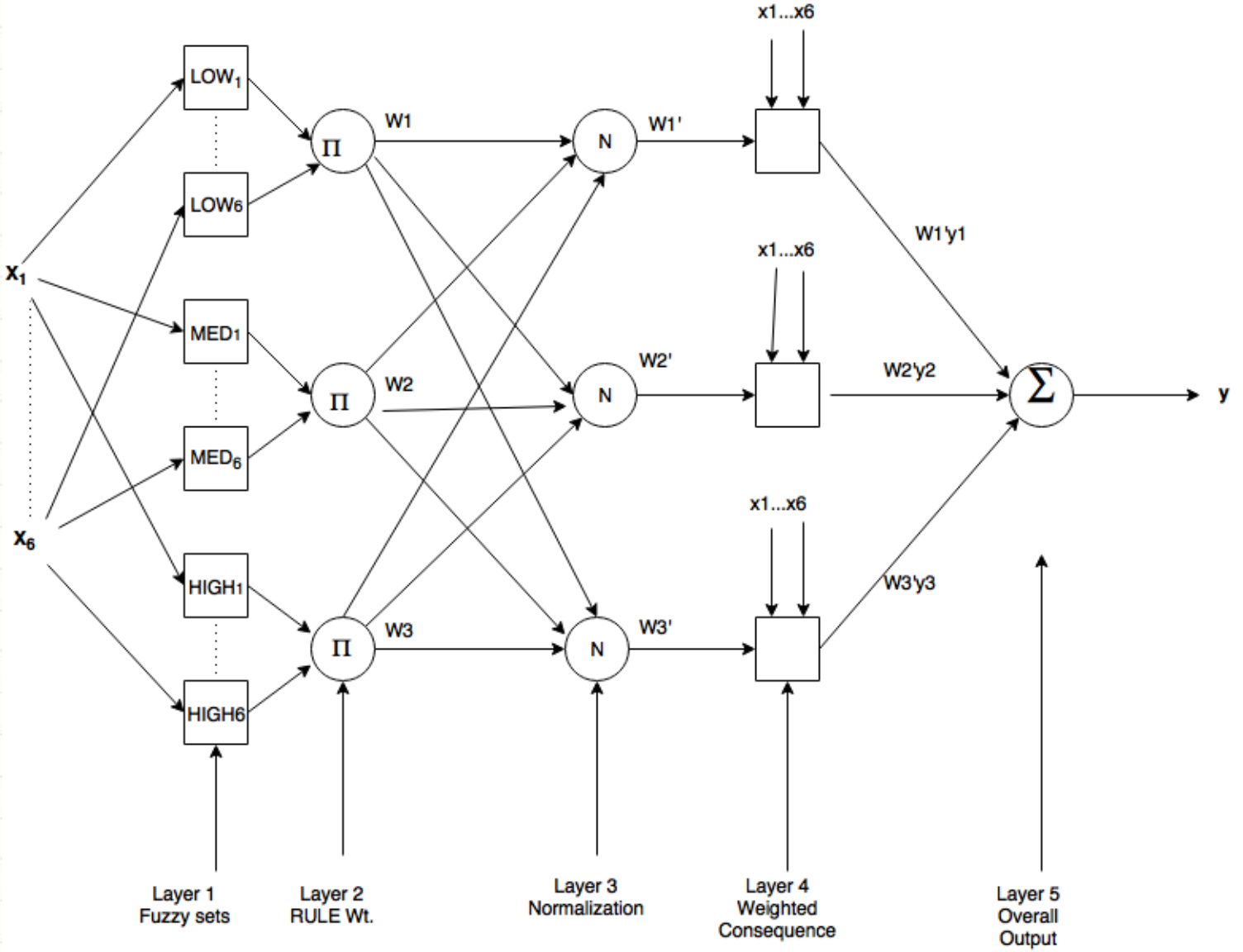
TEMPLATE BASED APPROACH

Rule No. 14 --> If Age is L AND Glucose is H AND Blood Pressure is M AND Insulin is H AND BMI is H AND DPF is H AND Diabetes Status is 1
Rule No. 15 --> If Age is L AND Glucose is L AND Blood Pressure is L AND Insulin is L AND BMI is M AND DPF is L AND Diabetes Status is 0
Rule No. 16 --> If Age is M AND Glucose is M AND Blood Pressure is L AND Insulin is M AND BMI is M AND DPF is H AND Diabetes Status is 1
Rule No. 17 --> If Age is H AND Glucose is M AND Blood Pressure is M AND Insulin is H AND BMI is H AND DPF is H AND Diabetes Status is 1
Rule No. 18 --> If Age is L AND Glucose is H AND Blood Pressure is L AND Insulin is L AND BMI is H AND DPF is L AND Diabetes Status is 0
Rule No. 19 --> If Age is H AND Glucose is H AND Blood Pressure is H AND Insulin is H AND BMI is H AND DPF is H AND Diabetes Status is 1
Rule No. 20 --> If Age is L AND Glucose is M AND Blood Pressure is M AND Insulin is L AND BMI is L AND DPF is M AND Diabetes Status is 0
Rule No. 21 --> If Age is L AND Glucose is M AND Blood Pressure is L AND Insulin is L AND BMI is M AND DPF is M AND Diabetes Status is 0
Rule No. 22 --> If Age is L AND Glucose is L AND Blood Pressure is M AND Insulin is L AND BMI is M AND DPF is M AND Diabetes Status is 0
Rule No. 23 --> If Age is H AND Glucose is H AND Blood Pressure is M AND Insulin is H AND BMI is H AND DPF is M AND Diabetes Status is 1
Rule No. 24 --> If Age is M AND Glucose is M AND Blood Pressure is M AND Insulin is H AND BMI is H AND DPF is H AND Diabetes Status is 0
Rule No. 25 --> If Age is M AND Glucose is H AND Blood Pressure is M AND Insulin is H AND BMI is H AND DPF is L AND Diabetes Status is 1
Rule No. 26 --> If Age is L AND Glucose is M AND Blood Pressure is M AND Insulin is L AND BMI is H AND DPF is H AND Diabetes Status is 0
Rule No. 27 --> If Age is L AND Glucose is M AND Blood Pressure is L AND Insulin is L AND BMI is H AND DPF is L AND Diabetes Status is 0
Rule No. 30 --> If Age is L AND Glucose is M AND Blood Pressure is M AND Insulin is L AND BMI is H AND DPF is L AND Diabetes Status is 0
Rule No. 32 --> If Age is L AND Glucose is M AND Blood Pressure is L AND Insulin is L AND BMI is H AND DPF is M AND Diabetes Status is 0
Rule No. 33 --> If Age is L AND Glucose is M AND Blood Pressure is M AND Insulin is H AND BMI is H AND DPF is L AND Diabetes Status is 0
Rule No. 34 --> If Age is M AND Glucose is L AND Blood Pressure is M AND Insulin is L AND BMI is H AND DPF is H AND Diabetes Status is 0
Rule No. 38 --> If Age is M AND Glucose is M AND Blood Pressure is M AND Insulin is M AND BMI is H AND DPF is M AND Diabetes Status is 0
Rule No. 39 --> If Age is M AND Glucose is L AND Blood Pressure is M AND Insulin is L AND BMI is H AND DPF is L AND Diabetes Status is 0
Rule No. 40 --> If Age is L AND Glucose is M AND Blood Pressure is M AND Insulin is L AND BMI is M AND DPF is H AND Diabetes Status is 0
Rule No. 41 --> If Age is M AND Glucose is M AND Blood Pressure is M AND Insulin is H AND BMI is H AND DPF is L AND Diabetes Status is 0
Rule No. 42 --> If Age is L AND Glucose is L AND Blood Pressure is L AND Insulin is L AND BMI is L AND DPF is M AND Diabetes Status is 0
Rule No. 43 --> If Age is L AND Glucose is L AND Blood Pressure is L AND Insulin is L AND BMI is H AND DPF is M AND Diabetes Status is 0
Rule No. 46 --> If Age is L AND Glucose is M AND Blood Pressure is L AND Insulin is M AND BMI is H AND DPF is H AND Diabetes Status is 0
Rule No. 50 --> If Age is L AND Glucose is H AND Blood Pressure is M AND Insulin is L AND BMI is H AND DPF is L AND Diabetes Status is 1
Rule No. 51 --> If Age is M AND Glucose is H AND Blood Pressure is L AND Insulin is H AND BMI is H AND DPF is M AND Diabetes Status is 1
Rule No. 52 --> If Age is L AND Glucose is L AND Blood Pressure is M AND Insulin is L AND BMI is H AND DPF is L AND Diabetes Status is 0
Rule No. 53 --> If Age is M AND Glucose is H AND Blood Pressure is L AND Insulin is M AND BMI is H AND DPF is M AND Diabetes Status is 1
Rule No. 54 --> If Age is L AND Glucose is M AND Blood Pressure is M AND Insulin is L AND BMI is M AND DPF is L AND Diabetes Status is 0
Rule No. 55 --> If Age is L AND Glucose is H AND Blood Pressure is M AND Insulin is L AND BMI is H AND DPF is H AND Diabetes Status is 1
Rule No. 61 --> If Age is M AND Glucose is H AND Blood Pressure is M AND Insulin is M AND BMI is H AND DPF is M AND Diabetes Status is 1
Rule No. 62 --> If Age is L AND Glucose is H AND Blood Pressure is L AND Insulin is H AND BMI is H AND DPF is M AND Diabetes Status is 1
Rule No. 69 --> If Age is L AND Glucose is M AND Blood Pressure is L AND Insulin is H AND BMI is H AND DPF is L AND Diabetes Status is 0
Rule No. 70 --> If Age is M AND Glucose is M AND Blood Pressure is L AND Insulin is L AND BMI is H AND DPF is H AND Diabetes Status is 0
Rule No. 72 --> If Age is M AND Glucose is H AND Blood Pressure is M AND Insulin is M AND BMI is H AND DPF is H AND Diabetes Status is 1
Rule No. 75 --> If Age is L AND Glucose is M AND Blood Pressure is L AND Insulin is L AND BMI is M AND DPF is H AND Diabetes Status is 0
Rule No. 77 --> If Age is M AND Glucose is H AND Blood Pressure is M AND Insulin is L AND BMI is H AND DPF is H AND Diabetes Status is 1
Rule No. 80 --> If Age is M AND Glucose is M AND Blood Pressure is M AND Insulin is M AND BMI is H AND DPF is H AND Diabetes Status is 1
Rule No. 84 --> If Age is M AND Glucose is L AND Blood Pressure is L AND Insulin is L AND BMI is H AND DPF is M AND Diabetes Status is 0
Rule No. 86 --> If Age is L AND Glucose is M AND Blood Pressure is H AND Insulin is L AND BMI is H AND DPF is M AND Diabetes Status is 1
Rule No. 87 --> If Age is L AND Glucose is M AND Blood Pressure is L AND Insulin is L AND BMI is H AND DPF is H AND Diabetes Status is 0

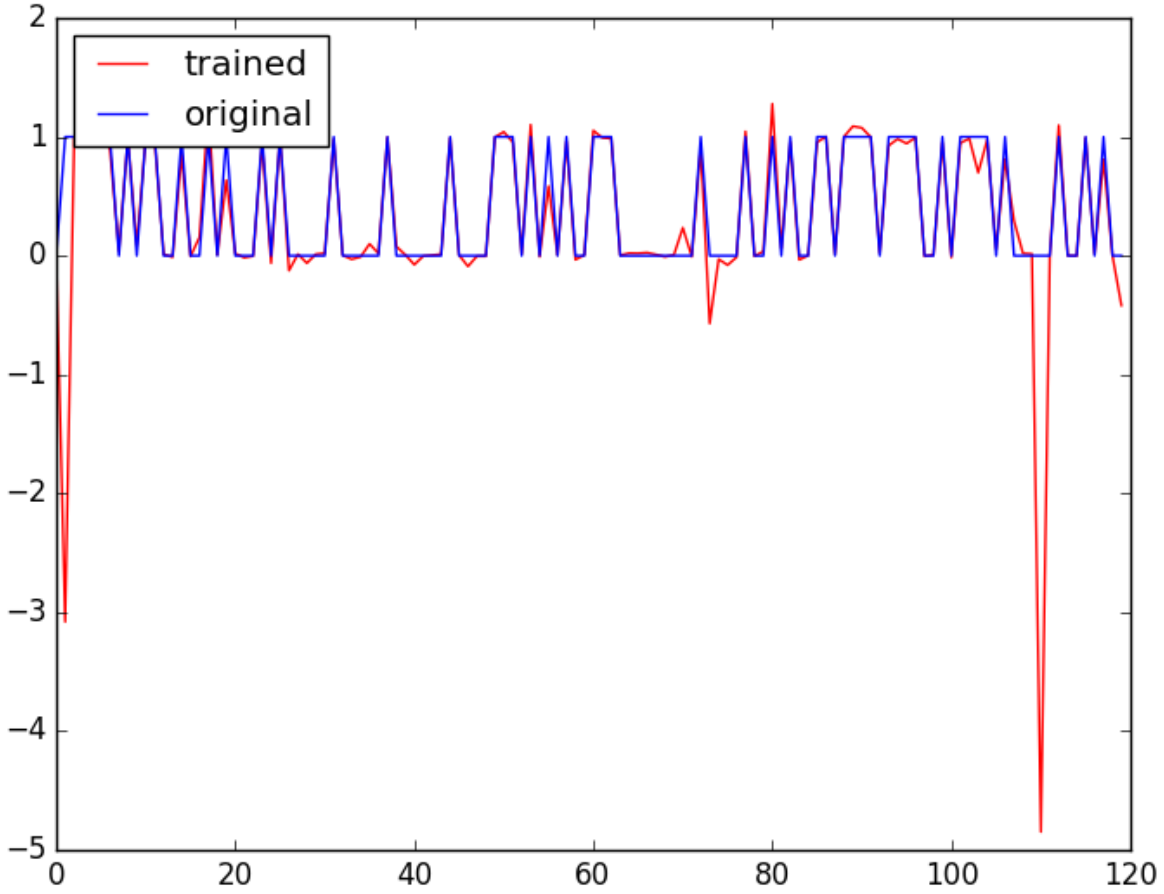
TEMPLATE BASED APPROACH



Neuro-Fuzzy Based Approach:



Neuro-Fuzzy Based Approach:



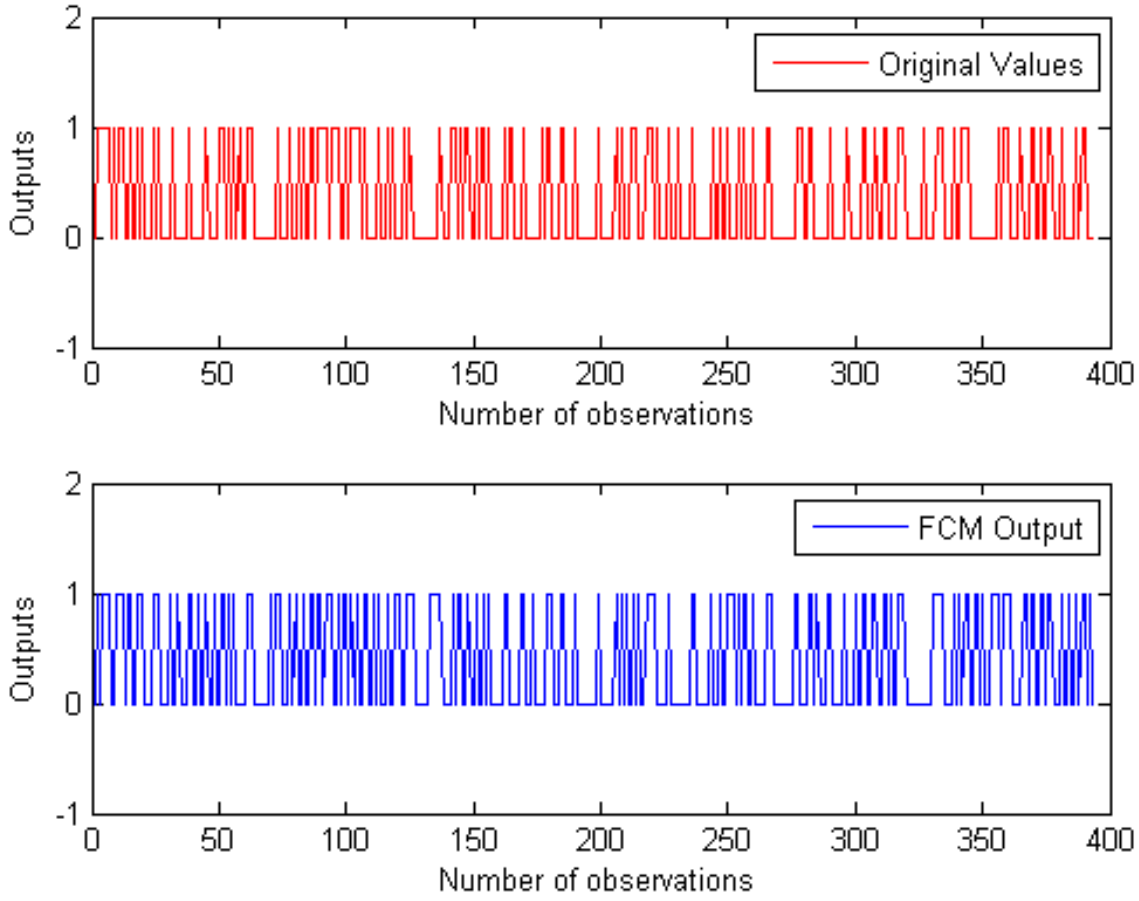
Fuzzy C-Means Clustering:

```
dataset = [  VarName1 VarName2 VarName3 VarName4 VarName5 VarName6  ];
[centers,U] = fcm(dataset,2);

c1 = centers(1,:);
c2 = centers(2,:);
```

```
dist2(i) = sqrt( t1 + t2 + t3 + t4 + t5 + t6) ;
if (dist1(i) > dist2(i))
    output(i) = 1;
else
     output(i) = 0;
end
```

Fuzzy C-Means Clustering:



Conclusion

Fuzzy Inference Methods	Accuracy
Template Based Approach	74.074%
Neuro-Fuzzy Approach	78.62%
Fuzzy C-Means clustering	76.84%.

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THANK YOU