LOAN APPLICATION EXPERT SYSTEM

MEGAMIND

CS 514

Applied Artificial Intelligence

Project 2

INDEX

ABSTRACT:

Loan Application Expert system is a rule based expert system designed using FUZZY JESS wherein information of a loan applicant is asserted by the user of the Bank, and finally concludes whether applicant is eligible to apply for a loan or not. System also provides suggestions to the user of the system to help him/her to make a decision in a very convenient manner. The expert system checks for all the boolean and Fuzzy parameters asserted by the user and finally claims the decision depending upon its interpretation and a few important rules set in the bank's policy.

FEATURES:

1. The system asks the bank's user admin to input all the required details of an applicant applying for a business loan; such as name, age, number of businesses, amount owed, education, experience, credit score etc.
2. The system first checks the age of an applicant whether if its above the minimum requirement.
3. System provides the feature to check for the limit of total amount an applicant can owe.
4. The system analyzes an applicant's history like *years of education*, and *experience* in the relevant business.
5. An applicants chance of approval increases if he/she have cleared all the previously borrowed loans.
6. The system checks for the minimum number of businesses an applicant should possess as an asset to apply for the business loan.
7. Bank always checks for the amount of investment an applicant have already made, or willing to make thereby making an interpretation if an investment made is above the threshold set or not.
8. At the end, the system provides features to input the behavioral aspects of an applicant on the basis of the information collected like, repayment ability and management capability.
9. Finally, an important aspect called *Credit Score* is verified i.e if he/she has a good or a poor credit score. If poor, the application is rejected straightaway.
10. The rules of the system are sequenced in such a way that if any/all of the top 4 parameters (Legal age, Amount owed, previous loans paid, and credit score) do not meet the required values, then the applicant's application is rejected.
11. System provides suggestions to the bank employee related to every parameter that is not satisfied so as to provide employee with the in-depth reasoning about client's information and application status.

RULES & DESCRIPTION:

Template 1 mentioned in the code describe variables used for storing applicant's information

```
(deftemplate Business_loan_applicant
    (slot applicant_name)
     ; Applicant's age in number(Integer VALUE only)
    (slot age (type INTEGER))
      ; Amount currently owed by applicant in Dollars(Integer VALUE
only)
    (slot current_owe (type INTEGER))
    ; Any pending payment of previously sanctioned loans?
    (slot paid (allowed-values Yes No))
    ; Applicant's Years of experience in related business
    (slot exp (type FlOAT))
    ; Total number of businesses owned by applicant
    (slot bus (type INTEGER))
    ; Years of education of an applicant
    (slot edu (type INTEGER))
    ; Total amount invested so far by the applicant in the business
    (slot inv (type INTEGER))
    ; Ability to repay loan
    (slot repay (allowed-values Good Poor))
    ; Management Ability of an applicant
    (slot mgmt (allowed-values Good Average Poor))
    ; Credit History of an applicant
    (slot credit (allowed-values Good Poor))
    )
```

Template 2 mentioned in the code describes Bank certain parameters.

```
(deftemplate Bank
    (slot bank_name)
    ; policy for Repayment ability
    (slot repay_ability (allowed-values Good Poor))
    ; policy for Management ability
    (slot mgmt_ability (allowed-values Good Average Poor))
    ; policy for credit history
    (slot credit_history (allowed-values Good Poor))
    )
```

Fuzzy Templates

```
(deftemplate current_owe
    "Auto-generated"
    (declare (ordered TRUE)))
(deftemplate experience
    "Auto-generated"
    (declare (ordered TRUE)))
(deftemplate business_owned
    "Auto-generated"
    (declare (ordered TRUE)))
(deftemplate education
    "Auto-generated"
   (declare (ordered TRUE)))
(deftemplate amount_invested
    "Auto-generated"
   (declare (ordered TRUE)))
```

In general, system uses 14 rules in total to make a decision for a loan application:

Rule 0: Fuzzifies the information of few parameters which have subtle differences in their value, according to the overall requirement.[check rule 0 in Megamind.clp]

1. **initial:** Outputs applicant information.
2. **ageCheck:** Checks if applicants age satisfies the legal age set by loan.
3. **currentOwedAmountCheck:** Checks if applicant's currently owed amount to bank is higher than the threshold limit.
4. **borrowedLoansCheck:** Checks if applicant has paid previously borrowed loans.
5. **experienceCheck:** Checks for the number of years of experience applicant possess.
6. **businessesOwnedCheck:** The bank needs minimum of businesses as an asset for the loan by applicant.
7. **educationCheck:** Checks for the minimum education qualification.
8. **investmentCheck:** Checks for the investment made by an applicant so far.
9. **repayAbilityCheck:** Analyses the ability of an applicant to repay the loan amount.
10. **managementAbilityCheck:** Analyses the ability of an applicant to manage the loan amount(paying interest and EMI's).
11. **creditScoreCheck:** Checks for the credit score rating of an applicant.
12. **finalDecision_Impparameters:** Final rule to make a decision of approving a loan application or not on the basis of satisfiability of the top 4 parameters set.
13. **printFacts:** To print all the facts.

FUZZIFICATION OF THE DATA:

The MAIN: init-FuzzyVariables rule is used divides the currentOwedAmount, experience, businessesOwned and , education into desirable fuzzy categories with the following template:

Example:

```
(call ?*currentOweVar* addTerm "low" (new ZFuzzySet 50000
100000))
(?*currentOweVar* addTerm "medium" (new TrapezoidFuzzySet 100001
140000 160000 180000))
(?*currentOweVar* addTerm "High" (new SFuzzySet 180000 200000))
```

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 is done using:

```
(assert (current_owe (new FuzzyValue ?*currentOweVar* (new
SingletonFuzzySet ?Business_loan_applicant.current_owe))))
```

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

—Modifiers Used for Fuzzy Variables: low, moderate/medium, high

USAGE MANUAL:

1. Create a new Java project in eclipse. Make sure you include the JAR file “fuzzyJ-2.0.jar” under New Project > Libraries.

2. Add Megamind.clp to the src folder of the project or create a new file and copy the contents of Megamind.clp into the blank file. Make sure you save the file with .clp extension.In the run configurations of the file, change “jess.Main” to “nrc.fuzzy.jess.FuzzyMain”.

3. Run the project. In case you run into any errors, make sure that the run configs is pointed to the FuzzyMain as by default it is shifted back to jess.Main.
   - In case the grader wants to tweak the input, he has to make changes to the init rule at the end of the program. The assertion there looks like:

```
(assert (Business_loan_applicant (applicant_name "Jon")
            (age 18) (current_owe 99999) (paid Yes)
            (exp 2.5)  (bus 2)  (edu 5)  (inv 30000)
            (repay Good)  (mgmt Poor)  (credit Good)))
```

4. And the allowed input values can be referred from through the template.

SAMPLE OUTPUTS:

NOTE: **(Minimum, Maximum) value that can be entered for every fuzzy variable are as follow:**

current_owe: (0, 200000) ; exp :(2.0, 12.0) ; bus:(1, 10) ; edu(0, 15); inv(0, 500000)

1. SAMPLE 1

```
(assert (Business_loan_applicant (applicant_name "Jon")
            (age 18) (current_owe 99999) (paid Yes)
            (exp 2.5)  (bus 2)  (edu 5)  (inv 30000)
            (repay Good)  (mgmt Poor)  (credit Good)))
```

Output:

```
This copy of Jess will expire in 1787 day(s).

-------------------------------------------------------
WELCOME TO THE EXPERT SYSTEM FOR BUSINESS LOAN APPLICATION
Assert the initial values of an applicant and the decision will be
made
-------------------------------------------------------------------
BUSINESS loan application for Jon under review.
Following is the Applicant's information that was feeded into our
system
Applicants legal age: 18 years
Amount currently owed by applicant is: 99999 Dollars
Any pending payment of previosuly sanctioned loans?(Yes/No): Yes
Applicant's Years of experience in related business: 2.5
Total number of businesses owned by applicant: 2
Years of education: 5years
Total amount invested so far by the applicant in the business is:
30000 Dollars
Does Applicant have the ability to repay the loan?(Good/Poor): Good
Applicant's ability to manage the loan?(Good/Average/Poor): Poor
Credit Rating?(Good/Poor): Good
```

```
---------------------------------------------------------
Following are the suggestions & interpretations derived:
---------------------------------------------------------
Applicant got a really low experience.While this may not necessarily
be a red flag, he/she can still apply depending on the other factors.
Applicant has poor management ability.Constant check required on his/
her management status.

--The Final Decision Suggested by the Expert System is that:-

Applicant is eligible to apply for the Business loan since one or all
of the top 4 parameter/s((Legal age, Amount owed, previous loans paid
and credit score) ) are satisfied
f-0    (MAIN::initial-fact)
f-1    (MAIN::Business_loan_applicant (applicant_name "Jon") (age 18)
(current_owe 99999) (paid Yes) (exp 2.5) (bus 2) (edu 5) (inv 30000)
(repay Good) (mgmt Poor) (credit Good))
f-2    (MAIN::current_owe <Java-Object:nrc.fuzzy.FuzzyValue>)
f-3    (MAIN::experience <Java-Object:nrc.fuzzy.FuzzyValue>)
f-4    (MAIN::business_owned <Java-Object:nrc.fuzzy.FuzzyValue>)
f-5    (MAIN::education <Java-Object:nrc.fuzzy.FuzzyValue>)
f-6    (MAIN::amount_invested <Java-Object:nrc.fuzzy.FuzzyValue>)
For a total of 7 facts in module MAIN.
```

2. SAMPLE 2

```
(assert (Business_loan_applicant (applicant_name "Jon")
            (age 18) (current_owe 200000) (paid Yes)
            (exp 12.0)  (bus 10)  (edu 2)  (inv 90000)
            (repay Good)  (mgmt Poor)  (credit Poor)))
```

Output:

```
This copy of Jess will expire in 1786 day(s).
---------------------------------------------------------
WELCOME TO THE EXPERT SYSTEM FOR BUSINESS LOAN APPLICATION
Assert the initial values of an applicant and the decision will be
made
-------------------------------------------------------------------

BUSINESS loan application for Jon under review.
Following is the Applicant's information that was feeded into our
system
```

```
Applicants legal age: 18 years
Amount currently owed by applicant is: 200000 Dollars
Any pending payment of previosuly sanctioned loans?(Yes/No): Yes
Applicant's Years of experience in related business: 12.0
Total number of businesses owned by applicant: 10
Years of education: 2years
Total amount invested so far by the applicant in the business is:
90000 Dollars
Does Applicant have the ability to repay the loan?(Good/Poor): Good
Applicant's ability to manage the loan?(Good/Average/Poor): Poor
Credit Rating?(Good/Poor): Poor

-----------------------------------------------------
Following are the suggestions & interpretations derived:
-----------------------------------------------------

Applicant owes more than the permitted amount as debt. Highly likely
for application to get rejected.
Applicant has extensive experience in business. This boosts overall
profile and makes his/her application stronger.
Applicant owns numerous businesses as an asset.This improves the
credibility of the application.
Applicant has poor management ability.Constant check required on his/
her management status.
Applicant has a low credit score which is considered to be a negative
flag. Bank can't process the loan application further.

--The Final Decision Suggested by the Expert System is that:--

Applicant is not eligible to apply for the Business loan since one or
all of the top 4 parameter/s(Legal age, Amount owed, previous loans
paid and credit score) are not satisfied
f-0   (MAIN::initial-fact)
f-1   (MAIN::Business_loan_applicant (applicant_name "Jon") (age 18)
(current_owe 200000) (paid Yes) (exp 12.0) (bus 10) (edu 2) (inv
90000) (repay Good) (mgmt Poor) (credit Poor))
f-2   (MAIN::current_owe <Java-Object:nrc.fuzzy.FuzzyValue>)
f-3   (MAIN::experience <Java-Object:nrc.fuzzy.FuzzyValue>)
f-4   (MAIN::business_owned <Java-Object:nrc.fuzzy.FuzzyValue>)
f-5   (MAIN::education <Java-Object:nrc.fuzzy.FuzzyValue>)
f-6   (MAIN::amount_invested <Java-Object:nrc.fuzzy.FuzzyValue>)
For a total of 7 facts in module MAIN.
```

OTHER TEST CASES: **Please use only one test case at a time in the Megamind.clp file**

```
(assert (Business_loan_applicant (applicant_name "Jon")
            (age 25) (current_owe 50000) (paid Yes)
            (exp 12.0)  (bus 10)  (edu 15)  (inv 500000)
            (repay Good)  (mgmt Poor)  (credit Good)))


(assert (Business_loan_applicant (applicant_name "Jon")
            (age 16) (current_owe 110000) (paid No)
            (exp 1.0)  (bus 1)  (edu 5)  (inv 4000)
            (repay Poor)  (mgmt Average)  (credit Poor)))
```