CS 514 - Applied Artificial Intelligence
Project -1 Rule Based Expert System (JESS)
Employee Performance Evaluation System

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Problem Specification: To automate the Employee performance evaluation in an organization.

Abstract:

The rule-based expert system is designed using JESS Rule Engine and can compute the performance rating of an employee in an organization. In this system, each employee is given five scores - a competency score (an overall score given for the employee skills which may include Job Knowledge, Proficiency, Quality of work, Productivity, Attendance, Interpersonal skills, decision making, analytical thinking, problem solving etc, to name a few), a goal accomplishments score(a score given to determine how well the employee has accomplished the assigned goals), additional achievements score(a score given to determine how well the employee has learned and improved his/her own skills like doing certifications, or setting milestones which would add great value to the team or organization), leadership score(a score given to determine delegation, supervisory and management skills) and teamwork score(a score given to determine the performance of the employee in a team which may include capabilities as a team member, taking initiatives, motivating others in the team).
I have considered these five variables, as they are the basic requirements to give a performance rating for an employee. Apart from the above variables, I have also considered designation and relevant experience as factors in deciding the weightage for the above five scores in computing the employee's rating. The weightage of all the scores is not same and it also changes across employees of different designations.

Scope – The system is designed to accept only five designations namely Software Engineer, Senior Software Engineer, Quality Analyst, Technical Lead, Dev Manager (which means the designation has to be a value from the list {SE, SSE, QA, TL, DM}). The experience value should be a number (>0 and <91) and competency-score, goal-accomplishments-score, additional-achievements-score, leadership-score and teamwork-score should also be numbers between (0-5).

Structure of the system – The system is designed to interact with the user by allowing the user to enter the required details. It then computes the overall performance rating of the employee and gives the description of what the rating means. The input values requested from the user include:

- Designation of the Employee (Software Engineer, Senior Software Engineer, Quality Analyst, Technical Lead, Dev Manager)
- Relevant experience in years
- Competency Score (0-5)
- Goal Accomplishments Score (0-5)
- Additional Achievements Score (0-5)
- Leadership Score (0-5)
- Teamwork Score (0-5)

Once we get all the required information from the user, we run the rule engine, which has rules corresponding to all the possible combinations of values for these given variables. It computes the overall performance rating of an employee based on the values of all these variables and gives the description. As mentioned before different importance or weight given to these variables depending on their logical importance towards the final performance rating. Different rules are defined to configure the resulting scenarios for computing the final performance rating.
The different weights that I gave to these variables for different designations are:

1. Software Engineer:
    - Relevant experience in years: 5%
    - Competency Score: 30%
    - Goal Accomplishments Score: 30%
    - Additional Achievements Score: 15%
    - Leadership Score: 5%
    - Teamwork Score: 15%
2. Senior Software Engineer:
    - Relevant experience in years: 5%
    - Competency Score: 25%
    - Goal Accomplishments Score: 25%
    - Additional Achievements Score: 20%
    - Leadership Score: 5%
    - Teamwork Score: 20%
3. Quality Analyst:
    - Relevant experience in years: 5%
    - Competency Score: 30%
    - Goal Accomplishments Score: 20%
    - Additional Achievements Score: 20%
    - Leadership Score: 10%
    - Teamwork Score: 15%

4. Technical Lead:
    - Relevant experience in years: 5%
    - Competency Score: 25%
    - Goal Accomplishments Score: 20%
    - Additional Achievements Score: 10%
    - Leadership Score: 25%
    - Teamwork Score: 15%
5. Dev Manager:
    - Relevant experience in years: 5%
    - Competency Score: 25%
    - Goal Accomplishments Score: 15%
    - Additional Achievements Score: 10%
    - Leadership Score: 30%
    - Teamwork Score: 15%

Since all the scores are between 0-5, I have normalized the experience value to use it in rating computation.
If (experience >0 and experience <3) then normalized experience =1
If (experience >2 and experience <7) then normalized experience =2
If (experience >6 and experience <13) then normalized experience =3
If (experience >12 and experience <21) then normalized experience =4
If (experience >20 and experience <91) then normalized experience =5

Forward chaining, Salience and Conflict resolution: The system by default uses forward chaining where the engine executes the right hand side of the activated rules. I have used salience for giving an order to the questions to be asked by the system to the user. For conflict resolution, the system uses the default 'depth' strategy - which fires the most recently activated rules before others.

Knowledge Base: The knowledge base of this system is composed of the following components.

Templates:

1. Employee template: This template corresponds to all the information of the employee which includes designation, experience, competency-score, goal-accomplishments-score, additional-achievements-score, leadership-score and teamwork-score.

```
(deftemplate employee
(slot designation)
(slot experience (default 0))
```

(slot competency-score (default 0))
(slot goal-accomplishments-score (default 0))
(slot additional-achievements-score (default 0))
(slot leadership-score (default 0))
(slot teamwork-score (default 0)))

2. Question template**:** This template corresponds to the questions asked by the system to the user.

(deftemplate question (slot text) (slot type) (slot ident))

3. Answer template**:** This template corresponds to the answers received from the user.

(deftemplate answer (slot ident) (slot text))

4. Rating template**:** This template corresponds to the overall performance rating given to the employee after computing it with all the details given by the user.

(deftemplate performance-rating (slot rating))

5. Recommendation template**:** This template corresponds to the rating and description of the final performance rating given to the employee.

(deftemplate recommendation (slot performance-rating) (slot description))

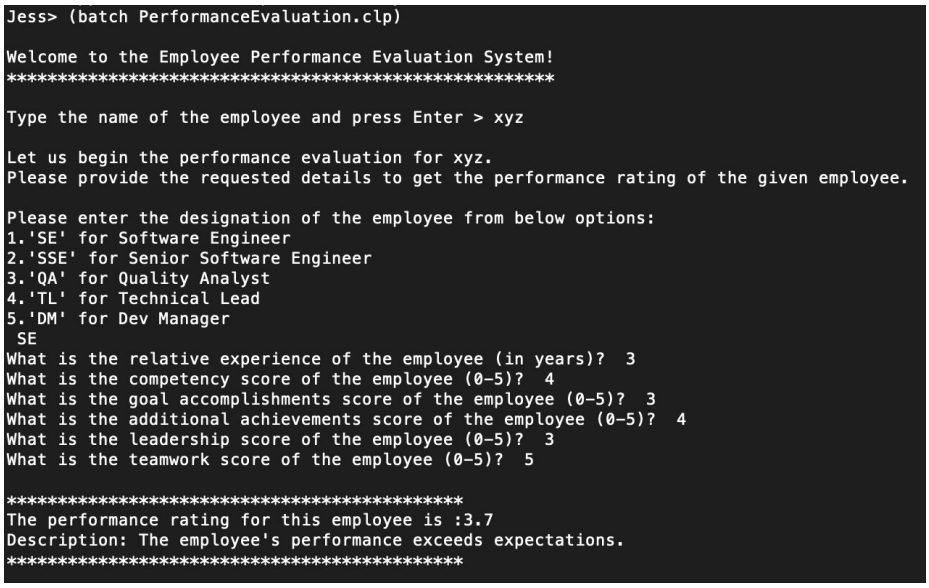
Questions Facts: This consists of a list of questions where each question has an id to distinguish from one another and a type, which corresponds to the type of answer the rule system is expecting. The questions I have included are:

1. Designation of the Employee - “Please enter the designation of the employee from below options:
   1.'SE' for Software Engineer
   2.'SSE' for Senior Software Engineer
   3.'QA' for Quality Analyst
   4.'TL' for Technical Lead
   5.'DM' for Dev Manager”
2. Relevant experience in years - “What is the relative experience of the employee (in years)? ”
3. Competency Score - “What is the competency score of the employee (0-5)?”
4. Goal Accomplishments Score - “What is the goal accomplishments score of the employee (0-5)? ”

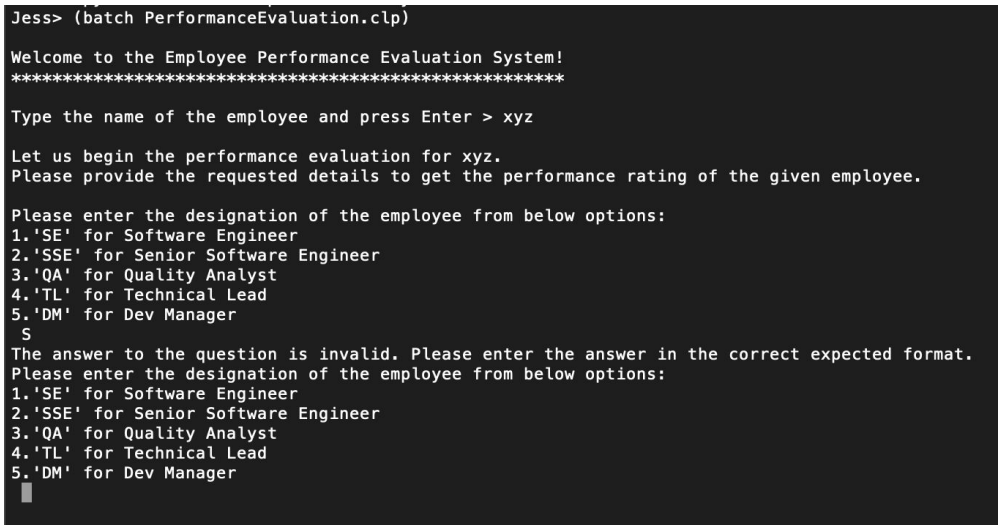
5. Additional Achievements Score - “What is the additional achievements score of the employee (0-5)?”
6. Leadership Score - “What is the leadership score of the employee (0-5)? ”
7. Teamwork Score - “What is the teamwork score of the employee (0-5)?”

Test Cases:

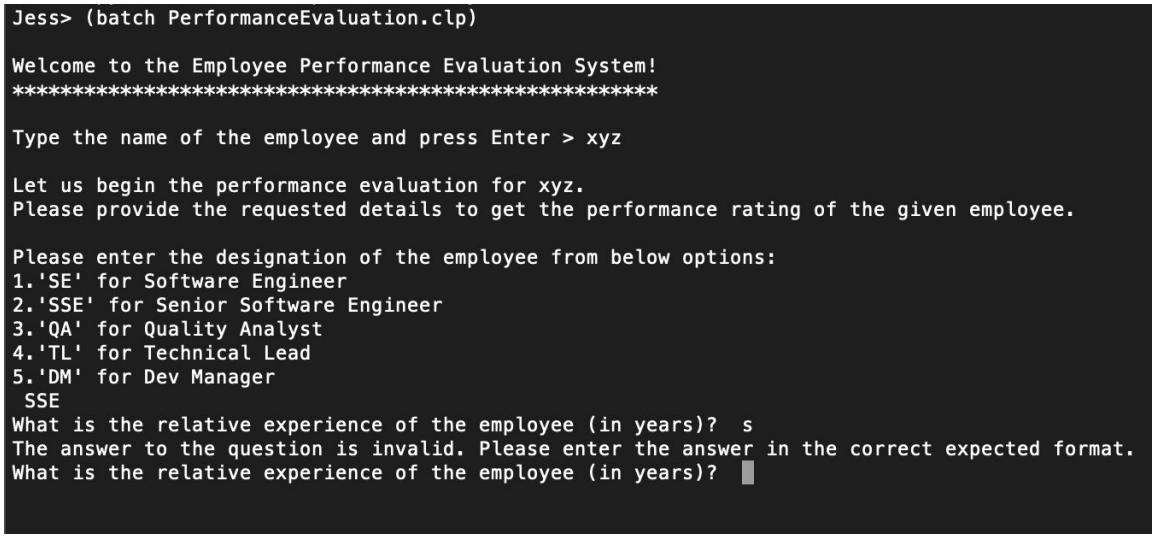
1) Valid scenario: All the inputs are correct and the final performance rating and description are given by the system.



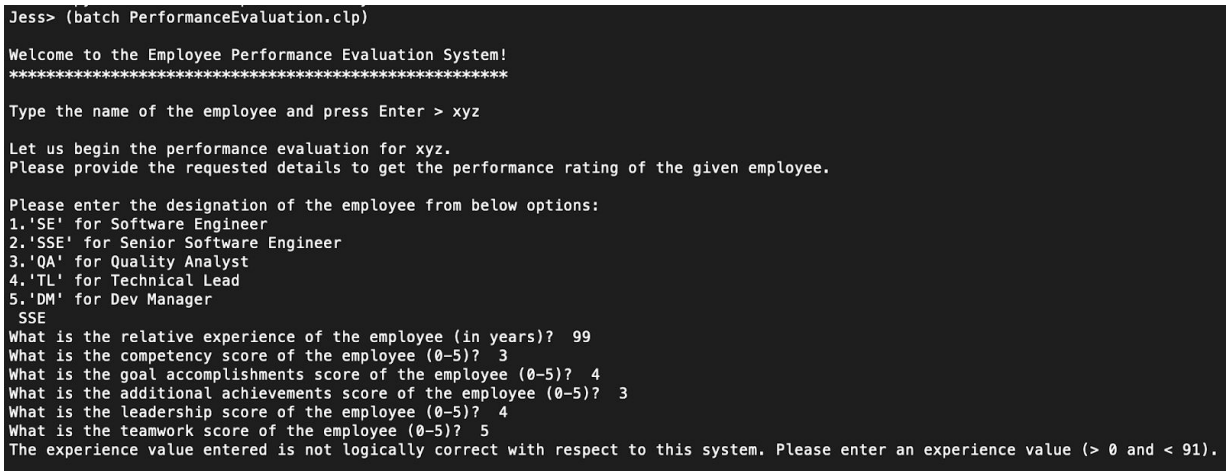
2) Error scenario: The input for designation is incorrect and the system asks to reenter the designation.



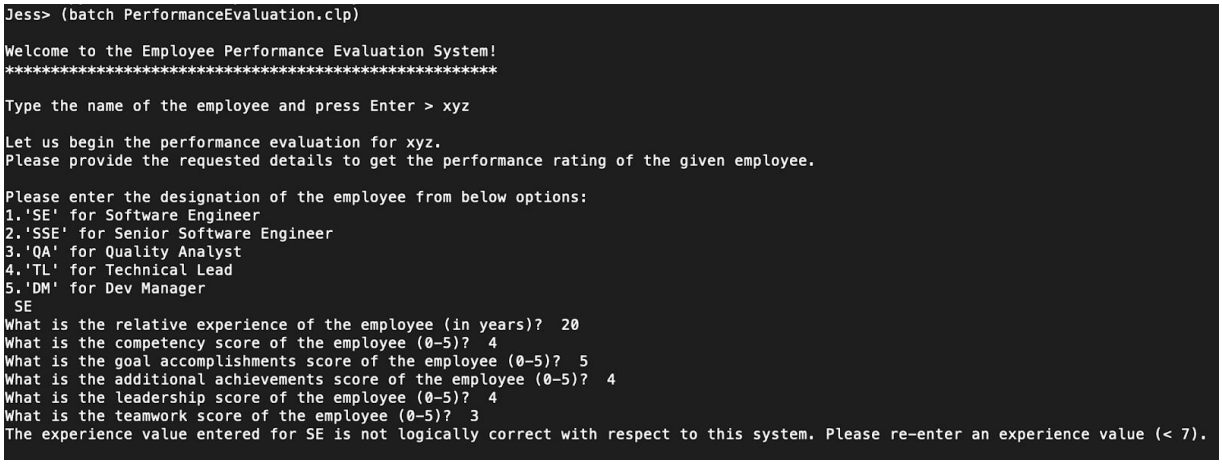
3) Error scenario: The input type of experience is incorrect and the system asks to reenter the experience.



4) Invalid scenario: The input of experience is not valid in this system and the system displays and error message.



5) Invalid scenario: The input of experience is not valid in this system and the system displays and error message.



Valid cases:

- Works for all the cases where designation has a value from the list {SE, SSE, QA, TL, DM}, experience has a value which is a number >0 and <91, competency-score, goal-accomplishments-score, additional-achievements-score, leadership-score and teamwork-score are numbers between 0 and 5.
- If the type of expected answer to a question is incorrect, the system asks to reenter the answer again in the correct expected format.
- Experience of the employee is logically dependent on the employee's designation. I have added conditions such that SE accepts experience (0-6), SSE accepts experience (0-12), DM accepts experience (>6), QA and TL accepts any experience. If the experience value does not satisfy the above conditions, the system displays a message to reenter the experience value.

Expected Output:

The system would give a performance rating for the employee and the description of the rating. The performance ratings can be between 0-5, where 0-0.9 refers to "The employee's performance is unsatisfactory", 1-1.9 refers to "The employee's performance needs improvement.", 2-2.9 refers to "The employee's performance meets the expectations", 3-3.9 refers to "The employee's performance exceeds expectations." and 4-5 refers to "The employee's performance is exceptional!"

Instructions to run the system:

- Save the "PerformanceEvaluation.clp" file in the "Jess71p2\bin\" folder on your local system.

- Go to the command line interface for Jess and execute the file using the batch command along with the correct location of the file on the system.

  (batch “PerformanceEvaluation.clp”).

Possible extensions:

- Additional designations can be added to the system or the existing designations can be updated based on the organization using the system.
- Additional scores can be added and the existing scores can be modified.
- The weightage given to the scores for different designations can be modified.
- The criteria(the acceptable values) given for the experience and scores can also be modified.
- The enlarged system can be used in an organization across all domains and across all hierarchy levels.