Title: An Expert Advisor for Graduate Students in the Engineering Management Program

Course:
Year: 1995
Author(s): M. Bayyigit and A. Uslu

Report No: P95008

Abstract: In our Engineering Management Program, the students are given a wide course diversity to select among them as elective courses. They need to be properly advised to fill the gap in the skills and knowledge level between the current and future opposition. An Expert Advisor for the graduate students in the Engineering Management Program is developed for mimicking the advisory sessions of the graduate students with the program head, Dr. Kocaoglu. During these sessions, the above factors are considered and the elective courses are selected accordingly.

An Expert Advisor for Graduate Students in the Engineering Management Program

Mete Bayyigit, Akin Uslu

EMP-P9508

EMGT 510/Fall 1994

DECISION SUPPORT SYSTEMS I

TERM PROJECT REPORT

An Expert Advisor for Graduate Students in The Engineering Management Program (EAGSEMP)

Submitted to:

Mani S. Manivannan, Ph. D.

Submitted by:

Mete Bayyigit

Akin Uslu

TABLE OF CONTENTS

I. Introduction

An Engineering Management Program or Department has students who would like to make significant contributions to their careers. In a sense, it is a professional program where the students strive to improve their weaknesses or to build more on their strengths in terms of skills and knowledge. This is needed, because the future careers of the people, in a very competitive job environment, demand them to possess the most in their knowledge and skills inventory. However, the current skills and knowledge level of a person might not be sufficient to achieve his/ her future goals regarding the future position.

In our program, the students are given a wide course diversity to select among them as elective courses. Considering the above facts, the student needs to be properly advised to fill the gap in the skills and knowledge level between the current and future position.

An Expert Advisor for the Graduate Students in the Engineering Management Program (EAGSEMP) is developed for mimicking the advisory sessions of the graduate students with the program head, Dr. Kocaoglu. During these sessions, the above factors are taken into consideration and the elective courses are selected accordingly.

II. Problem Description

2.1 Problem Overview

The system developed is an expert advisor (EA) for graduate students in The Engineering Management Program (EMP) at the Portland State University (PSU). The expert system is a microcomputer based knowledge for advising the graduate EMP students at PSU.

The basic framework of EAGSEMP system is composed of the subsystems as shown in figure 2.1.1

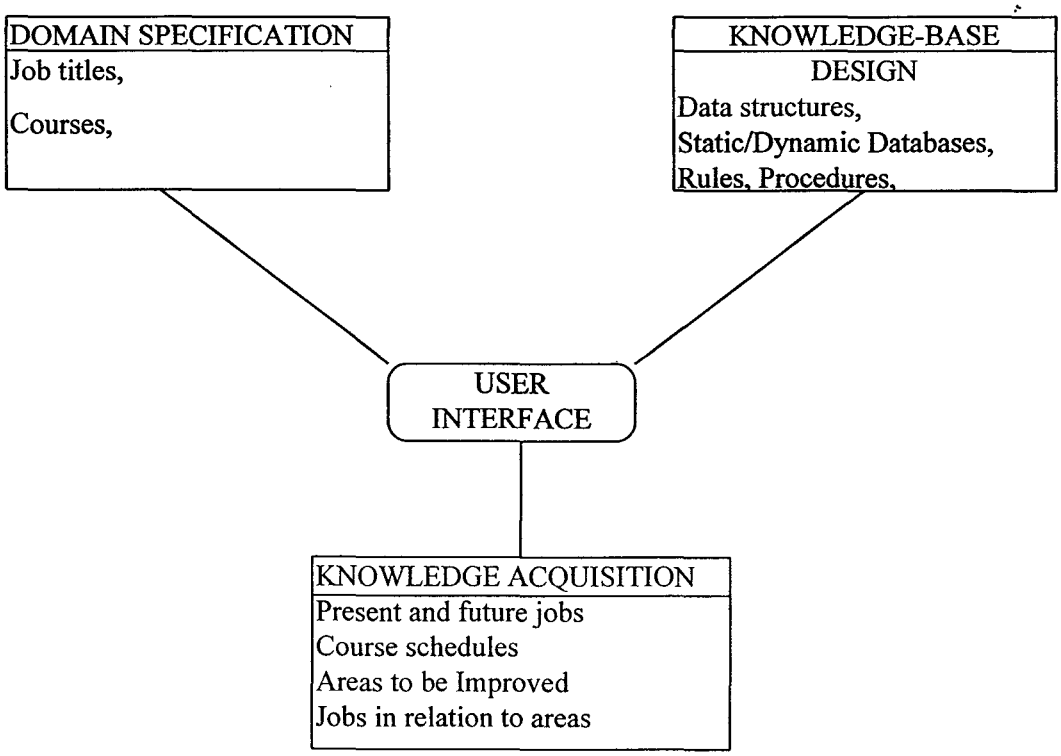


figure 2.1.1 Basic Framework of the EAGSEMP

Academic advising in a university environment usually consists of charting a student academic progress and ensuring satisfaction of all university and degree requirements. EAGSEMP will focus on the classes that an EMP graduate student needs to enroll with the following constraints:

Student's current position and his or her future expected position set as a goal

- Availability of the courses
- Prerequisites of the courses
- The elective courses he/she has enrolled before

Much of the required information above is scattered over such resources:

- University catalogs
- Advising worksheets
- Memos
- Other university records

There are many reasons to develop such an EA. One is that advising is taking more time than can be reasonably made available. The limited amount of time allocated to academic advising by the advisor might create a bias toward a limited number of choices.

Secondly, changing rules are of concern about consistency because of the dynamic structure of the availability of the classes, the prerequisites for these classes, and their profiles. Furthermore turnover of a faculty creates more chaos in an already complex class selection process, because the course sequence has to be understood and assessed by the replacing advisor.

In a person to person academic advising, the graduate students are asked to establish a future career in 5-year range. In these conditions students have no flexibility to try different scenarios for their future goals, and have no chance to see the result of these changes.

This kind of a sensitivity analysis is needed because of the stochastic nature of the future life. With our system, students will be able to see the result of their goal changes on their courses, in other words our system allows the student to analyze the demands, regarding the skills and the knowledge required of possible positions that student might want to undertake.

2.2 Specification of Domain

The application domain of EAGSEMP is limited to the advisement offered by EMP faculty members only. This includes:

- The EMP Faculty
- The EMP Graduate students

EAGSEMP's domain knowledge includes, classification of the classes according to the availability, interest areas, prerequisites and previously enrolled elective courses. Sources that will be used for acquiring EAGSEMP's domain knowledge are:

- The academic advisors
- University catalog
- Course schedules
- Infobase-a database for companies and people involved in them, including their job titles

III. Knowledge Acquisition and Knowledge-Base Design

We acquired the knowledge after a consultation with Dr. Kocaoglu (Dr. K)-The head of the Engineering Management Program. We have tried to imitate his advisory sessions, to understand through which steps he and the student are going.

At very beginning of the advisory session, Dr. K. gets the following information from the student:

- his/her educational background
- his/her current job position
- his/her goal in 5-year time period, in terms of job position

Next step of the session is to determine the strengths of the student depending his/her current position. Dr. K. has suggested us to use the table 1 in appendix A. During the consultation with Dr. K., the current or future job title of a student might be categorized as follows:

- Continuing Graduate Student
- Technical Specialist
- Team Leader
- Project/ Program Manager
- Division/ Department Manager
- High Level Executive

To eliminate the bias and also to give him/her a broader perspective, we have used an information database to extract the most widely used job titles, in the industry. The database used, includes the information about the companies and their employees' job title, in Oregon. Next we needed to assign the job titles extracted from database to the above grouping made by Dr. K. Assignment to the categories has been done as follows:

- **Technical specialist**
  - chief engineer
  - design engineer
  - engineer
  - sales engineer
  - software engineer
  - mechanical engineer
  - computer scientist
  - industrial engineer
  - civil engineer
  - system analyst
  - systems engineer programmer

- **Team leader**
  - manager
  - marketing communications
  - operations
  - quality assurance manager
  - office manager
  - sales coordinator
  - supervisor primary officer

- **Project manager**
  - administrative manager
  - engineering manager
  - operations manager
  - production manager
  - project manager
  - research administrator
  - R&D manager

- **Department manager**
    - branch manager
    - business manager
    - consultant
    - director of marketing
    - director of operations
    - director of sales
    - division manager
    - director of finance
    - human resources manager
    - manufacturing manager
    - marketing manager
    - plant manager
    - purchasing manager
    - sales manager

- **High level executive**
    - chief executive officer
    - chief financial officer
    - chief operations officer
    - executive director
    - executive vice president
    - general manager
    - national sales manager
    - president

- **Continuing graduate student**
    - graduate student

After the determination of student's current position and future goal, the areas needed to be strengthened to achieve the desired goal are found. Our assumption is that, different job

positions demand different skills and knowledge profile from the graduate student. These areas are categorized as follows:

- **TECHNICAL SPECIALTIES**
  - CE
  - ME
  - EE
  - CS
  - IE

- **TEAM BUILDING**

- **TECHNICAL MANAGEMENT CONCEPTS**
  - Innovation
  - R&D Management

- **TOOLS**
  - Statistics
  - Simulation
  - AI/ES

- **BEHAVIORAL ASPECTS**
  - Psychology
  - People/Human Resources

- **ORGANIZATIONAL ASPECTS**

- **FINANCIAL ASPECTS**
  - Economics
  - Financial Analysis
  - Accounting

- **STRATEGIC ASPECTS**

- Marketing
- Strategic Management
- International Considerations

- **DECISION MAKING ASPECTS**
  - Resource Allocation
  - Decision Analyses
  - Project Control

Using the above categories, the specific areas to be improved are determined for a transition from one position to another to fill the knowledge and skills gap. For example, when a person selects chief engineer as a current job and R&D manager as a goal, in the system he would be represented as a technical specialist for the time being, and as project manager for his/her future career. This person needs to improve him/herself in the areas of psychology, people/human resources, team building. resource allocation, decision analysis, project control, R&D management, to allow him/her to complete the transition from one position to another. It is obvious that each transition would have a different combination of areas to be strengthened. The relation between areas and the job categories are shown on Table-1. We also assume that the student possesses the required skills and knowledge of the position he or she is involved in.

After the determination of the areas to be improved, we use the next table which shows the relation of the areas and courses. From this table we extract the necessary courses to improve the area determined from Table-2 . As it can be seen from the table the courses have been marked by an 'X' sign, to show the relationship between the course and the area.

IV. System Design

4.1 Knowledge Representation and Rulebase Design

The most popular mode of knowledge representation within expert systems is the mode obtained through the use of rules, or rule-based systems. Alternatively, such rules are referred to as IF-THEN, or production rules. We have selected rule-based expert systems as our approach to knowledge representation. for a number of reasons, including their popularity and widespread use. Rule bases can be relatively easily modified. In particular, additions, deletions, and revisions to rule bases are relatively straightforward processes. Moreover, this is particularly so in the case of well-designed rule bases.

Figure 4.1.1 shows EAGSEMP's rulebase with various rulesets. Each ruleset performs a particular action and contains a set of rules chained through an inference mechanism.

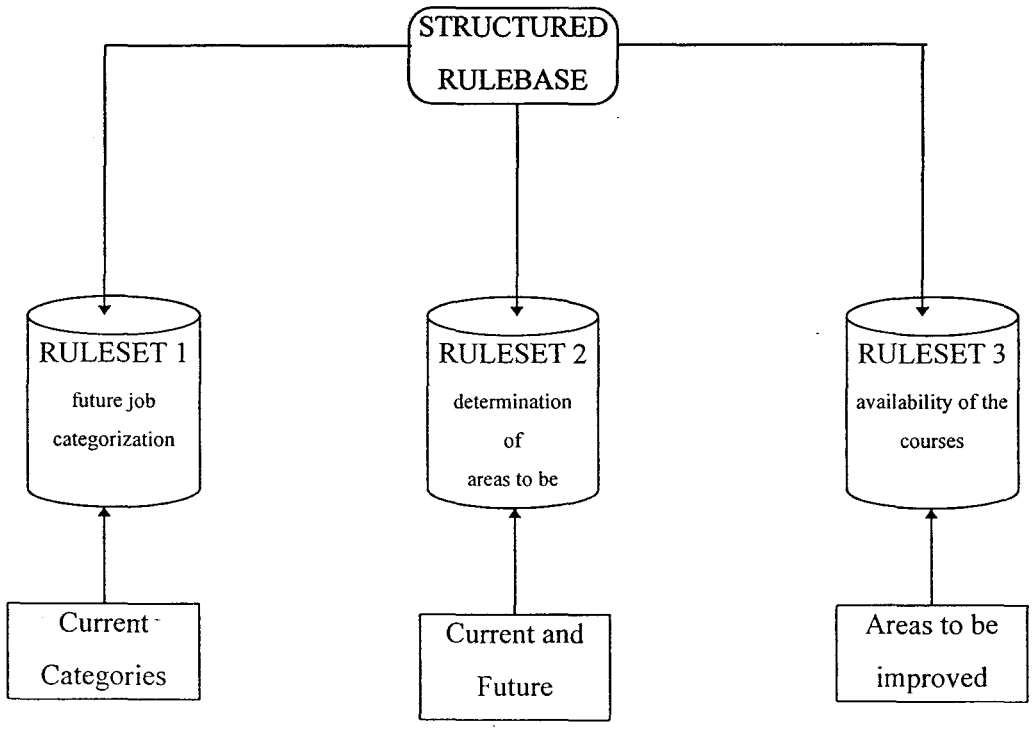
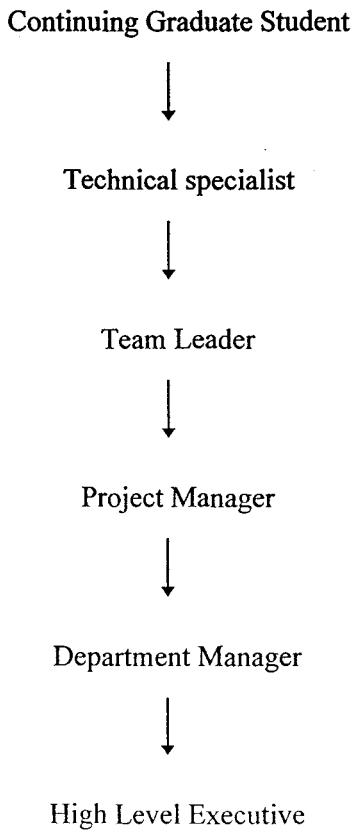


figure 4.1.1 EAGSEMP rulebase with various rulesets

Ruleset 1:

Ruleset 1 sets a restriction on the transition possibilities from the current position to the future position, since the student is asked to specify his future position in 5-year time period. The student is allowed to reach a future position in, at most two steps away from his/her current position. More specifically, if a graduate student's current position is categorized as "technical-specialist", he/she is allowed to choose a future position among the job titles of Team Leader or Project Manager category. The only exception is that the continuing graduate student can take a position in Project Manager category, meaning that the transition up to three levels is allowed during this time. Recall that the possible job titles that fall into different generalized categories are displayed in Section III. The long range career path of a person can be thought to be as follows from the low level to the highest level:



Ruleset 2:

The antecedent part of the rule in the Ruleset 2 evaluates the student's current and future category of his/her current and future position, respectively. Then, based on this evaluation, the consequent part sets the areas needed to be improved to achieve the goal of the student on his/her career path. Recall that the areas needed to be improved differ according to the skills and knowledge gap between the student's current and the future positions.

Ruleset 3:

This ruleset consists of 3 mutually exclusive rules to find the available courses of the quarter in which the student is currently enrolled. In User Interface, the student is asked to give such information to the database of our system.

4.2 Inference Engine

EAGSEMP system inferences on a forward-chaining basis. In forward chaining, the inference mechanism compares the information in the global data base with the IF part. The global database refers to the information supplied by the user and the information inferred or deduced by the system's inference mechanism working on the knowledge base. Should the comparison reveal a match between information in the global data base and the IF part of a rule, that rule fires; that is, the THEN part of a rule is added to the global data base. This process repeats until no matches occur between facts in the global database and the IF parts of rules in the knowledge base. The inference mechanism is nothing, but the interpreter for the rulebase applying the knowledge to the actual problem instance in arriving at a solution. In forward chaining, first, the Left Hand Sides (LHS), meaning IF-PART of each rule in the ruleset is evaluated. This is known as triggering a rule. The so called firing a rule comes next. If the evaluation of the antecedent part of a rule leads to the successful matching of the conditions, then the Right Hand Side (or consequent part) of the rule is evaluated. The RHSs in each rule set of our system determine the information specific to the user. In other words, the system categorizes the user according to the

static database, like possible transitions from his/her current job position, the available courses in which the student is enrolled etc.

4.3 Dynamic / Static Databases

EAGSEMP's static database consists of the translation of the information given in the tables mentioned in "Knowledge Representation" section. These are classification of the positions, classification of the areas to be improved according to the transitions from one position to another, the classification of courses according to their availabilities in a quarter and classification of courses according to the areas needed to be improved. In the static database, the associative list structure is used.

The dynamic database is designed for storage and retrieval of various parameter values obtained from the user. These are actually the inputs and output from the system and all feasible outcomes for the given problem.

4.4 User Interface

In the User Interface, the student is supposed to give some information to the system. The information required to be taken from the user includes his/her current job title, the quarter in which he/she is involved, the elective courses he/she has taken. The user is also involved in specifying the information about his/her future job title set on the career path.

4.5 Procedures

The functions of the procedures used in our system are explained below. The underlined and italicized words stand for the names of the functions used in LISP code.:

"lookfor": This procedures identifies the general category in which the user's current and future positions fall. For example, if the user selects his/her current position as the design engineer and sees himself/herself as being an engineering manager in 5-year tome period, his current and future positions fall in "Technical Specialist" and "Project Manager". Recall that the job titles that each category can have are stored in statistical database.

"find_courses_for_areas_needed_to_be_improved": After the areas needed to be improved are found to fill the knowledge and skills gap of the user, this function identifies the courses that are in relation to these areas, determined by Dr. Kocaoglu.

"check_availabilty_and_prerequisites": Among the courses determined by the previous procedure, some of them are available and moreover, the student might not take the prerequisites of some courses. The available courses which satisfy the prerequisite conditions are determined by this procedure. Obviously, it uses the information about the quarter in which the student is enrolled and the elective courses he/she has taken. Such information was made available to the system via the user interface.

"jobs": All the job titles available in the static database are printed on the screen by this method.

"future_print": Its function is very similar to the previous function. Because of the difference in data structure, a different method for printing purpose is used. It provides the future possible positions that the student can have. The "possible" word is important, because in 5-year time period, it is assumed that there is a limit for transition from one job to another.

"clear_screen" : This procedure is nothing, but a very simple one to clear the screen.

4.6 Explanation System

Generally speaking, explanation subsystem provides what the results by the inference engine and how they are achieved. Specifically, the system provides the steps and the information, which is not given by the user, but extracted by the system while arriving at a solution. In our system, the classification of his/her current and future position, the areas needed to be improved determined by the demands of his/her future job position (lacking or quite weak skills and knowledge of the current job position needed to achieve the desired position in the future). Furthermore, the courses related with the areas needed to be listed are listed. However, by a control mechanism, the user also is given a chance to see which ones of them are available. The available courses for

areas needed to be improved do not include the elective courses the student has taken before. These control mechanisms are performed by the procedures needed by factual rules.

VI. Analysis of Results/Scope for Future Research

We have tried EAGSEMP on several graduate students of EMP. Even though the number of users are not high enough to make a statistical analysis of their satisfaction level, their feedback to us was encouraging.

Even though we have used Dr. K. as a source of our advisory expert system, the relation of courses with areas to be improved and the strength of each job category can be defined in a scale where 5 would represents highest relation and 0 would represents no relation. This would give a better and more comprehensive course schedule to the student.

It is obvious that, the EAGSEMP runs in a limited environment, though the way it is designed allows it to be expanded easily. For future expansions, other departments courses, course instructors can be added to the system.

The assignment of each job title to any job category is another place that needs to be improved. It is required to spend more time to come up with a right categorization of each job title. Moreover, the user of the system might be given more job titles, since the user of this system might not find a job title for both his/her current or future job title that best describes his/her position. Increasing the number of general job categories on the long range career path might result in better advising process. Our system has the flexibility of incorporating such changes into its static database.

VII. Appendices

A- The Consultation Session

Table 1: Areas of need to be strengthened

Technical Specialist----------> Team Leader

Psychology, people/human resources, organizational aspects, resource allocation, team building

Technical Specialist----------> Project Manager

Psychology, people/human resources, team building, resource allocation, decision analysis, scheduling, project control, R&D management

Team Leader----------> Project/Program Manager

R&D Management, resource allocation, decision analysis, scheduling, project control

Team Leader----------> Division/Department Manager

R&D Management, innovation, organizational aspects, economics, financial analysis, accounting, marketing, resource allocation, decision analysis

Project/Program Manager----------> Division/Department Manager

R&D Management, innovation, organizational aspects, marketing, accounting, economics

Project/Program Manager----------> High Level Executive

Innovation, R&D management, organizational aspects, Marketing, strategic management, international considerations

Division/Department Manager----------> High Level Executive

Innovation, R&D management, marketing, strategic management, international considerations

Continuing Graduate Student----------> Technical Specialist

Statistics, optimization, simulation, AI/ES, decision analysis, resource allocation, financial analysis, scheduling

Continuing Graduate Student----------> Team Leader

Team building, psychology, people/human resources, organizational aspects, decision analysis, resource allocation, scheduling

Continuing Graduate Student----------> Project/Program Manager

Team building, psychology, people/human resources, financial analysis, accounting, resource allocation, decision analysis, scheduling, project control

table 2
Courses in Relation With Positional Needs

NEEDS		TECH. MGMT. CONC.	
	TEAM BUILDING	Innovation	R&D Management
DSS-I: Expert Systems in Engineering			
DSS-II: Intelligent Systems in Mfg.			
Manufacturing Systems Simulation			
TQM-I: Continuous Improvements	X		
TQM-II: Tools for Continuous Imprv.			
Re-engineering			
Strategic planning in Eng'g. Management			
Discrete Systems Simulation			
Continuous Systems Simulation			
Industrial Safety			
Environmental Engineering			
Manufacturing Operations Analysis			
Statistical Analysis for E.M.			
Concurrent Engineering			
Database Design			
Production Systems Design			
Statistical Process Control			
Design of Experiments			
Systems Planning & Management Information Systems - III			X

table 2
Courses in Relation With Positional Needs

NEEDS		TECH. MGMT. CONC.	
	TEAM BUILDING	Innovation	R&D Management
Cases in Managerial Accounting			
Legal Considerations for Managers			
International Financial Management			
Cases in Corporate Financial Mgmt.			
Advanced Financial Management			
Managing Hi-Tech & Entrepreneurship		X	X
Managing Information Envirornment			X
Quantitative Methods for Managers			
Managing Human Resources	X		
Management of Organizational Change		X	
Case Problems in Organization & Mgmt.			
Human Resources and Planning	X		
Business Policy and Strategy			X
Human Resources Policies	X		
Creative Marketing Strategy			
Analysis of Business Information			
Marketing Management			
Intemational Business Policy			
Cases in Marketing Management			
International Marketing Management			

table 2
Courses in Relation With Positional Needs

NEEDS		TECH. MGMT. CONC.	
	TEAM BUILDING	Innovation	R&D Management
Econometrics - I			
Econometrics - II			
Advanced Macroeconomics			
Advanced Mcroeconomics			
Cost / Benefit			
Industrial/Organizational Psychology	X		
Project Evaluation			
Behavioral Science	X		
Introduction to Marketing			
International Financial Management			
Team Building	X		
Adv. Industrial/Orgn'l. Psychology			

table 2
Courses in Relation With Positional Needs

NEEDS	TOOLS				BEHAVIORAL ASPECTS	
	Statistics	Optimization	Simulation	AI/ES	Psychology	People/Human Resources
DSS-I: Expert Systems in Engineering				X		
DSS-II: Intelligent Systems in Mfg.				X		
Manufacturing Systems Simulation		X	X			
TQM-I: Continuous Improvements					X	
TQM-II: Tools for Continuous Imprv.	X					
Re-engineering						
Strategic planning in Eng'g. Management						
Discrete Systems Simulation			X			
Continuous Systems Simulation			X			
Industrial Safety						X
Environmental Engineering						
Manufacturing Operations Analysis						
Statistical Analysis for E.M.	X	X				
Concurrent Engineering						
Database Design						
Production Systems Design		X				
Statistical Process Control						
Design of Experiments						
Systems Planning & Management Information Systems - III						

table 2
Courses in Relation With Positional Needs

NEEDS	TOOLS				BEHAVIORAL ASPECTS	
	Statistics	Optimization	Simulation	AI/ES	Psychology	People/Human Resources
Cases in Managerial Accounting						
Legal Considerations for Managers						
International Financial Management						
Cases in Corporate Financial Mgmt.						
Advanced Financial Management						
Managing Hi-Tech & Entrepreneurship						
Managing Information Enviromment						
Quantitative Methods for Managers						
Managing Human Resources						X
Management of Organizational Change						
Case Problems in Organization & Mgmt.						
Human Resources and Planning						X
Business Policy and Strategy						
Human Resources Policies						X
Creative Marketing Strategy						
Analysis of Business Information						
Marketing Management						
Intemational Business Policy						
Cases in Marketing Management						
International Marketing Management						

table 2
Courses in Relation With Positional Needs

NEEDS	TOOLS				BEHAVIORAL ASPECTS	
	Statistics	Optimization	Simulation	AI/ES	Psychology	People/Human Resources
Econometrics - I						
Econometrics - II						
Advanced Macroeconomics						
Advanced Mcroeconomics						
Cost / Benefit						
Industrial/Organizational Psychology					X	
Project Evaluation						
Behavioral Science						
Introduction to Marketing						
International Financial Management						
Team Building						
Adv. Industrial/Orgn'l. Psychology						

table 2
Courses in Relation With Positional Needs

NEEDS		FINANCIAL ASPECTS		
	ORGANIZATIONAL ASPECTS	Economics	Financial Analysis	Accounting
DSS-I: Expert Systems in Engineering				
DSS-II: Intelligent Systems in Mfg.				
Manufacturing Systems Simulation				
TQM-I: Continuous Improvements	X			
TQM-II: Tools for Continuous Imprv.				
Re-engineering	X			
Strategic planning in Eng'g. Management	X			
Discrete Systems Simulation				
Continuous Systems Simulation				
Industrial Safety				
Environmental Engineering				
Manufacturing Operations Analysis				
Statistical Analysis for E.M.				
Concurrent Engineering	X			
Database Design				
Production Systems Design				
Statistical Process Control				
Design of Experiments				
Systems Planning & Management Information Systems - III	X			

table 2
Courses in Relation With Positional Needs

NEEDS		FINANCIAL ASPECTS		
	ORGANIZATIONAL ASPECTS	Economics	Financial Analysis	Accounting
Cases in Managerial Accounting				X
Legal Considerations for Managers	X			
International Financial Management			X	
Cases in Corporate Financial Mgmt.			X	
Advanced Financial Management			X	
Managing Hi-Tech & Entrepreneurship				
Managing Information Enviromment				
Quantitative Methods for Managers				
Managing Human Resources				
Management of Organizational Change	X			
Case Problems in Organization & Mgmt.	X			
Human Resources and Planning				
Business Policy and Strategy				
Human Resources Policies				
Creative Marketing Strategy				
Analysis of Business Information				
Marketing Management				
Intemational Business Policy				
Cases in Marketing Management				
International Marketing Management				

table 2
Courses in Relation With Positional Needs

NEEDS		FINANCIAL ASPECTS		
	ORGANIZATIONAL ASPECTS	Economics	Financial Analysis	Accounting
Econometrics - I		X		
Econometrics - II		X		
Advanced Macroeconomics		X		
Advanced Mcroeconomics		X		
Cost / Benefit			X	
Industrial/Organizational Psychology	X			
Project Evaluation				
Behavioral Science				
Introduction to Marketing				
International Financial Management				
Team Building				
Adv. Industrial/Orgn'l. Psychology				

table 2
Courses in Relation With Positional Needs

NEEDS	STRATEGIC ASPECTS			DECISION MAKING ASPECTS		
	Marketing	Strategic Management	International Considerations	Resource Allocation	Decision Analysis	Project Control
DSS-I: Expert Systems in Engineering						
DSS-II: Intelligent Systems in Mfg.						
Manufacturing Systems Simulation					X	
TQM-I: Continuous Improvements		X				
TQM-II: Tools for Continuous Imprv.						
Re-engineering						
Strategic planning in Eng'g. Management		X				
Discrete Systems Simulation					X	
Continuous Systems Simulation					X	
Industrial Safety						
Environmental Engineering						
Manufacturing Operations Analysis				X	X	
Statistical Analysis for E.M.					X	
Concurrent Engineering						X
Database Design				X		X
Production Systems Design				X		
Statistical Process Control						
Design of Experiments				X		
Systems Planning & Management Information Systems - III						

table 2

Courses in Relation With Positional Needs

NEEDS	STRATEGIC ASPECTS			DECISION MAKING ASPECTS		
	Marketing	Strategic Management	International Considerations	Resource Allocation	Decision Analyses	Project Control
Cases in Managerial Accounting						
Legal Considerations for Managers						
International Financial Management						
Cases in Corporate Financial Mgmt.						
Advanced Financial Management						
Managing Hi-Tech & Entrepreneurship		X				
Managing Information Enviromment						X
Quantitative Methods for Managers					X	
Managing Human Resources						
Management of Organizational Change						
Case Problems in Organization & Mgmt.						
Human Resources and Planning						
Business Policy and Strategy		X				
Human Resources Policies						
Creative Marketing Strategy	X	X				
Analysis of Business Information						X
Marketing Management	X					
International Business Policy			X			
Cases in Marketing Management	X					
International Marketing Management	X		X			

table 2
Courses in Relation With Positional Needs

NEEDS	STRATEGIC ASPECTS			DECISION MAKING ASPECTS		
	Marketing	Strategic Management	International Considerations	Resource Allocation	Decision Analyses	Project Control
Econometrics - I						
Econometrics - II						
Advanced Macroeconomics						
Advanced Mcroeconomics						
Cost / Benefit						
Industrial/Organizational Psychology						
Project Evaluation						X
Behavioral Science						
Introduction to Marketing	X					
International Financial Management			X			
Team Building						
Adv. Industrial/Orgn'l. Psychology						

B- Program Listing

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;LOADER
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;To start the program please type (advise_me)
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


(defun advise_me ()
  (load "f:\\home\\grad\\mete\\610\\compiled.fsl")
  (main))
```

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;MAIN BODY/USER INTERFACE
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


(defun main ()
(Clear_screen '0)
(print "---------------------------------")
(terpri)
(print "An Expert Advisor for Graduate Students ")
(print " in The Engineering Management Program ")
(print "-------------------------------------------")
(terpri)
(print "Designed and programmed by")
(print "Mete Bayyigit / Akin Uslu")
(terpri)
(print "Please enter the quarter in which you want to be advised")
(terpri)
(princ "Fall, Winter, Spring?: ")
(setq quarter (read))
(terpri)
(prog () loop
 (cond((null (member quarter '(fall winter spring) :test #'equal))
      (terpri)
      (princ "Please Try Again:")
      (setq quarter (read))
      (go loop))))


(terpri)
(princ "Please enter the names of the elective courses that you have taken before in a list form")
(terpri)
(setq courses_taken (read))
(terpri)
(procedure_set)
)
```

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;STATIC DATABASE
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;Areas to be strengthened for career changes
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


(setq transitions '((from_tech_spec_to_team_leader (psychology
                                                     human_resources
                                                     organizational_aspects
                                                     resource_allocation
                                                     team_building))

                    (from_tech_spec_to_project_mngr (psychology
                                                      human_resources
                                                      team_building
                                                      resource_allocation
                                                      decision_analysis
                                                      project_control
                                                      r&d_management))

                    (from_team_leader_to_project_mngr (r&d_management
                                                        resource_allocation
                                                        decision_analysis
                                                        project_control))

                    (from_team_leader_to_dept_mngr (r&d_management
                                                     innovation
                                                     organizational_aspects
                                                     economics
                                                     financial_analysis
                                                     accounting
                                                     marketing
                                                     resource_allocation
                                                     decisison_analysis))

                    (from_project_mngr_to_dept_mngr (r&d_management
                                                      innovation
                                                      organizational_aspects
                                                      marketing
                                                      accounting economics))

                    (from_project_mngr_to_high_level_exec (innovation
                                                            r&d_management
                                                            organizational_aspects
                                                            marketing strategic_management
                                                            international_considerations))

                    (from_dept_mngr_to_high_level_exec (innovation
                                                         r&d_management
                                                         marketing
```

```
                                strategic_management
                                international_considerations))

    (from_cont_grad_stud_to_tech_spec (statistics
                                optimization
                                simulation
                                AI_ES
                                decision_analysis
                                resource_allocation
                                financial_ananlysis))

    (from_cont_grad_stud_to_team_leader (team_building
                                psychology
                                human_resources
                                organizational_aspects
                                decision_analysis
                                resource_allocation))

    (from_cont_grad_stud_to_project_mngr (team_building
                                psychology
                                human_resources
                                financial_analysis
                                accounting
                                resource_allocation
                                decision_analysis project_control))))

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;courses for areas to be strengthened
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(setq courses_offered '((marketing (creating_marketing_strategy
                   marketing_management cases_in_marketing_management
                   introduction_to_marketing
                   international_marketing_management))

     (strategic_management (concepts_in_continous_improvement
                   managing_high_tech_enterpreneurship
                   business_policy_and_strategy
                   creating_marketing_strategy
                   strategic_planning_in_EM))

     (international_considerations (international_financial_management
                   international_marketing_management
                   international_business_policy))

     (resource_allocation (manufacturing_operations_analysis
                   database_design
                   production_systems_design
                   design_of_experiments))

     (decision_analysis (statistical_analysis_for_EM
                   manufacturing_systems_simulation
                   quantitative_methods_for_managers))
```

```
                    business_policy_and_strategy
                    systems_planning_and_management))
          (team_building (team_building
                    managing_human_resources
                    human_resources_and_planning
                    human_resources_policies
                    industrial_organizational_psychology))))


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;courses,their quarters and prerequisites
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


(setq fall_courses '((manufacturing_systems_simulation (statistical_analysis_for_EM))
          (continuous_systems_simulation (statistical_analysis_for_EM))
          (expert_systems_in_engineering ())
          (cases_in_corporate_financial_management ())
          (statistical_analysis_for_EM ())
          (quantitative_methods_for_managers ())
          (industrial_safety ())
          (team_building ())
          (manufacturing_operations_analysis ())
          (fundamentals_of_accounting ())
          (corporate_financial_management (fundamentals_of_accounting))
          (cases_in_corporate_financial_management (corporate_financial_management))
          (behavioral_science_for_managers ())
          (managing_information_environment ())
          (quantitative_methods_for_management ())
          (advanced_micro_economics (micro_economic_theory))
          (econometrics_I ())
          (applied_linear_regression (statistics))
          (multivariate_statistics (statistics))
          (case_problems_in_organizations_problems (behavioral_science_for_management
                                    management_of_organizations))
          (business_policy_and_strategy (case_problems_in_organizations_and_management
                                cases_in_corporate-financial_management))
          (analysis_of_business_information ())
          (cases_in_marketing_management (corporate_financial_management
                                marketing_management))
          (international_marketing_management (marketing_management))))

(setq winter_courses '((database_design ())
          (production_systems_design ())
          (discrete_systems_simulation (statistics))
          (intelligent_systems_manufacturing (expert_systems_in_engineering))
          (cases_in_corporate_financial_management ())
          (concepts_in_continous_improvemnt ())
          (reeingineering_technical_enterprise ())
          (concurrent_engineering ())
          (quantitative_methods_for_managers ())
          (accounting_for_business_decisions (fundamentals_of_accounting))
          (legal_considerations_for_managers ())
          (international_financial_management (corporate_financial_management))
```

```
                (cases_in_corporate_financial_management (corporate_financial_management))
                (managing_high_tech_enterpreneurship ())
                (quantitative_methods_for_management ())
                (management_of_organizations ())
                (systems_planning_and_management ())
                (human_resources_and_planning (managing_human_resources))
                (advanced_macro_economics (macro_economic_theory))
                (econometrics_II ())
                (cost_benefit_analysis (macro_economic_theory))
                (case_problems_in_organizations_problems (behavioral_science_for_management
                                                          management_of_organizations))
                (business_policy_and_strategy
(case_problems_in_organizations_and_management
                                                  cases_in_corporate-financial_management))
                (analysis_of_business_information ())
                (introduction_to_marketing ())
                (marketing_management ())
                (international_business_policy (marketing_management
                                                management_of_organizations
                                                corporate_financial_management
                                                fundamentals_of_accounting))
                (cases_in_marketing_management (corporate_financial_management
                                                marketing_management))
                (international_marketing_management (marketing_management))))

(setq spring_courses '((legal_considerations_for_managers ())
                (cases_in_corporate_financial_management ())
                (managing_human_resources (behavioral_science_for_managers))
                (tools_for_continuous_improvement (concepts_in_continous_improvement))
                (design_of_experiments ())
                (strategic_planning_in_EM ())
                (fundamentals_of_accounting ())
                (accounting_for_business_decisions (fundamentals_of_accounting))
                (legal_considerations_for_managers ())
                (corporate_financial_management (fundamentals_of_accounting))
                (cases_in_corporate_financial_management (corporate_financial_management))
                (advanced_financial_management (corporate_financial_management))
                (behavioral_science_for_managers ())
                (managing_information_environment ())
                (management_of_organizations ())
                (management_of_organizational_change (management_of_organizations))
                (human_resources_policies (managing_human_resources))
                (creative_marketing_strategy ())
                (project_evaluation ())
                (case_problems_in_organizations_problems (behavioral_science_for_management
                                                          management_of_organizations))
                (business_policy_and_strategy
(case_problems_in_organizations_and_management
                                                  cases_in_corporate-financial_management))
                (industrial_organizational_psychology ())
                (analysis_of_business_information ())
                (introduction_to_marketing ())
                (marketing_management ())
                (international_business_policy (marketing_management
```

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;FACTUAL RULEBASES
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;Possible position changes
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(setq ruleset_1 '(((equal *current_category* 'technical_specialist)
                   (setq future_positions (append (car (cdr (assoc 'team_leader positions)))
                                                  (car (cdr (assoc 'project_manager positions))))))

                  ((equal *current_category* 'team_leader)
                   (setq future_positions (append (car (cdr (assoc 'project_manager positions)))
                                                  (car (cdr (assoc 'department_manager positions))))))

                  ((equal *current_category* 'project_manager)
                   (setq future_positions (append (car (cdr (assoc 'department_manager positions)))
                                                  (car (cdr (assoc 'high_level_executive positions))))))

                  ((equal *current_category* 'department_manager)
                   (setq future_positions (car (cdr (assoc 'high_level_executive positions)))))

                  ((equal *current_category* 'high_level_executive)
                   (setq future_positions '()))

                  ((equal *current_category* 'continuing_graduate_student)
                   (setq future_positions (append (car (cdr (assoc 'team_leader positions)))
                                                  (car (cdr (assoc 'project_manager positions)))
                                                  (car (cdr (assoc 'technical_specialist positions)))))))


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;AREAS NEEDED TO BE IMPROVED IN ORDER TO FULFILL POSITION CHANGE NEEDS
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(setq ruleset_2 '(((and (equal curr 'technical_specialist) (equal furr 'team_leader))
 (setq areas_needed_to_be_improved (car (cdr (assoc 'from_tech_spec_to_team_leader
transitions)))))

                  ((and (equal curr 'technical_specialist) (equal furr 'project_manager))
 (setq areas_needed_to_be_improved (car (cdr (assoc 'from_tech_spec_to_project_mngr
transitions)))))

                  ((and (equal curr 'team_leader) (equal furr 'project_manager))
 (setq areas_needed_to_be_improved (car (cdr (assoc 'from_team_leader_to_project_mngr
transitions)))))

                  ((and (equal curr 'team_leader) (equal furr 'department_manager))
 (setq areas_needed_to_be_improved (car (cdr (assoc 'from_team_leader_to_dept_mngr
transitions)))))

                  ((and (equal curr 'project_manager) (equal furr 'department_manager))
```

```
(setq areas_needed_to_be_improved (car (cdr (assoc 'from_project_mngr_to_dept_mngr
transitions)))))

        ((and (equal curr 'project_manager) (equal furr 'high_level_executive))
 (setq areas_needed_to_be_improved (car (cdr (assoc 'from_project_mngr_to_high_level_exec
transitions)))))

        ((and (equal curr 'department_manager) (equal furr 'high_level_executive))
 (setq areas_needed_to_be_improved (car (cdr (assoc 'from_dept_mngr_to_high_level_exec
transitions)))))

        ((and (equal curr 'continuing_graduate_student) (equal furr 'technical_specialist))
 (setq areas_needed_to_be_improved (car (cdr (assoc 'from_cont_grad_stud_to_tech_spec
transitions)))))

        ((and (equal curr 'continuing_graduate_student) (equal furr 'team_leader))
 (setq areas_needed_to_be_improved (car (cdr (assoc 'from_cont_grad_stud_to_team_leader
transitions)))))

        ((and (equal curr 'continuing_graduate_student) (equal furr 'project_manager))
 (setq areas_needed_to_be_improved (car (cdr (assoc 'from_cont_grad_stud_to_project_mngr
transitions)))))
    ))

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;IDENTIFICATION OF CLASSES ACCORDING TO QUARTER SELECTED
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(setq ruleset_3 '(((equal quarter 'fall) (setq quarter_courses fall_courses))
        ((equal quarter 'winter) (setq quarter_courses winter_courses))
        ((equal quarter 'spring) (setq quarter_courses spring_courses))))
```

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;PROCEDURES
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;Current position printing
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


(defun jobs (post)
(terpri)
(setq post positions)
      (prog () loop2
   (cond ((not (null post))
         (setq tempp (car (cdr (car post))))
         (setq post (cdr post))
         (prog () loop
            (cond ((not (null tempp))
                  (princ (car tempp))
                  (princ "               ")
                 (setq tempp (cdr tempp))
                  (cond ((not (null (car tempp))) (princ (car tempp))))
                  (setq tempp (cdr tempp))
                  (terpri)
                 (go loop))
            )
         (go loop2))
        ))))


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;Finding current and future position
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defun lookfor (current)
 (setq post positions)
    (prog () loop
          (cond ((not (null (member current (car (cdr (car post))) :test #'equal)))
                (setq *current_category* (car (car post))))
          (t (setq post (cdr post))
             (cond ((not (null post))
                   (go loop))
             (t (print "sorry your entry is wrong")
                (setq *current_category* nil)))))))


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;Statdata browser
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
(defun future_print (values)
 (prog () Loop
```

```
  (cond ((not (null values))
        (print (car values))
        (setq values (cdr values))
       (go loop)))))



;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;Screen cleaner
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defun clear_screen (spaces)
  (cond ((not (= spaces '20))
        (terpri)
        (clear_screen(+ spaces 1)))
       (t ())))

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;Finding the courses for areas needed to be improved
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defun find_courses_for_areas_needed_to_be_improved (areas)
  (setq courses_for_areas_needed_to_be_improved '())
    (prog ()loop
         (cond ((not (null areas))
               (setq courses_for_areas_needed_to_be_improved
                  (union (car (cdr (assoc (car areas) courses_offered)))
                           courses_for_areas_needed_to_be_improved))
               (setq areas (cdr areas))
     (go loop)))))


;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;Procedure to check the availability and prerequisites of the courses in
;the areas needed to be improved
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;



(defun check_availability_and_prerequisites (courses)
  (setq availables_and_prerequisites_satisfied '())
  (prog () loop
  (cond ((not (null courses))
        (cond ((and (not (null (assoc (car courses) quarter_courses)))
                  (null (set-difference (car (cdr (assoc (car courses) quarter_courses)))
                                courses_taken)))
        (setq availables_and_prerequisites_satisfied (append (list (car courses))
                                  availables_and_prerequisites_satisfied))))
        (setq courses (cdr courses))
  (go loop)))))
```

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;PROCEDURAL BASE
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;Procedural ruleset for identifying the available courses
;in the quarter, to fill the knowledge gap of the requirements
;between current job and future job
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


(defun procedure_set ()
(inferencer ruleset_3)
(print "Please Select One of the following Positions that best fits to your current situation")
(terpri)
(jobs positions)
(terpri)
(princ "Please enter here: ")
(setq current (read))
(terpri)
(lookfor current)
(prog () loop1
(cond ((equal *current_category* nil)
      (terpri)
      (Princ "Please try again")
      (terpri)
      (setq current (read))
      (lookfor current)
      (go loop1))))
(setq curr *current_category*)
(terpri)
(clear_screen '0)
(inferencer ruleset_1)
(cond ((not (equal curr 'high_level_executive))
(princ "Please select one of the following positions as your future job title on your career path")
(terpri)
(future_print future_positions)
(terpri)
(princ "Please enter here: ")
(setq future_demand (read))
(terpri)
(Lookfor future_demand)
(prog () loop1
(cond ((equal *current_category* nil)
      (terpri)
      (Princ "Please try again")
      (terpri)
      (setq future_demand (read))
      (lookfor future_demand)
      (go loop1))))
(setq furr *current_category*)
(inferencer ruleset_2)
(terpri)
(find_courses_for_areas_needed_to_be_improved areas_needed_to_be_improved)
```

```
(terpri)
(check_availability_and_prerequisites courses_for_areas_needed_to_be_improved)
(terpri)
(explain_what_how))
(t (princ "You probably need another program")))
)
```

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;INFERENCE ENGINE (USES FORWARD CHAINING PRINCIPLE)
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

(defun inferencer (ruleset)
  (prog ()
    loop
    (setq antecedent (caar ruleset))
    (setq consequent (cadar ruleset))
    (cond ((eval antecedent)
           (eval consequent))
          (t (setq ruleset (cdr ruleset))
          (go loop)))))
```

```
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;EXPLANATION SUBSYSTEM
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;Explain what are the inputs and what are the outputs
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;


(defun explain_what_how ()

(clear_screen '0)

(princ "Quarter in which you are enrolled: ")
(princ quarter)
(terpri)

(princ "Elective courses you have taken so far are: ")
(princ courses_taken)
(terpri)

(princ "You are currently a/an: ")
(princ current)
(terpri)

(princ "Your current job is categorized as: ")
(princ curr)
(terpri)

(princ "Your five year goal is to be a/an: ")
(princ future_demand)
(terpri)


(princ "Your future job is categorized as: ")
(princ furr)
(terpri)

(print "To fill the knowledge gap between your current position and")
(print "your future goal, following areas are needed to be improved:")
(terpri)
(future_print areas_needed_to_be_improved)
(terpri)
(terpri)

(princ "In the quarter of ")
(princ quarter)
(princ " following classes are available")
(terpri)
(future_print courses_for_areas_needed_to_be_improved)
(terpri)

(print "Among the courses suitable for your career development")
(print "you accomplished following classes' prerequisites")
```

```
(terpri)
(future_print availables_and_prerequisites_satisfied)
)
```

C- Sample Runs

SAMPLE RUN #1

"_____"
"An Expert Advisor for Graduate Students "
" in The Engineering Management Program "
"_____"

"Designed and programmed by"
"Mete Bayyigit / Akin Uslu"

"Please enter the quarter in which you want to be advised"
Fall, Winter, Spring?: spring

Please enter the names of the elective courses that you have taken before in a list form (statistics)

"Please Select One of the following Positions that best fits to your current situation"

CHIEF_ENGINEER DESIGN_ENGINEER
ENGINEER SALES_ENGINEER
SOFTWARE_ENGINEER MECHANICAL_ENGINEER
COMPUTER_SCIENTIST INDUSTRIAL_ENGINEER
CIVIL_ENGINEER SYSTEM_ANALYST
SYSTEMS_ENGINEER PROGRAMMER
MARKETING_COMMUNICATIONS OPERATIONS_MANAGER
QUALITY_ASSURANCE_MANAGER OFFICE_MANAGER
SALES_COORDINATOR SUPERVISOR
PRIMARY_OFFICER
ADMINISTRATIVE_MANAGER ENGINEERING_MANAGER
OPERATIONS_MANAGER PRODUCTION_MANAGER
PROJECT_MANAGER RESEARCH_ADMINISTRATOR
R&D_MANAGER
BRANCH_MANAGER BUSINESS_MANAGER
CONSULTANT DIRECTOR_OF_MARKETING
DIRECTOR_OF_OPERATIONS DIRECTOR_OF_SALES
DIVISION_MANAGER DIRECTOR_OF_FINANCE
HUMAN_RESOURCES_MANAGER MANUFACTURING_MANANGER
MARKETING_MANAGER PLANT_MANAGER
PURCHASING_MANAGER SALES_MANAGER
CHIEF_EXECUTIVE_OFFICER CHIEF_FINANCIAL_OFFICER
CHIEF_OPERATIONS_OFFICER EXECUTIVE_DIRECTOR
EXECUTIVE_VICE_PRESIDENT GENERAL_MANAGER
NATIONAL_SALES_MANAGER PRESIDENT
GRADUATE_STUDENT

Please enter here: computer_scientst

"sorry your entry is wrong"
Please try again
computer_scientist

Please select one of the following positions as your future job title on your career path

MARKETING_COMMUNICATIONS
OPERATIONS_MANAGER
QUALITY_ASSURANCE_MANAGER
OFFICE_MANAGER
SALES_COORDINATOR
SUPERVISOR
PRIMARY_OFFICER
ADMINISTRATIVE_MANAGER
ENGINEERING_MANAGER
OPERATIONS_MANAGER
PRODUCTION_MANAGER
PROJECT_MANAGER
RESEARCH_ADMINISTRATOR
R&D_MANAGER
Please enter here: primary_officer

Quarter in which you are enrolled: SPRING
Elective courses you have taken so far are: (STATISTICS)
You are currently a/an: COMPUTER_SCIENTIST
Your current job is categorized as: TECHNICAL_SPECIALIST
Your five year goal is to be a/an: PRIMARY_OFFICER
Your future job is categorized as: TEAM_LEADER

"To fill the knowledge gap between your current position and"
"your future goal, following areas are needed to be improved:"

PSYCHOLOGY
HUMAN_RESOURCES
ORGANIZATIONAL_ASPECTS
RESOURCE_ALLOCATION
TEAM_BUILDING

In the quarter of SPRING following classes are available

DESIGN_OF_EXPERIMENTS
PRODUCTION_SYSTEMS_DESIGN
DATABASE_DESIGN
MANUFACTURING_OPERATIONS_ANALYSIS
INDUSTRIAL_SAFETY
BEHAVIORAL_SCIENCE_FOR_MANAGEMENT
CONCEPTS_IN_CONTINUOUS_IMPROVEMENT
REENGINEERING_TECHNICAL_ENTERPRISE
STRATEGIC_PLANNING
CONCURRENT_ENGINEERING
LEGAL_CONSIDERATIONS_FOR_MANAGERS
MANAGEMENT_OF_ORGANIZATIONAL_CHANGE

CASE_PROBLEMS_IN_ORGANIZATION_AND_MANAGEMENT
SYSTEMS_PLANNING_AND_MANAGEMENT
TEAM_BUILDING
MANAGING_HUMAN_RESOURCES
HUMAN_RESOURCES_AND_PLANNING
HUMAN_RESOURCES_POLICIES
INDUSTRIAL_ORGANIZATIONAL_PSYCHOLOGY

"Among the courses suitable for your career development"
"you accomplished following classes' prerequisites"

INDUSTRIAL_ORGANIZATIONAL_PSYCHOLOGY
LEGAL_CONSIDERATIONS_FOR_MANAGERS
DESIGN_OF_EXPERIMENTS
NIL

SAMPLE RUN #2

```
> (advisor)
;;;; Loading from #P"f:\\home\\grad\\mete\\610\\compiled.fsl"
;;;; Load Successful
;;;; 19 forms read from #P"f:\\home\\grad\\mete\\610\\compiled.fsl".
;;;; Result of last form read was MAIN.


"-------------------------"

"An Expert Advisor for Graduate Students "
" in The Engineering Management Program "
"-----------------------------------"

"Designed and programmed by"
"Mete Bayyigit / Akin Uslu"

"Please enter the quarter in which you want to be advised"
Fall, Winter, Spring?: fell

Please Try Again:fall
Please enter the names of the elective courses that you have taken before in a list form
()

"Please Select One of the following Positions that best fits to your current situation"

CHIEF_ENGINEER                  DESIGN_ENGINEER
ENGINEER                          SALES_ENGINEER
SOFTWARE_ENGINEER               MECHANICAL_ENGINEER
COMPUTER_SCIENTIST              INDUSTRIAL_ENGINEER
CIVIL_ENGINEER                    SYSTEM_ANALYST
SYSTEMS_ENGINEER                      PROGRAMMER
MARKETING_COMMUNICATIONS          OPERATIONS_MANAGER
QUALITY_ASSURANCE_MANAGER          OFFICE_MANAGER
SALES_COORDINATOR                   SUPERVISOR
PRIMARY_OFFICER
ADMINISTRATIVE_MANAGER                ENGINEERING_MANAGER
OPERATIONS_MANAGER              PRODUCTION_MANAGER
PROJECT_MANAGER                RESEARCH_ADMINISTRATOR
R&D_MANAGER
BRANCH_MANAGER                  BUSINESS_MANAGER
CONSULTANT                      DIRECTOR_OF_MARKETING
DIRECTOR_OF_OPERATIONS            DIRECTOR_OF_SALES
DIVISION_MANAGER                DIRECTOR_OF_FINANCE
HUMAN_RESOURCES_MANAGER             MANUFACTURING_MANANGER
MARKETING_MANAGER               PLANT_MANAGER
PURCHASING_MANAGER              SALES_MANAGER
CHIEF_EXECUTIVE_OFFICER           CHIEF_FINANCIAL_OFFICER
CHIEF_OPERATIONS_OFFICER            EXECUTIVE_DIRECTOR
EXECUTIVE_VICE_PRESIDENT          GENERAL_MANAGER
NATIONAL_SALES_MANAGER            PRESIDENT
GRADUATE_STUDENT
```

Please enter here: president

You probably need another program
"You probably need another program"