# AN INTELLIGENT SYSTEM

# FOR

# COORDINATOR DECISION SUPPORT

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This project is carried out for the partialfulfilment of the Post Graduate Diploma course in Industrial Mathematics at the University of Sri Jayawardenepura

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# DECLARATION

I certify that this thesis will not carryout, without acknowledgment any pre-published material for a degree or diploma in any University or higher educational institution in Sri Lanka or abroad, to the best of my knowledge.

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# CONTENTS

# ABSTRACT

The aim of this project is to design an intelligent decision support system to facilitate the activities of coordinators in the faculty of Natural Sciences in the Open University of Sri Lanka. Coordinators decisions are generally based on dynamic and even on incomplete information. Therefore it is proposed to exploit expert system / knowledge based system techniques in Artificial Intelligence in building the proposed system. The system is capable of capturing the on-line data, handling dynamic information, use of heuristics, working on incomplete knowledge, handling uncertainty, etc. It can also explain why and how an answer is arrived. Since the system interactively ask for information whenever additional information is required, it eliminates the problem of keeping unnecessary information in the system. Once a particular session is finished the system retract all the unnecessary information in the system. The intelligent decision support system can be run on a Personal Computer with UNIX and X-windows. The system is implemented using XPCE/ Prolog. The implementation is incrementally tested and being evolved for a complex system in the University in the future.

# CHAPTER 1

# INTRODUCTION

## 1.1 INTRODUCTION

The Open University of Sri Lanka, as a higher education institution using the concept of distance education, mediating the academic activities between students and the University is vital. This task is mainly done by the coordinators of the respective subjects. In view of this complicated learning environments coordinators are generally supplied with many problems whose solutions needs not only well fixed, straight forward answers but also needs some coordinators' experience and knowledge, and heuristics in deriving the answers. It is evident that comprehensive information system is preferable to assist coordinators in making intelligent decisions. In meeting the requirements of the decision support system the techniques of classical Database has serious limitations. The classical Database method does not provide facilities in dealing with dynamic information and process on incomplete knowledge. It will not help in making suggestions to certain problems which in general could not find exact answers.

In developing a computer system which can tackle problems relating intelligent decision making, the knowledge based system technique in Artificial Intelligence can be used. Since this technique can be incorporated in building a system with ability to deal with incomplete knowledge, handle the uncertainty of an answer, explain *how* and *why* a particular answer is arrived at, and the use of heuristics.

This report describes the method and proceedings of the construction of the intelligent decision support system, the ISCoDeS, an acronym for **I**ntelligent **S**ystem for **Co**ordinator **De**cision **S**upport.

Chapter 2 discusses on problem specification and the objectives of the project. It aims at the need for a system for manipulation of dynamic information.

Chapter 3 reports on the methodology adopted for solving the issues mentioned in chapter 2. The chapter argues the importance of knowledge-based system technology for addressing the problem over the classical database approach.

Chapter 4 discusses on system specification. It briefs the system in terms of inputs, process and output.

Chapter 5 describes the design and implementation of the system specified in the previous chapter. It elaborates on modules / components in the system and design and implementation of each module.

Chapter 6 will elaborately discusses how the system works, when ISCoDeS is put in to function.

Chapter 7 reports on conclusions and further work. It explains how we achieve three objectives during the project. Several further work are also reported.

In the Appendix, at the end of the report, the sourse code of ISCoDeS is attached.

# CHAPTER 2

# PROBLEM SPECIFICATION AND OBJECTIVES

## 2.1 INTRODUCTION

This chapter discusses on the specification of the problem that is addressed in the project. It also describes the objective of the project.

## 2.2 PROBLEM SPECIFICATION

In the context of academic institutes, Open Universities deal with very complicated academic and administrative activities. It is fundamentally difficult as the target audience of Open Universities are very much diverse group of people in the society. Further since student-teacher interaction is limited in the system, there is a need for additional attempt to bridge the gap via efficient administrative strategies. Program administration has also reported unavoidable difficulties as there is no restriction on time duration that is required to complete a particular degree program. That means, one may even take 5-7 years to complete his/her degree.

In the light of these flexible and diverse characteristics associated with Open University system students frequently need guidance from university staff to follow a course effectively. For example one may want to get some advise in whether to select more credit courses for a given academic year. In such an event an academic or coordinator cannot use any theory to answer the question other than his or her heuristics, experience, etc. On top of that those decisions are to be made utilizing incomplete information. Depending on the soundness of the information provided the answer in associated with some level of certainty. Human academics coordinators have ability perform eligibility with regard to those situations. However, how they behave cannot be conversed or described in terms of any rules or theories. Further to manipulation on such implicit information, students often need some responses with regard to their static information. Province of answers for such questions are relatively straightforward in compared with that of previous cases.

## PROBLEM

In connection with above descriptions of the nature of the complicated activities in an Open University, the problem address in the project can be phrased as follows. This can also be noted as two uses.

1. Reasoning on static information of students.
2. Reasoning on dynamic and incomplete information of students.

In condensed form two issues can be specified as,

Need for designing of an information system that capable to manipulate both static and dynamic information pertaining to student's problems.

## 2.3 OBJECTIVES

In solving the above issue the objectives of the project are as follows.

- Survey a suitable methodology for developing a system for handling above issues.
- Design a system for handling above issues using the methodology selected.
- Evaluate the system for real world applicability.

# CHAPTER 3

# METHODOLOGY ADOPTED

## 3.1 INTRODUCTION

The previous chapter described the problem that is proposed to address in this project. This chapter reports on the possible approaches to design an information system that can address the requirement as described in problem specification. Two main approaches; data base and knowledge based systems are explained with an emphasis on the relevance of KBS technology for solving the problem at hand.

## 3.2 THE CLASSICAL DATABASE APPROACH

Manipulating information using classical methods of Database management systems is widely popular. The Database technique is highly structured with fixed information domains which will help in processing for exact solutions to problems referred. These solutions do not incorporate any uncertainty associated with the answers. Further this technique does not provide any method for interactive information collection, hence querying can only be done on the available data in the database. It will respond to the problems only if adequate information is stored in the database. Further there is no straightforward technique for retracting the unnecessary data. Hence it is evident that the classical approach have distinct limitations in modeling our proposed system, where there is a need for processing on incomplete knowledge, handle uncertainty, learn new knowledge etc.

## 3.3 KNOWLEDGE - BASED SYSTEMS

The knowledge-based systems technique in Artificial Intelligence provides a new dimension for information processing. It is evident that the KBS technique is ideal for manipulating information in a dynamic information domain, since it facilitates working on incomplete data. Interaction with end users for additional information which will be necessary only for a given instant, can be captured easily and effectively. When the session is ended the dynamically acquired data

can be easily retracted as appropriate. Further this technique will allow making suggestions to problems whenever exact solutions are impossible, and also contains mechanisms for exploring the information from different angles which are supported by different heuristics of solving a given problem. Moreover the KBS models can tackle the uncertainties associated with answers provided by the system. It also has the ability to explain why and how the system has arrived to certain conclusions.

In compared with classical information system the KBS technology suggest to distinguish between domain knowledge and knowledge required to explore domain knowledge as two different modules. It allows to manipulate domain knowledge and inference knowledge independently.

Since the KBS technique provides methods to meet the requirements in modeling the proposed intelligent system we adopt it in constructing the coordinator decision support system.

A typical knowledge base system has three essential components at the top level as shown in figure 3.1. Next we describe each component in detail.

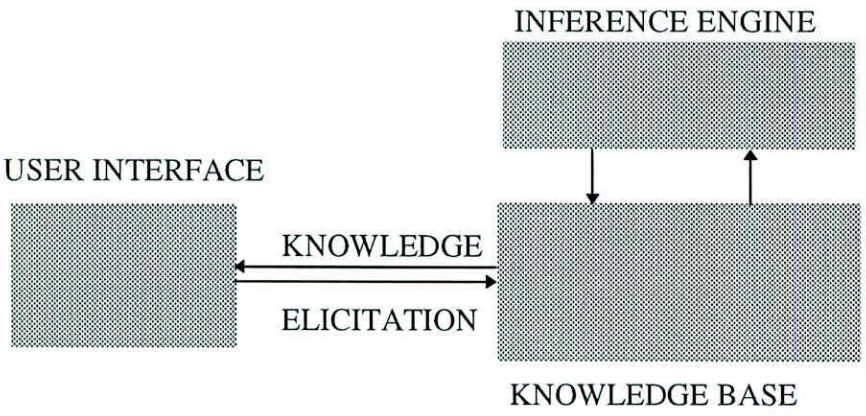


Figure 3.1 : Components of a KBS

### 3.3.1 KNOWLEDGE BASE

The knowledge base is rich with diverse forms of knowledge. As a simple case knowledge base may contain rules and facts which is usually refereed to as the rule base and the fact base. However the rules may be complex and the facts may include sequences, structured entities, attributes of such entities and the

relationships between them. The details of the representation used vary from system to system. Some systems may represent its' knowledge base by rules and facts, while some systems use frames and semantic nets. In a rule based system, rules could be represented easily enough as a conditional statement which is also called as a *production rule* and takes the form,

IF
<condition>
THEN
<conclusion>

When forming rules it would need to be carefully positioned within the program so that,

- The statement is applied whenever it is needed
- All relevant variables are in scope (the scope of a variable is that, part of the program to which the declaration of the variables applies)
- Any values that are assigned to variables remain active for as long as they are needed
- the rest of the program is not disrupted

The fact base would represent facts inside it. A fact in the fact base will be similar to the conditional part of a simple IF.. THEN rule or, simply facts are unconditional statements which are assumed to be correct at the time they are used. A fact will be of the form,

fact( <hypothesis> ,<logical value> )

As many systems need hundreds of thousands of facts and rules, slotting them to a conventional program is a task to be handled with utmost care. This can be contrasted with a knowledge based system in which the rule and the fact are represented explicitly and can be changed at will.

### 3.3.2 THE INFERENCE ENGINE

The task of interpreting and applying the rules belongs to the inference engine. Therefore the inference engine becomes the main part of control of the system. Inference engines vary greatly according to the type and complexity of knowledge with which they deal. There are two distinct types of inference

engines which is commonly used in Knowledge based system environments. One of them is with forward chaining and the other is with backward chaining. Former is also referred to as data driven strategy and the latter is called the goal driven strategy. A knowledge based system working in data driven mode takes the available information (the "given" facts) and generates as many derived facts as it can. The output is therefore unpredictable. This may either have the advantage of leading to a novel or innovative solutions to a problem, or the disadvantage of wasting time generating irrelevant information. The data driven approach might helpful in problems of interpretation, where we wish to know whatever the system can tell us about some data. A goal driven strategy is appropriate when a more tightly-focused solution is required. With regard to these strategies there are several search techniques are associated.

### 3.3.3 USER INTERFACE

In constructing an intelligent system, interaction with the end user is an important task since that will enable the system to capture and emulate additional knowledge on line by inquiring the user, and hence can make decisions on inadequate knowledge. This vital task is done by the user interface. Nowadays most interfaces are designed as graphical user interface. They include members, pulldown menus, radio buttons, browsers, etc. Todate the world wide web technology is used in designing interfaces.

# CHAPTER 4

# SYSTEM SPECIFICATION

## 4.1 INTRODUCTION

In this chapter an outline of the proposed system will be discussed. It includes the inputs that are required by the system and the types of possible output from the system and the technique of processing of input information in order to get the output.

## 4.2 USERS OF THE SYSTEM

The users for the system is defined as they are included in many categories, Some users are allowed to use the system freely, while there are restrictions for some users. For example,

- The teaching staff of the faculty and the coordinators of the courses conducted by the faculty can use the system freely.
- Internal students of the faculty can use the system but without access to certain parts of the system.

## 4.3 INPUTS TO THE SYSTEM

The system requires input when it responds to questions. Some basic information required such as registration number, course code, program of study, etc. However, more information will be dynamically acquired. When the system process, questions such as,

- are you employed?
- can you get duty leave?
- how many hours afford for studying?
- reside close to the University?