*Journal of Teaching and Education,*
CD-ROM. ISSN: 2165-6266 :: 05(01):191–208 (2016)

Journal of Teaching and Education

# IMPROVING ACADEMIC ADVISING SYSTEM BY USING IAMA

**Rasha Shakir Abdul Wahhab and Shakran Shakir Abdul Wahhab**

*College of Applied Sciences, Oman*

The aim of this paper is to propose an Intelligent Academic Management Advising system (iAMA) as a self-service and user-friendly system. iAMA overcomes the problems of the current manual academic advising system by included intelligent paradigms in its infrastructure. This system composes of four main units working in an integrated manner to provide quality services to the iAMA beneficiaries. The thematic units of iAMA are : the Plan Chart Unit that offers a student's plan chart according to the student's level, the Intelligent Mark Presumption Unit that facilitates the automatic discovery of empirical student's marks by using Genetic Algorithms as well as this unit will estimate the marks that need to be earn according to the student's GPA, the Study Plan Unit which displays the grades for all previously passed and failed registered courses and the Intelligent Drop Course Unit that helps users to take the right decisions about dropping any course for their current registered courses. Indeed, all the proposed units are used to assist advisors and students in doing advising online. The performance of the proposed system is successfully evaluated and tested at the college of applied sciences (CAS) through an experiment where experienced advisors and students are involved. The results indicate that advisors find this system very useful to complete their academic advising tasks on time, and it helps students to achieve their academic goals easily.

**Keywords:** Intelligent education, Intelligent management, Genetic algorithm.

## Introduction

Academic Intelligent Website in Education has been the objective of many researchers in both the fields of computer science and education. The history of Academic Website (AW) can be usefully divided into four periods. The early years of AW were a period of placed university's information on the websites which is similar to an electronic brochure where static content is converted into an electronic format. Then, AW entered a second period in which user might interact with the developed website by filling out some forms to submit them. This period still the websites are targeted towards delivery of static content. AW is designed to handle interactive transactions in the third period of its history. This period support student with the information that is more useful to finish their academic requirements. Recently, AW is perhaps a fully customized website for the student needs. The developed websites on this period are maintaining student's data in a database and supporting student's needs upon on the existence data.

This paper come up with the idea of using new technology to develop an on-line knowledge management tool tilted Academic Management Advising system (iAMA) that overcomes the mentioned problems of period 1 and 2. iAMA will explore how to integrate intelligent tools for tracking student performance, monitoring their performance, managing online registration courses and many more features that provide intelligibility and better flexibility to the current scenario of the education system.

iAMA is an intelligent web-based advising system for helping, notifying and providing some advices and directions to the students in a way that help them to meet a good performance in their study life. Indeed, iAMA will overcome the manual academic advising system problems by proposing some intelligent tools that will help both the students and advisors in developing a precise short–term curricular schedule. In addition, iAMA will save the time and the effort of the advisors and helps them to do their work efficiently. Above of that, iAMA provides the advisors with some services that facilitate them to see the status of their student by receiving some notifications. Indeed, it will help them to keep track their students easily and they will be able to manage some meetings with their students.

iAMA system is consisting of four main units. Each of these units is responsible to provide services for each of the advisors and students. Nevertheless, to reach a degree of automatic advising by the iAMA system, GA mechanism is adopted in the proposed intelligent units. In addition to the suggested intelligent units, iAMA able to displays the number of the completed credits, GPA, the study plan and the courses that they don't completed. All these features of iAMA make the advisor a useful system for those under proportion students.

## Problem Statement

As we mentioned earlier, in the traditional academic advising system, the students and advisors can only locate their academic information by clicking on their institution's website to retrieve the required academic rules and policies. Such a system will not help the students to make a reasonable decision for their academic career and life goal. In addition, advisor's time would be consumed without concentrating on the real advising issues. Furthermore, the traditional existing system does not have any kind of tools for helping the advisors to check their students' problems. Moreover, such system is lacking the distinct features over the intelligent system, namely convenience, accuracy, autonomy, consistency and anonymity.

## Objectives

This paper will work on enhancing and replacing the manual academic advising system. The main objectives of the proposed system are to save the time and the effort of the advisors and students. This system will provide some intelligent services to help the advisors to make reasonable decisions and provide the information and the guidance they need to achieve the goals of the student. In addition, the proposed system provides the required information during the registration time to ensure the students will not face any problem in their academic life.

In fact, one the main objective of the proposed system is to drive the possible alternate student's program plan. Then, the derived instances of the program plan must be evaluated using well defined criteria in order to choose the relevant plan. For this reason, we suggest to deploy GA's aspect with the proposed system for achieving the effectiveness in the task of the academic advising and self-activating for its services.

Finally, the proposed system would provide the expected grades which are represent the needs of the student for improving his performance. In order establishing this, Genetic Algorithm (GA) is highly recommended with the aim of supporting students and advisors to automate the processes of this unit.

## Literature Review

As the efficiency and effectiveness of the development of academic advising have been confirmed by any early studies, many researchers in educational fields have engaged in the development of such a system. For completeness sake, a brief overview of the related works is discussed below. In [11], the author

proposed a Web-Based Advising Tool for the Department of Computer Science and Engineering at Florida Atlantic University. Their system supports advising for students in which the students do not rely on their advisors to tell them what courses to take next. The proposed system provides a list of recommended courses based on the student information. However, their system has three different types of users (students, advisors, and secretaries), each of which has different privileges and allowed operations. Student users may use the system to find relevant advising related information, such as course descriptions and advising FAQs. In [3], the author proposed a spreadsheet-based Decision Support Tool for Academic Advising to aid the advisors in preparing pre-registration plans for students and the department in projecting the demand on each course and making decision on which courses should be offered each semester such that the resources are optimally allocated. The proposed is developed by using VBA scripts for Microsoft Excel to provide functions for the system tasks.

A web-based decision support tool in [6] is developed. The proposed system helps advisors and students make better use of an already present university student information system. In their system supports students with needed information for course planning in visually appealing way. However, the proposed system displays the major and overall average indicates which major, university and distribution requirements have been satisfied and which need to be completed. Also, it displays the number of credits completed and the number still needed for graduation. Their mechanism is to recommend schedule for the following semester by displaying all the information on one screen. Their online advisor is not 'intelligent'. In [2] proposed an advising system to assist postgraduate student to select their master courses in their study in CS at KAU. The proposed system is targeted the postgraduate student taking into account their thesis field. Their result was amused and satisfied by their postgraduate students. The disadvantage of their system is not a website based system and is not intelligent.

JESS-Java Expert System is proposed in [13]. The proposed system is a prototype that had been used to develop a Student Advising Expert System as a Graduate Program Advisor for Industrial Technology Department at California State University-Frenso. A graphical user interface (GUI)-based expert system has been used in their system. One of the objectives of the proposed system is to reduce the pressure on faculty for answering same questions that might be targeted by their students at the beginning of each semester. An Interactive Virtual Expert System for Advising is proposed in [16]. The proposed system is Java based with an object-relational database. In order to access system functionality by users, a web-based interface is used. The proposed system works with small and middle sized universities. One of the advantages of their proposal is to help the advisors and students as well to select the suitable course at the beginning of each semester.

BUADVIS is developed in [4]. BUADVIS is a decision support system that had been developed to advise student through registration stage. The idea of the proposed system was to help the students and the advisors to select their courses through a semester.

A prototype expert system supported with an object-oriented database is proposed in [1]. A decision support tool was used in their proposal. The developed tool provides the students (and academic advisors) with quick and easy major search and selection. The proposed system has a graphical user interface and simple menus.

KMCD is proposed in [16]. KMCD is based on knowledge of students who want to choose majors and students who have finished their studies. In addition, KMCD is a first-order reasoning system equipped with an uncertain reasoning function. The objective of their proposed system is to help the student to choose the best major. The idea of their system is to calculate the passing marks for each course, and count it to reach the whole major supporting degree.

In spite of the extensive enhancements achieved on the above approaches, still the academic community suffers from the following:

1. Some approaches [1][2][5][6][8][9][10] lack providing an automated solution to the academic community.
2. While some approaches are seeking to build a special purpose system. The ingredient of such approaches lacked intelligent tool in its architecture [3][10].

3. Another category of researcher is building a semi-intelligent academic system [3]. According to [2][3][8], an interactive website is a common drawback in its architecture.

To cope with and solve the problems of the above mentioned points, Genetic Algorithms (GAs) and Decision Tree are highly recommended as tools for designing units of iAMA system with the aim of supporting students and advisors to automate the processes of academic advising.

## Intelligent Academic Management Advising system (iAMA)

An Intelligent Academic Management Advising system (iAMA) is the new trend of Evolutionary Computation computer-based education system which is able to support students and advisors. Indeed, iAMA is an automated system that is intended to automate the process of academic advising at the College of Applied Science [17]. Such a system would use Evolutionary Computation with some of its components to help the advisor and student to decide the right decision about student course grading. In addition, iAMA is a management information System that uses database information to support students and advisors to make the right decisions for managing their study life.

iAMA consists of two intelligent units proposed to support advisors and students with valuable information to assist them and make their educational decisions relevant. More precisely, in order to obtain high-quality advising, additional units and tools need to be integrated with iAMA. All the proposed units and tools of iAMA system are presented in Figure 1.

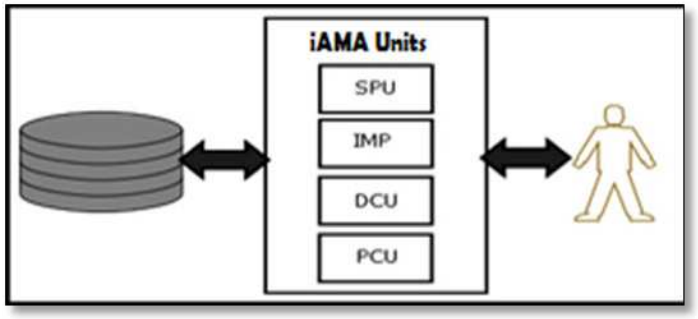



**Figure 1.** iAMA Units

### A. Plan Chart Unit (PCU)

One of the management information units in iAMA system is a Plan Chart Unit (PCU). PCU is meant to help students and advisors to develop a student's plan chart. This unit is capable to provide the information that the students and advisors need. Such unit is based on displaying visually a complete hierarchal chart for the student's courses that have been completed as well as the courses that have not completed yet. In addition, all the prerequisite courses of the displayed courses are also being presented in the hierarchy chart. All the visual information will be uploaded on a dynamic web page. PCU retrieves all the required information from many sources which are used as an input to display all the courses that within the current programme. Indeed, this unit will sketch the courses' chain as a way to represent the relationships between the courses in the student's study plan. This is then followed by a list of all the major electives and Non major electives courses in the student's academic plan. The deployed hierarchy chart are ordered on two levels of priority; the first are marking all the completed core courses with a green color and the second level of the page are marking all the elective and non-electives courses. All the courses that have not been taken yet would be marked with a red color.

### B. Study Plan Unit (SPU)

The idea of this unit for academic advising is an enticing one. The benefits of modelling this unit in iAMA system are manifold. Such a unit will improve the advising process and help the students and advisors to simplify their tasks such as:

- Help to save the time and the effort of the advisors for inputting the grades of all previously or currently registered courses.
- Help to prevent human induced errors.
- Help to enhance the manual academic advising system and help the college to introduce new technologies.
- Help the advisors and the students to concentrate on the advising issues such as developing the short-term curricular schedule for the next semester.

SPU is capable to display the grades for all previously passed and failed registered courses as well as this unit is displaying the information of all the courses that the students need to take such as the number of credit hours, course's code, course's title, semester's level, and the course's prerequisite. Moreover, this unit displays the registered courses of the current semester in case the student had finished his/her registration. And so, the main goal of this unit is aggregating all information in one interface and providing information needed for course planning in an understandable and visually appealing way.

Indeed, SPU encapsulates the real data available in the database system of iAMA in a color-coded dynamic page on-screen and printable display which organizes information from many sources as illustrated in Algorithm 1.

**Algorithm 1: The main retrieved information by SPU's Query.**

**Begin**

**Student**← $\sigma_{.}(\pi_{studID,studName,studMajor})$(Student Table)

**Courses** ← $\sigma_{.}(\pi_{CourseCode,\ CourseTitle,\ courseCredits,\ prerequistes,})$ (Course Table)

**Grades**← $\sigma_{.}(\pi_{CourseCode,\ studID})$ (Grade Table)

**End.**

### C. Intelligent Marks Presumption (IMP)

Intelligent Marks Presumption allows iAMA System to predict the grades of the registered courses and seeking to the target GPA. Indeed, IMP's architecture has three main components, including system local query process, GA engine for presumption marks of registered courses and a study plan sheet component. Figure 2 illustrates the main components of IMP unit. Local system query process is retrieved all the required information that would be used to find the desired solutions.

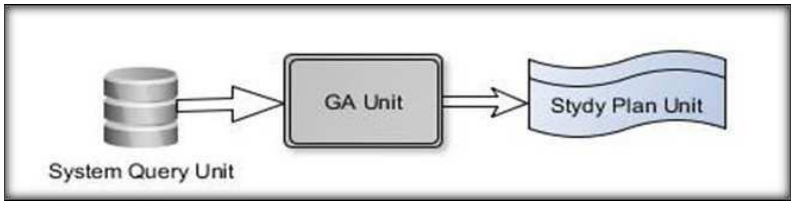



**Figure 2.** IMP components

The grades that have been predicted by IMP will be deployed to SPU. Indeed, all grades of registered courses with the predicted grades of the current registered courses are deployed in the dynamic designed sheet of the SPU unit as well as this unit automatically estimates the GPA and the enrolled credit hours for all the deployed courses. This unit deploys the predicted grades with a different color marker to see a glance for the required grades that the student needs to be gained for the new registered courses in the current semester.

The hart of this unit is designed to facilities the efficient automatic discovery of empirical grades through using GAs (Genetic Algorithms). GAs is a general adaptive optimization search based on s direct analogy to Darwinian natural selection and genetics in biological systems [5, 6, and 8]. The motivation to include this paradigm in this unit is that it precisely able to find the best solution automatically. The solutions of this unit is represented the grades of the registered courses that the student needs to reach his/her required GPA. Algorithm 2 precisely explains the main steps of this unit.

**Algorithm 2: Pseudo Code of the Engine of IMP.**

```
Let t=0;
 Call Initial Population and generate pop(t) of  PSize /* PSize is the population size*/
 WHILE NOT (stopping criterion)  DO
  begin
   Do PSize / 2
    begin
      {F1,F2}= Reproduction (POP(t)) /* Selection of 2 parents through a Tournament selection */
      {S1, S2) = Crossover-Mutation ({F1, F2},2) /* Generation of 2 offspring using {F1, F2} */
      POP(t+1)=POP(t+1)  ∪ {S1,S2}


   end
   t ←t + 1
 end
```

The design of the engine of IMP unit will be examined in more detail with respect to the GA's aspect as follows:

***Structure of Chromosomes:*** As mentioned before, GA utilize a pool of chromosomes each of which is comprised of fixed sequences of grads. Depending upon the characteristic of this problem, the chromosome $x_i = (g_{i,1}, g_{i,2}, \ldots, g_{i,NRC})$, which composes NRC genes where NRC is the number of registered courses , would be a vector a grads. Thus, each vector of marks is generated randomly to encode the chromosomes in which a letter coding strategy is adopted here. Letter encoding represents a grade which can be any letter from A through C, i.e., depending on the values of table 1 excepting failure letter F is avoided from the selection. An example of the letter value encoding is illustrated in Figure 3.

**Table 1.** Grade Scale [17]

| +Grades | Grade Points |
|---|---|
| A | 4.0 |
| A- | 3.7 |
| B+ | 3.3 |
| B | 3.0 |
| B- | 2.7 |

| | |
|---|---|
| C+ | 2.3 |
| C | 2.0 |
| C- | 1.7 |
| D+ | 1.3 |
| D | 1.0 |
| F | 0.0 |

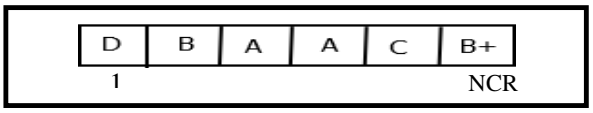



**Figure 3.** Grade Letter Representation of Chromosome

***Initial Population:*** The initial population is set of chromosomes of NRC length. The size of the population PG ={xi | i = 1, 2,….. PSize} of G generation consists of PSize chromosomes are generated randomly and is fixed depending on the resulting outcome after running the proposed algorithm with different values of PSize.

***Fitness Function:*** The fitness function is the most important point which can be used to control the application of the GAs' operators. The decision about whether to take or reject a solution depends only on the calculated value of the proposed fitness function. In IMP, the fitness function f(x) is the absolute value of the difference between intended GPA (TGPA) that is determined by the advisor or student and the current value of GPA for all the registered courses as well as presumption grades of current registered courses. Thus, f(x) should be calculated for each individual in the population and the goal of IMP is to minimize the value of f(x) where a value of 0 represents the perfect solution for our problem. Table 2 illustrates the terminologies of equations 1 to equations 4 that are used to estimate the value of f(x).

$$TCA = \sum_{i=1}^{NC} C_i + \sum_{i=1}^{NCC} C_i \quad \cdots\cdots\cdots\cdots\cdots (1)$$

$$TGPE = \sum_{i=1}^{NC} C_i * NGP_i + \sum_{i=1}^{NCC} C_i + NGP_i \cdots\cdots\cdots (2)$$

$$GPA = {}^{TGPE}/_{TCA} \quad \cdots\cdots\cdots\cdots\cdots (3)$$

$$f(x) = |GPA - TGPA| \quad \cdots\cdots\cdots\cdots\cdots (4)$$

**Table 2.** Description of Terminals of Equations 1-4

| **Terminology** | **Description** |
|---|---|
| TCA | Total Credits Attempts |
| NC | Number of Registered Courses |
| NCC | Number of Current Registered Courses |
| C | Credit Value |
| TGPE | Total Grade Pointed Earned |
| NGP | Numeric Grade Points |
| GPA | Grade Point Average |
| TPGA | Targeted Grade Point Average |

***Crossover Operator:*** In this step, one-point crossover [10] for producing two new offsprings is adopted here. The two parents of fixed lengths are aligned with each other and one crossover point cp is chosen at random over the range [2,..,NRC-1]. The selected crossover point will divide the selected two parents into two parts. And so, the two generated parts from the selected parents are interchanging the genes after the selected crossover point cp to form two new offspring.

***Mutation Operator***: After the crossover operator, mutation is carried out by randomly generate a new random gene's value to replace the current gene's value which is selected randomly according to the individual length (i.e, $g_i \in [1 \ldots NRC]$).

***Termination Criteria and Solution***: When the termination criteria are satisfied, the process ends; otherwise, the IMP's engine is processed iteratively with the next generation.

**Intelligent Course Selection unit (ICS)**

Intelligent Course Selection (ICS) is one of the important intelligent units in iAMA system. A set of short-term schedule will be provided by this unit by deploying three different short-term schedules to the user in the dynamic content of the display page of this unit. The three different results will be ranked as a high solution, medium solution and low solution. In addition, the user's selection will also be evaluated by this unit and will be integrated with the other solutions that are predicted by this unit. Figure 4 depicts the infrastructure of ICS unit. ICS consists of three main components including local system query process; ICS GAs based engine and the dynamic web page. The dynamic web page of ICS is displaying four short term schedules each which are labelled with a value to represent its rank. Thus, the highest system solution will be displayed first, and then followed by the medium system solution and finally low system solutions will be displayed at the bottom level of the page. Regarding user selection, this unit would evaluate it and would record it with the other solutions that have been predicted by ICS's engine.

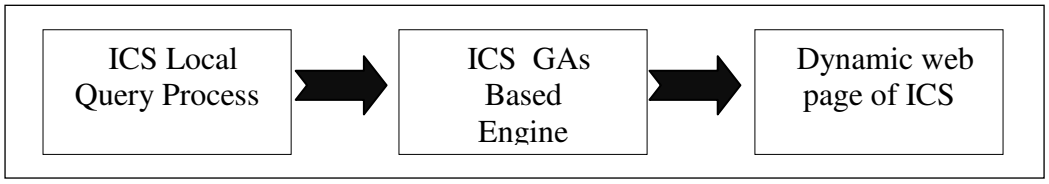



**Figure 4.** Infrastructure of ICS unit

ICS needs to send requests to retrieve the desired data from the database of iAMA system. The main information that needs to be retrieved by ICS unit is presented in Algorithm 3.

**Algorithm 3: Pseudo code of ICS's Local Query Process.**

**Begin**

**Student** $\leftarrow \sigma_{.}(\pi_{\text{studID,studName,studMajor}})(\text{Student})$

**Plan** $\leftarrow \sigma_{.}(\pi_{\text{planID}})(\text{Plan})$

**Courses** ← $\sigma_{.}(\pi_{\text{CourseCode, CourseTitle, courseCredits, prerequistes,}})$ (Course)

**End**

In order to optimize the output and trying to find the best short term schedule automatically, GA has also embedded in the engine of ICS unit. The design of ICS's engine will be represented in more details with the respect to GA's aspects as follows.

***The structure of ICS'S chromosome***: A chromosome of the proposed GA consists of sequences of the offered courses code. Each locus of the chromosome represents a suitable course code from the offered course list that is regularly offered by the registration department at the beginning of each semester. The length of the chromosome is fixed with NRC genes where NRC is the number of the courses that the student needs to register in the next semester. A chromosome encodes the problem by listing up sets of courses that are generated randomly to encode the chromosomes. Indeed, the selected gene (course) of the chromosome must be chosen at least once. This technique meant that genes within a chromosome are unique, i.e., given chromosome C=$g_1$, $g_2$, …$g_{NCR}$, and $g_i$ is a gene within chromosome C, then C ∩ $g_k$ = ∅ where $g_k$ is the new added gene to the chromosome C. Figure 5 depicts the proposed structure of ICS's chromosome.

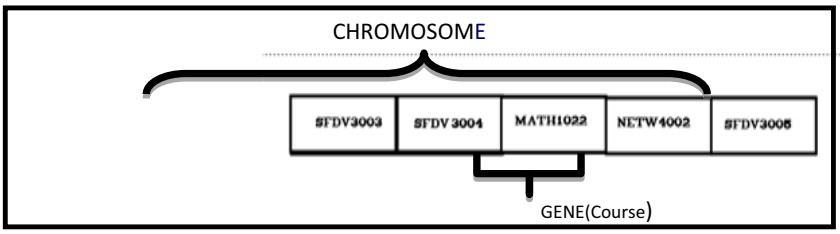



**Figure 5.** Course code Representation of Chromosome

***The initial Population:*** This step is to create the initial population of ICS, which must be a wide set consisting of disperse and good solutions. The chromosomes (individuals) to be included in the population PG ={$g_i$ | i = 1, 2,….. PSize} of G generation are generated randomly to achieve a certain level of diversity.

***The Fitness Evaluation***: The fitness function is a performance measure which rewards the right kinds of individuals. Indeed, the payoff (fitness) of each individual is computed by calculating the value of two proposed factors. For the experiments reported in this paper, the highest value that is estimated by the proposed function is representing the best solution of ICS. The terminals of the proposed function are presented in table 3.

$$f(x) = \sum_{i=1}^{NCR} |CR - level(c_i)| \qquad \dots\dots\dots\dots\dots\dots\dots\dots (5)$$

$$f_1 = \begin{cases} 2\,, & f(x) = 0 \\ 1/1 + f(x)\,, & f(x) > 0 \end{cases} \qquad \dots\dots\dots\dots\dots\dots\dots\dots (6)$$

$$f_2(x) = \sum_{i=1}^{NCR} \beta(c_i) \text{ where} \qquad \dots\dots\dots\dots\dots\dots\dots\dots (7)$$

$$\beta(c_i)=\begin{cases}1/1+|\text{CR-Level}(c_i)| \text{ if } |\text{CR-level}(c_i)|>2\\ 1+\text{NCO if } |\text{CR-level}(c_i|==2\\ \text{NCO}\end{cases} \quad \cdots\cdots\cdots\cdots\cdots\cdots (8)$$

$$f_{fitness} = f_1 + f_2(x) \quad \cdots\cdots\cdots\cdots\cdots\cdots (9)$$

**Table 3.** Terminal definitions of the proposed fitness function of ICS

| Terminology | Description |
|---|---|
| Level($c_i$) | Represent semester's number that will offer this $c_i$ |
| CR | The Level of student's semester |
| NCO | Number of the opened courses after this $c_i$ is taken. |
| NCR | Number of courses in the generated chromosome. |

The goal of ICS is to maximize the value of solution, whereas the highest value represents the perfect solution.

***Crossover Operator***: Crossover is one of the GA operators used to produce new generation. Here, One-point crossover operator is adopted and it is applied with two parents. The first Offspring's genes [$g_0$,.. $g_{cp}$] are copied from the candidate parent1 while the remaining genes of this offspring are copied from the second parent2 starting from cp point. Through the process of copying the remaining genes from the parent2, the uniqueness of the copied gene must be considered, i.e., each gene can occur only once in the new offspring. This is implemented by excluding the genes that already exist in the offspring. Thus, if the offspring's genes are not completed, the process will be continued by generating genes until the offspring's length is reached. The same steps must be followed to generate the genes of the second offspring.

***Selection Operator:*** As we mentioned before, the next new populations will be generated by applying GA's operators. One of the main operators is the selection. ICS used the same two techniques that have been implemented with the engine of IMP, which are tournament selection and elitism technique.

***Mutation Operator:*** Mutation is the last genetic operator used in the ICS's engine. In mutation, one gene is selected randomly to be replaced by another gene, whereas the new selected gene should not exist in this chromosome.

***Termination Criteria and Solution:*** The GA's engine is processed iteratively until an upper limit on the number of generations is reached or the average of the fitness values for the generations does not change in three generations respectively.

***Ranking the solutions:*** After the solutions is detected and stored, ranking is carried out by evaluating the optimized solutions. Basically, this unit evaluates the three best solutions that have been detected by GA. Such unit gives higher rank for the solutions (schedule) that has low distance (path) between the current semester of the students and the courses' distance. The ranking function of this unit is depicted in function 10 (see Table 3 for the meaning of terminal).

$$\text{Ranking} = \sum_{i=1}^{NCR} |\text{CR} - \text{level}(c_i)| \quad \cdots\cdots\cdots\cdots\cdots (10)$$

**D. Decision Course Unit (DCU)**

DCU used the Decision Tree mechanism to help the users to take decisions about dropping any course. DCU is retrieving all the registered courses to allow the student to choose the course that he/she wants to

drop. Then, the information about the selected course is retrieved from the database. This unit is capable of providing the most proper useful information about the consequences of dropping any course. This unit uses the decision tree mechanism. The most general conditions have located at the top (root node) of the decision tree for example the GPA followed by the other specific conditions. In the leaf nodes will be the result that describes the situation after dropping the course. Moreover, DCU also will display the remaining semesters that the student needs to finish the program after dropping the course. Such unit informs users that the drooped course will be a prerequisite to other courses in his/her academic plan, in case this dropped course has some prerequisite. The number of delayed semester is also shown by this unit.

**E. ICD Extra Embedded Tools**

In addition to the mentioned main units, iAMA offer students and advisors powerful functional tools to enhance the functionality and flexibility of the system such as e-mail, print and save and remaining semester calculator.

The remaining semester calculator helps student to calculate the remaining semesters to finish his/her program. Students by using this tool could display the student‘s completed credits hours and the current registered courses as well as the number of remaining credits would be presented with the result of this calculator. All the calculated values will be deployed in a dynamic web page which is structured as a table.

**Database of iAMA**

A database of iAMA has the required information that will be used as input to the iAMA’s units and tools. The basic structure of this database is made of a set of tables where information about a particular entity $(\text{Course}, \text{Student}, \text{ect.})$ is represented in columns and rows. The data pool adopted in the proposed system is the data pool of the student’s transcript and academic plan Information Technology’s programs at College of Applied Science. This pool consists of 20 different transcripts of 20 students from different batches.

**The Domain of Academic Advising**

The experiment that will be represented in this paper adopts College of applied Science data for exploring the feasibility of using iAMA to solve the problem of academic advising. Indeed, the Information Technology Department in the College of Applied Science of Oman, offers a BSc degree in Software Development, Computer Networks, IT Security and Data Management. Each course in IT program is labeled by code and catalogue number. Students can take from three to six courses per term. In selecting courses, the student must know the possibilities of courses’ combination taking into account the academic pre-requisites condition. However, the Information Technology’s program for each major is segmented into eight terms. The student need to complete 128 credit hours of his/her degree program with a minimum grade point average of 2.00.

From the above description, we can notice courses selection is not an easy work and selection of the optimal plan manually would be time consuming work for both the student and advisors. The risk of selecting wrong courses is high in the manual academic advising system and that would affect the student’s performance through his/her academic life. For this reason we suggest to adopt intelligent techniques in the iAMA system that would bring the effectiveness to the advising task.

## iAMA Implementation

iAMA system basically consists of a main page (Figure 6) from which all the proposed tools are accessible. iAMA system supports three different types of users includes:

1. Student users.
2. Faculty users (advisors).
3. Administrative users.


**Figure 6.** Main Page of iAMA

Each different type of user has a different GUI, a set of privileges, and a set of possible actions. From the main page the users (i.e., advisors or students) can be able to access Grading Page, Advising me Page and other advising-related services. Grading Page is consisting of two linked pages includes: Study Plan and Plan Chart Pages. These pages are generated on the fly by a JSP script that extracts information from iAMA's database. Figures 7 and 8 illustrate the output which is rendered via a web browser.

**Study Plan**

| Sem | Course ID | Course Title | Grade Points | Grade | Course Credits | Prerequistes | Comments |
|---|---|---|---|---|---|---|---|
| 1 | ARAB1100 | Arabic Language Skills | 3 | B | 3 | | Compulsory |
| | COMM1201 | Intro.to.Communication | 1 | D | 3 | | Compulsory |
| | ENGL1111 | Engllish for Academic purpose(1) | 0 | F | 4 | | Compulsory |
| | INFT1101 | IT foundementals | reg | reg | 3 | COMP5001 | Compulsory |
| | MATH1005 | Mathematic for IT | reg | reg | 2 | MATH5002 | Compulsory |
| 2 | ECON3402 | Omani Economy | 2.7 | B- | 2 | | Compulsory |
| | ENGL1222 | Engllish for Academic purpose(2) | reg | reg | 4 | ENGL1111 | Compulsory |
| | INFT1002 | Foundation of Degital Technology | reg | reg | 3 | | Compulsory |
| | SFDV1000 | Intro.to.Dynamic Web | reg | reg | 3 | | Compulsory |
| | SFDV1003 | programming Foundementals | 2.7 | B- | 3 | | Compulsory |
| 3 | ENGL2111 | English for Academic purpose(3) | | | 3 | ENGL1222 | Compulsory |
| | MATH1022 | Introduction to Descrete Mathematics | | | 3 | | Compulsory |
| | SFDV2001 | Web Development | | | 3 | SFDV1000 | Compulsory |

**Figure 7.** Study Plan Sheet Page

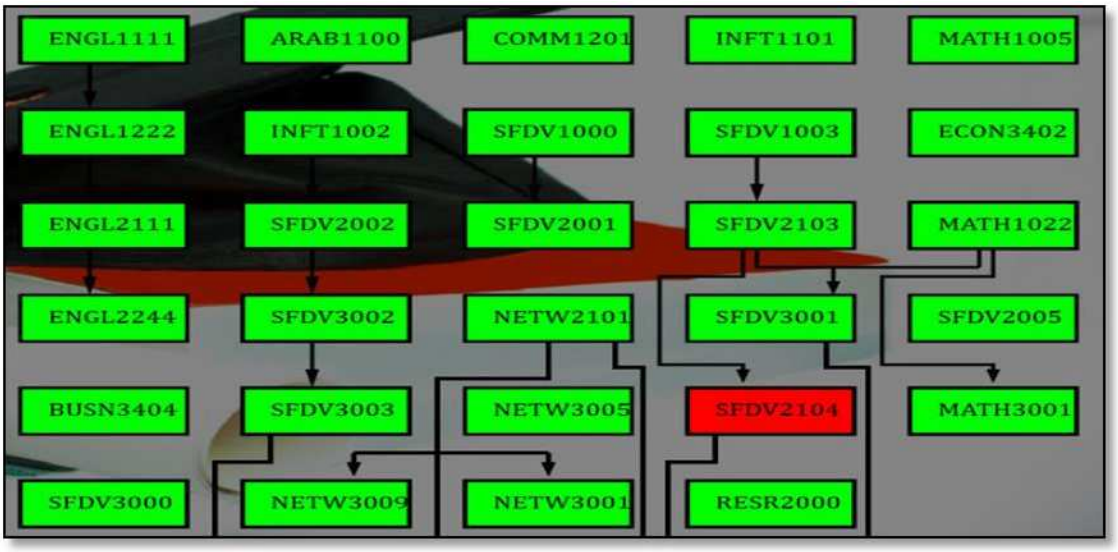



**Figure 8.** Plan Chart Web Page

As stated before, SPU and PSU units are responsible of managing and organizing all the retrieved information in the web pages of figures 7 and 8 respectively.

Advice Me web page is designed to support both of the advisors and students to make the right decision about the student's academic career. It's designed to include two of the powerful tools in iAMA system: IMP , ICS and IDU. As a student or advisors, possibly the most useful feature is the "IMP and ICS" links, which allows them the ability to predict automatically the empirical marks of the registered courses to seek the target GPA and predicting a set of short-term schedule automatically. Figures 9-12 illustrate IMP and ICS pages.


| Sem | Course ID | Course Title | Grade Points | Grade | Course Credits | Prerequisites | Comments |
|---|---|---|---|---|---|---|---|
| | ARAB1100 | Arabic Language Skills | 3 | B | 3 | | Compulsory |
| | COMM1201 | Intro.to.Communication | 1 | D | 3 | | Compulsory |
| 1 | ENGL1111 | Engllish for Academic purpose(1) | 0 | F | 4 | | Compulsory |
| | INFT1101 | IT foundementals | 3.3 | B+ | 3 | COMP5001 | Compulsory |
| | MATH1005 | Mathematic for IT | 3.0 | B | 2 | MATH5002 | Compulsory |
| | ECON3402 | Omani Economy | 2.7 | B- | 2 | | Compulsory |
| | ENGL1222 | Engllish for Academic purpose(2) | 4.0 | A | 4 | ENGL1111 | Compulsory |
| 2 | INFT1002 | Foundation of Degital Technology | 2.0 | C | 3 | | Compulsory |
| | SFDV1000 | Intro.to.Dynamic Web | 3.3 | B+ | 3 | | Compulsory |
| | SFDV1003 | programming Foundementals | 2.7 | B- | 3 | | Compulsory |
| | ENGL2111 | English for Academic purpose(3) | | | 3 | ENGL1222 | Compulsory |

**Figure 9.** IMP page

| Course ID | Course Title | Course Credits | Prerequistes | Comments |
|---|---|---|---|---|
| NETW4002 | Network Management | 3 | NETW2101 | Elective |
| NETW4004 | Wireless Networking | 3 | NETW2101 | Elective |
| NETW3005 | Advanced Operating System | 3 | NETW3005 | Elective |
| NETW3009 | Innovation In Network and Security | 3 | NETW2101 | Elective |

**Figure 10.** Sample of the result of ICS of student selection

| Hieghtest Level System Selection | | | | |
|---|---|---|---|---|
| Course ID | Course Title | Course Credits | Prerequistes | Comments |
| NETW4002 | Network Management | 3 | NETW2101 | Elective |
| NETW4005 | Computer Security A | 3 | NETW2101 | Elective |
| NETW4004 | Wireless Networking | 3 | NETW2101 | Elective |
| NETW3009 | Innovation In Network and Security | 3 | NETW2101 | Elective |

**Figure 11.** Sample of the result of ICS when score is high

| Medium Level System Selection | | | | |
|---|---|---|---|---|
| Course ID | Course Title | Course Credits | Prerequistes | Comments |
| NETW3009 | Innovation In Network and Security | 3 | NETW2101 | Elective |
| SFDV3007 | Advanced Data Base Design | 3 | SFDV3003 | Compulsory |
| NETW4005 | Computer Security A | 3 | NETW2101 | Elective |
| NETW4002 | Network Management | 3 | NETW2101 | Elective |

**Figure 12.** Sample of the result of ICS when score is Medium

| Low Level System Selection | | | | |
|---|---|---|---|---|
| Course ID | Course Title | Course Credits | Prerequistes | Comments |
| SFDV4002 | Software Project Management | 3 | SFDV3003 | Elective |
| NETW4004 | Wireless Networking | 3 | NETW2101 | Elective |
| NETW4002 | Network Management | 3 | NETW2101 | Elective |
| NETW4005 | Computer Security A | 3 | NETW2101 | Elective |

**Figure 13.** Sample of the result of ICS when score is Low

As stated before, IMP will produce the empirical grades and rendered them in the web page after the user entering the intended GPA and clicking on TEST button. While, ICS is rendered all the results produced by its engine in the web page and providing them with a variety of different solutions.

In addition, IDU is listed with the Advice Me page. It is designed for advising the student in case he wants to drop any course from his/her registered courses. Such a page provides a means for Web users to look the student's performance when the selected course is dropped from his/her current registered. Indeed, the main decision is forwarded to the web page after the user is selecting one of his/her registered courses. Thus, this interface is provide the user with some information such as prerequisite of the courses of that course, graduation delay, the number of delayed credits hours , the current credit hours and the number of semesters needed to graduate. Figure 15 illustrates the main items of a DCU Web page.

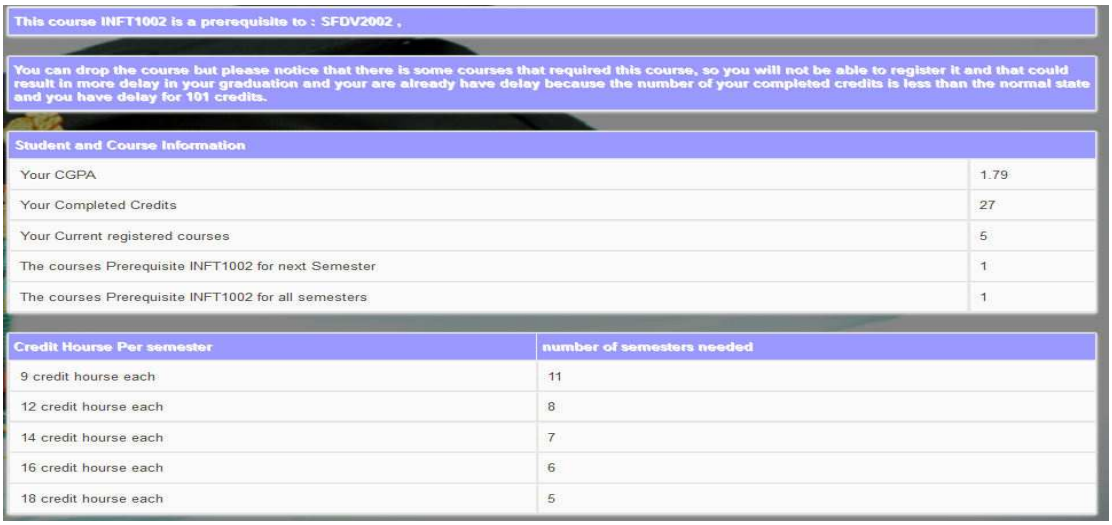



**Figure 14.** DCU Web Page

All of these aforementioned results by the proposed intelligent units give satisfactory advice that answer most common questions faced in academic advising. If however, the student find that the advice received is insufficient, he/she can then contact his/her advisor via email service which is supported by iAMA.

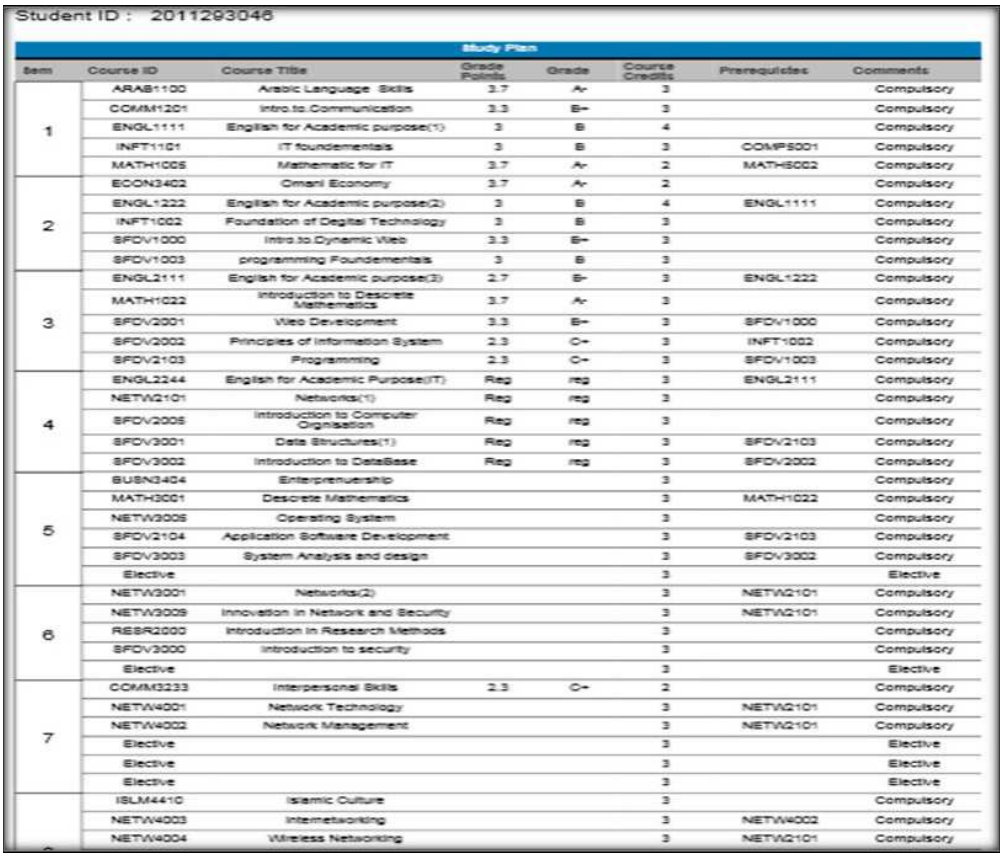
## IAMA's Evaluation

To examine the feasibility of iAMA, the performance of the proposed is investigated by examining the following hypotheses:

- Hypotheses 1: Is ICD a user friendly and easy to use.
- Hypotheses 2: Is ICS able to find the optimal solutions.

***Hypotheses 1***: Hypotheses 1 is examined in this section in which 20 students in different stages of study were involved. These students have been asked to use the proposed system to check its ability to solve their academic problems. The delivered results of those 20 students were analyzed with their academic advisors with the aim of evaluating iAMA's services and its efficiency for providing advices to students automatically. The results were very encouraging. In one of such 20 cases in this experiment, iAMA provides a study plan as shown in Figure 16 which was reviewed by the concerned student with his/her advisor easily and friendly. While, Figure 17 shows the expectations grade in which the targeted GPA was 3.2.

DCU have been examined by assuming SFDV3002 is the course that the user wants to drop. From his\her current registered courses. Figure 15 illustrates the result of this experiment. It is noticed that this unit give an advice of the possibility of dropping this course but there is some courses that are dependent on this course. And so, the student is not able to registering them, and that might lead to delay in the student's graduation. In addition, DCU inform users that generally SFDV3002 will be a prerequisite to one more course in his/her academic plan. Finally, the number of delayed semesters is also shown. The realized conclusion by this experiment, DCU able to provide the student and advisors with sufficient information to make the final decision.



Student ID : 2011293046

Study Plan

| Sem | Course ID | Course Title | Grade Points | Grade | Course Credits | Prerequisites | Comments |
|---|---|---|---|---|---|---|---|
| 1 | ARAB1100 | Arabic Language Skills | 3.7 | A- | 3 | | Compulsory |
| | COMM1201 | Intro.to.Communication | 3.3 | B+ | 3 | | Compulsory |
| | ENGL1111 | English for Academic purpose(1) | 3 | B | 4 | | Compulsory |
| | INFT1101 | IT foundementals | 3 | B | 3 | COMP5001 | Compulsory |
| | MATH1005 | Mathematic for IT | 3.7 | A- | 2 | MATH5002 | Compulsory |
| 2 | ECON3402 | Omani Economy | 3.7 | A- | 2 | | Compulsory |
| | ENGL1222 | English for Academic purpose(2) | 3 | B | 4 | ENGL1111 | Compulsory |
| | INFT1002 | Foundation of Digital Technology | 3 | B | 3 | | Compulsory |
| | SFDV1000 | Intro.to.Dynamic Web | 3.3 | B+ | 3 | | Compulsory |
| | SFDV1003 | programming Foundementals | 3 | B | 3 | | Compulsory |
| 3 | ENGL2111 | English for Academic purpose(3) | 2.7 | B- | 3 | ENGL1222 | Compulsory |
| | MATH1022 | Introduction to Descrete Mathematics | 3.7 | A- | 3 | | Compulsory |
| | SFDV2001 | Web Development | 3.3 | B+ | 3 | SFDV1000 | Compulsory |
| | SFDV2002 | Principles of Information System | 2.3 | C+ | 3 | INFT1002 | Compulsory |
| | SFDV2103 | Programming | 2.3 | C+ | 3 | SFDV1003 | Compulsory |
| 4 | ENGL2244 | English for Academic Purpose(IT) | Reg | reg | 3 | ENGL2111 | Compulsory |
| | NETW2101 | Networks(1) | Reg | reg | 3 | | Compulsory |
| | SFDV2005 | Introduction to Computer Orginisation | Reg | reg | 3 | | Compulsory |
| | SFDV3001 | Data Structures(1) | Reg | reg | 3 | SFDV2103 | Compulsory |
| | SFDV3002 | Introduction to DataBase | Reg | reg | 3 | SFDV2002 | Compulsory |
| 5 | BUSN3404 | Enterpreneurship | | | 3 | | Compulsory |
| | MATH3001 | Descrete Mathematics | | | 3 | MATH1022 | Compulsory |
| | NETW3005 | Operating System | | | 3 | | Compulsory |
| | SFDV2104 | Application Software Development | | | 3 | SFDV2103 | Compulsory |
| | SFDV3003 | System Analysis and design | | | 3 | SFDV3002 | Compulsory |
| | Elective | | | | 3 | | Elective |
| 6 | NETW3001 | Networks(2) | | | 3 | NETW2101 | Compulsory |
| | NETW3009 | Innovation in Network and Security | | | 3 | NETW2101 | Compulsory |
| | RESR2000 | Introduction in Research Methods | | | 3 | | Compulsory |
| | SFDV3000 | Introduction to security | | | 3 | | Compulsory |
| | Elective | | | | 3 | | Elective |
| 7 | COMM3233 | Interpersonal Skills | 2.3 | C+ | 2 | | Compulsory |
| | NETW4001 | Network Technology | | | 3 | NETW2101 | Compulsory |
| | NETW4002 | Network Management | | | 3 | NETW2101 | Compulsory |
| | Elective | | | | 3 | | Elective |
| | Elective | | | | 3 | | Elective |
| | Elective | | | | 3 | | Elective |
| 8 | ISLM4410 | Islamic Culture | | | 3 | | Compulsory |
| | NETW4003 | Internetworking | | | 3 | NETW4002 | Compulsory |
| | NETW4004 | Wireless Networking | | | 3 | NETW2101 | Compulsory |

**Figure 15.** Sample of Study Plan Sheet

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6 | RESR2000 | Introduction in Research Methods | 4.0 | A | 3 | | Compulsory |
| | SFDV3000 | Introduction to security | 4.0 | A | 3 | | Compulsory |
| | SFDV3004 | Data Structures(2) | 3.7 | A- | 3 | SFDV3001 | Compulsory |
| | SFDV3010 | Innovation in Software Development | 4.0 | A | 3 | SFDV2104 | Compulsory |
| | NETW4006 | Network Security A | 4.0 | A | 3 | NETW2101 | Elective |
| 7 | COMM3233 | Interpersonal Skills | | | 2 | | Compulsory |
| | SFDV3007 | Advanced Data Base Design | | | 3 | SFDV3003 | Compulsory |
| | SFDV3011 | Advance Web Development | | | 3 | SFDV2001 | Compulsory |
| | Non IT Elective | | | | 3 | | Major Elective |
| | Non IT Elective | | | | 3 | | Major Elective |
| | Non IT Elective | | | | 3 | | Non IT Elective |
| 8 | ISLM4410 | Islamic Culture | 3.3 | B+ | 3 | | Compulsory |
| | SFDV3008 | Database Development | | | 3 | SFDV3003 | Compulsory |
| | SFDV4005 | Distributed Data Management | | | 3 | SFDV3003 | Compulsory |
| | Non IT Elective | | | | 3 | | Major Elective |
| | Non IT Elective | | | | 3 | | Major Elective |
| | Non IT Elective | | | | 3 | | Non IT Elective |

**Figure 16.** Sample result of IMP unit

Furthermore, iAMA has been examined by supposing that the students had select four courses from the course announcement list. Indeed, the presented list on the ICS page is the courses that have been offered by the registration department. Figures 10 presents the result of this unit. The realized conclusion of this experiment, ICS able to provide the student and advisors with a variety of solutions that is also because of using GA in the engine of ICS.

***Hypotheses 2***: To examine Hypothesis 2 and because courses selection is not an easy work in ICS, the efficiency of ICS is addressed here to setup the population size (PSize) and the maximum number of generation (G_Max) of its engine. The output of ICS is those courses which have to include in the student's time table to end his studies without delay. Tables 4 -6 illustrate the results of running ICS with PSize=60,120 and 180 with G Max = 20. ICS archives best solutions when the PSzie=180 but the needed time to find such solutions is long. However, another experiment is conducted by fixing PSize=60 when the G Max = 40. The experimental result of Table 7 is fairly enough since the best solution is obtained at each run. The analytic results demonstrated that ICS is able to find the optimal solution (student's time table). Therefore, hypothesis 2 is accepted.

| Experiment 1 | | |
|---|---|---|
| Run | Solution | $G\_Max = 20$ |
| 1 | SFDV3001, NETW2101,SFDV2005,SFDV3002,SFDV2104 | 20 |
| 2 | **SFDV3001, ENGL2244,SFDV2005,SFDV3002,NETW2101** | 20 |
| 3 | **SFDV3001,SFDV2005,NETW2101,SFDV3002,ENGL2244** | 20 |
| 4 | SFDV3001,NETW3005,NETW2101,SFDV3002,ENGL2244 | 20 |
| 5 | **SFDV3001,SFDV2005,NETW2101,SFDV3002,ENGL2244** | 20 |
| | The Percentage of Best Solutions | 60% |

**Table 4.** RESULTS WHEN *PSize*=60,*G_Max* = 20

| Experiment 2 | | |
|---|---|---|
| Run | Solution | $G\_Max = 20$ |
| 1 | **SFDV3001, ENGL2244,SFDV2005,SFDV3002,NETW2101** | 20 |
| 2 | **SFDV3001, SFDV3002,SFDV2005,SFDV2104,NETW2101** | 20 |
| 3 | **SFDV3001, SFDV3002,SFDV2005,SFDV2104,NETW2101** | 20 |
| 4 | **SFDV3001,SFDV3002,SFDV2005,SFDV2104,NETW2101** | 20 |
| 5 | SFDV3002,NETW3005,NETW2101,SFDV2104,SFDV3001 | 20 |
| | The Percentage of Best Solutions | 80% |

**Table 5.** RESULTS WHEN *PSize*=120,*G Max* = 20

| Experiment 3 | | |
|---|---|---|
| Run | Solution | $G\_Max = 20$ |
| 1 | **SFDV3002,NETW3005,NETW2101,SFDV2104,SFDV3001** | 20 |
| 2 | **SFDV3002,NETW3005,NETW2101,SFDV2104,SFDV3001** | 20 |
| 3 | **SFDV3002,NETW3005,NETW2101,SFDV2104,SFDV3001** | 20 |
| 4 | **SFDV3002,NETW3005,NETW2101,SFDV2104,SFDV3001** | 20 |
| 5 | **SFDV3002,NETW3005,NETW2101,SFDV2104,SFDV3001** | 20 |
| | The Percentage of Best Solutions | 100% |

**Table 6.** RESULTS WHEN *PSize*=180,*G Max* = 20

| Experiment 4 | | |
|---|---|---|
| Run | Solution | $G\_Max = 40$ |
| 1 | **SFDV3002,NETW3005,NETW2101,SFDV2104,SFDV3001** | 40 |
| 2 | **SFDV3002,NETW3005,NETW2101,SFDV2104,SFDV3001** | 40 |
| 3 | **SFDV3002,NETW3005,NETW2101,SFDV2104,SFDV3001** | 40 |
| 4 | **SFDV3002,NETW3005,NETW2101,SFDV2104,SFDV3001** | 40 |
| 5 | **SFDV3002,NETW3005,NETW2101,SFDV2104,SFDV3001** | 40 |
| | The Percentage of Best Solutions | 100% |

**Table 7.** RESULTS WHEN *PSize*=60,*G Max* = 40

## Conclusion

We presented in this research an intelligent academic application iAMA which is used to reduce the cost, time, and effort for both the advisors and students. Using iAMA is considered a good idea to implement at the colleges and the universities in Oman to help track the performance of the Omani students and supporting them efficiently to success the plan of their academic life. However, based on the results of the empirical test conducted on 20 students; the iAMA can be suitably applied to help the students and advisors. In further studies, the optimization of student's performance in iAMA system will be considered.

## References

1. Ahmar M. Ayman Al, Prototype Rule-based Expert System with an Object-Oriented Database for University Undergraduate Major Selection, International Journal of Applied Information Systems (IJAIS) Foundation of Computer Science FCS, New York, USA, 2012.
2. Al Ghamdi Abdullah, An Expert System for Advising PostgraduateStudents, International Journal of Computer Science and Information Technologies, Vol 3, Issue 3, 2012.
3. Al Nory, M.T, Simple Decision Support Tool for university academic advising, International Symposium on Information Technology in Medicine and Education (ITME), 2012.
4. Ayan M. O. a. Z. BUADVIS- a Decision Support System for Student Advising Asian Network for Scientific Information, Pakistan. - 2001. - Vol. 1.
5. David E. Goldberg,Genetic Algorithms,Pearson Education,2006.
6. Eiben A. E. and Smith J. E. Introduction to Evolutionary Computing: Springer, 2007. 2 nd.
7. Feghali T., Zbib I., Hallal S., A Web-based Decision Support Tool for Academic Advising, Educational Technology and Society, Vol. 14, Issue 1, 2011.
8. George F. L. Artificial Intelligence Structures and Strategies for Complex Problem Solving: Addison Wesley, 2005.
9. Grefenstette J. J. Optimization of Control Parameters for Genetic Algorithms IEEE Transaction on System. - [s.l.] : Man and Cybernetics, 1986. - 1 : Vol. 16. - pp. 122 - 128.
10. Huang M. J., Huang H. S. and Chen M. Y. Constructing a Personalized E-Learning System Based on Genetic Algorithm and Case-Based Reasoning Approach Expert Systems with Applications: ScinceDirect, 2007. - Vol. 33. - pp. 551 - 564.
11. Hwang G. J. [et al.] An Enhanced Genetic Approach to Composing Cooperative Learning Groups for Multiple Grouping Criteria Educational Technology & Society. - 2008. - 1 : Vol. 11. - pp. 148 - 167.
12. Marques O., Ding X., Hsu S., Design and development of a webbased system for academic advising, ASEE/IEEE Frontiers in Education Conference, Reno, Nevad, 2001.
13. Mitchell M., An Introduction to Genetic Algorithms.Cambridge:MIT Press, 1998.
14. .Nambiar A.N., Dutta A.K, Expert system for student advising using JESS, International Conference on Educational and Information Technology (ICEIT), Vol. 1, 2010.
15. Ozturan M. , Ayan Zeynep., BUADVIS- a Decision Support System for Student Advising, Asian Network for Scientific Information, Pakistan, Vol 1, 2001.
16. Pokrajac D., Rasamny M., Interactive Virtual Expert System for Advising (InVEStA), Frontiers in Education Conference, 36th Annua, 2006.
17. Virginia N. GordonWesley R. HableyThomas J. Grites, Academic Advising: A Comprehensive Handbook, Jossey-Bass, 2008.
18. College of Applied Science Catalog.