An Effective and Efficient Class-Course-Faculty Timetabling Assignment for an Educational Institute

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Abstract: This paper proposes a class-course-faculty timetabling assigning model for an educational institute to increase the overall departmental performance, including enhancing teaching quality, making good use of student time, saving college budgets, and sharing departmental resources effectively. To achieve these goals, both faculty and classes are classified into different groups based on teachers' specialties and courses' attributes; the classified data and allocating rules are processed by a heuristic driven process and two fitness functions. The proposed heuristic driven process coupled with two fitness functions is mainly used to satisfy students' needs for taking or retaking certain courses without delaying their graduation where the class sizes are balanced and merged to decrease the number of elective courses opened to the students. Allocating rules applied in the classrooms and laboratories management are based on the attributes of the courses and the availabilities of the resources to ensure that the resources can be shared effectively. The proposed timetabling assigning model has been simulated in C programming codes and MS SQL server is used as backend database. It allows teachers to get on the Website to key in at least 7 different courses of their preferring teaching courses, where the keyed in courses should be either in the same attributes of the specific course group or in the general course group. From the experimental results, there are about 90% of 100 courses assigned to the specific professional teacher. The minimum and maximum average satisfaction for all students' needs is 0.8 and 0.9, respectively, where the lowest index value is 0.7 and the highest index value is 1. These results show that the difference of each student's satisfaction is small; and the teachers' and students' expectations on teaching specific subjects and taking specific courses can be satisfied as nearly as possible.
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1. Introduction

With the developed e-education technology, many different types of diplomas, certifications, and academic degrees are available from online learning institutions [1]. However, Behzadi and Ghaffari have pointed out that there are four drawbacks existing in e-education. They are (1) lacking face-to-face classroom and office interaction between students and teachers, (2) lacking study materials for traditional institutions with their on-campus libraries, (3) lacking Lab sessions for natural science majors, and (4) difficult self-discipline due to too much freedom for the online education. Therefore, traditional campus-based education cannot be replaced by the online education and it is crucial for an educational institution.

For the traditional campus-based education in an individual department at a university, scheduling class-course-faculty timetables is an routine administrative task because it has to be arranged every semester. This scheduling problem generally allocates all teachers' and students' courses to appropriate timeslots with the limited resources, including facilities, classrooms, and laboratories. Specifically in Taiwan, this task is complicate and difficult because of multi-educational systems, including four-year undergraduate program, four-year evening class college program, graduate school program, and two-year college program, existing in an academic department. Except that, students' career planning classes are also needed to be scheduled during their university education [2]. In addition, a class-course-faculty assigning problem has to concern about assigning classes to appropriate faculty, proper classrooms, and available timeslots [3]. Commonly, each educational system handles different class-course timetabling task; each professional teacher has different preferences on teaching timeslots; each student has to take (or retake) different courses in a semester for not delaying their graduation; and the board of college directors requires making the best use of the college budget. Therefore, inappropriate class-course-faculty assignment may bring some unwilling consequences, such as decreasing teaching quality, lessening faculties' expectations on preferred teaching courses and teaching timeslots, ineffective sharing departmental resources, increasing college cost by opening too many same elective courses, and delaying students' graduation.

In this paper, class-course-faculty assigning problem can be functionally viewed as employee scheduling problem which assigns employees to qualified required works where employees are faculty members and qualified required works are specific professional classes [3]. Generally, the employee scheduling problem builds the works and timeslots assignments in one stage. The literatures [4-7] utilize different technology to assign the schedule and place the employees to works simultaneously. Lapierre and Ruiz [4] applied Tabu search meta-heuristic technology on solving hospital supply systems located in Montreal, Canada. The approach mainly emphasizes on making scheduling decisions such as when each employee should work and what task should he do, etc. However, it needs more work on evaluating its performance efficiency by testing its practical value. Alvarez-Valdes et al. [5] proposed a heuristic algorithm to solve the glass factory scheduling problem for incoming customer order. Although this model can provide tight due dates and can perform a complete mid-term plan, it is lack of flexibility on adapting other customer order, such as rescheduling remaining jobs. Sherali et al. [6] and Seckiner [7] are two studies related to balance workload among workers. The study proposed by Sherali, etc. utilizes a quantitative approach to find out the optimal schedule on set-up task assignment for multi-objective program. The study proposed by Seckiner uses a simulated annealing approach to solve job rotation problem.

A number of researches have devoted in solving the class-course-faculty timetabling problem. Burke and Petrovic [8] studied some automated timetabling technologies in which heuristic based evolutionary timetabling algorithm, multi criteria decision method, and case-based reasoning approach are discussed. Burke et al. [9] applied Tabu search to solve permutations of graph-based hyperheuristic for examination and course timetabling problem. Petrovic et al. [10] proposed case-based reasoning methodology to solve metaheuristic examination timetabling problem by selecting the pairing of an appropriate sequential heuristic construction. Smith et al. [11] proposed two alternative formulations, a standard Hopfield-Tank approach and the Hopfield network, for solving school timetabling problem. Ozdemir and Gasimov [12] constructed a multi-objective 0-1 nonlinear model with the consideration of participants' average preferences. Daskalaki et al. [13] used NP-complete concept to solve the organizational associate constraints. Asratian and Werra [14] proposed a theoretical model which corresponds to some situations occurring frequently in the university's training programs. Three researches [15-17] applied integer programming technology to solve timetabling problem. MirHassani [15] applied 0-1 integer programming approach coupled with a number of operational rules and requirements of Shahrood University, Iran, to enhance the effectiveness of course timetables. Ismayilova et al. [16] proposed a multiobjective 0-1 linear programming model considering both the administration's and instructors' preferences and using weight priority to schedule the class-course timetable. Daskalaki and Birbas [17] developed an integer programming formulation for a university timetabling problem, which adopts universities constrains to ensure consecutiveness of certain courses. The literatures [18-20] built the schedule and place the teachers to classes simultaneously. Hsiung and Chang [18] proposed a genetic based algorithm for solving the course assigning problem with the consideration of faculty preferences, which has the disadvantage of repeating starting searching point for the proposed genetic algorithm. Beligiannis et al. [19] applied the mathematical model to solve course and time-slot assignment without the consideration of teachers' preferences. Head and Shaban [20] formulated a heuristic approach for course-student timetabling, which is the student-oriented scheduling model. The literatures [21-22] solved the class-faculty assignment in two stages, which has the advantage of presenting a complicated model as a more comprehensive model by simplifying one problem into two sub-problems. Badri [21] made class faculty assignments in the first stage and made class faculty time-slot assignments in the second stage, which seeks to maximize faculty course preferences. Alvarez-Valdes et al. [22] developed a set of heuristic algorithms with Tabu search to solve the problem for building the timetable in planning the third year in which the student would choose different professional orientation (Business Management, Financial Management, Accounting, etc.).

As described above, finding an effective and efficient approach for assigning appropriate courses to university faculty and scheduling class-course timetables is an urgent issue that must be solved. The objective of this study aims to solve the academic class-course-faculty timetabling problem existing at Electronic Engineering (EE) department of Kao Yuan University (KYU) based on the considerations of their specific needs and constraints. At EE department of KYU, there are about 25 full-time teachers and 20 classes with totally 100 teaching courses being scheduled every semester. Typically, the number periods per day and days per scheduling week are the same; a weekly timetable is divided into five days (Monday through Friday); and each day is divided into four and eight time periods for the day and evening classes, respectively. The number period for the day classes begins at 8:15 a.m. as the 1st timeslot, 9:15 a.m. as the 2nd timeslot, and so on; the number period for the night classes begins at 06:45 p.m. as the 1st timeslot, 7:35 p.m. as the 2nd timeslot, and so on. Currently, scheduling these numerous courses to specific time periods is often influenced by four factors, including: (1) the course catalog structure changes with the student demands for certain courses every semester; (2) the limited facilities, laboratories, and classrooms affect the effectiveness of allocating available resources; (3) the consideration of each faculty's preferring teaching timeslots increases the difficulties of the scheduling task; and (4) the organizational policies about requiring the days for each faculty staying at school and requiring the best use of the budgets also increase the difficulties of the scheduling task. Moreover, the class-course timetabling task at EE department traditionally relies on human labors. The generated class-course-faculty timetables have the disadvantages of time consuming, inefficient utilization of facility and human resources, biased class-course assignments, and dissatisfaction among students and teachers. Hence, in order to increase the overall performance of the departmental educational system, this study proposes a two-stage approach for the academic class scheduling and time tabling problem at EE department of KYU. Stage I is concerned with designing a student-oriented class-course timetabling model that has the advantages of making good use of student time, and saving college budgets. Stage II is concerned with assigning faculty members to different classes aiming at increasing teaching quality and sharing departmental resources effectively. The proposed method is based on the considerations of students' needs on retaking different courses for not delaying their graduation, teachers' preferences on specific teaching time periods, course catalog structure, and the organizational constraints and requirements. The proposed model allows teachers to key in their preferences and allows students to get on the Website keying in their needs of taking specific elective courses and retaking certain courses. The developed heuristic driven process coupled with two fitness functions can make good use of student time, cost down the budget by balancing the class sizes, share university teaching resources effectively, and build the optimal schedules for each class as nearly as possible. In the following, Section 2 describes the proposed class-course-faculty timetabling model. The experimental results are shown in Section 3. Finally, the conclusions are summarized in Section 4.

2. Class-Course-Faculty Timetabling Assignment

Figure 1(a) shows the block diagram of the class-course-faculty system, which includes two stages: the class-course scheduling system as shown in Figure 1(b) and the class-faculty assigning system as shown in Figure 1(c). As given in Figure 1(a), the class-course-faculty system consists of inputs, a class-course scheduling process, a class-faculty assigning process, and outputs. The inputs include faculty inventory, faculty/student preferences, course inventory, and resources. The class-course scheduling process and the class-faculty assigning process take the inputs through the heuristic driven process coupled with two fitness functions to generate the expected class/course/faculty assigning outputs. Each part of the system is described in detail as follows.

2.1. Inputs

As shown in Figure 1, the inputs of the class-course-faculty assigning model include faculty inventory, course inventory, resources, and faculty /student preferences on specific teaching subjects and timeslots. The faculty inventory is the list of all full-time teachers in the department; the course inventory is the list of all requirements and elective courses extracted from the class/course catalog; the resources are the departmental available resources including classrooms and laboratories; and the faculty/student preferences are the teachers' preferences of teaching courses/timeslots and students' needs of taking specific elective courses and retaking certain courses for not delaying the graduation. In this study, every faculty has to choose seven different courses and seven half days, at least, via the website. Table 1 shows the data structure of the faculty inventory. As shown in Table 1, the teachers are classified into four groups (including computer engineering, system control, navigation electricity, and semiconductor) and five levels (including instructor, assistant professor, associate professor, full professor, and teacher with administration work) based on their specialties and positions. Table 2 illustrates the data structure of the course inventory. In Table 2, all courses are indexed and classified into five groups (including the fields of navigation electricity, system control, computer engineering, semiconductor, and general courses) based on their attributes. Table 3 lists all departmental available classrooms and laboratories. Currently, there are 10 classrooms and 12 laboratories available at EE department of KYU. Table 4 gives the data structure of the faculty keyed in preferred teaching courses, which lists his/her keyed in classes, the course titles, and teaching hours. And then, Table 5 shows the data structure of the faculty preferring teaching timeslots.

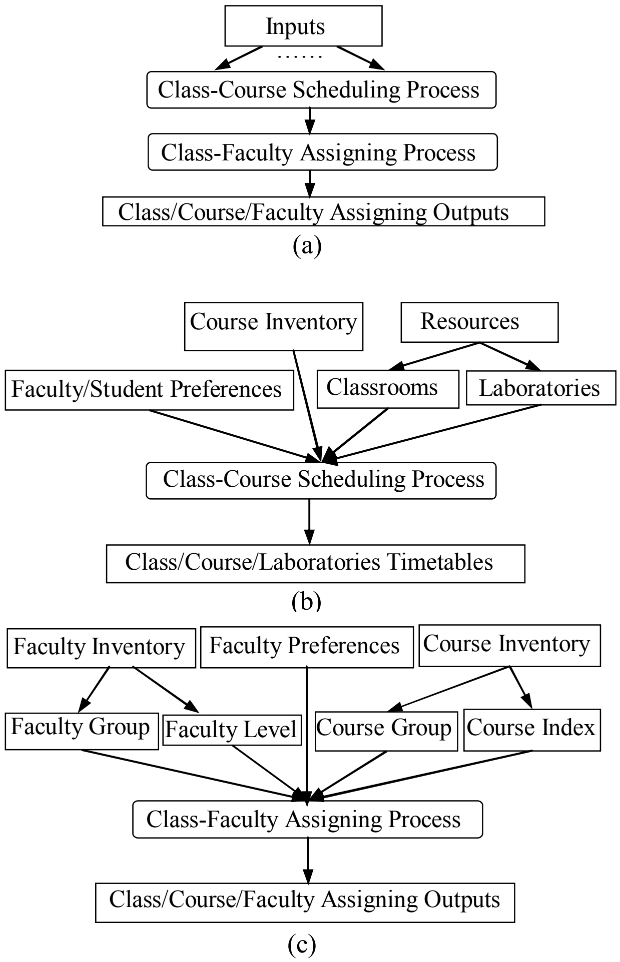

Figure 1. (a) Block diagram of class-course-faculty assigning system; (b) Block diagram of class-course scheduling system (c) Block diagram of class-faculty assigning system.

Table 1. The data structure of the faculty inventory

Teacher Group	Teacher's Name	Position/Priority
Comp. Eng.	David Wang	Prof / 1
Syst. Cont.	Jim Hsu	Asso. Prof / 2
Navi. Ele.	A.O. Brown	Assi. Prof / 3
Semi.	. . .	. . .

Table 2. The data structure of the course inventory

Course Group	Class/Course Title
Navi. Ele.	4EE21/Electronic Lab.
Syst. Con.	2EE11/Electronic Lab.
Comp. Eng.	5EE11/Fund. Navigation
Semi.	. . .
Gene. Cour.	. . .

Table 3. The data structure of the resources

Classrooms	Laboratories
EE101	VLSI
EE102	Network
EE103	Programming--1
. . .	Programming--2
EE201	Electronic Lab.--1
EE202	Electronic Lab.—2
. .	. . . .

Table 4. The data structure of the faculty keyed in preferred teaching courses

Teacher's Name	Class/Course Title/Teaching Hours
David Wang	4EE21/Electronic Lab./3
Jim Hsu	2EE11/Electronic Lab./3
A.O. Brown	4EE32/PLD Lab/4
Joanna Chen	4EE41/Microcontroller/3
	. . .

Table 5. The data structure of the faculty preferring teaching timeslots

Teacher Grp.	Teacher's Name	Unavailable Time slots
Comp.	David Wang	M. T. W. H. F.
Syst.	Jim Hsu	Morning X X
Navi.	A.O. Brown	Afternoon X
Semi.	. . .	. . .

2.2. Class-Course-Faculty Assigning Process

Both class-course scheduling process and class-faculty assigning process utilize the heuristic method coupled with two fitness functions to optimize the class-course-faculty assignment outputs, which includes three steps: organizing heuristic data, designing fitness functions, and iterative mutation.

Step 1: Organizing heuristic data

Organizing heuristic data means representing all necessary data sets and constraints as useful information in order to find an optimal solution. In this section, all courses, including required and elective courses, are numbered from 1 to n; all students are numbered from 1 to m; and all teachers are numbered from 1 to k where n, m, and k are the maximum index number of courses, students, and teachers, respectively. The definitions of the data sets and system constraints used throughout in this section are given as follows.

The data sets used in stage I include:

(1) SNum [*i*][*j*]=*m* :The student numbered *m* is assigned to the j^{th} class of the i^{th} year.

(2) CNum[*i*][*j*] =*n* : The course numbered *n* is assigned to the j^{th} class of the i^{th} year.

(3) CAssign[*q*][*p*]=*n* : The course numbered *n* is assigned to the p^{th} timeslot of the q^{th} weekday, where *p*=1…40, the index number of the timeslot for a week; *q* =1…5 (Mon... Fri.).

(4) LAssign[*x*][*p*]=*n* : The course numbered *n* is assigned to the p^{th} timeslot of the x^{th} laboratory.

(5) CRetaken[*m*]=*n* : The student *m* has marked the course number *n* as a retaken course.

(6) Retaken [*n*]=1 : The course numbered *n* is marked as a retaken course.

(7) TPref[*q*][*r*]=*k* :The preferred teaching timeslots chosen by the teacher *k* is on q^{th} weekday; *r* =0 --Morning, *r*=1 – Afternoon..

(8) MutOPT[*i*][*j*]=*n* : The course number *n* is assigned to the j^{th} class of the i^{th} year and labeled as an mutation operator.

The data sets used in stage II include:

(1) TGroup[*i*][*j*]=*k*: The teacher numbered *k* is classified into the index number *j* of the *i*th group.

(2) TPosition[*k*]=*m* : The position of the teacher numbered *k* is *m*.

(3) TPref[*k*]=*n*: The preferred teaching course chosen by the teacher *k* is the course number *n*.

(4) TOK[*i*][*j*]=1 : The teacher indexed number *j* of the *i*th group has completed the courses assignment.

(5) CGroup [*i*][*j*]=*n* : The course numbered *n* is classified into the index number *j* of the *i*th group.

(6) CPref[*i*][*j*]=*k* : The course indexed number *j* of the *i*th group is chosen by the teacher numbered *k*.

(7) TAssign[*k*][*p*]=*n* : The course numbered *n* is assigned to the teacher numbered *k*, where *p*=1…5, the index number of the assigned teaching course.

(8) MutOPC[*k*]=*n* : The course number *n* is assigned to the teacher *k* and labeled as an mutation operator.

The system constraints include:

(1) Before scheduling the general educational courses, scheduling junior-year professional courses' timeslots of four-year college program firstly.

(2) For the first year of four-year college program, evenly scheduling each class's professional courses on weekdays. Currently there are three classes in the bachelor year at EE department of KYU. Generally, only two require and one elective courses need to be scheduled for each class. Therefore, the proposed method would schedule one class's professional courses on Monday and Thursday, the other on Tuesday and Thursday, and another on Wednesday and Friday. This would help senior students to retake the first year's professional courses without conflicts.

(3) For the second year of four-year college program and the first year of two-year college program, scheduling each class's professional courses by considering students' needs on retaking specific courses. In this process, the priority for scheduling consecutive courses such as laboratory courses is higher than that of un-consecutive courses such as theoretical courses; the timeslots for the student needs of retaken courses, including bachelor's general educational courses and professional courses, are unfilled or assigned to the elective courses as nearly as possible.

(4) Scheduling senior courses with the considerations of merging each class's elective courses, balancing the timeslots of elective courses, scheduling requirements without affecting the students' needs of retaking certain courses.

(5) Whenever scheduling a course to a specific time period, checking the faculty's preferences on specific teaching timeslots as given in the Table 1.

(6) After scheduling a course to a specific timeslot, the corresponding classroom or laboratory is also mapped based on the consideration of fully utilizing a classroom's and a laboratory's timeslots

(7) Merging two same classes into one class when the number students are not over 30 students.

(8) Any subject is assigned to the teacher who is the only one choice that subject.

(9) If a subject is chosen by more than two teachers, the first priority of assigning teaching courses is the advisor of the class, the second priority is the teacher with the specific professional of the subject based on the data sets listed in the TGroup and CGroup.

(10) A teacher has to be assigned at least two different subjects except for the teacher also working at administration department; all teachers must have no more than three different subjects.

Step 2: Designing fitness functions

The fitness function is designed by satisfying different specific constraints and meeting the different needs to evaluate the degree of faculty /student satisfaction for their courses/classes assignment. Under the constraints described above, two fitness functions, the satisfaction and the average satisfaction of the faculty and the student, are given as follows.

The satisfaction of the teacher numbered k and the student numbered m are defined as

$$S_k = \frac{TM_k}{p_k} > 0.6$$

$$S_m = \frac{TM_m}{p_m} > 0.7$$

,where TM_k is the total number of the satisfaction matched for the teacher numbered k; TM_m is the total number of the satisfaction matched for the student numbered m; p_k is the total number of the assigned teaching courses to the teacher numbered k; p_m is the total student numbered m keying in their needs. The average all students' satisfaction (AS) and all the faculty (TS) are defined as

$$AS = \frac{\sum_{i=1}^{m} S_i}{m} > 0.8$$

$$TS = \frac{\sum_{i=1}^{k} S_i}{k} > 0.8$$

Step 3: Iterative mutations

An iterative mutation begins at the mutation operator marked in the array of MutOPT and MutOPC. The objective of this process is to increase the algorithm's effectiveness while searching another solution and gain better output optimization for the scheduling and assigning processes. Following shows the procedures of two-stage iterative mutations.

Iterative mutation procedures of Stage I are:

```
For each MutOPT do
    For each CAssign do
        Process1. Select another specific timeslots
        Process2. Assign the course to this
                  timeslots, if the selected
                  timeslots is allowed to assign a
                  course, TMm = TMm +1,
                  otherwise, go to Process 1.
        Process3. Update new state of CAssign of
                  this course.
    End CAssign
End MutOPT
```

Iterative mutation procedures of Stage II are:

```
For each MutOPC do
    For each TAssign do
        Process1. Select another specific
                  professional teacher
        Process2. Assign the course to this teacher,
                  if the selected teacher is
                  allowed to assign a course, TMk
                  = TMk +1, otherwise, go to
                  Process 1.
        Process3. Update new state of TAssign of
                  this teacher.
    End TAssign
End MutOPC
```

2.3. Outputs

The outputs of stage I process include each class's course timetable and laboratory's timetable. Figure 2 gives the 4EE3A class's course timetable where 4 means four-year college program; EE means electronic engineering department; 3 means the 3rd year; and A means class A. Figure 2(a) lists the course timetable of 4EE3A located at classroom EE301; Figure 2(b) lists communication laboratory's timetable.

The outputs of stage II include each faculty's teaching courses, corresponding teaching hours, and their satisfaction matched, as shown in Table 6.

Room: EE301 Class: 4EE3A

Fr	Th	We	Tu	Mo			
					08:15 | 09:05	1	MORNING
		Prog	SigSys.	El Mag.	09:15 | 10:05	2	
		Prog	SigSys.	El Mag.	10:15 | 11:05	3	
		Prog	SigSys.	El Mag.	11:15 | 12:00	4	
	AirMa	Contr	Micrp	Nav Tec	13:00 | 13:50	5	AFTERNOON
	AirMa	Contr	Micrp	Nav.Tec	13:55 | 14:45	6	
	AirMa	Contr	Micrp	Nav.Tec	14:50 | 15:40	7	
					15:55 | 16:40	8	

(a)

Communication

Fr	Th	We	Tu	Mo			
					08:15 | 09:05	1	MORNING
	Comm 4EE2B	SigSys 4EE3C.	SigSys 4EE3A.	Comm. 4EE2A	09:15 | 10:05	2	
	Comm 4EE2B	SigSys 4EE3C.	SigSys 4EE3A.	Comm. 4EE2A	10:15 | 11:05	3	
	Comm 4EE2B	SigSys 4EE3C.	SigSys 4EE3A.	Comm. 4EE2A	11:15 | 12:00	4	
		Comm 4EE2C		SigSys 4EE3B.	13:00 | 13:50	5	AFTERNOON
		Comm 4EE2C		SigSys 4EE3B.	13:55 | 14:45	6	
		Comm 4EE2C		SigSys 4EE3B.	14:50 | 15:40	7	
					15:55 | 16:40	8	

(b)

Figure 2. The 4EE3A class-course timetable outputs (a) classroom EE301's course timetable (b) communication laboratory's timetable.

Table 6. The outputs of stage II

Teacher Group	Teacher's Name	Cla./Cour. Title	H/Sat
Navi. Ele. →	David Wang Jim Hsu A.Brown . . . →	4E21/Ele. 2E11/Ele. GE11/Emb →	3/ Y 3 /Y. 4/ Y
Syst.			
Comp			
Semi.			

3. Experimental Results

The class-course-faculty assigning system is simulated in C programming codes with using MS SQL server as backend database. The proposed method has been tested at the EE department of KYU, Taiwan. The proposed approach allows teachers to get on the Website to key in at least 7 different courses of their preferring teaching courses, where the keyed in courses should be either in the same attributes of the specific course group or in the general course group. Table 7 lists Prof. Wang's keying in 7 different courses of his preferring teaching courses. From Table 7, because Prof. Wang is classified into the computer group, he can only choose the courses either in the field of computer group or in the general courses' group. Table 7 lists Prof. Wang's assigned courses and whether the assigned courses are matched to his satisfaction. From Table 8, Prof. Wang's assigned courses are all satisfied in his keyed in preferring teaching courses.

In this study, the students' and faculty's satisfaction is modeled as the 0-1 index value. From the experimental results, the difference of each student's and teacher's satisfaction is small, where the lowest index value is 0.7; the highest index value is 1; the minimum and maximum average satisfaction index value for all teachers is 0.9 and 0.95, respectively; the minimum and maximum average satisfaction for all students' needs is 0.8 and 0.9, respectively. Moreover, there are about 90% of 100 courses assigned to the specific professional teacher. Therefore, the proposed approach can support good enough faculty satisfaction and the fairness of the course assignment. Table 9 shows the differences of the number of elective courses and merged elective courses for senior-year classes. From Table 9, the number of merged elective courses takes about 50% off the number of original elective courses. This indicates that the proposed method can cost down the courses' budgets. Table 10 lists the number of laboratories available in the EE department. From Table 10, the laboratory of computer #2 is free for all semester; the unused timeslots for VLSI design laboratory are on Tuesday and Friday morning, etc. Conclusively, the available Labs can be used for certificate training courses, career planning classes, or other expanding courses.

Table 7. Prof. Wang's keying in 7 different courses of his preferring teaching courses

Teacher's Name	Class/Course Title/Teaching Hours
David Wang →	4EE21/Electronic Lab./3 2EE11/Electronic Lab./3 4EE31/PLD Lab/4 4EE32/PLD Lab/4 4EE41/Microcontroller/3 4EE42/Microcontroller/3 4EE43/Microcontroller/3

Table 8. Prof. Wang's assigned courses and the satisfaction matched

Name	Class/Course Title/Teaching ..	Satis.
David Wang →	4EE31/PLD Lab/4 4EE32/PLD Lab/4 4EE41/Microcontroller/3 4EE42/Microcontroller/3	Y Y Y Y

Table 9. Differences of the number of elective courses and merged elective courses for senior years classes

Prog. / #Courses	4-year college		2-year
	3^{rd} yr.	4^{th} yr.	2^{nd} yr.
Normal	12	9	4
Merged	8	6	2

Prog. / # Courses	5-year junior college	
	4^{th} yr.	5^{th} yr.
Normal	6	6
Merged	6	3

Table 10. The number of labs available in the department

TimeSlots / Labs	M.	T.	W.	H.	F
Microcontr.	MA		A		A
VLSI Design		M			M
Electronic	M		A		
Computer #2	MA	MA	MA	MA	MA

Note. M: Morning A: Afternoon

4. Conclusions

In order to increase the overall department-education performance, this paper proposes a heuristic based class-course-faculty assigning model with the considerations of teachers' specialties and preferences, students' needs of retaking different courses without delaying their graduation, course catalog structure, and all organizational constraints and requirements. The proposed approach provides four advantages: (1) By allowing teachers keying in their preferring teaching courses through the Website, this ensures that the courses can be assigned to a specific professional teacher and teachers' expectations on specific teaching subjects can be satisfied as nearly as possible, therefore teaching quality is guaranteed. (2) By formulating the rules for using the classrooms and laboratories based on the attributes of courses and availabilities of the resources, this makes near-optimal use of department teaching resources. (3) By balancing the class sizes and reducing the number of elective courses opened to students at an individual department, the cost for opening the courses in a semester is decreased. (4) The developed heuristic driven process with iterative mutation applies two fitness functions to achieve teachers' satisfaction, support the fairness of the class-course-faculty assignment, satisfy students' needs, and make good use of the student time. In addition, the proposed method puts the advisor of the class into the first priority of assigning courses. This would increase the teachers' opportunity for involving students' learning.

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