A One-Semester Course Planner for EE Students

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***Abstract*—Student course planning at the Department of Electrical Engineering, UAE University is an important process to ensure a student to fulfill the degree requirements of the university in a structured way and without encountering unnecessary delays. Most universities in the world spend a substantial amount of money for bespoke advising & registration programs to suit their needs. The students have faced problems because of a need of a proper advising system as well as a lack of seeking proper advising. A Student Course Planning Software (SCPS) package is devised in this respect. The software is developed by using the Python computer programming language. The software system guide students in selecting the most appropriate six courses suitable to register in the next semester. The outcome of the course selection is stored in a file to help students with the university registration system.**

***Index Terms*—Course planning, advising, software package, Python.**

I. Introduction

Course registration comprises of three main sections: what you need to know before you register, guidelines for registering, and what are the next steps after you are done. The process of registering and after steps is well established however, the knowledge of what courses to register is a significant process.

Typical registration problems that are based on course planning and advising include: advised or chosen courses with time conflicts, missed out on courses specific for alternating semesters, preferred electives bypassing track requirements and restrictions, chosen too many or too less courses in a specific semester, etc. Students in this category suffer with problems such as class expulsion after two or three weeks because of prerequisites, delay graduation because of unnecessary additional or missed out courses, drop a complete semester because of minimum number of courses requirement, etc.

The devised *SCPS* package, help and guide students in selecting six most appropriate courses suitable to register in the next semester. A typical course selection procedure starts with the student inserting a flash drive of the passed/current semester courses. The package then evolves through several procedures to advise student with an optimum list of most suitable courses. The course selection is based on priority process that includes a knowledge area build around all offered courses. The paper describes complete operation of the planning package that includes prioritized course selection, help menus, restrictions, etc.

The system is on a trial phase in the EE Department and modifications are under process to suit the department needs. Once the testing phase is complete, all the other departments of the college will share the benefit.

II. Background Information

Early course registration process involved students to register directly with their respected departments. Those early processes were concerned with delays, resources, and logistics. Later, academic institutions address this perspective of registration from many viewpoints including student course planning and advising, student course registration, class scheduling, and other related issues.

The trend of all above issues increased to near double with the expansion of post-secondary education in the late 1990s. This expansion has an indirect effect on the institution's enrolment as the number of students has also increased. As the demand is stabilized so is, a need to restructure the registration process that maximizes the allocation of course places and increases the number of registered students.

Moreover, the institutions, in general, have progressed to offer sophisticated programs that are specialized as well as multidisciplinary. The increased number of programs has introduced time conflicts while choosing courses. The required registration system is to be developed to provide real time registration for students and enable students to maximize their opportunities in registering courses of their own interest as well as advising students in completing their degree requirements in an optimum way.

With many of the advantages of the computerized registration systems, the major problem was to tolerate machine and network failures. It was hoped that most human errors, such as incorrectly inputting data, would be detected by the system as they occurred, but it was expected that some "off-line" data manipulation would be necessary for errors that had not been foreseen.

Therefore, the success of any attempt to computerize this activity depends on the reliability, availability and integrity of the computer systems, both software and hardware, on which

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the registration programs are run. Because many of the departments at any institution have most likely made significant investments in computer hardware, it is logical that no specialized hardware is to be purchased and software fault-tolerance is to be used instead.

An Arjuna distributed system was developed at The University of Newcastle upon Tyne, UK. It was aimed to provide tools to assist in the construction of highly available, fault tolerant distributed applications using atomic actions. Shrivastava, Dixon, and Parrington have discussed the design and implementation of a registration system that successfully met their requirements [1][2].

Another development was completed at the Wylie College IT for software architectural development of a course registration system using the specifications created for the college requirements. The Software Architecture Document provides an architectural overview of the C-Registration System. The C-Registration System was initiated by Wylie College IT to support online course registration [3].

The advising software at the Electrical Engineering, Texas Tech University featured a graphical user interface, that allowed students to request only courses for which they have appropriate prerequisites, co-requisites, and standing [4].

A Student Advising Software *(SAS)* was developed using JAVA computer programming language. The system helped and guided students in selecting appropriate courses suitable to register online with the University Registration System. The outcome of the course selection was stored in a file to show a complete typical plan. However, the registration system is no more in use as it was investigated on an old and phased out curriculum [5].

The Student Advising Software was improved to work with the old curriculum. It is a manual procedure, which guided students in selecting specific courses suitable for online registration with the University Registration System [6].

An improved version of course advising & planning software is developed at the Electrical Engineering Department, UAE University. It is again a manual system with limited functionality and about a 20% error rate [7].

The principal author developed another manual advising system *EECPS* on new curriculum and with improved functionality and lesser error rate [8].

An automated course advising system based on the new curriculum to show a complete typical plan (semester-wise) is developed that includes prioritized course selection [9].

The academics at the Florida Atlantic University developed a similar web-based advising system that supplemented the conventional advising process [10].

An expert system using JESS (a JAVA based rule engine and scripting environment) is developed that allows students to seek quick responses to their queries regarding their plan of study and progress in the program [11].

A Bayesian Network model for planning course registration and advising by using a data mining technique is developed to predict the sequences of courses to be registered by undergraduate students whose majors are computer science or engineering [12].

Two project management tools are designed to help the students complete their degree plan sooner. The first tool provides a visualization map of course sequences, customized for each student, making advising adjustments that will optimize the time to obtain the degree under a constrained set of resources. The second tool is to collect information from multiple students through several semesters and is used to identify bottlenecks in the curriculum [13].

A SASSY advising system is developed at the Armstrong Atlantic State University. This system suggests courses for an advisee based on; frequency of the course offering, balancing the course load, shortening the path length to graduation, preference of advisee and entertaining different scenarios of course loads for the entire duration of the advisee's university life [14].

III. The SCPS Package

The Electrical Engineering Department students take 147 credit hours to fulfill the B.Sc. degree requirements in either of the two fields of Electrical Engineering or Communication Engineering. Typically, the students take from a minimum of nine to a maximum of 12 semesters to complete their degree requirements with an average class load of 15 to 18 credits (from 5 to six courses) per semester.

The 147 credit hours course load is separated into General Education Requirements - 21 credits, College Requirements - 41 credits, Compulsory Specialization Requirements - 52 credits, Elective Specialization Requirements - 12 credits, Industrial Training - 15 credits, and Graduation Projects - 6 credits.

An *id* selection process downloads a student courses file. The package also downloads another file containing all (general education, college, compulsory, elective, etc.) courses offered in the investigating semester of Spring 2015. An alternating set of compulsory and elective courses are offered in the Fall semester, and there is need to investigate this in an improved version of the software package.

Figure 1 shows a hierarchical chart of all courses including the elective specialization requirements. The course selection hierarchies are shown including the hint of offering semesters. The electives offering (listed in the bottom section of the Figure) is also dependent on specific semesters. Industrial training is a complete semester and the registration requirements are after acquiring more than 93 credit hours however, the students target 100 credits before proceeding for industrial training as this leaves them six courses for each of the final two semesters after training. The prerequisite courses for industrial training are shown with thick edges (e.g. ELEC 320, ELEC 325, etc.)

The program creates another file that contains a sub-set (reduced in number) of all courses offered in the Spring semester. The courses belonging to this sub-set are those, whose prerequisite requirements are fulfilled by the student in the current and previous semesters. Hence, student is eligible to take any of the courses of this reduced sub-set. However, the final course selection is not decided by the student but is designed in the software package. The final selection of six

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courses is achieved with a devised knowledge area build around all courses. The knowledge area is defined by the following course example.

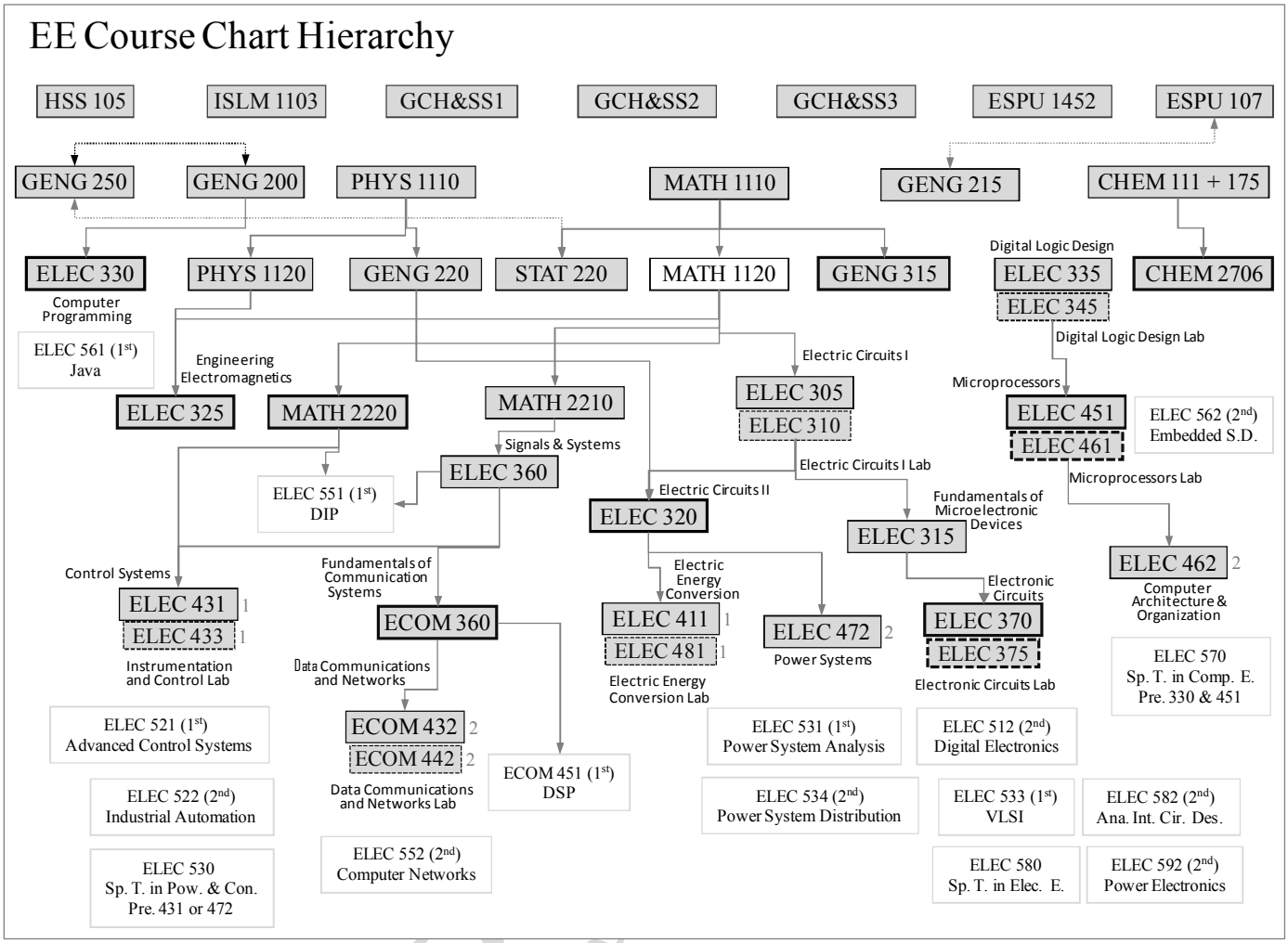


Fig. 1. The course hierarchical chart.

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[['HSS_105',0,0,0,0,0,0], ['ISLM_1103',0,0,0,0,0,0], ['ESPU_107', 1,0,0,0,0,0],
 ['ESPU_1452',1,1,0,0,0,0], ['GCH&SS1',0,0,0,0,0,0], ['GCH&SS2',0,0,0,0,0,0],
 ['GCH&SS3',0,0,0,0,0,0], ['GENG_250',1,0,0,0,0,0], ['STAT_220',1,1,0,0,0,0],
 ['GENG_200',1,0,1,1,0,0], ['GENG_215',1,0,0,0,0,0], ['GENG_220',1,1,1,4,0,0],
 ['MATH_1110',1,0,3,21,0,0], ['MATH_1120',1,1,5,18,0,0], ['MATH_2210',1,2,1,6,0,0],
 ['MATH_2220',1,2,2,2,1,0], ['PHYS_1110',1,0,2,7,0,0], ['PHYS_1120',1,1,1,1,0,0],
 ['CHEM_111',1,0,1,1,0,0], ['CHEM_175',1,0,1,1,0,0], ['GENG_315',1,1,0,0,0,0],
 ['CHEM_2706',1,1,0,0,0,0], ['ELEC_305',1,2,2,7,0,0], ['ELEC_310',1,2,2,7,0,0],
 ['ELEC_315',1,3,2,2,0,0], ['ELEC_320',1,3,3,3,0,0], ['ELEC_325',1,2,0,0,0,0],
 ['ELEC_330',1,1,0,0,2,0], ['ELEC_335',1,0,1,2,0,0], ['ELEC_345',1,0,1,2,0,0],
 ['ELEC_360',1,3,3,5,1,0], ['ECOM_360',1,4,2,2,1,0], ['ELEC_370',1,4,0,0,5,0],
 ['ELEC_375',1,4,0,0,5,0], ['ELEC_411',0,4,0,0,0,1], ['ELEC_431',0,4,0,0,3,1],
 ['ECOM_432',0,5,0,0,1,1], ['ELEC_433',0,4,0,0,3,1], ['ECOM_442',0,5,0,0,1,1],
 ['ELEC_451',1,1,1,1,2,1], ['ELEC_461',1,1,1,1,2,1], ['ELEC_462',0,2,0,0,0,1],
 ['ELEC_472',0,4,0,0,3,1], ['ELEC_481',0,4,0,0,0,1], ['ELEC_495',0,4,1,2,0,0],
 ['ELEC_585',0,5,1,1,0,0], ['ELEC_590',0,6,0,0,0,0], ['ECOM_451',0,5,0,0,0,1],
 ['ELEC_512',0,5,0,0,0,1], ['ELEC_521',0,5,0,0,0,1], ['ELEC_522',0,5,0,0,0,1],
 ['ELEC_530',0,5,0,0,0,0], ['ELEC_531',0,5,0,0,0,1], ['ELEC_533',0,5,0,0,0,1],
 ['ELEC_534',0,5,0,0,0,1], ['ELEC_551',0,4,0,0,0,1], ['ELEC_552',0,6,0,0,0,1],
 ['ELEC_561',0,2,0,0,0,1], ['ELEC_562',0,2,0,0,0,1], ['ELEC_570',0,2,0,0,0,0],
 ['ELEC_580',0,5,0,0,0,0], ['ELEC_582',0,5,0,0,0,1], ['ELEC_592',0,5,0,0,0,1]]
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Fig. 2. Knowledge area associated with all courses.

[ELEC_370, 1, 4, 0, 0, 5, 0]

The Electronic Circuits (ELEC 370) is appended with six digits of knowledge area.

The first digit is an indicative of whether the course is required for industrial training (a 1 for required or a 0 for not).

The second digit specifies the reverse hierarchy of the number of courses before this course. A *'4'* here is an indicative of four levels of courses before this course, which are ELEC 315, ELEC 305, MATH 1120, and MATH 1110.

The third digit points at the number of courses opened by this course in the immediate next semester. Elective specialization courses are not included in this knowledge area field. A *'0'* in this field indicates that there are no courses opened by this course. Whereas, the lab course of ELEC 375 is a co-requisite and is taken at the same level.

The fourth digit indicates the opening of the total number of courses dependent on this course. Again, a *'0'* shows that there are no courses that opens in the next or more hierarchal levels.

The fifth digit is an indicative of the number of elective specialization courses opened by this course. A *'5'* in this field indicates that the numbers of elective courses dependent on this course are ELEC 512, ELEC 533, ELEC 580, ELEC 585, & ELEC 592.

The sixth and the last digit indicates that course is either offered in both semesters (a *'0'* in the field) or in specific semester (a *'1'* for first semester or a *'2'* for the second semester).

All six fields are prioritized from highest to lowest with the first field having the highest priority. Figure 2 shows a list of all courses with their appended knowledge area based on courses shown in Fig. 1.

IV. Examples

Examples of two typical student course plans with different sets of completed courses have been shown.

The first example student (with university id #: 201015445) has completed 21 out of 63 total courses as shown in Fig. 3. The system shows that 48 courses are offered in the Spring Semester of 2015. There are 12 resultant courses, which the student is eligible to take because the prerequisite requirements for these courses have been satisfied.

In the next stage, the knowledge area associated with each course is tested to find an appropriate list level of the courses based on field priorities. As the first field that belongs to industrial training has the highest priority, 9 out of 12 courses fall in this group and reduces the choice of course selection.

The next field is now tested for the course selection choice. A high *'3'* in this field help selects the first three courses of ELEC 360, ELEC 320, & ELEC 315. A *'2'* in the same field selects another two courses of MATH 2220 and ELEC 325. For the last course selection, although there are three courses with a *'1'* in the second field, the first one in the course list is selected which is ELEC 451.

Figure 4 shows the results of the second example student. In this case, the student has completed 28 courses (passed/current). From the list of 48 courses offered, only 11 courses have been found eligible to be part of the selection process. The selection is reduced to 7 courses because of a *'1'* in the first field. First three courses are selected because of a *'4'* in the second field. ELEC 325 is selected due to *'2'*. Finally, ELEC 451 and ELEC 461 are selected because of *'1'* in the third field.

Future work needs to incorporate both offering semesters of the year.

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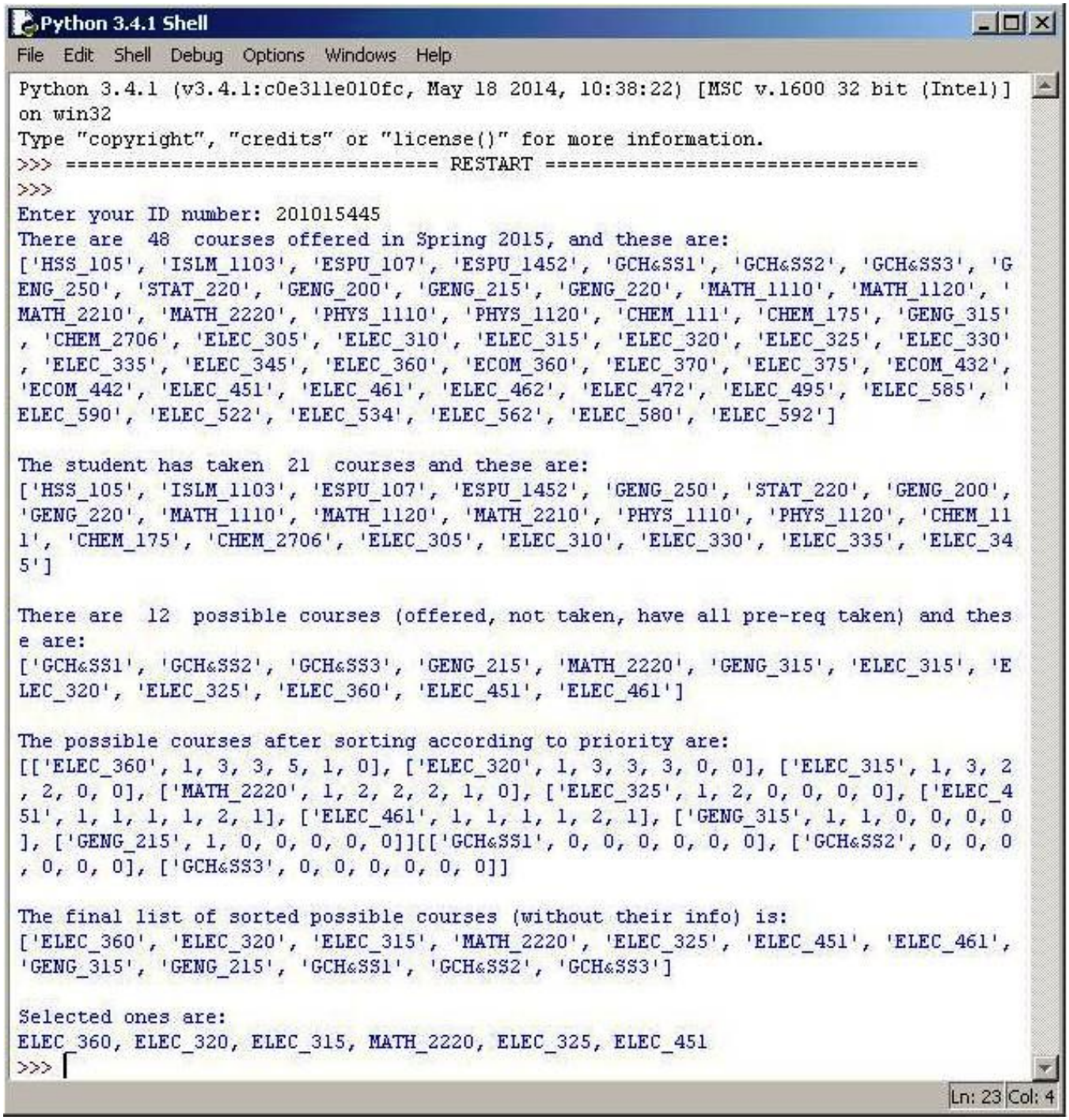


Fig. 3. Course selection procedure for example student one.

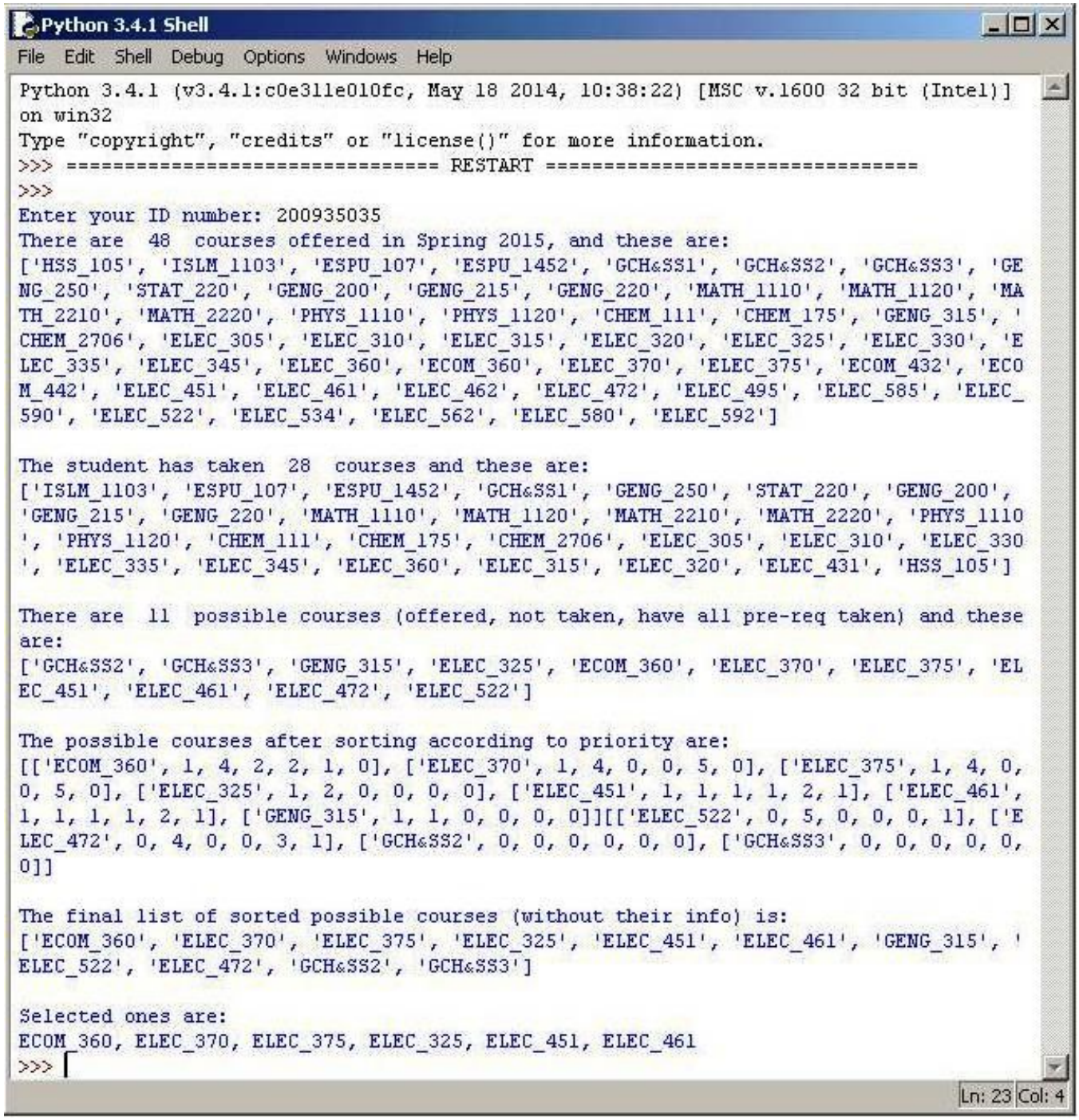


Fig. 4. Course selection procedure for example student two.