THE GRADUATION THESIS IN THE COMPUTER ENGINEERING PROGRAM AT UNICENP

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Abstract – This paper describes the Graduation Thesis Course (GT) of the Computer Engineering Program at UnicenP, an University in Curitiba, south of Brazil. The main objective of this course is the consolidation of the several contents and concepts handled throughout the entire Engineering Program. The graduation thesis is an interdisciplinary activity, obligatorily outlined for software and hardware development, the two great subject areas of the Program. Each student develops his own project or in two students' teams during the school year. A professor is assigned for each student's supervision. The supervision begins still in the project's proposal definition phase and lasts until its defense before the Board of Examiners of the GT. The projects' evaluation is carried through by the Board of Examiners, which is composed by the faculty, either supervisors or assigned by the Program’s Chair. The work themes are proposed by the student, however, subject to the approval, adaptation or substitution on the part of the Commission of the Course.


INTRODUCTION

This paper describes the Graduation Thesis Course (GT) from the Computer Engineering Program at UnicenP [1]. This course is part of the Program’s Pedagogical Project and has as main objective, the integration of the diverse knowledge handled during the Program in an interdisciplinary project, and it is developed by the students during the Program’s last year.

The paper was organized in order to describe the teaching-learning process adopted in the course, making possible a better understanding to the form of performance and the methodology used.

Currently the curricular guidelines from the Ministry of Education [4] establish as obligatory requirement the graduation thesis for all the program in the subject field of Engineering. However, since the beginning of the Computer Engineering Program, the UnicenP already contemplated in its curriculum the course of GT, which has as main objective, the consolidation of the several contents and concepts during the Program in an interdisciplinary project involving the Program’s two great subject areas: hardware and software.

THE GRADUATION THESIS

The Graduation Thesis Course (GT) has as its objective to allow the last years student the chance to use, prove and to strengthen the knowledge acquired along the Program in an interdisciplinary project. This opportunity is materialized by a project development, reconciling theory and practice and under the supervision of a professor and with the evaluation of a Board of Examiners, composed by at least three professors of the Program.

The chosen emphasis to guide the development of this discipline is that of the traditional conception of engineering. This choice was motivated by the demand for professional computer engineers in some areas of development (products and services) and also for the necessity to prepare them for the post-graduation. Many just-graduated continue their studies in "latu or strictu sensu" post-graduation programs.

Still, the emphasis in research and development (R & D) of products and systems are alike to the general principles of our program of the Computer Engineering, in contraposition to the typical questions of the engineering of products, production engineering or even to the ones related to the support for computational systems. By this guiding, more up-to-date project techniques as Concurrent Engineering [5] had been considered inadequate.

This choice made, the option for a based traditional approach in the cycle of development of projects was natural. The students cover the stages of R & D that initiate in the specification and are concluded in the implementation of prototypes. It must be standed out that stages previous to the specification (analysis of market necessities, for example) are summarized to the skeletons of specifications derived from projects of personal interest (of the student him/herself) or institutional (lines of research, didactic applications, and others) without the bolster of a marketing process or marketing analysis. With the same justification, the stages that follow the prototyping are ignored. The basic planning of efforts, resources and costs are inherent part of the project, but not the management and legal questions.

Besides evaluating, the student’s preparation level to the exercise of the profession, the GT can also be used as an instrument of evaluation of the teaching-learning process, as
well as the curricular structure and the program itself, because it allows to evaluate the integration among the course of the program in a interdisciplinary project.

The GT is annual, composed by two semesters, and it can only be accomplished by the students who are enrolled in this course. The workload of the course has 80 working hours, including the supervising activities and defense before the board of professors.

The subject of the GT can freely be chosen by the student between proposals presented by the professors or a proposal presented by the student him or herself, since it is approved by the Committee of the GT, which is formed by all the professors assigned for this course.

The theme obligatorily should approach the topics, course and matters handled in the Computer Engineering Program, being desirable that the inclusion of those items are as largest as possible.

The GT should include the two areas of performance of the program: Hardware and Software, in the proportion of, at least, 20% of each area, allowing the future engineer to consolidate the acquired knowledge during the program and the knowledge obtained during the execution of this project.

THE STAGES OF THE PROJECT

As mentioned previously, the GT is composed by four stages that represent the formal points of verification and validation of the developed projects. These stages, namely specification, project, implementation and documentation and validation, are detailed as follows.

- Stage 1 - Specification

The first stage of the GT, called Specification, has the followings objectives: study of literature on the state of the art; search for information and subsidies; elaboration of the project’s specification; public presentation of the project.

The evaluation of this stage is accomplished by means of the oral presentation (50%) and by the project report (50%), and the report must contain the theoretical basis and the project’s specification.

The presentation has the duration of, at least, 15 minutes and must be made with transparencies / slides. The defense has the duration of, at least, 5 minutes, and in the case of teams, the questions of the Board of Examiners must be directed to each member team.

- Stage 2 - Project

The second stage of the GT, called Project, has as objectives: revision of the specification; project’s elaboration of the considered and specified system; project’s documentation.

This stage’s evaluation is accomplished by means of the report of supervising and summaries for conference of scientific initiation. The report must contain the documentation of the previous stage, as well as the Project, the Summary in Portuguese and the respective Abstract, in English.

The score of this stage is composed by grades from the report and the summary and abstract for congress of scientific initiation, respectively, with weights of 90% and 10%.

- Stage 3 - Implementation

The third stage of the GT, called Implementation, has as objectives: project’s revision and project’s implementation.

The evaluation of this stage is accomplished through oral presentation and the report of supervision. The report must contain documents of the previous stages and the documentation related to the project’s Implementation.

The score of this stage is composed of grades from the report and the oral presentation of the prototype, respectively, with weights of 30% and 70%.

- Stage 4 - Validation and Documentation

The fourth and last stage of the GT is called Validation and Documentation. This stage has as objectives: revision of the implementation; compilation and elaboration of the final documentation; elaboration of a paper; preparation of the project’s public presentation.

The evaluation of this stage is accomplished through oral defense and the final documentation (corrected project, a paper and the user’s and services handbooks). The absence of any one of the above mentioned stages can cause the disapproval of the student or team.

The oral defense is composed of a presentation followed by an inquiry carried out by the Board of Examiners. The presentation has the duration of, in the maximum, 30 minutes and in the first 20 minutes it should be made a presentation with transparencies / slides. After that, the students have 10 minutes for the presentation of the functioning of the project. In the case of teams, the division of the presentation time between the components is mandatory. The defense to the inquiry has the duration of, in the maximum, 20 minutes, and that in the case of teams, the questions of the board are directed to each component and the number of questions must be the same for each member team.

The score of the stage is composed from grades of the oral defense, the project, the paper and manuals with weights of 40%, 30%, 10% and 20%, respectively.

The project must be delivered at the Protocol, after all the corrections, bound according to the specifications of the Library of UnicenP in three copies – one for the Library, another one for the Chair and one for the supervising professor. The standard adopted for the final documentation is that of monographies and the paper according to technical norms of ABNT (Brazilian Association of Technical Norms). All of the documents regarding the project should also be given in PDF (Portable Document Format) in CD-ROM, as well as a site on the project containing the links to
the documents to appendix and every pertinent material for the supervising professor of the project.

**SUPervision and Evaluation**

Each project is supervised by a professor assigned by the Program Chair and member of its Faculty. The schedules destined to the supervisions are the constants of the last school year schedule of the respective turn (4th year - mornings and 5th year – nights).

Weekly it has a supervision registered in appropriate form, in which the professors make question to the student or to the teams about some aspects, such as:

- presence and participation of the team’s members;
- project development;
- activities developed during the week;
- survey of problems found by the team;
- proposals of solution for such problems.

The evaluation of the GT can be made by means of written and oral tests, as well as verification of the documentation delivered by the students.

Along the year, partial grades from 0 to 10, will be attributed with intervals of 1 tenth. Each stage has a differentiated weight and it follows the determination in the table 1.

<table>
<thead>
<tr>
<th>TABLE I</th>
<th>BALANCE OF THE STAGES OF THE GT</th>
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<tbody>
<tr>
<td>Stage</td>
<td>Weight %</td>
</tr>
<tr>
<td>1 - Specification</td>
<td>20</td>
</tr>
<tr>
<td>2 - Project</td>
<td>20</td>
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<tr>
<td>3 - Implementation</td>
<td>20</td>
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<tr>
<td>4 - Validation and Documentation</td>
<td>40</td>
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</tbody>
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The grades are attributed by the Board of Examiners, gathered in classroom board and are individual for the student. By the way, it could have some differentiation between the grades from the members of a same team.

The last stage of the GT is eliminatory, and a student cannot be approved only with he three first partial notes.

A student is approved if he obtains a minimum of 7 points in the considered sum of the 4 evaluations, considered the established balance, according to Table 1.

If any correction is requested in the final phase, the definitive approval is pending until the Library of the UnicenP acknowledges receipt of the copy of the GT.

If the student receives a list of corrections that must be done in the documentation, these should be made and submitted to the supervising professor’s appreciation. In these cases there is no need for a new evaluation, and the requests’ execution is characterized by the emission in writing of a certificate by the referred professor confirming that the prescribed alterations have been accomplished.

The student fails if he does not reach the minimum grade of 7.0 points in the considered addition of the four evaluations.

**MULTI AND INTERDISCIPLINARITY**

The Computer Engineering Program, at UnicenP, has a strong emphasis in the interdisciplinarity and multidisciplinarity aspects.

The first course named Computer Engineering Project[2] presents, among other topics, the production of technical documentation. It is presented and practiced a style of technical writing for reports, experimental activities, papers and monographs. The skills in production of technical documentation are requested in the subsequent school years.

All the second semester of this course is dedicated to the students’ first technical multidisciplinary project development, under the supervision of the course’s professors. The concomitant courses: Algorithms and Computer Programming, Calculus, Technological Chemistry, Electronics, Mathematic Logic and Physics supplies and support this project. The needs of theoretical and practical skills are supplied in these courses and integrated in Engineering Computer Project.

Interdisciplinary activities are also incremented. We may use as an example the CISC microprocessor (Complex Instruction Set Computer) project in the Digital Systems course (second years’ course). This processor architecture is object of study in a concomitant course, named Computer Organization and Architecture. In the third school years, a more complex RISC processor (Reduced Instruction Set Computer) is developed in the Microprocessor course. Soon, the Language and Compilers course will be integrated, collaborating through the study and implementation of assemblers and compilers for these processors.

The AVIN (in portuguese, Avaliação Integradora) [3] helps a lot in the development of the GT, because it creates room for interdisciplinarity. With the GT the student has the possibility to have a more critical and global vision on the project’s insertion in the context of the Program, bearing in mind the application of theories and concepts in a more including project, associating with the concepts covered previously with the AVINs, since the students accomplish at least two AVINs during the Program.

Besides the supervision on the part of supervisor in the development of the project, the student creates a more critical and active posture, because he to defend his project (choices and solutions) in the presence of the board of professors. The board of professors has, as objective, to analyze the whole process and the defense on the part of the student, to attribute a note that expresses numerically the student’s effort and knowledge development during the whole project along the school year.

The course GT is directly related to other course, because in the project development, the student elaborates a
project that fully integrates the concepts of other course, mainly from the professionalizing area. However, with the Computer Engineering Project Course [2] has a more direct relationship with the GT, because in this course, which is in the first year, the student has the first contact with the systematic of projects’ elaboration, with the methodological aspects as well as the physical implementation of a simple project, serving as a motivator. In the year of 2002 the developed projects had involved concepts of the following curricular courses:

- Algorithms and Computer Programming
- Computer Organization and Architecture
- Database
- Applied Calculus
- Physics
- Electronics
- Software Engineering
- Foundations of Computation and Programming
- Management of Projects
- Electronic Instrumentation
- Biomedical Instrumentation
- Artificial Intelligence
- Microprocessors
- Digital Systems
- Computer Networks
- Signal Processing

Amongst the projects developed for the first graduated group, we can point two, as examples, that demonstrate the line of R&D adopted at UnicenP.

The first project, entitled ”Analytical System of Pulmonary Respirators based on Computer” had as objective the development of a portable electronic equipment, easily transportable, for analysis of pulmonary fans in hospitals, that interfaced to a computer for processing, analyzed the ventilatory parameters of the equipment under test, under the graphical and numerical form, facilitating the accomplishment of tests in the ventilation equipment mechanics of emergence rooms, surgical center, emergencies, etc, for the team of engineers and technician of a department of clinical engineering or company of maintenance of these equipment, in a fast and trustworthy way and for the recognition of technical problems. The developed system presented very good performance, being able to become a commercial product with some improvements, mainly as for the electronic components and to the tranductors.

The other project, entitled ”Monitor and Manager of Telephonic line Controlled by the Microcomputer”, had as objective to create a viable technological solution for small offices or residences, in which rarely exist some form of control of the use of the telephone, since the existing solutions in the market are very expensive and complex for this purpose, and consists of a management system for telephonic lines controlled by a microcomputer, that allows to verify all the effected occurrences within a determined period, as well as blocking a series of numbers or categories of numbers, as for example, long distance calls, cellular calls or any other number of interest. The adopted solution consisted of an hardware interface with the telephonic line and a computer host, in which the developed software is in charge to enable or not the requested calls, as well as manages all the effected calls.

The other projects had presented the same line of development, searching, in a general way, the integration between the hardware and software, main focus of the course, and of distinguished way, the use of the knowledge acquired in the diverse disciplines of the program, already mentioned, beyond the specific and inherent knowledge to each project in particular, thus compelling, the student to the search of new knowledge out of his/her area of specific formation and contributing for his/her full formation as engineer.

CONCLUSION

One of the key issues for the students is that they are forced to face an activity of academic nature, working as the market wants, with collection, schedules, following a methodology and with base in what was described in the proposal of GT. This approach type is only possible in a course with the characteristics of final project. However, it should be emphasized that the final project still has as main objective the development of a critical sense and research which are proper of the academy, but not forgetting the job market.

Along the year of 2002 the first GT from the Computer Engineering Program were accomplished and it can be verified that the students had a significant maturity in terms of projects’ elaboration, because they could live in practice all of the stages of the development, associated with all of the inherent difficulties in a project of this nature and complexity.

In addition to what was exposed here, the program also has significant profits, because it has generated specialized technical documentation, which can be used in future projects, so much in terms of new projects as for improvements of the accomplished projects.

We can still emphasize the projection of the program in the academic world by the popularization and presentation of the papers and documents. Another key factor is a better integration between the professors and students, due to the supervision during the project’s development.

Then, we can summarize some of the strong points of this course:

- The development of a methodologically guided work, what is not usual in training programs in companies; still, many students had not participated in activities of scientific initiation during the course.
- Obligatoriness of the multidisciplinarity. The student is forced to become involved
himself/herself with subjects that many times are not of total affability. A preference for subjects linked to the hardware or software is common. The integration complements formation.

- Improving the written expression skills. The students are instigated to improve the quality of their written expression. This capacity, essential for the professional exercise is especially problematic in Brazil. The content and the form of the written material is revised by the supervisor throughout each stage of the project.

- Improving the verbal expression skills. Through seminars that occur in the stages of evaluation the students must present their work for the set of supervisor (suffering verbal inquiring), for the colleagues of the disciplines and the colleagues of the firsts series. This strengthens the necessity of the use of formal language and it trains them for the confrontation of public presentations of ideas and concepts.

- The recognition that any development demands financial resources. The students must esteem the human effort and the necessary material resources.

REFERENCES


